Do Green Users Become Green Voters?

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Abstract

We estimate the causal effect of the diffusion of solar photovoltaic (PV) systems on the fraction of Green Party votes in federal and state elections in Baden-Württemberg, Germany. Our estimates are based on instruments that induce exogenous variation in roof appropriateness to PV installation. We find that PV adoption had a strong positive effect on Green Party votes. The effect is connected to the direct engagement of households with the PV system and does not reflect reciprocity to economic gains from PV. Our estimates likely reveal changing attitudes towards environmentally friendly values after adopting PV produced by cognitive dissonance.

Keywords: Voting, Green Technology Diffusion, PV Systems

JEL Codes: O14, O33, Q48, Q58

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The historic challenge of climate change requires economies to change from fossil to non-fossil sources of energy within a short horizon. So far, governments and supra-national organizations have relied heavily on economic incentives such as green tax rebates, price subsidies for green energy production and cap-and-trade schemes to reduce the use of fossil fuels; however, based on the limited impact that economic incentives are having,[1] it is becoming increasingly clear that a more comprehensive strategy will be necessary to meet this challenge.

A lever that has often been overlooked by governments is the implementation of policies that change citizens' attitudes towards green values.[2] Improving attitudes towards the environment would help in fighting climate change as environmentally conscious citizens undertake actions and support policies that favor an energetic transition. Additionally, firms adopt environmentally friendly production processes to please these pro-green consumers, as has recently been shown by Aghion et al. (2023).

Despite their potential, a key difficulty faced by policies that attempt to shape citizens' attitudes towards the environment is that we know little about what drives these attitudes. This paper intends to start closing this important gap by exploring one hypothesis about the drivers of pro-green attitudes.

Our research question is whether there is a causal effect of adopting solar photovoltaic (PV) panels on pro-green attitudes manifested as an increase in political support for the Green Party. To explore this question, we assemble a municipal-level dataset of PV diffusion and share of Green Party votes in federal and state (Laender) -level elections in Baden-Württemberg, Germany between 1996 and 2021. To ensure that our estimates reflect the causal effect of exogenous changes in PV adoption, we construct instruments based on the appropriateness of roofs in each municipality for the installation of PV systems using exogenous physical properties of the roofs, such as their orientation (North-South vs. East-West) and inclination. Our estimates show that the adoption of PV systems caused an increase in the share of the vote won by the Green Party. This effect is quantitatively significant and could account for the entire

[1] For example, Cullen (2013) estimates a low elasticity of wind power installations with respect to subsidies. Murray et al. (2014) show that production and investment tax credits for renewable electricity and tax credits for the production and use of biofuels have had a very limited impact on the emissions of greenhouse gases in the US. De Groote and Verboven (2019) show that consumers apply a very high discount rate to future revenues from selling green electricity to the grid, limiting the impact of feed-in tariffs on PV adoption.

[2] The notion that a government might try to affect the values of its citizens may be questionable on moral or even legal grounds. A prior consensus would be needed to collectively embrace those values and explicitly recognize them in a general law or the constitution.

increase in green votes between the late 1990s and 2021 in federal elections, and for more than half of that increase in regional elections. Furthermore, these findings are relevant beyond Baden-Württemberg, as we observe a similar reduced-form relationship between solar adoption and changes in attitudes towards the Green Party at the individual-level in other German regions, based on the Socio-Economic Panel (SOEP, 2022).

To understand the mechanism responsible for this effect, we study how the relationship between PV adoption and green votes depends on (i) the size of a PV installation, (ii) whether a household owns or rents the dwelling where a solar energy system is installed, and (iii) the feed-in tariffs paid to households that sell their green electricity to the grid. Our analysis indicates that the effect of PV adoption on green votes is entirely driven by household systems in resident-owned dwellings and that it is not larger in periods where feed-in tariffs were higher.[3] These observations suggest that being directly involved in the installation and maintenance of a PV system induces households to change their attitudes towards green values, not in response to an economic gain, but to derive greater utility from their environmentally-friendly actions. In this way, our findings are a manifestation of cognitive dissonance (Festinger, 1957).

The role of cognitive dissonance in political attitudes is an under-studied research area. One exception is Mullainathan and Washington (2009), who find that the act of voting for a candidate leads to a more favorable opinion of that candidate in the future. More generally, our investigation is also related to studies on the drivers of voting behavior. Deacon and Shapiro (1975) and Fischel (1979) use survey data from voters in referenda on environmental issues to study which factors affect the probability of voting in support of the environment. They find that occupation, political affiliation, education, income and location are important drivers of green voting.[4] Schumacher (2014) considers similar factors and reaches similar conclusions with respect to Green Party voting in Germany. Our analysis controls for these drivers of voting behavior to identify the independent effect of adopting green energy systems on Green Party voting. Finally, the literature on policy feedbacks (i.e. reverse causality)[5] has argued

[3]This is consistent with evidence that monetary rewards do not affect voting patterns(Cornelius, 2004; Wang and Kurzman, 2007; Schaffer and Schedler, 2007).

[4]Related studies (e.g., Tjernström and Tietenberg (2008), Torgler and García-Valiñas (2007), Whitehead (1991), Nord et al. (1998) and Zelezny et al. (2000)) use survey data to study the relationship between socio-economic and demographic variables and green attitudes.

[5]See Schattschneider (1935), Pierson (1993) and Soss and Schram (2007).

that new policies can create their own support through a range of mechanisms. The effects we identify are orthogonal to potential policy feedbacks since we exploit exogenous variation in adoption rates. Furthermore, the fact that some green policies can foster green attitudes is a powerful mechanism that governments may actively use to accelerate the transition to green energy paradigm.

The rest of this paper is organized as follows. Section I describes the Baden-Württemberg data. Section II presents the specification, the instrumentation strategy, and the estimates of the causal relationship between PV adoption and green votes. In this section, we also present robustness checks using household-level data from SOEP (2022) and discuss the mechanism driving the estimated effect of solar energy adoption and change in Green Party support. Section III concludes with some policy implications of our findings.

I Data

We study the relationship between PV adoption and green values at two different levels of aggregation. First, we analyze the relationship at the municipal level (Local Administrative Unit 2, LAU-2), examining the approximately 1100 municipalities in Baden-Württemberg (Figure 1), one of Germany's 16 federal states, located in the southeast of the country. We then gain additional insights on the role of various mechanisms by exploring household-level data from the German Socio-Economic Panel (SOEP, 2022), a representative longitudinal survey administered to approximately 30,000 individuals in 11,000 households.

The analysis relies mostly on three variables: support for the Green Party in elections and household surveys (our dependent variable), the adoption of PV systems (the independent variable), and, in the case of Baden-Württemberg, the appropriateness of roofs for the installation of PVs in each municipality (which is the basis for the instrument). Next, we describe the construction of these measures and their patterns for Baden-Württemberg. We will describe the equivalent measures in our household survey data in Section II.B.[6]

[6]See Online Appendix A for details on the regional data and Online Appendix B for details on the survey data.

A Green Votes

We use electoral results at the municipal level from all federal and state elections from 1996 until 2021.[7] The share of votes in Baden-Württemberg for the Green Party increased from 9.2 percent in 1998 to 17.1 percent in 2021 in federal elections and from 12.1 percent in 1996 to 32.6 percent in state-level elections. Underneath this aggregate trend, there has been considerable heterogeneity in the evolution of support for the Green Party, as seen in Figure 1 Panels A and B, which plot the change in the share of green votes in each municipality for federal and state-level elections.

B Diffusion of PV Systems

The level of PV diffusion in municipality r, $F_{r,t}$, is measured by the number of PV installations through time t, normalized to the number of residential buildings in the municipality. Since 2000, photovoltaic systems have diffused significantly throughout Baden-Württemberg, and across Germany (see Figure 1 Panel C and Figures A.4 and A.5 in the Online Appendix). The fraction of residential buildings with a PV system in Baden-Württemberg increased from 0.04 percent in 1999 to 16.8 percent in 2020. This increase coincided with the approval of the Renewable Energy Sources Act in 2000, which raised the feed-in tariff for electricity generated from PV systems.[8]

Underneath the general increase in the diffusion of PV systems, there is significant geographic variation. Figure 1 Panel C displays a map of Baden-Württemberg with the increase in PV diffusion between 1995 and 2020 in each municipality. The largest increases occurred in the southeast while the smallest occurred in the northwest.

In our analysis, we do not rely on the long-run relationship between green votes and PV diffusion to identify the effect of PV diffusion on green votes because other factors may spuriously affect the long-run relationship between these variables. These factors are absorbed by time dummies and a full set of municipal fixed effects (interacted with type of election). Our identification strategy relies on the association across municipalities and over time between the instrumented change in PV diffusion and the

[7] The number of second votes is normalized to the number of valid votes. Details are available in Online Appendix A.1.

[8] We describe the evolution of the feed-in tariff in Online Appendix A.2.

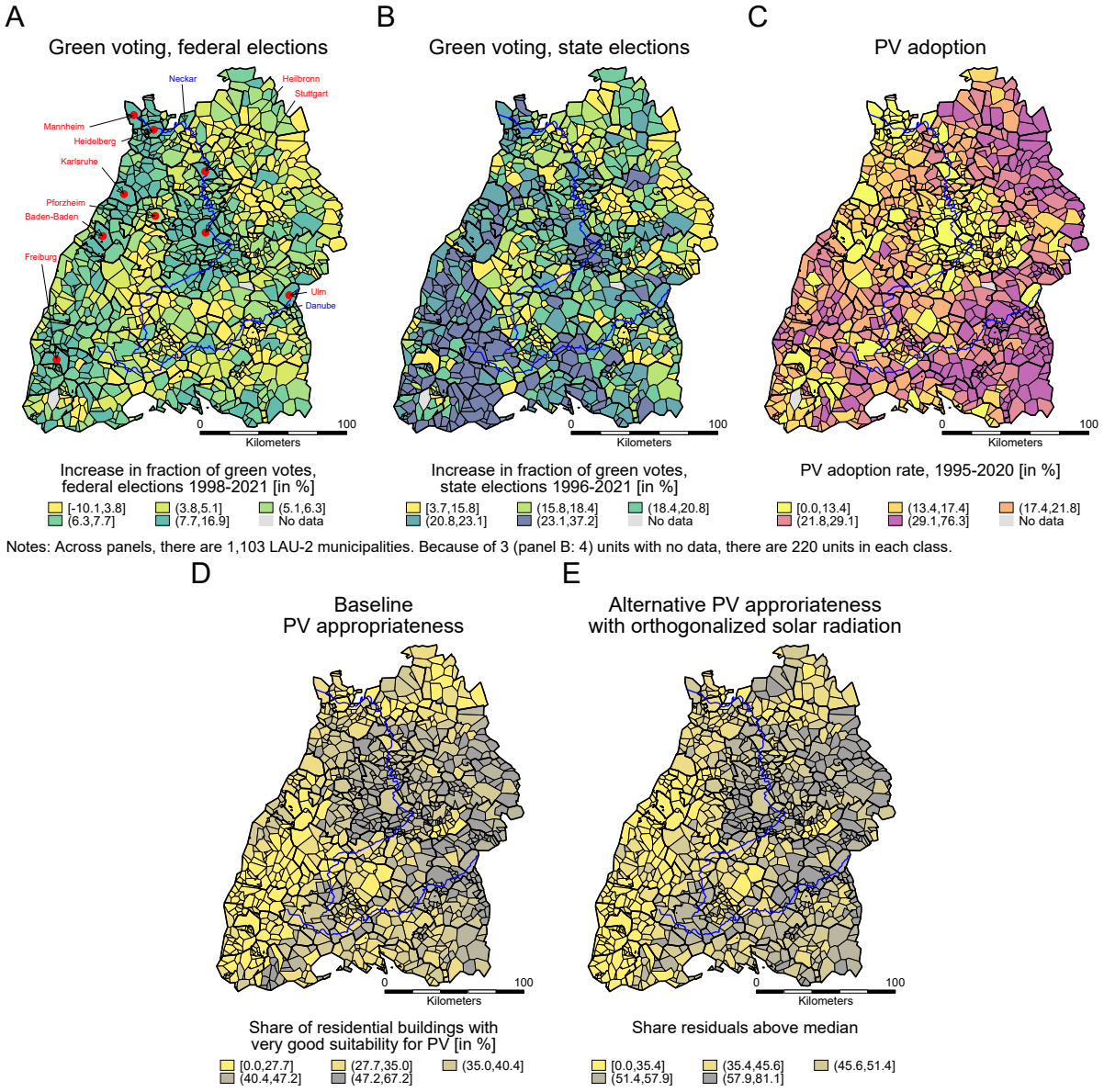


Figure 1: From left to right, the increase in the fraction of green votes in federal elections (1998-2021) and in state elections (1996-2021), the increase in the PV adoption rate (1995-2020), a baseline measure of PV appropriateness, and an alternative PV appropriateness measure with orthogonalized solar radiation for Baden-Württemberg on LAU-2 level.

Notes: Germany has 16 federal states (NUTS-1: Nomenclature des unites territoriales statistiques). Baden-Württemberg is one of the federal states in Germany. LAU-2 (Local Administrative Unit) municipalities are the smallest administrative unit in Germany. Because NUTS-3 districts and LAU-2 municipalities are constantly restructured, we do not have voting data for every single unit; we do, however, have data for the vast majority of them. We analyze data on green voting for the six landtag elections between 1996 and 2021, the seven federal elections between 1998 and 2021, and the yearly PV adoption for 1,099 (99.5 percent) LAU-2 municipalities in Baden-Württemberg. Maps are in Gauss-Krüger zone 3 projection (EPSG: 31467).

change in green votes. Critical to the construction of instruments for PV adoption are exogenous factors that determine the appropriateness of roofs for the installation of PV systems, which we will discuss next.

C Roof Appropriateness

Various roof and location characteristics determine the suitability of a building for a PV installation by changing the potential energy that a PV system can generate. These include solar radiation, roof orientation, inclination, altitude above sea level, shadowing, and roof size (see Online Appendix A.3). To the extent that (i) Green support across municipalities is orthogonal to these physical factors, (ii) that these factors are uncorrelated with potential drivers of green support (such as income or education), and (iii) that roof appropriateness is an important driver of PV adoption, measures of roof appropriateness are a valid instrument for PV adoption. Before discussing the details of how we constructed the appropriateness measures, we can check condition (ii) by computing the correlation between average income per capita (proxied by municipal income taxes per capita) and solar radiation and altitude across municipalities. We find that income and solar radiation are uncorrelated (0.03) while income and altitude are negatively correlated (-0.19). This suggests that instruments of PV adoption based on physical determinants of roof appropriateness will, in principle, satisfy the exogeneity requirement.

The State Office for the Environment, Measurement and Nature Conservation of Baden-Württemberg (LUBW, 2016) conducted an aerial roof census that collected high-resolution data (i.e., at the building level) on the determinants of roof appropriateness and computed the solar energy potential of each residential building. Our baseline appropriateness measure is the share of residential buildings in each municipality that have a solar energy potential between 95 and 100 percent of the maximum solar radiation.[9] (See panel D of Figure 1.)

In addition to this baseline measure, we consider two alternative measures of roof appropriateness constructed using subsets of the determinants of roof appropriateness in the baseline. Arguably, the physical dimensions captured by the alternative measures of appropriateness are the most exogenous

[9] LUBW (2016) uses the best suited roof area in the building to compute solar energy potential.

of all the determinants of appropriateness. Therefore, by showing the robustness of our estimates to using these alternative instruments, we should gain further assurance of the causal interpretation of the estimated association between PV adoption and Green support. The first alternative measure filters solar radiation from the baseline measure. We do so by regressing building-specific solar energy potential on the solar radiation in the one-square-kilometer area where the building is located.[10] We then use the residuals from this regression to construct a measure of roof appropriateness in a municipality that reflects the fraction of buildings in a municipality where residual solar energy potential is above the median residual in Baden-Württemberg.

Additionally, we consider measures of roof appropriateness that are exclusively based on roof orientation information. Orientation is an important driver of the energy generation potential of a roof. In Western Europe, the optimal orientation is to the south. A roof oriented to the east with an inclination of 37 degrees produces a quarter less electricity than a roof with the same inclination oriented to the south. Importantly, roof orientation largely depends on factors that are completely orthogonal to green sentiment, such as the direction in which a road or a river cuts a town (see Online Appendix A.3.3). Both its relevance and exogeneity make roof-orientation an ideal variable to construct instruments for PV adoption. We construct two different measures of municipal roof appropriateness based on information on roof orientation. The first, which reflects the extensive margin, consists in the fraction of residential buildings in a location with a deviation from the optimal orientation smaller than 30 degrees. The second, which captures the intensive margin, is the average deviation from optimal orientation among the buildings with a deviation of more than 30 degrees from the optimal orientation.[11]

It is worth noting that there is significant variation in all three measures of roof appropriateness across the municipalities of Baden-Württemberg, as illustrated in Figure 1 Panels D and E and Figure A.10 (Online Appendix).

[10] See Table A.3, Online Appendix.

[11] Because solar panels on flat roofs can be oriented in any direction, we consider flat roofs to have a southward orientation.

II Econometric analysis

A Econometric Model and Estimates

We hypothesize the following empirical relationship between green votes and the diffusion of PV systems:

$$V_{e,r,t} = \alpha_{0,e,r} + \alpha_{1,r} * t + \widetilde{\delta}_t + \beta * F_{r,t-1} + \widetilde{u}_{e,r,t}, \tag{1}$$

where $V_{e,r,t}$ is the fraction of green votes cast in LAU-2 municipality r, in election $e \in \{\text{Federal, State}\}$, in year t, and $F_{r,t-1}$ is the fraction of residential buildings in municipality r that have installed a PV system in year $t-1$. The coefficient β reflects the effect of PV diffusion on green votes which we are interested in estimating. To examine this relationship in the data, we take time-differences in the left and right sides of (1) across consecutive elections of a given kind (i.e., federal or state-level) to obtain the equation:

$$\triangle V_{e,r,t} = \alpha_{1,r} + \delta_t + \beta * \triangle F_{r,t-1} + u_{e,r,t}, \tag{2}$$

where $\triangle V_{e,r,t} = V_{e,r,t} - V_{e,r,t-k}$, with k being the number of years between elections, $\triangle F_{r,t-1} = F_{r,t-1} - F_{r,t-k-1}$ is the PV adoption rate in r between $t-k-1$ and $t-1$ and x_t denotes $\widetilde{x}_t - \widetilde{x}_{t-k}$.

OLS estimates of β in (2) may be biased by the omission of other relevant drivers of changes in green votes that may be correlated with PV adoption or by reverse causation. To obtain unbiased estimates of β, we instrument $\triangle F_{r,t-1}$ using exogenous municipal variation in roof appropriateness, as we explain next.

First, consider the realistic assumption that the diffusion of PV systems through municipality r approximately follows the logistic function:

$$F_{r,t} = \frac{a' * A_r}{1 + e^{-b*(t-c)}}, \tag{3}$$

where b is the speed of diffusion, c is the inflection point, and the ceiling $a' * A_r$ is determined by a vector of factors, A_r, some of which are endogenous to local Green attitudes while others are exogenous (both to Green attitudes and to other factors that may be correlated with Green attitudes, such as income).

Approximating $\triangle F_{r,t}$ with the time derivative of $F_{r,t}$, we obtain:

$$\triangle F_{r,t} \cong \frac{dF_{r,t}}{dt} = \frac{be^{b(t-c)}}{1+e^{-b(t-c)}} F_{r,t} = bF_{r,t} - b\frac{F_{r,t}^2}{a' * A_r}. \tag{4}$$

Expression (4) motivates the following strategy to construct instruments for $\triangle F_{r,t}$. (i) Estimate the diffusion curve using a subset of the exogenous drivers of the ceiling to proxy for A_r. (ii) With the estimates of a', b and c, construct the lagged predicted diffusion level, $\widehat{F}_{r,t}$. (iii) Instrument $\triangle F_{r,t-1}$ by $\widehat{F}_{r,t-k-1}$ and $\widehat{F}^2_{r,t-k-1}$.

The intuition behind this instrumentation strategy is simple. Exogenous variation in roof-appropriateness induces differences in the long-run diffusion of PV systems across municipalities. Since diffusion approximately follows a logistic pattern, this exogenous variation in the ceilings induces exogenous variation in the entire diffusion path. Consequently, exogenous drivers of roof-appropriateness also induce exogenous variation in the increase in the diffusion of PVs, the adoption rate.

By construction, our instruments are exogenous, as they consist of interactions of exogenous variables and non-linear functions of time. Additionally, they are relevant if the logistic curve is a good approximation to the municipal diffusion of PV and the exogenous drivers capture some of the cross-municipal variation in the ceiling diffusion level.

We implement this instrumentation strategy by estimating the diffusion process for PVs and then using these estimates to construct lagged predicted diffusion level (and its square). We use those predictions as instruments of the lagged adoption rate in (2). The first column of Table 1 reports the estimates of the PV diffusion model. As anticipated, the logistic curve fits the diffusion of PV systems at the municipal level very well. We precisely estimate the speed of diffusion and inflection point parameters, and obtain a significant positive estimate of the effect of the baseline roof appropriateness measure on the ceiling (a_1). The second column of Table 1 reports the estimates from the first stage regression where we instrument the adoption rate of PVs by the lagged level of predicted diffusion and its square.[12] As implied by equation (4), the coefficient on the lagged predicted diffusion is positive while the quadratic effect is negative. Both are significant at the 1 percent level, and the F-statistic for the test of joint significance of

[12]To capture other fixed drivers of PVs as well as time-varying factors that are common across municipalities, we include municipal fixed effects (which can potentially vary across election types) and time fixed effects.

Table 1: Instrument variable estimation of increase in share of green votes on increase in PV diffusion for Baden-Württemberg (weighted by eligible voters) for federal and state elections.

	Diffusion Model	IV		Alternat. appropriateness	
		1st stage	2nd stage	Orthogonal. Solar Rad.	Roof Orientation
	(1) $F_{\text{PV},t-1}$	(2) $\Delta F_{\text{PV},t-1}$	(3) $\Delta V_{e,t}$	(4) $\Delta V_{e,t}$	(5) $\Delta V_{e,t}$
Predicted PV adoption rate: $\Delta \hat{F}_{\text{PV},t-1}$			0.83	0.91	0.47
			(0.35)	(0.44)	(0.19)
Lagged, predicted instrument: $\hat{F}_{\text{PV},t-k-1}$		0.87			
		(0.21)			
Lagged, predicted instrument squared: $\left(\hat{F}_{\text{PV},t-k-1}\right)^2$		-0.02			
		(0.01)			
Constant: α		-0.70	0.24	0.03	1.25
		(0.88)	(1.00)	(1.25)	(0.55)
Ceiling: a_0	12.47				
	(0.99)				
Ceiling (Baseline PV appropriateness): a_1	0.21				
	(0.03)				
Speed: b	0.41				
	(0.00)				
Inflexion point: c	30.70				
	(0.03)				
LAU-2 x Election-type fixed effects	No	Yes	Yes	Yes	Yes
Year x Election-type fixed effects	No	Yes	Yes	Yes	Yes
R^2	0.79	0.75	0.82	0.82	0.82
Adj. R^2	0.79	0.70	0.78	0.78	0.78
Final log-likelihood $\mathcal{L}$	-137176.1	-21256.4	-25869.0	-25868.7	-25871.3
F		14.5	5.5	4.2	5.9
$F_{a_1=0} \quad \vert \quad F^{\text{1st stage}}_{\hat{F}_{\text{PV},t-k-1},\hat{F}^2_{\text{PV},t-k-1}=0}$ (p-value)	56.5 (0.00)		14.5 (0.00)	15.4 (0.00)	29.7 (0.00)
N	46158	12085	12085	12085	12085

Notes: Across columns, we analyze the LAU-2 level in the federal state of Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. In column (1), we include the 42 years t between 1980 and 2021. In columns (2-5), we focus on 11 points in time (state or federal election e in year t): six with federal elections (2021, 2017, 2013, 2009, 2005, and 2002, along with 1998, due to differencing) and five with state elections (2021, 2016, 2011, 2006, and 2001, along with 1996, due to differencing). Column (1) shows the estimates of the Diffusion Model (equation (3)) with non-linear least squares. a_0 and a_1 affect the diffusion ceiling, b the speed and c the inflexion point. a_1 is the coefficient for the baseline PV appropriateness, which is the share of residential buildings with very good appropriateness for PV. Column (2) presents the first stage (2SLS) estimates with the lagged, predicted instrument and the lagged, predicted instrument squared. The lagged instrument is predicted according to the Diffusion Model from column (1). Column (3) shows the second stage estimates (2SLS) of the increase in green votes on the predicted PV adoption rate (from column (2)). Columns (4) and (5) show alternative second stage estimates (2SLS) of the increase in green votes on the predicted PV adoption rate. Column (4) is based on a Diffusion Model in which alternative PV appropriateness with orthogonalized solar radiation affects the ceiling. Table C.3 in the Online Appendix includes the Diffusion Model, the first stage, and further details. Column (5) is based on a Diffusion Model in which alternative PV appropriateness based on roof orientation only affects the ceiling. Table C.4 in the Online Appendix includes the Diffusion Model, the first stage and further details. Columns (2)-(5) are weighted by the number of eligible voters at election e in year t. Table C.1 (Online Appendix) contains the descriptive statistics corresponding to this table. SE adjusted for clustering on LAU-2 level in parentheses.

the instruments is 14.5, considerably greater than the conventional threshold of 10 used to establish the strength of the instruments. Column (3) reports the estimates of the second stage regression. That is, the point estimate of β in (2) after instrumenting the PV adoption rate ($\triangle F_{r,t-1}$). We find a strong, positive and significant effect of PV adoption on the increase in the share of valid votes casted for the Green Party in a municipality.

Robustness

We next explore the robustness of the estimated effect of PV adoption on green votes along two dimensions. First, we re-estimate (2) using less comprehensive measures of roof-appropriateness as instruments of PV adoption. Second, we consider other specifications of the reduced-form relationship between green votes and PV diffusion in (1) that allow for non-linearities, heterogeneous effects across elections, and effects on green votes from the adoption of PV systems in neighboring municipalities.

Columns (4) and (5) of Table 1 present estimates of β corresponding to the alternative instruments. In Column (4), we use the instrument that is orthogonal to solar radiation; in Column (5), we use the instruments that are based exclusively on roof orientation. The estimated values of β are positive and significantly different from zero, and are in the same ballpark as the estimate obtained with the baseline measure of appropriateness in Column (3).[13]

Column (1) of Table 2 explores the presence of non-linearities in the relationship between PV adoption and green votes by including the quadratic of the PV diffusion level in a municipality in (1).[14] The coefficient of the quadratic term is zero, and its inclusion has no impact on the point estimate of the linear effect captured by β. Column (2) explores whether the relationship varies between federal and state elections, finding no significant difference, though the point estimate of β is smaller in state elections. Third, we explore whether Green sentiment is driven by the adoption of PVs in a given municipality or in its neighbors. The latter could be consistent with a positive estimate of β if there is spatial correla-

[13] The values of the F-statistics for the first-stage regressions indicate that the alternative instruments are also strong. (See Table 1.)

[14] This leads to the following version of Equation (2):

$$\triangle V_{e,r,t} = \alpha_{1,r} + \delta_t + \beta * \triangle F_{r,t-1} + \gamma * F_{r,t-1} * \triangle F_{r,t-1} + u_{e,r,t} \quad (5)$$

tion in both PV adoption and roof appropriateness. To disentangle these two hypotheses, we construct the average predicted (lagged) adoption rate among neighboring municipalities $\left(\triangle \widehat{F}_{PV,t-k-1}^{Neighbors}\right)$ for each location.[15] Column (3) of Table 2 reports the instrumented effects on the change in green vote shares of both the local and the neighbors' PV adoption rates. We find that only the adoption rate in the municipality affects the share of green votes, and that the magnitude of the coefficient is robust to controlling for the average PV adoption rate in the neighboring towns.

Magnitude

Having established the existence and robustness of a statistically significant causal relationship between PV diffusion and green votes, we explore the magnitude of the estimated effect. To get a sense of whether the estimated effect is large or small, we combine the estimates of β together with either the actual or predicted increases in the share of buildings with PV systems. The resulting magnitudes can be interpreted as the increase in the share of green votes induced by our channel if the causal estimates of β we have identified from short-run variation in PV adoption prevailed in the long-run. This condition is not generally warranted[16] and therefore one should take the calculations with caution. However, we believe that they provide a sense of of the quantitatively significance of our channel.

As a reference, the actual increase in green votes in Baden-Württemberg from the last election in the 1990s until 2021 was 7.8 percentage points in federal elections and 20.4 percentage points in state elections (see Table C.15, Online Appendix). The increase in green votes implied by our econometric model falls in between these two magnitudes. Using the baseline roof appropriateness measure as an instrument, the implied increase in green votes is 12.9 percentage points when using the actual increase in PV systems and 16.3 percentage points when using the predicted increases in PV systems. With the estimates from the two alternative instruments, we obtain similar magnitudes for this effect. Therefore, our estimates imply that the diffusion of PV systems lead to an important increase in the share of green votes.

[15] By neighboring we mean that they share a municipal border. This approach is similar to Comin et al. (2012).
[16] However, in Table 4 we show that the estimates of β do not diminish over time.

Table 2: Second stage instrument variable estimates of increase in share of green votes on increase in PV diffusion for Baden-Württemberg (weighted by eligible voters) for federal and state elections.

	Alternative specifications			PV system size			Other technologies	
	Quadratic	By election	Spatial cor.	Household		Industrial	Wind	Biogas
	(1) $\Delta V_{e,t}$	(2) $\Delta V_{e,t}$	(3) $\Delta V_{e,t}$	(4) $\Delta V_{e,t}$	(5) $\Delta V_{e,t}$	(6) $\Delta V_{e,t}$	(7) $\Delta V_{e,t}$	(8) $\Delta V_{e,t}$
Predicted PV adoption rate:								
$\Delta \hat{F}_{\text{PV},t-1}$	0.80	1.04	1.24					
	(0.37)	(0.47)	(0.49)					
Pred. adopt. rate interacted:								
$\Delta \hat{F}_{\text{PV},t-1} \times \hat{F}_{\text{PV},t-k-1}/100$	0.43							
	(0.47)							
StateElection $\times \Delta \hat{F}_{\text{PV},t-1}$		-0.42						
		(0.44)						
Pred. adopt. rate of neighbors:								
$\Delta \hat{F}^{\text{Neighbors}}_{\text{PV},t-1}$			-0.66					
			(0.86)					
Predicted adoption rates:								
$\Delta \hat{F}^{\leq 10\text{kW}_p}_{\text{PV},t-1}$				1.62				
				(0.76)				
$\Delta \hat{F}^{\leq 30\text{kW}_p}_{\text{PV},t-1}$					0.93			
					(0.41)			
$\Delta \hat{F}^{\geq 100\text{kW}_p}_{\text{PV},t-1}$						-2.40		
						(1.08)		
$\Delta \hat{F}_{\text{Wind},t-1}$							74.69	
							(52.28)	
$\Delta \hat{F}_{\text{Biogas},t-1}$								37.92
								(23.89)
Constant	0.14	0.16	0.94	-0.45	0.18	6.30	2.40	2.08
	(0.95)	(1.03)	(1.64)	(1.42)	(1.06)	(1.68)	(0.13)	(0.32)
LAU-2 x Election-type FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Election-type FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Adj. R^2	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
Final log-likelihood $\mathcal{L}$	-25868.3	-25867.6	-25821.5	-25876.8	-25870.2	-25600.1	-25888.5	-25883.9
F	5.7	2.8	4.7	4.6	5.2	4.9	2.0	2.5
$F^{\text{1st stage}}_{\hat{F}_{\text{PV,t-k-1}}, \hat{F}^2_{\text{PV,t-k-1}}=0}$ (p-value)	14.5 (0.00)	14.5 (0.00)	14.5 (0.00)	10.7 (0.00)	14.2 (0.00)	1.2 (0.30)	3.8 (0.02)	5.6 (0.00)
N	12085	12085	12067	12085	12085	11964	12085	12085

Notes: Across columns, we analyze the LAU-2 level in the federal state of Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. Across columns, we focus on 11 points in time (state or federal election e in year t): six with federal elections (2021, 2017, 2013, 2009, 2005, and 2002, along with 1998, due to differencing) and five with state elections (2021, 2016, 2011, 2006, and 2001, along with 1996, due to differencing). Across columns, we show second stage estimates. The following tables include the corresponding Diffusion Model, the first stage and further details: for columns (1-3), see Table 1; for column (4), see Table C.16 (Online Appendix); for column (5), see Table C.17 (Online Appendix); for column (6), see Table C.19 (Online Appendix); for column (7), see Table C.20 (Online Appendix); for column (8), see Table C.22 (Online Appendix). In column (3), $\Delta \hat{F}^{\text{Neighbors}}_{\text{PV},t-1}$ is the average predicted adoption rate in municipalities that share a border with municipality r. In this regression, we lose some observations because we focus on the balanced panel. SE adjusted for clustering on LAU-2 level in parentheses.

B Understanding the Mechanism

In the rest of this paper, we will explore the mechanism by which PV diffusion affects green votes. First, we study the variation in the relationship between PV adoption and green votes across household vs. industrial energy systems and between home-owners vs. renters to study the relevance of the household's direct involvement in the adoption of a PV system for the adoption to change the household's preferences for the Green Party. Second, we explore the "votes for money" hypothesis by which PV adopters reward the Green Party for increases in feed-in tariffs by voting for it. Based on our findings, we propose what we see as the most plausible mechanism.

Household vs. Industrial Systems

We use the installed capacity and energy source to classify of each system as household or industrial. We consider two cut-offs for household PV systems: 10 and 30 kilowatt-peak $\left(\mathrm{kW_p}\right)$. Alternatively, we use a conservative minimum threshold of 100 $\mathrm{kW_p}$ of installed capacity for industrial PV systems.[17] Columns (4) through (6) of Table 2 show the estimates of the instrumented effect of municipal PV adoption on the change in the share of green votes for each of these three classes of PV systems. We further extend the analysis to the installation of industrial facilities that produce green energy using wind turbines (Column 7) and biogas (Column 8).[18] Our key findings are that the effect of PV diffusion on green votes is entirely driven by the diffusion of household systems, and that, in contrast to household systems, the installation of industrial systems (PV, wind or biomass) in a municipality is not associated with an increase in green votes.

Owned vs. Rental Dwellings

Next, we turn our attention to household survey data to gain further insights on the mechanism behind the effect of PV adoption on Green Party votes. The Socio-Economic Panel (SOEP) is a representative household survey that (among other topics) inquires about the political party supported by an individual and the intensity of their support. We use this information to construct a binary measure of increase in

[17] We use solar radiation to measure the appropriateness for industrial PV. Online Appendices A.4 and C.3.1 contain details.

[18] We use the wind power potential to measure the appropriateness for wind power and solar radiation for biogas. Online Appendices A.5 and C.3.1 contain details.

support for the Green Party, $\Delta Green_t$, which equals one if an individual states a change in support from another party to the Green Party or if they states an increase in the intensity of support for the Green Party between years $t-1$ and t. $\Delta Green_t$ is zero in all other cases.

Since 2007, the SOEP has included a question about whether households live in dwellings with solar energy systems.[19] Using this information, we construct two independent variables. The first, $Solar_{t-1}$, measures whether the household had a solar energy system installed in its dwelling in year $t-1$. The second, $\Delta Solar_{(t-3:t-1)}$, measures whether a household did not have a solar system at $t-4$ and adopted one between $t-3$ and $t-1$.[20]

The first exercise we conduct with SOEP is to examine whether the patterns uncovered across the municipalities of Baden-Württemberg also hold nationally at the household level. To this end, we run logit regressions of $\Delta Green_t$ on $Solar_{t-1}$ and $\Delta Solar_{(t-3:t-1)}$ across households. In contrast to the Baden-Württemberg data, we do not have roof-appropriateness information to instrument solar adoption here; however we can partially capture other drivers of green sentiment by controlling for real household income. The point estimates are reported in the first two columns in Panel A of Table 3. Despite differences in geography and levels of aggregation, these estimates confirm that a household's adoption of a solar energy system is positively associated with an increase in its support for the Green Party. Next, we take advantage of the information in SOEP about whether a household owns or rents the unit where it lives to explore whether the association between the adoption of a solar system and support for the Green Party differs by ownership status. In the balanced sample, approximately 60 percent of the observations correspond to home owners while the rest are renters. Columns (3) through (6) in Panel A of Table 3 show that, while for home owners there is a strong positive association between the adoption of a solar system support for the Green Party, there is no association for non-home owners. Therefore, owning the dwelling where the solar system is installed is a critical part of the mechanism that causes the observed increase in support for the Green Party after installing a solar energy system.

The granularity of SOEP can be used to better understand the timing of solar energy system adoption and changes in household support for the Green Party. To this end, we define the variables $\Delta Solar_t$,

[19] Online Appendix B contains details.

[20] Here, we focus on a balanced sample of households. In Online Appendix C.3.2, we replicate the analysis for the unbalanced panel obtaining similar results.

Table 3: Logit coefficient estimates for Socio-Economic Panel, which is a representative longitudinal survey.

Panel A: Estimates of solar level and solar change on change in green attitude						
	All		Home owners		Non-home owners	
	(1) $\Delta Green_t$	(2) $\Delta Green_t$	(3) $\Delta Green_t$	(4) $\Delta Green_t$	(5) $\Delta Green_t$	(6) $\Delta Green_t$
$Solar_{t-1}$	0.42		0.51		-0.18	
	(0.13)		(0.14)		(0.54)	
$\Delta Solar_{t-3:t-1}$		0.44		0.56		-0.15
		(0.19)		(0.19)		(0.96)
$\ln$ (Real Income$_t$)	0.13		0.13		0.19	
	(0.07)		(0.11)		(0.11)	
$\Delta \ln$ (Real Income$_t$)		-0.13		-0.48		0.24
		(0.10)		(0.12)		(0.15)
N	57,933	53,599	32,478	28,992	21,714	20,882
# individuals	4,930	4,567	3,288	2,978	2,508	2,384
# households	3,573	3,342	2,224	2,032	2,020	1,931
DF_M	191	187	174	169	154	152
Final log-likelihood $\mathcal{L}$	-7006.8	-6433.8	-4152.2	-3561.8	-2733.1	-2744.6
Panel B: Reverse causality: Estimates of level and change in green attitude on solar change						
	All		Home owners		Non-home owners	
	(1) $\Delta Solar_t$	(2) $\Delta Solar_t$	(3) $\Delta Solar_t$	(4) $\Delta Solar_t$	(5) $\Delta Solar_t$	(6) $\Delta Solar_t$
$Green_{t-1}$	-0.04		0.11		-0.42	
	(0.22)		(0.26)		(0.42)	
$\Delta Green_{t-3:t-1}$		0.28		0.35		0.11
		(0.16)		(0.20)		(0.30)
$\ln$ (Real Income$_t$)	0.86		0.46		1.40	
	(0.12)		(0.18)		(0.21)	
$\Delta \ln$ (Real Income$_t$)		0.12		-0.00		0.47
		(0.24)		(0.29)		(0.42)
N	36,423	36,143	18,084	17,978	9,589	9,490
# individuals	4,540	4,539	2,899	2,897	2,106	2,100
# households	3,296	3,293	1,920	1,914	1,689	1,682
DF_M	107	104	86	83	65	62
Final log-likelihood $\mathcal{L}$	-1775.9	-1832.1	-1183.8	-1203.7	-488.1	-526.9

Notes: We study the years 2020 through 2009 (along with 2008 and 2007, due to differencing). In columns (1), (3) and (5), we include time∗NUTS-1, college, vocational degree and labor status dummies and control for age. In columns (2), (4) and (6), we include time∗NUTS-1 and dummies for changes in college, in vocational degree and in labor status. We only examine those who did not have a solar system in 2007. Table C.23 in the Online Appendix contains the corresponding descriptive statistics. SE adjusted for clustering on household level in parentheses.

$Green_{t-1}$ and $\Delta Green_{(t-3:t-1)}$. $\Delta Solar_t$ is a binary variable equal to 1 if the individual lived in a dwelling where a solar system has been installed between year $t-1$ and t; it is 0 otherwise. $Green_{t-1}$ is equal to 1 if the respondent claims to support the Green Party in year $t-1$, and is 0 otherwise. $\Delta Green_{(t-3:t-1)}$ is 1 if the individual moved to support the Green Party or if they increased the strength of their support for the Green Party over the previous three years, and 0 otherwise.

We use these variables to estimate logit regressions of $\Delta Solar_t$ on $Green_{t-1}$ and $\Delta Green_{(t-3:t-1)}$, controlling for either log of real household income at $t-1$ or the growth in real income from $t-1$ to t. In columns (1), (3) and (5) of Panel B of Table 3 we see that Green Party supporters are not more likely to adopt solar systems than those who do not support the Green Party. Columns (2), (4) and (6) of Panel B of Table 3 illustrate that individuals who became greener were not more likely to install solar energy systems than those who did not become greener in a previous three-year period. These findings suggest that greater Green support does not increase the likelihood of adopting solar energy systems. Therefore, the German household survey data is consistent with the direction of causation identified by our instrumented regressions with the municipality data from Baden-Württemberg.

Votes for Money

The Green Party was the key proponent of the new, non-retroactive, feed-in tariff scheme, EEG, that came into effect in 2000.[21] The impact that this policy had on the income of PV adopters raises the possibility that the increase in votes for the Green Party may be how grateful PV adopters reciprocate for the greater tariffs. To explore this "votes for money" hypothesis, we first compute the magnitude of the economic gains of installing a PV system and discuss whether they are significant enough to change voting behavior. Afterwards, we study the timing of feed-in tariffs under the new regime and explore whether the effect of PV adoption on green votes changed over time alongside with the feed-in tariffs.

Given the time-series variation in the feed-in tariff and installation costs over the period 2000-2020, we calculate the present discounted value of income net of installation and maintenance costs from a PV system (relative to the total disposable household income during the useful life of the system) in four systems that vary by installed capacity and solar radiation (full load hours). These cases correspond to

[21] Non-retroactive means that changes in the scheme only affected new PV installations.

the median and 90th percentile of each variable.[22] The profit-to-income ratio ranges from -1.9 percent to 2 percent, with the highest values in the years around 2010 and in systems with higher capacity and full-load hours. These magnitudes suggest that, even for high-capacity systems installed in areas with high solar radiation, the net revenues from PV electricity production were modest. Given the evidence that voters are insensitive to monetary rewards (Cornelius, 2004; Wang and Kurzman, 2007; Schaffer and Schedler, 2007), it seems unlikely that new PV adopters rewarded the Green Party for the net income they received from new PV system with their votes.

Under the EEG scheme, the rate for PV electricity sold back to the grid went from 0.1 euros per KWh to 0.5 per KWh in 2000, remaining around that level until 2010 (see Figure A.3, Online Appendix). In 2010, the feed-in tariffs started a steep, but gradual, decline until they reached a level of 0.15 euro per KWh in 2013. Since then, they have declined even further, to a price of 0.1 euros per KWh. The direct effects of these changes in feed-in tariffs on PV diffusion are absorbed by the time dummies and, therefore, do not affect the estimates of the impact of PV diffusion on green votes in the Baden-Württemberg and SOEP datasets. It might be the case, though, that feed-in tariffs differentially affected voting behavior across regions and that these changes in behavior were correlated with the exogenous component of the adoption rate. To rule this possibility out, we re-estimate our regressions, both for Baden-Württemberg and for the SOEP, allowing for a differential effect of PV and solar energy adoption rates on Green Party votes and support in periods with high feed-in tariffs and PV profitability.[23] Table 4 presents the results. The main finding is that we do not see a higher effect of PV adoption on green votes in periods with high feed-in tariffs and profitability. Indeed, in most specifications, the effect is significantly lower during these periods. This finding, together with the small magnitude of the potential economic profits from adopting PV systems, strongly suggests that the causal effect of PV adoption on green votes is not a manifestation of a "votes for money" effect.

[22] See Online Appendix C.3.3.

[23] See Online Appendix C.3.4 for details.

Table 4: Controlling for profitability for Baden-Württemberg (columns (1-3)) and for home owners in the Socio-Economic Panel (columns (4-7)).

	2nd stage OLS (for Baden-Württ.)			Logit coeff. estimates (home owners, SOEP)			
	(1) $\Delta V_{e,t}$	(2) $\Delta V_{e,t}$	(3) $\Delta V_{e,t}$	(4) $\Delta Green_t$	(5) $\Delta Green_t$	(6) $\Delta Green_t$	(7) $\Delta Green_t$
Predicted PV adoption rate: $\Delta\hat{F}_{\text{PV},t-1}$	0.83	0.93	1.75				
	(0.35)	(0.36)	(0.46)				
$\text{Dummy}_{\text{Before 2012}} \times \Delta\hat{F}_{\text{PV},t-1}$		-2.54					
		(0.55)					
$\text{Dummy}_{\text{High PV profits}} \times \Delta\hat{F}_{\text{PV},t-1}$			-2.44				
			(0.36)				
Household PV Profitability:							
$\frac{\Delta p_{\text{PV,t-1}}}{p_{\text{PV,t-k-1}}} *$ (Solar radiation / 1000)	0.67						
	(0.87)						
$Solar_{t-1}$				0.44		0.49	
				(0.14)		(0.14)	
$Solar_{t-1} \times \text{Dummy}_{\text{Before 2012}}$				0.31			
				(0.19)			
$Solar_{t-1} \times \text{Dummy}_{\text{High PV profits}}$						0.08	
						(0.18)	
$\Delta Solar_{t-3:t-1}$					0.62		0.74
					(0.21)		(0.21)
$\Delta Solar_{t-3:t-1} \times \text{Dummy}_{\text{Before 2012}}$					-0.29		
					(0.42)		
$\Delta Solar_{t-3:t-1} \times \text{Dummy}_{\text{High PV profits}}$							-0.67
							(0.39)
$\text{Dummy}_{\text{Before 2012}}$				-1.19	-1.71		
				(0.37)	(0.52)		
$\text{Dummy}_{\text{High PV profits}}$						-1.13	-1.70
						(0.38)	(0.52)
Constant: α	0.00	0.04	-0.99	-3.45	-2.57	-3.47	-2.57
	(1.10)	(1.02)	(1.14)	(0.94)	(0.24)	(0.94)	(0.24)
LAU-2 x Election-type fixed effects	Yes	Yes	Yes				
Year x Election-type fixed effects	Yes	Yes	Yes				
R^2	0.82	0.82	0.82				
Adj. R^2	0.78	0.78	0.78				
Final log-likelihood $\mathcal{L}$	-25868.5	-25838.3	-25802.7	-4150.9	-3561.4	-4152.1	-3559.9
F	2.8	11.2	28.0				
$F^{\text{1st stage}}_{\hat{F}_{\text{PV},t-k-1},\hat{F}^2_{\text{PV},t-k-1}=0}$ (p-value)	14.5 (0.00)	14.5 (0.00)	14.5 (0.00)				
N	12085	12085	12085	32478	28992	32478	28992
# individuals				3,288	2,978	3,288	2,978
# households				2,224	2,032	2,224	2,032
DF_M	2	2	2	175	170	175	170

Notes: In columns (1)-(3), we analyze the LAU-2 level in the federal state of Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. Across columns, we focus on 11 points in time (state or federal election e in year t): six with federal elections (2021, 2017, 2013, 2009, 2005, and 2002, along with 1998, due to differencing) and five with state elections (2021, 2016, 2011, 2006, and 2001, along with 1996, due to differencing). For the first stage estimates in column (1), we use the lagged predicted instrument (and the lagged, predicted instrument squared) from the Diffusion Model from Table 1, column (1). In columns (1)-(3), we show second stage estimates (2SLS) of the increase in green votes on the predicted PV adoption rate (from column (2), Table 1) and weight by the number of eligible voters in year t. In columns (1)-(3), we show SE adjusted for clustering on LAU-2 level in parentheses. In column (1), we control for the profitability of household PV systems (below 30kW$_p$), which has its median at 0, mean at 0.11, standard deviation at 1.31, minimum at -1.17, maximum at 6.75. In columns (4)-(7), we study home owners between the years 2020 through 2009 (along with 2008 and 2007, due to differencing) in the Socio-Economic Panel (in a balanced data set). In columns (4), and (6), we include time$*$NUTS-1, college, vocational degree and labor status dummies and control for age. In columns (5), and (7), we include time$*$NUTS-1 and dummies for changes in college, in vocational degree and in labor status. We only examine those who did not have a solar system in 2007. Table C.23 in the Online Appendix contains the corresponding descriptive statistics. In columns (4)-(7), we show SE adjusted for clustering on household level in parentheses.

Taking Stock

We have demonstrated the existence of a strong, positive causal effect of adopting PV systems on the share of votes for the Green Party. The effect is pretty immediate; in both municipal and household-level datasets, we observe an increase in green votes less than three years after PV adoption.

Direct involvement by households in the adoption and use of PV system appears important for this effect, based on the findings that (i) it is the municipal adoption of household systems, not the adoption of PV systems in neighboring municipalities, nor the adoption of industrial systems what drives the increase in Green Party votes, and (ii) the effect is driven by the households that own the dwellings where PV systems are installed, not by the households that rent them.

The effect is not driven by potential monetary gains from PV adoption because these gains are small, and the effect was not higher in periods where feed-in tariffs were high.

If monetary considerations are not a key channel, it must be the case that PV adoption directly changes the preferences of adopters towards green values. Why would that be the case? One possibility is that this effect is a manifestation of cognitive dissonance (Festinger, 1957), which causes agents to retroactively change their preferences or values in order to derive greater utility from their previous actions. In our context, this action is the adoption of a PV system. After adopting a PV system, agents derive a greater utility from adoption if they embrace green values, care more about the environment, and regard activities that contribute to preserving it more favorably.[24] The material manifestation of these new values is the observed increase in PV adopters' support for the Green Party.

III Conclusions

We have demonstrated that the adoption of PV systems causes an increase in the share of votes for the Green Party. This effect is unlikely to reflect a reciprocal, "votes for money" mechanism. Instead, it likely reflects a change in attitudes towards environmentally friendly values after adopting a solar energy system.

[24] See Comin and Rode (2013) for a model that precisely captures this mechanism.

The fact that engagement with green technology affects attitudes towards the environment to the point of affecting voting behavior has significant policy consequences. First, it shows that the diffusion of green technologies on climate change may have an overall impact that exceeds its direct effects — by inducing pro-environmental attitudes, adoption also prompts agents to embrace other behaviors that may lower greenhouse emissions. The change in green attitudes of consumers may further amplify the impact of public policies that foster green technology diffusion because firms engage in more pro-green behavior to please environmentally friendly consumers, as demonstrated by Aghion et al. (2023).

Second, our findings imply that the adoption of green energy by consumers may have a greater environmental impact than adoption by producers. Adoption by producers does not seem to induce green consumer attitudes; therefore, only adoption by consumers has an impact beyond its total installed capacity.

Third, the social desirability of the spread of green values, together with the effect of PV adoption on green attitudes and cross-sectional variation in geographic appropriateness for PV installation, could provide a rationale for using subsidies of consumer-oriented green technologies that vary negatively with the appropriateness of the technology.

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Online Appendix

Contents

A Details on Regional Data **33**

A.1 Green Votes . . . 35

A.2 Diffusion of PV Systems . . . 37

A.3 Appropriateness . . . 42

A.3.1 Drivers of PV Diffusion – Solar Radiation . . . 42

A.3.2 Drivers of PV Diffusion – Roof Appropriateness . . . 43

A.3.3 Raw Data on Appropriateness . . . 44

A.3.4 Our Measures of Appropriateness . . . 47

A.4 Household vs. Industrial PV . . . 50

A.5 Other Industrial Green Technologies . . . 53

B Details on Survey Data **55**

B.1 PV and Solar Thermal Systems . . . 55

B.2 Removed PV Systems . . . 56

B.3 Details on Controls . . . 57

C Results **58**

C.1 Robustness . . . 59

C.1.1 Alternative Appropriateness Measures . . . 59

C.1.2 Normalization . . . 63

C.1.3 Other Dimensions . . . 69

C.2 Magnitude . . . 76

C.3 Understanding the Mechanism . . . 77

C.3.1 Household vs. Industrial Systems . . . 77

C.3.2 Own vs. Rent Dwelling . . . 86

C.3.3 Votes for Money . . . 90

C.3.4 Periods with high feed-in tariffs and high profitability . . . 94

A Details on Regional Data

In the following, we describe our regional level data. Table A.1 summarizes the corresponding data sources. All data is available for free. It can either be downloaded from the specified websites (see reference in the source column of Table A.1) or is available after personal request at the specified institutions.

We move on by giving details on the diffusion of green votes. Thereafter, we describe the diffusion of PV systems. Then, we explain the drivers of PV diffusion and our measures of PV roof appropriateness in Baden-Württemberg. Finally, we distinguish between the diffusion of household and industrial PV and describe the diffusion of other green technologies.

Table A.1: Sources of regional level data.

Data	Source & Availability
Federal Elections:	
2021 at LAU-2 municipality level	Statistical State Office of Baden-Württemberg (Statistik BW, 2021b); downloaded Nov. 8, 2021
2009, 2013, 2017 at LAU-2 municipality level	Federal Statistical Office (DESTATIS, 2021a); table 14111-01-03-5 downloaded Aug. 31, 2021; data license: dl-de/by-2-0
1998, 2002, 2005 at LAU-2 municipality level	Statistical State Office of Baden-Württemberg (Statistik BW, 2021a); freely available upon personal request
State Elections:	
2021 at LAU-2 municipality level	Statistical State Office of Baden-Württemberg (Statistik BW, 2021d); downloaded Sept. 7, 2021
2011, 2016 at LAU-2 municipality level	Federal Statistical Office (DESTATIS, 2021b); table 14338-01-03-5 downloaded Sept. 7, 2021; data license: dl-de/by-2-0
1996, 2001, 2006 at LAU-2 municipality level	Statistical State Office of Baden-Württemberg (Statistik BW, 2021c); freely available upon personal request
Maps:	
LAU-2 municipalities (Administrative areas 1:250,000 as of 31.12.2013)	Federal Agency for Cartography and Geodesy (BKG, 2016); downloaded Nov. 4, 2016; © GeoBasis-DE / BKG (2016)
Large rivers	European Environment Agency (EEA, 2021); downloaded Sept. 21, 2021
PV appropriateness:	
PV appropriateness, solar radiation and orientation at roof level	State Institute for the Environment, Survey and Nature Conservation Baden-Württemberg (LUBW, 2016); freely available upon personal request
solar radiation, 1km x 1km raster	German Meteorological Service (DWD, 2010); downloaded July 26, 2010
Renewable energy adoption:	
Installation date, place and capacity of renewable energy plants as of 2020 at plant level	Information platform of the German transmission system operators (TSO, 2021); downloaded Sept. 6, 2021
Verification on number of PV systems in municipality as of 2018	State Institute for the Environment, Survey and Nature Conservation Baden-Württemberg (LUBW, 2022); downloaded Sept. 28, 2022
Further:	
Altitude, dgm1000-001, 1km x 1km raster	Federal Agency for Cartography and Geodesy (BKG, 2023); downloaded April 16, 2023; © GeoBasis-DE / BKG (2023)
Income tax payments per capita for 2010 at LAU-2 municipality level	Federal Statistical Office (DESTATIS, 2017); table 368-01-5 downloaded June 26, 2017
Number of buildings and residential buildings	State Institute for the Environment, Survey and Nature Conservation Baden-Württemberg (LUBW, 2016); freely available upon personal request; verification through StatistikBW (2023)
Rural vs. urban at LAU-2 municipality level	State Agency for Political Education Baden-Württemberg (LpB, 2016); downloaded Oct. 25, 2022
Share of single-family houses at LAU-2 municipality level	Federal Statistical Office (DESTATIS, 2016b); table: 035-21-4 downloaded Jan. 25, 2016
Wind power potential, 1km x 1km raster	German Meteorological Service (DWD, 2012); downloaded May 18, 2012

A.1 Green Votes

The lowest level of aggregation on which we can obtain spatial panel data over a long period of federal and state elections in Germany is the (LAU-2) municipality level.

Federal elections .– We obtain data for the federal elections in 1998, 2002, 2005, 2009, 2013, 2017 and 2021 from Statistik BW (2021b), DESTATIS (2021a), and Statistik BW (2021a). We consider the number of second votes (*Zweitstimmen*) for the Green Party normalized by valid votes.[25] We illustrate aggregate trends of the share of green votes for federal elections in Baden-Württemberg in Figure A.1 Panel A.

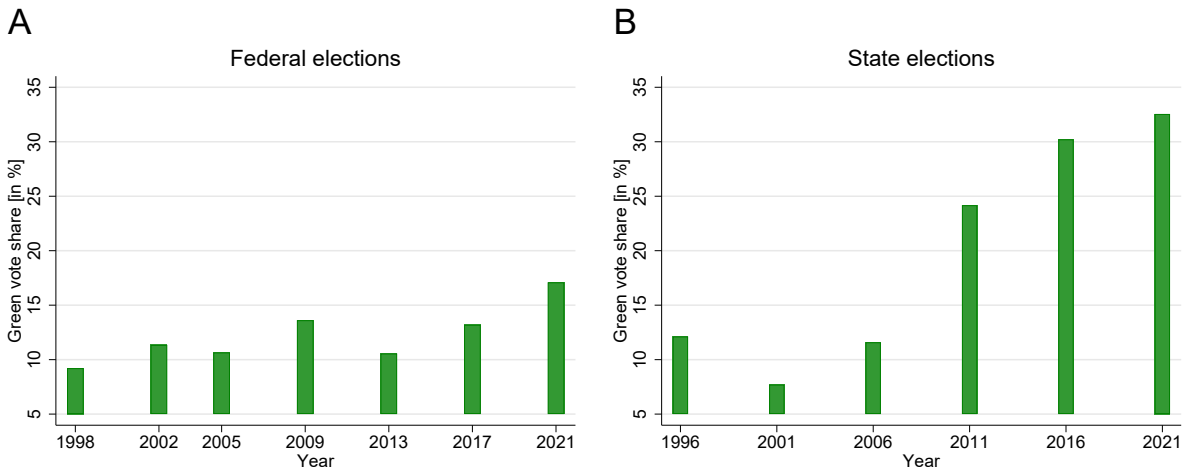


Figure A.1: Fraction of green votes at federal and at state elections in Baden-Württemberg over time.
Notes: We consider the number of second votes (*Zweitstimmen*) normalized by valid votes.

State elections .– We obtain municipality level data for the state elections in 1988, 1992, 1996, 2001, 2006, 2011, 2016 and 2021 from Statistik BW (2021d), DESTATIS (2021b), and Statistik BW (2021c). Again, we consider the number of second votes (*Zweitstimmen*) normalized by valid votes. We illustrate aggregate trends of the share of green votes for federal elections in Baden-Württemberg in Figure A.1 Panel B.

[25] As of 31.12.2013, Baden-Württemberg consists of 1104 LAU-2 municipalities. Due to the restructuring of municipalities, we do not have federal election data on all but nearly all of them. For almost all points in time, we have green voting data for 1099 municipalities. Only for the federal elections in 2013 and 2017, we do not have information on Green Party votes for Egesheim (Landkreis Tuttlingen) and for the federal elections in 2005 and 2009, we do not have information on Green Party votes for Lauda-Königshofen (Main-Tauber-Kreis).

In the 1998 elections, the Green Party received 9.2 percent of valid votes in federal elections. While there were decreases in green vote share in-between, we observe an increase to 13.6 percent in 2009 and 17.1 percent in 2021. There was significant regional variation in the increase of the support for the Green Party (Figure 1 Panels A and B). Across Baden-Württemberg, the largest increase in the share of green votes in federal elections between 1998 and 2021 took place in the city of Karlsruhe and the city of Konstanz. For state elections, the share of Green Party votes increased stronger. In 1996 the green vote share lay at 12.1 percent and in 2021 at 32.6 percent. We observe the largest increase in this time period in Wutöschingen and in Beuron.

A.2 Diffusion of PV Systems

As outlined in the main text, we focus on the diffusion of PVs at the level of the municipality. We denote by $F_{r,t}$ the number of PV installations in municipality r through t normalized by the number of residential buildings in the municipality. We first describe our raw data on PV diffusion and other green technologies. Then, we discuss the data on the number of residential buildings.

Raw Data on renewable energy systems.– We downloaded the data on the location and date of grid-connection of PV systems and other renewable energy installations from a joint portal of the German transmission system operators (TSO, 2021).[26] Table A.2 contains details on the number of systems by green technology in the raw data. The table illustrates that the data set contains some 2 million PV systems installed through 2020 across Germany and that almost 20 percent[27] of these were installed in Baden-Württemberg. Because the lowest level of aggregation on which we can obtain spatial long-term panel data on federal and state elections in Germany is the (LAU-2) municipality level, we are interested in the number of systems on the same level. The raw data set includes the LAU-2 municipality code for 98.6 percent of the PV systems. For Baden-Württemberg the data set contains the LAU-2 municipality code for 94.6 percent of the PV systems. We use the zip code to allocate the remaining systems to their LAU-2 municipality. The share of wind turbines and biogas plants for which we use the zip code is larger.

Table A.2: Number of renewable energy installations in Germany and Baden-Württemberg through 2020 according to the raw data from TSO (2021).

	Germany			Baden-Württemberg			
	# all	# with municipality code	share with municipality code	# all	# with municipality code	postal code used for allocation to municipality	share with municipality code
Biogas	15,539	14,522	93.5%	2,392	1,474	918	61.6%
PV	2,021,786	1,993,359	98.6%	378,330	358,010	20,320	94.6%
Wind	28,938	28,696	99.2%	889	715	174	80.4%

Notes: Wind turbines without offshore.

[26] Since the amendment of the Renewable Energy Sources Act on the 25th of October 2008, the German transmission system operators (TSOs) are obliged by law to publish address data and the date of grid connection of all renewable energy systems supported through the feed-in tariff.

[27] 18.7 percent (or 378,330) in Baden-Württemberg out of 2,021,786 in Germany.

Raw Data on number of buildings.– LUBW (2016) provides us with the number of buildings in Baden-Württemberg, their exact location, their roof area and whether a building is residential or not. We focus on residential buildings because more than 90 percent of the PV systems installed in Baden-Württemberg in 2020 or before are small systems $\left(\text{at most } 30\text{kW}_\text{p}\right)$.[28] These fit in terms of necessary roof area on residential roofs.[29] The exact locations of buildings allow us to calculate the number of residential buildings for each LAU-2 municipality.

We use all residential buildings to normalize $F_{r,t}$. According to LUBW (2016), these are 2,252,215 residential buildings in Baden-Württemberg, see Figure A.2.[30]

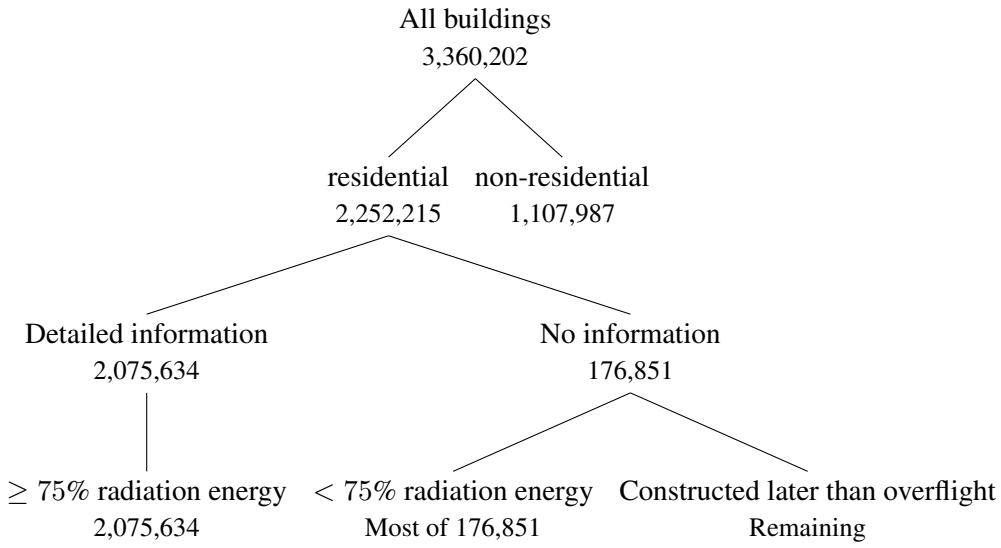


Figure A.2: The number of buildings in Baden-Württemberg according to LUBW (2016).

[28]The capacity (or nominal power) of a PV system is specified in kilowatt-peak $\left[\text{kW}_\text{p}\right]$, i.e., the system's maximum power output under defined conditions. In contrast, produced electricity is measured in kilowatt-hours [kWh].

[29]We calculate the median and 90^{th} percentile capacity for residential buildings in two steps. The median potential area for PV installations on residential buildings is 21 sqm, and the 90^{th} percentile is 50 sqm. LUBW (2016) documents that it is necessary to install between 6.6 and 11 sqm of solar modules to reach a capacity of 1 kW_p. (Of course, PV modules got more efficient over time. In 2022, only 5 sqm of PV modules may suffice for a capacity of 1 kW_p due to increased module efficiency. However, usually not the whole roof can be used for a PV system, e.g., because of chimneys or roof-lights.) Based on the range between 6.6 and 11 sqm, we use a value of 8 sqm per kW_p in our calculations. This yields a median capacity supported by residential buildings of 2.6 kW_p, while for the 90^{th} percentile it is 6.3 kW_p. That is why, we consider PV systems below 10 kW_p (and as an upper bound PV systems below 30 kW_p) as small household systems.

[30]We verify this number. With 2,261,583 residential buildings, StatistikBW (2023) confirms almost the same number for 2005. In one of our robustness checks, we normalize with the 2,075,634 residential buildings for which we have detailed information. We discuss this approach in Online Appendix C.1.2.

PV in Baden-Württemberg .– Since the year 2000, we have seen how photovoltaic systems have become wide-spread in Baden-Württemberg (and across Germany) while the support for the Green Party has increased significantly. Next we describe these trends as well as institutional settings in which they have taken place.

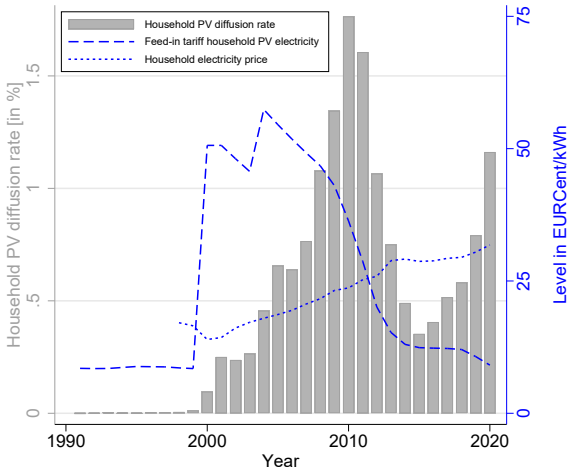


Figure A.3: Fraction of buildings with a new household PV system, level of the feed-in tariff for electricity from household PV and household electricity price in Germany from 1991 through 2020.

Notes: We show the feed-in tariff for systems with capacity of 30 kW_p or below through March 2012. From April 2012 on, we show the feed-in tariff for systems with capacity of 10 kW_p or below and build the average for each year because feed-in tariffs varied up to monthly. The household electricity price is a net average based on a yearly consumption of 3500kWh from BDEW (2016). The electricity price levels for 2008-2020 are confirmed by DESTATIS (2016a).

In 1998, the Social Democratic-Green coalition won the federal elections in Germany. Two years later, the government introduced a new law, the Renewable Energy Sources Act (Erneuerbare Energien Gesetz – EEG) (EEG, 2000), which raised the feed-in tariff for electricity produced from PV systems. For example, the feed-in tariff for systems with a capacity of at most 30 kW_p was raised to 50 EURCent/kWh (from 8.84 EURCent/kWh). The Renewable Energy Sources Act stipulated vintage-specific feed-in tariffs guaranteed for a twenty year period (Agnolucci, 2006; Altrock et al., 2011; Maurer et al., 2012).[31] In this system, feed-in tariffs were determined (for a period of twenty years) based on the year of installation of the PV system. Furthermore, changes in the system only affected new installations (i.e., they were non-retroactive). Additionally, between 1999 and 2003, the government provided low-

[31]However, starting in 2002, new installations received a feed-in tariff 5 percent lower than installations put in place the previous year. See Figure A.3.

interest loans for PV roof installations through the 100,000 roofs program (Jacobsson and Lauber, 2006). By 2003, the fraction of residential buildings with PV systems was 0.9 percent in Baden-Württemberg, more than twenty times larger than in 1999. 2004's Amendment to the Renewable Energy Sources Act (EEG, 2004) further raised the feed-in tariff to 57 EURCent/kWh (see Figure A.3). By 2009, 6.3 percent of residential buildings had PV systems; and in 2020, 16.8 percent of buildings were equipped with PV (see Figure A.4).[32]

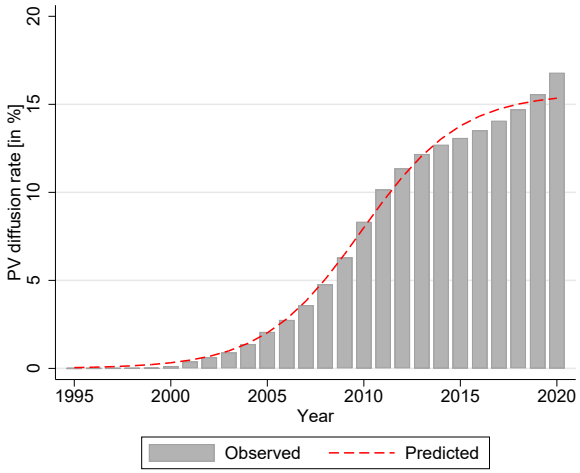


Figure A.4: Fraction of buildings with PV in Baden-Württemberg over time.

Underneath this trend there were important geographic differences across Baden-Württemberg. Figure 1 Panel C displays a map with the increase in PV diffusion between 1995 and 2020 on the LAU-2 level in Baden-Württemberg. By 2020, the highest adoption rates can be observed in the south-east (where solar radiation is higher, also see Figure A.6). In contrast, relatively few PV systems were installed in the north-west.

Panel A in the animated Figure A.5 shows how the PV adoption rate changed over time. While the adoption rate increased slowly in the 90s, it strongly increased since 2000 all over Baden-Württemberg. In the following, we discuss factors that drive the diffusion of PV systems.

[32]The Renewable Energy Sources Act also introduced new feed-in tariff schemes for electricity from wind power and biogas plants, though they rose comparatively less than for PV systems (to 9.1 EURCent/kWh for wind power and to 10.2 EURCent/kWh for biogas) (EEG, 2000).

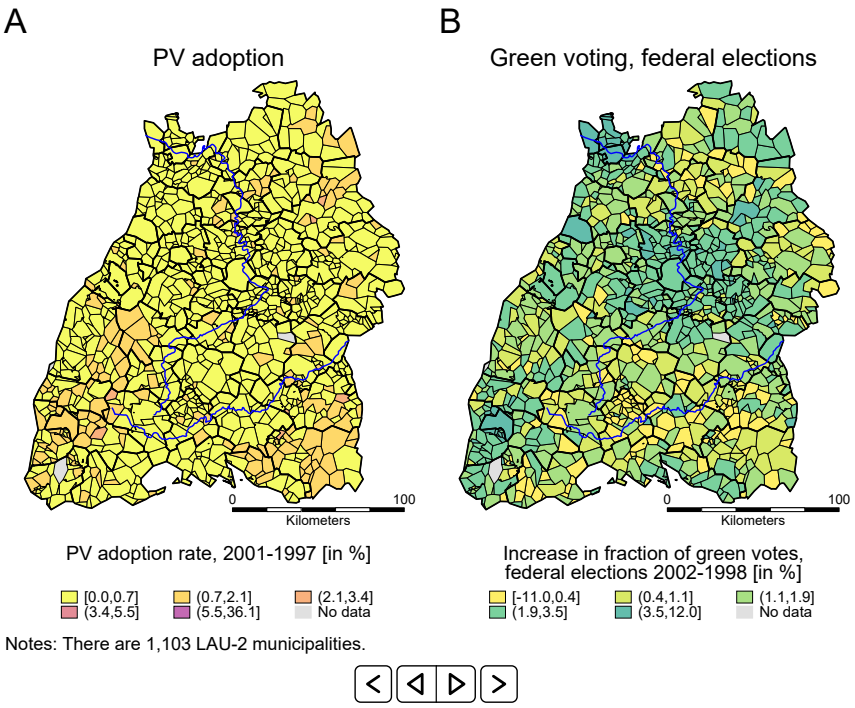


Figure A.5: Panel A shows the PV adoption rate and Panel B the increase in the fraction of green votes at federal elections for different time periods in Baden-Württemberg (LAU-2 level). The classes are cut at the 20th, 40th, 60th and 80th percentile of the full sample over all time periods. The animation changes the illustrated time periods.

Notes: Maps in Gauss-Krüger zone 3 projection (EPSG: 31467). The animation works with Adobe Acrobat Reader.

A.3 Appropriateness

A.3.1 Drivers of PV Diffusion – Solar Radiation

Several roof- and location-specific characteristics determine the suitability of a building for a PV installation based on the potential energy that a PV system can generate.[33] Such characteristics are solar radiation, roof orientation, inclination, altitude above the sea level, shadowing and roof size. We focus on the most important: solar radiation, roof orientation and roof inclination. Thereafter, we describe our measures of PV roof appropriateness.

Solar radiation is a measure of sun intensity. It refers to radiation on horizontal surface and is measured in kWh/sqm. We illustrate its regional variation across Baden-Württemberg in Figure A.6. We exploit data on average yearly solar radiation (1981-2000) from DWD (2010) for 1km times 1km raster cells across Germany.

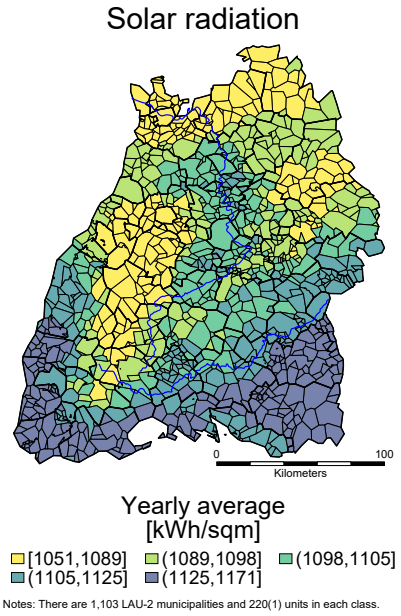


Figure A.6: Solar radiation (yearly average for 1981-2000) in Baden-Württemberg on LAU-2 level.

[33] Subsidies also determine or have determined the returns from a PV system. We describe the subsidy system for PV in Germany in Online Appendix A.2. It applies to all PV systems across Germany. Because it is not location-specific, we cannot exploit it to explain regional variation in the increase of green votes.

A.3.2 Drivers of PV Diffusion – Roof Appropriateness

Besides solar radiation, there are several other drivers of the suitability of a building for PV. Figure A.7 illustrates that roof orientation and inclination shape the potential energy that a PV system can generate.

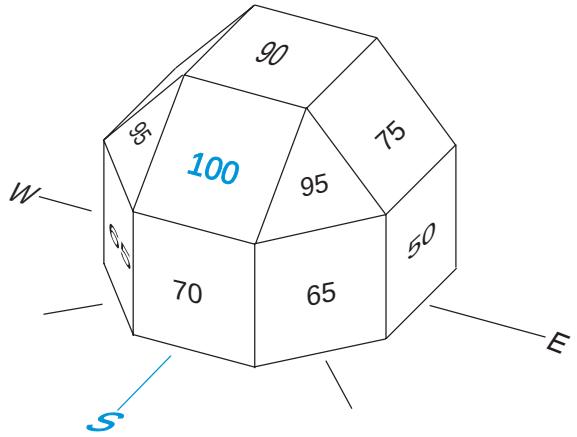


Figure A.7: Roof orientation and inclination shape the potential energy that a PV system can generate (Stark et al., 2005, p. 20).

Notes: The figure shows approximate ratios relative to the optimal orientation and inclination. In western Europe, the optimal orientation is to the south with an inclination of about 37 degrees. An inclination of 0 degrees refers to a flat roof.

The State Office for the Environment, Measurement and Nature Conservation of Baden-Württemberg (LUBW, 2016) conducted an aerial roof census that collected high-resolution data at the building level on these variables. The state office used this information to compute the solar energy potential of each residential building. Next, we describe the roof census in detail.

A.3.3 Raw Data on Appropriateness

Based on laser scan data from overflights between 2000 and 2005, the census uses information on the roof inclination, orientation, area, height above sea level, and shadowing to calculate whether a roof is suitable for PV.[34] Plausibly, LUBW (2016) uses the best suited roof area in a building to compute the building's solar energy potential.[35] The census considers buildings as appropriate for PV systems if they have a solar energy potential between 95 and 100 percent of the maximum solar radiation.[36]

Examples of the roof census data .– In Figure A.8, we illustrate the high level of detail of the raw appropriateness data. As an example, the figure shows the roof census information, which was available online, for Wolpertshausen. Wolpertshausen is a LAU-2 municipality in Baden-Württemberg with a high share of residential buildings with very good appropriateness for PV (52.1 percent). In the figure, red buildings have a very good appropriateness for PV. This corresponds to a solar energy potential between 95 and 100 percent of the maximum solar radiation. Orange buildings have a good appropriateness (solar energy potential between 80 and 94 percent), light blue a limited appropriateness (solar energy potential between 75 and 79 percent) and gray buildings have to be checked on-site (solar energy potential below 75 percent). Buildings with a solar energy potential below 75 percent are not considered as potentially appropriate for PV.

From Panel A, we learn that most buildings have a very good PV appropriateness in Wolpertshausen. In Panel B, we zoom in and observe the accurateness of the information with a satellite image below. In Panel C, we see the same details in map mode. When comparing Panels B and C, we observe several things. First, buildings in the same street located next to each other do not necessarily have the same appropriateness for PV. Second, there are buildings for which no appropriateness assessment is given (see lower part of Panels B and C). This can have different reasons. For buildings with inclined roofs,

[34]The census builds on the location of buildings from the cadastral land register of Baden-Württemberg as of 2012. In consequence, buildings that were constructed before 2012 but after the laser scan (between 2000 and 2005) are all classified as inappropriate for PV. However, out of the 2.3 million residential buildings only 176,573 (7.8 percent) are inappropriate. Some of them will indeed be inappropriate, for others no information on appropriateness is available since the laser scan was conducted (2000-2005) before they were constructed. In Figure A.2, we give an overview on the number of buildings and on how many we have detailed information.

[35]The outer walls of a building define its contour. Overhanging roofs are not included.

[36]The maximum value is calculated for 12 sub-regions in Baden-Württemberg independently. Our baseline appropriateness measure is therefore calculated relative to the potential in each of the 12 sub-regions. We construct alternative measures on PV appropriateness which do not rely on maximum values for the 12 sub-regions below.

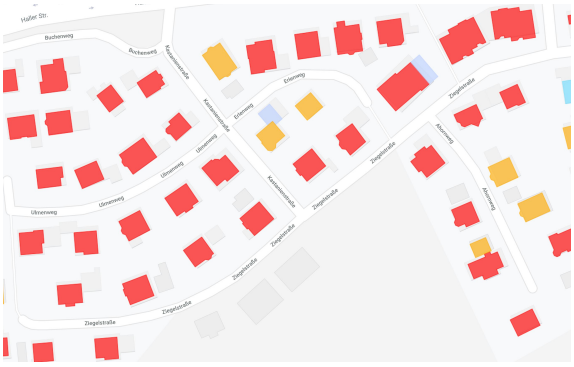
A Wolpertshausen



B Details with satellite image



C Details in map mode



Roof suitability for PV

Very good Good Limited On−site check

Figure A.8: Screenshots of information from roof-census for Wolpertshausen, which is a LAU-2 municipality in Baden-Württemberg with a high share (52.1 percent) of residential buildings with very good appropriateness for PV.

Notes: Wolpertshausen is located around 65km northeast of Stuttgart. It belongs to the district Landkreis Schwäbisch Hall. We took the screenshot on 30.08.2019 from the roof-census website, which is not online anymore.

areas have to allow for more than 10 sqm of PV modules to be included. Further, flat roofs are only included if they allow for more than 25 sqm of roof for PV systems because PV systems are usually built on stilts there, which requires more space. Finally, information for outer walls of buildings comes from cadastral maps from 2012, whereas the satellite image is newer. In consequence, we notice that some buildings in Figure A.8 are not included in the census.

In Figure A.9, we give another example for the high level of detail of the data. The figure shows the roof census information for Wannweil, which is a LAU-2 municipality in Baden-Württemberg with a low share of residential buildings with very good appropriateness for PV (15.7 percent). From Panel A, we learn that most buildings have a good or limited PV appropriateness in Wannweil. In Panel B, we zoom in again and observe the accurateness of the information with a satellite image below. In Panel C, we see the same details in map mode. When comparing Panels B and C, we again observe that buildings in the same street located next to each other do not necessarily have the same appropriateness for PV.



Figure A.9: Screenshots of information from roof-census for Wannweil, which is a LAU-2 municipality in Baden-Württemberg with a low share (15.7 percent) of residential buildings with very good appropriateness for PV.

Notes: Wannweil is located around 30km south of Stuttgart. It belongs to the district Landkreis Reutlingen. We took the screenshot on 30.08.2019 from the roof-census website, which is not online anymore.

A.3.4 Our Measures of Appropriateness

Baseline measure .– Our baseline PV appropriateness measure is the share of residential buildings in each municipality that have a solar energy potential between 95 and 100 percent of the maximum solar radiation. Figure 1 Panel D illustrates the regional variation in this measure. We also construct two alternative measures for PV appropriateness. The idea is to further eliminate anything from our measure that may be correlated with the green vote share.

PV appropriateness with orthogonalized solar radiation .– The first alternative measure filters solar radiation from the baseline measure. We do that by regressing the building-specific solar energy potential on solar radiation in the one-squared-KM area where the building is located.[37] Table A.3 contains the results. We use the residuals from this regression to construct a measure of roof appropriateness in a municipality that is orthogonal to solar radiation. The measure is the fraction of buildings in a municipality for which the residual solar energy potential is above the median residual in Baden-Württemberg.

Table A.3: Ordinary least squares estimation of building-specific solar energy potential on local solar radiation [1km x 1km] on residential building level.

	(1) Building-specific solar energy potential
Local solar radiation [1km x 1km]	0.74
	(0.00)
Constant: α	357.10
	(3.15)
Fixed effects	No
R^2	0.03
Adj. R^2	0.03
F	66286.84
N	2074619

Notes: Building-specific solar energy potential is from LUBW (2016) and refers to the *Mean solar radiation energy on the most appropriate roof area of a building. Minor shading on the surface is included in the calculation.* Local solar radiation comes from a 1km x 1km raster from DWD (2010). We use the location of the residential buildings to merge them to the 1km x 1km raster cells. Figure A.2 reveals there are 2,075,634 residential buildings in total. We can not merge a small share of them (2,075,634 - 2,074,619 = 1,015, or 0.05%). In the regression, we analyze the residential building level in the federal state Baden-Württemberg, Germany (for 2,074,619 residential buildings). Huber-White SE in parentheses.

[37] We run a simple linear regression because solar radiation is almost proportional to the building-specific solar energy potential (STMWI, 2015, pp. 50-52).

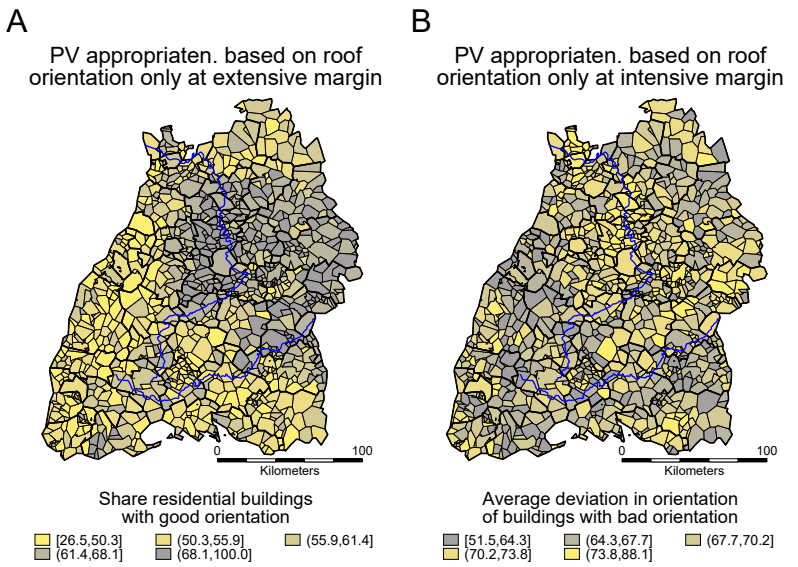


Figure A.10: Alternative PV appropriateness measures (based on roof orientation only) for Baden-Württemberg on LAU-2 level.

Notes: An orientation deviation to optimal orientation of zero refers to an orientation to the South. An orientation deviation to optimal orientation of 90 refers to an orientation to the East or West.

PV appropriateness based on roof orientation only .– As a final alternative, we only exploit the orientation of residential buildings. The orientation is one determinant of the energy generation potential of a roof. In western Europe, the optimal orientation is to the South. For example, a roof oriented to the East with an inclination of 37 degrees produces a quarter less electricity than a roof with the same inclination oriented to the South. We have information on the orientation of roofs in degrees, again from the roof census (LUBW, 2016). Raw orientation is specified in non-negative integers between 0 and 359. 0 refers to the North, 90 to the East, 180 to the South and 270 to the West.[38] Because the optimal orientation of a PV system in Germany is to the South and the orientation deviation to the South shapes the electricity production of a PV system, we re-scale raw orientation to values between 0 (worst) and 180 (best [to south]).[39] We calculate the mean re-scaled orientation for residential buildings for each LAU-2 municipality. Based on this, we construct two measures of appropriateness that only build on

[38] On a flat, PV system can have any orientation. We assume the optimal South orientation for flat roofs.

[39] E.g., a PV system with raw orientation of 170 and one of 190 will result in the same solar energy potential (all else equal) and the same re-scaled orientation.

roof orientation. The first measure is on the extensive dimension. We use the fraction of residential roofs in a location with a deviation from the optimal orientation of 30 or smaller degrees. Figure A.10 Panel A shows the resulting measure for residential buildings in Baden-Württemberg. The second measure is on the intensive dimension. It is the average deviation from optimal orientation in the buildings with a deviation of more than 30 degrees from the optimal orientation. Figure A.10 Panel B plots the result.

Table A.4 reports the correlation between the appropriateness measures. It shows that the measures capture different variation in appropriateness.

Table A.4: Correlation between measures of PV appropriateness.

	Baseline PV appropriat.	PV appr. orth. solar radia.	PV appr. orientat. at extensive margin	PV appr. orientat. at intensive margin
Baseline PV appropriateness	1.00			
PV appr. orth. solar radiation	0.83	1.00		
PV appr. orientation only at extensive margin	0.78	0.70	1.00	
PV appr. orientation only at intensive margin	0.16	0.14	0.42	1.00

Notes: We consider the 1,099 LAU-2 municipalities.

A.4 Household vs. Industrial PV

We can distinguish domestic PV systems from industrial systems by exploiting their capacity. This allows us to conduct robustness and placebo tests. Again, the data comes from the German transmission system operators TSO (2021). We distinguish between the household PV adoption rate of very small PV systems $\left(\Delta F_{\text{PV}\leq 10\,\text{kW}_\text{p},t-1}\right)$, i.e., the adoption rate for PV systems with a capacity of at most 10 kW_p, the household PV adoption rate of small PV systems $\left(\Delta F_{\text{PV}\leq 30\,\text{kW}_\text{p},t-1}\right)$, i.e., the adoption rate for PV systems with a capacity of at most 30 kW_p, and the industrial PV adoption rate $\left(\Delta F_{\text{PV}>100\,\text{kW}_\text{p},t-1}\right)$, i.e., the adoption rate for large PV systems with a capacity of more than 100 kW_p. Because small PV systems can be installed on small and large houses, we calculate $\Delta F_{\text{PV}\leq 10\,\text{kW}_\text{p},t-1}$ and $\Delta F_{\text{PV}\leq 30\,\text{kW}_\text{p},t-1}$ by dividing the number of small PV systems by the number of residential buildings (as for the adoption rate in general). In contrast, we define $\Delta F_{\text{PV}>100\,\text{kW}_\text{p},t-1}$ to be the number of large PV systems divided by the number of large enough buildings.[40]

Figure A.11 illustrates the diffusion of household $\left(\leq 30\text{kW}_\text{p}\right)$ and industrial PV $\left(\geq 100\text{kW}_\text{p}\right)$ over time. The figures indicate that the adoption rate of industrial systems increased later than for household systems. We also see that the observed PV diffusion rate is S-shaped as indicated by the predicted diffusion rate in red. Finally, we learn that the household PV diffusion rate (Panel A Figure A.11) and the general diffusion rate (Figure A.4) are very similar whereas the industrial PV diffusion rate (Panel B Figure A.11) differs from the two former.

In Figure A.12, we show the increase in the household PV adoption rate $\left(\leq 30\text{kW}_\text{p}\right)$ and the industrial PV adoption rate $\left(\geq 100\text{kW}_\text{p}\right)$ between 1995 and 2020. Because we observe regional differences, we can exploit the diffusion of industrial PV systems as a placebo test for our hypothesis.

[40] We approximate large enough buildings by those with a contour area larger than 800 sqm or an appropriate roof area for PV larger than 800 sqm. As explained in Footnote 29, we assume 8 sqm/kW_p and expect that PV systems with at least $100\,\text{kW}_\text{p}$ can only be installed on buildings with at least 800 sqm of contour area. We use this approximation because houses with gabled roofs usually have a smaller roof area than the building's contour and not all parts of the roof are oriented to the south, which is most appropriate for PV. Of course, inclined roofs can also have a larger roof area than the contour of a building. However, this mainly applies to single-pitch roofs, which are usually not very steep and therefore do not come with a large difference between roof area and a buildings contour area.

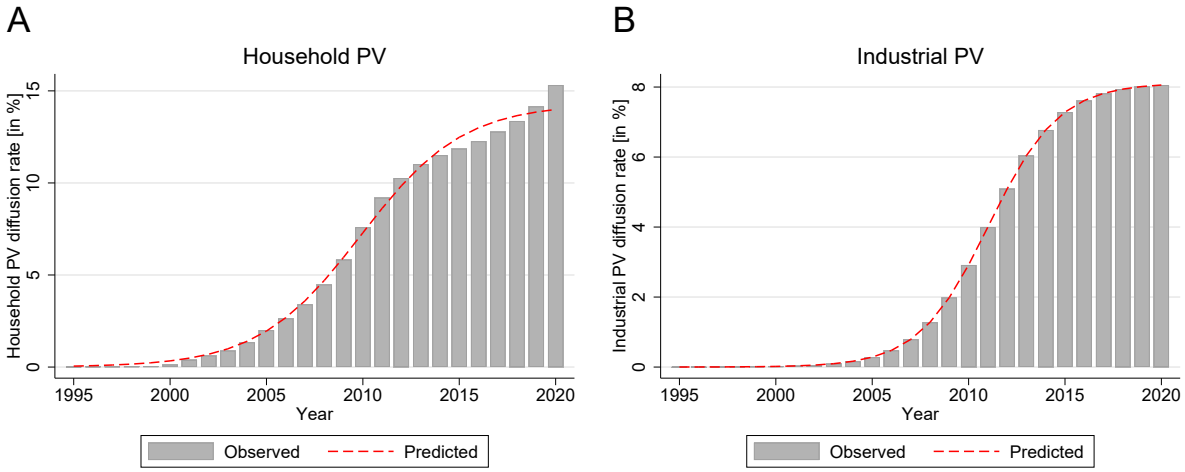


Figure A.11: Fraction of residential buildings with household PV $\left(\leq 30\text{kW}_\text{p}\right)$ and fraction of large buildings with industrial PV $\left(\geq 100\text{kW}_\text{p}\right)$ in Baden-Württemberg over time.

We use solar radiation (see Figure A.6) as a measure of appropriateness for industrial PV in the Diffusion Model because investors can search for locations with the highest potential returns, and because industrial PV systems are not only installed on roofs.

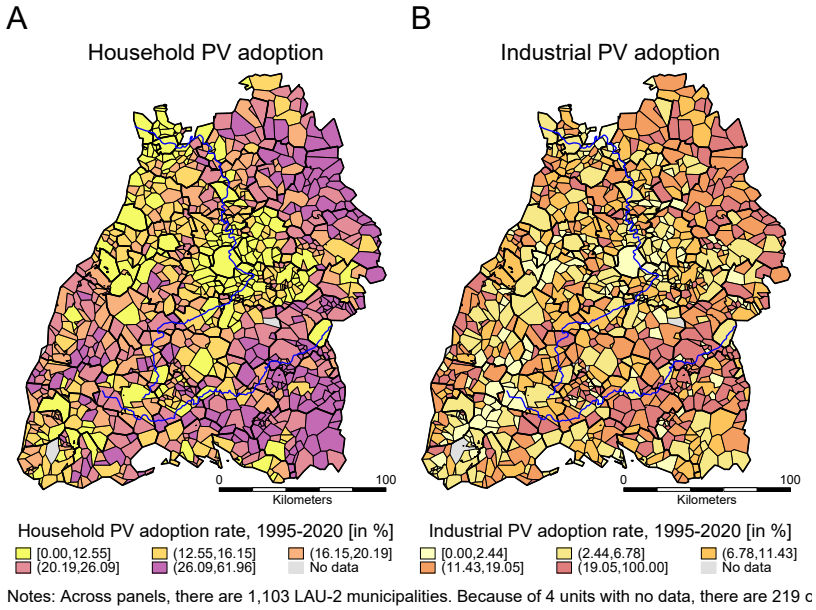


Figure A.12: Increase in household PV $\left(\leq 30\text{kW}_\text{p}\right)$ adoption rate (1995-2020) and increase in industrial PV $\left(\geq 100\text{kW}_\text{p}\right)$ adoption rate (1995-2020) in Baden-Württemberg on LAU-2 level.

A.5 Other Industrial Green Technologies

We study wind turbines and biogas plants, which are both industrial technologies. The 2000 EEG also introduced new feed-in tariff schemes for electricity from wind turbines and biogas plants, though they rose comparatively less than for PV systems. Figure A.13 illustrates the diffusion of wind turbines and biogas systems over time. Once again, we observe that the diffusion rate is S-shaped, especially for biogas systems.

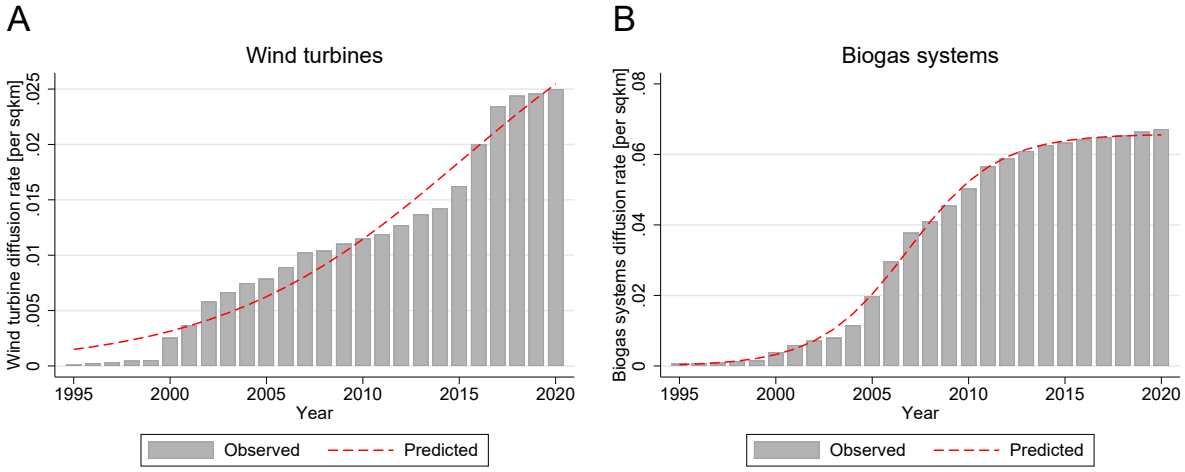
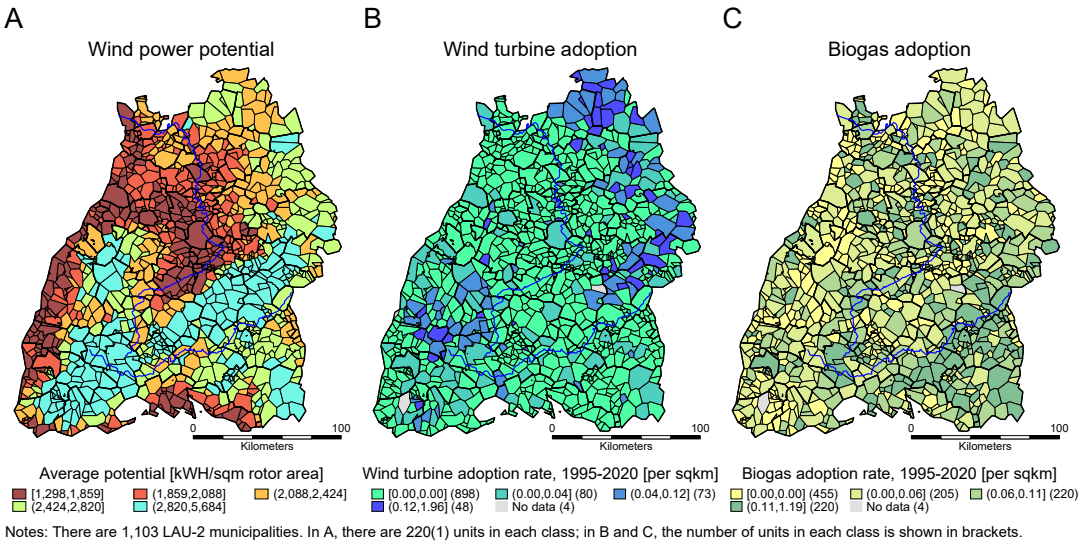


Figure A.13: Fraction of area [in sqkm] with wind turbines and fraction of area [in sqkm] with biogas systems in Baden-Württemberg over time.

In Figure A.14 Panel A, we show the average wind power potential (from DWD (2012)) by municipality, which is one major driver of wind turbine diffusion. We use solar radiation as a driver for biogas power (Figure A.6). In Figure A.14, we also show the wind turbine (Panel B) and biogas systems (Panel C) adoption rate between 1995 and 2020. Because wind turbines and biogas plants are not installed on roofs, we divide the number of systems by a municipality's area in sqkm to calculate adoption rates.



Notes: There are 1,103 LAU-2 municipalities. In A, there are 220(1) units in each class; in B and C, the number of units in each class is shown in brackets.

Figure A.14: Average wind power potential (based on 1km times 1km raster data from DWD (2012)), increase in wind turbine adoption rate (1995-2020) and increase in biogas systems adoption rate (1995-2020) in Baden-Württemberg on LAU-2 level.

B Details on Survey Data

Since 2007, the SOEP has included a question about whether households live in dwellings with solar energy systems. Solar energy includes both PV systems and solar thermal systems. We discuss the difference in Online Appendix B.1.

We only consider respondents who do not claim to have removed their solar system because there is strong evidence that this group best illustrates the effect under study. See Online Appendix B.2.

As outlined in the main text, we use two variables on the adoption of solar energy systems. The second is $\Delta Solar_{(t-3:t-1)}$. It measures whether a household did not have a solar system at $t-4$ and adopted one between $t-3$ and $t-1$. This measure conditions on not having a system. Doing so is relevant to prevent a downward bias in the estimates because for those that initially had a system, the independent variable is always 0, and the dependent can be either 0 or 1, forcing either a negative association or no association at all. Because SOEP started to ask households about solar energy systems only in 2007, we condition on not having a system in 2007. We consider a 2-year interval for 2009 and a 3-year interval afterwards. Table C.23 in the Online Appendix contains the descriptive statistics.

In all regressions run with SOEP, we include time and NUTS-1 dummies. Details on controls are available in Online Appendix B.3 and in Table Notes.

B.1 PV and Solar Thermal Systems

The difference between PV and solar thermal systems is that, while the latter produce energy that can only be used to heat water, the former produce electricity that can be either used or sold to the electric grid. For the purposes of the mechanisms explored in this paper, there is, a priori, no relevant difference between these two types of solar energy systems. Since 2007, a majority of the solar energy systems installed in Germany have been PV systems. According to BSW-Solar (2014), in 2007 there were 1 million solar thermal systems installed in Germany while there were only 360,000 PV systems. By end of 2022, the number of PV systems was 2.65 million (BSW-Solar, 2023a) while the number of solar thermal systems was 2.6 million (BSW-Solar, 2023b).

B.2 Removed PV Systems

We exclude respondents who claim that they have removed a PV system.[41] Figure B.1 compares the fraction of respondents who claim that they removed a solar system in the SOEP data set and those in the full sample of PV systems from the transmission system operators (TSO, 2021). The figure illustrates that, according to the SOEP (2022) data set, disproportionately many systems were removed.

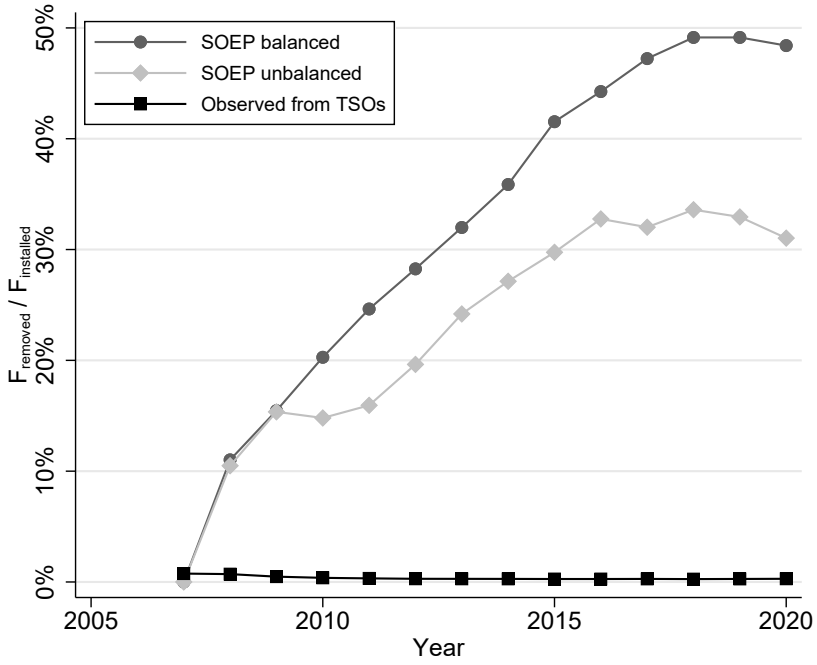


Figure B.1: Rate of cumulative removed divided by cumulative installed PV systems by year.

[41] Removed refers to respondents that first claim to have a solar system and at some later point in time claim that they do not have one.

B.3 Details on Controls

The SOEP estimations in columns (1), (3), and (5) of Table 3 and Table C.24 as well as those in columns (4) and (6) of Table 4 include the following controls:

- A dummy for vocational education. The dummy is set to one if the respondent states that she completed one of the following (zero otherwise): Lehre (Apprenticeship), Berufsfachschule, Gesundheitswesen (Vocational School), Schule Gesundheitswesen (bis 99) (Health Care School), Fachschule, Meister (Technical School), Beamtenausbildung (Civil Service Training), Sonstiger Abschluss (Other Training).
- A dummy for college education. The dummy is set to one if the respondent states that she completed one of the following (zero otherwise): Fachhochschule (Technical College), Universität, TH (University, Technical College), Hochschule im Ausland (College Not In Germany), Ingenieur-, Fachschule (Ost) (Engineering, Technical School (East)), Hochschule (Ost) (University (East)).
- A dummy for labor status. The dummy is set to one if the respondent states that she has a job (zero otherwise), in SOEP wording: Working (Working).
- Dummies for time t * NUTS-1. Because t is in years and we study the years 2009 through 2020, there are 12 time periods t and 16 NUTS-1 regions (federal states) in Germany.

The SOEP estimations in columns (2), (4), and (6) of Tables 3 and C.24 as well as those in columns (5) and (7) of Table 4 include dummies for time t * NUTS-1 and dummies for changes in college, in vocational degree and in labor status.

C Results

Table C.1 contains the descriptive statistics that correspond to the estimations shown in Table 1 and in Table 2 columns (1-3) in the main text.

Table C.1: Descriptive statistics, PV.

	Mean	St. Dev.	Min.	Max.
Panel A: Diffusion Model (Table 1 column (1))				
PV diffusion level: $F_{\text{PV},t-1}$	5.2	8.9	0	76
Predicted PV diffusion level: $\hat{F}_{\text{PV},t-1}$	5.2	7.5	4.6e-05	26
Baseline PV appropriateness	37	12	2.5	67
Mean(EligibleVoters)	6812	16839	80	3.7e+05
N	46158			
Panel B: Instrumental Variable Estimation (Table 1 columns (2-3) and Table 2 columns (1-3))				
Increase in share of green votes: $\Delta V_{e,t}$	2.3	4.7	-26	28
PV adoption rate: $\Delta F_{\text{PV},t-1}$	3.9	3.9	0	41
Lagged, predicted instrument: $\hat{F}_{\text{PV},t-k-1}$	6.8	7.3	.032	25
Lagged, predicted instrument squared: $\left(\hat{F}_{\text{PV},t-k-1}\right)^2$	100	143	.001	608
Predicted PV adoption rate: $\Delta\hat{F}_{\text{PV},t-1}$	2.8	3.1	-.67	7
Predicted PV adoption rate $\times$ lagged, pred. instr.: $\Delta\hat{F}_{\text{PV},t-1} \times \hat{F}_{\text{PV},t-k-1}/100$	.41	.52	-.0014	1.5
StateElection	.45	.5	0	1
EligibleVoters	6906	16840	72	3.8e+05
N	12085			

Notes: The Table contains the descriptive statistics that correspond to the estimations shown in Table 1 on the LAU-2 level in the federal state Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. Panel A refers to the 42 years t between 1980 and 2021. Panel B focuses on 11 points in time (state or federal election e in year t), six when federal elections (2021, 2017, 2013, 2009, 2005, and 2002 (and 1998 due to differencing) and five when state elections (2021, 2016, 2011, 2006, and 2001 (and 1996 due to differencing) took place.

C.1 Robustness

In the following, we explore the robustness of the estimated effect of PV adoption on green votes along various dimensions. In Online Appendix C.1.1, we use less comprehensive measures of roof-appropriateness as instruments of PV adoption. In Online Appendix C.1.2, we ignore the residential buildings for which we do not have detailed information for normalizing PV appropriateness, PV diffusion and PV adoption. In Online Appendix C.1.3, we verify the number of PV systems (based on another source), restrict the Diffusion Model to a shorter time period and correct instrument squared in the first stage regression (based on equation (4)).

C.1.1 Alternative Appropriateness Measures

Next, we show the robustness of our results for alternative appropriateness measures. The following Tables correspond to Table 1 columns (5) and (6). Table C.2 contains the corresponding descriptive statistics.

Table C.2: Descriptive statistics, PV.

	Mean	St. Dev.	Min.	Max.
Panel A: Diffusion Model (Table C.3 column (1))				
Predicted PV diffusion level: $\hat{F}_{\text{PV},t-1}$	5.2	7.5	3.9e-05	27
PV appropriateness with orthogonalized solar radiation	46	14	3.3	81
N	46158			
Panel B: Instrumental Variable Estimation (Table C.3 columns (2-3) and Table 1 column (4))				
Predicted PV adoption rate: $\Delta\hat{F}_{\text{PV},t-1}$	2.8	1.8	.74	5.2
N	12085			
Panel C: Diffusion Model (Table C.4 column (1))				
Predicted PV diffusion level: $\hat{F}_{\text{PV},t-1}$	5.2	7.5	3.2e-05	28
PV approp. based on roof orientation at extensive margin	59	10	27	91
PV approp. based on roof orientation at intensive margin	69	5.8	51	88
N	46158			
Panel D: Instrumental Variable Estimation (Table C.4 columns (2-3) and Table 1 column (5))				
Predicted PV adoption rate: $\Delta\hat{F}_{\text{PV},t-1}$	2.8	5.4	-3.2	10
N	12085			

Table C.3 contains results for the alternative measure for PV appropriateness based on orthogonalized solar radiation. The measure is the share of residuals in a LAU-2 municipality above median. The residuals come from the regression from Table A.3 (Online Appendix) at the building level. There, we regress building-specific solar radiation on local solar radiation. Panels A and B in Table C.2 contain the corresponding descriptive statistics.

The estimated value of β is positive and significantly different from zero (column (3), Table C.3). It is in the same ballpark as the estimate obtained with the baseline measure of appropriateness in column (3) (Table 1).

Table C.3: Instrument variable estimation of increase in share of green votes on increase in PV diffusion for Baden-Württemberg (weighted by eligible voters) for federal and state elections (alternative PV appropriateness with orthogonalized solar radiation).

	Diffusion Model	IV	
		1st stage	2nd stage
	(1)	(2)	(3)
	$F_{\text{PV},t-1}$	$\Delta F_{\text{PV},t-1}$	$\Delta V_{e,t}$
Predicted PV adoption rate: $\Delta\hat{F}_{\text{PV},t-1}$			0.91
			(0.44)
Lagged, predicted instrument: $\hat{F}_{\text{PV},t-k-1}$		0.56	
		(0.16)	
Lagged, predicted instrument squared: $\left(\hat{F}_{\text{PV},t-k-1}\right)^2$		-0.02	
		(0.00)	
Constant: α		0.72	0.03
		(0.67)	(1.25)
Ceiling: a_0	10.65		
	(0.85)		
Ceiling (PV approp. orthogonalized solar radiation): a_1	0.21		
	(0.02)		
Speed: b	0.41		
	(0.00)		
Inflexion point: c	30.69		
	(0.03)		
LAU-2 x Election-type fixed effects	No	Yes	Yes
Year x Election-type fixed effects	No	Yes	Yes
R^2	0.79	0.75	0.82
Adj. R^2	0.79	0.70	0.78
Final log-likelihood $\mathcal{L}$	-136578.0	-21266.5	-25868.7
F		15.4	4.2
$F_{a_1=0} \quad \vert \quad F^{\text{1st stage}}_{\hat{F}_{\text{PV},t-k-1},\hat{F}^2_{\text{PV},t-k-1}=0}$ (p-value)	107.4 (0.00)		15.4 (0.00)
N	46158	12085	12085

Notes: Across columns, we analyze the LAU-2 level in the federal state of Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. In column (1), we include the 42 years t between 1980 and 2021. In columns (2-3), we focus on 11 points in time (state or federal election e in year t): six with federal elections (2021, 2017, 2013, 2009, 2005, and 2002, along with 1998, due to differencing) and five with state elections (2021, 2016, 2011, 2006, and 2001, along with 1996, due to differencing). Column (1) shows the estimates of the Diffusion Model (equation (3)) with non-linear least squares. a_0 and a_1 affect the diffusion ceiling, b the speed and c the inflexion point. a_1 is the coefficient for the alternative PV appropriateness with orthogonalized solar radiation, which is the share of residuals above median in a LAU-2 municiality. The residuals come from the regression from Table A.3, in which we regress roof-specific solar radiation on local solar radiation. Column (2) presents the first stage (2SLS) estimates with the lagged, predicted instrument and the lagged, predicted instrument squared. The lagged instrument is predicted according to the Diffusion Model from column (1). Column (3) shows the second stage estimates (2SLS) of the increase in green votes on the predicted PV adoption rate (from column (2)). Columns (2)-(3) are weighted by the number of eligible voters at election e in year t. SE adjusted for clustering on LAU-2 level in parentheses.

Table C.4 shows results for the alternative measures for PV appropriateness based on roof orientation only. We use two measures. They both rely on the deviation to optimal orientation of buildings for PV. An optimal deviation of 0 degrees is best for PV, 180 degrees worst. The first measure reflects the extensive margin. It is the share of residential buildings with deviation to optimal orientation below or equal to 30 degrees. A larger share indicates better appropriateness for PV. The second measure is on the intensive margin. It is the average deviation from optimal orientation among the buildings with a deviation of more than 30 degrees from the optimal orientation. A smaller value indicates better appropriateness for PV. Panels C and D in Table C.2 contain the corresponding descriptive statistics.

Again, the estimated value of β is positive and significantly different from zero (column (3), Table C.4). It is in the same ballpark as the estimate obtained with the baseline measure of appropriateness in column (3) (Table 1).

Table C.4: Instrument variable estimation of increase in share of green votes on increase in PV diffusion for Baden-Württemberg (weighted by eligible voters) for federal and state elections (alternative PV appropriateness based on roof orientation only).

	Diffusion Model	IV	
		1st stage	2nd stage
	(1) $F_{\text{PV},t-1}$	(2) $\Delta F_{\text{PV},t-1}$	(3) $\Delta V_{e,t}$
Predicted PV adoption rate: $\Delta \hat{F}_{\text{PV},t-1}$			0.47
			(0.19)
Lagged, predicted instrument: $\hat{F}_{\text{PV},t-k-1}$		1.48	
		(0.21)	
Lagged, predicted instrument squared: $\left(\hat{F}_{\text{PV},t-k-1}\right)^2$		-0.04	
		(0.01)	
Constant: α		-3.22	1.25
		(0.86)	(0.55)
Ceiling:			
a_0	38.35		
	(3.97)		
PV approp. based on roof orientation at extensive margin: a_1	0.18		
	(0.04)		
PV approp. based on roof orientation at intensive margin: a_2	-0.41		
	(0.06)		
Speed:			
b	0.41		
	(0.00)		
Inflexion point:			
c	30.69		
	(0.03)		
LAU-2 x Election-type fixed effects	No	Yes	Yes
Year x Election-type fixed effects	No	Yes	Yes
R^2	0.79	0.76	0.82
Adj. R^2	0.79	0.70	0.78
Final log-likelihood $\mathcal{L}$	-137280.8	-21135.9	-25871.3
F		29.7	5.9
$F_{a_1=0} \mid F^{\text{1st stage}}_{\hat{F}_{\text{PV},t-k-1},\hat{F}^2_{\text{PV},t-k-1}=0}$ (p-value)	23.9 (0.00)		29.7 (0.00)
N	46158	12085	12085

Notes: Across columns, we analyze the LAU-2 level in the federal state of Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. In column (1), we include the 42 years t between 1980 and 2021. In columns (2-3), we focus on 11 points in time (state or federal election e in year t) as in Table 1 in the main part. Column (1) shows the estimates of the Diffusion Model (equation (3)) with non-linear least squares. a_0, a_1 and a_2 affect the diffusion ceiling, b the speed and c the inflexion point. a_1 and a_2 are the coefficients for PV appropriateness based on roof orientation only. The measure at the extensive margin is based on the share of buildings with deviation to optimal orientation of 30 degrees or below and the measure at the intensive margin is the mean deviation to optimal orientation of buildings with at least 31 degrees deviation to optimal orientation. Column (2) presents the first stage (2SLS) estimates with the lagged, predicted instrument and the lagged, predicted instrument squared. The lagged instrument is predicted according to the Diffusion Model from column (1). Column (3) shows the second stage estimates (2SLS) of the increase in green votes on the predicted PV adoption rate (from column (2)). Columns (2)-(3) are weighted by the number of eligible voters at election e in year t. SE adjusted for clustering on LAU-2 level in parentheses.

C.1.2 Normalization

In Figure A.2, we show that we do not have detailed information (e.g., on orientation) for 176,851 / 2,252,215 = 7.9 percent of the residential buildings. So far, we have assumed that all of these are inappropriate for PV. An alternative approach is to ignore these buildings. In the following, we show the robustness of our results for normalizing PV appropriateness, PV diffusion and PV adoption only by 2,252,215 - 176,851 = 2,075,634 residential buildings for which we have detailed information (although at least some of the 176,851 residential buildings will indeed be inappropriate for PV).

Our results are robust to this alternative normalization for our different PV appropriateness measures. Table C.5 show the estimates with the baseline PV appropriateness measure (the share of residential buildings with very good appropriateness for PV). Panels A and B in Table C.6 contain the corresponding descriptive statistics.

Table C.5: Instrument variable estimation of increase in share of green votes on increase in PV diffusion for Baden-Württemberg (weighted by eligible voters) for federal and state elections (baseline appropriateness measure, alternative normalization).

	Diffusion Model	IV	
		1st stage	2nd stage
	(1)	(2)	(3)
	$F_{\text{PV},t-1}$	$\Delta F_{\text{PV},t-1}$	$\Delta V_{e,t}$
Predicted PV adoption rate: $\Delta \hat{F}_{\text{PV},t-1}$			1.24
			(0.42)
Lagged, predicted instrument: $\hat{F}_{\text{PV},t-k-1}$		0.89	
		(0.30)	
Lagged, predicted instrument squared: $\left(\hat{F}_{\text{PV},t-k-1}\right)^2$		-0.02	
		(0.01)	
Constant: α		-0.77	-1.25
		(1.37)	(1.29)
Ceiling: a_0	15.11		
	(1.22)		
Ceiling (Baseline PV appropriateness): a_1	0.17		
	(0.03)		
Speed: b	0.41		
	(0.00)		
Inflexion point: c	30.70		
	(0.03)		
LAU-2 x Election-type fixed effects	No	Yes	Yes
Year x Election-type fixed effects	No	Yes	Yes
R^2	0.79	0.75	0.82
Adj. R^2	0.79	0.70	0.78
Final log-likelihood $\mathcal{L}$	-140790.2	-22228.9	-25858.5
F		8.9	8.8
$F_{a_1=0} \quad \vert \quad F^{\text{1st stage}}_{\hat{F}_{\text{PV},t-k-1},\hat{F}^2_{\text{PV},t-k-1}=0}$ (p-value)	29.9 (0.00)		8.9 (0.00)
N	46158	12085	12085

Notes: Across columns, we analyze the LAU-2 level in the federal state Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. In column (1), we include the 42 years t between 1980 and 2021. In columns (2-3), we focus on 11 points in time (state or federal election e in year t): six with federal elections (2021, 2017, 2013, 2009, 2005, and 2002 (and 1998 due to differencing) and five with state elections (2021, 2016, 2011, 2006, and 2001 (and 1996 due to differencing). Column (1) shows the estimates of the Diffusion Model (equation (3)) with non-linear least squares. a_0 and a_1 affect the diffusion ceiling, b the speed and c the inflexion point. a_1 is the coefficient for the baseline PV appropriateness, which is the share of residential buildings with very good appropriateness for PV. Column (2) presents the first stage (2SLS) estimates with the lagged, predicted instrument and the lagged, predicted instrument squared. The lagged instrument is predicted according to the Diffusion Model from column (1). Column (3) shows the second stage estimates (2SLS) of the increase in green votes on the predicted PV adoption rate (from column (2)). Columns (2)-(3) are weighted by the number of eligible voters at election e in year t. SE adjusted for clustering on LAU-2 level in parentheses.

Table C.6: Descriptive statistics, PV.

	Mean	St. Dev.	Min.	Max.
Panel A: Diffusion Model (Table C.5 column (1))				
PV diffusion level: $F_{\text{PV},t-1}$	5.6	9.6	0	79
Predicted PV diffusion level: $\hat{F}_{\text{PV},t-1}$	5.7	8.1	5.8e-05	27
Baseline PV appropriateness	40	11	2.9	73
N	46158			
Panel B: Instrumental Variable Estimation (Table C.5 columns (2-3))				
Predicted PV adoption rate: $\Delta\hat{F}_{\text{PV},t-1}$	3	3.4	-.74	7.6
N	12085			
Panel C: Diffusion Model (Table C.7 column (1))				
Predicted PV diffusion level: $\hat{F}_{\text{PV},t-1}$	5.7	8.1	4.7e-05	28
PV appropriateness with orthogonalized solar radiation	50	15	3.7	82
N	46158			
Panel D: Instrumental Variable Estimation (Table C.7 columns (2-3))				
Predicted PV adoption rate: $\Delta\hat{F}_{\text{PV},t-1}$	3	1.9	.94	5.6
N	12085			
Panel E: Diffusion Model (Table C.8 column (1))				
Predicted PV diffusion level: $\hat{F}_{\text{PV},t-1}$	5.7	8.1	4.4e-05	28
PV approp. based on roof orientation at extensive margin	59	10	27	91
PV approp. based on roof orientation at intensive margin	69	5.8	51	88
N	46158			
Panel F: Instrumental Variable Estimation (Table C.8 columns (2-3))				
Predicted PV adoption rate: $\Delta\hat{F}_{\text{PV},t-1}$	3	6.9	-4.5	12
N	12085			

Table C.7 includes the alternative measure for PV appropriateness based on orthogonalized solar radiation. The measure is the share of residuals in a LAU-2 municipality above median. The residuals come from the regression from Table A.3 (Online Appendix) in which we regress building-specific radiation energy on local radiation energy. Panels C and D in Table C.6 contain the corresponding descriptive statistics.

Table C.7: Instrument variable estimation of increase in share of green votes on increase in PV diffusion for Baden-Württemberg (weighted by eligible voters) for federal and state elections (alternative PV appropriateness with orthogonalized solar radiation, alternative normalization).

	Diffusion Model	IV	
		1st stage	2nd stage
	(1) $F_{\text{PV},t-1}$	(2) $\Delta F_{\text{PV},t-1}$	(3) $\Delta V_{e,t}$
Predicted PV adoption rate: $\Delta\hat{F}_{\text{PV},t-1}$			1.26
			(0.48)
Lagged, predicted instrument: $\hat{F}_{\text{PV},t-k-1}$		0.52	
		(0.18)	
Lagged, predicted instrument squared: $\left(\hat{F}_{\text{PV},t-k-1}\right)^2$		-0.01	
		(0.00)	
Constant: α		0.92	-1.31
		(0.81)	(1.49)
Ceiling: a_0	12.39		
	(0.97)		
Ceiling (PV approp. orthogonalized solar radiation): a_1	0.19		
	(0.02)		
Speed: b	0.41		
	(0.00)		
Inflexion point: c	30.69		
	(0.03)		
LAU-2 x Election-type fixed effects	No	Yes	Yes
Year x Election-type fixed effects	No	Yes	Yes
R^2	0.79	0.75	0.82
Adj. R^2	0.79	0.70	0.78
Final log-likelihood $\mathcal{L}$	-140082.2	-22229.6	-25858.1
F		9.0	6.8
$F_{a_1=0} \quad \vert \quad F^{\text{1st stage}}_{\hat{F}_{\text{PV},t-k-1},\hat{F}^2_{\text{PV},t-k-1}=0}$ (p-value)	84.7 (0.00)		9.0 (0.00)
N	46158	12085	12085

Notes: Across columns, we analyze the LAU-2 level in the federal state of Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. In column (1), we include the 42 years t between 1980 and 2021. In columns (2-3), we focus on 11 points in time (state or federal election e in year t): six with federal elections (2021, 2017, 2013, 2009, 2005, and 2002, along with 1998, due to differencing) and five with state elections (2021, 2016, 2011, 2006, and 2001, along with 1996, due to differencing). Column (1) shows the estimates of the Diffusion Model (equation (3)) with non-linear least squares. a_0 and a_1 affect the diffusion ceiling, b the speed and c the inflexion point. a_1 is the coefficient for the alternative PV appropriateness with orthogonalized solar radiation, which is the share of the residual from the regression from Table A.3 above median. In Table A.3, we regress roof-specific solar radiation on local solar radiation. Column (2) presents the first stage (2SLS) estimates with the lagged, predicted instrument and the lagged, predicted instrument squared. The lagged instrument is predicted according to the Diffusion Model from column (1). Column (3) shows the second stage estimates (2SLS) of the increase in green votes on the predicted PV adoption rate (from column (2)). Columns (2)-(3) are weighted by the number of eligible voters at election e in year t. SE adjusted for clustering on LAU-2 level in parentheses.

Table C.8 shows the alternative measures for PV appropriateness based on roof orientation. Here, we use two measures. They are both only based on the deviation to optimal orientation of buildings for PV. An optimal deviation of 0 degrees is best for PV, 180 degrees worst. The first measure is on the extensive margin. It is the share of residential buildings with deviation to optimal orientation below or equal to 30 degrees. A larger share indicates better appropriateness for PV. The second measure captures the intensive margin. It is the average deviation from optimal orientation among the buildings with a deviation of more than 30 degrees from the optimal orientation. A smaller value indicates better appropriateness for PV. Panels C and D in Table C.6 contain the corresponding descriptive statistics.

Table C.8: Instrument variable estimation of increase in share of green votes on increase in PV diffusion for Baden-Württemberg (weighted by eligible voters) for federal and state elections (alternative PV appropriateness based on roof orientation only, alternative normalization).

	Diffusion Model	IV	
		1st stage	2nd stage
	(1) $F_{\text{PV},t-1}$	(2) $\Delta F_{\text{PV},t-1}$	(3) $\Delta V_{e,t}$
Predicted PV adoption rate: $\Delta \hat{F}_{\text{PV},t-1}$			0.48
			(0.15)
Lagged, predicted instrument: $\hat{F}_{\text{PV},t-k-1}$		1.72	
		(0.20)	
Lagged, predicted instrument squared: $\left(\hat{F}_{\text{PV},t-k-1}\right)^2$		-0.04	
		(0.01)	
Constant: α		-4.57	1.09
		(0.92)	(0.45)
Ceiling:			
a_0	44.41		
	(4.24)		
PV approp. based on roof orientation at extensive margin: a_1	0.11		
	(0.04)		
PV approp. based on roof orientation at intensive margin: a_2	-0.42		
	(0.07)		
Speed:			
b	0.41		
	(0.00)		
Inflexion point:			
c	30.70		
	(0.03)		
LAU-2 x Election-type fixed effects	No	Yes	Yes
Year x Election-type fixed effects	No	Yes	Yes
R^2	0.79	0.76	0.82
Adj. R^2	0.79	0.71	0.78
Final log-likelihood $\mathcal{L}$	-140596.1	-22070.3	-25865.8
F		36.8	11.0
$F_{a_1=0} \quad \vert \quad F^{\text{1st stage}}_{\hat{F}_{\text{PV},t-k-1},\hat{F}^2_{\text{PV},t-k-1}=0}$ (p-value)	8.5 (0.00)		36.8 (0.00)
N	46158	12085	12085

Notes: Across columns, we analyze the LAU-2 level in the federal state of Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. In column (1), we include the 42 years t between 1980 and 2021. In columns (2-3), we focus on 11 points in time (state or federal election e in year t) as in Table 1 in the main part. Column (1) shows the estimates of the Diffusion Model (equation (3)) with non-linear least squares. a_0, a_1 and a_2 affect the diffusion ceiling, b the speed and c the inflexion point. a_1 and a_2 are the coefficients for alternative PV appropriateness based on roof orientation only. The measure at the extensive margin is based on the share of buildings with deviation to optimal orientation of 30 degrees or below and the measure at the intensive margin is the mean deviation to optimal orientation of buildings with at least 31 degrees deviation to optimal orientation. Column (2) presents the first stage (2SLS) estimates with the lagged, predicted instrument and the lagged, predicted instrument squared. The lagged instrument is predicted according to the Diffusion Model from column (1). Column (3) shows the second stage estimates (2SLS) of the increase in green votes on the predicted PV adoption rate (from column (2)). Columns (2)-(3) are weighted by the number of eligible voters at election e in year t. SE adjusted for clustering on LAU-2 level in parentheses.

C.1.3 Other Dimensions

Our results are also robust in other relevant dimensions. In the following, we stick to the baseline PV appropriateness measure in the Diffusion Model.

Verifying the number of PV systems .– In this robustness check, we verify the number of PV systems by municipality. LUBW (2022) reveals the numbers for 2018 and also accounts for removed PV systems. So far, we have neglected removed PV systems because their number is supposed to be low. We compare our data on the number of PV systems in 2018 with the one from LUBW (2022). We then focus only on municipalities which are below or above 2.5 percent of the number of PV systems in 2018 indicated by LUBW data. Table C.9 contains the results. The results are qualitatively similar to our baseline results in Table 1. Table C.10 reveals the corresponding descriptive statistics.

Table C.9: Instrument variable estimation of increase in share of green votes on increase in PV diffusion for Baden-Württemberg (weighted by eligible voters) for federal and state elections (only regions which are below or above 2.5% of the number of PV systems in 2018 indicated by LUBW data [for verification]).

	Diffusion Model	IV	
		1st stage	2nd stage
	(1)	(2)	(3)
	$F_{\text{PV},t-1}$	$\Delta F_{\text{PV},t-1}$	$\Delta V_{e,t}$
Predicted PV adoption rate: $\Delta \hat{F}_{\text{PV},t-1}$			0.58
			(0.29)
Lagged, predicted instrument: $\hat{F}_{\text{PV},t-k-1}$		0.74	
		(0.20)	
Lagged, predicted instrument squared: $\left(\hat{F}_{\text{PV},t-k-1}\right)^2$		-0.02	
		(0.01)	
Constant: α		-0.09	0.88
		(0.86)	(0.83)
Ceiling: a_0	7.54		
	(0.47)		
Ceiling (Baseline PV appropriateness): a_1	0.13		
	(0.01)		
Speed: b	0.40		
	(0.00)		
Inflexion point: c	30.76		
	(0.03)		
LAU-2 x Election-type fixed effects	No	Yes	Yes
Year x Election-type fixed effects	No	Yes	Yes
R^2	0.88	0.75	0.83
Adj. R^2	0.88	0.70	0.79
Final log-likelihood $\mathcal{L}$	-84226.7	-18226.3	-21502.0
F		10.7	4.1
$F_{a_1=0} \quad \mid \quad F^{\text{1st stage}}_{\hat{F}_{\text{PV},t-k-1},\hat{F}^2_{\text{PV},t-k-1}=0}$ (p-value)	100.2 (0.00)		10.7 (0.00)
N	38934	10193	10193

Notes: Across columns, we analyze the LAU-2 level in the federal state Baden-Württemberg, Germany (for 927 LAU-2 municipalities r) and several points in time. In column (1), we include the 42 years t between 1980 and 2021. In columns (2-3), we focus on 11 points in time (state or federal election e in year t): six with federal elections (2021, 2017, 2013, 2009, 2005, and 2002 (and 1998 due to differencing) and five with state elections (2021, 2016, 2011, 2006, and 2001 (and 1996 due to differencing). Column (1) shows the estimates of the Diffusion Model (equation (3)) with non-linear least squares. a_0 and a_1 affect the diffusion ceiling, b the speed and c the inflexion point. a_1 is the coefficient for the baseline PV appropriateness, which is the share of residential buildings with very good appropriateness for PV. Column (2) presents the first stage (2SLS) estimates with the lagged, predicted instrument and the lagged, predicted instrument squared. The lagged instrument is predicted according to the Diffusion Model from column (1). Column (3) shows the second stage estimates (2SLS) of the increase in green votes on the predicted PV adoption rate (from column (2)). Columns (2)-(3) are weighted by the number of eligible voters at election e in year t. Table C.10 contains the descriptive statistics corresponding to this table. SE adjusted for clustering on LAU-2 level in parentheses.

Table C.10: Descriptive statistics, PV (only regions which are below or above 2.5% of the number of PV systems in 2018 indicated by LUBW data [for verification]).

	Mean	St. Dev.	Min.	Max.
Panel A: Diffusion Model (Table C.9) column (1)				
PV diffusion level: $F_{\text{PV},t-1}$	3.2	5.1	0	38
Predicted PV diffusion level: $\hat{F}_{\text{PV},t-1}$	3.2	4.5	3.2e-05	16
Baseline PV appropriateness	37	12	2.5	67
Mean(EligibleVoters)	6328	15848	113	3.7e+05
N	38934			
***Panel B: Instrumental Variable Estimation (Table C.9)* columns (2-3)**				
Increase in share of green votes: $\Delta V_{e,t}$	2.3	4.7	-18	28
PV adoption rate: $\Delta F_{\text{PV},t-1}$	4	4	0	41
Lagged, predicted instrument: $\hat{F}_{\text{PV},t-k-1}$	6.9	7.4	.032	25
Lagged, predicted instrument squared: $\left(\hat{F}_{\text{PV},t-k-1}\right)^2$	103	147	.001	624
Predicted PV adoption rate: $\Delta\hat{F}_{\text{PV},t-1}$	2.8	2.6	-.066	6.4
EligibleVoters	6418	15808	106	3.8e+05
N	10193			

Notes: The Table contains the descriptive statistics that correspond to the estimations shown in Table C.9 on the LAU-2 level in the federal state Baden-Württemberg, Germany (for 927 LAU-2 municipalities r) and several points in time. Panel A focuses on 11 points in time (state or federal election e in year t), six when federal elections (2021, 2017, 2013, 2009, 2005, and 2002 (and 1998 due to differencing) and five when state elections (2021, 2016, 2011, 2006, and 2001 (and 1996 due to differencing) took place.

Restricting Diffusion Model .– Our Diffusion Model usually covers the time period 1980-2021. In this robustness check, we restrict the Diffusion Model to the period between 1990 and 2021. Table C.11 contains the results. They are qualitatively in line with our baseline results. Table C.12 shows the corresponding descriptive statistics.

Table C.11: Instrument variable estimation of increase in share of green votes on increase in PV diffusion for Baden-Württemberg (weighted by eligible voters) for federal and state elections (restricted Diffusion Model).

	Diffusion Model	IV	
		1st stage	2nd stage
	(1)	(2)	(3)
	$F_{\text{PV},t-1}$	$\Delta F_{\text{PV},t-1}$	$\Delta V_{e,t}$
Predicted PV adoption rate: $\Delta \hat{F}_{\text{PV},t-1}$			0.83
			(0.35)
Lagged, predicted instrument: $\hat{F}_{\text{PV},t-k-1}$		0.87	
		(0.21)	
Lagged, predicted instrument squared: $\left(\hat{F}_{\text{PV},t-k-1}\right)^2$		-0.02	
		(0.01)	
Constant: α		-0.70	0.24
		(0.88)	(1.00)
Ceiling: a_0	12.47		
	(0.99)		
Ceiling (Baseline PV appropriateness): a_1	0.21		
	(0.03)		
Speed: b	0.41		
	(0.00)		
Inflexion point: c	30.70		
	(0.03)		
LAU-2 x Election-type fixed effects	No	Yes	Yes
Year x Election-type fixed effects	No	Yes	Yes
R^2	0.79	0.75	0.82
Adj. R^2	0.79	0.70	0.78
Final log-likelihood $\mathcal{L}$	-109296.8	-21256.4	-25869.0
F		14.5	5.5
$F_{a_1=0} \quad \mid \quad F^{\text{1st stage}}_{\hat{F}_{\text{PV},t-k-1},\hat{F}^2_{\text{PV},t-k-1}=0}$ (p-value)	56.5 (0.00)		14.5 (0.00)
N	35168	12085	12085

Notes: Across columns, we analyze the LAU-2 level in the federal state Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. In column (1), we include the 32 years t between 1990 and 2021. In columns (2-3), we focus on 11 points in time (state or federal election e in year t): six with federal elections (2021, 2017, 2013, 2009, 2005, and 2002 (and 1998 due to differencing) and five with state elections (2021, 2016, 2011, 2006, and 2001 (and 1996 due to differencing). Column (1) shows the estimates of the Diffusion Model (equation (3)) with non-linear least squares. a_0 and a_1 affect the diffusion ceiling, b the speed and c the inflexion point. a_1 is the coefficient for the baseline PV appropriateness, which is the share of residential buildings with very good appropriateness for PV. Column (2) presents the first stage (2SLS) estimates with the lagged, predicted instrument and the lagged, predicted instrument squared. The lagged instrument is predicted according to the Diffusion Model from column (1). Column (3) shows the second stage estimates (2SLS) of the increase in green votes on the predicted PV adoption rate (from column (2)). Columns (2)-(3) are weighted by the number of eligible voters at election e in year t. Table C.12 contains the descriptive statistics corresponding to this table. SE adjusted for clustering on LAU-2 level in parentheses.

Table C.12: Descriptive statistics, PV (restricted Diffusion Model).

	Mean	St. Dev.	Min.	Max.
Panel A: Diffusion Model (Table C.11 column (1))				
PV diffusion level: $F_{\text{PV},t-1}$	6.8	9.6	0	76
Predicted PV diffusion level: $\hat{F}_{\text{PV},t-1}$	6.8	7.9	.0028	26
Baseline PV appropriateness	37	12	2.5	67
Mean(EligibleVoters)	6812	16839	80	3.7e+05
N	35168			
Panel B: Instrumental Variable Estimation (Table C.11 columns (2-3))				
Increase in share of green votes: $\Delta V_{e,t}$	2.3	4.7	-26	28
PV adoption rate: $\Delta F_{\text{PV},t-1}$	3.9	3.9	0	41
Lagged, predicted instrument: $\hat{F}_{\text{PV},t-k-1}$	6.8	7.3	.032	25
Lagged, predicted instrument squared: $\left(\hat{F}_{\text{PV},t-k-1}\right)^2$	100	143	.001	608
Linear prediction	2.8	3.1	-.67	7
StateElection	.45	.5	0	1
EligibleVoters	6906	16840	72	3.8e+05
N	12085			

Notes: The Table contains the descriptive statistics that correspond to the estimations shown in Table C.11 on the LAU-2 level in the federal state Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. Panel A refers to the 32 years t between 1990 and 2021. Panel B focuses on 11 points in time (state or federal election e in year t), six when federal elections (2021, 2017, 2013, 2009, 2005, and 2002 (and 1998 due to differencing) and five when state elections (2021, 2016, 2011, 2006, and 2001 (and 1996 due to differencing) took place.

Correcting Instrument Squared .– In Table C.13, we correct instrument squared by the ceiling in the first stage in column (2) and use the predicted values from column (2) in columns (3). We do so because equation (4) implies this correction. The results based on this procedure are qualitatively similar to our baseline results. Table C.14 contains the corresponding descriptive statistics.

Table C.13: Instrument variable estimation of increase in share of green votes on increase in PV diffusion for Baden-Württemberg (weighted by eligible voters) for federal and state elections (corrected instrument squared by the ceiling in the first stage in column (2)).

	Diffusion Model	IV	
		1st stage	2nd stage
	(1) $F_{\text{PV},t-1}$	(2) $\Delta F_{\text{PV},t-1}$	(3) $\Delta V_{e,t}$
Predicted PV adoption rate: $\Delta \hat{F}_{\text{PV},t-1}$			0.74
			(0.36)
Lagged, predicted instrument: $\hat{F}_{\text{PV},t-k-1}$		0.92	
		(0.22)	
Lagged, pred. instr. squared: $\frac{\left(\hat{F}_{\text{PV},t-k-1}\right)^2}{a_0+a_1 \times \text{Baseline PV Appropr.}}$		-1.03	
		(0.23)	
Constant: α		1.61	0.49
		(0.40)	(1.02)
Ceiling: a_0	12.47		
	(0.99)		
Ceiling (Baseline appropriateness): a_1	0.21		
	(0.03)		
Speed: b	0.41		
	(0.00)		
Inflexion point: c	30.70		
	(0.03)		
LAU-2 x Election-type fixed effects	No	Yes	Yes
Year x Election-type fixed effects	No	Yes	Yes
R^2	0.79	0.75	0.82
Adj. R^2	0.79	0.70	0.78
Final log-likelihood $\mathcal{L}$	-137176.1	-21255.7	-25873.3
F		13.9	4.2
$F_{a_1=0} \quad \mid \quad F^{\text{1st stage}}_{\hat{F}_{\text{PV},t-k-1},\hat{F}^2_{\text{PV},t-k-1}=0}$ (p-value)	56.5 (0.00)		13.9 (0.00)
N	46158	12085	12085

Notes: Across columns, we analyze the LAU-2 level in the federal state Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. In column (1), we include the 42 years t between 1980 and 2021. In columns (2-3), we focus on 11 points in time (state or federal election e in year t): six with federal elections (2021, 2017, 2013, 2009, 2005, and 2002 (and 1998 due to differencing) and five with state elections (2021, 2016, 2011, 2006, and 2001 (and 1996 due to differencing). Column (1) shows the estimates of the Diffusion Model (equation (3)) with non-linear least squares. a_0 and a_1 affect the diffusion ceiling, b the speed and c the inflexion point. a_1 is the coefficient for the baseline PV appropriateness, which is the share of residential buildings with very good appropriateness for PV. Column (2) presents the first stage (2SLS) estimates with the lagged, predicted instrument and the lagged, predicted instrument squared. The lagged instrument is predicted according to the Diffusion Model from column (1). Column (3) shows the second stage estimates (2SLS) of the increase in green votes on the predicted PV adoption rate (from column (2)). Columns (2)-(3) are weighted by the number of eligible voters at election e in year t. Table C.14 contains the descriptive statistics corresponding to this table. SE adjusted for clustering on LAU-2 level in parentheses.

Table C.14: Descriptive statistics, PV (corrected instrument squared by the ceiling in first stage).

	Mean	St. Dev.	Min.	Max.
Panel A: Diffusion Model (Table C.13 column (1))				
PV diffusion level: $F_{\text{PV},t-1}$	5.2	8.9	0	76
Predicted PV diffusion level: $\hat{F}_{\text{PV},t-1}$	5.2	7.5	4.6e-05	26
PV appropriateness: Baseline PV appropriateness	37	12	2.5	67
Mean(EligibleVoters)	6812	16839	80	3.7e+05
N	46158			
Panel B: Instrumental Variable Estimation (Table C.13 columns (2-3))				
Increase in share of green votes: $\Delta V_{e,t}$	2.3	4.7	-26	28
PV adoption rate: $\Delta F_{\text{PV},t-1}$	3.9	3.9	0	41
Lagged, predicted instrument: $\hat{F}_{\text{PV},t-k-1}$	6.8	7.3	.032	25
Lagged, predicted instrument squared: $\frac{\left(\hat{F}_{\text{PV},t-k-1}\right)^2}{a_0+a_1\times\text{Baseline PV Appropr.}}$	4.9	6.8	7.8e-05	23
Predicted PV adoption rate: $\Delta\hat{F}_{\text{PV},t-1}$	2.8	1.6	.61	6.8
StateElection	.45	.5	0	1
EligibleVoters	6906	16840	72	3.8e+05
N	12085			

Notes: The Table contains the descriptive statistics that correspond to the estimations shown in Table C.13 on the LAU-2 level in the federal state Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. Panel A refers to the 42 years t between 1980 and 2021. Panel B focuses on 11 points in time (state or federal election e in year t), six when federal elections (2021, 2017, 2013, 2009, 2005, and 2002 (and 1998 due to differencing) and five when state elections (2021, 2016, 2011, 2006, and 2001 (and 1996 due to differencing) took place.

C.2 Magnitude

Table C.15: Implied cumulative effect of long-term increase in PV adoption on long-term increase in green votes.

	Observed changes		Predicted changes					
			Baseline		Orthogonal. Solar Rad.		Roof orientation	
Election type	Federal	State	Federal	State	Federal	State	Federal	State
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Average long-term increase Green vote share	7.79	20.36						
Average long-term increase times beta PV Adoption rate			12.92	12.90	14.09	14.07	7.36	7.35
Predicted, average long-term increase times beta PV Adoption rate			16.33	16.38	17.81	17.87	9.19	9.22

Notes: There are 1,099 observations. Results are weighted by the average of the number of eligible voters in 1998 and 2021 for federal elections, and by the average of the number of eligible voters in 1996 and 2021 for state elections.

C.3 Understanding the Mechanism

C.3.1 Household vs. Industrial Systems

We use the installed capacity and energy source to classify each system as household or industrial. We consider two cut-offs for household PV systems: 10 and 30 kilowatt-peak $\left(\mathrm{kW_p}\right)$. For industrial PV systems, we use a conservative minimum threshold of 100 $\mathrm{kW_p}$ of installed capacity. We further extend the analysis to the installation of industrial facilities that produce green energy using wind turbines and biogas.

Our key findings from this exercise are that the effect of PV diffusion on green votes is entirely driven by the diffusion of household systems, and that, in contrast to household systems, the installation of industrial systems (PV, wind or biomass) in a municipality is not associated with an increase in green votes. The Tables below contain the details.

Household PV .– Table C.16 contains results for household systems (smaller than 10kWp). We use our baseline PV appropriateness measure, which is the share of residential buildings with very good appropriateness for PV. Panels A and B in Table C.18 contain the corresponding descriptive statistics. Table C.16 column (3) corresponds to column (4) in Table 2 in the main text.

Table C.16: Instrument variable estimation of increase in share of green votes on increase in household PV diffusion for Baden-Württemberg (weighted by eligible voters) for federal and state elections. Here, household PV refers to systems below 10 kWp.

	Diffusion Model	IV	
		1st stage	2nd stage
	(1) $F^{\leq 10\text{kW}_p}_{\text{PV},t-1}$	(2) $\Delta F^{\leq 10\text{kW}_p}_{\text{PV},t-1}$	(3) $\Delta V_{e,t}$
Predicted PV adoption rate: $\Delta \hat{F}^{\leq 10\text{kW}_p}_{\text{PV},t-1}$			1.62
			(0.76)
Lagged, predicted instrument: $\hat{F}^{\leq 10\text{kW}_p}_{\text{PV},t-k-1}$		1.20	
		(0.32)	
Lagged, predicted instrument squared: $\left(\hat{F}^{\leq 10\text{kW}_p}_{\text{PV},t-k-1}\right)^2$		-0.05	
		(0.01)	
Constant: α		-1.30	-0.45
		(0.90)	(1.42)
Ceiling: a_0	10.25		
	(0.52)		
Ceiling (Baseline PV appropriateness): a_1	0.08		
	(0.01)		
Speed: b	0.30		
	(0.00)		
Inflexion point: c	31.65		
	(0.04)		
LAU-2 x Election-type fixed effects	No	Yes	Yes
Year x Election-type fixed effects	No	Yes	Yes
R^2	0.87	0.79	0.82
Adj. R^2	0.87	0.74	0.78
Final log-likelihood $\mathcal{L}$	-97970.1	-12741.0	-25876.8
F		10.7	4.6
$F_{a_1=0} \quad \vert \quad F^{\text{1st stage}}_{\hat{F}_{\text{PV},t-k-1},\hat{F}^2_{\text{PV},t-k-1}=0}$ (p-value)	30.5 (0.00)		10.7 (0.00)
N	46158	12085	12085

Notes: Across columns, we analyze the LAU-2 level in the federal state Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. In column (1), we include the 42 years t between 1980 and 2021. In columns (2-3), we focus on 11 points in time (state or federal election e in year t): six with federal elections (2021, 2017, 2013, 2009, 2005, and 2002 (and 1998 due to differencing) and five with state elections (2021, 2016, 2011, 2006, and 2001 (and 1996 due to differencing) took place. Column (1) shows the estimates of the Diffusion Model (equation (3)) with non-linear least squares. a_0 and a_1 affect the diffusion ceiling, b the speed and c the inflexion point. a_1 is the coefficient for the baseline PV appropriateness, which is the share of residential buildings with very good appropriateness for PV. Column (2) presents the first stage (2SLS) estimates with the lagged, predicted instrument and the lagged, predicted instrument squared. The lagged instrument is predicted according to the Diffusion Model from column (1). Column (3) shows the second stage estimates (2SLS) of the increase in green votes on the predicted household PV adoption rate (from column (2)). Columns (2)-(3) are weighted by the number of eligible voters at election e in year t. SE adjusted for clustering on LAU-2 level in parentheses.

Table C.17 contains results for household systems (smaller than 30kWp). We use our baseline PV appropriateness measure, which is the share of residential buildings with very good appropriateness for PV. Panels C and D in Table C.18 contain the corresponding descriptive statistics. Table C.17 column (3) corresponds to column (5) in Table 2 in the main text.

Table C.17: Instrument variable estimation of increase in share of green votes on increase in household PV diffusion for Baden-Württemberg (weighted by eligible voters) for federal and state elections. Here, household PV refers to systems below 30 kWp.

	Diffusion Model	IV	
		1st stage	2nd stage
	(1) $F^{\leq 30\text{kW}_p}_{\text{PV},t-1}$	(2) $\Delta F^{\leq 30\text{kW}_p}_{\text{PV},t-1}$	(3) $\Delta V_{e,t}$
Predicted PV adoption rate: $\Delta \hat{F}^{\leq 30\text{kW}_p}_{\text{PV},t-1}$			0.93
			(0.41)
Lagged, predicted instrument: $\hat{F}^{\leq 30\text{kW}_p}_{\text{PV},t-k-1}$		0.90	
		(0.22)	
Lagged, predicted instrument squared: $\left(\hat{F}^{\leq 30\text{kW}_p}_{\text{PV},t-k-1}\right)^2$		-0.03	
		(0.01)	
Constant: α		-0.79	0.18
		(0.87)	(1.06)
Ceiling: a_0	11.89		
	(0.89)		
Ceiling (Baseline PV appropriateness): a_1	0.18		
	(0.02)		
Speed: b	0.39		
	(0.00)		
Inflexion point: c	30.71		
	(0.03)		
LAU-2 x Election-type fixed effects	No	Yes	Yes
Year x Election-type fixed effects	No	Yes	Yes
R^2	0.80	0.76	0.82
Adj. R^2	0.80	0.70	0.78
Final log-likelihood $\mathcal{L}$	-130292.5	-19534.7	-25870.2
F		14.2	5.2
$F_{a_1=0} \quad \vert \quad F^{\text{1st stage}}_{\hat{F}_{\text{PV},t-k-1},\hat{F}^2_{\text{PV},t-k-1}=0}$ (p-value)	51.5 (0.00)		14.2 (0.00)
N	46158	12085	12085

Notes: Across columns, we analyze the LAU-2 level in the federal state Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. In column (1), we include the 42 years t between 1980 and 2021. In columns (2-3), we focus on 11 points in time (state or federal election e in year t): six with federal elections (2021, 2017, 2013, 2009, 2005, and 2002 (and 1998 due to differencing) and five with state elections (2021, 2016, 2011, 2006, and 2001 (and 1996 due to differencing). Column (1) shows the estimates of the Diffusion Model (equation (3)) with non-linear least squares. a_0 and a_1 affect the diffusion ceiling, b the speed and c the inflexion point. a_1 is the coefficient for the baseline PV appropriateness, which is the share of residential buildings with very good appropriateness for PV. Column (2) presents the first stage (2SLS) estimates with the lagged, predicted instrument and the lagged, predicted instrument squared. The lagged instrument is predicted according to the Diffusion Model from column (1). Column (3) shows the second stage estimates (2SLS) of the increase in green votes on the predicted household PV adoption rate (from column (2)). Columns (2)-(3) are weighted by the number of eligible voters at election e in year t. SE adjusted for clustering on LAU-2 level in parentheses.

Table C.18: Descriptive statistics, PV.

	Mean	St. Dev.	Min.	Max.
Panel A: Diffusion Model (Table C.16 column (1))				
Household PV diffusion level: $F_{\text{PV},t-1}^{\leq 10\text{kW}_p}$	3.1	4.8	0	35
Predicted household PV diffusion level: $\hat{F}_{\text{PV},t-1}^{\leq 10\text{kW}_p}$	3.1	4.3	.0007	15
PV appropriateness: Baseline PV appropriateness	37	12	2.5	67
N	46158			
Panel B: Instrumental Variable Estimation (Table C.16 columns (2-3) and Table 2 column (4))				
Household PV adoption rate: $\Delta F_{\text{PV},t-1}^{\leq 10\text{kW}_p}$	2.4	1.9	0	15
Predicted household PV adoption rate: $\Delta \hat{F}_{\text{PV},t-1}^{\leq 10\text{kW}_p}$	1.8	2.6	-1.2	5.6
N	12085			
Panel C: Diffusion Model (Table C.17 column (1))				
Household PV diffusion level: $F_{\text{PV},t-1}^{\leq 30\text{kW}_p}$	4.7	7.9	0	62
Predicted household PV diffusion level: $\hat{F}_{\text{PV},t-1}^{\leq 30\text{kW}_p}$	4.8	6.8	7.3e-05	23
PV appropriateness: Baseline PV appropriateness	37	12	2.5	67
N	46158			
Panel D: Instrumental Variable Estimation (Table C.17 columns (2-3) and Table 2 column (5))				
Household PV adoption rate: $\Delta F_{\text{PV},t-1}^{\leq 30\text{kW}_p}$	3.6	3.4	0	37
Predicted household PV adoption rate: $\Delta \hat{F}_{\text{PV},t-1}^{\leq 30\text{kW}_p}$	2.5	2.9	-.75	6.5
N	12085			
Panel E: Diffusion Model (Table C.19 column (1))				
Industrial PV diffusion level: $F_{\text{PV},t-1}^{\geq 100\text{kW}_p}$	2.3	6.7	0	100
Predicted industrial PV diffusion level: $\hat{F}_{\text{PV},t-1}^{\geq 100\text{kW}_p}$	2.4	3.9	2.0e-08	14
Solar radiation / 1000	1105	23	920	1172
N	45696			
Panel F: Instrumental Variable Estimation (Table C.19 columns (2-3) and Table 2 column (6))				
Industrial PV adoption rate: $\Delta F_{\text{PV},t-1}^{\geq 100\text{kW}_p}$	2.2	5.3	0	100
Predicted industrial PV adoption rate: $\Delta \hat{F}_{\text{PV},t-1}^{\geq 100\text{kW}_p}$	1.5	.39	1.3	2.7
N	11964			

Industrial PV .– Table C.19 contains results for industrial systems $\left(\geq 100\text{kW}_\text{p}\right)$. We normalize the number of industrial PV systems by the number of buildings with appropriate roof larger than 800 sqm, the results are as expected. As instrument for industrial PV, we use average solar radiation [from 1 km times 1km raster cells], see Figure A.6. Panels E and F in Table C.18 contain the corresponding descriptive statistics. Table C.19 column (3) corresponds to column (6) in Table 2 in the main text.

Table C.19: Instrument variable estimation of increase in share of green votes on increase in industrial PV diffusion (normalized by number buildings with appropriate roof larger than 800 sqm) for Baden-Württemberg (weighted by eligible voters) for federal and state elections. Industrial PV refers to systems above 100 kWp.

	Diffusion Model	IV	
		1st stage	2nd stage
	(1)	(2)	(3)
	$F^{\geq 100\text{kW}_p}_{\text{PV},t-1}$	$\Delta F^{\geq 100\text{kW}_p}_{\text{PV},t-1}$	$\Delta V_{e,t}$
Predicted PV adoption rate: $\Delta \hat{F}^{\geq 100\text{kW}_p}_{\text{PV},t-1}$			-2.40
			(1.08)
Lagged, predicted instrument: $\hat{F}^{\geq 100\text{kW}_p}_{\text{PV},t-k-1}$		0.08	
		(0.38)	
Lagged, predicted instrument squared: $\left(\hat{F}^{\geq 100\text{kW}_p}_{\text{PV},t-k-1}\right)^2$		0.00	
		(0.02)	
Constant: α		1.27	6.30
		(0.68)	(1.68)
Ceiling: a_0	-46.46		
	(14.99)		
Ceiling (Solar radiation): a_1	0.05		
	(0.01)		
Speed: b	0.55		
	(0.02)		
Inflexion point: c	32.12		
	(0.10)		
LAU-2 x Election-type fixed effects	No	Yes	Yes
Year x Election-type fixed effects	No	Yes	Yes
R^2	0.41	0.44	0.82
Adj. R^2	0.41	0.31	0.78
Final log-likelihood $\mathcal{L}$	-142122.9	-26814.8	-25600.1
F		1.2	4.9
$F_{a_1=0} \quad \vert \quad F^{\text{1st stage}}_{\hat{F}_{\text{PV},t-k-1},\hat{F}^2_{\text{PV},t-k-1}=0}$ (p-value)	14.4 (0.00)		1.2 (0.30)
N	45696	11964	11964

Notes: Across columns, we analyze the LAU-2 level in the federal state Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. In column (1), we include the 42 years t between 1980 and 2021. In columns (2-3), we focus on 11 points in time (state or federal election e in year t): six with federal elections (2021, 2017, 2013, 2009, 2005, and 2002 (and 1998 due to differencing) and five with state elections (2021, 2016, 2011, 2006, and 2001 (and 1996 due to differencing). Column (1) shows the estimates of the Diffusion Model (equation (3)) with non-linear least squares. a_0 and a_1 affect the diffusion ceiling, b the speed and c the inflexion point. a_1 is the coefficient for solar radiation. Column (2) presents the first stage (2SLS) estimates with the lagged, predicted instrument and the lagged, predicted instrument squared. The lagged instrument is predicted according to the Diffusion Model from column (1). Column (3) shows the second stage estimates (2SLS) of the increase in green votes on the predicted industrial PV adoption rate (from column (2)). Columns (2)-(3) are weighted by the number of eligible voters at election e in year t. SE adjusted for clustering on LAU-2 level in parentheses.

Wind power .– In Table C.20, we focus on wind power plants normalized by a regions area in square kilometers. We use the average wind power potential (see Figure A.14 Panel A) in the diffusion model. Panels A and B in Table C.21 contain the corresponding descriptive statistics. Table C.20 column (3) corresponds to column (7) in Table 2 in the main text.

Table C.20: Instrument variable estimation of increase in share of green votes on increase in wind power diffusion for Baden-Württemberg (weighted by eligible voters) for federal and state elections.

	Diffusion Model	IV	
		1st stage	2nd stage
	(1)	(2)	(3)
	$F_{\text{Wind},t-1}$	$\Delta F_{\text{Wind},t-1}$	$\Delta V_{e,t}$
Predicted wind power adoption rate: $\Delta \hat{F}_{\text{Wind},t-1}$			74.69
			(52.28)
Lagged, predicted instrument: $\hat{F}_{\text{Wind},t-k-1}$		0.44	
		(0.22)	
Lagged, predicted instrument suqared: $\left(\hat{F}_{\text{Wind},t-k-1}\right)^2$		-11.20	
		(4.34)	
Constant: α		0.00	2.40
		(0.00)	(0.13)
Ceiling: a_0	-0.04		
	(0.01)		
Ceiling (Wind power potential/1000): a_1	0.03		
	(0.01)		
Speed: b	0.16		
	(0.02)		
Inflexion point: c	34.07		
	(3.46)		
LAU-2 x Election-type fixed effects	No	Yes	Yes
Year x Election-type fixed effects	No	Yes	Yes
R^2	0.07	0.25	0.82
Adj. R^2	0.07	0.09	0.78
Final log-likelihood $\mathcal{L}$	89957.1	33562.4	-25888.5
F		3.8	2.0
$F_{a_1=0} \quad \mid \quad F^{\text{1st stage}}_{\hat{F}_{\text{Wind},t-k-1},\hat{F}^2_{\text{Wind},t-k-1}=0}$ (p-value)	16.2 (0.00)		3.8 (0.02)
N	46158	12085	12085

Notes: Across columns, we analyze the LAU-2 level in the federal state Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. In column (1), we include the 42 years t between 1980 and 2021. In columns (2-3), we focus on 11 points in time (state or federal election e in year t): six with federal elections (2021, 2017, 2013, 2009, 2005, and 2002 (and 1998 due to differencing) and five with state elections (2021, 2016, 2011, 2006, and 2001 (and 1996 due to differencing). Column (1) shows the estimates of the Diffusion Model (equation (3)) with non-linear least squares. a_0 and a_1 affect the diffusion ceiling, b the speed and c the inflexion point. a_1 is the coefficient for wind power potential. Column (2) presents the first stage (2SLS) estimates with the lagged, predicted instrument and the lagged, predicted instrument squared. The lagged instrument is predicted according to the Diffusion Model from column (1). Column (3) shows the second stage estimates (2SLS) of the increase in green votes on the predicted wind power adoption rate (from column (2)). Columns (2)-(3) are weighted by the number of eligible voters at election e in year t. SE adjusted for clustering on LAU-2 level in parentheses.

Table C.21: Descriptive statistics, wind and biogas.

	Mean	St. Dev.	Min.	Max.
Panel A: Diffusion Model (Table C.20 column (1))				
Wind diffusion level: $F_{\text{Wind},t-1}$	.005	.035	0	2
Predicted wind diffusion level: $\hat{F}_{\text{Wind},t-1}$	.0053	.0079	-.0027	.082
Wind power potential	2394	654	1307	5684
N	46158			
Panel B: Instrumental Variable Estimation (Table C.20 columns (2-3) and Table 2 column (7))				
Wind turbine adoption rate: $\Delta F_{\text{Wind},t-1}$	.0033	.028	0	1.5
Predicted wind turbine adoption rate: $\Delta \hat{F}_{\text{Wind},t-1}$	.0028	.0014	-.02	.0052
N	12085			
Panel C: Diffusion Model (Table C.22 column (1))				
Biogas diffusion level: $F_{\text{Biogas},t-1}$	.02	.056	0	1.2
Predicted biogas diffusion level: $\hat{F}_{\text{Biogas},t-1}$	.02	.026	-.021	.093
Solar radiation / 1000	1105	23	920	1172
N	46158			
Panel D: Instrumental Variable Estimation (Table C.22 columns (2-3) and Table 2 column (8))				
Biogas adoption rate: $\Delta F_{\text{Biogas},t-1}$	.012	.035	0	.6
Predicted biogas adoption rate: $\Delta \hat{F}_{\text{Biogas},t-1}$	.013	.019	-.054	.035
N	12085			

Biogas plants .– In Table C.22, we focus on biogas normalized by a regions area in square kilometers. We use mean average solar radiation [from 1 km times 1km raster cells] in the diffusion model. Panels C and D in Table C.21 contain the corresponding descriptive statistics. Table C.22 column (3) corresponds to column (8) in Table 2 in the main text.

Table C.22: Instrument variable estimation of increase in share of green votes on increase in biogas systems diffusion for Baden-Württemberg (weighted by eligible voters) for federal and state elections.

	Diffusion Model	IV	
		1st stage	2nd stage
	(1)	(2)	(3)
	$F_{\text{Biogas},t-1}$	$\Delta F_{\text{Biogas},t-1}$	$\Delta V_{e,t}$
Predicted biogas adoption rate: $\Delta\hat{F}_{\text{Biogas},t-1}$			37.92
			(23.89)
Lagged, predicted instrument: $\hat{F}_{\text{Biogas},t-k-1}$		1.71	
		(0.55)	
Lagged, predicted instrument squared: $\left(\hat{F}_{\text{Biogas},t-k-1}\right)^2$		-15.31	
		(4.63)	
Constant: α		-0.01	2.08
		(0.01)	(0.32)
Ceiling: a_0	-0.44		
	(0.12)		
Ceiling (Solar radiation / 1000): a_1	0.45		
	(0.11)		
Speed: b	0.46		
	(0.01)		
Inflexion point: c	27.89		
	(0.15)		
LAU-2 x Election-type fixed effects	No	Yes	Yes
Year x Election-type fixed effects	No	Yes	Yes
R^2	0.31	0.38	0.82
Adj. R^2	0.31	0.24	0.78
Final log-likelihood $\mathcal{L}$	73037.6	28743.7	-25883.9
F		5.6	2.5
$F_{a_1=0} \quad \vert \quad F^{\text{1st stage}}_{\hat{F}_{\text{Biogas},t-k-1},\hat{F}^2_{\text{Biogas},t-k-1}=0}$ (p-value)	16.3 (0.00)		5.6 (0.00)
N	46158	12085	12085

Notes: Across columns, we analyze the LAU-2 level in the federal state Baden-Württemberg, Germany (for 1,099 LAU-2 municipalities r) and several points in time. In column (1), we include the 42 years t between 1980 and 2021. In columns (2-3), we focus on 11 points in time (state or federal election e in year t): six with federal elections (2021, 2017, 2013, 2009, 2005, and 2002 (and 1998 due to differencing) and five with state elections (2021, 2016, 2011, 2006, and 2001 (and 1996 due to differencing). Column (1) shows the estimates of the Diffusion Model (equation (3)) with non-linear least squares. a_0 and a_1 affect the diffusion ceiling, b the speed and c the inflexion point. a_1 is the coefficient for solar radiation. Column (2) presents the first stage (2SLS) estimates with the lagged, predicted instrument and the lagged, predicted instrument squared. The lagged instrument is predicted according to the Diffusion Model from column (1). Column (3) shows the second stage estimates (2SLS) of the increase in green votes on the predicted biogas adoption rate (from column (2)). Columns (2)-(3) are weighted by the number of eligible voters at election e in year t. SE adjusted for clustering on LAU-2 level in parentheses.

C.3.2 Own vs. Rent Dwelling

Table C.23 contains the descriptive statistics for the balanced panel (shown in column (1) of Table 3 in the main text).

Table C.23: Descriptive statistics, SOEP.

	Mean	Std. Dev.	Min.	Max.
$\Delta Green_t$	.029	.17	0	1
$Solar_{t-1}$	.086	.28	0	1
$\Delta Solar_{t-3:t-1}$	.026	.16	0	1
$\Delta Solar_t$	.006	.077	0	1
$\Delta Green_{t-3:t-1}$	.14	.35	0	1
N	57933			

Notes: There are 4930 individuals from 3573 households in the balanced sample. We focus on the years 2020 through 2009 (along with 2008 and 2007, due to differencing).

Table C.24 contains the logit coefficient estimates for the unbalanced panel. In Table C.25, we show the corresponding descriptive statistics (for Panel A column (1), Table C.24).

The results are in line with those obtained with the balanced panel: (i) the estimates confirm that a household's adoption of a solar energy system is positively associated with an increase in its support for the Green Party (column (1) in Panel A of Table C.24). (ii) Columns (3) through (6) in Panel A of Table C.24 show that, while for home owners there is a strong positive association between the adoption of a solar system support for the Green Party, there is no association for non-home owners. (iii) In columns (1), (3) and (5) of Panel B of Table C.24, we see that Green Party supporters are not more likely to adopt solar systems than those who do not support the Green Party. (iv) Columns (2), (4) and (6) of Panel B of Table 3 illustrate that individuals who became greener were not more likely to install solar energy systems than those who did not become greener in a previous three-year period.

Table C.24: Logit coefficient estimates for Socio-Economic Panel (unbalanced panel), which is a representative longitudinal survey.

Panel A: Estimates of solar level and solar change on change in green attitude						
	All		Home owners		Non-home owners	
	(1) $\Delta Green_t$	(2) $\Delta Green_t$	(3) $\Delta Green_t$	(4) $\Delta Green_t$	(5) $\Delta Green_t$	(6) $\Delta Green_t$
$Solar_{t-1}$	0.36		0.39		-0.06	
	(0.06)		(0.07)		(0.17)	
$\Delta Solar_{t-3:t-1}$		0.45		0.57		-0.34
		(0.15)		(0.15)		(0.68)
$\ln$ (Real Income$_t$)	0.20		0.18		0.19	
	(0.04)		(0.05)		(0.05)	
$\Delta \ln$ (Real Income$_t$)		-0.04		-0.28		0.19
		(0.08)		(0.10)		(0.11)
N	231,111	106,130	116,200	56,800	114,648	45,131
# individuals	42,748	15,049	22,244	8,913	24,816	7,859
# households	25,305	9,675	12,211	5,272	16,045	5,687
DF_M	196	189	195	176	193	166
Final log-likelihood $\mathcal{L}$	-27994.2	-11492.2	-14796.6	-6198.4	-13065.2	-5162.0
Panel B: Reverse causality: Estimates of level and change in green attitude on solar change						
	All		Home owners		Non-home owners	
	(1) $\Delta Solar_t$	(2) $\Delta Solar_t$	(3) $\Delta Solar_t$	(4) $\Delta Solar_t$	(5) $\Delta Solar_t$	(6) $\Delta Solar_t$
$Green_{t-1}$	0.01		0.03		-0.02	
	(0.15)		(0.19)		(0.27)	
$\Delta Green_{t-3:t-1}$		0.18		0.20		0.19
		(0.12)		(0.15)		(0.21)
$\ln$ (Real Income$_t$)	0.74		0.48		0.96	
	(0.09)		(0.13)		(0.14)	
$\Delta \ln$ (Real Income$_t$)		0.20		0.09		0.56
		(0.19)		(0.24)		(0.27)
N	92,748	91,620	46,601	46,043	31,174	30,406
# individuals	15,140	15,061	8,726	8,671	7,360	7,283
# households	9,711	9,652	5,100	5,069	5,304	5,243
DF_M	139	138	115	114	95	91
Final log-likelihood $\mathcal{L}$	-4146.5	-4201.5	-2779.2	-2788.4	-1212.6	-1245.7

Notes: We study the years 2020 through 2009 (along with 2008 and 2007, due to differencing). In columns (1), (3) and (5), we include time∗NUTS-1, college, vocational degree and labor status dummies and control for age. In columns (2), (4) and (6), we include time∗NUTS-1 and dummies for changes in college, in vocational degree and in labor status. We only examine those who did not have a solar system in 2007. Table C.25 in this Online Appendix contains the corresponding descriptive statistics. SE adjusted for clustering on household level in parentheses.

Table C.25: Descriptive statistics, SOEP, unbalanced panel.

	Mean	Std. Dev.	Min.	Max.
$\Delta Green_t$	.029	.17	0	1
$Solar_{t-1}$	.076	.26	0	1
$\Delta Solar_{t-3:t-1}$	.023	.15	0	1
$\Delta Solar_t$	.0074	.086	0	1
$\Delta Green_{t-3:t-1}$	.099	.3	0	1
$\ln$ (Real Income$_t$)	7.9	.58	2.3	12
$\Delta \ln$ (Real Income$_t$)	.024	.29	-7	3.9
Vocational education$_t$	.66	.48	0	1
College education$_t$	.24	.43	0	1
Labor status$_t$	.6	.49	0	1
Age$_t$	50	17	18	105
N	231111			

Notes: There are 42748 individuals from 25305 households in the unbalanced sample. We examine the years 2020 through 2009 (along with 2008 and 2007, due to differencing).

C.3.3 Votes for Money

The Green Party was the key proponent of the feed-in tariff scheme, EEG, implemented in 2000. The EEG was significantly more generous than the previous system (see Figure A.3). One possibility is that agents that adopted PV systems after 2000 voted for the Green Party in subsequent elections to reward the party for the income they accrued by selling the electricity they produced at the higher tariffs.

We consider this is an unlikely rationale for our findings. Our estimated effect of PV adoption on change in Green Party votes is unaffected by controlling for changes in the profitability of the PV systems (see Table 4 column (1) in the main text). If the votes for money mechanism lies behind our effect, one would expect that controlling for variation in electricity income should make the effect of PV adoption on green votes insignificant. Instead, we observe that the effect of instrumented adoption is unaffected by controlling for the changes in the profitability of PV system adoption.

To further explore this issue we calculate the net income from installing a PV system relative to household income. (See Table C.26 for a definition of the parameters in expression (6), their value and source.)

$$\begin{aligned}\text{Profit Income Ratio} = \text{Capacity} * \Bigg[\sum_{t=0}^{T=19} \left(\frac{1-v}{1+r}\right)^t \Big[&\text{\# Full-load Hours } * (\text{Feed-in Tariff} \\ &* (1 - \text{Self-consumption share}) + \text{Household electricity price} \\ &* \text{Self-consumption share } * (1+d)^t) \Big] - \text{Investment per kW}_\text{p} \\ &* \left(1 + \sum_{t=0}^{T=19} \frac{b}{(1+r)^t}\right) \Bigg] / (\text{Household Income} * 20).\end{aligned} \tag{6}$$

In this formula, both the costs and revenues from PV systems are proportional to the capacity of the PV system. The first term in the numerator is the present discounted value of revenues per unit of capacity installed,[42] while the second term is the cost of installing and operating the PV system per unit

[42] We use a standard value for the annual discount rate, 5 percent per year (e.g., Cooley and Prescott (1995)).

of capacity. Because we want to evaluate the economic significance of the net revenues from PV systems, we scale them by the annual average household income (DESTATIS, 2022).

Revenues from PV systems are calculated by multiplying the level of the feed-in tariff times the number of full-load hours the system operates per year. The feed-in tariff varies with the year of installation of the system. The number of full-load hours mainly depends on the location, the orientation and the inclination of the installation. The median number of full-load hours for roof areas suitable for PV on residential buildings in Baden-Württemberg is 1117 hours (LUBW, 2016). We also consider a value for the full-load hours of 1,245, which is at the 90^{th} percentile for roof areas suitable for PV on residential buildings in Baden-Württemberg. For the profit Income Ratio since 2012, we also account for the Household electricity price and the self-consumption share of PV electricity because around 2012 the household electricity price surpassed the level of the feed-in tariff (see Figure A.3). Before it was more attractive to feed all PV electricity into the grid, since then households had the incentive to consume PV electricity themselves.[43]

The costs of installing PV systems dropped very significantly between 2000 and 2020 (Janzing, 2010; BSW-Solar, 2012; Solaranlagen Ratgeber, 2022). In 2000, the cost of installing one kW_p was 8,000 EUR while in 2009 it was approximately 4,000 EUR and in 2020 it was approximately 1670 EUR. In addition to the installation costs, there is an annual cost of operation and maintenance (b) which amounts to 1 percent of the cost of installation (BMU, 2011; Wirth, 2013).

We calculate the median and 90^{th} percentile capacity installed in residential buildings in two steps. The median potential area for PV installation in residential buildings is 21 sqm, and the 90^{th} percentile is 50 sqm. LUBW (2016) documents that it is necessary to install between 6.6 and 11 sqm of solar modules to reach a capacity of 1 kW_p. Based on this range, we use a value of 8 sqm per kW_p in our calculations. This yields a median capacity supported by residential buildings of 2.6 kW_p, while for the 90^{th} percentile it is 6.3 kW_p.[44]

[43] We use the average increase of the household electricity price between 1998 and 2021, which is 3 percent per year, as the annual discount rate in the electricity price (d).

[44] We verify our calculation: For this second attempt, we again calculate the median and 90^{th} percentile capacity installed in residential buildings in two steps. First, we use the information from another roof census conducted by the Karlsruher Energie- und Klimaschutzagentur (KEK, 2010) for Karlsruhe in Baden-Württemberg (Karlsruhe is a 300,000 city (among the 25 largest in Germany) with a solar radiation similar to the average in Baden-Württemberg (DWD, 2010)), to calculate the potential area

Table C.26: Details on the calculation of PV profits.

Definition	Parameter	Value	Source
Household Income	Disposable income per household [EUR]	Yearly	DESTATIS (2022)
Feed-in Tariff	Level feed-in tariff [EUR]	Yearly	StromEinspG (1990); EEG (2000, 2004, 2009, 2011, 2012, 2014, 2017)
Household electricity price	Level [EUR]	Yearly	BDEW (2016); DESTATIS (2016a)
Investment per kW_p	Investment costs [EUR]	Yearly	2000-05: Janzing (2010); 2006-09: BSW-Solar (2012), pvX (2012) 2012-20: Solaranlagen Ratgeber (2022)
r	Weighted average cost of capital	5.0 percent	Cooley and Prescott (1995), BMU (2011),Wirth (2013)
b	Yearly operating costs	1.0 percent	BMU (2011), Wirth (2013)
d	Yearly increase in electricity price	3.0 percent	average increase for households between 1998 and 2021: BDEW (2016)
$T+1$	Life span [years]	20	EEG (2000, 2004, 2009, 2011, 2012, 2014, 2017), BMU (2011),Wirth (2013)
v	Yearly decrease in revenue	0.5 percent	BMU (2011), Wirth (2013)
Capacity	Median capacity $\left[\mathrm{kW_p}\right]$	3	LUBW (2016)
	90^{th} percentile capacity $\left[\mathrm{kW_p}\right]$	7.1	LUBW (2016)
Full-load Hours	Median (for roof areas suitable for PV) on residential buildings in Baden-Württemberg [hours/year]	1117	LUBW (2016)
	90^{th} percentile (for roof areas suitable for PV) on residential buildings [hours/year]	1245	LUBW (2016)
Potential module area	Median potential module area (of roof areas suitable for PV) on residential buildings in Baden-Württemberg [sqm]	21	LUBW (2016)
	90^{th} percentile of potential module area (of roof areas suitable for PV) on residential buildings in Baden-Württemberg [sqm]	50	LUBW (2016)
Self-consumption share	for 2.6 kW_p and for 6.3 kW_p PV system	30 percent	based on Weniger et al. (2012), who specify a self-consumption share of 30 percent for a 5 kW_p PV system

Table C.27 reports the value of the profit to income ratio (equation 6) for four combinations of full-load hours and capacity, that represent the median and 90^{th} percentile values in each dimension. Given the time series variation in the feed-in tariff and installation costs, we report the ratios for six years over the period 2000-2020. The profit to income ratio ranges from -1.9 percent to 2.0 percent with lower values for earlier years and for systems with lower capacity and full-load hours.

Table C.27: Yearly profits from investment in PV as share of yearly average household income according to yearly full load hours and time of installation.

Year of installation	PV system with 2.6 kW_p		PV system with 6.3 kW_p	
	Full load hours [h/a]		Full load hours [h/a]	
	Median	90^{th} percentile	Median	90^{th} percentile
	1117	1245	1117	1245
2000	-0.8 percent	-0.5 percent	-1.9 percent	-1.1 percent
2004	0.2 percent	0.6 percent	0.4 percent	1.3 percent
2006	0.3 percent	0.6 percent	0.7 percent	1.4 percent
2010	0.6 percent	0.8 percent	1.5 percent	2.0 percent
2015	0.2 percent	0.3 percent	0.4 percent	0.6 percent
2020	0.2 percent	0.3 percent	0.5 percent	0.7 percent

The main conclusion we extract from this exercise is that, even for systems with high capacity and installed in areas with high solar radiation, the net revenues from PV electricity production are relatively negligible for households. Therefore, we do not consider plausible that PV adopters are compensating to the Green Party with their votes *in exchange for* the net income they earn from PV systems.

in residential buildings' roofs to install PV systems. In particular, the census used information on the roof inclination, area, orientation and solar radiation to calculate the potential capacity of PV systems on each roof. The census covered 40,043 residential buildings in Karlsruhe. DESTATIS (2013) reports that in 2010 there were 17,631 single-family homes in Karlsruhe. We now focus on single-family homes because for these one household can easily decide whether to install a PV systems. In contrast, the coordination between several households is a relevant barrier to adoption. KEK does not identify which of the residential buildings correspond to single-family dwellings. We assume in our calculations that they are the 17,631 residential buildings with smaller potential roof area for PV installation. It follows that the median potential area for PV installation in single household residences is 37 sqm, and the 90^{th} percentile is 58 sqm in Karlsruhe. KEK (2010) documents that it is necessary to install between 8 and 10 sqm of solar modules to reach a capacity of 1 kW_p. Based on this range, we again use a value of 8 sqm per kW_p in our calculations. This yields a median capacity supported by single-family residences of 4.6 kW_p, while for the 90^{th} percentile it is 7.3 kW_p. Both values are within or close to the range of our first attempt (median of 2.6 kW_p and the 90^{th} percentile of 6.3 kW_p.

C.3.4 Periods with high feed-in tariffs and high profitability

Feed-in tariffs were high before 2012, and profitability was high in 2004 and 2006-2011. We define high profitability as a PV profit-to-income ratio of more than 1 percent for systems with installed capacity and potential solar radiation (full load hours) at the 90th percentile (shown in the last column of Table C.27). We calculate averages for consecutive elections of a given kind and observe that the time periods before the federal elections in 2009 and 2013 and the period before the state election in 2011 were periods with high average PV profitability.