Climate Policy

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tcpo20

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To cite this article: Alice Garvey, Milena Büchs, Jonathan B. Norman & John Barrett (2023) Climate ambition and respective capabilities: are England's local emissions targets spatially just?, Climate Policy, 23:8, 989-1003, DOI: 10.1080/14693062.2023.2208089

To link to this article: https://doi.org/10.1080/14693062.2023.2208089

CLIMATE POLICY
2023, VOL. 23, NO. 8, 989–1003
https://doi.org/10.1080/14693062.2023.2208089

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RESEARCH ARTICLE

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Climate ambition and respective capabilities: are England's local emissions targets spatially just?

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ABSTRACT

To date, 79% of Local Authorities (LAs) in England have a climate plan to reduce their greenhouse gas emissions by 2050 or sooner. Yet questions remain over the collective impact of these plans and targets in terms of their contribution to a national net zero carbon budget given that the LA targets are voluntary and largely uncoordinated. There is therefore scope to explore if and how the LA target-setting process could be improved. We evaluate regional ambition in the emissions targets of 311 English LAs. We assess whether the subnational targets are aligned with a national net zero carbon budget and whether LAs take proportionate action based on their respective capabilities. It is also unclear whether LAs have the resources to implement the often highly ambitious targets they have committed to. Using a composite indicator approach, we assess the relative capability of different LAs to decarbonize, as well as the degree of ambition they are demonstrating. We find that many LAs are not taking as much action as other LAs that may have less capability to act. This suggests that burden-sharing between regions and LAs is inequitable. We offer a series of policy recommendations to improve the fairness and effectiveness of the LA target-setting process as a climate governance mechanism, including establishing a statutory target-setting requirement with appropriate resourcing, and introducing a national net zero indicator framework to monitor progress. This framework could be used in England, or in other countries, to assess progress. It would also allow funding and resources to be better directed to regions and LAs that require more support to reach net zero emission targets, rendering the transition more 'spatially just' and enabling its delivery.

Key policy insights:

- The English LA targets contribute to achieving a national net zero carbon budget. However, there is still a 1.2 $GtCO_2$ gap in achieving this by 2050.
- The most ambitious LAs did not necessarily score highly in terms of capability.
- Seven of the ten LAs with the highest capability scores were in London; the least capable LAs were more dispersed.
- Greater standardization, oversight and coordination could improve the effectiveness and fairness of LA target-setting, and help direct resources from the central government to less capable LAs and regions. This could render the targets 'spatially just' and enable their delivery.
- This could be achieved by developing a statutory target-setting requirement and national net zero indicator framework such as the one laid out in this paper.

ARTICLE HISTORY
Received 14 July 2022
Accepted 24 April 2023

KEYWORDS
Net zero; emissions targets; regional; capability; local authorities; climate change mitigation

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Supplemental data for this article can be accessed online at https://doi.org/10.1080/14693062.2023.2208089.

1. Introduction

A notable recent climate governance paradigm has been the proliferation of net zero greenhouse gas (GHG) targets at the local scale. A majority of UK local authorities (LAs) have committed to achieving net zero GHG emissions by 2050 or sooner, rendering many targets more ambitious than national policy. However, these targets are essentially voluntary and are unaccompanied by national oversight, questioning the credibility of this ambition in light of varying regional[1] capabilities to decarbonize.

In 2021, the UK committed to a 78% reduction in GHG emissions by 2035, in line with the Climate Change Committee's (CCC) national level Sixth Carbon Budget advice (Department for Business, Energy and Industrial Strategy [BEIS], 2021a). 82% of UK councils[2] have a target to reach net zero operational GHG emissions,[3] whilst 62% have an area-wide target for net zero and 61% of councils have a target for both sources.[4] Whilst the UK's national target for net zero emissions by 2050 is ambitious, we found that 56% of UK LAs have an operational target and 26% have an area-wide target to meet net zero *before* this date.

The CCC provides guidance to the UK government on 5-yearly carbon budget levels (i.e. the amount of GHG emissions that can be produced on a cumulative basis in line with long-term emissions targets such as net zero). Whilst these budgets are legislated at the national scale, there is no clear structure for devolving responsibility to deliver these emissions reductions at the subnational scale. Similarly, there is little guidance as to how responsibilities should be distributed between central government, the Devolved Administrations (DAs) of Scotland, Wales and Northern Ireland, and LAs, or a sense of the relative scale of the duties of each actor.

LAs represent one of the smallest scales of government in the UK (except town or parish councils), and are formed of elected councillors, as well as council officers responsible for delivering services. To fulfil their statutory responsibilities or 'duties', councils often work in partnership with other private or public organizations across different scales. The 333 LAs in England provide over 700 services (Local Government Association, 2010), with legislative powers in several key sectors that have implications for net zero including transport, buildings (through planning powers), energy and waste (UK100, 2021).[5]

However, climate action is not a statutory responsibility (Bulkeley & Kern, 2006). Uncertainty over roles and responsibilities have been cited as drivers of inaction to date (Creasy et al., 2021; Yuille et al., 2021). Additionally, there are currently ten Combined Authorities (CAs) in England, legal partnerships of two or more LAs, nine of which have a directly elected mayor. CAs are proposed as an important new climate governance mechanism, but their powers vary due to differences in the way devolution deals were negotiated (UK100, 2021). This further complicates how responsibility for delivering a net zero carbon budget is downscaled.

The voluntary nature of net zero targets is perhaps highlighted in the fact that a third of councils with 2030 targets have not created or updated climate plans (Howarth et al., 2021a), creating a gap between stated ambitions and action on implementation (Yuille et al., 2021). Councils are estimated to be able to influence a third of emissions in their local area due to their role in service delivery (CCC, 2020a), but they have no statutory requirement to do so. This makes the delivery of the UK's national net zero target at least partly contingent on voluntary action (CCC, 2020a).

This paper aims to evaluate whether the spatial variation in the ambition of LA net zero targets is fair. Spatial justice as it applies to the low carbon transition can be defined as the fair geographical distribution of benefits and burdens arising from transition (Garvey et al., 2022). Similar to the UNFCCC principle of Common But Differentiated Responsibility and Respective Capabilities,[6] a spatially just approach to local emissions targets would mean that those LAs that are more 'capable' are taking proportionate action. A spatial justice framing is chosen given the UK is one of the most regionally unequal of all developed countries (McCann, 2020), and there is a current political agenda to 'level up' the UK's subnational regions (HM Government, 2022). There is a need to ensure that subnational climate mitigation does not result in exacerbating regional inequalities in the UK.

Our first research question asks: to what extent do the LA targets contribute to achieving a national net zero carbon budget? We develop emissions scenarios of English LA target implementation and evaluate whether their cumulative impact is consistent with CCC net zero carbon budgets. Secondly, we question how target

ambition varies by LA type and region, to assess whether there are inequalities in responsibility-taking. We finally explore whether regions capable of undertaking greater decarbonization are taking more ambitious action, via LAs, using a composite indicator framework to explore and compare the ethical concepts of responsibility, ambition and capability.

1.1. Words speaking louder than actions? The target-setting phenomenon

With the worldwide growth of local climate commitments, whether in the form of quantitative emissions reduction targets or so-called Climate Emergency Declarations,[7] there has been corresponding growth in research assessing the intent and effectiveness of such commitments. There has typically been a weighting in the literature towards qualitative evaluation (Gudde et al., 2021; Howarth et al., 2021a; Ruiz-Campillo et al., 2021; Yuille et al., 2021); the quantitative carbon accounting approach of this analysis aims to correct this research gap.

There is reasonable consensus across the literature in the gap between commitments and action, at the local, national and international levels. Other analyses support this by providing quantitative evaluation. Such 'progress tracking' has a long prehistory (Allman et al., 2004; Gibbs et al., 1996; Reckien et al., 2014). In their recent review of global net zero targets, Hale et al. (2022) find that only 20% of the recent round of targets are robust (detailing their 'timing', 'coverage', 'use of offsets' and 'governance'), and indicate that although 'net zero' is conceptually ubiquitous it is limited in practice. Howarth et al. (n.d.) evaluate the cumulative ambition of local targets, finding that the LA targets have the potential to exceed national net zero ambitions. However, this analysis is restricted to urban authorities and does not therefore explore regional differences in ambition. Armstrong's (2019) US case study finds that local energy action could exceed that targeted at the state level. Local areas are shown to have at least the ambition to bypass any conservatism of national, higher-tier targets (Roppongi et al., 2017), a premise this analysis tests.

The literature on subnational climate action is typically oriented around the urban or city-scale (Bulkeley & Betsill, 2005; Castán Broto et al., 2019; Grafakos et al., 2020; Reckien et al., 2018; Russell & Christie, 2021; Salvia et al., 2021). However, this ignores the role of large rural counties, of regions with industrial facilities outside the boundaries of metropolitan city regions, and results in a partial approach to emissions coverage when net zero demands action from authorities of all types and across the urban-rural dichotomy (CCC, 2020a). Therefore, we consider *all* English LAs to shape a more inclusive and representative approach.

Whilst questions of responsibility, ambition and capability are important to discussions of net zero emissions targets and pathways, there have been few attempts to quantify these concepts at the subnational level. This study takes a spatial justice-based approach in assessing disparities in subnational mitigation ambition and capability. In the following sections, we outline the methods and data used (Section 2), before presenting the results – structured by the three stated research questions (Section 3). We finally discuss the findings, proposing a series of policy recommendations and areas for further research (Section 4), and outline our conclusions (Section 5).

2. Methods

The modelling involved three dimensions: (1) analysing LA target ambition; (2) exploring the cumulative impact of the LA targets in context of national carbon budgets; and (3) constructing composite indicators (Co-Is) for each LA to assess their relative level of ambition and capability.

2.1. Analysing local authority target ambition

2.1.1. Compiling a LA target database

Two datasets provided detail on LA emissions targets: one constructed by the Place-Based Climate Action Network (PCAN, Howarth et al., 2021a), and another by Climate Emergency UK (CEUK, 2022). We cross-referenced each dataset to ensure reliability. Target data verification was undertaken in March 2022, therefore it is possible that this dataset may change in future and cannot be considered a fixed entity given ongoing

commitments by authorities. We limited our analysis to England due to issues of harmonizing datasets for emissions and indicator data from each DA. We filtered the sample to LAs with data available across all sub-indicators to ensure consistency, resulting in a sample of 311 English LAs from a total possible 343[8] (Sandford, 2021). For further detail on the authorities included, see Sections 2 and 3 in the Supplementary Material. The final sample represents 96% of England's CO_2 emissions in 2019. County councils are comprised of multiple LAs and were excluded to avoid double counting administrative areas.

2.1.2. Building emissions reduction pathways for English local authorities

To model the impact of LAs achieving their committed net zero targets, we adopted the BEIS (2021b) 'UK Local Authority and regional CO_2 statistics' for 2005–2019, and assumed 2019 as a standardized baseline year for the start of emissions reductions. The precise trajectory of emissions reductions was rarely specified in LA climate plans. We therefore assumed that LAs would implement linear emissions reductions between the baseline year (2019) and target year. LAs setting an interim target were the exception.

2.1.3. Operational vs. area-wide targets

The target dataset includes net zero dates for LA council operations and for reaching area-wide[9] net zero. 192 LAs in the sample had both target types. By contrast, 30 LAs had neither target. 78 of the LAs had an operational target but no area-wide target, suggesting the relative ease in setting the former target type. Only one LA had only an area-wide target. In many cases it was unclear whether the area-wide target included the council's own operations. The most common target date for both types was 2030, and in the case of 167 LAs the date was the same for both targets. Operational targets were modelled as reductions in the public sector emissions as a fraction of the area-wide emissions. Therefore, where LAs had both operational and area-wide targets they were applied simultaneously whilst ensuring double counting did not occur. For both target types we assumed that emissions levels remained constant at their target values after their target date had been reached.

2.2. Local CO_2 targets in context of national carbon budgets

Modelling the emissions reduction profiles of the LAs allows an accounting of their cumulative emissions between 2020 and 2050, and a comparison with the national net zero carbon budget. To establish how future LA emissions compare to a business-as-usual case, the Sixth Carbon Budget baseline emissions scenario was adopted (CCC, 2020b). The CCC's 'baseline' scenario assumes that 'no further climate action is taken beyond today' (CCC, 2020c, p. 20). Our baseline emissions scenario is therefore based on estimates of conservative policy action at the national scale. The baseline scenario provides a sense of the scale of national emissions LAs are mitigating, and therefore of the value of local action in a potential future context of unambitious national policy.

The baseline scenario can be contrasted against the CCC's 'balanced net zero pathway' (BNZP), which we also adopt as a reference scenario. The Sixth Carbon Budget analysis sets out four pathways to reach net zero emissions by 2050, reflecting various uncertainties in technological innovation and societal change that could occur to get there. The BNZP is a balanced product of these four distinct scenarios that 'keeps in play a range of ways of reaching that target' (CCC, 2020c, p. 13). We scaled the CCC's BNZP to the England level. See Section 2.3 in the Supplementary Material for more detail on the reference scenarios.

2.3. Constructing composite indicators

Co-Is integrate multiple indicators into one index, and 'measure multi-dimensional concepts' (OECD, 2013). Table 1 outlines the structure of the Co-Is used in this analysis. 2019 is chosen as a baseline year in most datasets, since this is when the majority of LAs set targets. A comprehensive literature review informed the choice of indicators for the two Co-Is: ambition and capability (Eder & Narodoslawsky, 1999; Frumhoff et al., 2015; Höhne et al., 2014; Newell et al., 2015).

Table 1. Overview of indicators in the ambition and capability composite Indicators (Co-I).

Co-I	Dimension addressed	Indicators
Ambition	Action to date	Historic reductions in LA CO_2 per capita emissions (2005–2019); (BEIS, 2021b)
	Future action	Projected future reductions (2020–2050); (own analysis)
Capability	Socioeconomic baseline	Indices of Multiple Deprivation 2019; (Ministry of Housing Communities and Local Government, 2019)
	Economic capability	LA spending power (2019/20); (Brien, 2022)
	Likelihood of implementing plan	CEUK Climate Plan Quality Scores; (CEUK, 2022)
	Technical capability	Percentage of LA area emissions in scope of council control; (BEIS, 2021b)

Responsibility and capability are viewed as key 'equity principles' in climate action (Höhne et al., 2014) and are enshrined in the UNFCCC framework of Common But Differentiated Responsibility and Respective Capabilities. These principles are drawn from international environmental law to determine the 'fair share' of climate mitigation that states should be implementing (Rajamani et al., 2021). We consider how the concept of 'fair shares' of climate mitigation can be applied to the subnational scale, through applying the concepts of capability and responsibility to English LA net zero targets. Responsibility is most commonly conceptualized as *historic* responsibility. However, the socioeconomic fortunes of formerly productive regions have changed considerably, meaning these regions are less likely to be able to take responsibility for their current, let alone historic, emissions. Responsibility is therefore expressed through the indicator of 'ambition', suggesting the levels of responsibility-*taking* by LAs in England.

2.3.1. Ambition

The ambition Co-I is constructed from mitigation action by LAs (2005–2019) and projected future action (2020–2050). Historic reductions were assessed using the BEIS CO_2 dataset, and percentage reductions are then transformed into percentile ranks. The larger the reductions to date, the greater the rank. The second indicator ranked the difference in cumulative CO_2 emissions between 2020 and 2050 between the baseline and implemented targets scenario. This suggests how ambitious LAs are going to be should their targets be implemented. In this case, the greater the rank, the greater the planned mitigation.

2.3.2. Capability

Capability refers to the variable ability of different actors or regions to decarbonize. Four indicators of LA capability to decarbonize were chosen, based on the literature and best available data. The indices of multiple deprivation were used as a measure of LA social capital and of the relative ability to mitigate due to baseline socioeconomic challenges (Ministry of Housing, Communities and Local Government, 2019). Local authority spending power was used as a metric of economic capability (Brien, 2022). To suggest how likely LAs were to implement the targets they had committed to, we adopted the scores from CEUK of the quality of climate plans (CEUK, 2022). To indicate technical capabilities, we use the fraction of total area emissions that are considered within the scope of the LA's control. This suggests the administrative control LAs have over emissions within their area, therefore how capable they are to influence them. We disaggregated the fraction of emissions in control to the industrial and transport sectors, as the most variable sectors. In all cases, raw values were normalized with a percentile rank method. In each case, the higher the value, the more capable the LA.

2.3.3. Using the composite indicators

After the construction of the respective Co-Is, analysis was carried out to determine statistical relationships between the indicator sets. Descriptive analysis on the datasets was conducted, including the D'Agostino-Pearson statistical normality test. This allowed trends and notable cases in the data to be established. A Spearman's r correlation was then conducted to determine the relationship between the ambition and capability

scores. For further detail on the approach taken to construct and statistically evaluate the Co-Is, see Sections 4 and 5 (Supplementary Material).

2.4. Methodological limitations

The need to harmonize across datasets to develop each indicator resulted in using CO_2 rather than more comprehensive GHG estimates and excluding the DAs. A critical assumption of the scenarios is that GHG removals will be implemented; this is an area of uncertainty given the lack of widely available commercial GHG removal technologies. The choice of indicators and equal weighting approach in the composite indicator (Co-I) framework may be sources of uncertainty (see Supplementary Material, Section 4).

3. Results

3.1. To what extent do the LA targets contribute to achieving a national net zero carbon budget?

3.1.1. Operational vs. area-wide targets

Predictably, the achievement of area-wide targets would result in emissions reductions of an order of magnitude greater than operational targets alone (Figure 1).[10] As would be expected, there is a noticeable change at the year 2030, marking the significance and frequency of this target date. Though improving on baseline projections, the operational targets fail to make a substantial difference to achieving the CCC's BNZP. This underlines the importance of LAs having targets which aim to influence area-wide emissions (though LAs should be considered as contributing to and facilitating other reductions in the area, rather than being solely responsible for delivering them). Ambitious operational targets could be considered preparation for later area-wide action.

There is a gap of 1.2 $GtCO_2$ between the cumulative budget of the 'all targets' scenario and a cumulative budget consistent with the net zero pathway. However, the 'all targets' scenario is a 51% reduction against the baseline budget. The emissions gap for net zero widens to 4.7 $GtCO_2$ if only the operational targets are met, but the scenario still marks a 14% reduction in cumulative emissions against the baseline case. This

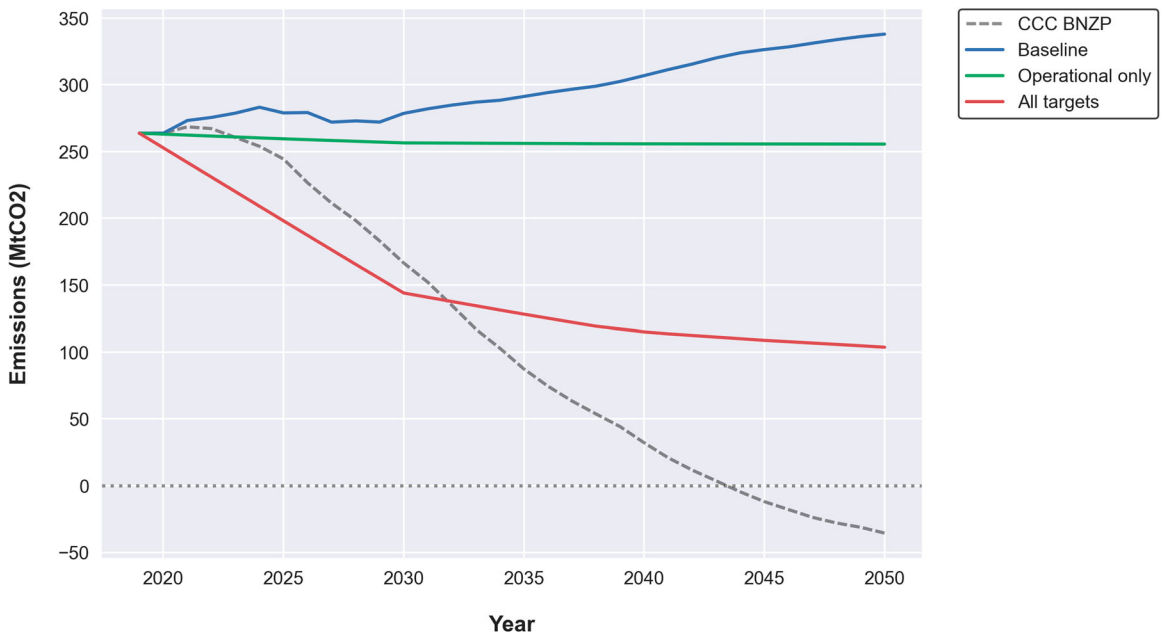

Figure 1. Comparison of emission pathways in each target scenario, assuming constant emissions after the achievement of original net zero targets. 'CCC BNZP' refers to the Sixth Carbon Budget 'Balanced Net Zero Pathway' (n = 301).

indicates that whilst the LA targets are ambitious, they are not sufficient if relied upon to reach a national net zero carbon budget. This may be due to the lack of LAs with area-wide targets, or with no targets at all.

We also assumed constant levels of emissions after LAs achieve their net zero targets, to reflect uncertainties in the achievement of the current targets and in what course of action LAs might pursue after reaching these initial targets. Similarly, the assumption of constant emissions allows for a continuous time series to 2050, which enables the comparison of cumulative emissions. However, it may be that in reality LAs set even more ambitious targets which further reduce their residual emissions after their original target dates. Additionally, this presents a scenario in which LA action is the dominant driver of national mitigation, and further gains would likely be made through specific sectors, and as driven by national policy. For instance, the achievement of the LA targets would be affected by the decarbonization of the national electricity grid.

Responsibility for achieving a net zero consistent carbon budget is ultimately within the remit of national government, but the purpose of this analysis is to consider the scale of impact that local action could have in delivering this, in the absence of any assumed national policy action. By the very act of setting area-wide net zero targets, LAs are implicitly suggesting that they can feasibly decarbonize those areas, but given the lack of local powers, there are clearly areas which will need to be covered by national policy. In practice, a range of actors and sectors will need to decarbonize, and there is a role for central government in coordinating these emissions reductions.

3.2. How does target ambition vary by LA type and region?

3.2.1. LA type

Figure 2 shows the aggregated emissions reduction pathways of the sample by LA type. The 2020–2050 emissions for each type of LA are indexed against their total 2019 baseline emissions. The results suggest that

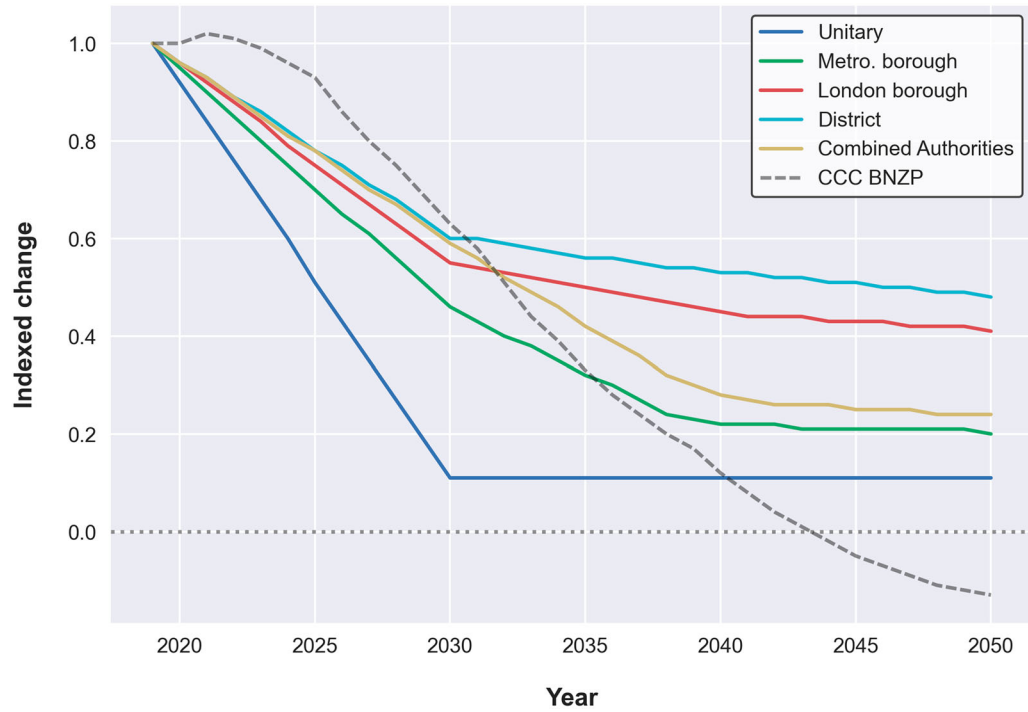

Figure 2. Comparison of emissions reduction pathways aggregated by LA type, and compared against the CCC BNZP scenario (sample: n = 311, in which unitary authorities: n = 54, metropolitan boroughs: n = 36, London boroughs: n = 33, district authorities: n = 178, and CAs: n = 10; indexed to 2019 = 1.0).

unitary authorities[11] display the greatest ambition, particularly in terms of the pace of reductions, with 2030 evidently a key date for this authority type. This may be due to the single tier structure of unitary authorities, where decision-making is in the ownership of one authority, rather than split between tiers (see Supplementary Material, Section 1). Metropolitan boroughs and CAs also appeared ambitious, perhaps reflecting relatively greater powers. Slower progress was suggested by district authorities, perhaps reflecting the issues in allocating responsibilities for decarbonization between the district and county level.

3.2.2. Regional variations in ambition

Figure 3 reveals considerable variation in the indexed aggregated ambition of LAs between nine different regions in England. The 2020–2050 emissions for all LAs within each region are indexed against the total 2019 regional baseline emissions. The LAs in the South West region displayed the greatest ambition in terms of the cumulative reduction pathway, followed by the North West, and Yorkshire and the Humber. Demonstrating a slower pace and scale of reduction were the East of England, the East Midlands, and the North East.

3.3. Are regions capable of undertaking greater decarbonization taking more ambitious action?

Statistical tests of correlation (see Supplementary Material, Section 5) showed that there is a very weak positive correlation between the capability and ambition scores ($r = 0.29$); however, the positive correlation was statistically significant ($p = 3.45e\text{-}07$). This suggests that higher capability is moderately associated with higher ambition.[12] Nevertheless, as noted, this is not a strong positive correlation, and there are several regional anomalies.

Though it is difficult to identify definitive patterns in the comparison of Co-Is scores, there are certain regional trends. Notably, seven of the ten LAs with the highest capability scores were in London, with two in the South East and one in the South West. The ten least capable areas were in the North West ($n = 4$),

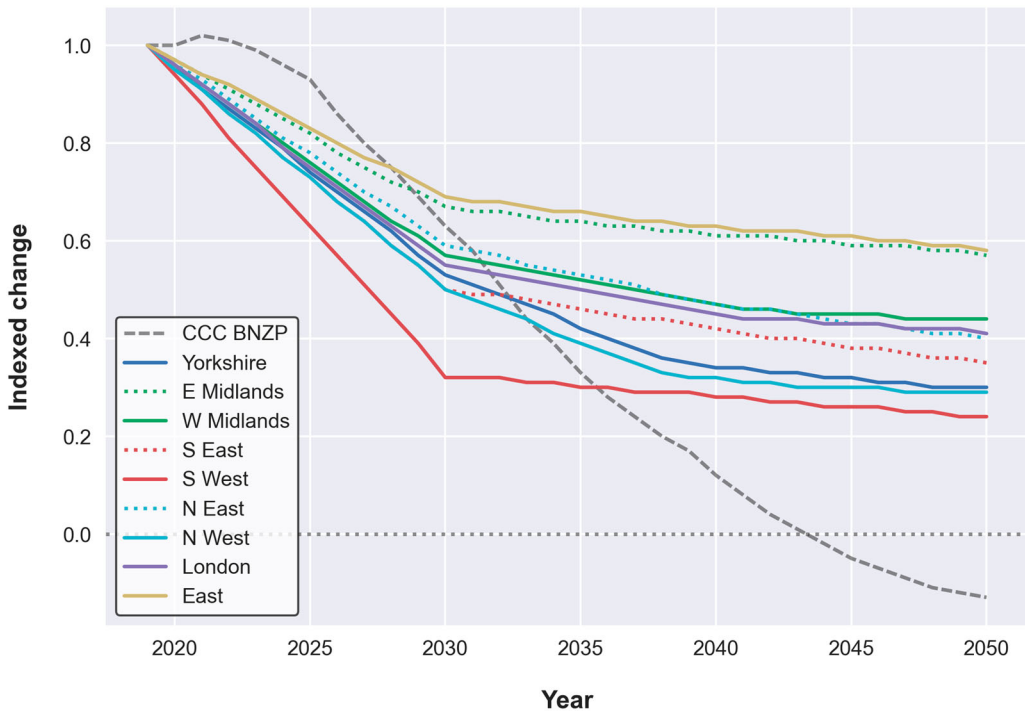

Figure 3. Comparison of emissions reduction pathways aggregated by region against the CCC BNZP pathway (n = 301; indexed to 2019 = 1.0).

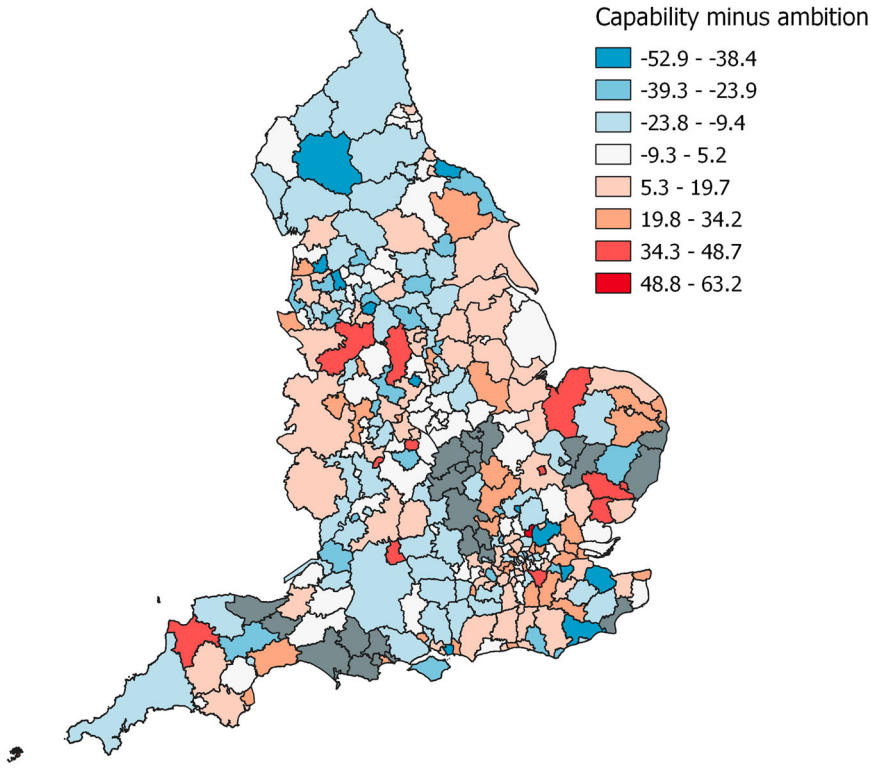

Figure 4. Choropleth indicating the difference between capability and ambition scores by LA (n = 301).

East Midlands (n = 2), East of England (n = 2), and West Midlands (n = 2). With respect to ambition, half of the ten lowest ambition scores were in the East of England, two in the East Midlands, and three in the West Midlands. Extreme low scores indicate limited action relative to the scale of emissions, suggesting action is not proportionate to responsibility. By contrast, the highest ambition scores were largely concentrated in the South; for instance, four of the ten top-scoring regions were in London, three in the South East, two in the East of England and one in the South West (Bristol). London presents an interesting case: in terms of indexed ambition, London boroughs as an authority type appeared less ambitious overall (Figure 2). There are therefore extremes of ambition within London, which accords with understanding that it is an area with significant intraregional socioeconomic inequality which could impact the capability to respond to a non-statutory area like climate mitigation.

When comparing the scores across the two Co-Is, it is apparent that several regions are more ambitious than they are perhaps capable of. In Figure 4, a low score suggests that ambition is greater than the capability to take action; a high score suggests a capable region may not be taking action proportionate to its capability. This suggests that many LAs may be demonstrating more ambition than they are perhaps capable of. That is, relative to other LAs or regions with the same level of ambition, their capability score is lower, suggesting potential issues with delivering that level of ambition. These regions with divergence between ambition and capability are geographically dispersed. This variability suggests a more complex picture of regional ambition and capability than a simple North–South dichotomy. Regions that are taking less action than they are perhaps capable of are also dispersed. This gap could be due to a lack of ambition (resulting from a lack of resources and/or political support), or higher initial emissions which render action less effective. The comparison of Co-I scores suggests a clear need for further action on the part of certain LAs, and greater national coordination and resourcing of the target setting and *implementing* process.

4. Discussion

4.1. Local ambition in national context

The results highlight that although the majority of LA targets are ambitious, and more ambitious than their equivalents at the national scale, they do not collectively achieve a net zero carbon budget. A common target date was 2030, meaning the targets assume a constrained time horizon for available action. This relatively near-term focus is exacerbated by a challenging operating context of global conflict and a cost-of-living crisis, which is only likely to worsen the capability of LAs to respond to a 'non-statutory' responsibility such as climate (Bulkeley & Kern, 2006). Similarly, whilst the targets demonstrate considerable ambition, the capability Co-I scores suggest that their implementation is often not realistic. Low capability may be driven by different indicators within the overall Co-I, but the areas highlighted are generally associated with higher socioeconomic deprivation which may challenge action in non-mandatory areas.

Operational targets suggest a greater degree of realism, given the control LAs can exert over their own emissions, but their contribution to a national net zero carbon budget is relatively minimal in carbon accounting terms. Operational emissions reductions are often energy-oriented, particularly in terms of renewable energy procurement, and energy efficiency in council properties. LAs have limited capacity to act on broader energy issues given the centralized nature of energy policymaking in the UK and the privatization of municipal energy companies (Bale et al., 2012; Bulkeley & Kern, 2006). However, others suggest there may be scope for greater involvement of LAs in renewable energy provision, given the rising interest in forms of decentralized energy (Fudge et al., 2016), and in the role LAs could play in supporting energy efficiency in small-to-medium enterprises (Bradford & Fraser, 2008).

The emissions gap between the delivery of LA targets and the national net zero budget may be driven by the LAs with no target (n = 30) or those which had set targets which were unambitious relative to their initial emissions. Indeed, our findings differ to those of a forthcoming research article (Howarth et al., n.d.), which suggests that LA climate targets (if implemented) would exceed delivery of the CCC net zero carbon budget; this may be due to their assumption that residual emissions would only be 5% (rather than 11% as used in the CCC's and our own analysis here). The existence of the gap also raises questions over who would be responsible for closing it. For instance, does central government ultimately hold the responsibility for delivering net zero emissions? Or should it be a combination of the local and national in the 'interactive federalist' model proposed by Sovacool (2008)? Responsibility is necessarily delimited by the actual powers available at the subnational scale, and at the moment, this would suggest central authorities should take action as they are the only ones with the powers and resources to do so, and since LA targets are essentially 'voluntary'.

Local action is often viewed as a means of incremental change and challenge whilst waiting for national action (Hsu et al., 2020; Marsden et al., 2014), and as a means of overcoming perceived conservatism and political 'gridlock' at the national scale (Armstrong, 2019). However, others see the need for central government resourcing for substantive change to occur (CCC, 2020b). In cases where the scale of the issue being addressed better suits national governance (for instance industrial decarbonization or cross-boundary issues such as transport), central government could assume responsibility for this to ensure there are no gaps in economy-wide decarbonization.

The concept of multi-level governance is frequently proposed as an appropriate scalar framework for climate governance (Betsill & Bulkeley, 2006). We found that LA targets were marginally more ambitious than the CA targets, meaning there is value to multi-level coordination. Marsden and Anable (2021) suggest that this form of governance would address cross-boundary issues for priority sectors such as transport, improving policy coherence, and highlighting that there is no 'optimal' scale for allocating carbon budget responsibility. It is important to note that LAs operate in neither sectoral, scalar nor spatial siloes, and are generally actively engaged in national and international state and non-state networks, partnerships with civil society, and national policy programmes. For instance, Smith and Christie (2021) highlight the extensive networks between state and non-state climate actors across scales, including LAs in the UK. On a more formal basis, LAs frequently engage with multiple government departments as the delivery bodies for many national policies, and the recent Local Net Zero Forum is an attempt to streamline communications between the two scales on activities surrounding net zero (Department for Levelling Up, Housing and Communities, 2022).

LAs are therefore integrated through partnerships with many actors and sectors at multiple spatial scales. However, whilst LAs do work in partnership to deliver many statutory services, delivery of climate mitigation is seen to suffer from a lack of policy coordination, particularly when considering formal relationships between the state and local government. This was highlighted in a recent House of Lords motion debating the cross-governmental coordination of net zero policymaking (Smith, 2021). As Hsu et al. (2017) note, there is a need for greater vertical (cross-government) and horizontal (cross-regional and cross-sectoral) alignment on subnational climate action. The budgetary gap found in this analysis suggests that there is indeed a role for top-down oversight and coordination in the setting and delivery of net zero emissions targets.

4.2. Spatial justice in regional ambition

One benefit of having a system of national oversight of local targets would be in monitoring regional differences in ambition, to ensure that equitable action is taken by English regions. London generally led in terms of ambition and capability. The Greater London Authority is seen as playing an important coordinating role in devolving responsibility between different London boroughs (Howarth et al., 2021b), suggesting that a nested institutional structure may be important in guiding and allocating levels of ambition for particular LAs. Yet ambition loses significance at the local level when initial emissions are low. Whilst London LAs are taking action, and are capable of doing so, this may also reflect their lower baseline emissions (due to a relatively small amount of industrial activity in this area).

In contrast, the East Midlands region had low capability and ambition scores, as well as high initial emissions. This suggests that there is a need to target support to LAs or regions with higher emissions that are not taking proportionate action, which may in turn be due to a lack of capability. There were particular gaps between the scores in traditionally industrial areas, which highlights the persistent importance of patterns of industrial activity to achievement of net zero goals. There was generally a slower pace of emissions reductions in the East of England, East Midlands and North East, which could reflect a lower perceived ability to decarbonize and the influence of industrial actors. It has been noted that industrial areas tend to lack the governance resources of 'elite world cities' (Pearce & Cooper, 2013).

The gaps in capability and ambition are significant, and they suggest full implementation of the targets is unlikely without a change in policy or support. Nevertheless, where capability is low but ambition high, it suggests a political willingness to act despite a lack of available funds or other resources. This gap analysis provides an evidence base for greater support to be directed to specific LAs or regions.

4.3. Governing effective regional targets

There is consensus in the general merit of the local target-setting approach, given any action of this kind is 'additional' to national policy requirements. However, the process could be empowered through a number of structural changes. These include creating a statutory target-setting requirement with appropriate central government resourcing, and reintroducing a national net zero indicator framework to effectively monitor progress against such targets.

The voluntary target-setting could be interpreted as filling a governance gap in the lack of devolved responsibility for climate action at the local level, but a key barrier to local climate action is the lack of statutory responsibility for it (Yuille et al., 2021). Introducing a statutory requirement for LAs to set a net zero-consistent GHG emissions reduction target could give LAs the authority for climate action, and simultaneously create a reporting requirement (Bale et al., 2012). However, this approach would require more resources be allocated from central to local government to help deliver the targets. There is often a normative expectation of local action, without the appropriate downscaling of resources to match (Gillard et al., 2017; Newell et al., 2015; Thaler & Priest, 2014).

The national indicators (NIs) represented standardised 'top-down' oversight of emissions monitoring and encouraged target-setting by LAs (Dixon & Wilson, 2013). 97% of LAs were reported to have prioritized at least one of the climate change 'improvement targets' (Cooper & Pearce, 2011). Given the variability in GHG emission inventorying and reporting practices between LAs, the reintroduction of the NI framework could be a means of improving the accuracy of progress monitoring. A complete national emissions inventory

disaggregated to the local scale would enable an assessment of how well various mitigation efforts 'fit together', ensuring complete emissions coverage. It would also facilitate iterative policymaking, where the effectiveness of different interventions could be measured and monitored.

4.4. Limitations and directions for future research

Further empirical research with practitioners could aim to understand the complexities of delivering mitigation at the local scale (Pearce & Cooper, 2013), while building on existing qualitative work in this area and improving the representation of 'capability'. Action on adaptation is notably lacking in most local climate plans (Grafakos et al., 2020; Reckien et al., 2014, 2018; Salvia et al., 2021), therefore further research should address this policy gap. Although something not considered in the present analysis, political party affiliation of local leadership may be an explanatory factor for the variation in ambition (Howarth et al., 2021a). Analysis of this kind is complicated by electoral churn, the presence of coalition administrations, and boundary changes, all of which would complicate attributing climate plans to any one political party. Further analysis could also valuably explore the relationship between per capita emissions and how this affects regional ambition or capability.

5. Conclusions

Whilst Local Authority (LA) net zero commitments (as essentially voluntary targets) are laudable and generally ambitious, they collectively fail to meet the scale and pace of decarbonization required to be consistent with a national net zero budget. The national net zero target currently has no devolved governance, and this shapes considerable uncertainty in terms of what type of action, and how much of it, LAs are expected to take. The voluntary and variable LA targets are a product of this uncertain scalar policy framework and of historic dynamism in the role of regional (i.e. subnational) institutions within national policy in England. Our composite indicator (Co-I) analysis reveals that half of all LAs in the sample were not taking as much action to decarbonize as they were hypothetically capable of, suggesting a lack of spatial justice in English regional climate governance.

To improve the fairness and effectiveness of delivery of LA net zero targets in England, we propose introducing a statutory target-setting requirement (to ensure equal participation in mitigation action), and the introduction of a national net zero indicator framework. Such a framework could enable monitoring of progress and iteratively guide policy development and local resourcing. Specifically, such improvements to the target-setting process would provide an evidence base for central government through which it could more effectively direct funding to those LAs that need greater support in delivering their targets. Currently, ad-hoc pots of funding are distributed through a competitive process which further disadvantages those LAs with less capability to start with (Bale et al., 2012). In this way, LAs, working with the targeted support of the national government, could begin to 'level up' the capability to decarbonize in those LAs or regions that most need to.

Though there are singularities in the structure of English subnational governance, the high-level conclusions of the analysis have transferability to other country contexts. This is important given the global nature of the local net zero target-setting trend. For instance, the proposed indicator framework could be applicable to different countries, and improve effectiveness and fairness in the governance of subnational climate commitments. There is particular potential in the framework in jurisdictions where subnational powers are stronger.

Whilst the LA target-setting phenomenon in England represents notable action at the local scale and demonstrates a commendable degree of ambition, there are perhaps limits to local action without national oversight and resourcing. There is therefore a need for scalar and spatial coordination of subnational net zero targets – that is, multi-level governance of the targets and their delivery. This could contribute to fair governance in delivering the UK's net zero carbon budget, in recognizing the spatially differentiated capabilities to mitigate in the English regions.

Notes

1. Though definitions of 'region' vary, we use the term to refer to the nine administrative regions in England (including London, the North East, North West, Yorkshire and the Humber, East Midlands, West Midlands, South East, East of

England and the South West). We aggregate trends to the regional scale when appropriate to simplify comparisons between English regions.
2. We refer to 'Local Authorities' (LAs) or 'councils' interchangeably and as shorthand for all local authority types, though in practice they vary in terms of administrative functions, statutory responsibilities and sizes. We similarly refer to 'net zero' targets as an umbrella term (though LAs use varying terminology, see Supplementary Material, Section 2.4).
3. Operational targets mean councils commit to act on emissions produced through their activities and estates, whilst area-wide targets mean acting on all the emissions produced within a given area. Targets are largely set for Scope 1 (direct) and 2 (indirect via purchased electricity) emissions, rather than Scope 3 (indirect supply chain emissions).
4. These estimates are from the authors' own analysis of the target data. For further methodological information see Section 2.1.1.
5. For detailed discussion of the types of powers available to LAs, see UK100 (2021).
6. As first outlined in Principle 7 of the 1992 Rio Declaration (Voigt & Ferreira, 2016).
7. A Climate Emergency Declaration is typically a public statement made by an individual or institution, acknowledging the climate crisis and the need for urgent action.
8. Both figures include Combined Authorities.
9. As previously noted, 'area-wide' emissions are those occurring within the administrative boundaries of a given LA.
10. Unless explicitly noted, references to the 'final sample' include the 301 LAs excluding the CAs. For results for the CAs, see Supplementary Material, Section 3.
11. Unitary authorities are single tier authorities that deliver services which county and districts typically carry out in tandem. For further detail see Section 1 of the Supplementary Material.
12. Statistical normality of sample scores was conducted using the D'Agostino-Pearson test. The capability sample was normally distributed, but the ambition sample was non-normal. Since the data was non-parametric, the Spearman's r correlation coefficient was calculated to determine relationships between the scores.

Acknowledgements

We would like to thank Climate Emergency UK for providing access to a dataset containing Local Authority net zero target dates (https://www.climateemergency.uk/).

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

AG was supported by an EPSRC Doctoral Training Programme Scholarship. MB, JN and JB were supported by the Centre for Research into Energy Demand Solutions, award EP/R035288/1.

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