Power to the People: The Local Economic Effects of Renewable Energy Communities in the UK

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Abstract

Local responses to renewable energy projects range from opposition that delays or blocks deployment to active support and participation. A common narrative underlying these behaviors emphasizes economic considerations: projects that impose local externalities without delivering local benefits tend to face resistance, whereas renewable energy communities (RECs) that are formed by citizens are argued to generate more local economic value than corporate plants. This paper examines these two related claims by comparing the local economic effects of community-owned and corporate-owned renewable energy plants. Using heterogeneity-robust difference-in-differences estimators and panel data for UK local authority districts, we estimate the income and employment impacts of community and corporate solar and wind projects. We find evidence of local economic benefits for some ownership–technology combinations, with substantial heterogeneity across ownership structures and technologies. Overall, the results point to a nuanced relationship between renewable energy deployment, ownership models, and local economic outcomes.

JEL Classification: C33 E24 J21 L94 O13 Q52 R23

Keywords: : The United Kingdom, renewable energy communities, energy transition, renewable energy, green growth

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Acknowledgements: We thank Natalia Fabra and Belén Rodríguez Moro for sharing their codes. We are also grateful for the comments of the participants of the II Workshop in Energy Policy. We benefitted greatly from comments and suggestions by Olga Chiappinelli, Caio Lorecchio, Jordi Teixidó, and Mònica Serrano. This research received funding from the Observatori d'Anàlisi i Avaluació de Polítiques Públiques.

1) Introduction

Even in the face of a pressing need for climate mitigation, renewable energy investments are met with growing local resistance, which risks slowing down the energy transition. The main reason for this opposition against renewables projects are externalities such as noise and visual pollution (Schütt, 2024; Jarvis, 2025). These externalities are partly reflected in reductions in house and residential land prices (Gibbons, 2015; Sunak and Madlener, 2016; Dröes and Koster, 2016; Frondel et al., 2019; Maddison et al., 2023; Gaur and Lang, 2023), largely because of the visual impacts of new plants. Sometimes, opposition to renewable energy plants also arises from disputes over land use and perceptions of speculative behavior that is seen to privilege external developers at the expense of the local communities (ABC News, 2022; The Guardian, 2024; BBC News, 2025). All in all, this fuels the view that local communities bear most of the costs of renewable projects, but few of the benefits.

While often resisting renewable plants, citizens also often come together to form renewable energy communities (RECs)[1] to invest in them. These citizen initiatives are motivated by a willingness to contribute to the energy transition, engage in community building, and generate economic benefits for their communities. Against the backdrop of local resistance to renewable plants, RECs present a case where locals become proactive participants of the energy transition rather than reactionary resisters.

Local opposition to renewable energy projects and participation in renewable energy communities (RECs) are multi-faceted phenomena influenced by social, environmental, and economic motives. For instance, some people may oppose projects due to a lack of participation, concerns related to procedures, landscape protection, or for socio-cultural reasons, even if the projects bring local economic benefits. After all, the transformation of landscapes and visual environments, and modes of engagement in decision-making have been shown to influence local acceptance and resistance (Enserink, et al., 2022; Lennon et al., 2019; Sanchez Nieminen and Laitinen, 2025; Zaharuddin et al., 2025). Conversely, others may join RECs for psychosocial or environmental reasons, to achieve social cohesion or to be part of the community identity, even when the projects are too small to have measurable economic impacts: Social norms, trust, identity, and a combination of social, environmental, and community motives influence engagement in energy cooperatives (Goedkoop et al., 2022; Menegatto et al., 2025; De Simone et al., 2025). However, for those citizens opposing renewable energy projects or not yet participating in RECs, the (expected) economic effects may play a decisive role in determining their stance towards the energy transition.

In this study, we therefore focus on the economic dimension to better understand one aspect of these behaviors. Specifically, we ask: (i) What are the local economic benefits of corporate renewable plants? (ii) What are the local economic benefits of community renewable plants? Answering these questions informs the potential justification of local resistance claims and the

[1] A more elaborate definition of RECs is presented in Section 2.

validity of REC engagement claims. In addition, if ownership type significantly affects local economic outcomes, the results carry policy relevance, providing guidance on which ownership models best support climate objectives, social well-being, and economic development in the context of 'green growth' and the Sustainable Development Goals (World Bank, 2021).

We seek to answer these questions in the context of the United Kingdom (UK). The UK transformed its energy system substantially in less than a decade. The country was producing 39% of its electricity in 2012 from coal and this share dropped to 2% in 2020, while renewables' share increased from 7% to 30% in the same period. This was an unmatched coal phase out process.[2] Hence, the research questions that we answer also have a contextual value: Who was the winner of this energy transition process? If different ownership types have different local economic benefits, then they might have reshaped the energy transition process and recovery efforts for the economic loss due to coal phase-out. In addition, the UKs around 300 active RECs operating over 1000 plants in various sizes make it a natural candidate to study the comparison between these two ownership structures. Through their homogenous organizational structures, RECs in the UK allow for a clean comparison between community and corporate plants. This homogeneity stems from the fact that there are only two legal categories for RECs in the UK: Cooperatives and community benefit societies,[3] a level of homogeneity in the legal forms of RECs that is hard to find in any other country. Moreover, the UK has rich publicly available income and labor market data at subnational levels, yearly as well as monthly.

We assemble a panel dataset of UK local authority districts (LADs), which includes economic indicators such as the employment rate and income per capita along with the cumulative capacities of renewable plants, differentiated according to technology (solar and wind) and ownership (community and corporate): Community solar, community wind, corporate solar, and corporate wind. The community plant data is gathered using web scraping and AI search, then aggregated to the LAD level. Both community plants data and LAD aggregated capacities are made public in the supplementary documents. To estimate the effect of a particular type of renewable plant, e.g. community solar, the Callaway and Sant'Anna (2021) estimator is used. We define treatment as 'receiving the first renewable plant (community solar plant)'. In addition, we employ local projections difference-in-differences estimators (Dube et al., 2025) to estimate the construction period effects on the local labor market, i.e. the short-term employment effects.

The local economic benefits can be grouped into three categories: income, long-term employment, and short-term employment. The results indicate heterogeneous local economic effects across technologies and ownership types. Community solar, community wind, and corporate wind plants

[2] We are aware the complex effects of coal phase out in the UK economy. We do not enter this discussion as it is beyond the scope of the paper. In our empirical approach, we include coal power plant closures to check if there are any change in our results.

[3] Definitions of cooperatives and community benefit societies are presented in Section 2.

offer local economic benefits of some kind, while corporate solar plants do not exhibit measurable effects.

We find that community solar, and community wind plants have sizeable effects on income per capita. The dynamic increase of the effect over time is detectable; however, not all average point estimates are statistically significant at the conventional levels. More specifically, the point estimates for community solar plants range from 72.2 to 186.3 pounds per capita. The income effect of community wind plants is much stronger, especially in LADs that receive them more intensely (5 MW and more), and the point estimates range from 326.5 to 426.7 pounds per capita. Corporate wind plants increase income per capita by 111.4 to 200.4 pounds per capita in LADs that have at least 5 MW installed capacity, and this effect gets bigger in LADs with 50 MW installed capacity, reaching 446.4 pounds per capita. [4]

Long-term employment is affected as follows: We do not find any impact by any type of renewable plant on the headline employment rate. However, community solar plants and corporate wind plants show a sustained increase in the energy industry employment rate. Community wind and corporate solar plants do not have any long-term effect on the energy industry employment.

On the other hand, during the construction period, we report positive impacts of wind plants on the local labor market, regardless of ownership type. We see that payrolled employment[5] per capita increases during the construction of wind plants, while the proportion of the labor force claiming unemployment benefits ("claimant proportion") also decreases. These effects fade away once the plants start to operate. Such short-term impacts on the local labor market are not found in the case of community and corporate solar plants.

The income effect of community plants aligns with the fact that these plants pay directly to REC members or to community benefit funds. The income effects associated with corporate wind plants can be understood in the context of benefit-sharing practices in the wind industry. Scotland and Wales have a strong tradition of community benefit funds that are created along with wind plants, and wind energy generators contribute to the funds a fixed annual amount of money per MW capacity for the entire lifetime of the plant—5,000 pounds per MW per year is stated as a "good practice benchmark" (Local Energy Scotland, 2024; Scottish Renewables and Renewable UK, 2025). These funds are governed by the local community through councils or board members selected from the community (Scottish Renewables and Renewable UK, 2025). Solar generators, on the other hand, engage less in such practices, although the framework is developing (Solar Energy UK, 2024).

However, long-term and short-term labor market outcomes present a more complicated picture. Wind plants' construction period effect can be explained by the specialized workforce for this type

[4] Due to the fact that there are few LADs with more than 5 MW installed community wind capacity, we cannot test the effect of higher capacity installation in this case.

[5] People who are employed on a payrolled job.

of projects. Given that wind plants are concentrated in certain geographies, this specialized workforce might live in these areas and respond to construction of new plants. The long-term energy industry employment effect found in community solar and corporate wind can be explained by two distinct dynamics. Community solar tends to be dispersed, requiring more labor to manage many distributed systems as compared to condensed corporate solar projects. On the other hand, corporate wind might require substantial maintenance work while community wind projects are managed by the same people. This is reasonable given that many community wind projects are developed along with corporate ones most of the time by the same developer firm.

Returning to our research questions, we can conclude that community ownership indeed generates local economic benefits, and that corporate plants generate local economic benefits if there are benefit-sharing practices in place. Hence, these results support the claim that the benefits of renewable plants accrue outside the community, while the negative externalities remain local – namely in the case of corporate plants with no explicit benefit-sharing practices. Also, our findings support the claim in the grey literature that RECs being more benefits to the local economy. This is the case especially when compared to corporate projects without benefit-sharing practices, in this case, corporate solar. Thus, part of the motives both for local opposition to renewable energy projects and for local engagement with RECs seem to be driven by economic considerations.

Our work contributes to three literatures. Studies most closely related to our work investigate the economic benefits of community-owned renewable energy models. Using German data, Hoeschle et al. (2025) study bioenergy villages and find positive effects on income and tax revenues, but no clear employment effects. Related evidence from the grey and policy-oriented literature similarly suggests that community ownership can increase local income retention and employment relative to conventional projects. Lantz and Tegen (2009) found that community-owned plants generate between 10% and 30% more employment during construction and up to nearly three times as much once operational. Using the National Renewable Energy Laboratory's JEDI model, Farrell (2014) reached similar conclusions, estimating that community projects create almost three times as many jobs as conventional ones. More recent data from Community Energy England (2024) reinforce this pattern, showing that its member RECs employ 796 people across 398 MW of capacity—roughly two jobs per MW, far above typical industry averages (Brown et al., 2012; Hartley et al., 2015; Brunner and Schwegman, 2022; Fabra et al., 2024; Scheifele and Popp, 2025). Beyond employment, community projects also generate wider local value by reducing household energy bills and funding local initiatives through community benefit schemes (Community Energy England, 2024). Moreover, by retaining and circulating income within the area, RECs help to strengthen local economies and keep financial returns in the hands of residents (Vansintjan, 2015; Kienbaum et al., 2023).

Another key contribution of this study is its emphasis on ownership structure when assessing the local economic impacts of renewable energy plants. Existing research on renewables more generally offers mixed evidence on this relationship. Some studies find clear economic benefits: Renewables have been associated with higher employment and income levels, as well as lower unemployment rates (Brown et al., 2012; Mauritzen, 2020; Costa and Veiga, 2021; Gilbert et al., 2024). Others, however, suggest more limited or short-lived effects, often confined to the construction phase (Hartley et al., 2015; Fabra et al., 2024; Scheifele and Popp, 2025). Beyond employment, a number of studies highlight broader macroeconomic gains, including increases in GDP per capita (De Silva et al., 2016; Brunner and Schwegman, 2022; Scheifele and Popp, 2025), as well as fiscal benefits such as higher tax revenues and public spending linked to wind plant installations (Shoeib et al., 2021; Brunner et al., 2022; Serra-Sala, 2024). Moreover, our study is among the few that conduct local economic analysis for both short-term and long-term effects, in the vein of work by Scheifele and Popp (2025) who look at short-term labor market and long-term GDP outcomes.

This paper also adds to the growing broader institutional literature on renewable energy communities (RECs). So far, most of this work has examined the social and institutional dimensions of community energy—exploring what motivates individuals to participate (Horstink et al., 2020; Cohen et al., 2021), how governance and legal frameworks shape these entities, and how they organize their business models and relationships with other actors (Funkhouser et al., 2015; European Committee of the Regions, 2018; Inês et al., 2020; Bauwens et al., 2020). By contrast, our study shifts the focus toward the local economic impacts of RECs, offering an empirical assessment of their broader value to communities.

The remainder of this paper is structured as follows: Section 2 details the renewable plant and REC development in the UK by explaining the current legal structure and definitions of RECs. Section 3 presents the data and methodology. Section 4 provides the results, and Section 5 concludes.

2) The background of renewable electricity and RECs in the UK

Defining REC across different countries is not straightforward. In the UK, the Co-operative and Community Benefit Societies Act (2014) defines two legal forms for RECs: Co-operatives and Community Benefit Societies. The two definitions are similar, the only difference being to whom the society serves. Co-operatives serve their members, and they may pay interest or dividends to their members although economic benefit should not be the main goal. Community Benefit Societies, on the other hand, cannot pay dividends, they must invest the money back in a community benefit fund or projects that benefit society more broadly. The 2014 Act does not define any proximity criteria; hence, the UK definitions are more similar to The EU Energy Directive (2019/944) "citizen energy community" (CEC) definition rather than REC definition of EU Directive 2018/2001[6]. We refer to co-operatives and community benefit societies as RECs if they

[6] The EU legal framework defines RECs as a legal entity which is based on open and voluntary participation, is controlled by shareholders and members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity. The primary purpose of REC is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it

invest in renewable energy plants, although there are some discrepancies between the EU and the UK definitions, yet the two legal frameworks have more in common regarding such institutions. Most importantly, the two legislations define such initiatives as democratic institutions organized according to "one member one vote" criteria.

Community engagement is not restricted to RECs in the UK, especially for the wind plants. Wind projects in Scotland and Wales establish community benefit funds and contribute financially to these funds (i.e. benefit-sharing), and these funds are managed with participation from the local community (Scottish Renewables and Renewable UK, 2025). The contribution to the community benefit funds is not compulsory; however, it is a well-established business practice. The Scottish government has an official best practice guidance since 2014 (Scottish Government, 2019). The guidance has a target of 5,000 pounds per MW capacity per year over the lifetime of the plant and the current average is 5,400 pounds per MW per year as of 2025. The yearly amount of community benefit funds connected to wind plants is 29 million pounds in Scotland as of 2025 (Local Energy Scotland, n.d.). There is no data on Wales and Northern Ireland wind farms regarding their community benefit fund contributions; however, wind developers in Wales signed a declaration to commit to community benefits in 2013 (Research Senedd Wales, 2013). The UK government also has a community benefit guidance document for wind plants for England since 2013, and the 2025 updated version also states the 5,000 pounds per MW per year contribution as a benchmark amount (Department for Energy Security and Net Zero and Department for Business, Energy and Industrial Strategy, 2025).

Figure 1 shows the geographical distribution of solar and wind plants. As a general pattern, there is more solar power in England and more wind power in Scotland and Northern Ireland, while Wales has both. While this is also true for community solar and wind plants, community plants make up a small share of overall solar and wind capacity. The geographical distribution of power plants does not entirely reflect its potential across countries, especially for wind power: In 2015, the UK Government introduced changes to England's National Planning Policy Framework that effectively created a de facto ban on new onshore wind farms. The amendment required that any proposed onshore wind project be located within an area specifically identified as suitable for such development in the local planning authority's development plan and that it demonstrates clear community support. In practice, very few local plans had designated suitable areas, and local objections were sufficient to block most proposals. These conditions made it nearly impossible to secure planning consent for new onshore wind projects in England. However, the policy did not apply to Scotland, Wales, or Northern Ireland, where planning powers are devolved and governments continued to support onshore wind development through their own frameworks. The National Planning Policy Framework was amended again in 2024, and the exceptional stringency

operates, rather than financial profits (EU Parliament and Council, 2018). The EU Energy Directive (2019/944) makes "citizen energy community" (CEC) definition in a very similar way. The two differences are that CEC does not require its governing members and shareholders to be in the proximity of the energy projects, and it includes but does not limit the energy activity to be renewable.

was removed. Due to this legal history, the community benefit commitment of the wind plant developers might accrue in England in a limited way. We consider different geographical subsamples in our estimations to account for the de facto ban and different distribution of solar and wind plants across the UK. This subsampling, along with full sample estimations, is motivated by the consideration that the geographical segregation of solar and wind plants might also correspond to economic differences. South England is the most developed part of the UK in terms of GDP per capita (ONS, 2023), income per capita (ONS, 2024), and it has a consistently higher employment rate than northern parts of the UK (ONS, 2025).

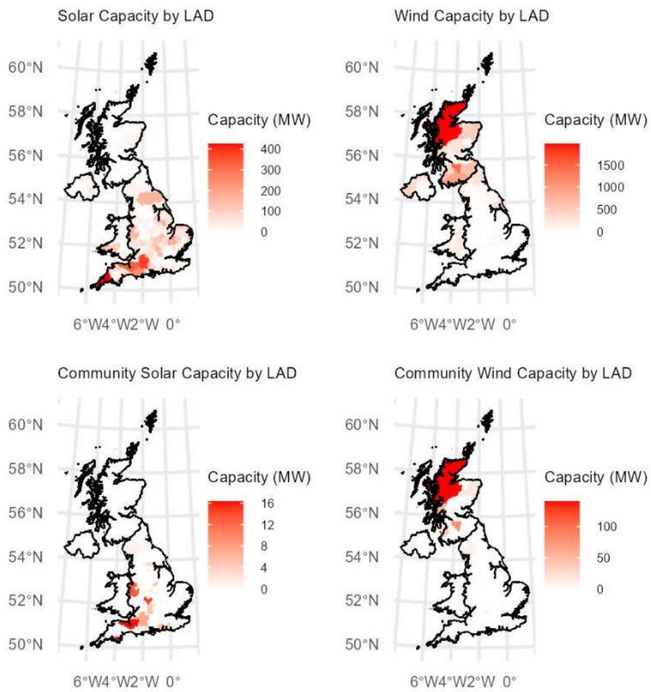

Figure 1: Geographical distribution of solar and wind plants in the UK. The upper panel shows the total solar and wind distribution in LADs in MW capacity. The panel below shows the distribution of community plants in MW capacity.

Figure 2 shows the yearly added capacity of solar and wind plants. Wind has a longer history in the UK, as the first plants were started to be built mid-1990s while solar is a much more recent phenomenon. The years following 2010 witnessed a boom in both technologies. The reason is that the UK introduced a feed-in tariff with the 2008 Energy Act, and it came into force in April 2010. It ceased to accept new application from April 2019 onward. [7]

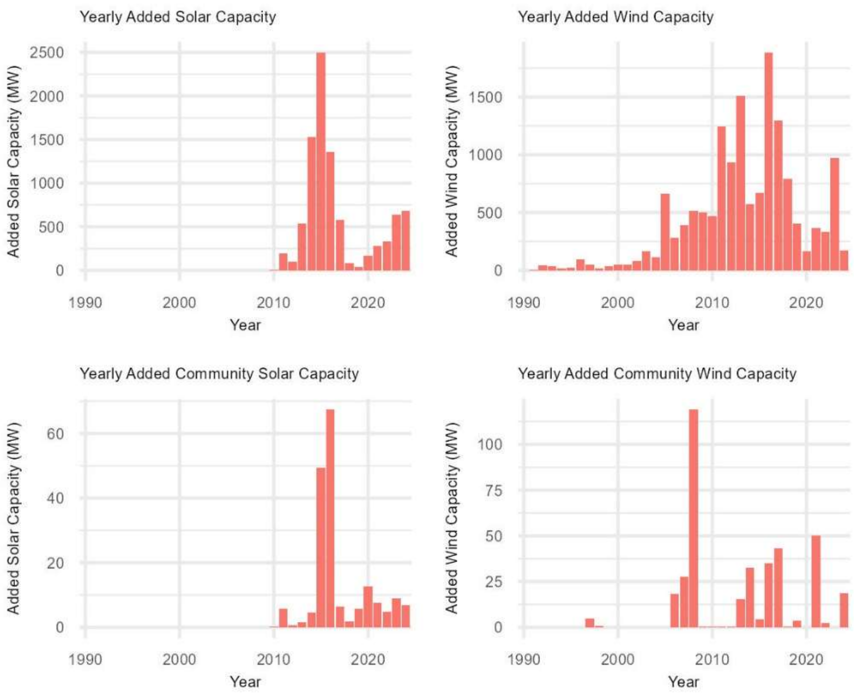

Figure 2: Added yearly MW capacity of solar and wind. The upper panel shows the totals, without any differentiation of ownership type. The panel below shows the community plants.

3) Data and methodology

3.1) Data

To make a differentiation of solar and wind plants with respect to ownership type, we used the Wierling et al. (2023) data that provides the list of cooperatives and community benefit societies in the energy sector in the UK. This list was expanded by the most recent list from Cooperatives UK (n.d.). However, the data does not contain information on renewable plants; hence, we used web sources, web scraping, and open-source AI services to gather plants' location, capacity, and operation start date. We then combine this information with a second data source, the OFGEM's

[7] The FiT rate was dependent on the technology type and the system size, it was 30.7 pence per kWh for ground mounted solar plants and 4.7 pence for wind plants exceeding 1.5 MW capacity (Department of Energy and Climate Change, 2011).

Renewable Energy Guarantees of Origin (REGO) list, [8] which provides postal addresses, dates of commission and generation capacity for renewables plants with capacities above 50 KW, but no information on ownership type. OFGEM REGO data is not an exhaustive list of renewable plants in the UK, because only the renewable plants that are subscribed to REGO program are listed. However, the total capacities correspond well with the official total capacities published bythe Department for Energy Security and Net Zero (n.d.).

Once our plant data was ready, the capacities were aggregated in time and in geography to create two datasets: LAD-level yearly data, and LAD-level monthly data. These datasets provide information on community solar, community wind, OFGEM solar, and OFGEM wind capacities for each geography for each time in a cumulative way. We simply subtract community capacities from OFGEM capacities to calculate 'corporate' capacities. Hence, the unit of analysis is the LADs in this study. These two datasets span from 1990 to 2024.

The capacity datasets are combined with economic indicators. NOMIS publishes yearly employment data, and yearly gross disposable household income (NOMIS, n.d.). The income variable is in 2015 constant pounds. Employment can be divided into nine sectors according to Standard Industry Classification 2007. We used only the mining, energy, and water (B, D, E) [9] disaggregation, because this sector is potentially directly affected by renewable energy investments, due to the activities in "electricity, gas, steam and air conditioning supply" (from now on, we refer to this B, D, E total shortly as *energy employment*) [10]. These yearly indicators are available at LAD level as subnational units; hence, they are matched with yearly renewable capacity data. Monthly data is combined with two labor market indicators: Monthly payrolled employment from ONS. (n.d. a) and monthly claimant proportion data from NOMIS (n.d.). Payrolled employment provides only salaried employment and excludes self-employment while claimant proportion is the number of people who claim unemployment benefits divided by the labor force at 16-64 age bracket.

The yearly employment rate variable runs from 2004 to 2024, while income's range is from 1997 to 2023. Monthly payrolled employment data starts in July 2014 and finishes in May 2025. Monthly claimant proportion, on the other hand, runs from January 1990 to July 2025. Hence, depending on the outcome variable that we use in our estimations, the data covers different time periods.

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[8] Any discrepancies between our REC plant data and OFGEM REGO data in terms of capacity information and date of operation start are corrected by using the information presented on the websites of RECs. Such differences were minor: For dates of operation start, the discrepancies are under 6 months, while the discrepancies regarding the capacity of the plants were under 100 KWs. Some plants in OFGEM REGO have outdated address information regarding the postal codes and these were also corrected.

[9] B: Mining and quarrying, D: Electricity, gas, steam and air conditioning supply, E: Water supply; sewerage; waste management and remediation activities

[10] Unfortunately, the data is not further disaggregated into each B, D, and E category.

The datasets include a yearly population variable from ONS (n.d. a), which is used to normalize the income variable and payrolled employment. Also, the dataset includes an urban dummy[11] from ONS (n.d. c), manufacturing and service employment shares in 2004 from NOMIS (n.d.), the labor market resilience score calculated by Sensier et al. (2024) for UK ITL 2 regions[12], and population density (population divided by LADs' surface area). These indicators are used as matching variables for monthly estimations of payrolled employment and claimant proportion. Table 1 presents the summary statistics for the yearly and monthly datasets together for four different renewable types.

Table 1: The summary statistics of yearly and monthly datasets

	Full sample	LADs with community solar	LADs with community wind	LADs with corporate solar	LADs with corporate wind
Number of LADs	323	146	35	307	183
Community solar capacity (kW)	1192	1192	1605	1228	1038
	(2847)	(2847)	(3272)	(2895)	(2871)
Community wind capacity (kW)	10434	2190	10434	11134	11232
	(29256)	(2776)	(29256)	(30243)	(30661)
Corporate solar capacity (kW)	36565	62607	178409	36565	53639
	(41625)	(53112)	(67944)	(41625)	(45697)
Corporate wind capacity (kW)	53569	22807	110993	53139	53569
	(143227)	(46168)	(245985)	(145575)	(143227)
Employment rate (%)	74.6	74.6	74.1	74.6	73.9
	(5.58)	(5.67)	(5.14)	(5.56)	(5.41)
Energy employment rate (%)	1.8	1.6	2.6	1.8	2.0
	(1.44)	(0.89)	(2.46)	(1.44)	(1.69)
Payrolled employment per capita (monthly)	42.7	42.3	41.3	42.7	42.0
	(3.11)	(3.21)	(3.31)	(3.12)	(3.13)
Claimant proportion (%) (monthly)	3.2	3.2	3.2	3.2	3.3
	(2.02)	(2.05)	(1.75)	(2.01)	(1.94)
Income per capita (£)	17377	17539	16243	17450	16500
	(3595)	(3516)	(2333)	(3625)	(2727)

[11] The rural urban classification consists of 8 categories. We define the urban dummy as 1 for the classification UUN, the most urban, and zero otherwise.

[12] Sensier et al. (2024) calculated the resilience score for ITL 2 regions in the UK by examining the ITL 2 regions' recovery from 2008 Global Financial Crisis by calculating how fast (or slow) regions converged to pre-crisis levels in certain macroeconomic indicators. ITL 2 regions usually include several LADs together; hence, we assign the same resilience score for LADs that are under the same ITL 2 regions. The assumption we make by employing this indicator is that the regions' 2008 crisis response is driven by time-invariant characteristics.

Population (persons, 000)	166	191	174	169	170
	(119)	(143)	(119)	(120)	(117)
Population density (persons per sq. km)	971	1050	245	955	555
	(1116)	(1100)	(325)	(1110)	(722)
Urban dummy	0.45	0.47	0.11	0.44	0.28
	(0.49)	(0.49)	(0.31)	(0.49)	(0.45)
Resilience score	5.50	5.64	5.30	5.52	4.88
	(2.64)	(2.85)	(2.53)	(2.68)	(2.28)
2004 manufacturing emp. share (%)	14.4	13.9	14.2	14.4	15.3
	(4.63)	(4.47)	(4.60)	(4.63)	(4.64)
2004 services emp. share (%)	73.7	74.5	71.4	73.8	72.1
	(5.01)	(5.04)	(4.51)	(5.05)	(4.55)

Notes: This table presents the LAD level datasets constructed for this study. kW stands for kilowatts. The figures give the mean values for variables for the full sample, and for LADs that receive community solar, community wind, corporate solar, and corporate wind. Renewable capacities are expressed in a cumulative way and their mean values drop zeros; hence, they show average plant size for LADs for 2024.

It should be noted that certain LADs are excluded from the sample. There are 361 LADs in the UK but as Table 1 shows, the full sample contains 323 LADs. Firstly, we exclude 33 LADs that are in Greater London from the sample. The reason is that the London economy as a global financial center is different from other parts of the UK. Brighton and Hove, Reading, and Surrey Heath are also excluded because these cities developed a digital and technology sector in 2010s, directly coinciding with solar adoption. Additionally, Mole Valley, and Watford are excluded because these cities are commuter towns to London and have experienced different income dynamics than the rest of the UK[13].

3.2) Methodology

We aim to estimate both the long-term and short-term economic impacts of different types of renewable energy plants on employment and income. Specifically, we consider four types of plants: community solar, community wind, corporate solar, and corporate wind.

For long-term effects, we use yearly data and define the treatment as absorbing, assuming that once an LAD receives a plant, it remains treated. For employment outcomes, this assumption is justified because operations and management jobs continue to exist once the plant is operational. For income outcomes, the absorbing assumption is supported by the fact that community plants

[13] Including these LADs only compromises the income estimations of corporate solar. In this case, the estimations suggest that corporate solar causes income to reduce substantially. This is not true, as these inappropriate comparison LADs' income increases because of other dynamics, such as recently developed technology and information sectors, that time-wise coinciding with the solar adoption.

distribute dividends to members or contribute to community benefit funds, and corporate plants may similarly establish community benefit funds, generating sustained local income effects.

To estimate short-term labor market impacts during the construction period, we use monthly data. We assume that these effects begin before the plant's commissioning date, defining the treatment period as the eighteen months preceding commissioning. While the exact start date of construction is unknown and can vary by project, this eighteen-month assumption is common in the literature (Fabra et al., 2024; Scheifele and Popp, 2025). Because construction-related jobs are temporary, these effects are expected to fade once the plant is completed. Therefore, in this context, the treatment is non-absorbing, in contrast to the absorbing nature of the long-term yearly estimations.

The Two-way fixed effects (TWFE) estimator is shown to be inappropriate by the recent literature when the treatment affects the units at different times when the treatment effects are unit-wise and/or time-wise heterogeneous (Goodman-Bacon, 2021; Callaway and Sant'Anna, 2021; Borusyak et al., 2024). The main cause of the bias is that TWFE does a "forbidden comparison" between units that are already treated by taking them as controls and comparing them with the units that are newly treated (Goodman-Bacon, 2021).

In our setting, renewable energy plant openings occur at different points in time across local authority districts (LADs), within a country characterized by substantial regional heterogeneity. Therefore, for the yearly analysis, we employ the estimator proposed by Callaway and Sant'Anna (2021), which is designed for staggered treatment adoption and allows for treatment effect heterogeneity across cohorts and over time. For the monthly analysis, we adopt a difference-in-differences approach based on local projections to estimate dynamic treatment effects at higher frequency.

For the yearly estimations, we implement the doubly robust difference-in-differences estimator developed by Sant'Anna and Zhao (2020) and extended to the staggered adoption case by Callaway and Sant'Anna (2021). The doubly robust approach combines an outcome regression model and an inverse probability weighting scheme, yielding consistent estimates provided that at least one of these components is correctly specified. Intuitively, the method adjusts outcomes using a model for the untreated potential outcome conditional on covariates and then reweighs observations according to their propensity to receive treatment.

In the simple case of a single treatment period, the intuition of the doubly robust estimator can be expressed as:

$$ATT = E\left[w^{ipw}\left(Y_{treated} - Y_{control} - E(\,Y_{treated} - Y_{control} \mid X\,)\right)\right] \tag{1}$$

where ATT denotes the average treatment effect on the treated, $w^{ipw}$are inverse probability weights, Y represents outcome variables such as the employment rate or income per capita, and $X$is a vector of control variables. In our application, X includes the cumulative per-capita capacity of other types of renewable plants. For example, when treatment is defined as having positive community solar capacity, the control variables include community wind, corporate solar, and corporate wind capacities [14].

In the staggered treatment setting, treatment effects are defined at the group-time level. Specifically, cohorts are defined by the period in which units first receive treatment, and average treatment effects are estimated separately for each cohort and time period. For a cohort first treated in period g, the group-time average treatment effect is defined as:

$$ATT(g,t) = E\left[Y_t(g) - Y_t(0) \mid G_g = 1\right] \quad (2)$$

where $Y_t(g)$ denotes the potential outcome at time $t$if first treated in period g, $Y_t(0)$ denotes the untreated potential outcome, and G_g is an indicator for belonging to cohort g.

Estimation proceeds by comparing treated units in cohort g to units that are not yet treated or never treated by time g. Outcome regressions are estimated using the subsample of not-yet-treated and never-treated units, and inverse probability weights are constructed based on the probability of belonging to cohort g conditional on covariates. Group-time average treatment effects are then aggregated using appropriate weighting schemes.

Identification relies on a conditional parallel trends assumption. Specifically, for all periods $t < g$, we assume:

$$E\left[Y_t(0) - Y_{t-1}(0) \mid X, G_g = 1\right] = E[Y_t(0) - Y_{t-1}(0) \mid X, G = 0 \text{ or } G > t] \quad (3)$$

This assumption states that, conditional on covariates, the untreated potential outcomes of treated units would have evolved in parallel with those of the not-yet-treated and never-treated units in the absence of treatment [15].

For the monthly short-term estimations, we use local projections difference-in-differences (LPDID) (Dube et al., 2025) using monthly LAD-level data, which contains payrolled employment

[14] The estimations of corporate solar only include community solar capacity as control. The reason for this is that wind capacities almost perfectly predict the treatment timing of corporate solar and this amplifies IPW weights in such a way that the estimation becomes unstable. We checked this by running a logistic regression of wind capacities on the timing of the first corporate solar plant opening and the logistic model predicted the timing with a 95% rate. We think that this is caused by England's de facto ban on wind between 2015-2024, as when we drop England the predictive power of wind capacities reduces. Also, when the LADs that heavily received wind plants are concerned, controlling for solar capacities can make the estimator unstable. Other than these two cases, the estimations always include community solar and wind, and corporate solar and wind as controls. We would like to note that the main findings hold true even without control variables.

[15] The estimations use binary treatment; however, there is an alternative estimator proposed by de Chaisemartin and D'Haultfoeuille (2024) (DCDH) which can use continuous treatment. We do not prefer the DCDH estimator because it uses covariates to calculate the residuals of the outcome variable for the entire period. This can be problematic as many community plants open after the corporate ones. Secondly, DCDH does not have the doubly robust approach; hence, Callaway and Sant'Anna (2021) appears to be more robust. However, we present the main estimations using continuous treatment DCDH in Appendix A1.

per capita and claimant proportion. Payrolled employment per capita and claimant proportion are not equivalent to employment and unemployment rates; however, they are good indicators of them. The aim is to capture pre-opening construction period employment and unemployment effects mainly due to the construction work. LPDID estimator can accommodate non-absorbing treatment while Callaway and Sant'Anna (2021) cannot, therefore we change the estimator for short-term effects.

LPDID regresses the difference of the outcome in horizon $\hbar$ on the difference in treatment by setting a "clean control condition". The clean control condition is defined for each horizon so that the estimator does not suffer from the bias due to the differential treatment timing when there is heterogeneity in treatment effect in units and/or in time. LPDID relies on the no anticipation and the parallel trends assumption for identification. Also, we use entropy balance weights (Hainmueller, 2012) for better comparison. More formally, LPDID regresses:

$$y^*_{i,t+h} - y^*_{i,t-1} = \beta_h \Delta D^*_{i,t} + \theta^*_t + \varepsilon^*_{i,t} \quad (4)$$

$$\text{When} \quad \Delta D_{i,t} = 1 \; or \; D_{i,t+h} = 0$$

The starred variables mean that the sample is weighted according to entropy balance weights. $\Delta D_{i,t} = 1$ ensures that the regression includes treated units as this means a switch of treatment status from 0 to 1 at time t. $D_{i,t+h} = 0$ condition defines the clean control units at time t and for horizon $\hbar$. The outcome differences cancel out the fixed effects and the outcome difference at horizon $\hbar$ is regressed on period t's treatment difference $\Delta D_{i,t}$.

When the treatment can turn on and off (as in our case, i.e. non-absorbing treatment), every treatment difference $\Delta D_{i,t} = 1$ is considered as a new treatment period. Hence, an LAD can be treated more than once. The reason is that renewable plants can be constructed sequentially in an LAD.

By the same logic, an LAD can experience subsequent plant openings within eighteen months. This makes some months being treated by more than one plant construction. This potentially causes the treatment period to be longer than eighteen months, as the second or third plant opens some months after the first plant. We deal with this contamination by putting another clean control condition: Periods under the influence of more than one plant are dropped from the estimation.

4) Results

4.1) Income effects

4.1.1) Solar capacity

Figure 3 presents the effects of corporate and community solar capacities on income per capita. One estimation is carried out with the whole sample, and the other is carried out with a geographical restriction that only uses LADs of England and Wales. This restriction is applied because solar capacity is concentrated in England and Wales, which may have different economic dynamics than Scotland and Northern Ireland.

As Figure 3 shows, community solar has an impact on income per capita in both samples while the effect of corporate solar is flat in England and Wales.

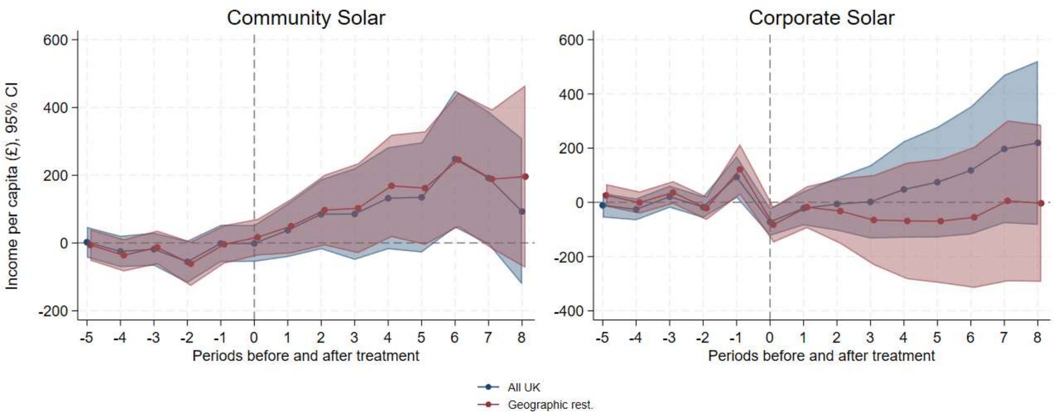

Figure 3: Event-study estimates of community and corporate solar on income per capita (£). Geographic restriction means using only England and Wales LADs. The results correspond to the average total effect presented in Table 2.

The income effect is expected to increase with higher received capacity. Hence, we test this by dropping LADs that receive cumulative capacity of less than 1 MW by 2024 for both community and corporate type capacity. [16] Income per capita increases after the third year when LADs receive their first community solar capacity, and then the effect fades away at the seventh year. The effect of corporate solar reduces with this restriction. The results are presented in Figure 4.

[16] Alternative cutoffs can be tested. Estimations using 0.5 MW, and 5 MW cutoff are presented in Appendix A2. A cutoff higher than 5 MW would drop too many observations especially in the community solar case.

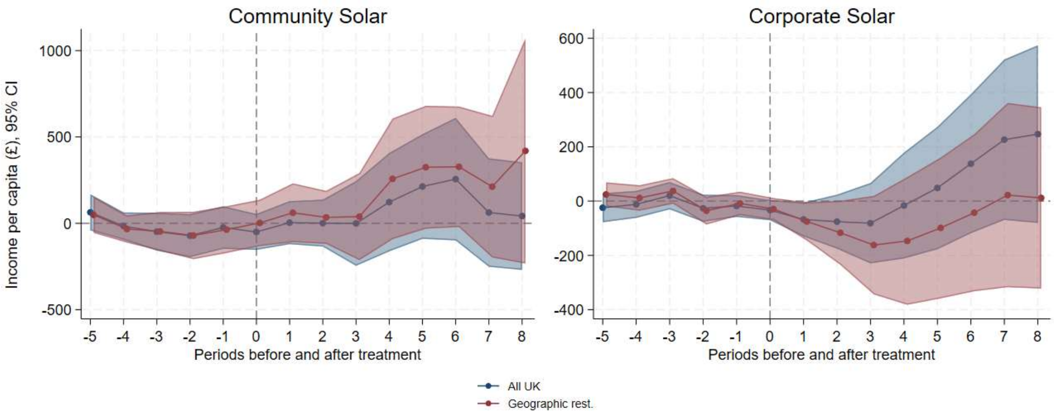

Figure 4: Event-study estimates of community and corporate solar on income per capita (£) when LADs that receive less than 1 MW capacity by 2024 are dropped. Geographic restriction means using only England and Wales LADs. The results correspond to the average total effect presented in Table 2.

When the less intensely treated LADs are dropped, the effect of community solar is higher in England and Wales but the estimate loses its significance at conventional levels. Hence, community solar has a positive impact on income per capita but the statistical significance is not robust. On the other hand, the point estimates of corporate solar are not consistently positive or negative without any statistical significance and the magnitude of the effects are much smaller than the effect of community solar. LADs that receive smaller solar capacities, both community and corporate, tend to be more urban. Hence, the capacity restriction of dropping LADs that receive less than 1 MW solar capacity by 2024, also prevents comparing urban economies with rural ones[17]. Table 2 presents the average post-treatment effects that correspond to Figure 3 and Figure 4.

[17] Adding urban dummy to the estimations as a control variable does not alter the results. The point estimates change slightly.

Table 2: The effect of community and corporate solar capacities on income per capita in the UK LADs

	Community solar, all capacities		Community solar > 1 MW		Corporate solar, all capacities		Corporate solar > 1 MW	
Income per capita (£)	111.87*	136.42**	72.22	186.34	62.00	-43.14	42.76	-70.85
	(60.53)	(62.10)	(89.36)	(124.96)	(76.08)	(83.38)	(81.78)	(92.80)
Number of obs.	8721	7560	5562	4617	8721	7560	6804	6102
Sample	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.

Notes: This table shows the average treatment effect on income per capita of community solar, and corporate solar. All estimations use covariates that consist of other types of renewable plants' capacity when one type is defined as treatment, i.e. when community solar is defined as treatment, community wind, corporate solar, and corporate wind capacities are controlled. Geo. Rest. means that the estimations use England and Wales. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

4.1.2) Wind capacity

Figure 5 shows the event study graphs of the estimations of community and corporate wind capacity on income per capita. One estimation uses all LADs in the UK and the other one drops Southern England and the Midlands.[18] The geographical restriction is motivated by the fact that wind capacity is concentrated in Scotland, Wales, Northern England and Northern Ireland, a result of the de facto ban on onshore wind in England. In addition, these regions might be economically different to the South England and Midlands; hence, this subsampling is intended to eliminate potential confounding factors and establish more robust results.

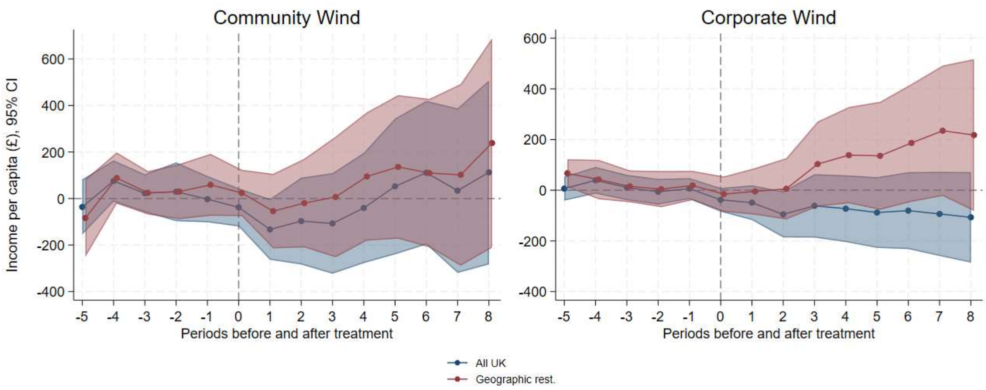

Figure 5: Event-study estimates of community and corporate wind on income per capita (£). Geographic restriction means dropping LADs of South England and Midlands. The results correspond to the average total effect presented in Table 3.

[18] South England consists of ITL regions TLH, TLI, TLJ, TLK; Midlands consists of TLF and TLG.

As Figure 5 shows, the effects of community and corporate wind on income are not significant while the restricted sample estimations show a convincing dynamic increase in the impact. We further explore this by dropping the less intensely treated LADs from the sample. More specifically, we define a cutoff of 5 MW cumulative capacity by 2024. [19]

Figure 6 shows that more intense treatment by community and corporate wind plants causes higher income growth. The impact of community wind is substantial, reaching to an average of 426.7 pounds per capita for LADs of Scotland, Wales, Northern Ireland, and Northern England; however, the estimate is not statistically significant. Corporate wind, on the other hand, shows a lower but statistically significant effect of 200.4 pounds per capita in geographically restricted estimation.

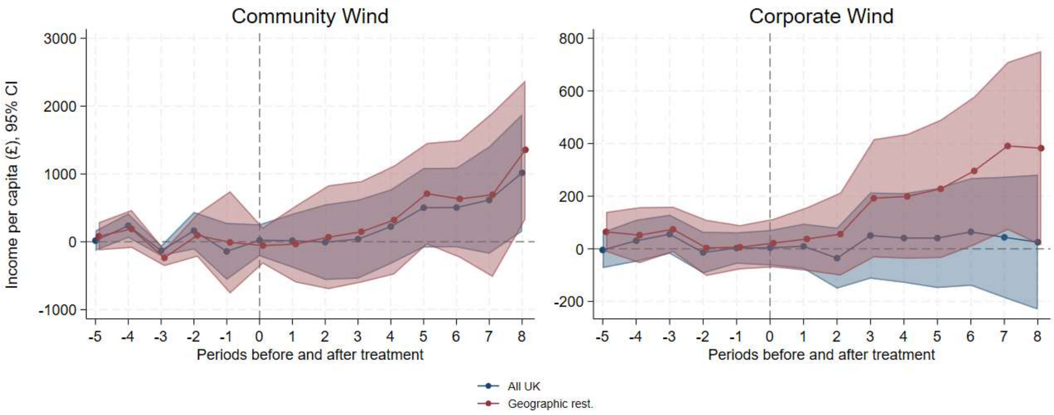

Figure 6: Event-study estimates of community and corporate wind on income per capita (£) when LADs that receive less than 5 MW capacity by 2024 are dropped. Geographic restriction means dropping LADs of South England and Midlands. The results correspond to the average total effect presented in Table 3.

The effect of corporate wind increases further when the cutoff cumulative capacity is set to 50 MW (Appendix A3), reaching 296 pounds per capita in the full UK sample and 446.4 pounds when Southern England and the Midlands are dropped. For community wind plants, however, applying the 50 MW cutoff results in a sharp reduction in the number of treated LADs. This leads to unstable estimates with poor pre-treatment trends and high statistical uncertainty; we therefore disregard the community wind results under this stringent capacity restriction due to a lack of precision.

[19] The cutoff is set to a higher level for wind capacities than solar because wind plants have higher capacities. More estimations are presented with cutoffs of 1 MW, 10 MW, and 50 MW in Appendix A3. However, 10 MW cutoff starts to be costly, in terms of data losses, for community wind estimations.

Table 3: The effect of community and corporate wind capacities on income per capita in the UK LADs

	Community wind, all capacities		Community wind > 5 MW		Corporate wind, all capacities		Corporate wind > 5 MW	
Income per capita (£)	-11.88 (108.54)	70.77 (114.37)	326.49 (259.87)	426.71 (367.99)	-76.22 (53.96)	111.38 (81.66)	27.14 (70.97)	200.39** (100.79)
Number of obs.	8694	3402	7965	2862	8127	2943	6129	2160
Sample	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.

Notes: This table shows the average treatment effect on income per capita of community wind, and corporate wind. All estimations use covariates that consist of other types of renewable plants' capacity when one type is defined as treatment, i.e. when community wind is defined as treatment, community solar, corporate solar, and corporate wind capacities are controlled. Geo. Rest. means that the estimations drop South England and Midlands. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

4.2) Labor market effects

We have presented above the different impacts of different types of renewable plants both in terms of ownership and technology. To draw a more complete picture and make our results more comparable to previous studies, we now provide results on the labor market effects of the renewable plants under investigation.

We first present the results on yearly employment rate and energy employment rate under the long-term effects of the plants as the time horizon spans to eight years after an LAD receives its first plant. Later, we give the construction period effects, in section 4.2.2, as this period is defined as eighteen months before the plant opening which corresponds to the construction activities

4.2.1) Long-term effects

4.2.1.a) Solar capacity

The estimation results suggest that corporate solar capacity does not have any effect on employment and energy employment, as Figure 7 shows. This holds true with geographical restrictions as well as when less-intensely treated LADs are dropped (< 1 MW cumulative capacity by 2024) in the case of the estimations presented in Figure 8.

Community solar increases the energy employment rate by 0.17 percentage points when the full sample is used, as shown in Table 4. However, the event study graph in Figure 7 does not show a consistent long-term increase. When more intensely treated LADs are used by contrast (> 1 MW cumulative capacity by 2024), the point estimates rise to 0.36 to 0.46 percentage points and Figure 8 demonstrates more convincing dynamic effects.

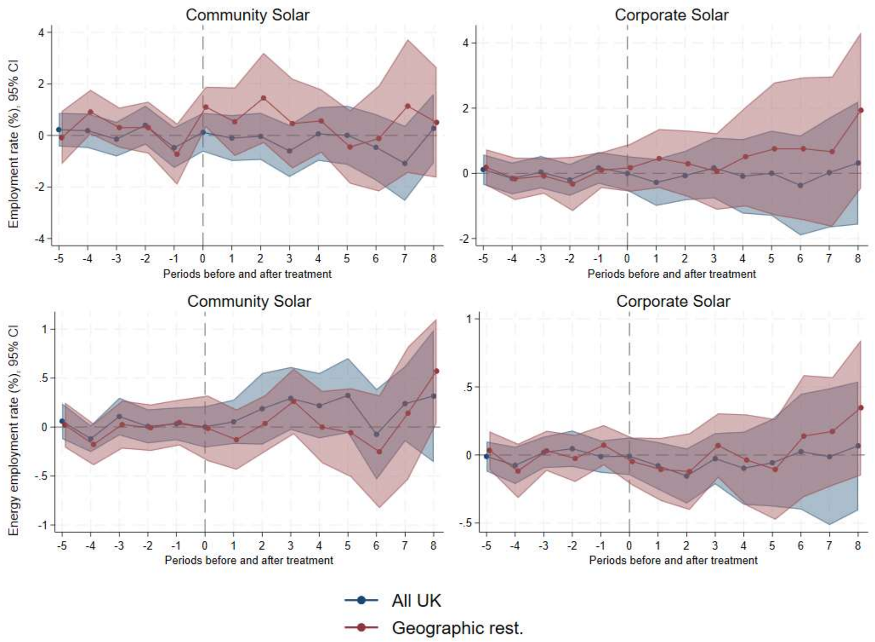

Figure 7: Event-study estimates of community and corporate solar on employment and energy employment rate (%). Geographic restriction means using the LADs of England and Wales. The results correspond to the average total effect presented in Table 4.

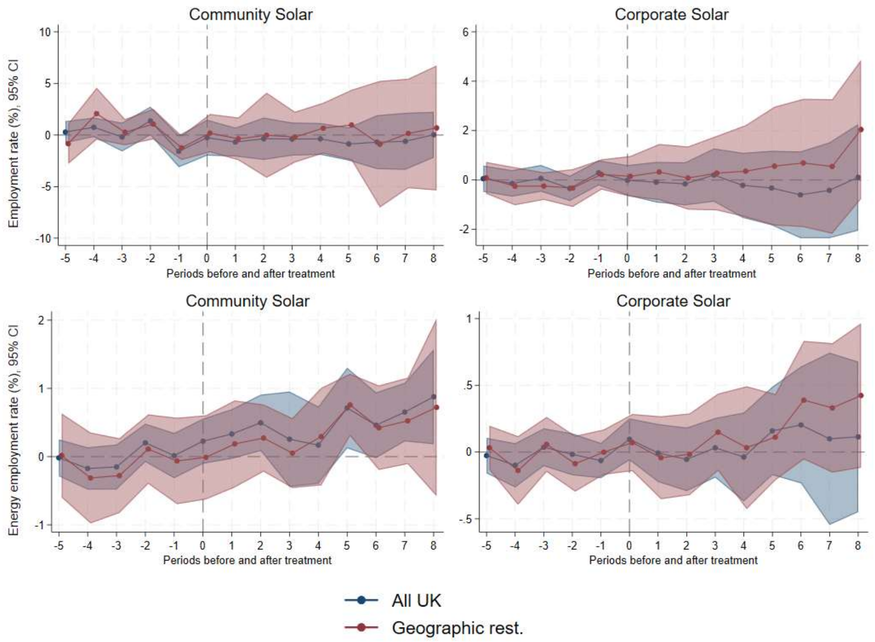

Figure 8: Event-study estimates of community and corporate solar on employment and energy employment rate (%) when LADs that receive less than 1 MW capacity by 2024 are dropped. Geographic restriction means using the LADs of England and Wales. The results correspond to the average total effect presented in Table 4.

Table 4: The effect of community and corporate solar capacities on employment and energy employment rate in the UK LADs

	Community solar, all capacities		Community solar > 1 MW		Corporate solar, all capacities		Corporate solar > 1 MW	
Employment rate (%)	-0.2	0.58	-0.47	0.13	-0.03	0.62	-0.17	0.56
	(0.40)	(0.58)	(0.64)	(1.44)	(0.49)	(0.68)	(0.56)	(0.81)
Energy emp. rate (%)	0.17*	0.06	0.46***	0.36*	-0.04	0.03	0.07	0.16
	(0.10)	(0.13)	(0.13)	(0.19)	(0.11)	(0.12)	(0.13)	(0.14)
Number of obs.	6531	2428	4211	1806	6510	2436	5103	1847
Sample	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.

Notes: This table shows the average treatment effect on employment rate and energy employment rate of community solar, and corporate solar. All estimations use covariates that consist of other types of renewable plants' capacity when one type is defined as treatment, i.e. when community solar is defined as treatment, community wind, corporate solar, and corporate wind capacities are controlled. Geo. Rest. means that only England and Wales LADs are used. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

4.2.1.a) Wind capacity

Corporate wind capacity increases the long-term energy employment rate by 0.29 to 0.39 percentage points when the more intensely treated LADs are used as treated units (> 5 MW cumulative capacity by 2024) while the overall employment rate is not affected in a statistically significant way. Community wind does not show any impact on either the employment or energy employment rate. Figure 9 and Figure 10 present the event-study graphs. We see that the energy employment rate increases after the third year of the post-treatment period for corporate wind plants when there is no capacity restriction implemented. However, we see that energy employment increases right after the plant opening when we consider LADs that receive at least 5 MW corporate wind plant capacity by 2024.

Table 5 gives the average estimates of the estimations of community and corporate wind capacity for employment and energy employment rates that correspond to Figure 9 and Figure 10.

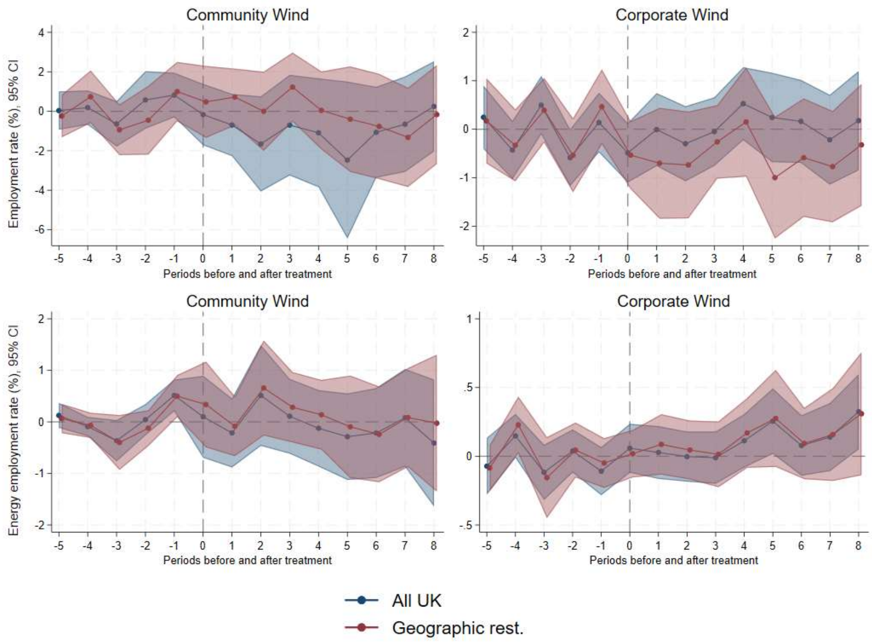

Figure 9: Event-study estimates of community and corporate wind on employment and energy employment rate (%). Geographic restriction means dropping LADs of South England and Midlands. The results correspond to the average total effect presented in Table 5.

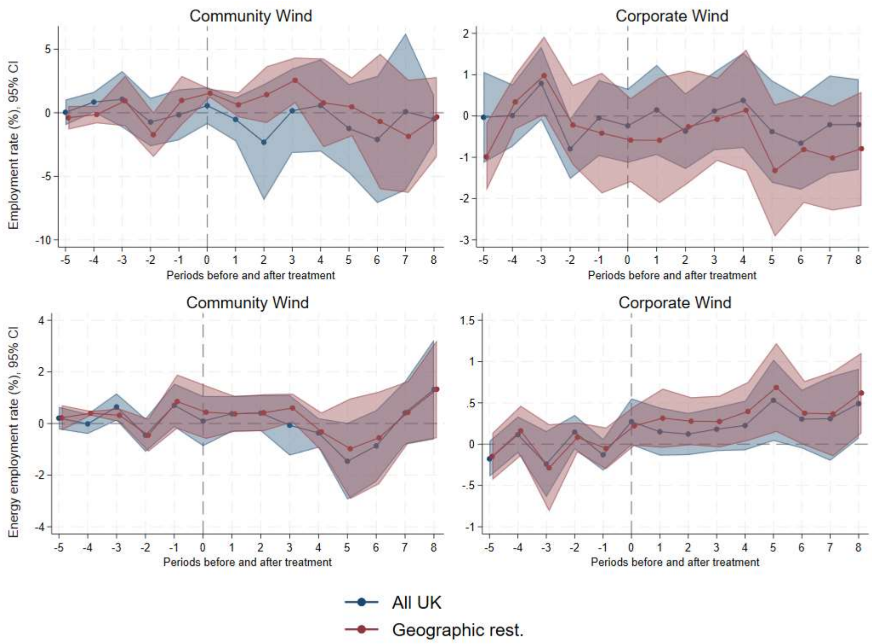

Figure 10: Event-study estimates of community and corporate wind on employment and energy employment rate (%) when LADs that receive less than 5 MW capacity by 2024 are dropped. Geographic restriction means dropping LADs of South England and Midlands. The results correspond to the average total effect presented in Table 5.

Table 5: The effect of community and corporate wind capacities on employment and energy employment rate in the UK LADs

	Community wind, all capacities		Community wind > 5 MW		Corporate wind, all capacities		Corporate wind > 5 MW	
Employment rate (%)	-0.92	-0.02	-0.61	1.44	0.01	-0.53	-0.16	-0.59
	(0.93)	(0.76)	(1.26)	(1.12)	(0.29)	(0.42)	(0.37)	(0.48)
Energy emp. rate (%)	-0.05	0.12	1.19	1.25	0.11	0.13	0.29**	0.39***
	(0.27)	(0.26)	(1.04)	(0.97)	(0.08)	(0.11)	(0.12)	(0.15)
Number of obs.	6468	2373	5733	1785	6468	2373	5733	1785
Sample	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.

Notes: This table shows the average treatment effect on employment rate and energy employment rate of community wind, and corporate wind. All estimations use covariates that consist of other types of renewable plants' capacity when one type is defined as treatment, i.e. when community wind is defined as treatment, community solar, corporate solar, and corporate wind capacities are controlled. Geo. Rest. means that the estimations drop South England and Midlands. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

4.2.2) Short-term effects

Figure 11 presents the event study graphs for community and corporate solar plants that are carried out with the whole sample that consists of all four countries in the UK. Figure 12 presents the same estimations for community and corporate wind plants. As Figure 11 shows, Solar plants do not affect the labor market in the construction period.

On the other hand, the wind plants indicate some slight increase in the construction period in payrolled employment as presented in Figure 12. The increase in payrolled employment is not statistically significant at conventional levels for estimations that use full sample and the impact fades away once the wind plants start to operate, as expected. The effect of wind plants on claimant proportion is more pronounced and again it fades away in time. Claimant proportion decreases by 0.1 percentage points at the twelfth month before plant opening in the case of community wind plants. The effect is smaller, around 0.05 percentage points, for corporate wind plants at the same time periods.

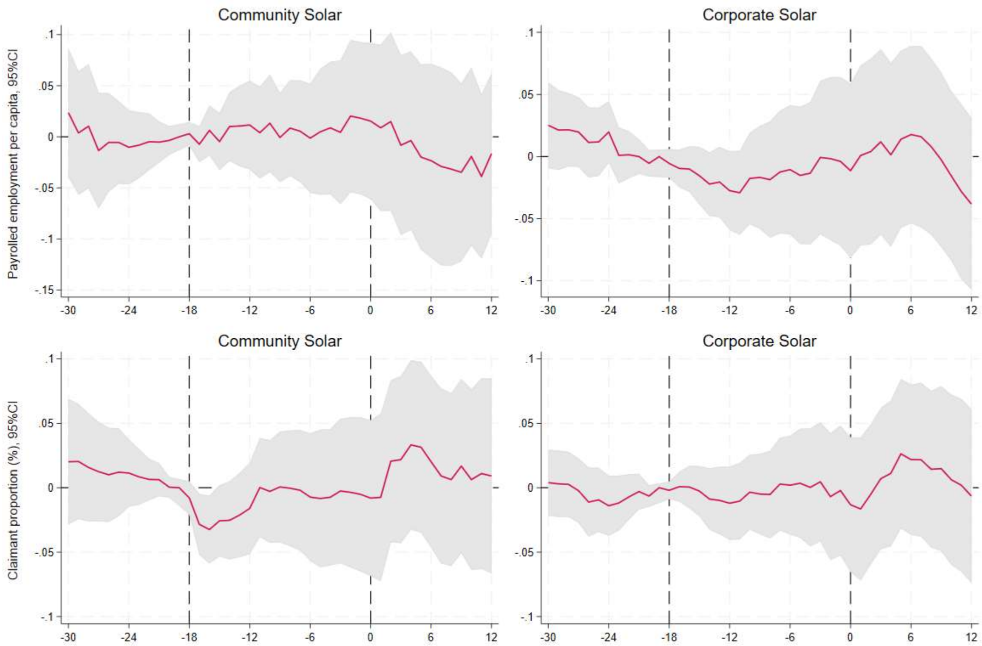

Figure 11: Event-study estimates of community and corporate solar plants on payrolled employment per capita in the first row, and claimant proportion (%) in the second row when the full sample is used. The results correspond to the average total effect presented in Table 6.

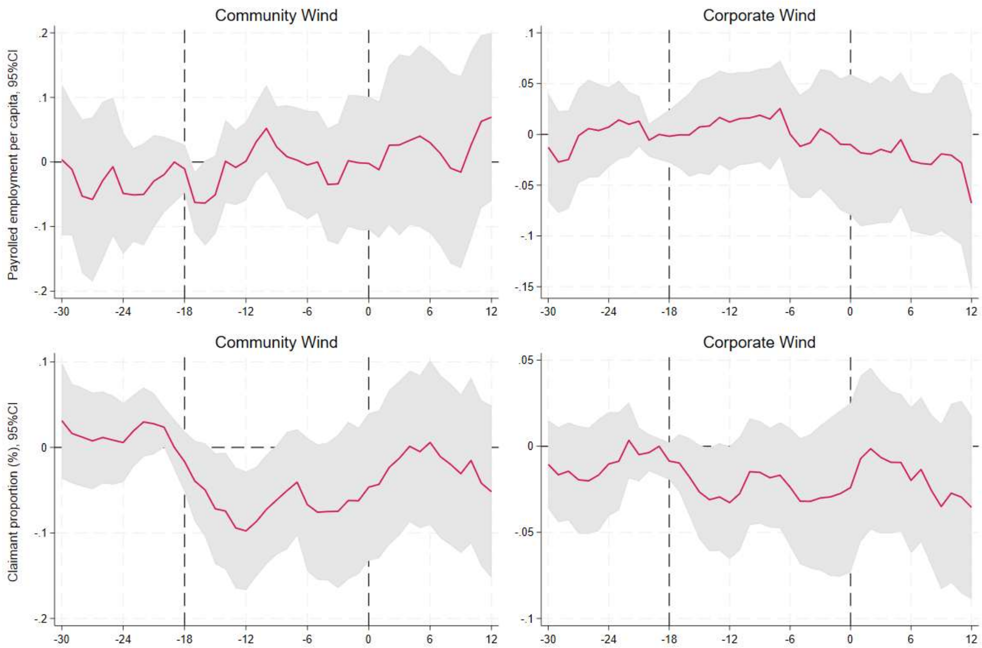

Figure 12: Event-study estimates of community and corporate wind plants on payrolled employment per capita in the first row, and claimant proportion (%) in the second row when the full sample is used. The results correspond to the average total effect presented in Table 6.

Figure 13 shows the results of solar plants when the sample is geographically restricted, i.e. using England and Wales. Similar to Figure 11, we do not detect any construction period effect on payrolled employment per capita nor on claimant proportion.

Figure 14 presents the estimations for wind plants when South England and Midlands are dropped as geographic restrictions. Compared to the event study graphs in Figure 12, the effects are more pronounced now. There is a clear rise in payrolled employment per capita during the construction period and a decline in claimant proportion.

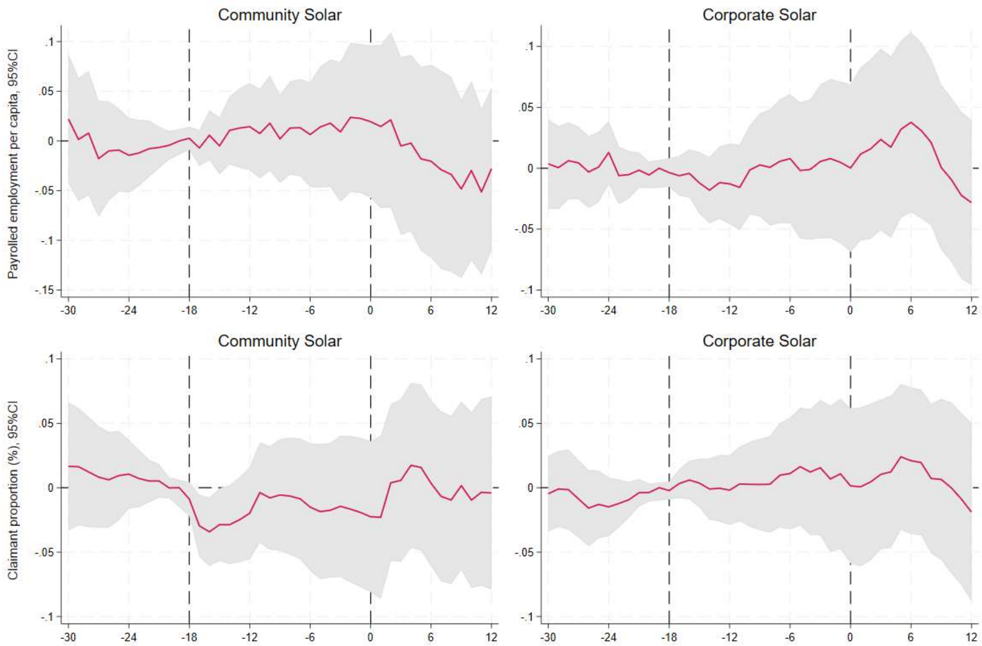

Figure 13: Event-study estimates of community and corporate solar plants on payrolled employment per capita in the first row, and claimant proportion (%) in the second row. Only England and Wales are used for these estimations. The results correspond to the average total effect presented in Table 6.

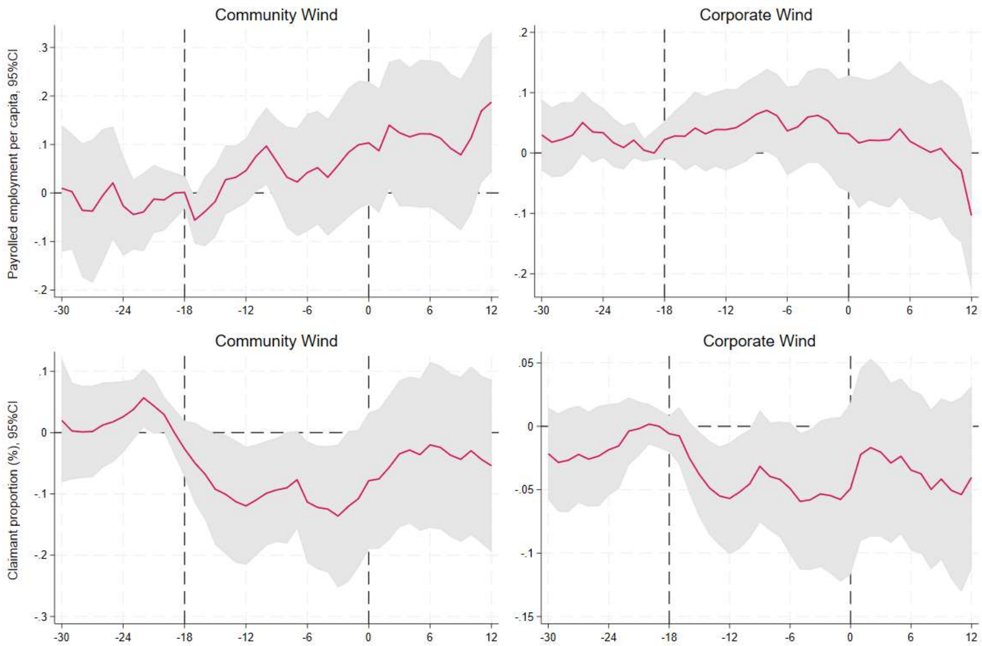

Figure 14: Event-study estimates of community and corporate wind plants on payrolled employment per capita in the first row, and claimant proportion (%) in the second row. South England and Midlands are dropped for these estimations. The results correspond to the average total effect presented in Table 6.

Table 6 shows the average point estimates that correspond to the event study graphs in Figures 11 to 14. The point estimates suggest that the effect on payrolled employment per capita is not statistically significant for any of the renewable plant types. The effect on claimant proportion is significant for wind plants and community wind plants' impact is larger than corporate wind plants, -0.072 percentage points and -0.046 percentage points respectively.

All these effects are transitional, and they fade away once the plant starts to operate as Figures 11 to 14 show. The effects being stronger for claimant proportion than payrolled employment per capita, both in terms of significance and magnitude, may come as puzzling. However, these results reveal an important aspect of the UK's construction industry. The construction industry has the highest self-employment rate, around 35%, while the economy wide average in the UK is 16% (Rhodes, 2019). Since self-employed workers are not recorded in payrolled employment, these statistics do not reflect a part of the employment created in this case.

Table 6: The effect of renewable plants by type on payrolled employment per capita, and claimant proportion in the UK LADs

	Community Solar		Community Wind		Corporate Solar		Corporate Wind	
Payrolled employment per capita	-0.0104	-0.0100	0.0155	0.0737	-0.0170	-0.0117	-0.0120	0.0000
	(0.0286)	(0.0294)	(0.0390)	(0.0501)	(0.0210)	(0.0210)	(0.0267)	(0.0373)
Observations	20852	18227	23245	7262	17714	15571	22642	6721
Sample	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.
Claimant proportion (%)	-0.0096	-0.0194	-0.0455	-0.0726*	0.0004	-0.0028	-0.0238	-0.0462*
	(0.0232)	(0.0221)	(0.0301)	(0.0423)	(0.0191)	(0.0187)	(0.0173)	(0.0244)
Observations	116349	104257	121270	36546	98977	88427	109881	29487
Sample	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.

Notes: This table shows the average treatment effect on two outcome variables: Payrolled employment per capita, claimant proportion (%); of four different renewable plant types: Community solar, community wind, corporate solar, corporate wind. The treatment is set to eighteen months before the plant opening month to capture the construction period effects. The treatment is defined as binary and non-absorbing. The effect is assumed to stabilize once the plant opens and construction period ends. Covariates consist of other types of renewable plants' capacity when one type is defined as treatment, i.e. when community solar is defined as treatment, community wind, corporate solar, and corporate wind capacities are controlled. Geographical restriction means using only England and Wales LADs for solar and dropping LADs of South England and Midlands for wind. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

4.3) Further robustness checks

The analysis so far contains several geographical and capacity restrictions, functioning as robustness checks. However, it is worth looking at the effect of community plants on top of corporate capacities to further check whether LADs that receive community capacity, but not corporate capacity are driving the results. To this end, we restrict the sample to the LADs that are treated by corporate solar and then estimate the effect of community solar to capture this effect. Also, in separate estimations, the sample is restricted to LADs that are treated by corporate wind, and the effect of community wind capacity is estimated subsequently. Again, the same capacity cutoffs are also implemented along with estimations without any cutoff. The results are given in Appendix A4.

As Appendix A4 shows, community plants increase income per capita, although the estimates are not statistically significant. Community solar shows a positive effect on energy employment rate while community wind does not affect labor market outcomes. These findings are in line with the ones presented in the main text.

5) Concluding remarks and discussion

We answer two related empirical questions to compare the local economic impacts of renewable plants in comparison to their ownership types. We detect important indications of income gains created by community renewable plants. Also, corporate wind plants increase local income per capita meaningfully when an LAD has more capacity installed. We explain this effect by the benefit sharing practices of the corporate wind developers. The employment effects are more nuanced and present a complicated picture: Community solar plants and corporate wind plants increase long-term energy employment. Only wind plants show construction-period effects on the labor market, regardless of their ownership type.

In relation to the local opposition towards renewable energy projects, our findings suggest that this behavior cannot be simply explained by economic motives across ownership types, because we find economic benefits of corporate wind plants. Considering that the corporate wind plants actively contribute to the community benefit funds, the local economic benefits are not due to side effects but rather the results of deliberate institutional arrangements. This is obvious from the reverse case: Corporate solar plants do not contribute to income, long-term or short-term employment in the host communities as corporate solar developers do not engage in regular benefit-sharing practices. On the other hand, the economic motive for engaging in RECs is stronger and supported by our findings.

The findings of this study are crucial for several reasons: First, our results imply that community ownership and benefit-sharing can be viable tools to merge environmental and inclusive economic growth goals. This means that local ownership and/or benefit-sharing present a unique opportunity to meet several Sustainable Development Goals at the same time. These include “affordable and clean energy” (SGD 7), “inclusive economic growth” (SDG 8), and “sustainable cities and communities” (SDG 11). It is a vital addition to green growth policies to present a viable narrative that they should consider the ownership structure and business practices of the energy transition process. In the face of rapid energy transition, such as the one experienced by the UK, RECs and corporate wind plants with community-benefits might have been an important tool to alleviate, or partially offset, the negative effects of coal phase out in the affected regions. Hence, the discussion of the ownership structure and business practices presents a way of thinking about and redefining the winners and losers of the energy transition process. Secondly, as incentive policies evolve, the success of community ownership and benefit-sharing may justify renewed support for FiTs or differentiated incentives for projects that deliver local benefits beyond clean energy. Governments initially promoted renewables through generous FiTs in the 2000s and 2010s. Yet, concerns about rising electricity prices and windfall profits led to auction-based schemes. If community participation, either through ownership or benefit funds, enhances local economic outcomes, policymakers could consider targeted incentives for projects in less developed regions or those benefiting disadvantaged groups.

It is noteworthy that good practice guidance documents, elaborated by the government in collaboration with the wind industry, made a substantial economic difference. These guidelines attempt to make developers consider local people and define a benchmark amount of 5,000 pounds per MW per year as a contribution to the community benefit funds. Solar plant developers could adopt similar guidance, enabling local governments to leverage renewable plants as tools for local economic development.

Finally, this study can be extended to several countries. Foremost to Denmark, Germany, the Netherlands, Belgium, and France, which have a widespread presence of RECs.

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APPENDIX

A1) Yearly estimations when treatment is defined continuously

Table A1.1: The effect of renewable plants by type on employment rate, unemployment rate and income per capita in the UK LADs

	Community Solar		Community Wind		Corporate Solar		Corporate Wind	
Employment rate (‱)	-0.0107 (0.020)	-0.0245 (0.021)	-0.0114* (0.006)	-0.0020 (0.004)	0.0053** (0.002)	-0.0013 (0.006)	-0.0018 (0.002)	0.0024 (0.008)
Unit-time pairs	5766	5222	6146	1780	5545	4994	5244	1169
Sample	All	Geo. Rest.	All	Geo. Rest.	All	Geo. Rest.	All	Geo. Rest.
Energy employment rate (‱)	0.0084* (0.005)	0.0129*** (0.004)	-0.0013** (0.001)	0.0001 (0.000)	0.0019** (0.001)	0.0024** (0.001)	0.0003 (0.000)	-0.0006 (0.001)
Unit-time pairs	5016	4501	5377	1686	4995	4469	4637	1122
Sample	All	Geo. Rest.	All	Geo. Rest.	All	Geo. Rest.	All	Geo. Rest.
Income per capita (p)	15.74*** (3.675)	11.32*** (3.500)	-0.05 (1.014)	1.08** (0.543)	1.52 (1.307)	-1.15*** (0.126)	-0.12 (0.337)	-0.50 (0.935)
Unit-time pairs	5615	4982	8754	2636	6344	5624	7477	1823
Sample	All	Geo. Rest.	All	Geo. Rest.	All	Geo. Rest.	All	Geo. Rest.

Notes: This table shows the kW capacity treatment effect on three outcome variables: Employment rate (‱), unemployment rate (‱), income per capita (p); of four different renewable plant types: Community solar, community wind, corporate solar, corporate wind; when the treatment is defined as continuous and staggered. The results should be interpreted as "the effect of 1 kW capacity increase". Unit-time pairs show the number of unit-time pairs used to estimate the average treatment effect. Covariates consist of other types of renewable plants' capacity per capita (kW per capita) when one type is defined as treatment, i.e. when community solar is defined as treatment, community wind, corporate solar, and corporate wind are controlled. Sample shows the sample restrictions. Geographic restriction means using LADs of England and Wales for solar estimations and dropping LADs of South England and Midlands for wind estimations.

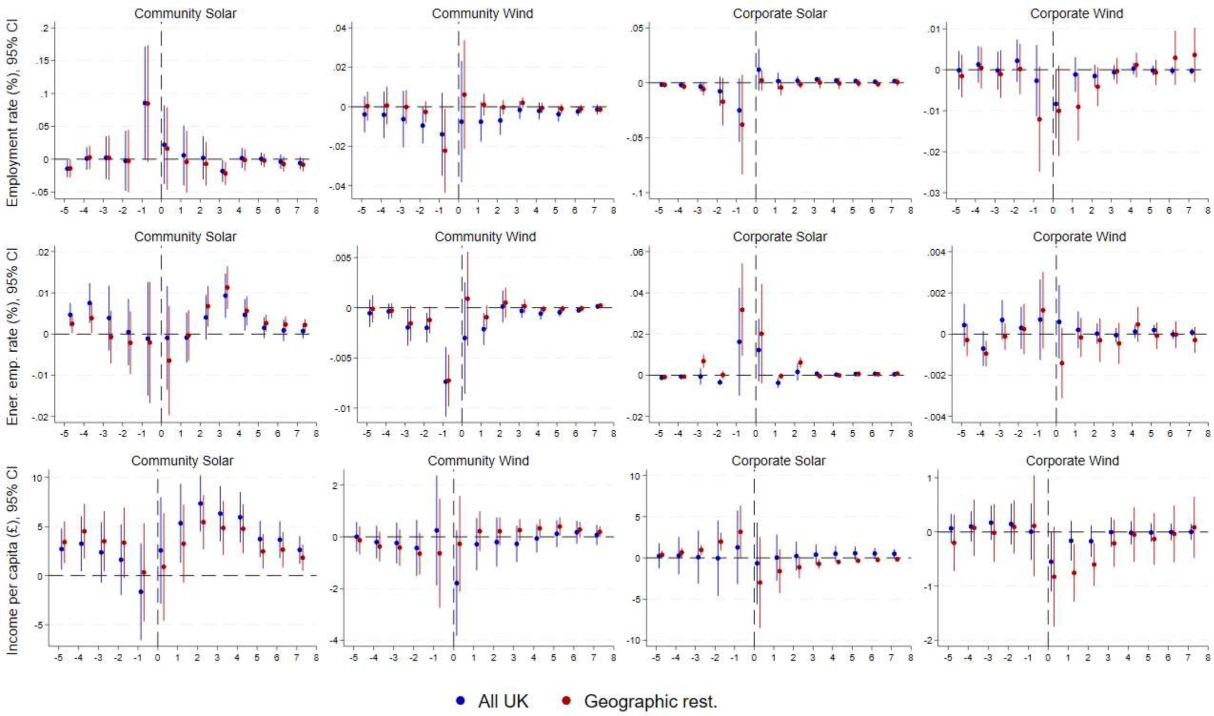

Figure A1.1: Event-study estimates of four different types of renewable plants on employment rate (‰o) in the first row, energy employment rate (‰o) in the second row, and income per capita (p) in the third row. The results correspond to the kW capacity treatment effect presented in Table A1.

A2) Solar estimations on income per capita with different capacity cutoffs

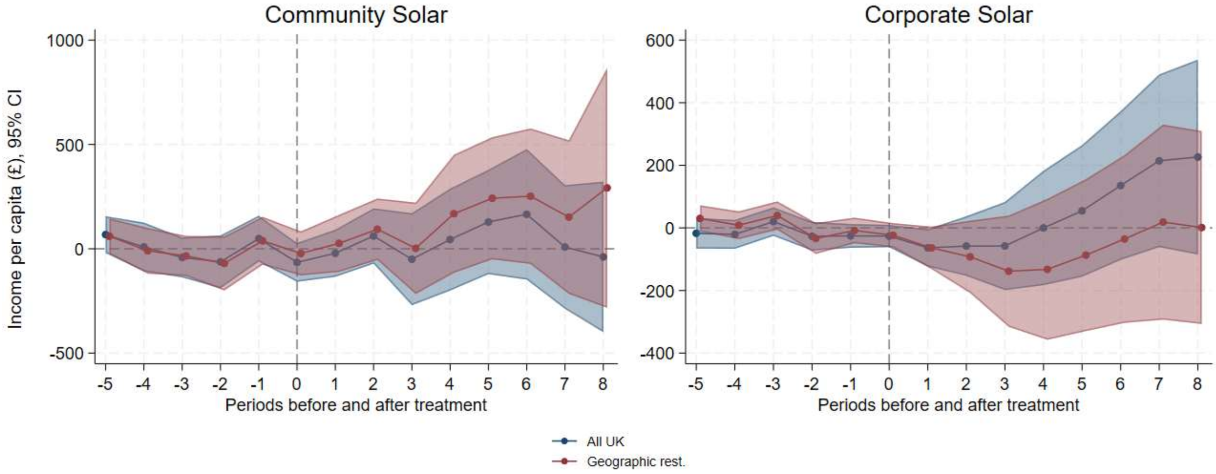

Figure A2.1: Event-study estimates of community and corporate solar on income per capita (£) when LADs that receive less than 0.5 MW capacity by 2024 are dropped. Geographic restriction means using only England and Wales LADs. The results correspond to the average total effect presented in Table A2.

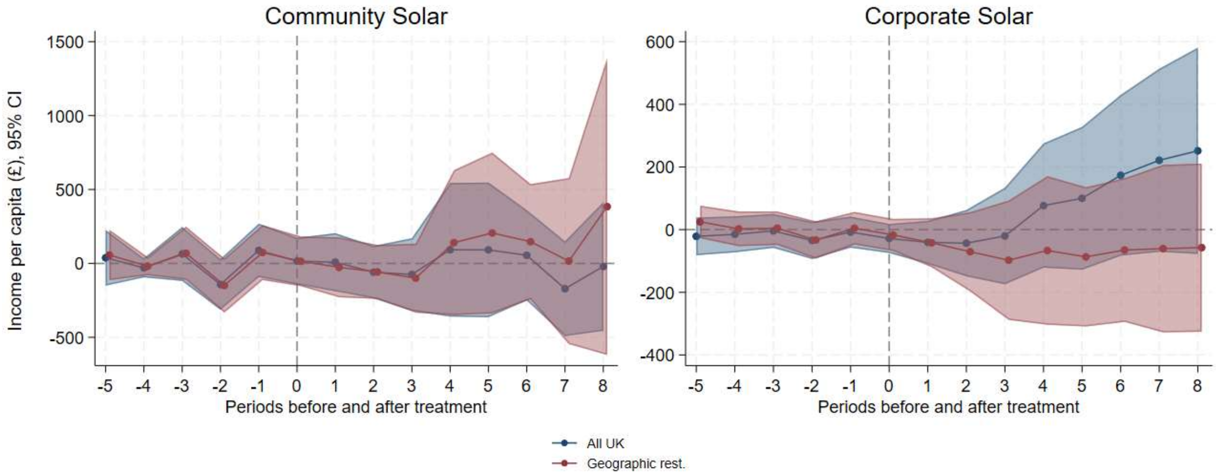

Figure A2.2: Event-study estimates of community and corporate solar on income per capita (£) when LADs that receive less than 5 MW capacity by 2024 are dropped. Geographic restriction means using only England and Wales LADs. The results correspond to the average total effect presented in Table A2.

Table A2.1: The effect of community and corporate solar capacities on income per capita in the UK LADs

	Community solar > 0.5 MW		Community solar > 5 MW		Corporate solar > 0.5 MW		Corporate solar > 5 MW	
Income per capita (£)	25.76 (85.76)	133.95 (109.75)	-6.95 (106.69)	80.49 (159.44)	47.26 (76.73)	-61.42 (86.35)	76.82 (81.38)	-62.58 (76.72)
Number of obs.	5886	4941	5157	4266	7506	6507	5130	4617
Sample	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.

Notes: This table shows the average treatment effect on income per capita of community solar, and corporate solar. All estimations use covariates that consist of other types of renewable plants' capacity per capita (kW per capita) when one type is defined as treatment, i.e. when community solar is defined as treatment, community wind, corporate solar, and corporate wind capacities are controlled. Geo. Rest. means that the estimations use England and Wales. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

A3) Wind estimations on income per capita with different capacity cutoffs

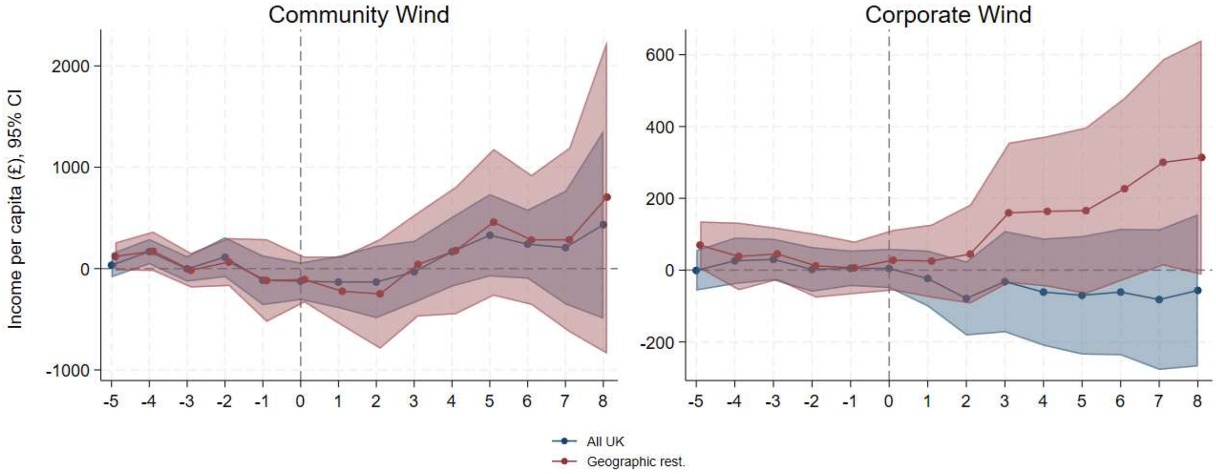

Figure A3.1: Event-study estimates of community and corporate wind on income per capita (£) when LADs that receive less than 1 MW capacity by 2024 are dropped. Geographic restriction means dropping LADs of South England and Midlands.

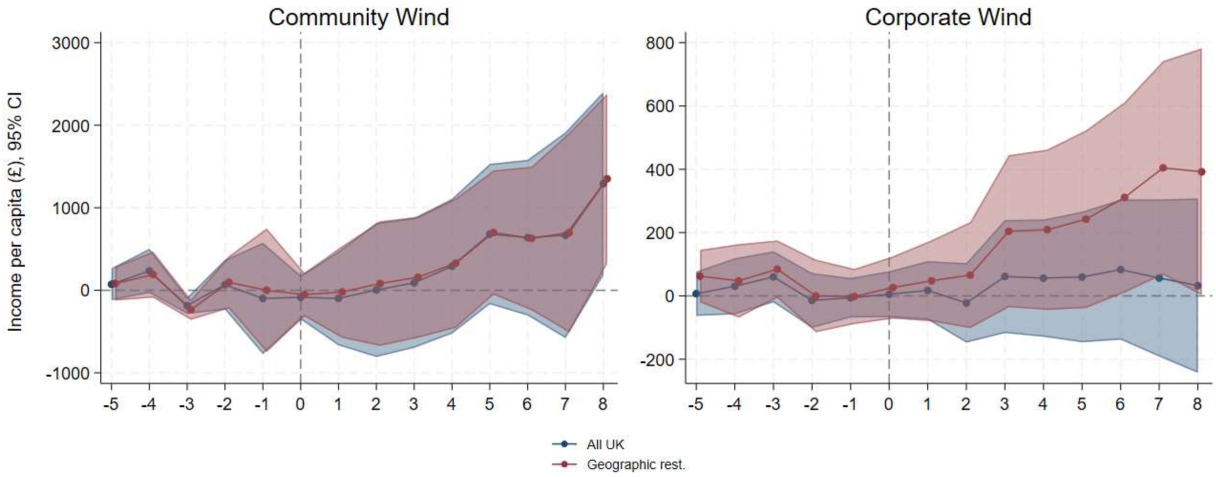

Figure A3.2: Event-study estimates of community and corporate wind on income per capita (£) when LADs that receive less than 10 MW capacity by 2024 are dropped. Geographic restriction means dropping LADs of South England and Midlands.

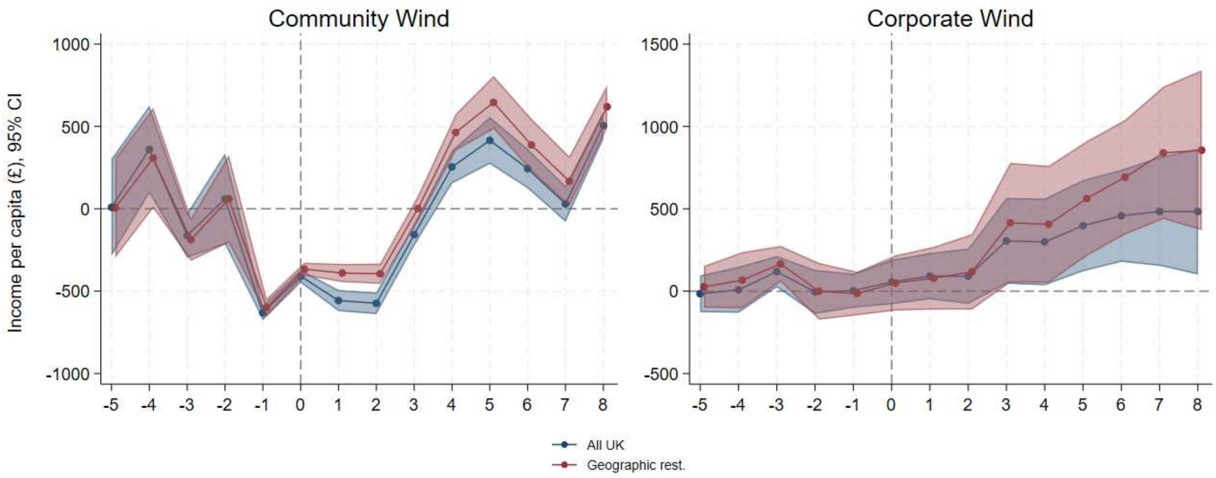

Figure A3.3: Event-study estimates of community and corporate wind on income per capita (£) when LADs that receive less than 50 MW capacity by 2024 are dropped. Geographic restriction means dropping LADs of South England and Midlands.

Table A3.1: The effect of community and corporate wind capacities on income per capita in the UK LADs

	Community wind > 1 MW		Community wind > 10 MW		Community wind > 50 MW		Corporate wind > 1 MW		Corporate wind > 10 MW		Corporate wind > 50 MW	
Income per capita (£)	106.02 (160.87)	151.87 (263.26)	386.56 (397.00)	430.25 (365.98)	-27.54 (39.01)	126.16*** (44.58)	-51.17 (61.79)	158.62* (89.72)	38.94 (76.83)	211.48** (107.10)	296.00*** (99.89)	446.44*** (134.47)
Number of obs.	8153	2969	7883	2834	7826	2777	6939	2476	5913	2044	4779	1385
Sample	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.	All UK	Geo. Rest.

Notes: This table shows the average treatment effect on income per capita of community wind, and corporate wind. All estimations use covariates that consist of other types of renewable plants' capacity when one type is defined as treatment, i.e. when community wind is defined as treatment, community solar, corporate solar, and corporate wind capacities are controlled. Geo. Rest. means dropping LADs of South England and Midlands. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

A4) Further robustness checks: community-treated LADs are a subset of corporate -treated LADs

A4.1) Community solar

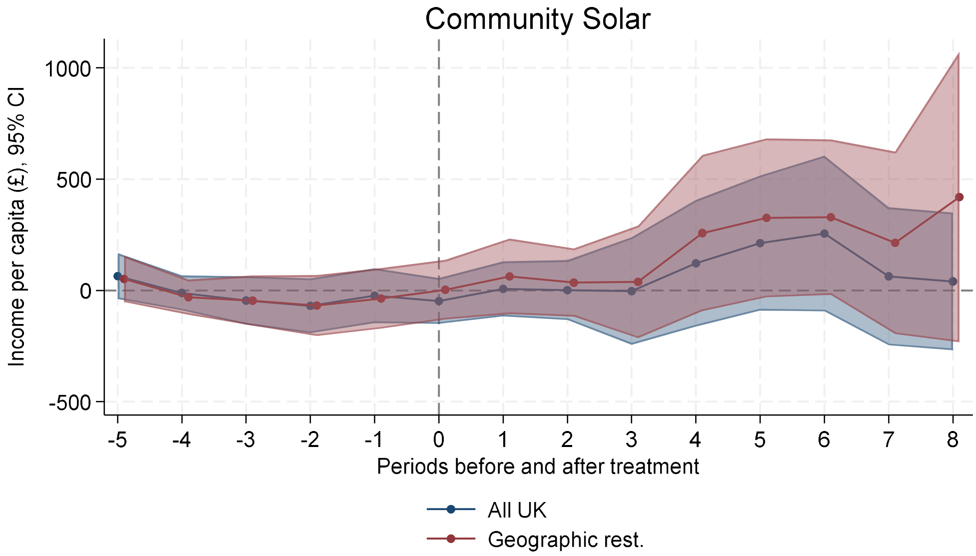

Figure A4.1: Event-study estimates of community solar on income per capita when LADs that receive community solar are a subset of LADs that receive corporate solar. LADs that receive less than 1 MW community solar capacity by 2024 are dropped. Geographic restriction means using LADs of England and Wales.

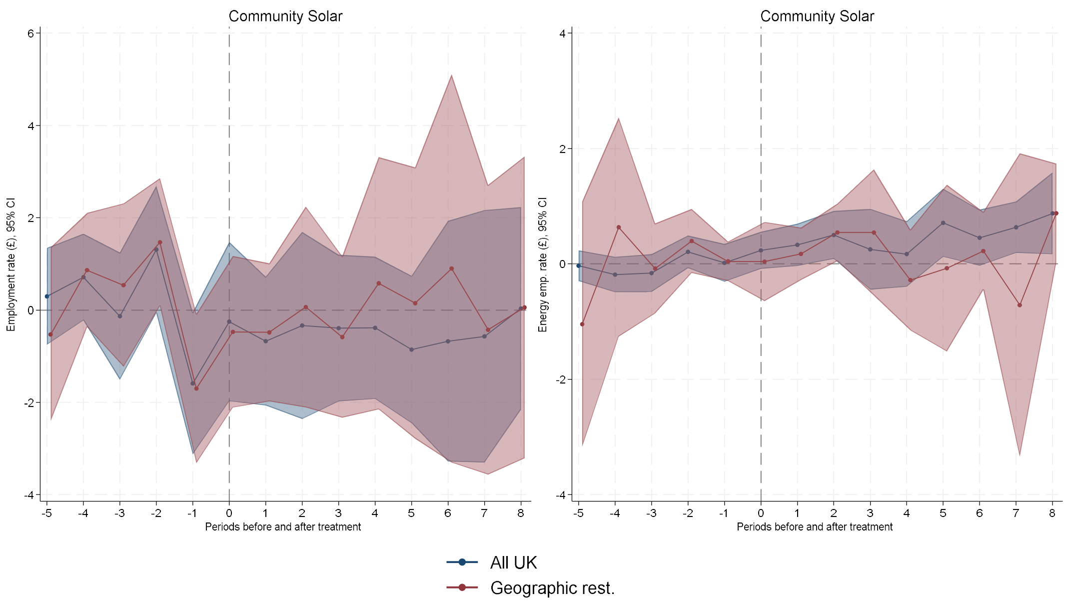

Figure A4.2: Event-study estimates of community solar on employment and energy employment rates when LADs that receive community solar are a subset of LADs that receive corporate solar. LADs that receive less than 1 MW capacity by 2024 are dropped. Geographic restriction means using LADs of England and Wales.

A4.2) Community wind

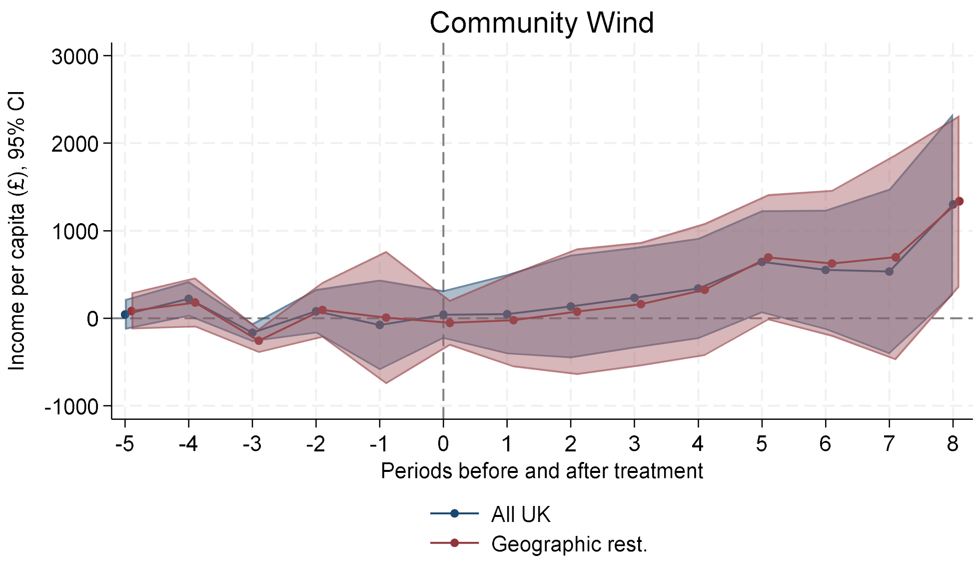

Figure A4.3: Event-study estimates of community wind on income per capita when LADs that receive community wind are a subset of LADs that receive corporate wind. LADs that receive less than 5 MW community wind capacity by 2024 are dropped. Geographic restriction means dropping LADs of South England and Midlands.

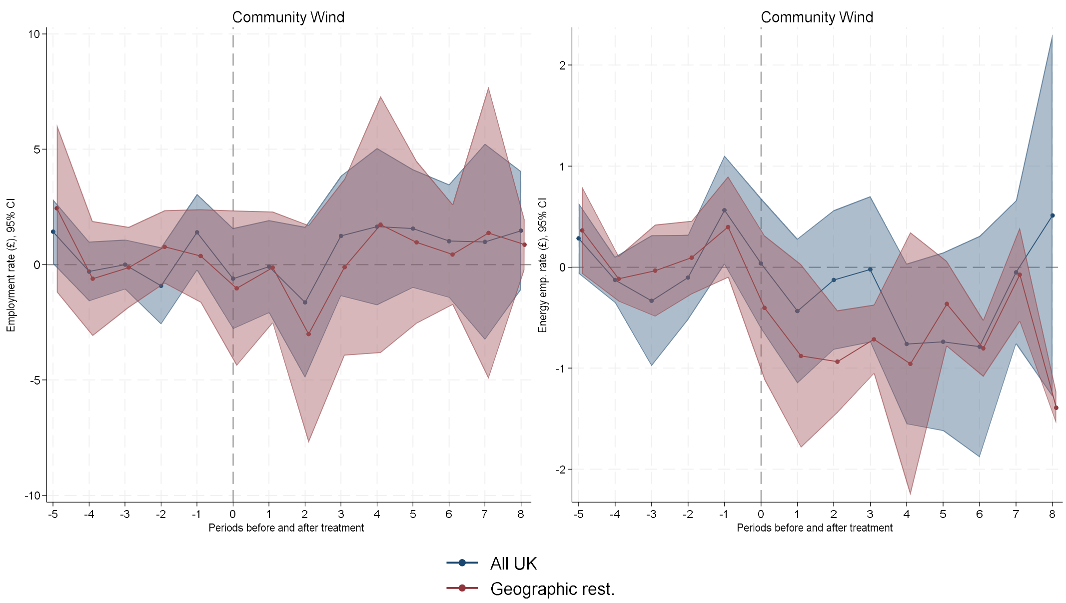

Figure A4.4: Event-study estimates of community wind on employment and energy employment rates when LADs that receive community wind are a subset of LADs that receive corporate wind. LADs that receive less than 5 MW capacity by 2024 are dropped. Geographic restriction means dropping LADs of South England and Midlands.

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