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Far-right ideology slows adoption of green technologies, but the partisan gap is dynamic

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ABSTRACT

The diffusion of green technologies is critical for climate goals, yet political polarization influences adoption. We examine how ideology affects electric vehicle (EV) and residential solar photovoltaic (PV) uptake in Germany, drawing on three-wave survey data ($n=2,356-3,092$; 2022–24) and municipality-level registrations, installations, and voting data ($n=10,733$; 2014–23). Supporters of the far-right AfD show significantly lower willingness to adopt EVs and, to a lesser degree, PVs, compared to Green Party voters. Polarization is not static: while PV adoption was initially strongly tied to political preferences, this effect weakened as the technology matured. EV adoption is more polarized but exhibits a declining trend over time. Yet, we also find that previously unpolitical technologies, like heat pumps, can suddenly become polarized. Using an instrumental variable approach based on wolf attacks – a proven predictor of far-right voting – we address endogeneity concerns and identify a causal negative impact of far-right voting on green technology adoption.

INTRODUCTION

The transition to a sustainable energy future necessitates a substantial reduction in fossil fuel use. Households contribute to over 70% of global greenhouse gas emissions through their consumption behavior¹, making the rapid scaling of green technologies – such as solar photovoltaics (PVs), electric vehicles (EVs) and electric heating – a critical component of this effort^{2,3}. Early adoption was supported by policy interventions, such as purchase price reductions^{4,5}. However, their long-term impact depends on driving lasting behavioral change^{6,7}. While demand-side subsidies and declining costs have spurred growth, nonmonetary factors – such as ease of installation, aesthetics, charging infrastructure, peer effects and cultural acceptance – are increasingly critical for sustaining demand^{8–11}, as evidenced by the recent slowdown in EV adoption momentum in major economies like Germany^{12,13}, the UK, and the

US¹⁴. A key factor is the rise of political partisanship, which has turned EV adoption into a “cultural war,” undermining public support¹⁵.

Previous research shows that political ideology influences energy and climate-related behavior^{16,17}. Social identity theory highlights two key mechanisms: identity consistency, where actions align with beliefs¹⁸, and signaling of political and social identity¹⁷. This is particularly relevant for green technologies, often perceived as “virtuous consumption” and a symbol of environmental commitment¹⁹. Existing research suggests that PV adoption is less polarized²⁰, whereas EVs are more politically divisive²¹. This is partly because cars serve as strong status symbols with both symbolic and emotional significance²². For example, survey research suggests that pro-environmental party affiliation is linked to increased EV adoption in Switzerland²³. Similarly, in the U.S., Democrats are more likely than Republicans to purchase an EV²⁴. Ideology joins other factors previously linked to PV and EV adoption, ranging from demographics (e.g., income, age, education) to the contextual (e.g., local charging network, electricity pricing, housing type)²⁵. However, much of the previous research relies on self-reported behavior, which is often prone to biases and lacks geographic and temporal scope. Studies on how political ideology influences adoption over time as these technologies mature remain limited. Most of the research is also heavily focused on the U.S., despite the need for more country-specific analyses to account for the diverse political and contextual influences on adoption globally²⁶. Most importantly, the existing empirical studies do not sufficiently address endogeneity issues^{27,28} which arise from the strong correlation between political ideology and socioeconomic factors like education, income, and infrastructure. As some of these variables are unobservable, the estimated effects of political ideology on green technology adoption are potentially suffering from omitted variable bias. These limitations restrict our understanding of the causal relationship between political ideology and green technology adoption.

In this study, we address these gaps by exploring three critical questions: (RQ1) Does political ideology have a causal influence on the adoption of green technologies? (RQ2) How does the influence of polarization differ by technology? (RQ3) How does the influence of polarization differ over time?

To explore these research questions, we construct a unique dataset that integrates government-reported and self-reported data on the adoption of green technologies in Germany. Our approach combines observed adoption behavior at the municipality level ($n=10,733$; 2002–2023 for PV, and 2016–2023 for EV) with a panel of self-reported survey data ($n=2,356$ – $3,092$; 3 survey waves, Dec. 2022–Aug. 2024). We focus on Germany, Europe’s largest economy, renowned for its competitive auto industry and as one of the first countries to adopt residential solar PV at scale. The widespread adoption of residential solar panels in Germany began in the 2000s and an initial surge peaked around 2010. What followed were years of moderate growth until the late 2010s, when adoption rates surged again. Although initial EV adoption began in 2014, substantial growth only occurred after 2019. Germany’s political system comprises a range of small, mid-sized, and large parties spanning the entire political spectrum. When it comes to energy and climate-related policies, the strongest divide, as identified by the Manifesto Project’s²⁹ analysis of party platforms, exists between the pro-environmental Green Party and the far-right AfD Party (Supplementary Note 2). While the Greens advocate for decarbonization, the AfD opposes EV adoption, denies human-driven

climate change, claims that EVs are more harmful than combustion engines^{30,31}, and frames them as symbols of urban elitism³². The AfD holds similar resentments against PV and electric heating^{33–35}, which they claim are driven by a green political agenda and curtail personal freedom. Having gained political traction in recent years, the AfD secured 10.3% of the vote in the 2021 federal election³⁶ and 20.8% in 2025³⁷.

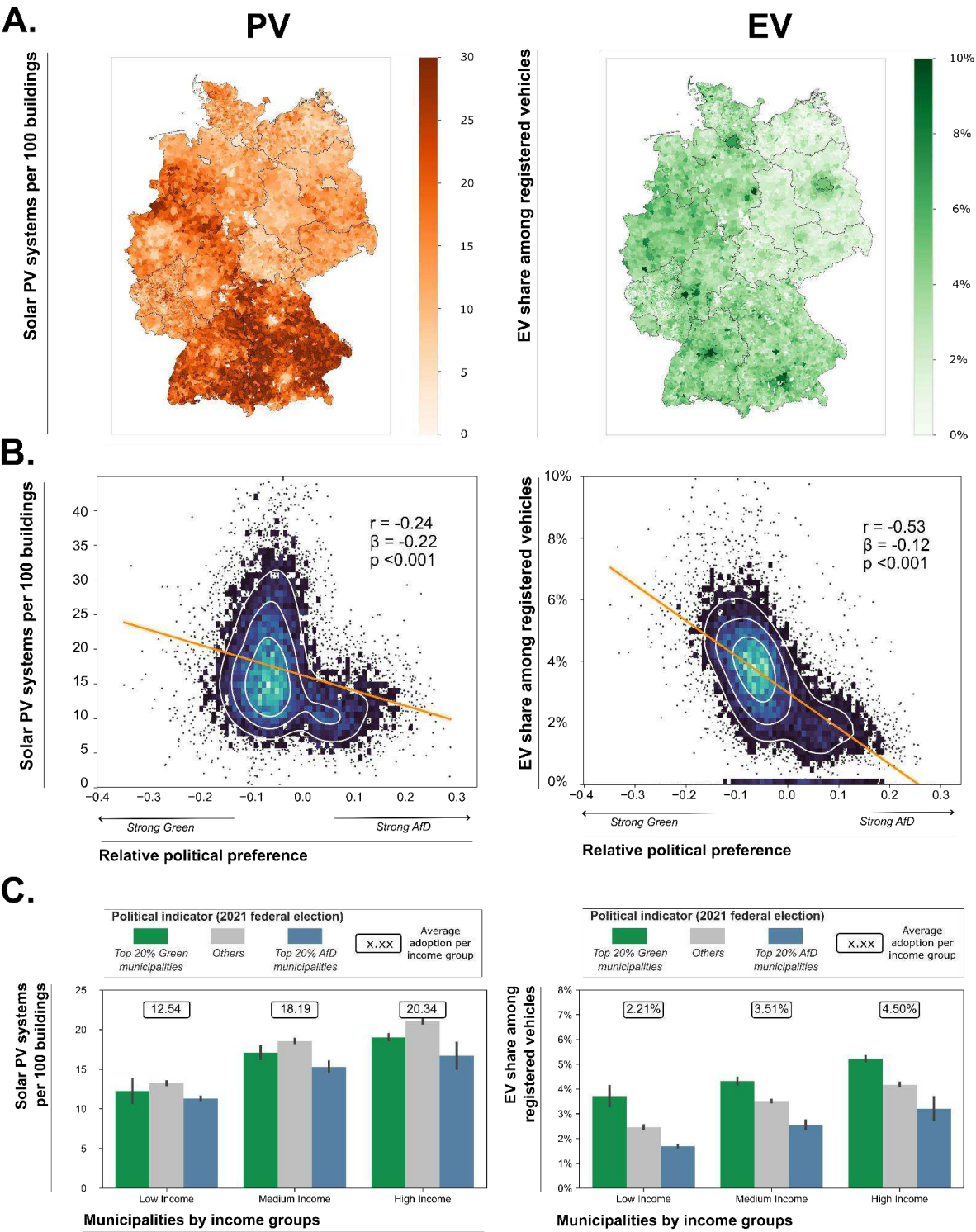
Here, we show that far-right ideology is consistently and negatively associated with adoption of green technologies, a core conclusion that is robust across multiple data sources and methodological approaches. We interpret this relationship causally, supported by the use of wolf attacks on livestock as an instrumental variable. However, we find substantial differences between technologies, with EVs consistently exhibiting greater polarization than PVs. In our survey responses, EV adoption intentions are 2.5 times higher for supporters of the pro-environmental Green Party than for those supporting the far-right AfD. By contrast, the relationship between political ideology and PV adoption is significantly weaker, with Green Party voters being 78% more likely to adopt solar PV systems. This heightened polarization around EVs is also evident in observed adoption behavior. When analyzing the influence of political ideology over time, we observe that the impact of ideology on PV adoption has significantly decreased as the technology matured. In the early 2000s, a 1% increase in Green Party vote share corresponded to a 15% higher growth rate of residential PV relative to the average growth that year. By the late 2010s, this effect had diminished to around 2-3% and plateaued thereafter. While the ideological effect has also weakened for EVs, it remains higher than for PVs, having stabilized between 5-8%. Despite this decline, far-right ideological resistance persists for both technologies. We also show that technologies can *become* polarized when entangled in political debates, as shown by the case of heat pumps in Germany following the contentious 2023 debate over a law aimed at promoting sustainable heating options³⁸.

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108 **RESULTS**

109 *Partisan gap in the adoption of green technologies*

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Fig. 1. A. Heterogeneity across German municipalities ($n=10,733$). (1) Residential solar PV systems per 100 residential buildings (2) Share of EVs among registered cars **B.** Density plot of the relationship between the relative political preferences and green technology penetration in 2023 for German municipalities ($n= 10,733$). Relative political preference is based on the 2021 federal election results and is defined as the difference between vote shares for the pro-environmental Green Party and the far-right AfD Party. Residential solar PV penetration is measured as the number of installed systems per 100 residential buildings. It includes all active solar panels which are classified as “residential” in the official registry of German solar PV systems³⁹. EV penetration is measured as the share of EVs (including both BEVs and PHEVs) among registered vehicles. The orange line depicts the correlation between relative political preferences and green technology penetration. **C.** Relationship between municipality income level and green technology adoption in 2023 (population-weighted, $n= 10,733$ municipalities). Income groups are defined by the 33rd and 66th percentiles of median income. Political orientation is categorized based on the 2021 federal election results.

Our findings reveal a strong political divide in the adoption of green technologies in Germany. Residential solar adoption is highest in southern and large non-city states, while EV adoption follows a similar pattern, with 84% higher registration rates in southern than eastern states (Fig. 1A). Population density correlates negatively with solar PV adoption and positively with EV adoption (Supplementary Note 3). Pro-environmental Green Party supporters adopt solar PV and EVs at higher rates than supporters of the far-right AfD (Fig. 1B), with a stronger divide for EVs. In 2023, solar PV penetration was 14% higher in Green-leaning municipalities, while EV adoption showed nearly twice the gap, with over 5% of registered vehicles being electric compared to 3% in AfD-leaning areas. Adoption rates of both residential solar PV systems and EVs are positively associated with income level (Fig. 1C). Notably, the relationship between income and EV adoption is weaker in AfD strongholds, where adoption remains lower despite higher incomes. This pattern persists across eastern and western states and is most pronounced in wealthy municipalities.

To some extent, the political divide in green technology adoption partly reflects historical differences between eastern and western Germany in both political preferences and adoption rates. Eastern states have had lower solar adoption growth, especially before 2015, while also showing higher AfD support. To account for regional differences, we standardized political preferences at the state level in an additional specification and show that the overall relationship between political preferences and green technology adoption remains consistent (Supplementary Note 4).

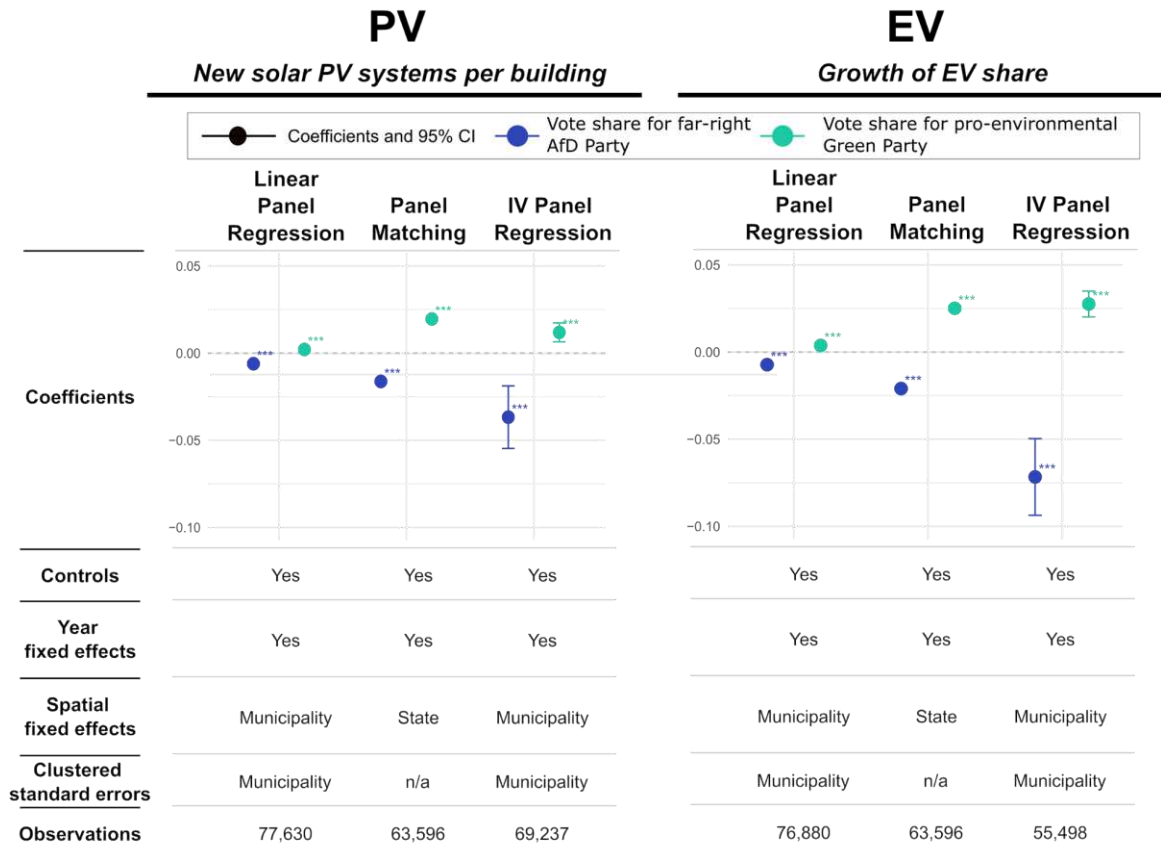


Fig. 2. Regression analyses with the dependent variables being the number of newly installed residential solar PV systems (left) and the growth rate in EV penetration (right). Coefficients are shown for three panel data models: (1) Linear panel regression with demographic, household and adoption-related control variables (2) Panel matching algorithm using propensity scores for continuous exposures following Wu et al.⁴⁰ (3) Instrumental variable (IV) panel regression using wolf attacks as an instrument for AfD vote shares. Statistical significance levels are * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

To assess the effect of political ideology on green technology adoption, we use panel regression models with spatial and temporal fixed effects (Fig. 2, Methods). The key independent variables are AfD and Green Party vote shares (2014–2023). Our results indicate that higher AfD support is associated with lower adoption rates for both technologies (PV: -0.0018, $p < 0.001$; EV: -0.024, $p < 0.001$), while higher Green Party support corresponds to increased adoption (PV: +0.001, $p < 0.001$; EV: +0.02, $p < 0.001$). Our models control for sociodemographic and contextual factors identified by prior research, such as solar irradiation, the number of newly constructed residential buildings, and the number of EV charging stations. Different estimation methods, such as panel matching, yield comparable results and our findings also remain valid across a series of robustness tests (Supplementary Note 5).

A common challenge in empirical studies examining the link between political ideology and green technology adoption is the potential for omitted variable bias²⁷. To address the endogeneity of political ideology, we utilized wolf attacks on livestock as an instrumental

variable (IV) for AfD Party support, applying a two-stage least squares estimation. The resurgence of wolves in Germany has led to increased attacks on livestock⁴¹, raising safety and livelihood concerns, particularly among farmers. This has sparked a political debate over their ecological role⁴² and protection status. Among conservative voters, anti-wolf sentiments are linked to cultural resentment and traditional views on resource use. European far-right parties have amplified the issue, portraying wolves as a significant threat to rural communities⁴³. Recent research has shown a positive and significant correlation between wolf attacks and increased far-right support⁴⁴. Using wolf attacks on livestock as an instrumental variable, we isolate variations in the endogenous predictor (i.e., the AfD vote share) that are directly attributable to political ideology (Methods and Supplementary Note 6 for detailed discussion). The IV regression confirms the negative relationship between AfD voting shares and adoption of both EV (-0.04, $p < 0.001$) and PV (-0.07, $p < 0.001$). The estimates are larger in magnitude than the linear panel regression estimate, as IV coefficients capture the local average treatment effect.

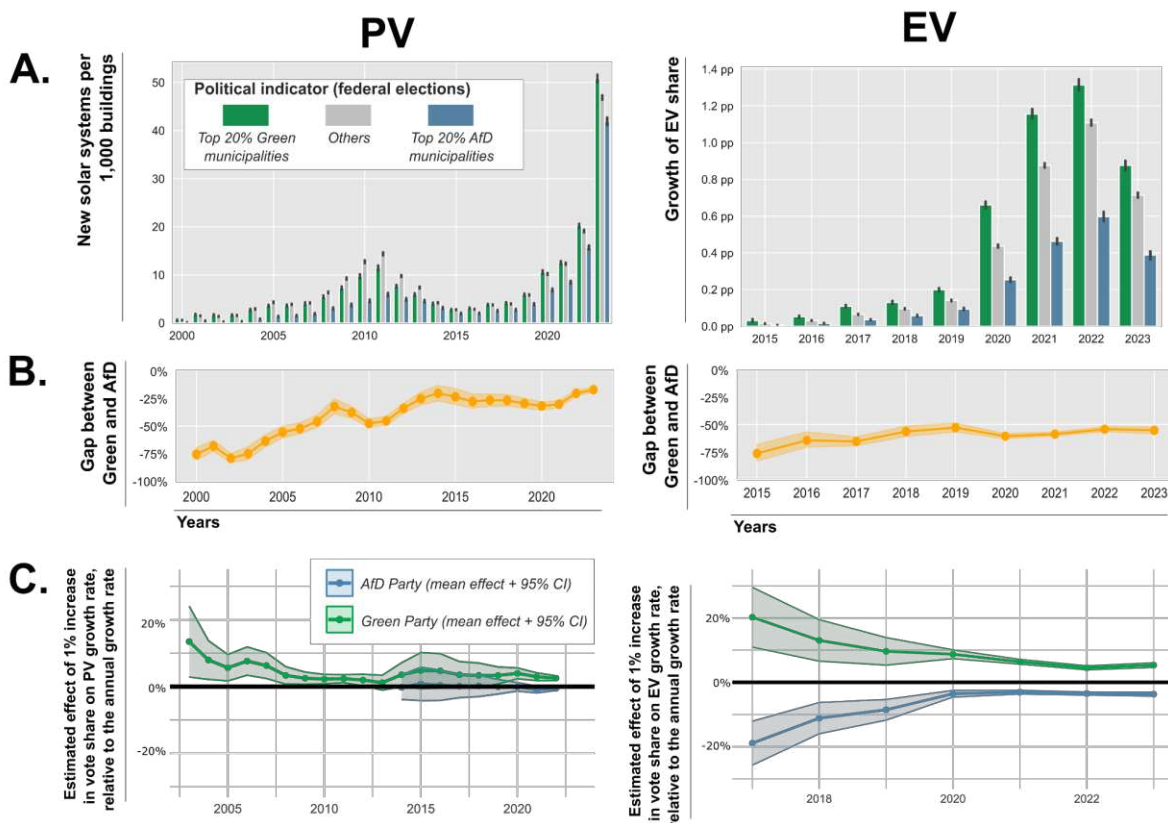


Fig. 3: A. Adoption of green technologies over time. PV adoption is measured as the number of new solar PV systems per 1,000 residential buildings. EV adoption is measured as the percentage point increase in the share of EVs (BEV and PHEV) among registered vehicles. Bars indicate adoption levels for different sets of municipalities ($n = 10,733$): adoption levels for municipalities that are above the 80th percentile for support of the pro-environmental Green Party (vs. far-right AfD Party) are shown by green (blue) bars and gray bars indicate the average adoption level across all municipalities. **B. Partisan gap over time.** Relative difference in adoption level between municipalities with strong support for the pro-environmental Green Party (municipalities that are above the 80th percentile for Green Party vote share, average across 2000–2021) and those with strong support of the far-right AfD Party (municipalities that are above the 80th percentile for AfD Party vote share, average across 2013–2021). A difference of -50% indicates that adoption of the respective technology was 50% lower in municipalities with strong support for the AfD Party as compared to the adoption level in municipalities with strong support for the Green Party. Shaded areas represent 95% confidence intervals estimated via bootstrapping with resampling 10,000 times. **C. Influence of political ideology on green technology adoption over time, relative to annual growth rate.** Influence of political ideology is measured as the effect of a 1% increase in vote share, estimated using a panel regression with interaction effects between vote share and year. The panel regression includes fixed effects at the municipality and year level, along with socioeconomic and adoption-related control variables (Methods). Impact is measured relative to the annual growth rate, i.e. for instance in 2015, a 1% increase in the vote share for the Green Party would be associated

with a 5% increase in new solar panels, *ceteris paribus*. PV adoption is measured by the growth in the number of solar PV systems per residential building within a municipality (n=10,733 municipalities, t=20 years), while EV adoption is measured by the growth in the share of EVs among total registered vehicles within a municipality (n=10,733 municipalities, t=7 years).

As technologies mature, the influence of political ideology shifts. While our earlier estimates capture average effects across municipalities and time, we now examine how this relationship evolved. Comparing growth rates in municipalities with strong support for the pro-environmental Green Party and the far-right AfD Party (Fig. 3A), we find the partisan gap was largest in the early years of adoption. Initially, far-right-leaning municipalities adopted green technologies at rates 60% (PV) to 80% (EV) lower than pro-environmental municipalities. However, these differences declined substantially over time (Fig. 3B).

We estimate the temporal variation of the effects that a 1% increase in the vote shares for the Green Party and the AfD Party had on green technology adoption (Fig. 3C, Methods). In the early 2000s, a 1% increase in Green Party support corresponded to a 15% rise in solar adoption relative to the annual average, but this effect fell to around 3% by the late 2020s and then levelled off. This suggests that as PV technology matured, political ideology became less influential. A similar trend is observed for EV adoption, where ideological influence was strongest early on but weakened over time. However, unlike PVs, EV adoption remained negatively associated with AfD vote shares, indicating greater polarization.

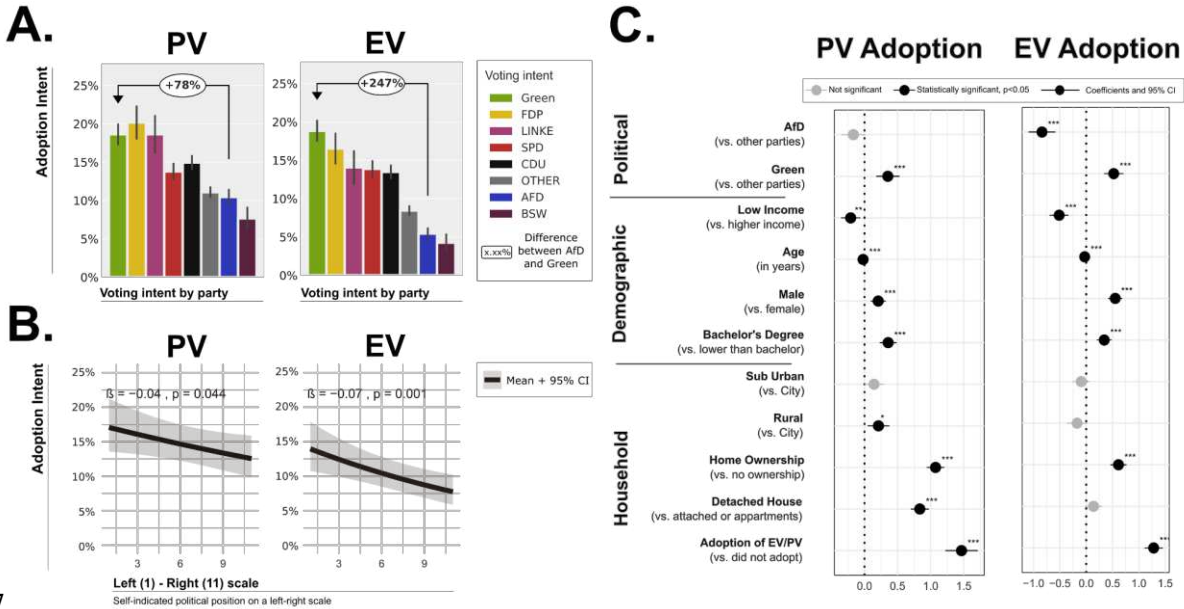


Fig. 4. A. Aggregated survey responses showing the association between voting intention and green technology adoption intention across three survey waves (Wave 1, Dec 2022, $n=2,356$; Wave 2, May 2024 $n=3,092$; Wave 3, August 2024, $n=2,500$). **B.** Relationship between self-reported political preferences of survey respondents and green technology adoption intention. Political preferences are measured on a left (1) to right (11) scale (see Methods). Coefficients are estimated by a Logistic Regression model with the dependent variable being a binary indicator of adoption status or intention (i.e., survey responses “Have adopted” and “Have not adopted, but intend to adopt” were coded as one and others were coded as zero). The models include socioeconomic control variables as well as spatial and temporal fixed effects at the federal state ($n=16$) and survey wave ($n=3$) level. **C.** Relationship between political, demographic, and household characteristics and green technology adoption intentions. Coefficients are estimated by a Logistic Regression model with the dependent variable being a binary indicator of adoption status or intention (i.e., survey responses “Have adopted” and “Have not adopted, but intend to adopt” were coded as one and others were coded as zero). Besides the independent variables displayed in the figure, the models also include spatial and temporal fixed effects at the federal state ($n=16$) and survey wave ($n=3$) level. “Adoption of EV/PV” indicates that an indicator of previous EV adoption is used as an independent variable when PV adoption intention is the dependent variable, and vice versa. Statistical significance levels are $*p<0.05$, $**p<0.01$, and $***p<0.001$.

To further examine the link between political ideology and green technology adoption, including individual perceptions, we complement our municipal-level analysis with self-reported data from a three-wave survey of German residents ($n = 2,356$; $n = 3,092$; $n = 2,500$). In the first wave, 4.5% of participants had adopted an EV, with 12.4% intending to adopt. For residential solar PV, 7.6% had installed systems, while 17.3% planned to adopt. Notably, adoption intent varied substantially by voting preference (Fig. 4A). Among Green Party supporters, 17% planned to adopt an EV, compared to 7% of AfD supporters. For residential solar PV, the gap was smaller, with Green Party voters showing 78% higher adoption intent.

Self-reported ideology on a left-right scale confirms that right-leaning individuals are less likely to adopt green technologies, with a stronger effect for EVs ($\beta = -0.07$, $p = 0.001$, Fig. 4B) than for PVs ($\beta = -0.04$, $p = 0.039$).

We modeled self-reported EV adoption intent using logistic regression with sociodemographic, household, and state-level controls. Consistent with our descriptive analysis, EV adoption is more strongly tied to political preferences than PV adoption (Fig. 4C). While AfD voters are 18% less likely to express PV adoption intent, this effect is not statistically significant ($p = 0.072$). In contrast, Green Party voters are 35% more likely to adopt PV systems ($p < 0.001$). For EVs, the partisan divide is sharper: AfD voters are 67% less likely to express adoption intent ($p < 0.001$), with aversion increasing among politically engaged individuals. A reinforcing pattern emerges for both technologies – participants who have adopted PV systems are more likely to consider an EV purchase, and vice versa. Adoption is also positively associated with higher income, younger age, college education, and homeownership. Our results are robust across other variable definitions and model specifications (Supplementary Note 7).

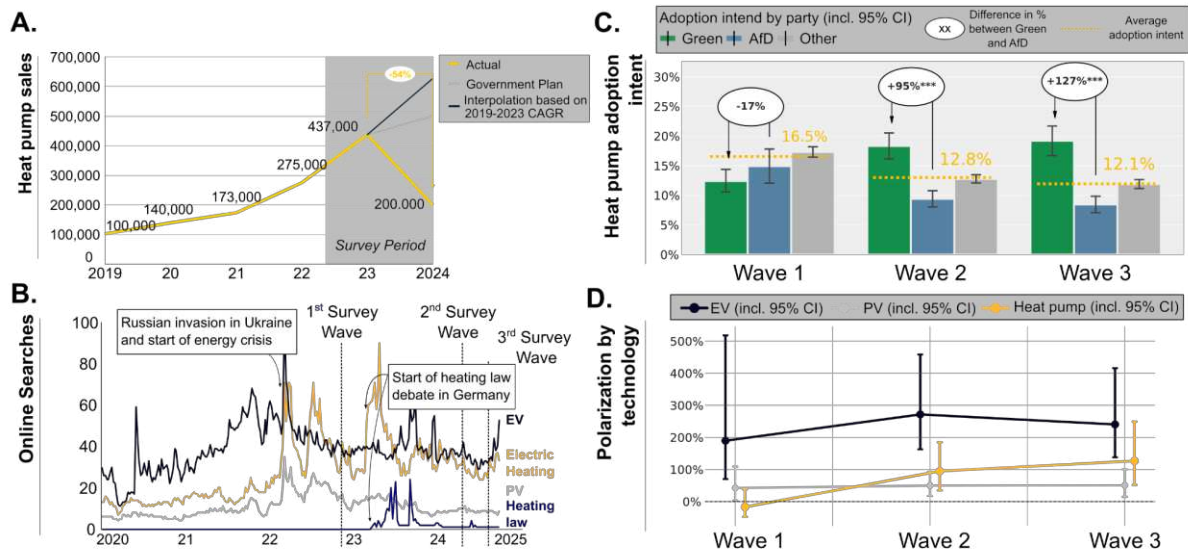


Fig. 5. A. Heat pump sales in Germany based on sales data from the European Heat Pump Association⁴⁵. **B.** Online search behavior in Germany for selected terms based on Google Trends⁴⁶. Search behavior is reported in relative terms with an index varying between 0 and 100. Search terms included the German terms for heating law, solar PV, electric heating, electric vehicles, and variations with equivalent meaning. **C.** Heat pump adoption intent across three survey waves (Wave 1, Dec 2022, $n=2,356$; Wave 2, May 2024 $n=3,092$; Wave 3, August 2024, $n=2,500$). Statistical significance levels are * $p<0.05$, ** $p<0.01$, and *** $p<0.001$. **D.** Polarization by technology across three survey waves. Polarization is calculated as the percentage difference between the adoption intents of Green Party voters and AfD Party voters. Error bars represent 95% confidence intervals estimated via bootstrapping with resampling 10,000 times.

Unlike EV and PV adoption, where partisan differences have declined over time, polarization around heat pumps has recently emerged. Germany has historically lagged behind other European countries in heat pump adoption, partly due to high electricity costs⁴⁵. Sales began accelerating after 2020, peaking at over 430 thousand units in 2023. However, in 2024, sales dropped by more than 50% – far below expectations (Fig. 5A). The decline was attributed to an economic downturn, slowed building construction, and pull-forward effects from 2023. Uncertainty over a new heating law further dampened demand⁴⁷, despite subsidies covering up to 70% of costs. Indeed, online search trends show a strong correlation between interest in heat pumps and the heating law (Fig. 5B). Survey results also indicate a decline in adoption intent, from 16.5% in December 2022 to 12.1% in August 2024 (Fig. 5C). Initially, heat pump adoption showed little political polarization, but as overall adoption intent declined – especially among AfD voters – Green Party supporters reported increased willingness to adopt. By Wave 2, Green Party voters were 95% ($p<0.001$) more likely to intend heat pump adoption than AfD voters (Fig. 5D). While this partisan divide remains lower than for EVs (250%), it is significantly higher than for PV systems (50%).

DISCUSSION

We provide robust evidence that political ideology is closely tied to green technology adoption decisions. Specifically, far-right voters are less likely to adopt green technologies, while pro-environmental party voters are more willing to do so. Crucially and in contrast to previous research, we address endogeneity by using wolf attacks on livestock as an instrumental variable to establish causality. Our analysis also reveals distinct differences across technologies. The political divide is more pronounced for adoption of EVs than for solar PV systems. This conclusion is supported by multiple approaches: (1) observed purchasing and election data reveal that a 10% increase in support for the pro-environmental Green Party increases EV adoption growth by 14% on average, compared to 7% for PV, and (2) self-reported survey data showing Green Party voters have a 245% higher intention to adopt EVs than AfD supporters, whereas the gap for PV is 78%.

One factor contributing to the differences between technologies and the existence of a partisan gap is the technology's maturity. In the early stages of technology diffusion, both PV and EV adoption exhibit similar sensitivities to pro-environmental vote shares. However, the relative influence of political ideology decreases over time. This is consistent with the theory of diffusion of innovation⁴⁸, which suggests that early adopters are typically more "socially forward," while later adopters tend to be more conservative. In the early 2000s, PV adoption showed a strong political correlation, with a 1% increase in Green Party vote share resulting in a 15% higher growth rate compared to the average growth that year. However, by the late 2010s, this influence had diminished significantly to 2-3% and subsequently leveled off. For EVs, although the impact of political ideology has also declined over time, it remains more pronounced, stabilizing at a range of 5-8%.

EVs may be inherently more polarizing than solar PV due to their visibility and role as status symbols, enhancing their identity-signaling²². Moreover, stark differences in underlying beliefs among party supporters amplify this polarization. When presented with statements about climate benefits, raw material use, lifespan, and explosion risks of EVs, AfD voters expressed substantially more negative views compared to Green Party supporters and the general public (Supplementary Note 8). For example, only 26% believe replacing a combustion engine with an EV is climate-friendly, compared to 61% of Green party voters. Similarly, 9% of AfD voters think raw materials for EV production are abundant, compared to 31% of Green Party voters. Statements regarding the adoption of solar PV received a generally higher level of positive beliefs, even among AfD voters. While differences between political sides remain, they are notably less pronounced in the case of solar PV.

However, technologies can also *become* polarized, as demonstrated by the case of heat pumps. The enactment of a law aimed at replacing oil and gas heaters sparked a contentious public debate^{38,49}. Conservative and far-right parties criticized the law as ideologically motivated, thereby mobilizing opposition. This debate coincided with a halving of demand for heat pumps, despite subsidies covering up to 70% of costs⁵⁰. Our findings show a sharp decline in adoption intentions following the debate, along with the emergence of a partisan gap. Initially, polarization was minimal, aligning with prior research suggesting low political division over heat pumps²¹. However, by 2024 (i.e. after the debate), Green Party voter adoption intent rose from 13% to 19%, while AfD voter intent dropped from 15% to 9%. This

suggests that political discourse can transform technologies into political battlegrounds, affecting overall adoption rates.

Our study is not without limitations, presenting avenues for future research. First, our municipality-level analysis is limited to election vote share data, which serves as a proxy for regional ideological trends but does not directly capture individual-level beliefs or alignment with far-right platforms. Second, although far-right parties held no governing power during the study period, the Green Party's presence in municipal, state, and federal governments may have strengthened the influence of its vote share. If these parties gain power, their direct and indirect influence on green technology adoption could grow, shaping local debates – such as charging station construction – and further impacting adoption decisions. To help account for policy changes, we include county-year fixed effects (Supplementary Note 5). Third, our dataset is uniquely comprehensive, capturing early adoption trends over a 20-year period. However, due to privacy restrictions it is aggregating PHEVs and BEVs under EVs and combines commercial and residential ownership. While these markets differ slightly, robustness checks on a limited subset confirm that political ideology remains a significant factor.

Our research shows that political ideology shapes green technology adoption in Germany, potentially hindering European decarbonization efforts. These findings have important implications for policymakers and firms promoting green technologies. For one, charging infrastructure deployment strategies must be revisited. The current German approach, which prioritizes areas with higher existing adoption rates, risks exacerbating regional disparities, as far-right-dominated regions tend to have lower adoption rates and often cluster geographically. Also, communication strategies should reflect ideological differences. Reducing uncertainty and addressing negative expectations could help overcome resistance to adoption⁵¹. Tailored messaging that addresses specific concerns and values is likely to be more effective than uniform approaches⁵². For example, the appeal of personal freedom through energy independence – especially in the context of rising energy costs and growing residential solar PV penetration – may resonate across ideological divides.

Still, technology perceptions may not yet be deeply entrenched, influenced by broader societal and political dynamics. For instance, Tesla CEO Elon Musk's growing alignment with conservative and far-right parties⁵³ raises key questions: Could this shift encourage EV adoption among skeptical far-right voters or deter left-leaning consumers? Understanding these dynamics is important, as anecdotal evidence suggests that broader adoption can positively shift attitudes toward green technologies⁵⁴. This underscores the importance of overcoming initial inertia and achieving a critical adoption mass – potentially through the (re-)introduction of subsidies – to normalize EVs across ideological divides.

389 **METHODS**

390 *Data sources*

391 This study utilizes two primary datasets: an observational dataset that includes green
392 technology adoption, socio-economic characteristics, and relevant controls at the municipality
393 level as well as a survey dataset that includes self-reported political affiliations, socio-economic
394 characteristics, and technology adoption intentions of respondents.

395 To construct the observational dataset, we combined the following municipality level
396 data that were obtained from publicly accessible sources and public record requests: (1) Vehicle
397 registrations were sourced from the German Federal Motor Transport Authority (Kraftfahrt-
398 Bundesamt, KBA) for the years 2014 to 2023⁵⁵. The scientific use-files contain the number of
399 vehicles per 1st of January and we thus interpreted the 2024 file as the vehicle fleet of 2023. (2)
400 Solar deployment data were extracted from the official registry of German solar PV systems
401 (Marktstammdatenregister), which covers the period from 2000 to 2023³⁹. (3) Records of wolf
402 attacks, voting data, and shapefiles for municipalities were obtained from the repository of
403 Clemm von Hohenberg and Hager (2022)⁴⁴. (4) Panel data encompassing income,
404 unemployment rates, demographic composition, and housing statistics were extracted from a
405 database managed by federal and state governments (“Regionaldatenbank”)⁵⁶. While data
406 availability varies across variables, it typically covers the period spanning from 2007 to 2022.
407 (5) Data on the deployment of electric vehicle charging stations between 2000 and 2023 were
408 obtained from Germany’s Federal Network Agency (“Bundesnetzagentur”)⁵⁷. (6) As an
409 additional control variable, we sourced the locations of German highways (Autobahnen) from
410 the geoportal of the Federal Agency for Cartography and Geodesy⁵⁸. (7) The shapefiles of
411 postal code areas for the year 2022 were obtained from Suche-Postleitzahl.de, a publicly
412 accessible website offering detailed geographical information for Germany at the postal code
413 level⁵⁹.

414 To construct the survey dataset, we conducted a three-wave survey in December 2022,
415 May 2024, and August 2024, targeting residents of Germany. The survey explored participants’
416 concerns about energy availability and costs, their support for various government policies, and
417 their willingness to adopt green technologies, including electric vehicles (EVs) and solar panels
418 (PVs). Sociodemographic and household information were also collected. The survey waves
419 included 2,356 participants in December 2022, 3,092 in May 2024, and 2,500 in August 2024.
420 Of these, 816 participants completed all three waves. Additional participants were recruited in
421 later waves to ensure a representative sample for each wave. The internet-based survey,
422 conducted by YouGov, targeted individuals aged 18 years and older. It was designed in
423 English, translated into German, and administered in German to participants. The
424 representation of party affiliations aligns closely with the outcomes of the 2021 federal
425 election; Federal Election Results vs. Survey outcome: SPD 25.7% vs. 25.4%, CDU 24.1% vs.
426 19.7%, AFD 10.3% vs. 9.1%, Greens 14.8% vs. 18.4%, FDP 11.5% vs. 11.4%, Left 4.9% vs.
427 6.7%.

Econometric approach for estimating the effect of political ideology on green technology adoption

To identify the effect of ideology and partisanship on the adoption of solar PV systems and EVs, we applied various econometric modelling techniques to our observational dataset. Specifically, we employed Linear Panel Regression, a Panel-matching algorithm, and Instrumental Variable Regression to estimate causal effects. Furthermore, we utilized Logistic Regression to explore the relationship between self-reported political affiliations and technology adoption intentions.

Linear Panel Regression

To estimate the effect of political ideology on technology adoption behavior, we specified the following regression model:

$$TechShareGrowth_{Mun,Year} = \alpha + \beta AfD_{Mun,Year-1} + \eta Green_{Mun,Year-1} + \gamma X_{Mun,Year} + \delta_{Mun} + \phi_{year} + \epsilon \quad (1)$$

where *TechShareGrowth* is the change in the adoption rate of green technologies within a municipality in a given year. *TechShareGrowth* is either the number of residential solar installations per residential building or the share of electric vehicles among the total number of registered passenger cars within a municipality. Due to data availability limitations, we considered both battery electric and plug-in hybrid electric vehicles as EVs. We further include the share of commercially-owned vehicles in a robustness check to control for the potential impact of company car privileges and density of corporations. As we lack observations of the share of commercially-owned vehicles for ~50% of observations, we do not include it in our main specification (Supplementary Note 5).

We observed vote shares for the AfD and Green parties across federal, state, and municipality-level elections since 2013. In our main specification, we define *AfD* and *Green* as the average share of votes for the respective party across all elections and interpolate years without an election. In Supplementary Note 5, we tested other definitions of the vote share variables, which confirm our main results. We did not use polling data, as to the best of our knowledge it is not available at the municipality-level. δ_{Mun} is a spatial fixed effect at the municipality-level and ϕ_{year} a temporal fixed effect at the year level. $X_{Mun,Year}$ is a control vector that includes previously identified determinants of technology adoption^{23,25} such as income, population density, unemployment level, prevalence of single-family homes, age demographics, existing solar PV deployment, the availability of charging stations, and access to highways. Data on vote shares for the AfD Party is available from 2013, the year the party was founded, and EV adoption is observed from 2014 to 2023. Consequently, our dataset is limited to 87,340 observations across 9 years for 10,267 municipalities, with 9,257 observations excluded due to missing data on technology adoption, election outcomes, or control variables. For some specifications that focus on solar panel installations, we include only Green Party vote shares, which enables us to extend the panel analysis back to the year 2000. This results in 220,878 observations, with 31,602 excluded due to incomplete data.

Panel-matching algorithm

We then estimated the effect of political preferences on green technology adoption using the panel matching algorithm proposed by Wu et al. (2024)⁴⁰, which is specifically designed for continuous exposure variables, such as the voting shares of the AfD and Green parties in our case. We used the same control variables as in equation (1), including a year variable and an eastern state indicator, to generate a pseudo-population. After obtaining the matched dataset, we fitted a non-parametric exposure-response function using a kernel smoother to determine the effect of higher vote shares for the AfD Party on green technology adoption. Confidence intervals were obtained by applying bootstrapping with 1,000 repetitions.

Instrumental Variable Regression

Our identification strategy is based on the use of wolf attacks as an instrument for the share of AfD Party voters. Prior research has shown that wolf attacks on livestock affects voting behavior, especially as far-right parties such as the AfD explicitly exploit changes in sentiment and potential fear for loss of livelihoods⁴⁴. We used a two-stage-least-squares approach⁶⁰: In the first-stage regression, we regress *AfD* vote share on *WolfAttacks* and all control variables from equation (1), which is then specified as:

$$AfD_{Mun,Year-1} = \alpha + \beta WolfAttacks_{Mun,Year-1} + \gamma X_{Mun,Year} + \delta_{Mun} + \phi_{year} + \epsilon \quad (2)$$

where *WolfAttacks* is an indicator variable set to 1 in case of a wolf attack in the municipality during the previous 4 years. For the instrument to be valid, it must satisfy the relevance condition, meaning it must be sufficiently correlated with the variable of interest. The resurgence of wolves in Germany, migrating primarily from Eastern European countries⁶¹, has resulted in a rise in livestock attacks⁴¹, sparking concerns about both safety and, more critically, the livelihoods of rural communities. The far-right AfD Party has amplified these fears, leveraging social media to depict wolves as a major threat. Recent research has revealed a positive and significant correlation between wolf attacks and increased vote shares for the far-right⁴⁴. The coefficient of *WolfAttacks* in the first-stage regression is positive and significant ($p < 0.001$). The size of the effect is similar to the effect sizes reported by Clemm von Hohenberg and Hager (2022)⁴⁴. Staiger and Stock (1997)⁶² state that a sufficiently strong instrument is indicated by an F-statistic of at least 10 for the null hypothesis that the instrument is irrelevant (i.e., $\beta = 0$). We find an F-Statistic of 258 which strongly supports the assumption that wolf attacks are a suitable instrument. Consistent with prior research, we conclude with high confidence that weak identification is not a concern.

In addition, the instrument must satisfy the exclusion restriction, i.e. it is required that *WolfAttacks* have no direct effect on the adoption of solar PV systems or EVs. This hypothesis is generally not testable, but we argue, it is highly unlikely that wolf attacks have a direct effect on green technology adoption. By including population density, income and age groups as well as municipality-level fixed effects, we control for any unobserved time-invariant municipality variation, such as the degree of urbanization or (persistent) differences in housing characteristics. Wolf attacks are independent of economic cycles and energy prices, especially after including year fixed effects. Other direct effects, such as farmers in very small

municipalities losing their livelihoods and income, thus forgoing an investment in green technologies, are unlikely to have a measurable effect due to the scale of wolf attacks relative to the size of the average municipality. The highest number of wolf attacks within a four-year period in our sample is 67, while the average rural municipality has 2,288 inhabitants. Also, compensation payments by the government reduce the economic impact of wolf attacks⁶¹. Furthermore, we conducted an out-of-sample test by focusing on solar adoption during the period prior to 2013 (before the establishment of the AfD Party), as there were no EVs available at that time. While this test falls under an out-of-sample approach and is not without flaws – such as other political parties potentially addressing the wolf issue and fewer wolf attacks occurring before 2013 – it represents the closest comparable setting available. In this earlier period, not only does the strength of the instrument significantly diminish (F-statistics of 20, and an insignificant WU-Hausman test), but the effect of Green Party vote share is also found to be insignificant (Supplementary Note 6).

Influence of ideology over time

To estimate the effect of political ideology on green technology adoption over time, we employed a linear panel regression model with municipality and year fixed effects, thereby controlling for time-invariant differences across municipalities as well as broader temporal trends. Our main focus was on analyzing the interactions between vote shares (AfD and Green Party) and year, to understand how the impact of ideology evolves over time. For solar PV adoption, growth was measured as the number of new residential solar PV systems installed per residential building in each municipality. For EVs, growth was quantified as the increase in the share of EVs among registered vehicles within a municipality across years. The panel dataset for solar PV adoption covers a span of 20 years, whereas the dataset for EV adoption includes 7 years of data, reflecting the more recent uptake of EV technology. Data on vote shares for the AfD Party has been available since the party's founding in 2013, which limits the timeframe of AfD-related effects on solar PV adoption that we could analyze. Our model included controls for the level of technology diffusion in the previous year, such as the total number of installed solar panels or the share of EVs among registered cars, as well as socioeconomic and other standard control variables commonly associated with adoption decisions, such as income, population demographics, and education levels.

We then calculate the relative impact of political ideology on technology uptake by dividing the effect of ideology on adoption growth by the average growth rate within a year. The results quantify the expected effect of a 1% increase in AfD or Green party vote share on the growth rate, as a percentage of the average growth rate of the technology in a given year.

Exploring the association between self-reported political affiliations and technology adoption intention through Logistic Regression

We applied Logistic Regression to estimate the association of self-reported political affiliation and technology adoption intention. Our dependent variable is adoption willingness (AW), a binary variable set to 1 if respondents answered the question “Do you plan to purchase solar panels /an electric vehicle in the next year?” with either “Have purchased” or “Have not

purchased but intend to purchase”. Our main variables of interest are measures of party affiliation and political orientation. We control for demographic variables such as gender (46% male), household income (50% 3,000 Euro or higher), education (52.1% Abitur or higher) and age (mean = 49.9) along with an indicator for the respective federal state of the respondent to account for the socio-economic contrasts between East and West Germany. Furthermore, we included household-level characteristics such as the number of household members (mean = 2.25), car ownership (mean = 80% of households) and homeownership status (mean = 18%).

Our model is specified as follows:

$$\log\left(\frac{AW}{1-AW}\right) = \alpha + \beta AFD_{Resp.} + \eta Green_{Resp.} + \gamma Control_{Resp.} + \delta_{State} + \epsilon \quad (3)$$

AFD and *Green* are binary variables, indicating the respective party affiliation. *Control* is a vector containing all previously mentioned control variables. Our findings are robust to alternative specifications of the regression models, including linear regression and the integration of various control variables (see Supplementary Note 7). Similarly, we applied this approach to estimate the influence of left-right political positioning on adoption willingness. We define the left-right scale in alignment with the RILE score methodology from the MANIFESTO project²⁹. The left is associated with a commitment to social equality, government regulation of the economy, wealth redistribution, comprehensive public welfare programs, and progressive social policies⁶³. Conversely, the right reflects an emphasis on free market principles, limited government intervention, lower taxation, strong national defense, and conservative social values. In our survey, participants provided self-assessments of their political orientation (*Ideology*) on a scale from 1 (strongly left-leaning) to 11 (strongly right-leaning) (mean = 5.5) and we then fit a logistic regression structured as follows:

$$\log\left(\frac{AW}{1-AW}\right) = \alpha + \beta Ideology_{Resp.} + \gamma Control_{Resp.} + \delta_{State} + \epsilon \quad (4)$$

DATA AVAILABILITY STATEMENT

German vehicle fleet and EV adoption data was acquired through the scientific use-files of the German Federal Motor Transport Authority (“Kraftfahrt-Bundesamt”, KBA) and is not publically available (https://www.kba.de/DE/Statistik/Forschungsdatenzentrum/Datenangebot/Bestand_im_ZFZR/2023/bestand_zfzr_2023_node.html#offs2023.1). Solar panel installation data was sourced from the official registry of German solar PV systems (Marktstammdatenregister, <https://www.marktstammdatenregister.de/MaStR>). Data regarding the location of the German Autobahn network was obtained from the Geoportal, which is publicly accessible at (<https://www.geoportal.de/>). Wolf attacks, voting data, and municipality shapefiles were acquired from the publicly available repository of Clemm von Hohenberg and Hager (2022) (<https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/OOHLX&version=1.0>). EV charging station data was sourced from the Ladesäulenregister by the Bundesnetzagentur (<https://www.bundesnetzagentur.de/DE/Fachthemen/ElektrizitaetundGas/E-Mobilitaet/Ladesaeulenkarte/start.html>). The postal code areas (PLZ) were obtained from Suche-Postleitzahl.de, a publicly accessible website providing detailed geographical information at the postal code level (<https://www.suche-postleitzahl.org/downloads>). Panel data on income, unemployment, age, and buildings were sourced from the Regionaldatenbank (<https://www.regionalstatistik.de/genesis/online>).

We cannot share the raw EV adoption data due to the conditions of the data use agreement. Those interested in obtaining this data should contact the Kraftfahrt-Bundesamt directly. All other datasets, including the survey results, to replicate the results, are available through the Open Science Framework at https://osf.io/hk85r/?view_only=4a13ba446f21434c8fc7d83e35f91cd3. This is a private link for peer review that will be made public before publication.

CODE AVAILABILITY STATEMENT

The code to replicate the results and figures is available through the Open Science Framework at https://osf.io/hk85r/?view_only=4a13ba446f21434c8fc7d83e35f91cd3. This is a private link for peer review that will be made public before publication.

COMPETING INTERESTS

The authors declare no competing interests.

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AUTHOR CONTRIBUTIONS

S.R., M.W., C.Z., R.S. and D.N. conceptualized and designed the research; S.R. performed the research and analyzed data; S.R., M.W., and C.Z. wrote the initial paper draft; all authors

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REFERENCES

1. Dubois, G. *et al.* It starts at home? Climate policies targeting household consumption and behavioral decisions are key to low-carbon futures. *Energy Res. Soc. Sci.* **52**, 144–158 (2019).
2. Ajanovic, A. & Haas, R. Dissemination of electric vehicles in urban areas: Major factors for success. *Energy* **115**, 1451–1458 (2016).
3. Breyer, C., Koskinen, O. & Blechinger, P. Profitable climate change mitigation: The case of greenhouse gas emission reduction benefits enabled by solar photovoltaic systems. *Renew. Sustain. Energy Rev.* **49**, 610–628 (2015).
4. Sierzechula, W., Bakker, S., Maat, K. & van Wee, B. The influence of financial incentives and other socio-economic factors on electric vehicle adoption. *Energy Policy* **68**, 183–194 (2014).
5. Lévy, P. Z., Drossinos, Y. & Thiel, C. The effect of fiscal incentives on market penetration of electric vehicles: A pairwise comparison of total cost of ownership. *Energy Policy* **105**, 524–533 (2017).
6. Stern, P., Dietz, T., Nielsen, K., Peng, W. & Vandenbergh, M. Feasible climate mitigation. *Nat. Clim. Change* **13**, (2022).
7. Nielsen, K. S. *et al.* Underestimation of personal carbon footprint inequality in four diverse countries. *Nat. Clim. Change* **14**, 1136–1143 (2024).
8. Walzberg, J., Carpenter, A. & Heath, G. A. Role of the social factors in success of solar photovoltaic reuse and recycle programmes. *Nat. Energy* **6**, 913–924 (2021).
9. Archsmith, J., Muehlegger, E. & Rapson, D. S. Future Paths of Electric Vehicle Adoption in the United States: Predictable Determinants, Obstacles, and Opportunities. *Environ. Energy Policy Econ.* **3**, 71–110 (2022).
10. Gillingham, K. & Bollinger, B. Social Learning and Solar Photovoltaic Adoption: Evidence from a Field Experiment.
11. Bollinger, B. & Gillingham, K. Peer Effects in the Diffusion of Solar Photovoltaic Panels. *Mark. Sci.* **31**, 900–912 (2012).
12. Gnann, T. Markthochlaufszenarien für Elektrofahrzeuge - Rückblick und Ausblick bis 2030. (2030).
13. Meza, E. German EV sales off track to reaching 15 million target by 2030 – researchers. *Clean Energy Wire* <https://www.cleanenergywire.org/news/german-ev-sales-track-reaching-15-million-target-2030-researchers> (2023).
14. Carey, N. & White, J. Industry pain abounds as electric car demand hits slowdown. *Reuters* (2024).
15. Middleton, N. New campaign to stop ‘EV culture wars and misinformation’. *Fleet World* <https://fleetworld.co.uk/new-campaign-to-stop-ev-culture-wars-and-misinformation/> (2023).
16. Stolle, D., Hooghe, M. & Micheletti, M. Politics in the Supermarket: Political Consumerism as a Form of Political Participation. *Int. Polit. Sci. Rev. Rev. Int. Sci. Polit.* **26**, 245–269 (2005).
17. Gromet, D. M., Kunreuther, H. & Larrick, R. P. Political ideology affects energy-efficiency attitudes and choices. *Proc. Natl. Acad. Sci.* **110**, 9314–9319 (2013).

18. Steg, L., Bolderdijk, J. W., Keizer, K. & Perlaviciute, G. An Integrated Framework for Encouraging Pro-environmental Behaviour: The role of values, situational factors and goals. *J. Environ. Psychol.* **38**, 104–115 (2014).
19. Brick, C., Sherman, D. K. & Kim, H. S. “Green to be seen” and “brown to keep down”: Visibility moderates the effect of identity on pro-environmental behavior. *J. Environ. Psychol.* **51**, 226–238 (2017).
20. Mildenberger, M., Howe, P. D. & Miljanich, C. Households with solar installations are ideologically diverse and more politically active than their neighbours. *Nat. Energy* **4**, 1033–1039 (2019).
21. Burgess, M. G. *et al.* Supply, demand and polarization challenges facing US climate policies. *Nat. Clim. Change* **14**, 134–142 (2024).
22. Steg, L. Car use: lust and must. Instrumental, symbolic and affective motives for car use. *Transp. Res. Part Policy Pract.* **39**, 147–162 (2005).
23. Brückmann, G., Willibald, F. & Blanco, V. Battery Electric Vehicle adoption in regions without strong policies. *Transp. Res. Part Transp. Environ.* **90**, 102615 (2021).
24. Sintov, N. D., Abou-Ghalioum, V. & White, L. V. The partisan politics of low-carbon transport: Why democrats are more likely to adopt electric vehicles than Republicans in the United States. *Energy Res. Soc. Sci.* **68**, 101576 (2020).
25. Stockkamp, C., Schäfer, J., Millemann, J. A. & Heidenreich, S. Identifying Factors Associated with Consumers’ Adoption of e-Mobility—A Systematic Literature Review. *Sustainability* **13**, 10975 (2021).
26. Nielsen, K. *et al.* Realizing the full potential of behavioral science for climate change mitigation. *Nat. Clim. Change* **14**, (2024).
27. Dokshin, F. A. & Gherghina, M. Party affiliation predicts homeowners’ decisions to install solar PV, but partisan gap wanes with improved economics of solar. *Proc. Natl. Acad. Sci.* **121**, e2303519121 (2024).
28. Sinton, J., Cervini, G., Gkritza, K., Labi, S. & Song, Z. Examining electric vehicle adoption at the postal code level in US states. *Transp. Res. Part Transp. Environ.* **127**, 104068 (2024).
29. Lehmann, P. *et al.* Manifesto Project Dataset. Manifesto Project <https://doi.org/10.25522/MANIFESTO.MPDS.2024A> (2024).
30. AfD-Fraktion Sachsen. Ladenhüter E-Auto: Irrweg Elektromobilität stoppen. *AfD-Fraktion Sachsen* <https://afd-fraktion-sachsen.de/ladenhueter-e-auto-irrweg-elektromobilitaet-stoppen/> (2023).
31. dpa. Elektroauto: Sächsische AfD hält Elektromobilität für einen Irrweg. *Heiseonline* <https://www.heise.de/news/Elektroauto-Saechsische-AfD-haelt-Elektromobilitaet-fuer-einen-Irrweg-9220074.html> (2023).
32. Rall, P. ‘Die verhassten Eliten’: Das hat die AfD gegen Elektroautos. *Futurezone* <https://www.futurezone.de/produkte/article521109/elektroautos-darum-ist-die-afd-dagegen-so-experte.html> (2024).
33. AfD-Fraktion im Deutschen Bundestag. Kostenfalle Wärmepumpe. *AfD-Fraktion im Deutschen Bundestag* <https://afdbundestag.de/kostenfalle-waermepumpe/>.
34. NRW, P. Habecks Heiz-Irrsinn rächt sich: 80 Prozent der Wärmepumpen müssen wieder raus! | AfD NRW. <https://afd.nrw/aktuelles/2023/07/habecks-heiz-irrsinn-raecht->

- sich-80-prozent-der-waermepumpen-muessen-wieder-raus/ (2023).
35. Zentner, C. AfD: Wind und Solar bekämpfen, Landschaften schützen. *Deutscher Bundestag* <https://www.bundestag.de/presse/hib/kurzmeldungen-984366> (2023).
 36. Bundeswahlleiterin. Bundestagswahl 2021: Endgültiges Ergebnis. *Statistisches Bundesamt* https://www.bundeswahlleiterin.de/info/presse/mitteilungen/bundestagswahl-2021/52_21_endgueltiges-ergebnis.html (2021).
 37. Die Bundeswahlleiterin. Ergebnisse Deutschland. <https://www.bundeswahlleiterin.de/bundestagswahlen/2025/ergebnisse/bund-99.html> (2025).
 38. Kaufmann, D. Heat pumps: Why Germany's heating revolution is stalling – DW – 09/20/2024. *dw.com* <https://www.dw.com/en/heat-pumps-why-germanys-heating-revolution-is-stalling/a-70192621> (2024).
 39. Bundesnetzagentur für Elektrizität, Gas, Telekommunikation, Post und Eisenbahnen. Datendownload | MaStR. *Marktstammdatenregister* <https://www.marktstammdatenregister.de/MaStR/Datendownload>.
 40. Wu, X., Mealli, F., Kioumourtoglou, M.-A., Dominici, F. & Braun, D. Matching on Generalized Propensity Scores with Continuous Exposures. *J. Am. Stat. Assoc.* **119**, 757–772 (2024).
 41. Khorozyan, I. & Heurich, M. Large-Scale Sheep Losses to Wolves (*Canis lupus*) in Germany Are Related to the Expansion of the Wolf Population but Not to Increasing Wolf Numbers. *Front. Ecol. Evol.* **10**, 778917 (2022).
 42. Zscheischler, J. & Friedrich, J. The wolf (*canis lupus*) as a symbol of an urban–rural divide? Results from a media discourse analysis on the human–wolf conflict in Germany. *Environ. Manage.* **70**, 1051–1065 (2022).
 43. Leser, J. & Pates, R. The Framing of Right-Wing Populism: Intricacies of ‘Populist’ Narratives, Emotions, and Resonance. in *The Palgrave Handbook of Populism* (ed. Oswald, M.) 437–450 (Springer International Publishing, Cham, 2022). doi:10.1007/978-3-030-80803-7_27.
 44. Clemm von Hohenberg, B. & Hager, A. Wolf attacks predict far-right voting. *PNAS* **119**, e2202224119 (2022).
 45. Westring, P., Gibb, D., Uguen, G., Azau, S. & Vanbecelaere, J. *European Heat Pump Market and Statistics Report 2024*. https://www.euractiv.com/wp-content/uploads/sites/8/2024/07/Statistics_2024MarketReport_Marketandstatisticreport2024_EuropeanHeatPumpAssociation_forEHPAmembersonly.pdf (2024).
 46. Google Trends. *Solaranlage, E-Auto, Heizungsgesetz, Wärmepumpe* <https://trends.google.de/trends/explore?date=today%205y&geo=DE&q=Solaranlage,%2Fm%2F0hw90,%2Fm%2F03nlf2w,Heizungsgesetz,%2Fm%2F01ms6r&hl=de> ((n.d.)).
 47. Sackmann, C. Wärmepumpen: Warum der Absatz trotz neuem Gesetz einbricht. *FOCUS online* https://www.focus.de/immobilien/wohnen/energieverbrauch/mehr-oelheizungen-verkauft-warum-der-absatz-von-waermepumpen-trotz-neuem-gesetz-einbricht_id_260102201.html (2024).
 48. Rogers, E., Singhal, A. & Quinlan, M. Diffusion of Innovations. in *An Integrated Approach to Communication Theory and Research* (Routledge, 2008).

49. Angst mounts over Germany's green transition. *The Economist* (2023).
50. Bundesministerium für Wirtschaft und Klimaschutz. Gesetz zum Erneuerbaren Heizen | Bundesregierung. *Die Bundesregierung informiert | Startseite* <https://www.bundesregierung.de/breg-de/aktuelles/neues-gebaeudeenergiegesetz-2184942> (2024).
51. Thøgersen, J. & Ebsen, J. V. Perceptual and motivational reasons for the low adoption of electric cars in Denmark. *Transp. Res. Part F Traffic Psychol. Behav.* **65**, 89–106 (2019).
52. Debnath, R., Bardhan, R., Reiner, D. & Miller, J. R. Political, economic, social, technological, legal and environmental dimensions of electric vehicle adoption in the United States: A social-media interaction analysis. *Renew. Sustain. Energy Rev.* **152**, 1–23 (2021).
53. Brennan, C. N., Sophie Tanno, Eve. Musk urges Germans to vote for AfD in latest involvement in European politics. *CNN* <https://www.cnn.com/2025/01/09/world/musk-livestream-afd-weidel-germany-intl/index.html> (2025).
54. McDonnell, T. E., Gabur, A. & Keynton, R. "I'm Saving Fuel to Buy More Guns": The Electric Vehicle as Cultural Object and Climate Policy Solution ¹. *Sociol. Forum* **38**, 1408–1422 (2023).
55. Kraftfahrt-Bundesamt (KBA). Bestand im Zentralen Fahrzeugregister 2023. (2023) doi:10.25525/kba-fdzoff.zfzrbs.2023.1.
56. Landesbetrieb & Information und Technik Nordrhein-Westfalen. Regionaldatenbank Deutschland. <https://www.regionalstatistik.de/genesis/online> (2024).
57. Bundesnetzagentur. Ladesäulenregister. <https://www.bundesnetzagentur.de/DE/Fachthemen/ElektrizitaetundGas/E-Mobilitaet/Ladesaeulenkarte/start.html>.
58. Bundesamt für Kartographie und Geodäsie. Geoportal.de. *Geoportal* <https://www.geoportal.de/Download/E068415C-D7B1-4D96-B8A0-FA1C23DF5CC7>.
59. Schwochow, M. Kostenlose Postleitzahlenkarte. <https://www.suche-postleitzahl.org/plz-karte-erstellen> (2023).
60. Wooldridge, J. M. *Econometric Analysis of Cross Section and Panel Data*. (The MIT Press, 2010).
61. Reinhardt, I. & Kluth, G. Wolfsverursachte Schäden, Präventions- und Ausgleichszahlungen in Deutschland 2021. (2022).
62. Staiger, D. & Stock, J. H. Instrumental Variables Regression with Weak Instruments. *Econometrica* **65**, 557–568 (1997).
63. Laver, M. J. & Budge, I. Measuring Policy Distances and Modelling Coalition Formation. in *Party Policy and Government Coalitions* (eds. Laver, M. J. & Budge, I.) 15–40 (Palgrave Macmillan UK, London, 1992). doi:10.1007/978-1-349-22368-8_2.

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