Walking the Talk? Green Politicians and Pollution Patterns*

Michael Koetter Alexander Popov

Abstract

Exploiting three decades of detailed regional data for Germany, we find that when the Green Party is successful at the polls, local hazardous emissions decline. The level of political representation matters, too. Green politicians' gaining power at county level is followed largely by a decline in air pollutants that have an immediate adverse health effect. In contrast, when the Green party joins the state government, only greenhouse gas emissions that affect the welfare of future generations via climate change decline. The primary mechanism to achieve lower emissions appears to be a reduction in output, rather than more efficient energy use.

JEL classification: D72, Q53

Keywords: Politics, hazardous emissions, growth

*Michael Koetter: Halle Institute of Economic Research (IWH), michael.koetter@iwh-halle.de. Alexander Popov: ECB and CEPR, alexander.popov@ecb.europa.eu. We thank Hannes Bohm and Karin Hansson for outstanding research assistance. We thank Maria Petrova and Isabel Schabel for valuable comments. The opinions expressed herein are those of the authors and do not necessarily reflect those of the ECB or the Eurosystem.

1 Motivation

Climate change is by definition a global challenge to society, which is mainly driven by the emission of greenhouse gases like carbon dioxide (CO_2). Markets fail to price CO_2 efficiently as polluting agents do not incur the social cost they inflict on future generations. The trivial first-best solution is a Pigouvian tax, which is infeasible in reality (Hassler, Krusell, and Olovsson, 2021). Given re-election incentives of politicians, they cannot credibly commit to future policy paths featuring significant reductions in CO_2 emissions as these require sacrifices in economic activity for a given production technology.

We study empirically whether electoral success by environmental political parties, paired with decentralized political decision-making, can alleviate this friction. In doing so, we build on two theoretical insights. First, Besley and Persson (2023) show that a green transformation requires the joint evolution of (firms') production technologies *and* (consumers') preferences, which we approximate with local green party representation. As consumers are increasingly willing to incur a premium for sustainable goods and services, producers adapt their technologies. Second, Folke (2014) demonstrates that in proportional representation systems a larger local vote share of parties specialized in secondary policy issues, like arresting environmental degradation, significantly influences policies.

We mobilize three decades (1990–2018) of hand-collected data on the electoral performance of the Green Party across 542 counties and 16 federal states in Germany. The crucial tension that we exploit is that local constituencies may elect ecological politicians given their preferences, but may find it difficult to sacrifice local welfare to tackle environmental externalities. As shown by Geelen, Hajda, and Starmans (2023), delegated agents like elected politicians can pursue sustainable policies for as long as they do not deviate too far from the principal's (i.e. voters') preferences. The moment the agent does, she is dismissed by the principal. Acting to reduce industrial pollutants that have immediate adverse effects on human health, such as nitrogen oxide and Total Suspended Particulates, is an example of local politicians dealing with an environmental issue that has adverse local effects. In contrast, reducing CO_2 emissions that have no immediate health effects via policies that burden high-emission firms might be in line with an ecological political ideology, but it is not in the best interest of the local constituency of an elected politician if the policy requires to sacrifice economic output. Rational local politicians voted into office with a "green" agenda may therefore abandon or at a minimum dilute their initial sustainability objectives.

Our main hypothesis therefore is that local and non-local pollutant emissions will respond differently to the representation of ecological ideologies at different levels of political decision making. To overcome this "abandoning" of environmental political objectives, "green" political representation is required at a higher (state) level of government to pursue at a lower (county) level non-local objectives, such as the green transformation dynamics described in Besley and Persson (2023). In contrast to local politicians, Green state politicians are more likely to internalize what is an intertemporal externality at the local level: lowering emissions of greenhouse gases come at the cost of foregone economic output without immediate welfare gains. Such politicians optimize vote shares in multiple counties, which allows local Green politicians to focus on local sustainability objectives while Green state politicians address non-local objectives. Thereby, elected politicians' actions do not deviate too far from their respective constituencies' preferences as in Geelen, Hajda, and Starmans (2023), contributing to the endogenous adaptation of consumer preferences and production technologies in Besley and Persson (2023). The political alignment at different levels of government, in turn, allows for state policies to compensate for local sacrifices in terms of economic activity, thereby allowing green politicians to "walk the talk".

Consider an example to illustrate the mechanism we have in mind. Assume that there exist two layers of political entities, states ("Bundesländer") that nest counties ("Kreise"), with different election cycles. Suppose that a state s nests three counties of equal population, c_1, c_2, and c_3. Counties c_1 and c_2 suffer from local pollution, for example in the form of locally emitted total suspended particulates (TSP) by heavy traffic. In addition, county c_1 also generates high CO_2 emissions by industrial activity such as metallurgy or cement production. There are no CO_2

emissions in county c_2. There are no emissions of any kind in county c_3. At time t, the electorate in all three counties elect politicians from the Green party to deal with environmental problems, as follows: counties c_1 and c_2 elect green politicians to the local council to deal with local pollution, and counties c_2 and c_3 elect green politicians to the state government to deal with CO_2 emissions from county c_1. All voters care about their welfare today and discount the welfare of future generations.

Consistent with our hypothesis, local politicians in c_1 and c_2 will enact policies to successfully tackle TSP emissions in their respective county. In contrast, elected representatives in county c_1 will have little incentives to bring down local CO_2 emissions by enacting policies that slow down economic activities: such policies bring benefits to future generations, in the form of a stable climate, but they bring no immediate health benefits and come at the cost of reduced local economic welfare today. But as voters from countries c_2 and c_3 have sent members of the Green party to the state government, state party politics can align their local preferences with the intertemporal scope of the environmental problem. A climate-conscious state government can, for example, tax carbon-intensive firms, it can impose strict emissions standards on industry in county c_1, and it can use tax revenues collected from all three counties to subsidize firms in county c_1 to invest in costly modern technologies that maintain economic activity at reduced emission levels. In this setting, Green Party politicians can credibly defend the objectives of their local constituencies by enacting different policies at different levels of political representation. As such, local ecological preferences would eventually shape production practices as in Besley and Persson (2023), signalling to voters in both counties that their representatives at the county and the state level put their political programs into practice.

To test the "abandoning" versus the "walk the talk" hypotheses, we use election and emission data in Germany between 1990 and 2018. Germany is a perfect laboratory to answer the question whether stronger revealed green preferences spur a green transformation for three reasons. First, environmental preferences of voters map clearly to party representation already for a long time in German politics: the Green party ("Die Grünen") was founded already in January 1980 with environmental politics as their central theme. Second, observing both voting and emission patterns in an industrialized emissions-intensive economic structure for almost three decades renders Germany the perfect testing ground for transformation dynamics where consumer preferences change over time together with technology adoption. Third, the federal structure of German politics with Green preferences and party representation at various levels of government paired with different types of industrial emissions helps us to better isolate whether, and at what level of government, Green Party representation affects industrial emissions. Our empirical tests compare emission dynamics across counties conditional on county-level and state-level green party representation. Besides providing empirical evidence for a long time series of granular voting behavior in a large, developed democracy, another important innovation is our ability to distinguish between various types of pollutants at the local level: those hazardous to local health and those adversely affecting the welfare of future generations. In particular, we have data on Total Suspended Particulates (TSP), nitrogen oxides (NO_x), sulfur dioxide (SO_2), and carbon monoxide (CO), all of which have well-documented adverse effects on health (see also Jarvis, Deschenes, and Jha, 2022). We also have detailed data on emissions of carbon dioxide (CO_2), the greenhouse gas chiefly responsible for relatively slow-moving climate change that affects future generations more than current ones.

Our first main result is that if the Green Party is either the strongest or the second strongest party during local elections – meaning that it cannot be ignored in local decision making – all types of emissions decline. A representation of the Green party at the state level, in turn, is only accompanied by a reduction in CO_2 emissions. Second, we find evidence that only CO_2 emissions per unit of output decline when the Green party is represented in local and state politics. While this effect is statistically weak, it indicates that Green politicians "walk the talk" and promote the adoption of cleaner technologies. Third, the economically more meaningful mechanism appears to be a general output reduction in particularly carbon-intensive industries once the Green party representation is non-negligible at the local and at the state level. Once again, there are important differences at local versus state level of government. When Green politicians are represented in local government, output declines in mining and utilities, manufacturing, and construction, i.e. industries that emit locally hazardous pollutants as well as greenhouse gases. In contrast, output in agriculture – a sector that emits only greenhouse gases but no pollutants hazardous to local health – declines only when Green politicians are represented in State government.

Overall, the evidence suggests that the political representation of ecological interests is useful to reduce emissions. Yet, there are two important nuances. First, the representation of the green political ideology at the local level is associated with a reduction in emissions that are hazardous to current generations, but is insufficient to fully deal with greenhouse emissions whose hazardous effect is realized in the future. To address the latter, ecological interests need to be represented at the supra-local level of government. Second, the goal of emissions reduction cannot be achieved by the employment of more sustainable technologies alone. Instead, the reduction of intertemporal environmental externalities in the form of CO_2 emission entails also the contraction of economic activity in specific sectors of the economy. Once again, at least in some cases, this is only achieved when the Green Party is represented at a level of government that spans multiple local jurisdictions.

This paper complements theoretical studies on whether and how green political representation affects environmental policies. On this account, Besley and Persson (2023) is most relevant. They show theoretically that a "green" political multiplier endogenously increases the speed by which consumers and firms adapt preferences to demand and supply goods and services that are generated with less polluting production processes. Therefore, we focus on the participation of the Green party in state governments and county leadership, respectively. Related, Cheikbossian and Hafidi (2022) show that green politicians are more likely to implement environmentally friendly policies, but lack empirical evidence on the long-run effectiveness to actually reduce negative environmental externalities. In that regard, a number of studies provide evidence on the political economy of one specific form of pollution. Zhang, Chen, and Guo (2018) use Chinese firm-level data on their chemical oxygen demand (COD) emissions to show that the centralization of environmental supervision from the local to the federal level reduced COD emissions by more than a quarter. Burgess, Hansen, Olken, Potapov, and Sieber (2012) employ satellite data on deforestation in Indonesia as a source of CO_2 emissions to study the important role that local politicians play in halting such dynamics. We, in turn, do not only provide evidence for a mature, industrialized economy with reasonably good governance mechanisms in place, but can exploit detailed data on different types of local and non-local emissions to study the role of politics in arresting different types of pollution externalities.

2 Local vs. non-local pollution

The vast majority of air pollutants result from the (high temperature) combustion of fossil fuels during industrial processes, heating, and transportation. These activities tend to be locally conducted. Accordingly, the European Environment Agency's report on air quality (2022) identifies residential energy consumption, the manufacturing and extractive industries as well as the agricultural sector as the main sources of particulate matter and TSP. Nitrogen oxide emissions (NOx) are primarily driven by local traffic, whereas the energy supply sector accounts for more than 40% of sulphur dioxide SO_2) emissions.

The main negative externality generated by these pollutants are adverse health effects. In the medical literature air pollutants have been identified as the cause of various disease for a long time; see for example Chen, Kuschner, Gokhale, and Shofe (2007). Donzelli and Linzalone (2023) review recent evidence from studies aiming to isolate the most important *local* pollutants that drive health hazards. Approximately 80% of the reviewed studies identify air pollution as the most important threat, assessing in particular particulate matter less than 10 μm ($PM10$) and fine particles less than 2.5 μm ($PM2.5$), nitrogen oxides (NO_x) and dioxides (NO_2), total suspended particulates (TSP), sulphur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), and respirable suspended particles (RSP). All of these are significantly positively associated with respiratory and cardiovascular diseases of local populations. The World Health Organization (2010) attributes, for example, ischaemic heart diseases, strokes, lung cancer, and other adverse respiratory impacts to particulate matter. Asthma and other respiratory conditions are closely linked to nitrogen and sulfur dioxide exposure whereas carbon monoxide interferes with the oxygen delivery to the body's organs and is especially harmful to people with cardiovascular or respiratory conditions.

CO_2 is, in turn, not poisonous and only leads to cardiovascular health problems in extremely high concentrations. Evidence for such health problems suggests a critical value of 40,000 parts per million, approximately 100 times the current level. The negative externality caused by carbon dioxide emissions is instead a long-term deterioration of climate conditions. Already Plass (1956) theorized and Manabe and Wetherald (1967) demonstrate empirically the adverse effects of CO_2 emissions on climate change in general and rising temperatures in particular. Nordhaus (1977) articulates the negative economic implications of thereof by modelling adverse climate developments due to carbon dioxide emission in a macroeconomic framework to quantify the cost of alternative policy interventions. Since then numerous integrated assessment models of climate change emerged, all of which suggesting variants of optimal policy paths that rely in one form or another on the gradual reduction of CO_2 emissions.

Contrary to the salient local negative externalities caused by air pollution, the adverse climate effects due to CO_2 emissions are not directly felt by local agents. The social cost inflicted by, for example, extreme weather events or rising sea levels are hard to attribute directly to observable drivers, contrary to, for example, local traffic directly causing air pollution. Put differently, the realization of adverse effects of CO_2 emissions deviate both geographically and dynamically substantially from their sources of origin. Hickel (2020) estimates, for example, that the G-8 countries alone accounted for 85% of all emissions over the period 1850–2015. Virtually all transition economies, in turn, remained within the derived "boundary fair CO_2 shares". Thus, carbon dioxide emission represent an inherently non-local pollutant that cannot be subjected to a local policy planner intervening in a Nordhaus fashion. Our setting provides evidence on the existence of such frictions in decision-making at different policy levels. We test whether local planners matter for local pollutants while policymakers at higher level of political decision-making matter especially for non-local pollutants.

3 Data

For the empirical analysis, we combine data from two separate sources. Data on emissions of various pollutants come from the Federal Ministry for the Environment, Nature Conversation, Nuclear Safety, and Consumer Protection. Data on election results at the Kreis and Land level come from the German Federal Statistics Office.[1]

3.1 Emissions

We obtain emission data from the Federal Ministry for the Environment, Nature Conversation, Nuclear Safety, and Consumer Protection (”Bundesministeriums für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz”, BMUV) for five types of pollutants that are allocated to counties (”Kreise”) for the period 1990 until 2018.[2] The data is spatially allocated by the BMUV to polygons of 2-by-2 kilometers that we allocate based on the centroid location to each of the existing counties in each year, which are 542 in 1990 and 401 in 2018. We use contemporaneous administrative boundaries in each year to match it with according historical regional election data below. The pollution data uses an ArcGIS solution (Schneider et al., 2016) to allocate point based pollution reports reported individually to the Pollutant Release and Transfer Register (PRTR), from street, train, ship, and flight transportation line emissions obtained from the Transport Emission Model (TREMOD-Emissions), and from area-wide pollution data, such as agricultural activity.[3]

As a result we observe five pollutants: carbon dioxide (CO_2), nitrogen oxides (NO_X), sulfur dioxide (SO_2), carbon monoxide (CO), all measured in kilo tonnes, and Total Suspended Partic-

[1] All data are summarized in Appendix Table 1.

[2] We obtain data for 1990 and 1995 and annual data as of the year 2000.

[3] Pollution data is further allocated to NFR (Nomenclature for Reporting) sectors by the BMUV. We aggregate all emissions across NFR per county.

ulates (TSP), measured in micrograms per cubic meter. Whereas CO_2 exerts non-local adverse health and, more importantly, environmental adverse effects, the subsequent three types of pollutants are generally a local environmental burden. Likewise, TSP emissions are primarily a local burden, but measured in different units. We therefore test below for different effects of local and state politics on non-local versus local pollutants.

3.2 Politics

Data on the outcomes of State parliament election results are readily available from the German Federal Statistical Office. Figure 1 illustrates the staggered timing of State-level elections per Bundesland between 1990 and 2018. The figure also indicates color-wise the parties that end up forming the state government, in a declining order of vote shares. Changes in the color correspond to outcomes from state elections that are held every four to five years, yet at different points in time across States. We show the name or names of the parties winning the election and forming a coalition. The color of the first band indicates the senior partner in these coalitions. CDU are the Christian Democratic Union, a conservative party. SPD abbreviates the Social Democratic Party. The Green party signature mark is the representation of ecological interests. Other parties are the liberal party FDP (Free Democratic Party), the socialist party Die Linke, and other regional interest groups that occasional are part of coalitions at the state level.

We also collect information for the share of the vote for each party at the county level. These elections are held usually in each county within each state at the same time to determine the local council of politicians. We hand collect data on the votes cast per party from State Statistical Offices and county administrations for at most 542 counties between 1990 and 2018. There are a total of 3,480 country elections during the sample period. Figure 2 illustrates, in shades of green, the average share of the Green party vote over the sample period.

4 Empirical model and identification

We test if variations in the extent to which politicians from the Green Party are represented at the Kreis (county) and Land (State) level correlate with varying emissions paths of individual pollutants. To that end, we estimate the following panel regression model:

$$Log(Pollutant_{kt}) = \beta_1 Greens\ In\ Kreis_{kt} + \beta_2 Greens\ In\ Land_{lt} + \theta_k + \phi_t + \varepsilon_{kt} \tag{1}$$

The variable $Log(Pollutant_{kt})$ denotes the natural logarithm of the levels of three types of pollutants measure at the Kreis level: 1) the sum of carbon monoxide, nitric oxide, and sulphur dioxide; 2) the sum of micro and small particle matter; and 3) carbon dioxide. 1) and 2) are "local" pollutants, which we aggregate into two groups rather than one because they are measured in different units (metric kilograms and parts per million, respectively). The last one is a "non-local" pollutant.

The main explanatory variables are two dummies. $Greens\ In\ Kreis_{kt}$ is equal to one if in the last elections, the Green Party was the strongest or the second-strongest party in the Kreis, in terms of vote share, and to zero otherwise. $Greens\ In\ Land_{lt}$ is equal to one if during the current term, the Green Party is part of the governing coalition at the Land level, and to zero otherwise.

The regression also includes a vector of Kreis dummies θ_k and a vector of year dummies ϕ_t. This is important for two separate reasons. First, there can be local factors that do not vary over time and that might influence the propensity of the local economy to emit certain pollutants. The most obvious is the structure of the local economy, with more industrialized counties naturally producing more pollutants than counties dominated by services. By including county dummies, we ensure that the effect of the local election cycle on the evolution of pollution is measured while holding such background forces fixed. Moreover, given that the dependent variable is measured as a county aggregate in levels, the inclusion of county dummmies means that we are identifying the growth of emissions over time.

Second, emissions may be going down across Germany for reasons related to the overall "greening" of the economy pursued the federal government (e.g., the reduction in emissions from electricity generation because of the transition away from fossil fuels). Including time dummies in the specification ensures that we are identifying local effects net of the nation-wide trend.

Finally, we cluster the standard errors by Kreis. This allows us to account for the plausible correlation of pollution levels across time.

5 Empirical evidence

5.1 Headline results

In Table 1 we report the estimates from Equation (1), for the three types/groups of pollutants. We estimates the equation for changes in the extent to which the Green party is represented at the Kreis level (Panel A), at the Land level (Panel B), and for both (Panel C).

The evidence reported in Panel A indicates that all three types of pollutants contract when the Green party is strong enough at the local level. Specifically, compared with years when the Green party is not in the position to affect local decision making, and within the same Kreis, in years when the Green party is either the strongest or the second-strongest party, emissions of CO, NO_x and SO_2 decrease by 5.1%, TSP emissions contract by 9%, and CO_2 emissions are reduced by 8.8%. All three results are significant at least at the 5-percent statistical level.

Panel B reports the analogue of these regressions for the case when the Green party is officially part of the governing coalition at the Land level. In this case, we find that CO, NO_x and SO_2 emissions are not statistically affected, and the same applies to TSP emissions. In other words, we confirm that the level of "local" pollutants at the more local levels of political decision-making is not affected by the extent of representation of Green politicians at the higher level thereof. However, we also find that the emissions of the "non-local" pollutant CO_2 declines by 4.2% (column (3)). This effect is significant at the 1-percent statistical level.

In Panel C we include both dummies simultaneously. The result that a stronger representation of the Green party at the local level implies generally lower local pollutants still obtains. We also continue to find that when the Green party is in government at the state level, CO_2 emissions at the Kreis level are lower (column (3)). Importantly, this result does not extend to the other two groups of "local" pollutants.

The evidence therefore strongly suggests that the representation of environmental preferences at the local level is associated, in what appears to be a causal way, with lower emissions of both "local" and "non-local" pollutants. At the same time, only the levels of more "non-local" types of pollutants are affected when a party with an ecological ideology is represented at a higher-than-local level.

5.2 Robustness

In the Appendix, we report the estimates from a number of robustness tests. For a start, recall that whereas the election data are annual, the data on emissions are reported with annual frequency only as of 2000, but only reported once every five years until 2000. This means that there is no pre-post comparison within a Kreis or a Land around elections. In Appendix Table 2, we mitigate this problem by dropping the observations from 1990 and 1995. Broadly, the results hold, with both "local" and "non-local" emissions being lower when the Green party came first or second in the latest elections. Note, however, that the point estimate for the pollutant group comprising CO, NO_x and SO_2 is marginally insignificant (p-value of 0.109). Only "non-local" emissions are affected when the Green party is part of the governing coalition at the Land level.

In Appendix Table 3, we account for the possibility that because we give all observations an equal weight, our results may be driven by a few very small counties. The distribution of county population is very uneven, with a median of 148,100, but a minimum of 34,000. We exclude 19 counties with population of less than 50,000, which leaves the results economically and statistically unaffected.

In Appendix Table 4, we use a robust measure of Green-party power at the Kreis level. Recall that we observe the actual governing coalition at the Land level. However, at the Kreis level fixed coalitions as a rule do not exist. In the main model, we therefore define a Kreis as Green-party-dominated when the Green party came out first or second in the last elections. The rational for this approach is the arguably severe difficulty to take local decisions while altogether ignoring the Greens if they are one of the two strongest parties. We now use three alternative measures of the extent of Green party presence. In Panel A, we use the actual vote share for the Green party. The point estimates are marginally insignificant (p-value of 0.145) in column (1), suggesting strong non-linearities in the vote share necessary to exert influence on decision making. The same is true when we include cases where the Greens were the third biggest party at the Kreis level in the dummy $GreensinKreis$ (Panel B). However, when we define the dummy to be one if the Green party has at least 15% of the local vote (Panel C), we obtain a strong negative effect on all three types of emissions. The according point estimate is uniformly significant at the 1-percent statistical level. The results are thus consistent with the notion that a party needs to win the elections, to come in second, or to have a substantial share of the overall vote in order to be able to act on its ideological tenets. Importantly, in all case, the effect of the Green party being in coalition at the Land level on CO_2 emissions continues to be significant.

In Appendix Table 5, we account for the possibility that the two levels of government may be complements or substitutes in decision making. For example, the power of the Greens to reduce emissions locally may be amplified if the Green party is also in the governing coalition at the Land level. This turns out not to be the case, with the two levels of government not interacting in determining emissions levels.

In Appendix Table 6, we look at the individual components of the composite variable $CO + NO_x + SO_2$ which merges three types of local emissions. Neither of the three moves when the Green party is in power at the Land level, and only the former and the latter are lower when the Greens have a substantial presence at the Kreis level.

Finally, we account for the possibility that elections always bring a reduction in emissions after elections, because most parties want to beef up their environmental credential early on. To that end, in Appendix Table 7, we include a dummy variable, which is equal to 1 during the two years after a local election, and equal to 0 during the two years before a local election. In Appendix Table 8, we do the same, but only for the year before and the year after a local election.[4] We broadly confirm the reduction of both "local" and "non-local" emission at the Kreis level when the Green party is locally strong, as well as the reduction in "non-local" emissions when the Green party serves in the Land government. Moreover, in the latter case, Green party power is associated with lower carbon dioxide emissions only at the Land and not at the Kreis level. This fact provides strong support to the notion that externalities need to be tackled at the unit where they are observed.

5.3 Mechanisms

In this section, we investigate two potential mechanisms via which meaningful representation of the Green party in local and state government leads to a reduction in hazardous emissions. The first mechanism is one whereby holding output constant, and thanks to the implementation of costly abatement technologies, industrial processes become less polluting. Such mechanism would be manifested in the data in the form of lower emissions per unit of output. The second mechanism is one whereby holding the technology constant, output declines, in particular in relatively more polluting industries, in response to tighter environmental regulation. The two are not necessarily mutually exclusive, but they have different welfare implications: while the first mechanism achieves a reduction in pollution without a reduction in output, in the second case environmental targets are achieved at the cost of growth.[5]

In Table 2, we test for the first mechanism. We run the following regression:

$$\frac{Pollutant_{kt}}{GDP_{kt}} = \beta_1 Greens\ In\ Kreis_{kt} + \beta_2 Greens\ In\ Land_{lt} + \theta_k + \phi_t + \varepsilon_{kt} \quad (2)$$

[4] The number of observations declines by 46.2% in the first case, and by 70% in the latter case.

[5] De Haas and Popov (2023) provide evidence that the latter mechanism is more important than the former when countries are compared based on their mix of debt and equity investment.

where relative to Equation (1), the dependent variable is now the ratio of either of the three types of emissions that we identified in particular year to local (Kreis-level) output in that same year. As before, the inclusion of year dummies means that we are identifying county-specific trends, and the inclusion of county dummies means that we are identifying changes in the growth in emissions intensity.

Table 2 points to weak evidence of a reduction in emissions via an improvement in emissions intensity. In all cases, the point estimate of the ratio of emissions to GDP is negative, suggesting that when the Green party is meaningfully represented at the local or at the state level, emissions per unit of output declines. Put differently, output becomes "greener". At the same time, this effect is statistically significant only in the case of CO_2 emissions, and only at the 10-percent statistical level.[6] This suggests that while stricter emissions standards may be put in place when the Green party cannot be ignored in decision making, a "greening" of output is unlikely to be the main explanation for the effect documented in Table 1.

In Table 3, we test for the second mechanism. We run the following two regressions:

$$Log(Output_{kt}) = \beta_1 Greens\ In\ Kreis_{kt} + \beta_2 Greens\ In\ Land_{lt} + \gamma Share + \theta_k + \phi_t + \varepsilon_{kt} \tag{3}$$

and

$$\Delta Output_{kt} = \beta_1 Greens\ In\ Kreis_{kt} + \beta_2 Greens\ In\ Land_{lt} + \gamma Share + \theta_k + \phi_t + \varepsilon_{kt} \tag{4}$$

In equation (3), the dependent variable is the natural logarithm of output at the Kreis-level) output in a particular year. In Equation (4), the dependent variable is the year-on-year log difference thereof. We run these regresssions for aggregate Kreis-level output, as well as for seven different sectors. This time we also include the variable $Share$, which measures the share of that sector's output out of total output. In this way, we control for the fact that large sectors have larger output

[6] In the case of the statistical association between $GreensinKreis$ and the ratio of particulate matter to GDP, the point estimate is only marginally insignificant at the 10-percent statistical level, with a p-value of 0.11.

and grow more slowly. Once again, the inclusion of year dummies means that we are identifying county-specific trends net of a global one.

The evidence strongly suggests that when the Green party is electorally powerful at local or state level, output declines in certain carbon-intensive industries. In particular, when the Green party came first or second in the last county elections, local output declines significantly in mining, utilities and construction (Panels A and B), as well as in manufacturing (Panel A). These are sectors associated with significant emissions of local pollutants. In contrast, industries producing negligible quantities of local pollutants, like agriculture or services, do not decline appreciably. In addition, when the Green party is part of the governing coalition at the state level, output declines in mining and utilities (Panels A and B), as well as in agriculture and manufacturing (Panel A) and transport and communications (Panel B). All of these industrial processes are typically associated with high emissions of carbon dioxide.

The evidence thus points to a trade-off between emissions and growth. The presence of Green politicians at the level of government where emissions can be affected via stricter regulation is also accompanied by a slowdown in local growth, suggesting that preventing environmental degradation is not a free lunch.

6 Conclusion

We use data on local and global pollutants for 542 counties and 16 states in Germany to test for whether the level of authority matters for the effect on Green politicians in government on industrial pollutants, and how the local economy is affected by environmental policies. We find that during periods when members of the Green party are in position of influence, emissions of hazardous pollutants decline. The level of political representation matters, too: pollutants that are hazardous locally only decline when the Green party is strong at the county level, while emissions of carbon dioxide, which have non-local consequences but are not detrimental to local health outcomes, decline further when the Green party is in power at the higher (State) level. While there is weak evidence that the reduction in emissions is achieved via the "greening" of industrial processes, the main channel is a slowdown in the growth of polluting industries.

In addition to informing the debate on the costs and benefits of political centralization, our findings also have implications for the implication of policies aimed at addressing global warming. Unlike the smog from coal plants which plagued large global urban centers for centuries and galvanized the early green movement, anthropogenic greenhouse gases create a global externality with limited immediate impact on local health. Our evidence makes a strong case for global coordination of climate policies, and simultaneously cautions against the notion that such policies can be pursued at no cost to economic development.

References

[1] Besley, T. and Persson, T. (2023) The Political Economics of Green Transitions. *Quarterly Journal of Economics* 138(3), 1863–1906.

[2] Burgess, R., Hansen, M., Olken, B., Potapov, P., and Sieber, S. (2012) The Political Economy of Deforestation in the tropics. *Quarterly Journal of Economics* 127(4), pp. 1707-1754.

[3] Cheikbossian, G., and Hafidi, H. (2022) Lobbying, Public Persuasion, and Environmental Policy under Imperfect Competition. *Annals of Economics and Statistics* 145, 91-116.

[4] Chen, T.-M., Kuschner, W., Gokhale, J., and Shofer, S. (2007) Outdoor Air Pollution: Nitrogen Dioxide, Sulfur Dioxide, and Carbon Monoxide Health Effects. *The American Journal of the Medical Sciences*, 333(4), 249–256.

[5] De Haas, R., and POpov, A. (2023) Finance and Green Growth. *The Economic Journal* 133(650), pp. 637–668.

[6] Donzelli, G.. and Linzalone, N. (2023) Use of Scientific Evidence to Inform Environmental Health Policies and Governance Strategies at the Local Level. *Environmental Science & Policy*, 146, 171–184.

[7] European Environment Agency (2022) Air Quality in Europe. European Environment Agency Report, 24 November 2022.

[7] Folke, O. (2014) Shades of Brown and Green: Party Effects in Proportional Election Systems. *Journal of the European Economic Association* 12(5), 1361–1395.

[8] Geelen, T., Hajda, J., and Starmans, J. (2023) Sustainable Organizations. CBS Working Paper.

[9] Hassler, J., Krusell, P. Olovsson, C. (2021) Presidential Address 2020: Suboptimal Climate Policy. *Journal of the European Economic Association* 19(6), 3039-3072.

[10] Hickel, J. (2020) Quantifying National Responsibility for Climate Breakdown: An Equality-Based Attribution Approach for Carbon Dioxide Emissions in Excess of the Planetary Boundary. *The Lancet Planetary Health* 4(9), E399–E404.

[11] Jarvis, S., Deschenes, O., and Jha, A. (2022) The Private and External Costs of Germany's Nuclear Phase-Out, *Journal of the European Economic Association*. 20(3), 1311–1346.

[12] Manabe, S. and Wetherald, R. (1967) Thermal Equilibrium of the Atmosphere with a Given Distribution of Relative Humidity, *Journal of the Atmospheric Sciences*. 24(3). 241-259.

[13] Nordhaus, W. (1977) Economic Growth and Climate: The Case of Carbon Dioxide. *American Economic Review*. 67(1). 341–346.

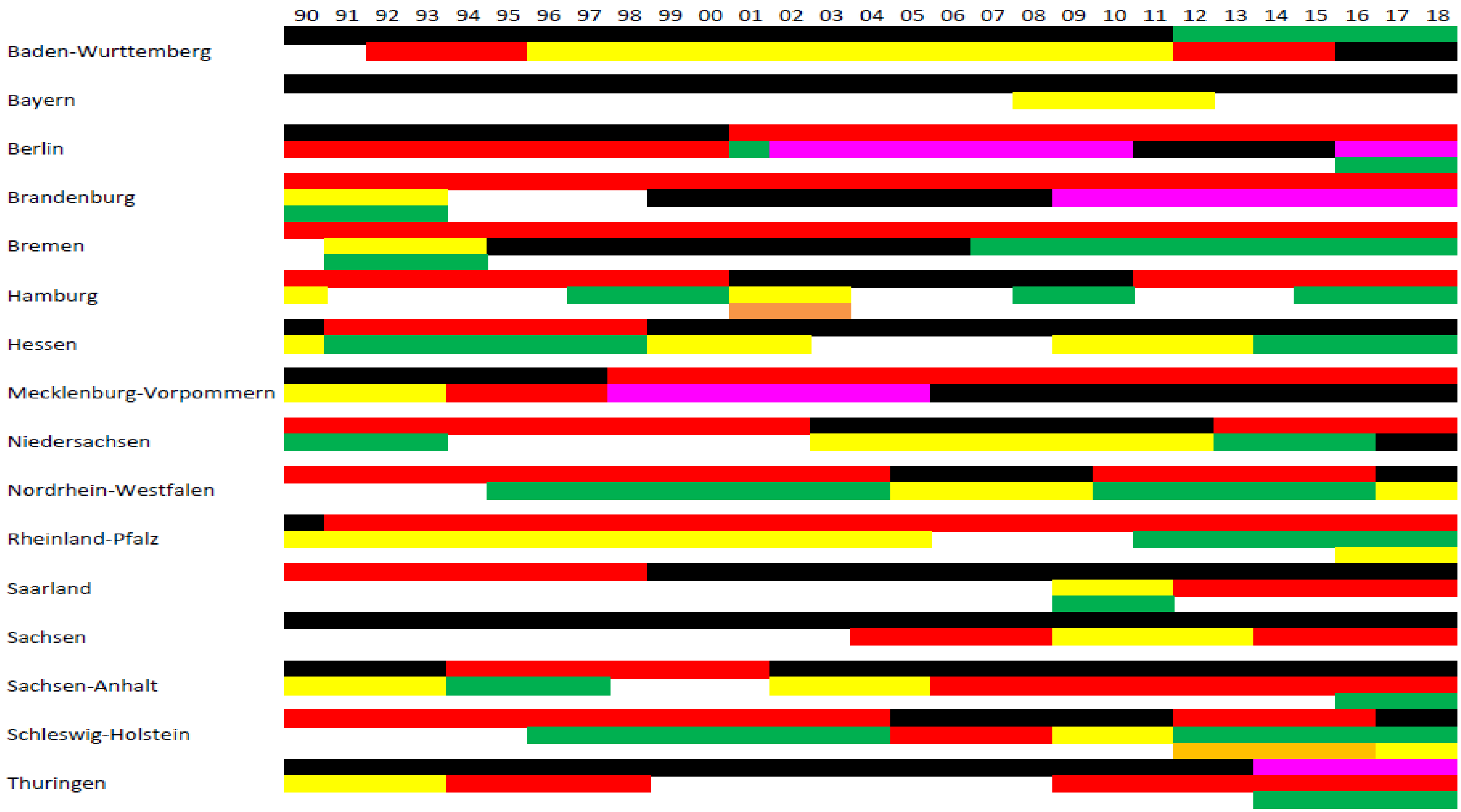
[14] Plass, G. (1956) The Carbon Dioxide Theory of Climatic Change. *Tellus*. 8(2). 140–154.

[15] Schneider, C., Pelzer, M., Toenges-Schuller, N., Nacken, M., and Niederau, A. (2016) ArcGIS basierte Lösung zur Detaillierten, Deutschlandweiten Verteilung (Gridding) Nationaler Emissionsjahreswerte auf Basis des Inventars zur Emissionsberichterstattung. *Umweltbundesamt*.

[16] World Health Organization (2010) WHO Guidelines for Indoor Air Quality: Selected Pollutants. Wprld Health Organization Regional Office for Europe.

[17] Zhang, B., Chen, X., and Guo, H. (2018) Does Central Supervision Enhance Local Environmental Enforcement? Quasi-Experimental Evidence from China. *Journal of Public Economics* 164(C), 70-90.

Figure 1. Coalition composition changes between 1990 and 2018, by state and year



Note: This figure shows the composition of the governing coalition at the state level, by year, between 1990 and 2018. The senior coalition partner is shown in the first row. The junior coalition partner is shown in the second row. If the ruling coalition consists of more than two parties, the third coalition partner is shown in the third row. A black color stands for CDU (Christian Democratic Union of Germany), the main center-right party, or its sister party CSU (Christian Social Union), which is only active in the state of Bayern. Together, CDU and CSU form one common parliamentary group in the federal parliament. A red color stands for SPD (Social Democratic Party of Germany), the main center-left party. A yellow color stands for FDP (Free Democratic Party), a liberal center-right party. A green color stands for the Bündnis 90/Die Grünen (Alliance '90/The Greens), the ecological center-left party. A purple color stands for Die Linke, a democratic-socialist party. An orange color stands for a local party that is active in one state only (such as the Schill Party in Hamburg, or the South Schleswig Voters' Assoication (SSW) that represents the Danish minority in Schleswig-Holstein).

Figure 2. Green party vote at the Kreis level 1990–2018

Note: Green party vote share, by county, 1990–2018. Source: German Federal Statistics Office and authors' calculations.

Table 1. Green politicians and types of emissions

Panel A. Green politicians in local administration

	Log (CO+NOx+SO2)	Log (Particulate Matter)	Log (CO2)
	(1)	(2)	(3)
Greens in Kreis	-0.0522***	-0.0942**	-0.0858**
	(0.0147)	(0.0434)	(0.0382)
Kreis dummy	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
Clustering at Kreis level	Yes	Yes	Yes
Observations	8,629	8,286	8,629
R-squared	0.97	0.97	0.92

Panel B. Green politicians in Land government

	Log (CO+NOx+SO2)	Log (Particulate Matter)	Log (CO2)
	(1)	(2)	(3)
Greens in Land government	-0.0120	-0.0021	-0.0429***
	(0.0077)	(0.0090)	(0.0140)
Kreis dummy	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
Clustering at Kreis level	Yes	Yes	Yes
Observations	8,629	8,286	8,629
R-squared	0.97	0.97	0.92

Panel C. Green politicians in local administration and in Land government

	Log (CO+NOx+SO2)	Log (Particulate Matter)	Log (CO2)
	(1)	(2)	(3)
Greens in Kreis	-0.0512***	-0.0940**	-0.0821**
	(0.0148)	(0.0433)	(0.0373)
Greens in Land government	-0.0117	-0.0016	-0.0426***
	(0.0077)	(0.0090)	(0.0139)
Kreis dummy	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
Clustering at Kreis level	Yes	Yes	Yes
Observations	8,629	8,286	8,629
R-squared	0.97	0.97	0.92

Notes: The Table reports the point estimates from OLS regressions where the dependent variable is the natural logarithm of the sum of carbon monoxide emissions, nitric oxide emissions and sulphuric dioxide emissions, in metric tons (column (1)), the natural logarithm of inhalable particulate matter with a diameter of 10 microns or less, per million (column (2)), and the natural logarithm of carbon dioxide emissions, in metric tons (column (3)), all measured at the Kreis level. 'Greens in Kreis' is a dummy equal to one if the Green party is the number one or the number two party in the Kreis, according to vote shares. 'Greens in Land government' is a dummy variable equal to one if the Green party is part of the government coalition at the Land level. The sample period is 1990—2018. Standard errors clustered at the Kreis level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 2. Mechanism 1: Efficiency

	Log ((CO+NOx+SO2) / GDP)	Log (Particulate Matter / GDP)	Log (CO2 / GDP)
	(1)	(2)	(3)
Greens in Kreis	-0.0015	-0.0604	-0.0582*
	(0.0193)	(0.0385)	(0.0322)
Greens in Land government	-0.0022	-0.0010	-0.0285*
	(0.0092)	(0.0091)	(0.0159)
Kreis dummy	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
Clustering at Kreis level	Yes	Yes	Yes
Observations	7,062	7,062	7,062
R-squared	0.97	0.96	0.89

Notes: The Table reports the point estimates from OLS regressions where the dependent variable is the natural logarithm of the sum of carbon monoxide emissions, nitric oxide emissions and sulphuric dioxide emissions, in metric tons, divided by GDP (column (1)), the natural logarithm of inhalable particulate matter with a diameter of 10 microns or less, per million, divided by GDP (column (2)), and the natural logarithm of carbon dioxide emissions, in metric tons, divided by GDP (column (3)), all measured at the Kreis level. 'Greens in Land government' is a dummy variable equal to one if the Green party is part of the government coalition at the Land level. 'Greens in Kreis' is a dummy equal to one if the Green party is the number one or the number two party in the Kreis, according to vote shares. The sample period is 2000—2018. Standard errors clustered at the Kreis level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 3. Mechanism 2: Scale effect

	Total	Agriculture	Mining and utilities	Manufacture	Construction	Transport and communication	Private services	Public services
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Log (output)								
Greens in Kreis	-0.0208	-0.0745	-0.1432**	-0.0393**	-0.1107***	-0.0176	-0.0201*	0.0054
	(0.0134)	(0.0515)	(0.0581)	(0.0178)	(0.0256)	(0.0123)	(0.0114)	(0.0068)
Greens in Land government	-0.0045	-0.0241*	-0.0456***	-0.0132**	-0.0058	-0.0062	-0.0015	-0.0027
	(0.0044)	(0.0139)	(0.0146)	(0.0054)	(0.0054)	(0.0045)	(0.0040)	(0.0029)
Industry share		14.4933***	14.4990***	4.0542***	9.1551***	3.7987***	3.1078***	1.5867***
		(1.2636)	(1.9831)	(0.2395)	(0.6353)	(0.1917)	(0.1917)	(0.1286)
Panel B. Δ Output								
Greens in Kreis	-0.0025	0.0257	-0.0543***	0.0104	-0.0406***	-0.0055	0.0026	-0.0034
	(0.0027)	(0.0187)	(0.0143)	(0.0106)	(0.0087)	(0.0044)	(0.0061)	(0.0033)
Greens in Land government	-0.0017	-0.0054	-0.0146**	-0.0006	-0.0018	-0.0051***	0.0045	-0.0012
	(0.0011)	(0.0044)	(0.0060)	(0.0138)	(0.0029)	(0.0018)	(0.0019)	(0.0009)
Industry share		-12.4836***	-3.0520***	-2.0392***	-5.8472***	-0.8349***	-1.0500***	-0.3336***
		(0.8134)	(0.5612)	(0.1289)	(0.2993)	(0.0583)	(0.0668)	(0.0354)
Kreis dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustering at Kreis level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations Panel A	7,091	6,718	6,681	6,762	6,765	6,766	6,765	6,766
R-squared Panel A	0.99	0.99	0.96	0.99	0.99	0.99	0.99	0.99
Observations Panel B	6,701	6,718	6,681	6,762	6,765	6,766	6,765	6,766
R-squared Panel B	0.31	0.57	0.19	0.35	0.37	0.33	0.22	0.16

Notes: The Table reports the point estimates from OLS regressions. In Panel A, the dependent variable is total output (column (1)) and the natural logarithm of output in Agriculture (column (2)), Mining & utilities (column (3)), Manufacturing (column (4)), Construction (column (5)), Transportation & communications (column (6)), Private services (column (7)), and Public services (column (8)), measured at the Kreis level. In Panel B, the dependent variable I the year-on-year log difference in output of the variables in Panel A. 'Greens in Land government' is a dummy variable equal to one if the Green party is part of the government coalition at the Land level. 'Greens in Kreis' is a dummy equal to one if the Green party is the number one or the number two party in the Kreis, according to vote shares. 'Industry share' is the ratio of the industry's output to total output in the Kreis. The sample period is 2000—2018. Standard errors clustered at the Kreis level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 1. Summary statistics

Variable	#	Mean	Median	St. dev.	Min	Max
CO	10,134	8.678	5.681	20.208	0	478.581
NOx	10,134	3.209	2.489	3.681	0	38.566
SO2	10,134	1.402	0.289	4.424	0	103.603
Particulate matter	10,134	0.458	0.397	0.449	0	7.565
CO2	10,134	1,718.305	896.909	3,745.818	0	44,116.23
Greens in Kreis	10,134	0.009	0	0.097	0	1
Greens in Land government	10,134	0.231	0	0.422	0	1
Log (Output)	7,091	15.291	15.201	0.715	13.601	18.575
Δ Output	6,701	0.026	0.028	0.039	-0.354	0.443
Δ Output, Agriculture	6,648	0.030	0.034	0.178	-0.817	0.975
Δ Output, Mining & utilities	6,620	0.037	0.021	0.166	-0.950	0.998
Δ Output, Manufacturing	6,690	0.030	0.029	0.116	-0.515	0.975
Δ Output, Construction	6,693	0.032	0.031	0.092	-0.490	0.725
Δ Output, Transportation & communications	6,694	0.027	0.027	0.047	-0.293	0.407
Δ Output, Private services	6,693	0.029	0.027	0.055	-0.416	0.852
Δ Output, Public services	6,694	0.028	0.028	0.027	-0.172	0.293

Notes: 'CO' denotes carbon monoxide emissions, in metric tons. 'NOx' denotes nitric oxide emissions, in metric tons. 'SO2' denotes sulphuric dioxide emissions, in metric tons. 'Particulate matter' denotes the sum of particular particulate of 2.5 microns in diameter or less and particulate matter of between 2.5 and 10 microns in diameter, in micrograms per cubic meter. 'CO2' denotes carbon dioxide emissions, in metric tons. Data come from the Federal Ministry for the Environment, Nature Conversation, Nuclear Safety, and Consumer Protection. 'Greens in Kreis' is a dummy variable equal to one if the Green Party had the most or the second-most votes in the last county elections. 'Greens in Land government' is a dummy variable equal to one if the Party is a member of the government coalition at the state level. Data come from the German Federal Statistics Office. 'Δ Output' denotes the year-on year change in output, at the aggregate (country) level, or at the level of a sector in a county. Data come from the Regional Statistics of Statistisches Bundesamt (Destatis).

Appendix Table 2. Green politicians and types of emissions: Excluding 1990s

	Log (CO+NOx+SO2)	Log (Particulate Matter)	Log (CO2)
	(1)	(2)	(3)
Greens in Kreis	-0.0187	-0.0811**	-0.0686**
	(0.0116)	(0.0395)	(0.0290)
Greens in Land government	-0.0086	-0.0063	-0.0451***
	(0.0081)	(0.0089)	(0.0161)
Kreis dummy	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
Clustering at Kreis level	Yes	Yes	Yes
Observations	7,878	7,878	7,878
R-squared	0.98	0.97	0.98

Notes: The Table reports the point estimates from OLS regressions where the dependent variable is the natural logarithm of the sum of carbon monoxide emissions, nitric oxide emissions and sulphuric dioxide emissions, in metric tons (column (1)), the natural logarithm of inhalable particulate matter with a diameter of 10 microns or less, per million (column (2)), and the natural logarithm of carbon dioxide emissions, in metric tons (column (3)), all measured at the Kreis level. 'Greens in Kreis' is a dummy equal to one if the Green party is the number one or the number two party in the Kreis, according to vote shares. 'Greens in Land government' is a dummy variable equal to one if the Green party is part of the government coalition at the Land level. The sample period is 2000—2018. Standard errors clustered at the Kreis level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 3. Green politicians and types of emissions: Excluding small counties

	Log (CO+NOx+SO2)	Log (Particulate Matter)	Log (CO2)
	(1)	(2)	(3)
Greens in Kreis	-0.0542***	-0.0956**	-0.0923**
	(0.0146)	(0.0434)	(0.0375)
Greens in Land government	-0.0089	0.0009	-0.0356***
	(0.0066)	(0.0086)	(0.0131)
Kreis dummy	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
Clustering at Kreis level	Yes	Yes	Yes
Observations	8,320	7,965	8,320
R-squared	0.97	0.96	0.91

Notes: The Table reports the point estimates from OLS regressions where the dependent variable is the natural logarithm of the sum of carbon monoxide emissions, nitric oxide emissions and sulphuric dioxide emissions, in metric tons (column (1)), the natural logarithm of inhalable particulate matter with a diameter of 10 microns or less, per million (column (2)), and the natural logarithm of carbon dioxide emissions, in metric tons (column (3)), all measured at the Kreis level. 'Greens in Kreis' is a dummy equal to one if the Green party is the number one or the number two party in the Kreis, according to vote shares. 'Greens in Land government' is a dummy variable equal to one if the Green party is part of the government coalition at the Land level. The sample period is 1990—2018. The sample excludes counties with population < 50,000. Standard errors clustered at the Kreis level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 4. Green politicians and types of emissions: Alternative definition of "Greens in Kreis"

Panel A. Continuous green vote

	Log (CO+NOx+SO2)	Log (Particulate Matter)	Log (CO2)
	(1)	(2)	(3)
Greens in Kreis	-0.1740	-0.0904	0.0339
	(0.1192)	(0.1341)	(0.1926)
Greens in Land government	-0.0121	-0.0021	-0.0429***
	(0.0077)	(0.0090)	(0.0140)
Kreis dummy	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
Clustering at Kreis level	Yes	Yes	Yes
Observations	8,629	8,286	8,629
R-squared	0.97	0.97	0.92

Panel B. Greens one of the three strongest parties

	Log (CO+NOx+SO2)	Log (Particulate Matter)	Log (CO2)
	(1)	(2)	(3)
Greens in Kreis	0.0000	0.0231*	-0.0071
	(0.0099)	(0.0123)	(0.0201)
Greens in Land government	-0.0120	-0.0028	-0.0431***
	(0.0078)	(0.0091)	(0.0140)
Kreis dummy	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
Clustering at Kreis level	Yes	Yes	Yes
Observations	8,629	8,286	8,629
R-squared	0.97	0.97	0.92

Panel C. Green vote > 15%

	Log (CO+NOx+SO2)	Log (Particulate Matter)	Log (CO2)
	(1)	(2)	(3)
Greens in Kreis	-0.0306***	-0.0429***	-0.0441***
	(0.0109)	(0.0137)	(0.0211)
Greens in Land government	-0.0117	-0.0016	-0.0425***
	(0.0077)	(0.0090)	(0.0139)
Kreis dummy	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
Clustering at Kreis level	Yes	Yes	Yes
Observations	8,629	8,286	8,629
R-squared	0.97	0.97	0.92

Notes: The Table reports the point estimates from OLS regressions where the dependent variable is the natural logarithm of the sum of carbon monoxide emissions, nitric oxide emissions and sulphuric dioxide emissions, in metric tons (column (1)), the natural logarithm of inhalable particulate matter with a diameter of 10 microns or less, per million (column (2)), and the natural logarithm of carbon dioxide emissions, in metric tons (column (3)), all measured at the Kreis level. 'Greens in Kreis' equals the vote share of the Green party in the past elections (Panel A), a dummy variable equal to one if the Green party was one of the top-3 parties in terms of vote share in the last election (Panel B), and a dummy equal to one if the Green party got at least 15% of the vote in the past election (Panel C), all at the Kreis level. 'Greens in Land government' is a dummy variable equal to one if the Green party is part of the government coalition at the Land level. The sample period is 1990—2018. Standard errors clustered at the Kreis level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 5. Green politicians and types of emissions: Land-Kreis interaction

	Log (CO+NOx+SO2)	Log (Particulate Matter)	Log (CO2)
	(1)	(2)	(3)
Greens in Kreis	-0.0436**	-0.0684***	-0.0895***
	(0.0190)	(0.0264)	(0.0348)
Greens in Land government	-0.0115	-0.0008	-0.0428***
	(0.0077)	(0.0090)	(0.0141)
Greens in Kreis ×	-0.0150	-0.0505	0.0145
Greens in Land government	(0.0285)	(0.0382)	(0.0335)
Kreis dummy	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
Clustering at Kreis level	Yes	Yes	Yes
Observations	8,629	8,286	8,629
R-squared	0.97	0.97	0.92

Notes: The Table reports the point estimates from OLS regressions where the dependent variable is the natural logarithm of the sum of carbon monoxide emissions, nitric oxide emissions and sulphuric dioxide emissions, in metric tons (column (1)), the natural logarithm of inhalable particulate matter with a diameter of 10 microns or less, per million (column (2)), and the natural logarithm of carbon dioxide emissions, in metric tons (column (3)), all measured at the Kreis level. 'Greens in Kreis' is a dummy equal to one if the Green party is the number one or the number two party in the Kreis, according to vote shares. 'Greens in Land government' is a dummy variable equal to one if the Green party is part of the government coalition at the Land level. The sample period is 1990—2018. Standard errors clustered at the Kreis level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 6. Green politicians and types of emissions: CO, NOX, and SO2 emissions

	Log (CO)	Log (NOx)	Log (SO2)
	(1)	(2)	(3)
Greens in Kreis	-0.0432**	0.0036	-0.1564**
	(0.0149)	(0.0167)	(0.0775)
Greens in Land government	-0.0068	-0.0098	-0.0327
	(0.0075)	(0.0082)	(0.0232)
Kreis dummy	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
Clustering at Kreis level	Yes	Yes	Yes
Observations	8,629	8,629	8,629
R-squared	0.97	0.98	0.92

Notes: The Table reports the point estimates from OLS regressions where the dependent variable is the natural logarithm of carbon monoxide emissions, in metric tons (column (1)), the natural logarithm of nitric oxide emissions, in metric tons (column (2)), and the natural logarithm of sulphuric dioxide emissions, in metric tons (column (13)), all measured at the Kreis level. 'Greens in Kreis' is a dummy equal to one if the Green party is the number one or the number two party in the Kreis, according to vote shares. 'Greens in Land government' is a dummy variable equal to one if the Green party is part of the government coalition at the Land level. The sample period is 1990—2018. Standard errors clustered at the Kreis level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 7. Green politicians and types of emissions: Election cycles, 4 years

	Log (CO+NOx+SO2)	Log (Particulate Matter)	Log (CO2)
	(1)	(2)	(3)
Greens in Kreis	-0.0301**	-0.0743**	-0.0707**
	(0.0135)	(0.0330)	(0.0335)
Greens in Land government	0.0098	-0.0054	-0.0287*
	(0.0076)	(0.0089)	(0.0164)
Kreis dummy	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
Election cycle	Yes	Yes	Yes
Clustering at Kreis level	Yes	Yes	Yes
Observations	4,636	4,593	4,636
R-squared	0.98	0.97	0.93

Notes: The Table reports the point estimates from OLS regressions where the dependent variable is the natural logarithm of the sum of carbon monoxide emissions, nitric oxide emissions and sulphuric dioxide emissions, in metric tons (column (1)), the natural logarithm of inhalable particulate matter with a diameter of 10 microns or less, per million (column (2)), and the natural logarithm of carbon dioxide emissions, in metric tons (column (3)), all measured at the Kreis level. 'Greens in Kreis' is a dummy equal to one if the Green party is the number one or the number two party in the Kreis, according to vote shares. 'Greens in Land government' is a dummy variable equal to one if the Green party is part of the government coalition at the Land level. The regressions control for 'Election cycle', a variable equal to 1 during the two years after, and to 0 during the two years before, a Kreis-level election. The sample period is 1990—2018. Standard errors clustered at the Kreis level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 8. Green politicians and types of emissions: Election cycles, 2 years

	Log (CO+NOx+SO2)	Log (Particulate Matter)	Log (CO2)
	(1)	(2)	(3)
Greens in Kreis	-0.0235**	-0.0656*	-0.0510
	(0.0113)	(0.0364)	(0.0349)
Greens in Land government	-0.0224	-0.0238**	-0.0588**
	(0.0126)	(0.0119)	(0.0268)
Kreis dummy	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
Election cycle	Yes	Yes	Yes
Clustering at Kreis level	Yes	Yes	Yes
Observations	2,594	2,458	2,594
R-squared	0.98	0.97	0.92

Notes: The Table reports the point estimates from OLS regressions where the dependent variable is the natural logarithm of the sum of carbon monoxide emissions, nitric oxide emissions and sulphuric dioxide emissions, in metric tons (column (1)), the natural logarithm of inhalable particulate matter with a diameter of 10 microns or less, per million (column (2)), and the natural logarithm of carbon dioxide emissions, in metric tons (column (3)), all measured at the Kreis level. 'Greens in Kreis' is a dummy equal to one if the Green party is the number one or the number two party in the Kreis, according to vote shares. 'Greens in Land government' is a dummy variable equal to one if the Green party is part of the government coalition at the Land level. The regressions control for 'Election cycle', a variable equal to 1 during the year after, and to 0 during the year before, a Kreis-level election. The sample period is 1990—2018. Standard errors clustered at the Kreis level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.