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How nuclear power hurts the Greens: Evidence from German nuclear power plants☆

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ABSTRACT

What are the electoral consequences of nuclear energy for Green parties? Despite the centrality of nuclear opposition to Green party platforms, and the social movements that helped them emerge, little research has examined the electoral impact of this stance. Building on work on energy transitions and local political economy, we propose that the economic benefits of nuclear power can mitigate local public opposition to such otherwise unpopular energy policies. We test this by analyzing the effect of nuclear power plants on electoral support for the German Greens, one of the most vocal opponents of nuclear energy. Using a novel dataset that combines the geolocation of nuclear plants with voting records since the 1980s, and employing difference-in-differences and instrumental variable designs, we find that the opening of nuclear plants correlates with a decrease in Green party vote share. These findings are relevant for understanding Green parties, energy transitions, and unpopular policies.

Green parties emerged as one of the most significant outcomes of *New Left* political movements, gaining traction in the 1970s and 1980s amid rising environmental concerns and grassroots activism (Inglehart, 1977; Kitschelt, 1993). A central focus of both Green parties and the movements that inspired them was a strong opposition to nuclear energy. However, despite this resistance, many European countries continued to invest in and build nuclear power facilities. The link between these developments on public support for Green parties remains uncertain.

As the effects of climate change become increasingly evident, environmental issues are gaining prominence across numerous democracies. In many European countries, Green parties have achieved record electoral results in recent years, even as nuclear energy remains a significant part of the energy landscape. Nevertheless, the relationship between these two factors is still not well understood. In this paper, we examine the electoral consequences of a policy position that served as a foundation for various European Green parties and shaped environmental politics in the 1970s and 1980s (De Vries and Hobolt, 2020; Müller and Thurner, 2017): opposition to nuclear energy. This relationship is important because local opposition to policies is a common feature of climate policy. Policymakers often have to implement policies that are unpopular in affected local communities such as open pit mining, the construction of nuclear power plants, or more recently, the establishment of wind farms. While the public at large generally supports and profits from such policies, there is often fierce local opposition. The construction of wind farms is a typical recurring example. While public opinion surveys in Germany for instance show that the overwhelming majority of citizens supports wind energy (Uken, 2019), resistance to new wind farms has been growing at the local level (see also Otteni and Weisskircher, 2022; Widmann, 2025). In Germany, about 1000 citizens' initiatives are fighting against the construction of wind farms in their communities and more than 300 lawsuits were filed against wind turbines (Uken, 2019).

This tension between nation-wide public support for a policy and local opposition has famously been coined the "NIMBY"-ism (not-in-my-backyard) (Welsh, 1993). NIMBY-ism is an important challenge for

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policy-makers, as many public policies that are deemed necessary for the national well-being of a society face strong local opposition. In order to implement such policies while at the same time maintaining social cohesion, it is important to understand how such local opposition can be overcome. While the literature has primarily focused on explaining local resistance (e.g., Stokes, 2016), we focus on how opposition can be mitigated and show that opposition to those policies is lower when they have economic benefits.

Despite the fact that nuclear energy was a core issue for Green parties and contributed to their formation (De Vries and Hobolt, 2020; Müller and Thurner, 2017), we know very little about how nuclear energy may affect electoral outcomes. In addition to its historical relevance, nuclear power also provides an interesting case for understanding how energy policies impact electoral outcomes. While previous work on infrastructure projects suggests that these can lead to voter opposition (e.g., Otteni and Weisskircher, 2022; Stokes, 2016), other studies indicate that the local economic benefits of such projects can increase support for similar policies (e.g., Gazmararian and Tingley, 2023). At the same time, while nuclear energy faced significant local opposition starting in the 1980s, this resistance has gradually shifted from nuclear facilities to nuclear waste disposal sites (Rucht and Roose, 2004). Consequently, the emphasis on constructing new facilities appears to have diminished in local protests (Rucht and Roose, 2004). We inform this puzzle by studying the relationship between Green party support and nuclear energy – a key policy issue in the 1980s for Green parties which remains hotly debated nowadays. We argue that local communities grow more likely to support policies when they perceive them to be economically beneficial, suggesting that these benefits can increase the popularity of otherwise unpopular policies.

We study the case of Germany, where the Green party serves as a prominent or even "prototypical" example of this party family (De Vries and Hobolt, 2020; Frankland, 1989). In Germany, debates about nuclear energy remain politically relevant as a central issue in the modern German party system (Thurner et al., 2017)—highlighting the importance of studying this context. We collected a novel dataset on the geographic location of nuclear plants and county-level voting records from the 1980s until 2017. Using panel estimates and instrumental variable designs, we find that the *commissioning* of nuclear power plants has a negative association with the Green party's vote share. Using panel surveys, we first replicate these patterns at the individual level and then find evidence suggesting that economic considerations may drive these patterns. We find no evidence that these findings are due to population changes in districts with nuclear power plants.

Understanding the electoral consequences of nuclear energy is important for several reasons. First, opposition to nuclear energy was one of the key triggers of environmental movements in the 1970s and 1980s and an important driver for the emergence of Green parties (e.g., Kitschelt, 1989; Rootes, 2003). However, this study is also relevant to current discussions, as nuclear energy has recently reemerged on the agenda, with the U.S. planning to triple its nuclear capacity by 2050 (Ainger et al., 2023), environmental movements reconsidering their stance on this energy source (Horton, 2023), German coalition parties initially postponing the phase-out in light of the Russian full-scale invasion of Ukraine in 2022 (RND, 2022) (though the phase-out ultimately proceeded as planned Der Spiegel, 2023), and major tech companies turning to nuclear energy to meet AI's energy demands (Browne, 2024; Silva, 2024).

Our study makes several contributions. First, we contribute to work on politicization and issue entrepreneurs (Albrecht, 2002; De Vries and Hobolt, 2012; Hobolt and de Vries, 2015). The Greens emerged partly as a coalition of groups opposing nuclear energy, thus politicizing this issue. Our study adds to this literature by examining the consequences of implementing policies on this issue, particularly when these policies may generate (perceived) economic benefits at the community level. In essence, we demonstrate that policy feedback on issues that issue entrepreneurs focus on can actually have a negative impact on their electoral results.

Second, we contribute to the literature on unpopular policies (e.g., Martin and Myers, 2005; Liebe and Dobers, 2019; Xu and Lin, 2020) by showing that "NIMBY" attitudes can be mitigated when local communities anticipate economic benefits from otherwise unpopular policies. Citizens are more likely to accept such policy projects if they feel they are adequately compensated.

Third, we also add to the study of climate policies generally and energy transitions in particular. Nuclear power plants share characteristics with other energy and climate policies – such as concentrated benefits or losses – which affect voter attitudes in specific communities differently than in the broader electorate (Gaikwad et al., 2022; Mildenberger, 2020; Stokes, 2016). Therefore, our findings offer valuable insights for building support for energy transitions, especially among groups who may be disadvantaged by climate policies (Mildenberger, 2020). Moreover, most research on energy transitions examines prospective policies and the conditions under which local communities might support these changes. In this paper, we leverage nearly 50 years of voting records and survey data to investigate the relationship between energy transitions and voters' long-term attitudes and political behavior, demonstrating how communities initially opposed to such projects can become more supportive over time.

Finally, we contribute to the literature on party competition (e.g., Adams et al., 2006; Spoon, 2011; Meyer and Wagner, 2016) by showing that parties may face local electoral penalties for policies that enjoy broader public support. This suggests that parties must carefully balance local electoral costs with the benefits of implementing national-level policies.

1. Literature review and theoretical argument

Nuclear energy is a contentious issue in many countries and a key policy concern for Green parties, yet its relationship with electoral outcomes is largely underexplored. Western European Green parties emerged during the 1970s and 1980s, driven by a post-war generation that had been socialized in an era of relative economic prosperity and peace. For this generation, other issues and values, such as gender equality, environmental protection, and multiculturalism, became increasingly significant (Inglehart, 1977). This *silent revolution* played a crucial role in many social movements centered on ecology, environmentalism, pacifism, institutional change, and critiques of capitalism — movements that, in turn, were fundamental to the development of Green parties across Western Europe (Burchell, 2002; Inglehart, 1977; Kitschelt, 1993; De Vries and Hobolt, 2020).

Nuclear energy, or opposition to it, was a major driver of the Green movement (Doherty, 2002) and a core component of the programmatic identity of Green parties (Burchell, 2002). Opposition to nuclear energy was crucial for the growth of environmental movements and Green parties in the 1970s and 1980s, particularly in Western Europe and specifically in Western Germany. These groups viewed environmental protection as an essential issue warranting targeted policy and political action (Burchell, 2002). In fact, the conflict and opposition to nuclear energy in the 1970s were instrumental in uniting a broader coalition of left-leaning groups in Germany to create Green Lists, which preceded the establishment of the Green Party (Rucht and Roose, 2004). This conflict served as a catalyst for the emergence of Green parties (Müller and Thurner, 2017) and became a symbol of their broader policy positions (Poguntke, 1993).

While there is a substantial body of research on how post-materialistic values (e.g., Blumberg, 2024; Grant and Tilley, 2019; Siegers et al., 2016), economic factors (Abou-Chadi and Kayser, 2017), and the strategies of other parties (e.g., Meguid, 2008; Spoon et al., 2014) influence the electoral outcomes of the Greens, the relationship between the location of nuclear power plants and Green electoral

results is surprisingly less explored.[4] While living near a nuclear power plant may seem unattractive, it can also offer significant advantages.

We study the local effects of nuclear power plants, focusing on their opening. If opposition to nuclear energy was so crucial for the emergence and growth of Green parties, what could drive these localized grievances? While the arguments fueling most protests against nuclear energy emphasized concerns about global pollution and the prevailing economic model, protests were concentrated in areas with existing nuclear power plants or plans to build them (Rucht and Roose, 2004). Opposition to these projects is often framed and evaluated through the lens of "NIMBY"-ism (not-in-my-backyard) (Uji et al., 2021; Vittes et al., 1993; Welsh, 1993).

To understand the relationship between the opening of nuclear power plants and local voting behavior and preferences, two bodies of work are particularly relevant: the electoral consequences of NIMBY-ism and the effects of energy transitions. Infrastructure projects such as energy facilities often generate local voter discontent and backlash against the elites who implement or support them (Ansolabehere and Konisky, 2009; Stokes, 2016; Stokes et al., 2023). This local opposition is frequently analyzed as part of a broader pattern where voters do not want specific policies – or events or facilities – to be allocated to their region or community (Welsh, 1993)[5] Most work on NIMBYism consists of case studies focusing on local opposition to specific policies, such as nuclear waste disposal sites (Welsh, 1993), waste incineration power plants (Xu and Lin, 2020), wind parks (Liebe and Dobers, 2019), the establishment of prisons (Martin and Myers, 2005), the arrival of asylum seekers (Marbach and Ropers, 2018), or local opposition to tourism (Litvin et al., 2020).

However, less is known about the conditions under which NIMBY-ism can be attenuated and the circumstances that may lead to voter backlash. Early research in urban planning has suggested that communication strategies and the inclusion of affected neighborhoods in the planning process are crucial to gaining support of local communities (Dear, 1992). Focusing specifically on energy plants, Ansolabehere and Konisky (2009) found that Americans oppose any type of new power plant in their area, although they support wind facilities.[6] These effects can be conditional on perceptions of cost and environmental harm. Likewise Uji et al. (2021), using a survey experiment in Japan, suggest that support for nuclear energy among low-income residents can be bolstered by information highlighting nuclear energy's low contribution to local air pollution (Uji et al., 2021).

A growing body of research on energy transitions and the behavior of local communities provides important insights into the conditions that make voters more willing to support these policies. A recent study by Gaikwad et al. (2022) indicates that voters' support for energy transitions is influenced not only by their level of vulnerability to climate change but also by their vulnerability to policy changes — specifically, the material costs they may incur as a result of these policies. In examining the electoral consequences of coal phase-outs in Spain and the USA, Bolet et al. and Egli et al. (2022) found mixed results. While Bolet et al. show that municipalities affected by the phase-out increased support for the political party responsible for the policy, Egli et al. (2022) observed the opposite trend. A key factor contributing to this difference may be the process through which the policies were enacted. For example, research on Just Transitions – the practice of including compensation for affected workers, communities, and industries in energy transition plans – suggests that economic compensation and benefits could be crucial for garnering support for coal phase-outs among impacted communities (Bergquist et al., 2020; Evans and Phelan, 2016; Weber, 2020; Gaikwad et al., 2022; Gazmararian and Tingley, 2023; Mayer, 2018; McCauley and Heffron, 2018). This approach may also serve as an effective strategy for political parties advocating these policies (Bolet et al.).

We build on these bodies of work to suggest that voters' skepticism may decrease if they perceive economic benefits from new infrastructures. As a result, voters may shift their support away from parties that oppose these policies. Specifically, we argue that voters are more likely to support nuclear power plants in their communities when they view them as economically advantageous.

The local economy is a relevant factor for voters because they directly experience, or at least observe, the benefits of a thriving local economy. A healthy local economy fosters investments in infrastructure and generates tax revenue, which can be used for social, educational, and cultural facilities. Even if certain policy projects – such as nuclear power plants – are initially unpopular, they can yield significant benefits for the local community. Increased tax revenue allows for substantial donations and investments in local areas, enabling local governments to make generous improvements to the social, educational, and cultural infrastructure available to residents. Accordingly, local economic performance is a strong predictor of economic voting (e.g., Books and Prysby, 1999; Healy and Lenz, 2017) and influences voting behavior in Germany, which is our case study (e.g., Colantone and Stanig, 2018; Dippel et al., 2015). Consequently, positive economic perceptions among citizens in local communities may be an important factor through which support for opposing parties could diminish.

Our argument aligns with existing research indicating that the perceived costs and benefits of energy infrastructures are particularly relevant in explaining local opposition to these projects (Carley et al., 2020). Economic benefits can sometimes effectively alleviate NIMBY (Not In My Backyard) concerns (see Petrova, 2013, for a review), and researchers have sought to understand the challenges of changing public perceptions regarding local energy infrastructure (e.g., Ladenburg and Dubgaard, 2007; Petrova, 2013). However, most studies have concentrated on wind farms, where opposition is often driven by environmental and aesthetic concerns (Devine-Wright, 2005; Ladenburg and Dubgaard, 2007). In contrast, the local grievances regarding nuclear power plants in West Germany during the period we studied were primarily focused on safety and environmental issues, which are quite different from those associated with wind energy.

We test our argument by examining the relationship between opening nuclear power plants and the voting behavior of local communities. Specifically, we analyze the connection between nuclear power plants and voting for the Green Party in Germany from the 1980s onward. For a significant period, the Greens stood alone in their opposition to nuclear energy, as all other parties represented in parliament supported its use. Notably, their skepticism toward nuclear energy remained consistent, allowing the Green Party to claim ownership of the anti-nuclear stance (Bernardi et al., 2018). Therefore, we use the Greens' electoral support (or lack thereof) as a proxy for public support for nuclear energy and nuclear power plants specifically. To conduct this analysis, we collected a novel dataset that maps the locations and opening dates of nuclear power plants and combined it with county-level electoral results from federal elections.

We argue that, on average, perceived economic benefits will outweigh the costs and risks associated with a nuclear power plant for several reasons. Previous research indicates that economic benefits can significantly influence the political behavior of coal communities and their support for phasing out coal (Bergquist et al., 2020; Bolet et al.; Gazmararian, 2024). While communities in coal regions have much to lose from job reallocation and disruptions to the local economy, a

[4] At the national level, Grant and Tilley (2019) find that nuclear power production is positively associated with Green party support.

[5] While traditional NIMBY discourse suggests that voters may support policies in general but oppose them in their local surroundings (e.g., Liebe and Dobers, 2019; Petrova, 2013, for examples on energy infrastructure), the concept is often applied to refer to locally-based opposition more broadly (Carley et al., 2020), which we follow.

[6] However, once implemented, opposition to wind infrastructure has been well documented (Otteni and Weisskircher, 2022; Stokes, 2016; Stokes et al., 2023).

nuclear power plant does not necessarily pose a similar risk to local economic stability. Instead, opposition to nuclear power has often focused on concerns about environmental harm and the potential risks of accidents or long-term exposure consequences (Huhtala and Remes, 2017; Müller and Thurner, 2017).

While economic benefits are directly tangible, the risks and costs of a nuclear power plant are psychologically distant. Psychological distance can be simply understood as the idea that factors that are spatially, mentally or temporally distant are less likely to guide individual behavior (Liberman and Trope, 2008). Consequently, an unlikely and distant event, such as a potential nuclear accident or its associated health consequences, may not motivate individual behavior as effectively as immediate economic considerations. For example, Hüppe and Weber (1999) found that individuals living closer to nuclear plants tend to experience less fear and hold less negative attitudes toward the facilities compared to those living farther away. This further supports the idea that the risk of a nuclear accident is likely not a significant factor in shaping the behavior of these communities in general – and voting behavior in particular – especially as the economic benefits of the plant become more apparent over time and as no accidents occur following its opening.

2. Empirical approach

2.1. German nuclear energy and the German Greens

Despite the horrors of nuclear warfare, policymakers in the postwar era were very optimistic and enthusiastic about the "Atomic Age". Atomic power promised progress and was seen as an abundant new energy source, with nuclear power plants being planned in many countries. Germany, in particular, was faced with a scarcity of power for its resurgent economy after World War II, and nuclear power was often seen as a solution. The three major German political parties at the time, the Christian Democrat CDU/CSU, the Social Democrat SPD, and the liberal FDP were all in favor of nuclear energy. As an example of this broad enthusiasm and support, the SPD, nowadays a clear opponent, was hopeful that "man can make life easier in the Atomic Age" (SPD, 1959). Germany started building its first commercial nuclear power plant in 1958 and in the 1960s it built eleven nuclear reactors followed by twelve more during the 1970s.

Despite the broad support at the national level, local opposition was strong since the launch of the German nuclear energy program. Earlier protests against nuclear power plants were small and local, often driven by local farmers, but they became more organized over time. The 1973 Oil Crisis is reported to have weakened the opposition to nuclear power in light of rising energy prices (Hillengaß, 2011). By 1975, protests resurged and led to the first protest attracting national attention, when thousands occupied the construction site of the Wyhl nuclear plant for months (Rucht, 1980). The project was eventually abandoned following several legal disputes. Spurred by this success, larger and more violent protests ensued in the following year at planned nuclear sites in Brokdorf, Grohnde, and Kalkar (Hillengaß, 2011). However, organized opposition to nuclear plants decayed significantly in the late 1980s and the 1990s (Thurner et al., 2017) and there are no other reports of nuclear plants that were stopped due to these. What could explain this pattern?

In the late 1970s, anti-nuclear environmentalist groups started systematically politicizing the issue and participated in the first elections as "Green Lists". These groups ultimately joined their forces and, together with other groups, founded the Green party in 1980 which saw itself as the parliamentary representation of "thousands of citizen's initiatives that have opposed the construction of nuclear power plants through powerful demonstrations" (Die Grünen, 1980), and facing electoral backlash as a consequence (Arend et al., 2025). Therefore, the anti-nuclear movement was always very anchored into the Green Party and its origins.

As the Greens' position on nuclear energy was central to their emergence, it is reasonable to assume that many local voters likely associate the Greens to (opposition to) nuclear energy. Opposition to nuclear energy has been one of the major policy demands of the Green party and when governing together with the SPD, the Greens ultimately decided the phase-out of nuclear power plants in 2000, formalized through the Nuclear Exit Law.[7] This decision was the result of extensive negotiations within the coalition. The phase-out policy faced significant opposition from other parties, particularly the CDU and FDP, who argued that it would lead to energy insecurity and economic challenges. This political debate intensified party competition, as energy policy became a central issue in electoral campaigns, influencing voter preferences and party dynamics (see e.g., Thurner et al., 2017, for a thorough discussion of these debates). Likewise, there are multiple reports of the resistance of the German Greens to re-activate nuclear plants as a way of diminishing dependency from Russian energy following its full-scale invasion of Ukraine in early 2022 (e.g. Alkousaa and Rinke, 2022). Therefore, it is interesting to try to understand how the nuclear plants influence their electoral support, our key objective.

Importantly for our argument about the local economy, power companies in Germany pay trade tax to the municipality in which they are located, which then forwards part of it to the county based on an allocation formula. This is important for the longevity of our findings, and for their scope conditions: While in other countries, the economic benefits of nuclear power plants decrease after its construction (Gallo-Rivera et al., 2013), this tax set-up in Germany makes it more likely that the economic effects are visible, and for a longer span of time. As an example of how meaningful these contributions can be, in the municipality of Biblis (Hessen), the local nuclear power plant contributed with over half of the trade tax in 2011, totaling over 7M Euros in total and about 800 Euros per resident, while companies in the region reportedly received contracts from the power company totaling around 70M Euros annually – about 8000 Euros per resident (Der Spiegel, 2011). The municipalities and counties therefore profit immensely from the operation of a nuclear power plant. These plants create significant gains in a community's budget, and therefore provide the financial means to provide services and local public goods. Moreover, because our argument is relative to the perceived economic gains of these plants, and not their anticipated benefits, we use the operating start date of each nuclear power plant as our treatment of interest. For these reasons, we study the link between nuclear power plants *commissioning* and voting for the Green Party at the county level.

2.2. Data

2.2.1. Electoral data

To study the relationship between opening nuclear power plants and voting behavior we rely on two main sources of data: Data on electoral outcomes, and data on the location and operation periods of nuclear power plants. In this section, we outline how we collected and merged these data.

For electoral results, we obtained official records at the county level for all federal elections from 1953 to 2017 from the Federal Returning Officer, which are restricted to 1980 onwards for the main analyses, as the Greens only ran from then. As outlined above, German nuclear power plants pay taxes at the municipality level, while part of those taxes are then allocated to the county at the next administrative level. Therefore, the county while perhaps providing a more conservative

[7] Although the Greens and their internal factions were united in their opposition to nuclear energy – and likely perceived as such by voters – the intensity of their opposition varied over time (see e.g., Thurner et al., 2017) and across factions. However, since the factions did not run on separate electoral lists, we cannot assess whether they received differing levels of support.

measure of exposure to nuclear power plants and their benefits, is the adequate unit of analysis as it includes all the regions that will likely benefit from the economic consequences of nuclear power plants.

Since the last nuclear power plant in West Germany was opened before the fall of the Berlin Wall (in 1987 more specifically), we restrict our analyses to West Germany for the entire period. Since our analyses rely on panel data and unit fixed-effects, we require stable geographical units over time. Therefore, to deal with boundary changes, we use areal weighted interpolation.[8] The raw historic election results from West Germany are not directly comparable because the county boundaries have been redrawn multiple times since the first election in our data set in 1953. This procedure allow us to map previous election results onto 2017 county boundaries, and is commonly used in political science (e.g. Homola et al., 2020; Suryanarayan and White, 2021). We proceed as follows: First, we calculate the share of historic counties that lie within the boundaries of 2017 counties. Subsequently, we multiply these shares with the election results of each year. This approach is based on the assumption that voters were evenly distributed throughout the county.

We believe that this conversion approach is well suited for West German counties because most redistricting consisted of merging two counties. Historically cities and the surrounding areas often constituted two separate counties that were later integrated into one. We believe, that if anything, this provides a more conservative estimate of the true effect. In section C, we provide an example of this procedure. In the case of county mergers, our approach works perfectly because all voters of the merging counties are present in the new merged county. In the rare cases where a county was split,[9] mostly small areas at the county's periphery with a low population density were reallocated to a neighboring county.

2.2.2. Data on nuclear power plants

To identify the geographic location of operating and decommissioned West German nuclear power plants we extracted a list of locations from Wikipedia[10] and geocoded the location names using the Google API. We paired the information on the location of the plants and the start and end date of their operation with electoral results, and thus measured when and which counties had operating nuclear power plants. Fig. 1 illustrates the plants' locations within West Germany.

2.3. Research design

2.3.1. Fixed effects models

Nuclear power plants are not randomly located, so comparing counties with and without them likely yields biased results due to confounding factors. We attempt to mitigate some of those concerns with two complementary research designs.

To study the relationship between nuclear power plants and support for the Green party we use two research designs: we estimate panel models akin to difference-in-differences designs (DiD) and an instrumental variable (IV) approach. These two strategies complement each other as they rely on different assumptions, and we believe the fact that they provide similar results and interpretations is strong evidence for our findings. However, given that nuclear power plants are not randomly assigned to counties, that neither of our research designs is an experimental design, and given the specific challenges of our setting – which we discuss below – we refrain from a causal interpretation of our findings. We first estimate panel models in the spirit of difference-in-differences of the following form:

$$Greenvote_{it} = \alpha_i + \gamma_t + \beta Plant_{it} + \varepsilon_i t \quad (1)$$

where $Greenvote_{it}$ is the vote percentage of the Green party in county i in election year t, α_i are county fixed effects, which account for all the county-specific stable characteristics, and γ_t are election year fixed effects, which control for all time-specific potential confounders. $Plant_{it}$ is our treatment indicator and takes the value of 1 in the counties that have a nuclear power plant within their borders, after the nuclear power plant has been opened, and 0 otherwise. Eight reactors were built at the site of an existing nuclear plant. The respective were coded 1 once the first reactor has been opened. We cluster standard errors at the county level.

There are two key differences between this design and that of a "standard" DiD. First, because the Greens first ran in a German federal election in 1980, there are several counties that are treated before we can observe the outcome (see Figure B.2). The second key difference has to do with the key identification assumption of DiD designs, that of parallel trends. In our case, that assumption would mean that – absent of nuclear plants – the Greens' vote share in counties where a nuclear power plant opened would have developed in parallel to those in which no power plant opened. In order to evaluate the plausibility of this assumption, it is common practice to plot the averages of the outcome – Green vote share in our case – among treated and control units prior to treatment. Because the Greens first ran in a German federal election in 1980 and most plants were opened before 1980, we cannot do that with all our *treated* units. However, we take two steps to attenuate concerns that this setting might raise. First, we plot the trends between counties that were never treated, and those that were only treated in 1987, several elections after the Greens first made it to the ballot (in 1980). As Figure F.5 illustrates, the parallel trends assumption appears to be met in this setting. We also visualize these in an event study setting using *fect* (Liu et al., 2022) in Figure F.4 and Figure F.6, providing similar conclusions. Additionally, we observe in Table F.4 that the effects are very similar when using only a subsample of these "late-adopters". In addition to that, to account for the fact that the treatment is staggered and turns "on" and "off" (i.e. several nuclear power plants are phased-out during our panel), we also use Imai et al.'s (2023) difference-in-differences estimators and find similar results to those of our main analyses (see Figure F.8). This estimator allows for units to go in and out of treatment, whilst matching control and treatment units based on history of relevant covariates. We match on a series of social and political covariates that could confound the effect, which we outline in the Appendix in F.8.

If our expectations are correct, the perceived economic benefits and the political effects of the plants should decrease as the distance from them increases. To test this idea directly, we also run analyses where we include a measure of the distance (in 100 km) between a county's centroid and the closest operating nuclear power plant. This indicator is set to zero for counties with operating plants. The rationale for this analysis is that if the economic benefits of these plants are spatially concentrated in the county where they are, the perception of these benefits will be smaller in counties further away from the plants.[11] Consequently, the effects on voting behavior should also decrease in counties that are further away from nuclear power plants.[12] Since the

[8] See section C for an example to illustrate the approach and https://github.com/cornelius-erfort/germany-53-21-districts for additional details.

[9] If one counts a 1953 county as split if its largest part in a 2017 county is less than 70%, then only about 8.6% of counties were split. In other words, for 91.4% of 1953 counties, at least 70% of its former territory have been merged into one 2017 county.

[10] https://de.wikipedia.org/wiki/Liste_der_Kernreaktoren_in_Deutschland.

[11] More specifically, the direct economic benefits of a nuclear plant, like tax revenues, mostly stay within the county where the plant is located. However, there are also taxes collected at the state level (income and VAT), benefiting a wider area. Additionally, while the financial gains are local, the opinions and attitudes about nuclear power can spread to nearby counties, as suggested by Uji et al. (2021).

[12] Due to data access limitations, we are only focused on the distance between a nuclear plant and *counties' boundaries or centroids*, not *individual respondents*.

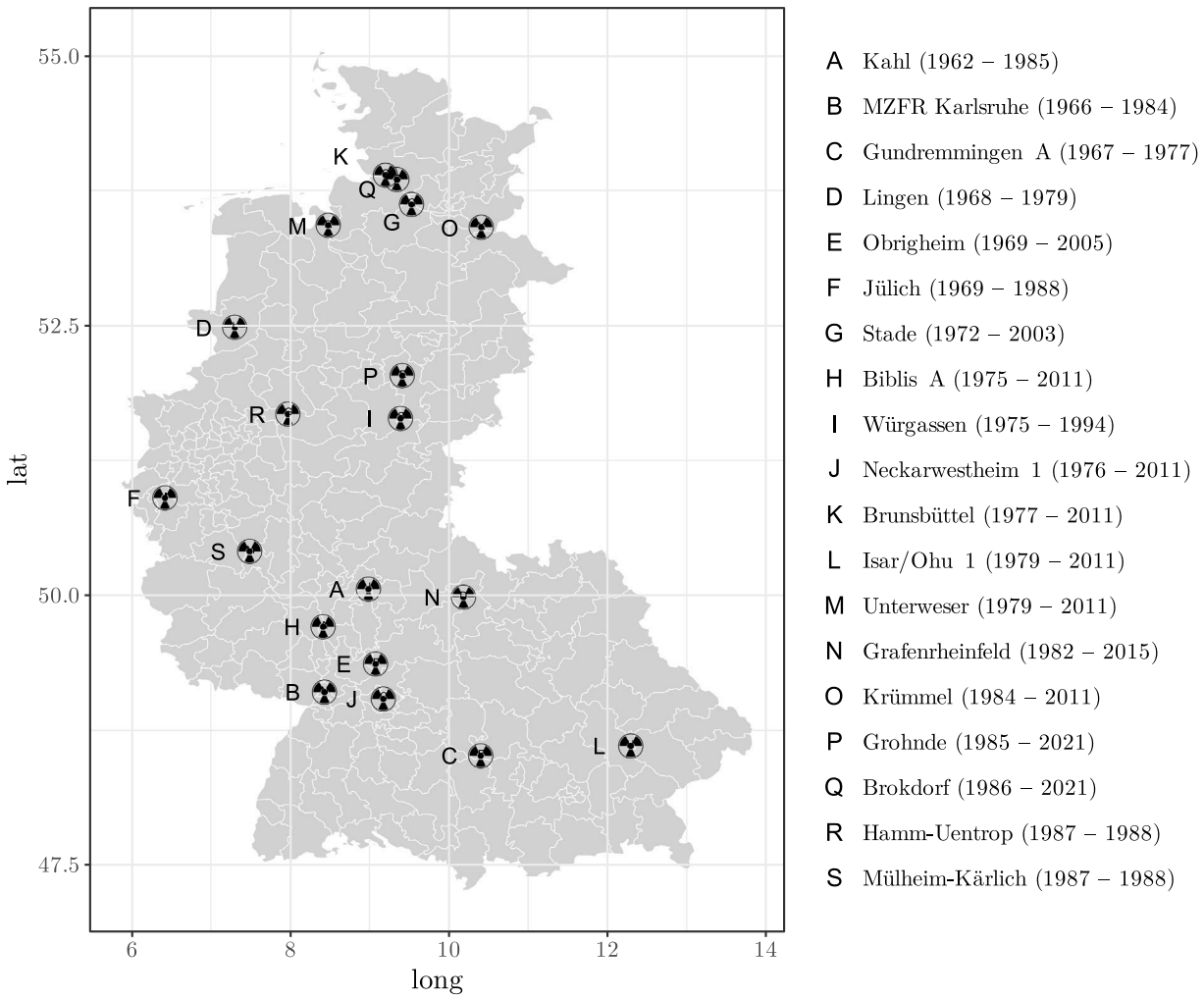

Fig. 1. Spatial distribution of nuclear power plants.
Note: The map shows the location of the nuclear power plants in West Germany and the 2017 county boundaries. Only the first plant or reactor in each county is shown. Start and end dates in parentheses.

phase-out of nuclear plants was first announced in 2000 which could have different effects on the affected electorates, and because our focus is on the *opening* of the plants, we present the analyses for prior to 2002, the first federal election following the announcement of the phase-out in 2000. For the sake of transparency, we also present analyses until 2017, although the interpretation of those findings is complicated by these events and by the extensive time period.

2.3.2. Instrumental variable

As a complement to our fixed-effects estimates, and given the specific challenges of this setting that we discussed, we also use an instrumental variable (IV) design. Here, we instrument nuclear power plants by historical seismic activity, a variable that is plausibly quasi-exogenous to our relationship of interest.

Multiple factors enter the process of finding a location for a nuclear power plant. Given how dramatic nuclear accidents can be, a key concern for decision-makers is that the location they choose minimizes the likelihood of accidents. When considering the potential threats to a nuclear power plant, earthquakes are a particularly important concern.[13] Even in Germany, a country with historically low levels of earthquake hazard, seismic activity was not only considered upon deciding where to allocate nuclear power plants, but policymakers have always been strongly invested in studying, testing and minimizing the risk of earthquake damage for German nuclear plants (Birkhofer, 1997; (BMU), Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2014).

We measure historic seismic activity using data from Grünthal et al. (2018)'s probabilistic seismic hazard assessment of Germany. This measurement provides seismic hazard maps based on specific time periods. We use the period from 1550 until 1956, two years before the construction start of the first nuclear power plant. Specifically, we take the mean intensity hazard map for RP = 475a, which can be thought as a measure of hazard based on the intensity of seismic events during the period we mention above. This measure takes values of 0 to 7, where 7 represents the highest hazard. In Fig. 2, we map both the measure of distance to nuclear power plant (in 1990) as well as our measure of seismic hazard.

The rationale for this instrument is that because there is a concern with preventing nuclear accidents, policymakers will allocate nuclear power plants to places with little history of seismic events and instead (i) to those that have little history of seismic hazard and (ii) to those areas which are further away from high seismic hazard zones. For that reason, seismic hazard should predict our treatment assignment and be plausibly exogenous.

The identification assumptions of an IV design require that the instrument – historical seismic activity in our case – is exogenous

[13] As an example, the Fukushima nuclear accident in 2011 was caused by an earthquake in the Pacific and the resulting tsunami.

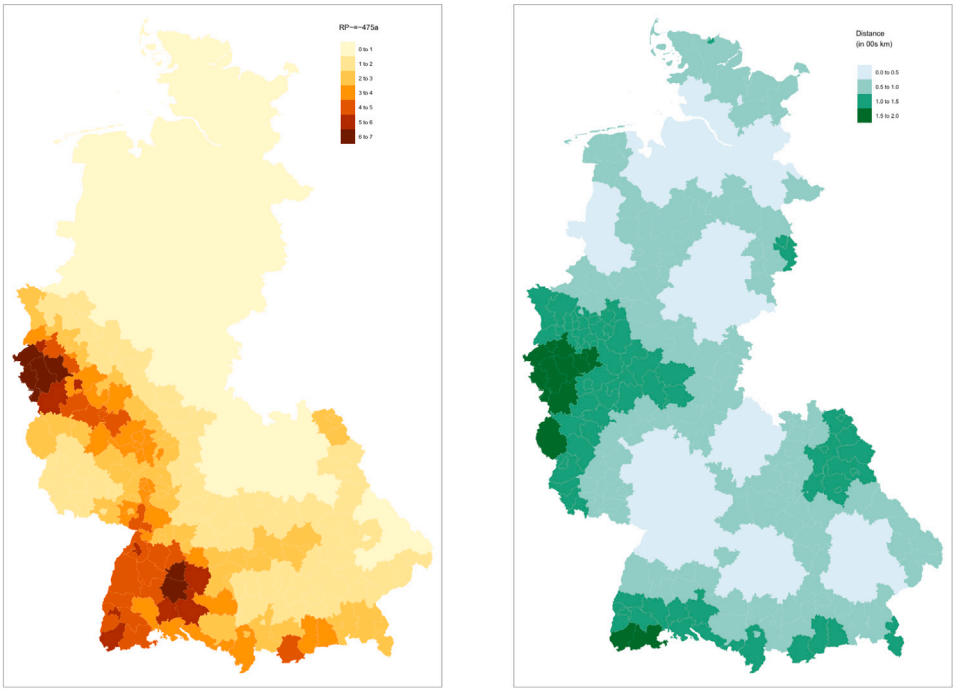

Fig. 2. Spatial distribution of seismic hazard and of distance to nuclear power plant.
Note: The map to the left shows the spatial distribution of the instrument – seismic hazard using data from Grünthal et al. (2018). The map on the right displays the distance to the closest nuclear power plant, in hundreds of kilometers, in 1990. The treated counties take the value of zero.

to the relationship we study and affects the outcome (Green vote share) only via the treatment, nuclear power plants (or distance to them). It is unlikely that seismic activity is correlated with economic activity or other variables that could predict political outcomes – unlike other geographical instruments that are often used in political science and economics such as altitude or agricultural and mineral indicators. Nevertheless, we identify two potential backdoor paths that could violate the exclusion restriction – altitude and the presence of large waterways. Both altitude and large waterways could explain why counties without a nuclear power plant (or those further away from a operating nuclear power plant) are different in socioeconomic or political characteristics. In Europe, seismic activity is highest in mountain regions such as the Alpes or the Adriatic region. Altitude could be a confounder of our relationship as it constrains population settlements and population density. At the same time, the allocation of nuclear power plants takes into consideration regional population and Green Party support is highest in places with high population density. Secondly, historical seismic activity seems to have been higher in the areas surrounding the rivers Ruhr and Rhine. Since large waterways are needed for a nuclear plant's reactor cooling (and thus affect the likelihood of allocation) and are linked to higher economic activity (which is linked to higher Green Party support), we should account for both whether the county has a large waterway and for population density. As such, we account for whether a county has any waterways and also other non-observable fixed characteristics. Additionally, we also account for population density in the last available census and include year fixed-effects, accounting for any election-year specific characteristics.

Given that our instrument is stable across time, we use the interaction between our measure of historic seismic activity with the election year (for a similar approach, see Noort et al., 2022). As Noort et al. (2022) mention, this allows for within-unit variation, so we can also include county fixed effects in our estimate, which allows us to account for stable characteristics, such as the presence of waterways or altitude. We present our first-stages in Table D.2 and both the first-stage regression results predicting the dichotomous treatment and that predicting the measurement of distance from the closest operating plant are well-above the critical value of 10 (Stock and Yogo, 2005), with 35.7 and 21.6, respectively. As such, this instrument appears to fulfill the relevance assumption. Furthermore, we also report Anderson-Rubin confidence intervals, as suggested by Andrews et al. (2019). Despite this discussion, instrumental variables can be a limited design to attain causal identification, as its assumptions are particularly challenging in the absence of true randomization (see e.g., Lal et al., 2024, for a discussion).

3. Results

3.1. Fixed effects models

We start by presenting our results from the panel estimations. Model 1 in Table 1 shows that having had an operating nuclear power plant in the county is associated with a decrease in Green party support by about 0.5 to 0.6 percentage points (which is statistically significant at 0.1 when including elections after the phase-out, and at the 0.01 level when not including those). These effects suggest that the opening of a nuclear power plant penalizes the Green Party, the key actor opposing nuclear energy. In terms of the effect size, this represent 0.17 and 0.18 standard deviation units, for the full sample and the pre-2000 only sample, respectively — suggesting that the associations are meaningful.

Turning to estimates using distance from the closest opened nuclear power plant as predictor (Models 3–4 in Table 1) the association is not statistically different from zero for the full panel (including elections after the phase-out was announced), and for elections only up to 2002 (only elections prior to the announcement of the nuclear phase-out) it shows that counties further away from the plants are more supportive of the Greens. This suggests that this distance association might fade away quicker over time.[14] Taken together, the findings reported in Table 1 show that the opening of a nuclear power plant is negatively

[14] When we split that effect by each election year in Figure F.7, we also find that the effect of distance from plants on voting for the Greens is higher in the

Table 1
The effect of nuclear power plants on Greens' vote share: Panel results.

Dependent variable:	Green vote (%)			
Model:	(1)	(2)	(3)	(4)
Variables				
Post-plant opening	−0.604*	−0.525***		
	(0.347)	(0.180)		
Distance (00s km s)			−0.090	0.487***
			(0.168)	(0.127)
Sample	Full	Pre-2002	Full	Pre-2002
Fixed-effects				
County	Yes	Yes	Yes	Yes
Election year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	3564	1944	3564	1944

Note: Two-way Fixed effects estimates of the effect of nuclear power plants on the Greens' vote share. Standard errors are clustered at the county level (in parentheses). Signif. codes: ***: 0.01, **: 0.05, *: 0.1.
Clustered (County) standard-errors in parentheses.
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1.*

Table 2
The effect of nuclear power plants on Greens' vote: IV results.

	Model (1)	Model (2)
Open plant	−1.226***	
	(0.343)	
Distance (in 100 km)		0.630***
		(0.157)
Num.Obs.	3564	3564
Anderson-Rubin CI	[−1.897, −0.554]	[0.321, 0.938]
Fixed effects: County	Yes	Yes
Fixed effects: Year	Yes	Yes

Note: 2SLS estimates of the effect nuclear power plants on the Greens' vote share. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.

associated with the vote share of the Greens in the plant's county, and that these fade away for distant counties.

The allocation and starting of operations of these plants does not happen at the same time for every single one of them. To address the well-documented issues of staggered treatment in TWFE designs, we use Imai et al.'s (2023) difference-in-differences estimators (see Figure F.8). We also find negative associations of nuclear power plants on the vote share of the Green party. We also find that these are delayed, which is not surprising given that the effects of higher tax revenue and local investment probably take time to have an impact. This could also be in line with our argument, as economic effects of plants are likely not immediate.

3.2. Instrumental variable

We now turn to our IV results, presented in Table 2. When instrumenting for the existence of an operating plant and distance from closest operating nuclear plant with historical seismic activity interacted with election year, we find results that are very similar to those of our panel estimates, as shown in Table 2. When taking into consideration the effects for the dummy of whether there is an open nuclear plant (Model 1), instrumented by seismic activity, we find that it is a negative effect on the Greens' vote share, of around 1.2 percentage points. Distance to a nuclear power plant, on the other hand, has a positive effect on the vote share of the Greens, of around 0.6 percentage points. Specifically, we find that for every additional 100 km distance between the county's centroid and the closest nuclear power plant, the Greens gain around one percentage point of the vote. Both of these effects are in the same direction as the panel estimates and they are also slightly larger in magnitude. Overall, our IV results suggest that i. Counties with nuclear power plants penalize the Greens, and ii. Counties further away from an operating plant are more likely to support the party.

All in all, this section has shown that nuclear power plants are negatively correlated with the Greens' electoral result in the local community where the power plant was established, particularly in elections prior to the announcement of the nuclear plants phase-out in 2000. These patterns are shown using both panel estimates and an IV design. Our results also hold in a number of robustness checks, such as including only those counties that had nuclear power plants in 1987, allowing to see trends on Green support before and after the plant (see Table F.4), using distance from the counties' closest boundary instead of their centroid (see Table F.12), accounting for spatial autocorrelation (see Table F.13), and using Imai et al.'s (2023) estimator for DiD with staggered period times (see Figure F.8) somewhat persistent over time (see Figure F.8), and clustered in the areas around the plants, as shown in the models using distance as a predictor. To be clear, our results do not suggest that the German electorate became very supportive of nuclear energy after the opening of the plants. There is plenty of evidence that the German public is often less positive about it than other European countries. Instead, our findings show that, in Germany, the counties where the plants were put in place became more supportive of nuclear energy *relative to* the counties where no nuclear plant was built.

3.3. Results on economic output

Our argument is based on the idea that voters will punish political parties that oppose a policy they perceive as economically beneficial. We now test the economic effects of having a nuclear power plant in a county. We do so using data on a county's GDP and its unemployment rate.

As before, we estimate the association between operating nuclear power plant and economic output with a two-way fixed effects specification. Our measures of economic performance at the county level are only available from the 1990s onwards so we have no pre-treatment observations. For that reason, we change $\beta Plant_{it}$ in Eq. (1) to an indicator measuring whether a nuclear power plant was in operation that year. To improve these estimations and to approximate an ideal experiment, we also replicate them using coarsened exact matching (CEM) (Iacus et al., 2012) on a series of pre-treatment covariates: number of households, share of catholic population, number of in-commuters, civil servants, foreign residents, and of working places on energy sector, all from 1961, as well as the vote share of the CDU/CSU and turnout in the 1953 election. While matching in general attempts to approximate an ideal randomized experiment by reducing the variance in observed characteristics between the treatment and control groups, CEM addresses several of the criticisms of other matching techniques, such as propensity score matching (Iacus et al., 2012).

The results are presented in Fig. 3. We find that there is a clear and large association between nuclear plant operation and GDP per capita (of around 0.2 to 0.3 standard-deviation units), but that the association is not different from zero on unemployment rate. These findings suggest that there is a clear economic growth in the county, as it is shown that for the most important measure of economic output of a county – GDP per county – nuclear power plants have a clear positive effect. Regarding unemployment rate, we find no meaningful association, suggesting that the effects of nuclear power plants might not be driven solely by job growth. These findings are in line with the direct employment creation of nuclear power plants. While these infrastructures create large revenue and tax returns for the local area, their direct employment is low (as an example, the Obrigheim plant is

elections closer to the initial activation of nuclear plants (1980s and 1990s), as well as when shortly after the announcement of the closing of these plants in the early 2000's (a policy the Greens push for and supported).

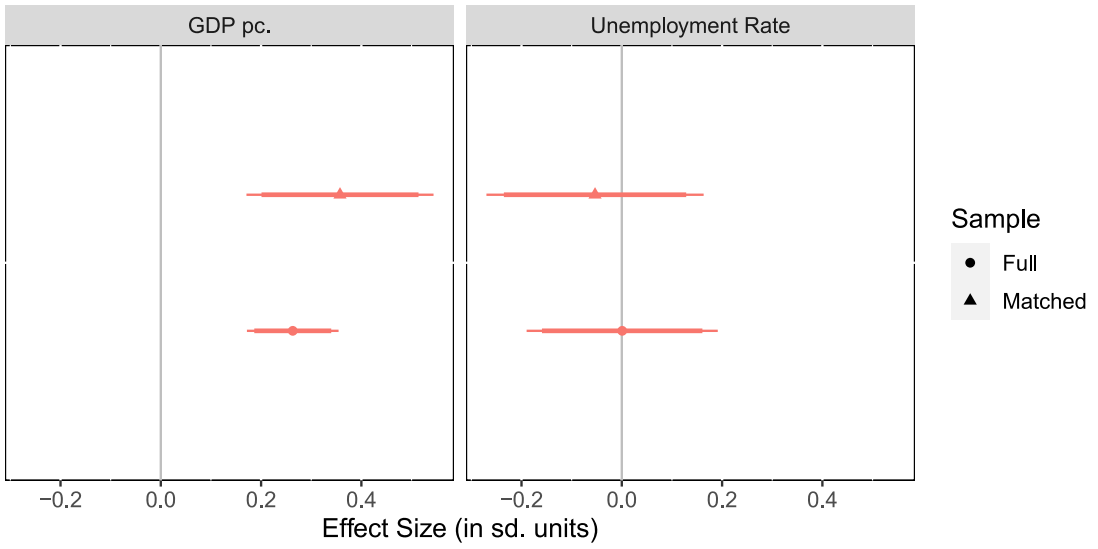

Fig. 3. Objective economic effects of nuclear power plants.
Note: All Panels show TWFE estimates of the effect of nuclear power plants on economic output: GDP per capita and unemployment rate. Outcomes in standard-deviation units.

reported to employ only 350 people during its operation Waltz, 2015). To better understand the mechanisms underlying our results, we next turn to individual-level data and economic perceptions.

3.4. Exploring individual-level mechanisms: Economic perceptions

We argued that the electoral penalty of the Greens in counties with a nuclear power plant is driven by a county's economic performance and citizens' economic perceptions. While the available data does not allow us to explore the entire causal path of this mechanism, we can test its empirical implications. Having explored the patterns on counties' economic performance in the preceding section, we will now turn to the economic perceptions of individual citizens. If our results are driven by voters' perceptions of the economy, a nuclear power plant should have an association with these perceptions. This section explores this expectation.

We use data from the German Socio-Economic Panel (SOEP) (Liebig et al., 2021). The SOEP is a socio-economic panel survey that interviews a representative sample of the German population every year since 1984. We use data on individuals' concerns about their finances which we take as a measure of people's perception of economic benefits. If our expectations are correct, we should observe that individuals in counties with nuclear power plants are less worried about their finances after it has started operating.

Specifically, we use an item that asks participants how much they worry about finances, to which they reply on a three-point scale from 1 "Very concerned" to 3 "Not concerned at all". We invert this scale so that higher scores mean respondents are more worried.

In order to define the predictor as in our main analyses, we use respondents' counties of residence (using 2017 boundaries as well). To run analyses in the difference-in-differences framework, we include respondents who have been surveyed before and after a plant's operation start and a comparable control group. More specifically, we restrict our sample to those respondents who are treated and were surveyed at least once before treatment and those non-treated respondents who have been observed at least once before 1987 (the timing of opening of the last nuclear power plant) (see Table E.3 for balance). With this, we run two-way-fixed-effects and event study analyses, as we do in the main analysis, using survey wave and respondent fixed effects and a post-treatment indicator that takes the value of 1 for people in treated counties after the plant was opened. As before, we cluster standard errors at the county level.

Our results are presented in Fig. 4. They show that, whether we just take the post-treatment dummy or whether we look at the event study, nuclear power plants have a negative association with worrying about finances — that is, individuals in counties with nuclear power plants worry less about finances after the plants have been opened. In line with the analyses on elections, we find that the associations are statistically significant after 4 years, larger in magnitude after 10 years, and they seem to decrease after 15 years (our event study for electoral outcomes presented in Figure F.8, show that the differences are larger for the third election after opening of the plant — roughly 12 years). These effects are of 0.5 standard deviation units in the dummy indicator and of between almost zero to little over 1 standard deviation unit in the event study. In F.15, we present results from a sensitivity analysis.

Due to the staggered nature of the treatment in this setting, we also estimate event studies using Sun and Abraham's (2021) estimator and find similar results and that, again, these effects are somewhat delayed (see Figure F.9).

Given the complexities associated with staggered treatment adoption, we also apply the Fixed Effects Counterfactuals (fect) method to our analysis. This approach allows us to construct more accurate counterfactual scenarios by accounting for unobserved heterogeneity and dynamic treatment effects. Our findings using the fect model corroborate the results obtained from the TWFE estimates (see Figure F.10).

If economic perceptions are a key mechanism of the effects of nuclear power plants on Green support, the associations should disappear once we account for these factors. In Table F.14, we formally test by first testing the association between nuclear power plants and individual-level support for the Greens and then repeating the analyses controlling for this potential mechanism. We show two pieces of important evidence: First, the result we find on elections is replicated at the individual level on support for the Greens (i.e., voters are less likely to support the Green after the nuclear plant has been opened). Second, we show that the association of nuclear plants and Green support is much smaller in magnitude and no longer statistically significant once we account for subjective and objective economic perception.

3.5. Alternative explanations and additional analyses

The findings we report could be a mechanical result of changes in the composition of the electorate once a plant is opened. These are large infrastructure projects that require specialized workers so one might argue that the effects we presented above are a consequence of

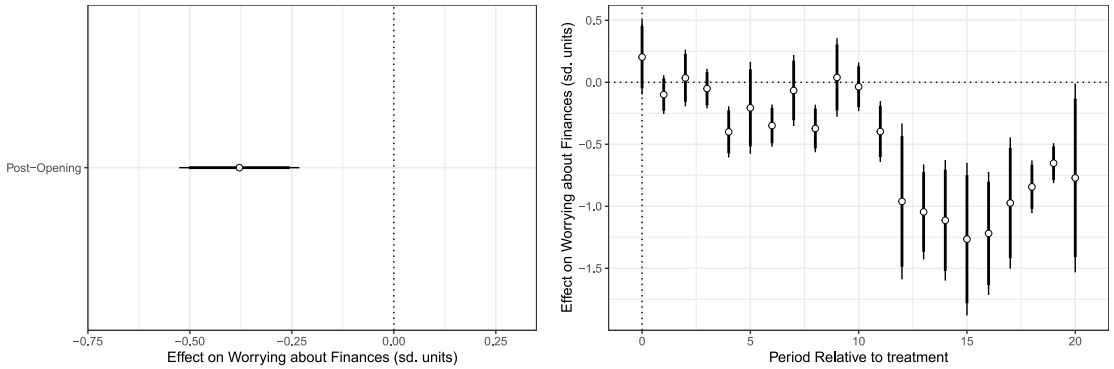

Fig. 4. The effects of nuclear power plants on worrying about finances.
Note: Both panels show TWFE estimates of the effect of nuclear power plants on respondents' worrying about finances.

Table 3
The effect of nuclear power plants on population size.

Dependent variable:	Residents (thousands)	
Model:	(1)	(2)
Variables		
Post-plant opening	14.608	
	(18.769)	
Distance		4.179
		(7.579)
Fixed-effects		
County	Yes	Yes
Year	Yes	Yes
Fit statistics		
Observations	1296	1296

Note: TWFE estimates of the effect of nuclear power plants on population size. Standard errors are clustered at the county level (in parentheses). Signif. codes: ***: 0.01, **: 0.05, *: 0.1.
Clustered (County) standard-errors in parentheses.
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1.*

those workers moving to treated areas to work in the plants, and thus changing the composition of the population and the electorate. Given that workers at nuclear power plants will most likely not support a party that seeks to abolish these plants, their move into treated areas could explain the results presented above.

To test whether that is the case we look at census data and see if the opening of plants had an effect on population size. We do so by using data from Schmitt et al. (1994), who collected data at the county level since 1939. Using data on the number of residents from each county from 1939, 1950, 1961 and 1970 and shapefiles on the counties' boundaries from this time and the current period, we map these population indicators to current county boundaries, as we did in the main analyses (see C for an example). With this, we create a dataset where the unit of analyses are county*years pairs for 1939, 1950, 1961 and 1970. Using this dataset we run a TWFE analysis similar to our main panel models on the effects for Green party support, but using the number of residents (in thousands) as the outcome. The rationale of this analysis is to test the effect of having a nuclear power plant opening on a county's population size.

Results are presented in Table 3. This is a formal test of whether the "early-adopters" – i.e. the first counties to have nuclear power plants – had disproportionate population growth as a consequence of the plants. As can be seen, although all point estimates are positive, none of these effects is statistically different from zero. This suggests that nuclear power plants have no effect on population size and – more importantly – that our results are not driven by population changes.

Moreover, a compositional change large enough to produce an effect on a county's votes in the magnitude we find is unlikely. For instance, the county of Günzburg, where the nuclear plant "Grundremmingen" is located, had approximately 50,000 valid votes in the 1990 federal election for 80,000 registered voters. An increase in the Green vote share of 0.6 percentage points would only require about 300 new Green voters moving to the county. But a compositional change negatively affecting the vote share of the Greens would rather require non-Green voters moving to the county or a crowding-out of a stable number of Green voters by additional non-Green voters moving to the county. In 1990, the Greens had a vote share of 4.3% here, so about 2150 voters of 50,000. To lower the share of these 2150 to 3.7% (0.6 percentage points), would require more than 8000 new voters for other parties. Assuming they have the same turnout rate as the existing population, 12,800 new non-Green voting residents would be needed to explain our finding with such a compositional change of the electorate, which we believe is highly unlikely. Additionally, it is possible that such a decrease in the Green vote share could occur if approximately 300 Green voters decided to leave the county. This would, however, constitute a substantial out-migration.

It could be the case that voters perceive positive economic outcomes, and reward the incumbent, instead of punishing the Greens, or that these two patterns are happening at the same time. We replicate the main analyses using the federal incumbent as the outcome in Table F.8, and find no association of opening a nuclear plant on support for the federal incumbent. We also explore the differences in our results by level of population density in tables F.9 and F.10, showing our findings are mainly driven by counties with high population density. Finally, as we discussed earlier, there were several nuclear power plants that were deactivated. In Table F.11, we replicate our fixed-effects analyses excluding counties where that happened. In general, the effects are replicated in their direction, magnitude and statistically significance, but only for the pre-2000 period.

4. Conclusion

Green parties have achieved record results in many European countries recently. A key driver and stance of their formation in the 1970s and 1980s was stark opposition to nuclear energy, and its potential dire consequences for the environment and human life. How do these concerns evolve as the threat of nuclear accidents diminishes and the economic benefits of these plants become clear?

As countries move to decarbonize their economies in the face of climate change, understanding the electoral consequences of alternative energy sources is a crucial endeavor. In this paper, we study the link between nuclear energy and local support for the German Green Party, a party that has historically opposed this policy and even partially grew out of local resentment against nuclear energy.

We argue and show empirically that local communities turn against the party that opposed nuclear energy, and that economic benefits seem to be associated with these changes. These economic benefits do not have to be side-payments or fiscal compensation as for instance the

case when citizens are subject to compulsory relocation (as in the case of open pit mining) or when citizens are exposed to aircraft noise in the proximity of an airport. Economic benefits could also take the form of increased tax revenues, jobs or private investments into local infrastructure that are due to the establishment of an otherwise unpopular project such as a nuclear power plant, a waste disposal site, or an airport. For example, our results regarding distance to the plants are interesting as they are not in line with those of Konisky et al. (2020), who find that in the US, distance has a minimal effect on opposition to most energy infrastructures. While our survey evidence and our context might suggest that local economic benefits might drive those differences, further research ought to clearly study these contrasts. An important scope condition of our findings is that they require that these infrastructures create economic benefits, or the perception of them. As such, for infrastructures that create smaller, or shorter, local economic benefits (such as wind energy (e.g., Fabra et al., 2024)), patterns similar to the ones we document here should be more difficult.

The results of our study have important implications for managing public policies, for our understanding of electoral competition and of Green politics. First, whenever policy projects are unpopular locally and governments face the risk of being confronted with major local resistance, governments are well-advised to very clearly communicate the economic, but also the social and cultural benefits that come with the implementation of such policy projects in a local community. Tax revenues should directly benefit local communities and if necessary, financial compensation and side-payments are also promising instruments to obtain local support. Second, our study contributes to the literature on electoral competition by showing that political parties are electorally punished in local communities that have to bear the consequences of a public policy that is otherwise broadly supported. Third, our findings also contribute to a literature on how economic considerations can increase public support for climate and energy policies (Bechtel and Scheve, 2013; Gaikwad et al., 2022). An examples of such design features is the EU's *Renewable Energy Communities* program, that allows citizens to directly sell surplus renewable energy to others in their community. In addition to economic benefits – as we have shown here – elite signals (Rinscheid et al., 2021) or policy timing (Rinscheid et al., 2020) can have an important effect on generating public support for policies in general and energy transitions in particular. Future research ought to explore these questions more deeply. Finally, we contribute to work on Green parties and environmental politics. By studying a historical position at the core of European Green parties, we shed light on the electoral consequences of the policies these parties push for.

CRediT authorship contribution statement

António Valentim: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Heike Klüver:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization. **Cornelius Erfort:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used ChatGPT (GPT-4) in order to improve the readability of the introduction and literature review. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article.

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Declaration of competing interest

All authors declare they have no competing or conflict of interests. Funding details are outlined in the title page and the submission platform.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.electstud.2025.102959.

Data availability

Replication materials can be found here (will be made available after publication): https://github.com/antoniovalentim/how-nuclear-hurts-the-greens.

We would like to highlight that, per SOEP policy, some of the data we use in survey data includes participants' district and those data cannot be shared publicly, researchers can only access it in residence, and only export outputs (more information https://www.diw.de/en/diw_01.c.602977.en/soep-in-residence_our_guest_program.html).

For these reasons, we will not be able to share our survey data, but make public all our code and data for the remaining analyses.

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