



BIROn - Birkbeck Institutional Research Online

Mann, Sarah and Briant, Rebecca M. and Gibin, Maurizio (2014) Spatial determinants of local government action on climate change: an analysis of local authorities in England. *Local Environment* 19 (8), pp. 837-867. ISSN 1354-9839.

Downloaded from: <https://eprints.bbk.ac.uk/id/eprint/5942/>

Usage Guidelines:

Please refer to usage guidelines at <https://eprints.bbk.ac.uk/policies.html> or alternatively contact lib-eprints@bbk.ac.uk.

Spatial determinants of local government action on climate change: an analysis of local authorities in England

Mann, Sarah^a, Briant, Rebecca M^a, Gibin, Maurizio^a

^aDepartment of Geography, Environment and Development Studies, Birkbeck, University of London, London, UK.

Correspondence details: Dr Rebecca Briant, Department of Geography, Environment and Development Studies, Birkbeck, University of London, Malet Street, London, WC1E 7HX, UK. Email: b.briant@bbk.ac.uk.

Note to editor: the first author was an MSc student at Birkbeck who has since moved away from academia; hence the second author is the corresponding author in this case.

Abstract

The engagement of UK local authorities is vital if national government is to meet its climate change commitments. However, with no mandatory targets at local government level, other drivers must explain engagement. Using a Geographic Information System, this study compares the spatial distribution of action on climate change based on past actions and stated intentions to a suite of relevant independent variables. The Action Index created is among the first to quantify climate change engagement beyond a simple binary measure and provides a useful comparative study to recent work in the US. The Index enables investigation of both mitigation and adaptation, which show different trends in relation to some variables. The study shows that action is strongest where the voting habits of the local population suggest environmental concern and where neighbouring local authorities are also engaging in action on climate change. Physical vulnerability to the effects of climate change is a motivator for action only where the dangers are obvious. Action is less likely where other resource intensive issues such as crime and housing exist within a local authority area.

Keywords (3-6): local government, mitigation, adaptation, climate change

Introduction

Local Government action on Climate Change

Under the Climate Change Act of 2008 the UK introduced the world's first legally binding greenhouse gas emissions reduction target with a pledge to cut emissions by 80% relative to a 1990 baseline by 2050 (DECC, 2011). In May 2011 intentions to pass ambitious interim targets into law were announced which would see the country's emissions reduced to 50% of their 1990 level by the middle of the next decade (Harvey and Stratton, 2011). The coalition government has also been instrumental in lobbying for an increase in the European Union's 2020 emissions reduction target from 20% to 30% (Press Association, 2011).

Although local authority estates generate only 1% of national emissions (National Audit Office, 2007) their influence via procurement policies such as the integration of environmental responsibility criteria (e.g. Surrey County Council, 2012) and choice of service providers is significant given their sizable budgets. In addition local authorities can tackle climate change through their role as estate manager, planner, services provider and community leader. Their decisions regarding land use, transport infrastructure and waste management have a direct impact on greenhouse emissions. For example, Stockton-on-Tees Borough Council (2009) have taken steps to ensure that less than 5% of domestic waste goes to landfill and to recover energy from the waste that is incinerated. They can also have an indirect impact through their role as community leaders and examples to local businesses and residents. Despite this, local authority action on climate change remains largely voluntary with no central government policy incentives or penalties, although some reporting has been required.

In 2008 the incumbent Labour government mandated the first Local Area Agreements (LAAs). Local authorities were strongly encouraged by the Department for Environment, Food and Rural Affairs (DEFRA) to include targets relating to at least one of the three climate change related National Indicators¹ in their three year LAA plan (Pearce and Cooper, 2011). In October 2010 the system of National Indicators and

¹ The three climate specific National Indicators were:

- NI 185 - CO₂ emissions reductions from local authority operations
- NI 186 - Per capita CO₂ emissions reductions in the local authority area
- NI 188 - Adapting to climate change

LAAs was abolished by the new coalition government and it is unclear what reporting will be required from local authorities in the future.

Despite the lack of policy incentives for action and the disincentive provided by the global nature of the climate change problem, current research reveals that the level of engagement to tackle climate change varies widely across local government in England (Davies, 2009; Footitt *et al.*, 2007; Friends of the Earth, 2011a; Local Government Group, 2010; National Audit Office, 2007). This raises the question; what motivates some local authorities to do more than others in the face of disincentives for action?

This study therefore investigates whether spatial differences in the consequences of climate change in England affect the degree to which local authorities commit to take action. This is a comparative study with the United States, where there has been a wealth of research done around the voluntary participation of US cities in the Cities for Climate Protection (CCP) Programme (Betsill, 2001; Lindseth, 2004; Pitt and Randolph, 2009; Zahran *et al.*, 2008a; Zahran *et al.*, 2008b). Despite the absence of Federal government engagement with climate change policy, 565 municipal governments have currently signed up to CCP (ICLEI, 2011). Studies have found involvement to be linked to local environmental issues such as air quality (Betsill, 2001; Lindseth, 2004), whilst Zahran *et al.* (2008a; 2008b) found that factors related to a municipal area's geographic location and socioeconomic structure variously motivated or discouraged engagement with the programme.

In contrast, whether or not a local government office chooses to take action on climate change has traditionally been viewed in the UK as a function of internal politics (Bulkeley and Betsill, 2005; Bulkeley and Kern, 2006; Urwin and Jordan, 2008). By examining the issue from a different perspective i.e. that a local authority is motivated to take action on climate change by specific and spatially differentiated characteristics of the local authority area, it is hoped that this research will provide some insights into drivers of climate policy which will complement current research. Specifically these findings should provide a framework in which decisions can be made about future case study research.

Collective Interest and Drivers of Climate Change Action

Lubell *et al.* (2007) applied the collective interest model of mass political action to explain citizen support for climate policy. This is an appropriate model to use because the potential for an individual party acting alone to influence the climate is virtually zero, action by others benefits everyone and many mitigation initiatives are relatively costly to implement. This means that there are strong disincentives to engage in climate protection unless there is a collective desire to act.

In the context of local government action on climate change, this can be applied at two levels. Firstly the local government institution will have its own internal perceptions of the risk posed by climate change to the area under its jurisdiction. It will weigh up the costs and benefits of action, the likelihood that national and international targets will be met and how instrumental their involvement is in meeting these targets. Secondly the success or otherwise of climate change policy in a local authority area will depend heavily on the support of the electorate and their willingness to make necessary behavioural changes (Lubell *et al.*, 2007). Given the short electoral cycle in England local governments are generally reluctant to introduce changes which would be unpopular with local citizens and business for fear of electoral revolt (Lorenzoni *et al.*, 2007; Local Government Group, 2010).

A number of factors can affect the perceived collective interest of local authorities and individual citizens in relation to climate change action. Zahran *et al.* (2008b) found motivation to participate in voluntary climate protection schemes to be influenced by factors relating to the physical vulnerability of an area, the structure of the local economy and the capacity of the local residents to support climate policy. For example, studies by Baldassare and Katz (1992) and more recently by Zahran *et al.* (2006) found perceived physical risk to be a strong predictor of support for climate policy and willingness to absorb the costs of mitigation and adaptation. Perceptions of risk are affected by knowledge of the potential impacts of climate change and by personal experience of events linked to the changing climate (Grothmann and Patt, 2005) such as floods and heatwaves.

Local economic landscapes have also been found to influence political will to engage in climate change policies (Bulkeley and Betsill, 2003; Bulkeley and Kern, 2006; Elliott *et al.*, 1997; Lorenzoni *et al.*, 2007; O'Connor *et al.*, 2002; Zahran *et al.*, 2006; Zahran

et al., 2008a; Zahran *et al.*, 2008b). Thus the areas which contribute most to the climate change problem in terms of industrial structure and per capita carbon emissions are least likely to be involved in voluntary climate protection schemes (Zahran *et al.*, 2006; Zahran *et al.*, 2008a; Zahran *et al.*, 2008b). Local governments can then be reluctant to take action on climate change in the face of opposition from businesses and the public (Bulkeley and Betshill, 2003; Bulkeley and Kern, 2006; Lorenzoni, 2007).

Furthermore, numerous studies have identified links between demographic factors and levels of support for environmental policy (Dietz *et al.*, 1998; Elliot *et al.*, 1997; Klineburg *et al.*, 1998; Konisky *et al.*, 2008; O'Connor *et al.*, 2002; Torras and Boyce 1998; Zahran *et al.*, 2006; Zahran *et al.*, 2008a; Zahran *et al.* 2008b). Willingness to absorb the cost of implementing climate change initiatives increases with successive levels of education (Dietz *et al.*, 1998; Elliott *et al.*, 1997; Klineburg *et al.*, 1998; Lubell *et al.*, 2006; O'Connor *et al.*, 2002; Zahran *et al.*, 2008a; Zahran *et al.* 2008b). Less convincingly, younger people and women are generally reported as showing greater environmental concern (Klineberg *et al.*, 1998).

Research Design

The objective was to evaluate the relationship between a local authority's commitment to action on climate change and a number of spatially variable factors which have been found to motivate or discourage action. This is placed within the framework of the collective interest theory which postulates that involvement in climate protection initiatives will occur when participation is perceived to be more beneficial than non participation (Lubell *et al.*, 2007). The hypotheses tested are the same as those formulated by Zahran *et al.* (2008b):

- (i) Local authority areas with greater vulnerability to the anticipated physical effects of climate change are more likely to commit to action.
- (ii) Local authorities with economies which are heavily reliant on carbon intensive activities are less likely to commit to action.
- (iii) Local authorities whose residents are more socially inclined to support climate policy are more likely to commit to action.

Areal Units

The units of study for this research are 325 of the 326 local authorities of England². These include single level Unitary Authorities and Metropolitan Districts, also District Councils and London Boroughs which form the lower tier in a two tier political system. Despite having no control over influential services such as transport and strategic planning the lower tier authorities were used because they are responsible for housing and local planning and closest to the community. In recent years the potential impact of local authorities in the success or otherwise of national climate change policy has been increasingly acknowledged (Environment Agency, 2008). They also have ready availability of relevant data. National government indicators, national statistics and data from government agencies such as the Environment Agency are all available at local authority level.

Variables

Quantitative data was gathered in relation to the dependent variable, ‘action on climate change’, and independent variables relating to (i) physical vulnerability, (ii) economic structure and (iii) social capacity. This was analysed using ESRI’s ArcGIS and a chi squared test. Both dependent and independent variables were mapped as high, medium or low in relation to the full range of values.

Dependent Variable – ‘Action Index’ on Climate Change

In previous studies (Zahran *et al.*, 2008a; 2008b) commitment to action on climate change has been defined by ascertaining whether or not a US local government has signed up to the CCP campaign. CCP is a performance based programme and participants work towards a series of five milestones from an initial inventory of their emissions to implementing a climate plan and monitoring its results (Pitt and Randolph, 2009). Zahran *et al.* (2008a; 2008b) do not attempt to evaluate how much progress local governments have made towards implementing the programme but rather classify them dichotomously as either committed or not committed.

In the UK the CCP has not enjoyed as much support as in the US and only 9 local governments have registered with the scheme to date (ICLEI, 2011), probably because

² The Isles of Scilly were omitted from this research due to a lack of data for some of the relevant indicators

of the comparable initiative ‘The Nottingham Declaration on Climate Change’. Signing the Nottingham Declaration is a public acknowledgement that climate change will have an effect in the local area. It also commits the signatory to work towards 7 climate change action points (both mitigation and adaptation). Over 90% of local authorities had signed up as of May 2011 (Energy Saving Trust, 2011a). However, given the almost ubiquitous nature of commitment to the Nottingham Declaration, and the further fact that it appears to have little bearing on actual action on climate change (Environment Agency, 2008), it was not considered a sufficiently strong indicator of commitment to action for use in this research.

Instead, a quantified ‘Action Index’ (Table 1; Figures 1-3) based on local authority reporting on climate change related indicators set by national government has been used to enable a more meaningful comparison between local governments. These indicators provide an integrated overview of action, although there was a gap around medium-term target setting, which this study sought to fill with additional data from Friends of the Earth (see below). Measures of mitigation (M1-M3) are based on both past reported emissions and future targets in the short and medium term (Table 1). Past trends and short-term targets were taken from data reported under NI 186 (Per capita CO₂ emissions reductions in the local authority area)³. Due to a change in reporting requirements, medium-term targets have not been officially reported. Therefore these are based on a recent survey by Friends of the Earth (2011b, Table 1). Where lower-tier local authorities were the unit of study, climate change indicators and targets selected at county level were assigned to all local authorities within that county. This is because all district councils were involved in target setting negotiations. In instances where there was not full agreement on targets the lowest proposed target was adopted (Pearce and Cooper, 2011). The past data gives information about results but no insight into the ambition of the local authority’s emission reduction intentions whereas the data relating to targets provides information on intentions but cannot provide statistics on performance, although the majority of local governments do appear to follow through

³ NI 185 (CO₂ emissions reductions from local authority operations) was not used because it was less stringent than NI 186.

on their commitments (Lindseth, 2004). This is also seen in the UK, where despite recent changes to national government requirements, Local Authorities are continuing to develop Climate Change Strategies and take mitigative action such as the installation of renewable energy technologies on Council properties (e.g. Surrey County Council, 2012). Equal weighting has therefore been given to past performance and future intentions and overall mitigation performance varies considerably spatially (Figure 1).

Adaptation measures (A1-A3) were based on data relating to NI 188 'Preparing to Adapt to Climate Change' (Table 1, Figure 2). In addition to the absolute score for NI188 from 2010 (0 to 4) there is a measure of whether a local authority is actively working to integrate adaptation into core policy, based both on making progress with NI 188 between 2009 and 2010 and including NI 188 in their Local Area Agreement (Table 1). Level 0 is characterised as 'Getting started'; Level 1 as 'Public commitment and impacts assessment'; Level 2 as 'Comprehensive risk assessment'; Level 3 as 'Comprehensive action plan' and Level 4 as 'Implementation, monitoring and continuous review'. These scores are self-assessed, but submitted to Defra with associated evidence. Between 2008 and 2009, c. 82% met or exceeded their target levels set for 2009 (Davies, 2009). This gives confidence that targets set into the future may also be met.

The mitigation and adaptation indices were combined with equal weighting to produce an overall Action Index (Table 1, Figure 3). This equal weighting reflects the inevitability of some degree of climate change (IPCC, 2007) and recent concern that adaptation be given more weight in local climate change policy (e.g. Environment Agency, 2008). *Independent Variables – Physical Vulnerability, Economic Structure, Social Capacity (Table 2)*

In addition to absolute physical vulnerability to risk, e.g. to flooding (*Area on flood plain, Property at risk*), *Coastal* inundation or projected climatic changes (*Summer temperature, Summer precipitation, Winter precipitation*), indicators were included to assess perception of risk. For example, direct experience of extreme events were captured by the extent to which local authority areas were affected by *Summer flood 2007*, the estimated cost of which was c. £3 billion (Environment Agency, 2007) may increase the perception of the risk posed by potential changes in the climate. The

existence of sensitive or valuable landscapes (*SSSIs*) in an area has also been found to increase the perceived risk attached to climate change because of the personal value attached to them (Raymond and Brown, 2011).

Indicators of the degree of urbanisation (*Population density*), types of economic activity (*Carbon employment, CO₂ per capita*) and the carbon intensity of the lifestyles of citizens within a local authority area (*Domestic energy consumption, Travel to work*) were analysed within the economic structure category. Urban communities are more likely to suffer negative effects from climate change whilst exerting less pressure on the climate per capita (Zahran *et al.*, 2008b) and may therefore be more likely to be committed to action. Conversely, local authority areas relying heavily on carbon intensive industry may be less likely to commit to action because they are more likely to experience selective costs of action on climate change in the form of retrofits to local industrial infrastructure, possible job losses and resistance from local businesses and residents. Climate policy tends to be unpopular if it perceived to be interfering with personal freedoms and lifestyle choices (Lorenzoni *et al.* 2007; O'Connor *et al.*, 2002). Since this is experienced more negatively by areas with high domestic energy use and where a large percentage of the population drive to work, it is probable that they will be less inclined towards action on climate change.

In terms of social capacity, strong evidence has been found for a link between education (*Higher education*) and support for climate policy (Dietz *et al.*, 1998; Elliott *et al.*, 1997; Klineburg *et al.*, 1998; Lubell *et al.*, 2006; O'Connor *et al.*, 2002; Zahran *et al.*, 2008a; Zahran *et al.* 2008b). Also, *Young people* are more likely to hold post materialist values than older individuals and are therefore more inclined towards making sacrifices for the sake of environmental protection (Klineburg *et al.*, 1998). Conversely, deprivation (*Income, Employment, Skills*) as measured using the English Indices of Deprivation (EID - Communities and Local Government, 2010b) may link to less action on climate change because economically insecure individuals are less likely to hold the post materialist values seemingly required to support climate policy (Inglehart and Abramson, 1994). Local authorities with higher numbers of people living in a state of economic deprivation are therefore less likely to commit to action on climate change. A further set of EID measures relating to the broader social structure in the local authority

area was also examined (*Health and disability, Barriers to housing and services, Crime, Living environment*). All of these conditions require attention and funding from local government and are likely to move climate change down the political agenda (Betshill and Bulkeley, 2003; Lorenzoni *et al.*, 2007). Two indicators of political ideology have also been included in the social capacity category (*Political control, Green councillor*). Liberalism has been linked to support for climate policy (Deitz *et al.*, 1998; Elliott *et al.*, 1997, Klineberg *et al.*, 1998; Konisky *et al.*, 2008; Zahran *et al.*, 2008a) and these variables test whether councils controlled by more left leaning parties such as the Liberal Democrats are more committed to action on climate change. Similarly councils containing members of the Green Party are expected to be more involved with climate policy. The final variable examined, *Recycling*, reflects on both the actions of individuals in the local authority area and the level of services offered by the local council in terms of kerbside recycling, both presumably reflecting the value placed on climate protection or other environmental values (e.g. Barr, 2007).

Results and Analysis

14% of local authorities scored high on the Action Index (Figure 3) with the North East, East Anglia and an area extending from Bristol into south Dorset appearing to be particularly committed. In the North, a band of local authority areas stretching from West Lancashire to the City of York were found to be taking strong action as were cities such as Nottingham, Leicester and Northampton in the Midlands. Most local authorities (55%) were rated medium with 30% rated low. Three local authorities scored zero on the index, two of which were in central London.

In relation to mitigation only (Figure 1), scores are generally low, with only a few pockets of higher action in the North East and East Anglia and the high-action Midlands cities noted above. Most Local Authorities achieved emissions reductions between 2005 and 2008 (M1), although these were modest. Short-term target setting (M2) was also common; but few Local Authorities outside the North East and East Anglia had set medium-term targets (M3).

Many more Local Authorities score highly on adaptation, and managed to improve their NI 188 scores between 2009 and 2010 (Figure 2). This probably reflects the greater ease

of mainstreaming adaptation due to decisions being part of many normal Local Authority functions such as planning and infrastructure development. Mitigation, in contrast, requires greater sacrifice and behaviour change. The band of Local Authorities between Bristol and south Dorset that score highly on the overall Action Index also score highly on adaptation, as do the North East and East Anglia. The high action Midlands cities are less clear here, possibly because they are masked by generally higher levels of action in surrounding Authorities.

Table 3 shows that there was a statistical relationship using chi squared between 6 of the 25 independent variables and the Action Index: *Coastal*, *Summer temperature*, *Skills*, *Barriers to housing and services*, *Crime* and *Green councillor*. 8 of the variables showed a significant relationship with mitigation (*Summer Temperature*, *Domestic Energy Consumption*, *Young People*, *Income*, *Skills*, *Political Control*, *Green Councillor* and *Recycling*); and 6 with adaptation (*Carbon Intensive Employment*, *Travel to Work*, *Young People*, *Income*, *Barriers to Housing and Services* and *Recycling*)

Physical Vulnerability

Chi squared analysis suggested that only proximity to the *Coast* and projected *Summer temperatures* affected perceptions of climate change risk sufficiently to drive local authority action. Rising sea levels and the increased frequency and severity of storms which will affect coastal areas are amongst the most palpable expected impacts in England. Coastal local authorities were found to be significantly more likely (23% scoring high compared with the 14% expected if there was no association between the variables - Figure 3) to be taking a strong stance on climate change suggesting that the threat posed by these expected changes is indeed motivation for action. Since neither mitigation nor adaptation separately shows a significant relationship with this variable (Table 3), the action undertaken must be on both fronts. This mirrors the findings of Zahran *et al.* (2008a; 2008b) in relation to US local government engagement in CCP.

The relationship identified between climate change action and *Summer temperature* (Figure 4) was unexpected because greater action, particularly mitigation (Table 3), was identified in areas where temperature changes are expected to be less pronounced. As

the projected temperature change to 2050 is only 0.65°C it would seem likely that the observed relationship is a function of the fact that low Action Index scores, particularly low mitigation scores (Figure 2) are found in the South of England where projected *Summer temperatures* are higher. This may be driven by an unrelated variable that has not been measured.

Finally, it was expected that local authorities which had suffered from severe weather events in the past few years would identify selective benefits in climate change action, as in the US (Zahran *et al.*, 2008a) and other previous studies (Pearce and Cooper, 2011). The results of this study suggest that the same does not hold true in England. The 2007 floods were amongst the most widespread and costly natural disaster to occur in England in recent history, and yet local authorities which were affected showed no greater tendency towards action than those unaffected. Additionally, local authorities which are selectively at risk by virtue of having a relatively high percentage of properties at significant risk of flooding, or a substantial expected increase in winter precipitation, were not found to be especially active on climate change. However, it is possible that affected councils are carrying out local projects to tackle these issues which have not been picked up in the Action Index.

Economic Structure

None of the 5 indicators relating to economic structure were statistically linked to the overall Action Index on climate change

In the US, participation in CCP was found to have a significant negative relationship with per capita air pollutants and the level of carbon intensive employment in a municipal area (Zahran *et al.*, 2008a; 2008b). This study found a significant negative association between *Domestic energy consumption* (Figure 5) and mitigation scores. In relation to collective interest, where citizens have relatively carbon intensive lifestyles, they are likely to face a selective disadvantage of tackling climate change in the form of expense and personal sacrifice. These local authorities seem therefore less inclined to take action on climate change.

In contrast with the US, this study found a positive association between *Carbon intensive employment* (Figure 6) and *Travel to Work* (Figure 7) and adaptation scores.

This may reflect differences in the way carbon emissions are controlled. In the UK, heavy emitters are covered by the EU Emissions Trading Scheme and large companies are regulated by National Government's Carbon Reduction Commitment. Local authorities may therefore not feel responsible for imposing restrictions on greenhouse gas emissions in the same way as US local governments. For this reason, these Local Authorities may have resources freed up to concentrate on adaptation.

Social Capacity

Variables linked to individual propensity to support climate policy including income, higher education, and recycling activity were found to be positively and significantly correlated with CCP involvement in the US (Zahran *et al.* 2008a; 2008b). In the UK, significant positive correlations were found between mitigation and *Young People* and *Income* (Figures 8 and 9), but negative relationships between these and adaptation. There was no relationship seen with the overall Action Index because the mitigation and adaptation responses cancelled each other out. Whilst the mitigation relationships fit with those previously observed elsewhere, including the US (e.g. Klineberg *et al.*, 1998; Inglehart and Abramson, 1994); the adaptation relationships are the opposite, suggesting that Local Authorities with more young people and higher average incomes are taking less adaptive action. It seems likely that this reflects their lower vulnerability – these areas do not need protection from climate change impacts; rather they are able to take the sacrificial measures required to facilitate mitigation.

Local authority levels of *Skills* deprivation displayed the opposite correlation to that observed in previous studies, with high deprivation areas exhibiting higher commitment to action, specifically mitigation action (Table 3, Figure 10). This trend may be related to the desire to create new local industries and training opportunities in areas where skills are currently lacking. For example, the Stockton Climate Change Action Plan 2009-2020 (Stockton-on-Tees Borough Council, 2009) mentions the importance of supporting the move from existing petrochemical-based industry to 'green business' through their partner organisation Renew@CPI, an Economic Support Project for SMEs and companies working in the Low Carbon Energy and Environmental Goods and Services Sectors.

The broader social structure of the local authority area appears to have a significant influence over whether or not a local authority is committed to tackling climate change. Two out of four of these variables, housing deprivation (*Barriers to housing and services* – Figure 11, related both to adaptation and the Action Index) and *Crime* (Figure 12, related to the Action Index only) were found to have a significant negative relationship with level of action on climate change. Both of these factors require substantial resources in terms of staff and funding. In areas which suffer high deprivation in these domains, tackling climate change may pose a selective disadvantage since it is likely to divert vital resources from these areas. Indicators of community level deprivation were not included in the US studies by Zahran *et al.* (2008a; 2008b) but these findings are in agreement with previous studies by Bulkeley and Betshill (2003).

Liberalism has been linked to support for environmental policy in the US (see for example Konisky *et al.*, 2008; Zahran *et al.* 2008a) where the dual party system makes distinguishing between liberal (Democrat) voters and people with a more conservative (Republican) political ideology relatively straight forward. The existence of multiple parties in the UK, and the fact that over 20% of English local councils are controlled by more than one party, clouds this distinction somewhat. However, the statistical relationship between *Political control* and mitigation shows that Conservative led local authorities are less likely to be engaged in climate change policy than those controlled by the Liberal Democrats (Table 3, Figure 13). Councils with no overall control are more likely to score highly. However the presence of a *Green councillor* was a more important factor in determining the level of commitment of a local authority to action on climate change. 36 local authorities had a Green Party member on the council (Figure 14) and significantly more local authorities with green councillors fall into the high Action Index and high mitigation score categories than expected. This shows a link between collective interest in environmental issues and willingness to engage in the sacrificial activities associated with mitigation. Previous research has suggested that it is not only a green presence which is important but also the position and standing of that individual within the council (e.g. Bulkeley and Betshill, 2003).

The nature of the overall relationship with *Recycling* (Figure 15, positive correlation with adaptation, unclear relationship with mitigation, no relationship with the Action Index) is unclear, possibly because of the influence of practical constraints that are specific to each council.

From a collective action perspective the likelihood of an initiative succeeding is greater where others are seen to be working towards the common goal. Interestingly, of the local authorities which appear to be taking strong action on climate change, several were clustered together in groups (Figures 1-3). Specifically these were found in the North East, East Anglia (both mitigation and adaptation, Figures 1 and 2) and the South West (adaptation only, Figure 2). Whilst some of these local authorities are from the same county and therefore share Local Area Agreements, this does not explain the clustering completely. This is because counties contain local authorities displaying a range of levels of commitment to action and the clusters contain local authorities from more than one county. The North East cluster for example is composed of 5 independent unitary authorities. In fact only Suffolk, which prides itself on its pioneer status (Green Suffolk, 2011) has a full complement of local authorities which were found to be highly committed. Whilst there is some diversity, Suffolk can be characterised as a sparsely populated county with relatively few young people and little deprivation with the exception of the skills domain. The observed clustering of high action local authorities gives weight to the argument that the adoption of pro climate policy is more likely when neighbouring localities are seen to be engaging in action (Lubell *et al.*, 2006) and suggests that regional partnerships could prove an important tool in encouraging action on climate change.

Discussion and Conclusion

If the UK government is to meet its national and international climate change commitments, buy in from local authorities is essential. However, the absence of excludable benefits of taking action, and a lack of mandatory climate change related targets for English local authorities, makes doing the minimum a perfectly rational choice. Given that the climate is a global common, the positive outcomes of the actions of any individual local authority are likely to be imperceptible if they are acting in isolation. Despite this the level of engagement with climate policy varies widely across

local governments in England. The aim of this research was to examine the relationship between spatial variations in the impacts of climate change and support for related policy in England, and the degree to which local authorities are taking action to address the issue, as a comparison to previous US-based studies.

A key achievement of this study is the creation of an Action Index attempting to quantify local authority action on climate change. This builds on and expands the binary classification previously used in the US and is in line with recommendations for future research (Zahran *et al.*, 2008a; 2008b). It enables the inclusion of reporting from government National Indicators and Local Area Agreements on both mitigation and adaptation activities, supplemented by data gathered by Friends of the Earth on emissions reduction targets to 2020. This longer-term perspective is crucial because local authority reporting only covers the period to 2011 when the current national government discontinued this requirement. The inclusion of indicators relating to adaptation is also important, as can be seen in the results above, where mitigation and adaptation show opposite relationships with the variables *Young people* and *Income*. Despite the benefits of this approach, there are also difficulties, since much important information is left out, and the index is necessarily based on what has been reported rather than what might be important. Examples of important aspects of action on climate change that are not reported are small scale projects and the degree to which local government has managed to engage the local community in climate protection activities; also the number of staff hours and funding allocated to climate change. It has also been assumed that data from the National Indicators gives a good proxy of the importance attached by a local authority to tackling climate change. However, there may be other reasons behind the inclusion/exclusion of some indicators or the setting of specific targets in a Local Area Agreement. For example councillors reported that DEFRA applied substantial pressure for the inclusion of NI 186 (Pearce and Cooper, 2011) and that some councils refused to select the indicator, not because they do not value climate change mitigation, but because they believed it to be flawed (Eadson, 2008). Similarly setting targets and producing plans does not necessarily mean that those targets will be met or that the plans could be implemented immediately, although as noted above, often they are

Nonetheless, the purpose of the index was not to measure the absolute level of action, but rather to allow a comparison to be made between each local authority's commitment to tackling climate change. As such the scores for the Action Index were categorised into three equal interval classes, high, medium and low. Almost all local authorities were found to be embracing climate change policy in some way. 14% were classified in the high action bracket and 55% and 30% respectively classified as medium and low. Only 3 local authorities scored zero for action. Whilst most Local Authorities are integrating adaptation into their planning to some degree, fewer are taking mitigative action.

Compared with the findings of the US research on motivation for involvement in CCP, this study found fewer significant associations between engagement in climate policy and the spatially variable features of the local government areas examined. This may in part be due to the added complexity relating to quantifying the level of action taken. This complexity is increased by the overall higher levels of climate change action in England which leads to lower differentiation between local authorities. Furthermore, because England is a much smaller and more densely populated country there is less variation in the expected physical impact of climate change and greater social and economic diversity over small geographical areas. This is enhanced by the multi-party system meaning that support for the mainstream parties are less sharply differentiated, both spatially (Figure 13) and politically, than in the US. The lower spatial differentiation in England both relating to climate change action and to those factors which might drive it combines to mean that spatial characteristics alone are less likely to explain local authority action in England than the US.

Therefore, of the physical vulnerability measures, only coastal proximity displayed a similar relationship with engagement in climate protection activities on both sides of the Atlantic. The threat from accelerated coastal erosion and storm surges linked to rising sea levels is one of the most tangible physical threats in England. The fact that coastal local authorities were found to be significantly more likely to be highly committed to tackling climate change leads to the conclusion that where selective physical dangers are recognised they are a motivator for action.

For the set of indicators related to social capacity there was less evidence that the factors discovered to be significant in the US were also influential in England. This is probably partly because of the greater complexity of the Action Index, since investigation of young people and income showed opposing tendencies towards mitigation and adaptation. At the level of these separate scores, it was clear that the political control of the council and the presence of Green party council members made a difference to local authority mitigation decisions. However, the significant negative relationship identified between the existence of issues requiring high levels of resources to address (high crime rates and severe housing deprivation) and commitment to action on climate change leads to the conclusion that where other social problems which are the direct responsibility of local authorities exist, climate change action takes lower priority. It is possible that the provision of additional resources dedicated purely to climate change may increase levels of engagement. However, climate policy is innately linked to other areas of local government responsibility such as housing, transport and planning and therefore cannot be considered in isolation. Further work on the effectiveness of such resources would be required before making this recommendation.

Finally, the existence of clusters of high action local authorities suggests that regional alliances and/or local competition could be important in motivating action on climate change. In depth case studies carried out on a sample of the local authorities found to be highly committed to action on climate change would shed further light on the key drivers of engagement. Particularly interesting are the clusters of local authorities identified through this research. Detailed information collected from the members of these clusters would shed light on the extent to which they are working together and the benefits gained from regional alliances.

Motivation for action on climate change is an extremely complex issue. This study has revealed that some of the drivers of local government action previously identified in the US explain action in England. While some measures analysed were found to have a significant relationship it is not envisaged that these are the only, or even dominant drivers of political involvement. Other issues such as leadership, staffing and employee buy in are all likely to affect the extent to which a local government is committed to

action. Further detailed research is required in this area to verify and expand on the findings of this research.

Acknowledgements

This research was carried out whilst Sarah Mann was a student on the MSc in Climate Change Management at Birkbeck, University of London. Thanks are extended to David Powell and Glyn Thomas from Friends of the Earth for results from their survey on local authorities' medium term emissions reduction targets, and to staff at the Environment Agency's Customer Contact Centre.

References

- Baldassare, M. and Katz, C., 1992. The Personal Threat of Environmental Problems as Predictor of Environmental Practices , *Environment and Behaviour*, 24(5), 602-616.
- Barr, S., 2007. Factors influencing environmental attitudes and behaviours. A UK case study of household waste management. *Environment and Behaviour*, 39(4), 435-473.
- Betsill, M., 2001. Mitigating Climate Change in US Cities: opportunities and obstacles. *Local Environment*, 6(4), 393-406.
- Bulkeley, H. and Betsill, M., 2003. *Cities and Climate Change. Urban sustainability and global environmental governance*. Oxon: Routledge
- Bulkeley, H. and Betsill, M., 2005. Rethinking Sustainable Cities: Multilevel Governance and the 'Urban' Politics of Climate Change. *Environmental Politics*, 14(1), 42-63.
- Bulkeley, H. and Kern, K., 2006. Local government and the governing of climate change in the UK and Germany. *Urban Studies*, 43(12), 2237-2259.
- Communities and Local Government (2010a) *Data Interchange Hub - Data Download: October 2010* [online] Available at: <https://www.hub.info4local.gov.uk/DIHWEB/HubCommunications.aspx> [Accessed 2 May 2011].
- Communities and Local Government (2010b) *English Indices of Deprivation 2010* [online]. Available at: <http://www.communities.gov.uk/publications/corporate/statistics/indices2010> [Accessed 2 May 2011].

Davies, A., 2009. *National Indicator (NI) 188: Year 1 Review and Analysis. Executive Summary* [online]. Available at: <http://www.defra.gov.uk/corporate/about/with/localgov/indicators/ni188.htm> [Accessed 2 October 2010].

Department for Environment Food and Rural Affairs 2011. *Local Authority Collected Waste for England – annual statistics* [online]. Available at: <http://www.defra.gov.uk/statistics/environment/waste/wrfg23-wrmsannual/> [Accessed 2 May 2011].

Department of Energy and Climate Change (2010a) *Local and regional CO₂ emissions estimates for 2005-2008 – full dataset* [online]. Available at: http://www.decc.gov.uk/en/content/cms/statistics/climate_stats/gg_emissions/uk_emissions/2008_local/2008_local.aspx [Accessed 2 May 2011]

Department of Energy and Climate Change (2010b) *UK Statistics Authority 23 December 2010: 2008 Local Authority Energy Use Data* [online]. Available at: <http://www.decc.gov.uk/en/content/cms/statistics/uksa/sa20101223c/sa20101223c.aspx> [Accessed 2 May 2011].

Department of Energy and Climate Change 2011. *Climate Change Act 2008* [online]. Available at: http://www.decc.gov.uk/en/content/cms/legislation/cc_act_08/cc_act_08.aspx [Accessed 2 May 2011].

Dietz, T., Stern, P.C. and Guagnano, G.A., 1998. Social Structural and Social Psychological Bases of Environmental Concern. *Environment and Behavior*, 30(4), 450-471.

Eadson, W., 2008. Climate change mitigation in Local Area Agreements: an enforced lack of ambition? *People, Place and Policy Online* 2/3, 140-150.

EDINA 2011. *Digimap Collections* [online]. Available at: <http://edina.ac.uk/digimap/> [Accessed 2 May 2011].

Elliott, E., Seldon, B.J., and Regens, J.L., 1997. Political and economic determinants of individuals support for environmental spending. *Journal of Environmental Management*, 51(1), 15-27.

Energy Savings Trust 2011a. *The Nottingham Declaration on Climate Change* [online]. Available at: <http://www.energysavingtrust.org.uk/nottingham/Nottingham-Declaration/The-Declaration/About-the-Declaration> [Accessed 10 July 2011].

Energy Savings Trust 2011b. *Local Area Agreements* [online].

Available at: <http://www.energysavingtrust.org.uk/nottingham/Nottingham-Declaration/Performance-Measures/Local-Area-Agreements> [Accessed 2 May 2011].

Energy Savings Trust 2011c. *NII86: Per capita CO2 emissions in a local authority area – improvement target values* [online]. Available at: <http://www.energysavingtrust.org.uk/nottingham/content/download/169622/371735/file/NII86%20LAA%20targets%20by%20region.pdf> [Accessed 2 May 2011].

Environment Agency 2007. *Review of 2007 summer floods* [online]. Available at: <http://www.environment-agency.gov.uk/research/library/publications/33887.aspx> [Accessed 14 July 2011].

Environment Agency 2008. Memorandum submitted by the Environment Agency, in House of Commons Environmental Audit Committee, *Climate Change and Local, Regional and Devolved Government*, Eighth Report of Session 2007-2008, Ev 145, HC 225. London: TSO.

Environment Agency 2011a. *Appendix H – Properties at risk from flooding by NaFRA category V40* Obtained through personal communication with the National Customer Contact Centre.

Environment Agency 2011b. *The costs of the summer 2007 floods in England – Annexes. Report SC 070039/SR*. Obtained through personal communication with the National Customer Contact Centre.

Footitt, A., Wood, R. and Turnpenny, J., 2007. *Review of local government action on climate change*. Tyndall Centre for Climate Change Research [online].

Available at: <http://www.lga.gov.uk/lga/publications/publication-display.do?id=21816> [Accessed 25 June 2011].

Friends of the Earth 2011a. *Committee on Climate Change advice on local action to meet national carbon budgets*. Discussion Paper. [online]. Available at: <http://www.foe.co.uk/resource/index.shtml?v=reports> [Accessed 26 June 2011].

Friends of the Earth 2011b. *Council Survey Results 7th Feb 2011*. Personal communication with David Powell and Glyn Thomas from Friends of the Earth.

Green Party 2011. *Green Party Councillors* [online]. Available at: <http://www.greenparty.org.uk/links/councillors.html> [Accessed 2 May 2011].

Green Suffolk 2011. *About: Suffolk – creating the greenest county* [online]. Available at: <http://www.greensuffolk.org/about> [Accessed 21 August 2011].

Grothmann, T. and Patt, A., 2005. Adaptive capacity and human cognition: The process of individual adaptation to climate change. *Global Environmental Change* 15 199–213.

Harvey, F., and Stratton, A., 2011. Chris Huhne pledges to halve UK carbon emissions by 2025. *The Guardian* [online].

Available at: <http://www.guardian.co.uk/environment/2011/may/17/uk-halve-carbon-emissions>

[Accessed 25 June 2011].

ICLEI, 2011. ICLEI Global Members [online].

Available at: <http://www.iclei.org/index.php?id=11454> [Accessed 2 July 2011].

Inglehart, R., and Abramson, P.R., 1994. Economic security and value change. *The American Political Science Review*, 88(2), 336-354.

IPCC, 2007. *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.

Klineberg, S.L., McKeever M. and Rothenbach, B., 1998. Demographic Predictors of Environmental Concern: It Does Make a Difference How It's Measured? *Social Science Quarterly*, 79(4) 734-755.

Konisky, D.M., Jeffrey, M. and Richardson Lilliard E. Jr., 2008. Environmental Policy Attitudes: Issues, Geographical Scale, and Political Trust. *Social Science Quarterly* 89(5) 1066-1086.

Lindseth, G., 2004. The Cities for Climate Protection Campaign (CCPC) and the Framing of Local Climate Policy. *Local Environment*, 9(4), 325-336.

Local Government Group 2010. *Climate change survey of local authorities* [online].

Available at: <http://www.lga.gov.uk/lga/core/page.do?pageId=1095283>

Accessed [25 June 2011].

Lorenzoni, I., Nicholson-Cole, S. and Whitmarsh, L., 2007. Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change*, 17, 445-459.

Lubell, M., Vedlitz, A., Zahran, S. and Alston, L.T., 2006. Collective Action, Environmental Activism, and Air Quality Policy. *Political Research Quarterly* 59(1) 146-160.

Lubell, M., Zahran, S. and Vedlitz, A., 2007. Collective action and citizen responses to global warming. *Political Behavior* 29(3), 391-413.

- National Audit Office 2007. *Central Government Support for Local Authorities on Climate Change* [online]. Available at: http://www.nao.org.uk/publications/0607/climate_change.aspx Accessed [3 July 2011].
- Natural England 2011a. *Sites of Special Scientific Interest* [online]. Available at: <http://www.naturalengland.org.uk/ourwork/conservation/designatedareas/ssi/default.aspx> [Accessed 15 July 2011].
- Natural England 2011b. *GIS Digital Boundary Datasets* [online]. Available at: http://www.gis.naturalengland.org.uk/pubs/gis/GIS_register.asp [Accessed 22 May 2011].
- NOMIS 2011. *Official labour market statistics* [online]. Available at: <http://www.nomisweb.co.uk/> [Accessed 2 May 2011].
- O'Connor, R.E., Bord, R.J., Yarnal, B. And Wiefek, N., 2002. Who wants to reduce greenhouse gas emissions? *Social Science Quarterly*, 83(1), 1-17.
- Office for National Statistics 2011. *Office for national statistics* [online]. Available at: <http://www.ons.gov.uk/ons/index.html> [Accessed 2 May 2011].
- Pearce, G. and Cooper, S., 2011. Sub-national responses to climate change in England: Evidence from Local Area Agreements. *Local Government Studies*, 37(2), 199-217.
- Pitt, D. and Randolph, J., 2009. Identifying obstacles to community climate protection planning. *Environment and Planning C: Government and Policy*, 27, 841-857.
- PPS Group 2010. *PPS local authority political control database* [online]. Available at: www.ppsgroup.co.uk/pdf/PPS-Local-authority-political-control-database.pdf [Accessed 15 July 2011].
- Press Association 2011. Tory MEPS warned not to undermine PM over European Climate Targets. *The Guardian* [online]. Available at: <http://www.guardian.co.uk/politics/2011/jun/23/european-climate-change-targets-conservatives> [Accessed 25 June 2011].
- Raymond, C.M. and Brown, G., 2011. Assessing spatial associations between perceptions of landscape value and climate change risk for use in climate change planning. *Climatic Change*, 104, 653–678.
- Stockton-on-Tees Borough Council (2009). *Climate Change Action Plan 2009-2020*. Available at: <http://www.stockton.gov.uk/citizenservices/envpol/envclich/climch/> [Accessed 18/12/12].

Surrey County Council (2012). *Surrey Climate Change Strategy*. Available at: <http://www.surreyimprovement.info/climate/SCCS/sccs> [Accessed 18/12/12].

UKCP09 (UK Climate Projections 2009) 2011. *UKCP09 User Interface* [online]. Available at: <http://ukclimateprojections-ui.defra.gov.uk/ui/admin/login.php> [Accessed 15 July 2011].

Urwin, K. and Jordan, A., 2008. Does public policy support or undermine climate change adaptation? Exploring policy interplay across different scales of governance. *Global Environmental Change*, 18, 180-191.

Zahran, S., Brody, S.D. and Grover, H., 2006. Climate change vulnerability and policy support. *Society and Natural Resources*, 19, 771-789.

Zahran, S., Brody, S.D., Vedlitz, A., Grover, H. and Miller, C., 2008a. Vulnerability and Capacity: explaining local commitment to climate-change policy. *Environment and Planning C: Government and Policy*, 26, 544-562.

Zahran, S., Grover, H., Brody, S.D. and Vedlitz, A., 2008b. Risk, Stress and Capacity. Explaining metropolitan commitment to climate protection. *Urban Affairs Review*, 43(4), 447-474.

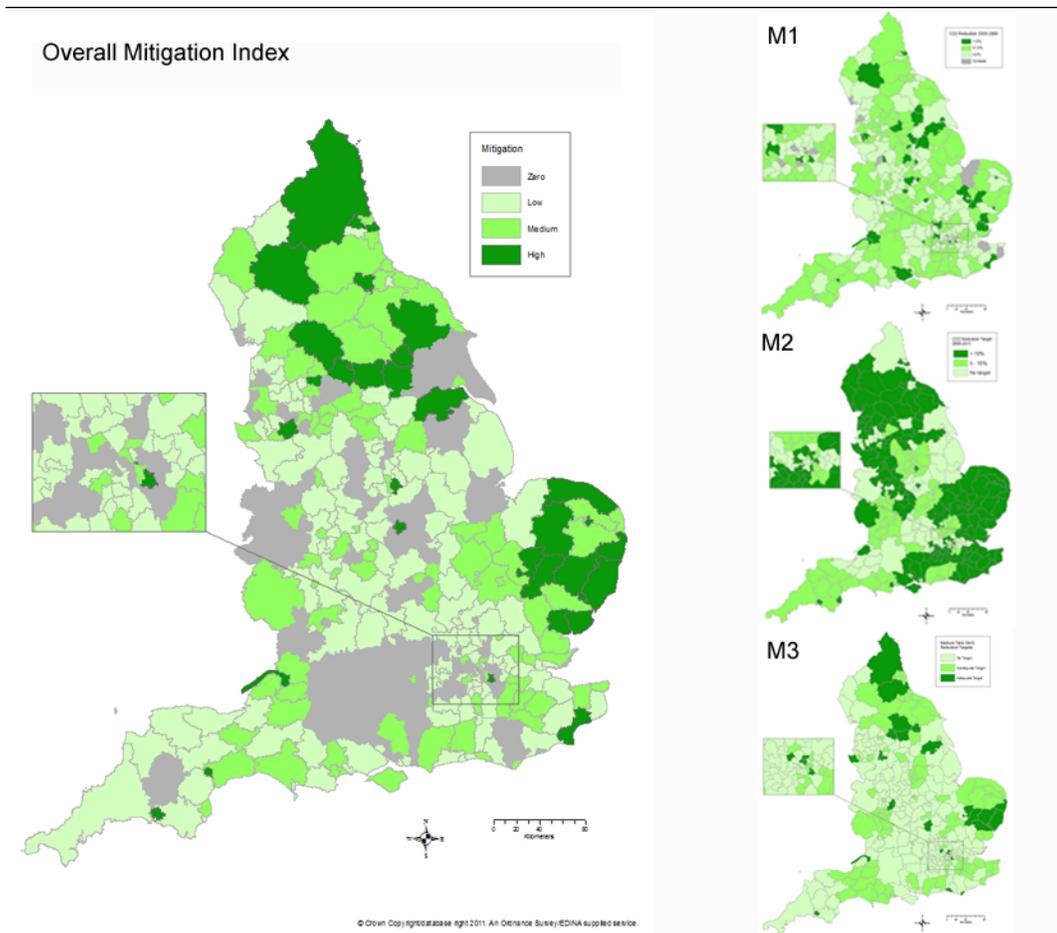


Figure 1: Climate change mitigation in England, including inset maps of scores for indicators M1 (CO₂ emissions trends 2005-2008); M2 (CO₂ emissions reduction targets 2008-2011) and M3 (Medium term CO₂ emissions reduction targets). The data sources used are outlined in Table 1. Areal unit of study is local authority.

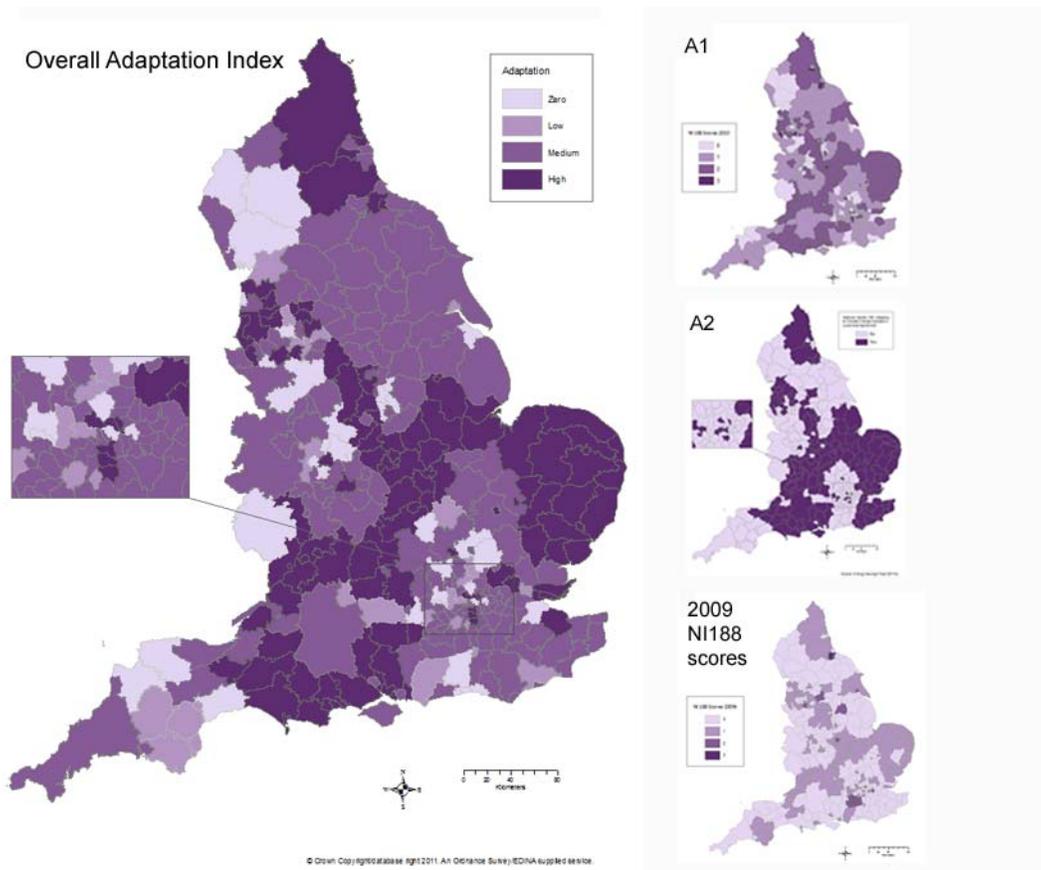


Figure 2: Climate change adaptation in England, including inset maps of scores for indicators A1 (NI 188 score for 2010); A2 (inclusion of NI 188 in the Local Area Agreement) and the NI 188 score for 2009 (indicator A3 is a measure of the change between 2009 and 2010). The data sources used are outlined in Table 1. Areal unit of study is local authority.

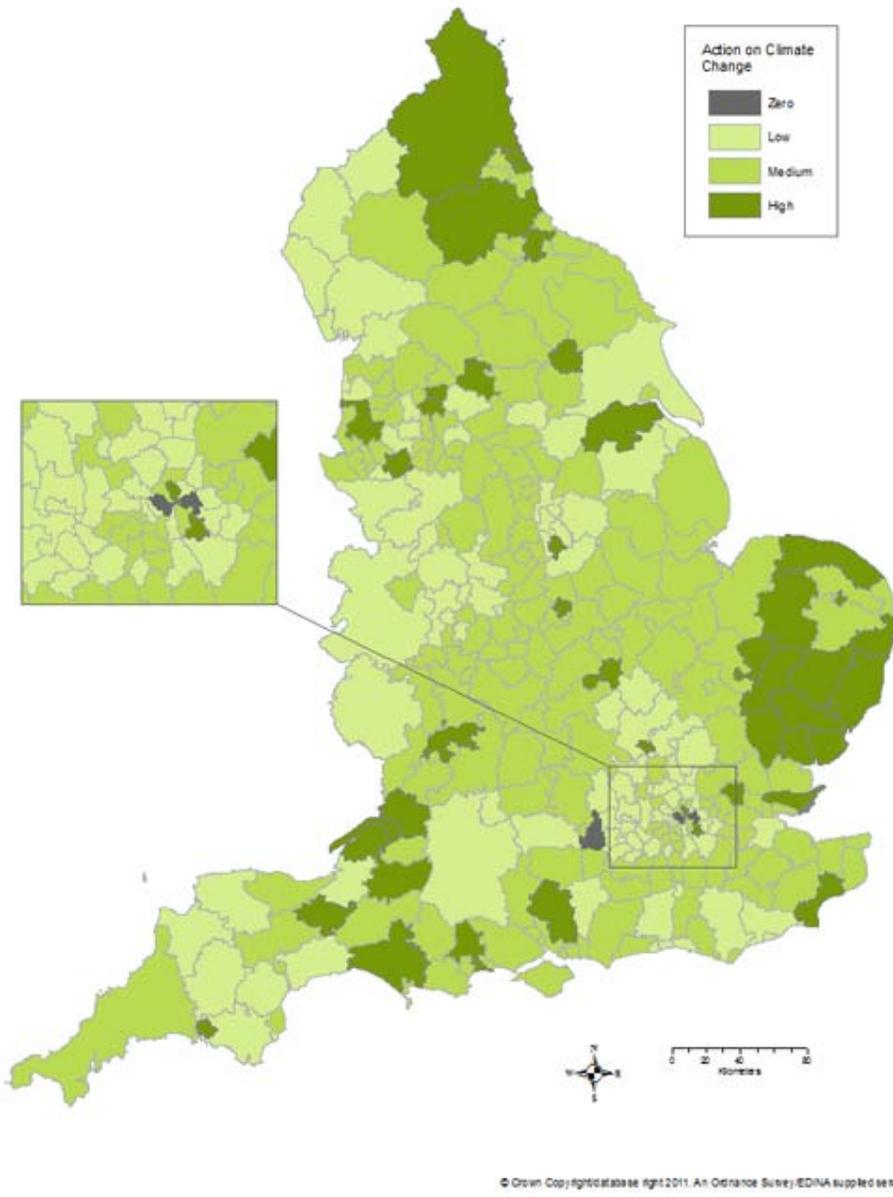


Figure 3: Action Index on climate change in England. The data sources used are outlined in Table 1. Areal unit of study is local authority.

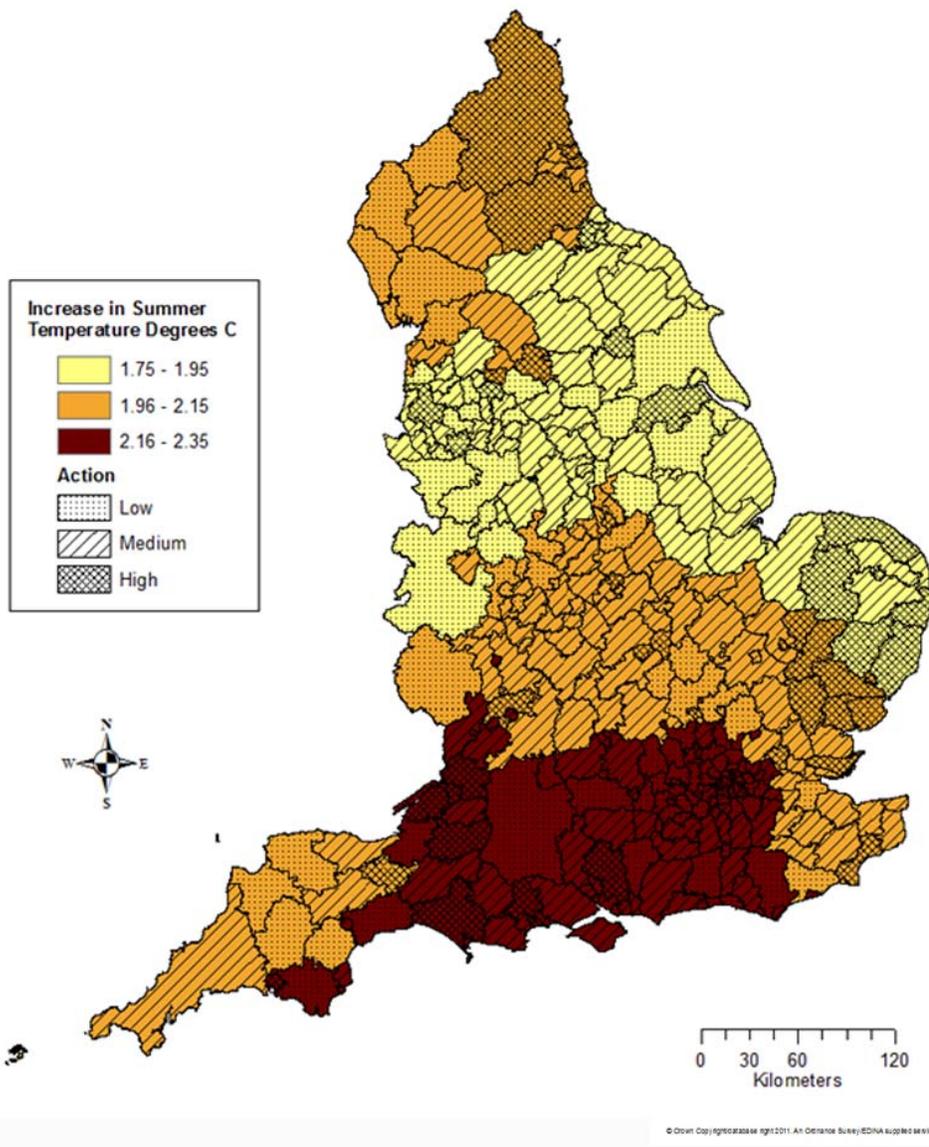
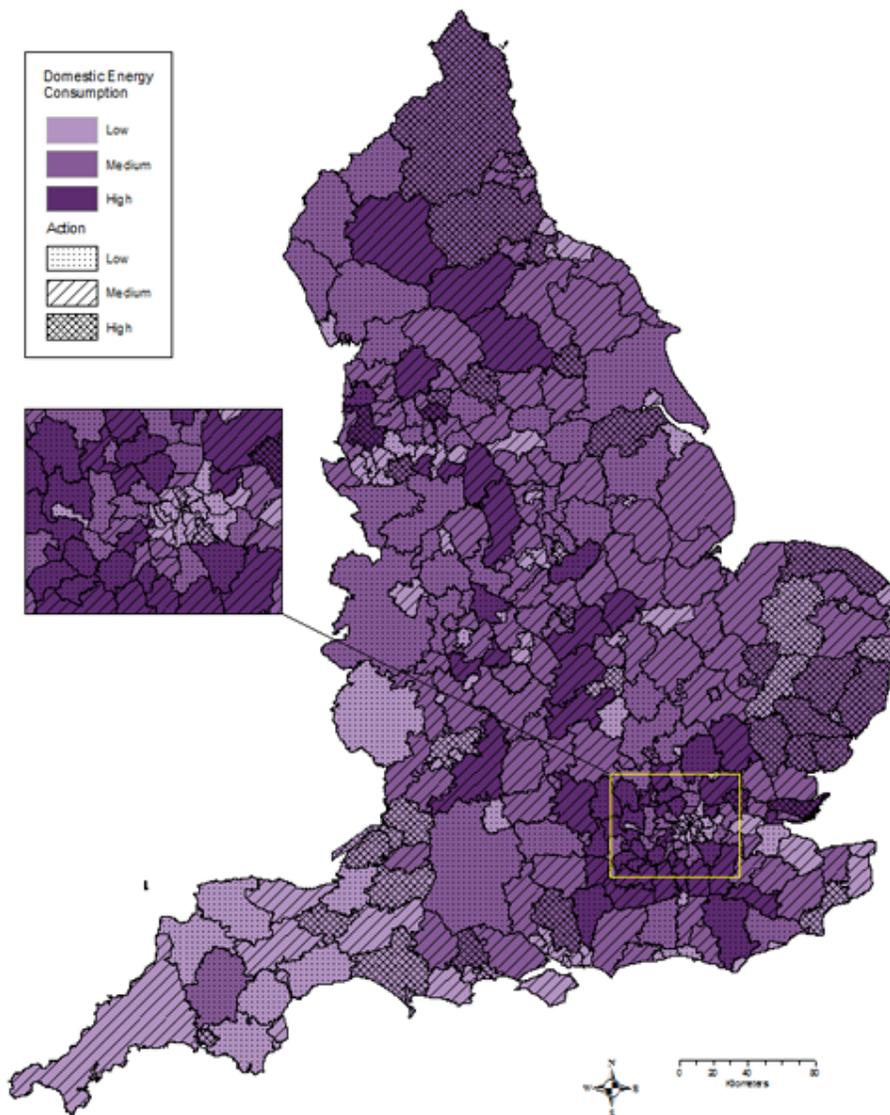
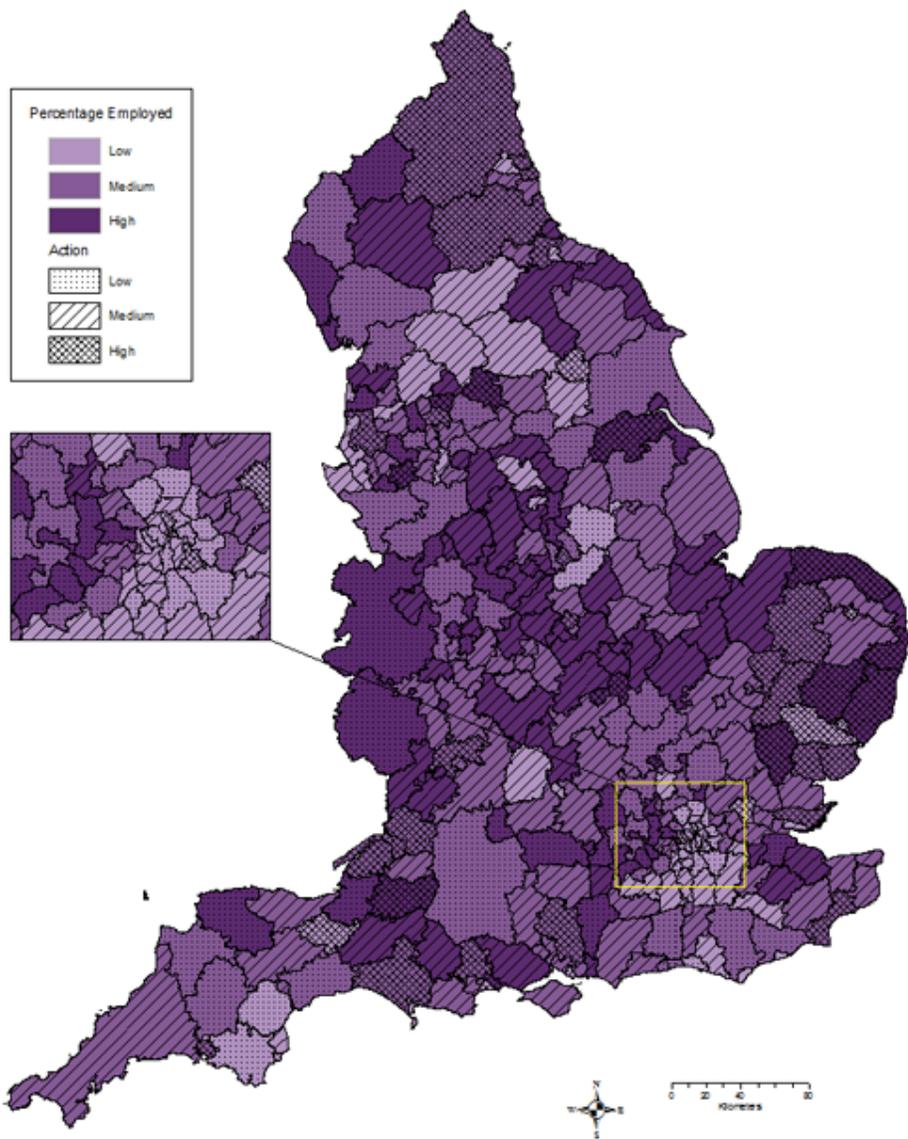


Figure 4: Projected increase in summer temperatures to 2050 in England (*Summer temperature*). The data sources used are outlined in Table 2.



Source: Department of Energy and Climate Change (2010b)
 © Crown Copyright/database right 2011. An Ordnance Survey/EDINA supplied service.

Figure 5: *Domestic energy consumption* per consumer in England. The data sources used are outlined in Table 2. Areal unit of study is local authority. 11% more of the low consumption and 9% less of the high consumption fell into the high Action Index category than anticipated.



Source: Nomis (2011)

© Crown Copyright/database right 2011. An Ordnance Survey/EDINA supplied service.

Figure 6: Percentage employment in carbon intensive industry in England (*Carbon employment*). The data sources used are outlined in Table 2. Areal unit of study is local authority. 6% more of the local authorities with a low dependence on carbon intensive industry had high Action Index scores than would be expected if there was no relationship. 4% less of the local authorities with a high dependence on carbon intensive industry than expected had high Action Index scores.

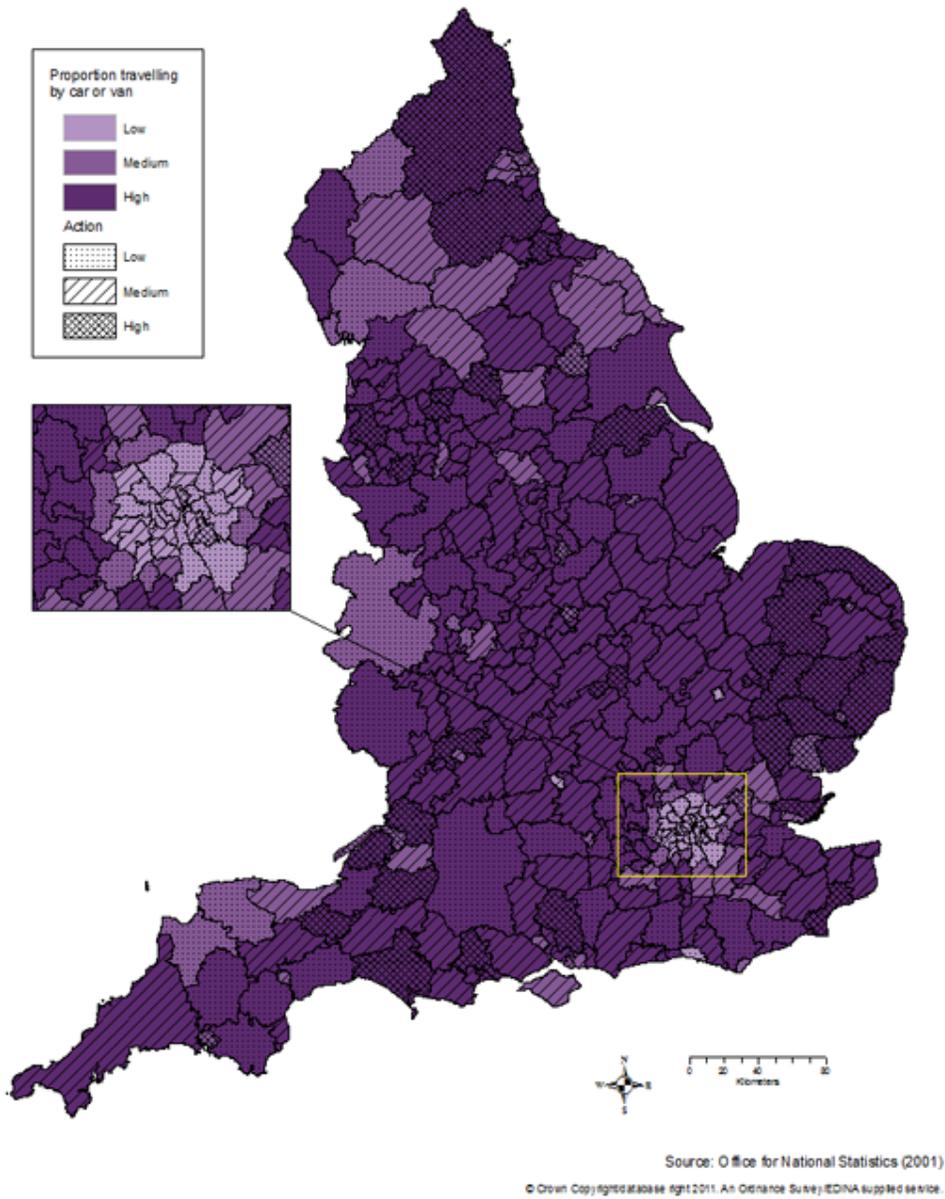
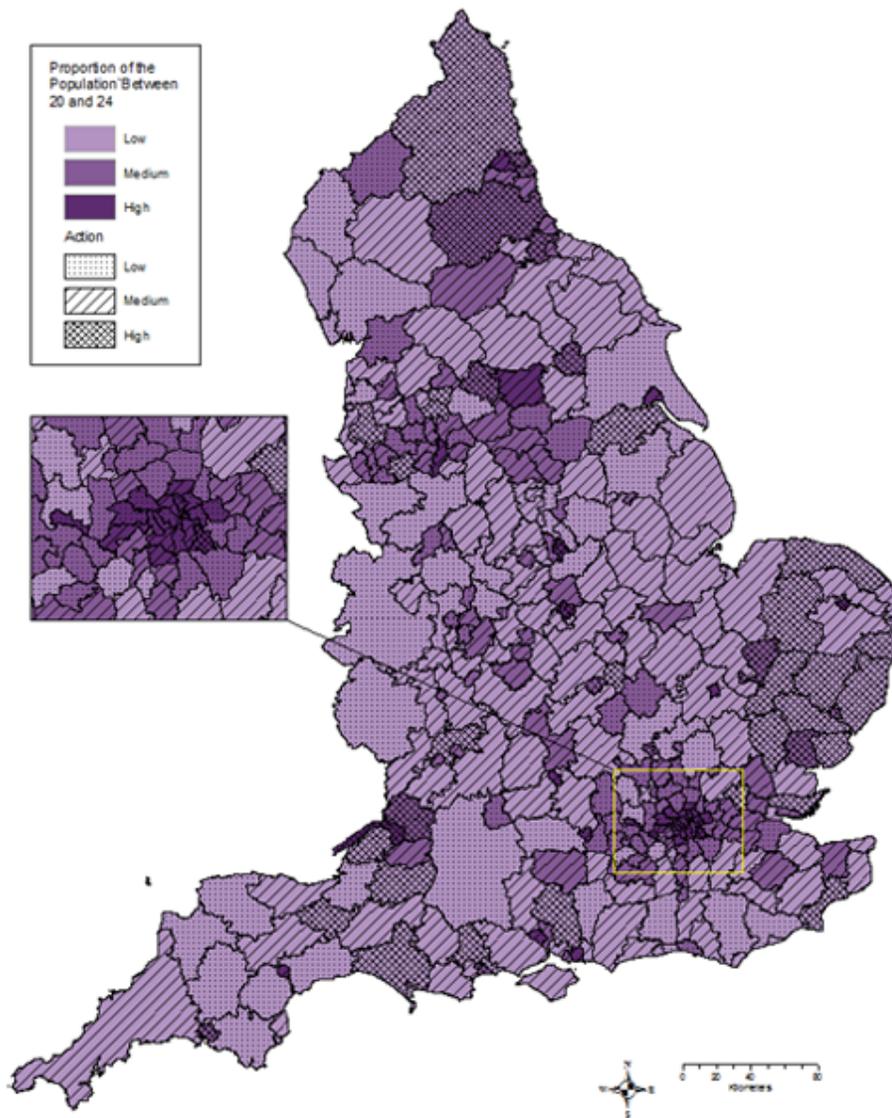
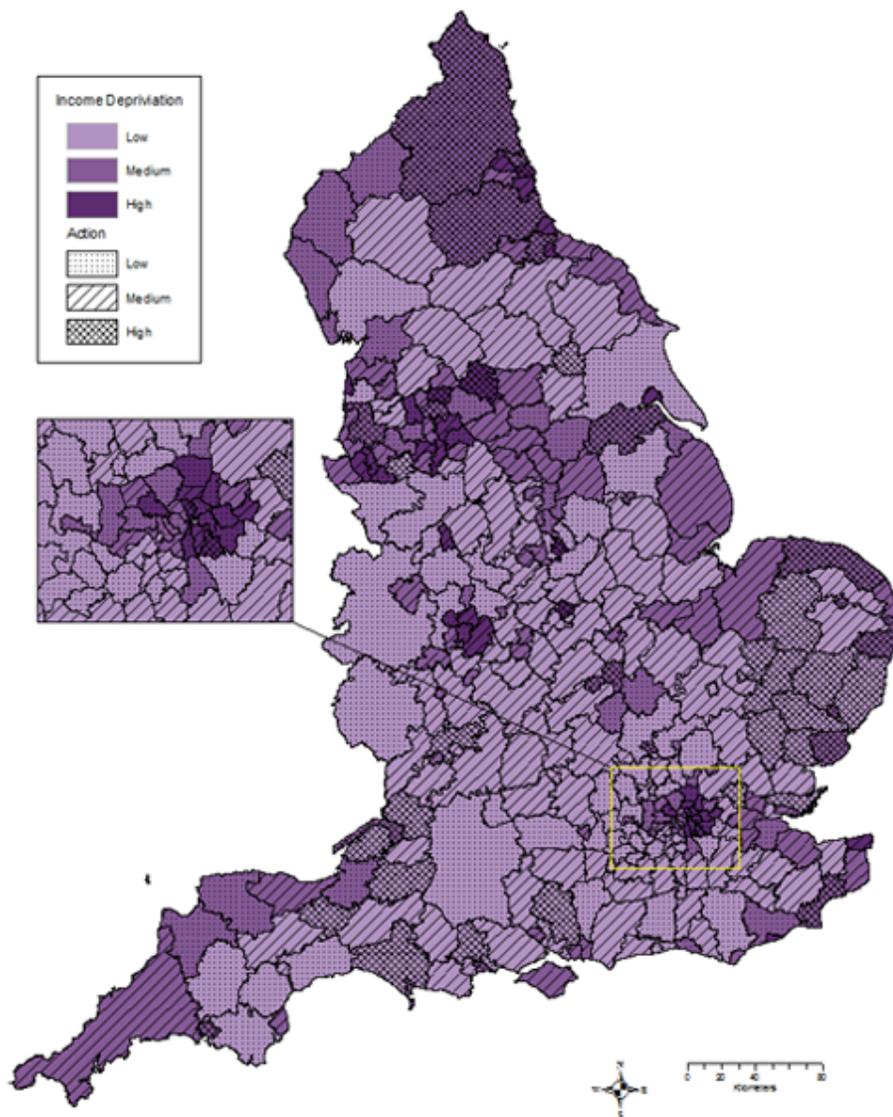


Figure 7: Number of people aged 16-64 who *Travel to work* via car or van as a percentage of the number of working people aged 16-64. The data sources used are outlined in Table 2. Areal unit of study is local authority.



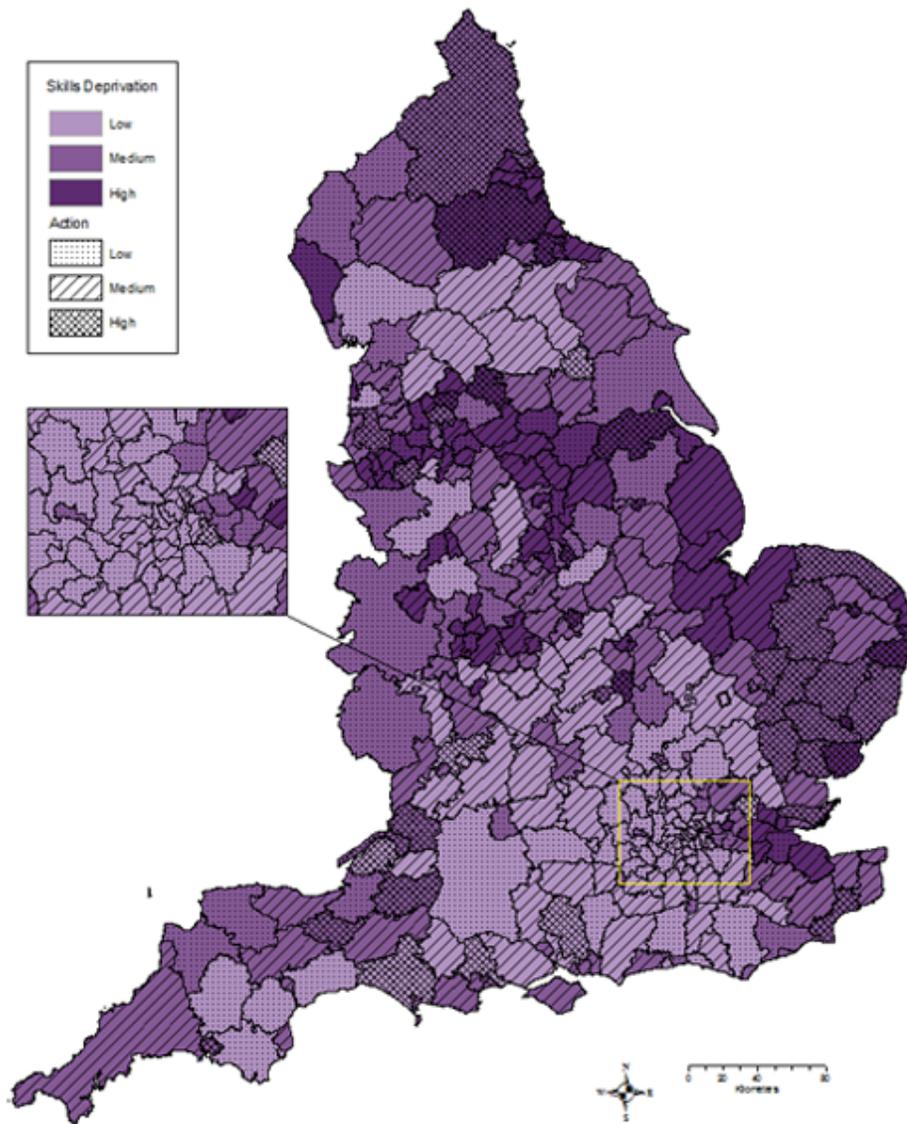
Source: Office for National Statistics (2011)
 © Crown Copyright/database right 2011. An Ordnance Survey/EDINA supplied service.

Figure 8: Number of *Young people* (aged 20-24) as a percentage of the total population of the local authority area. The data sources used are outlined in Table 2. Areal unit of study is local authority.



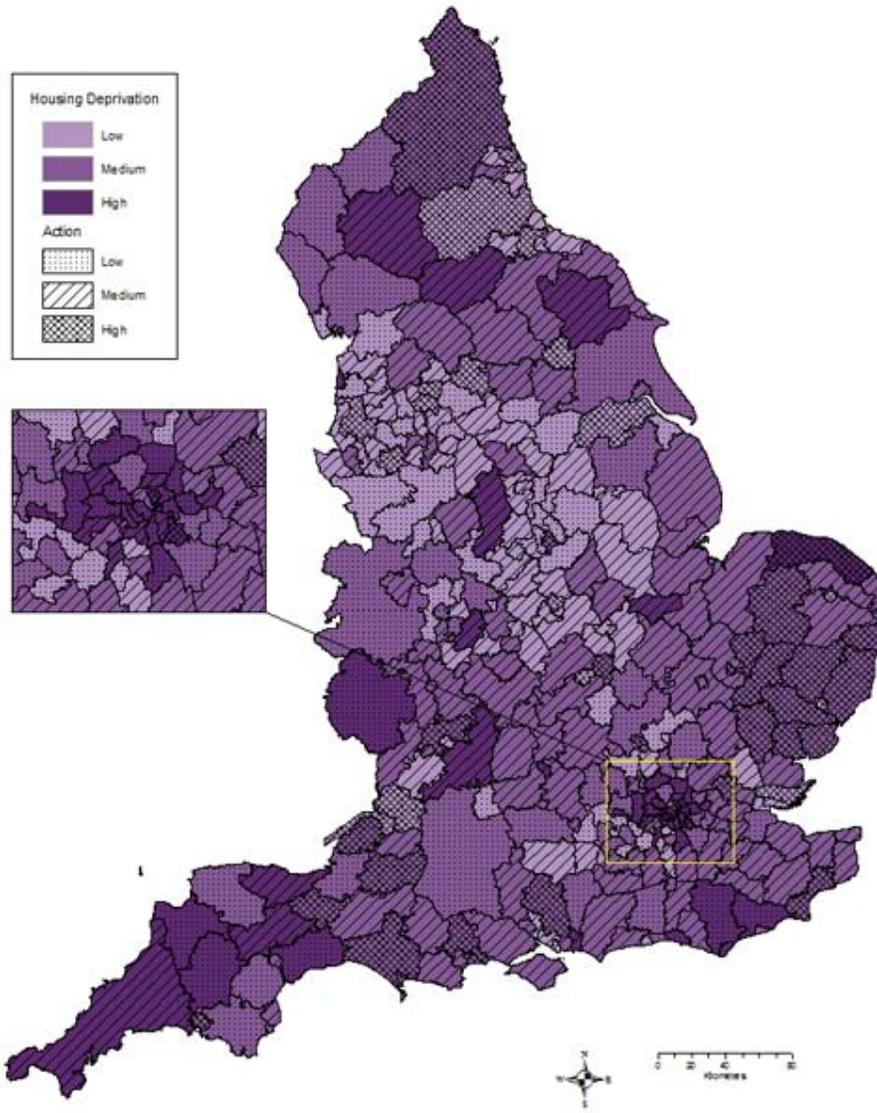
Source: Communities and Local Government (2010b) English Indices of Deprivation 2010
 © Crown Copyright/database right 2011. An Ordnance Survey/EDINA supplied service.

Figure 9: Proportion of residents in a local authority area suffering deprivation as a result of low *Income*. The data sources used are outlined in Table 2. Areal unit of study is local authority.



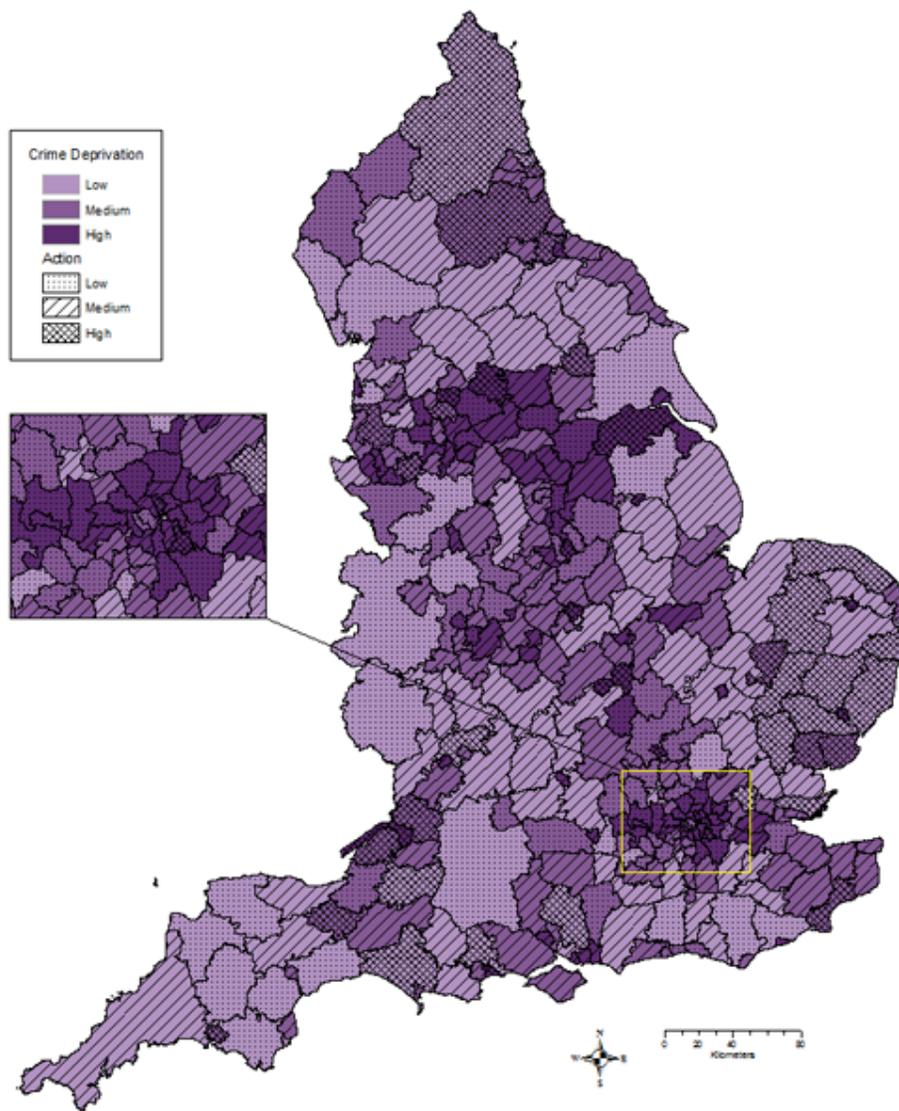
Source: Communities and Local Government (2010b) English Indices of Deprivation 2010
 © Crown Copyright/database right 2011. An Ordnance Survey/EDINA supplied service.

Figure 10: Proportion of the population suffering skills deprivation in England (*Skills*). The data sources used are outlined in Table 2. Areal unit of study is local authority. Of the low deprivation local authorities, 11% more than expected fell into the low action category, and 15% less than anticipated were classified in the high action bracket. In addition, there were less high deprivation local authorities than expected in the low action bracket.



Source: Communities and Local Government (2010b) English Indices of Deprivation 2010
 © Crown Copyright/database right 2011. An Ordnance Survey/EDINA supplied service.

Figure 11: Proportion of the population suffering housing deprivation in England (*Barriers to housing and services*). The data sources used are outlined in Table 2. Areal unit of study is local authority. 8% more high deprivation local authorities than expected were identified in the low action bracket and 6% less in the high action category.



Source: Communities and Local Government (2010b) English Indices of Deprivation 2010
 © Crown Copyright/database right 2011. An Ordnance Survey/EDINA supplied service.

Figure 12: Proportion of the population suffering from crime related deprivation in England (*Crime*). The data sources used are outlined in Table 2. Areal unit of study is local authority. 7% more high deprivation local authorities than expected were found to be in the low climate change action category. For low deprivation authorities, 6% less than anticipated were found in the low action bracket and 7% more in the high action category.

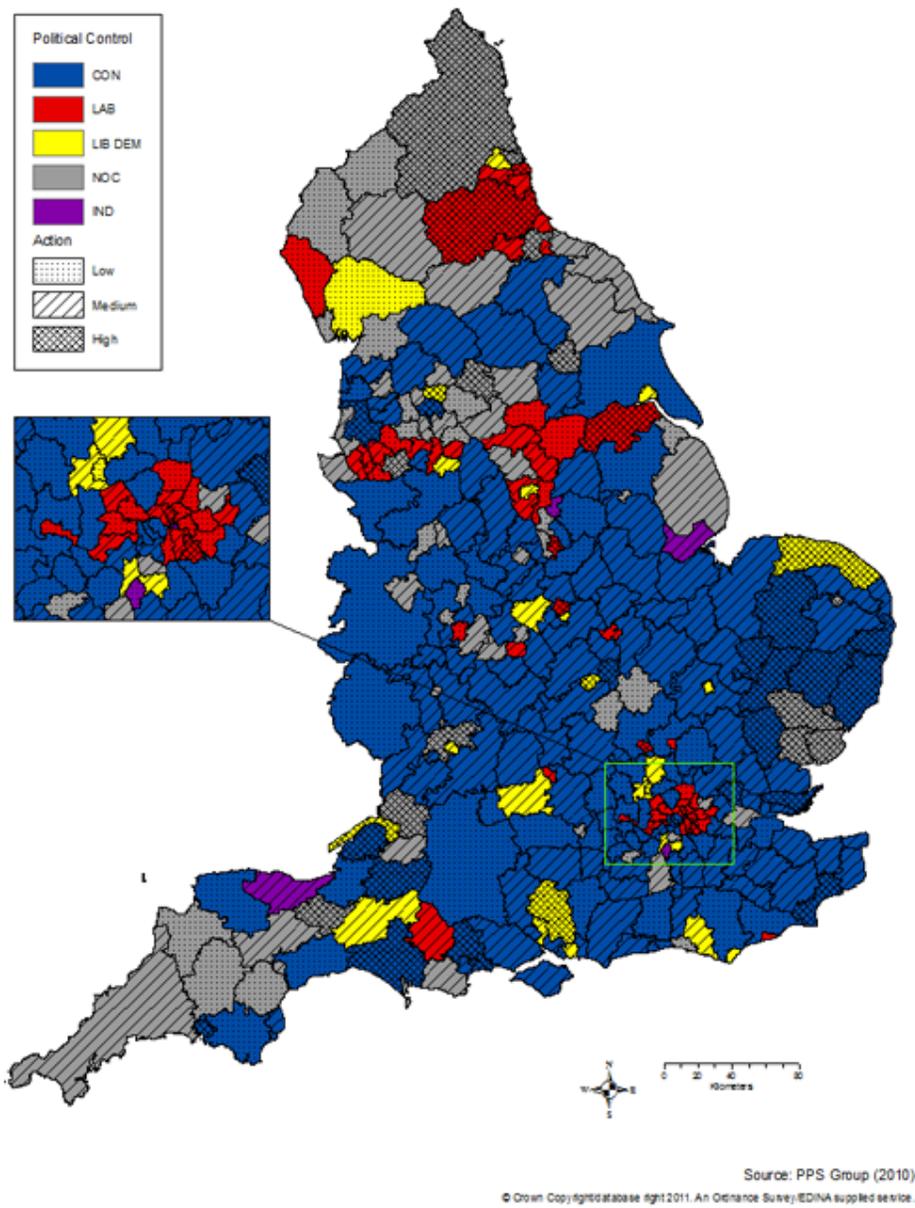


Figure 13: *Political control* in the local election cycle to May 2011 in England. The data sources used are outlined in Table 2. Areal unit of study is local authority.

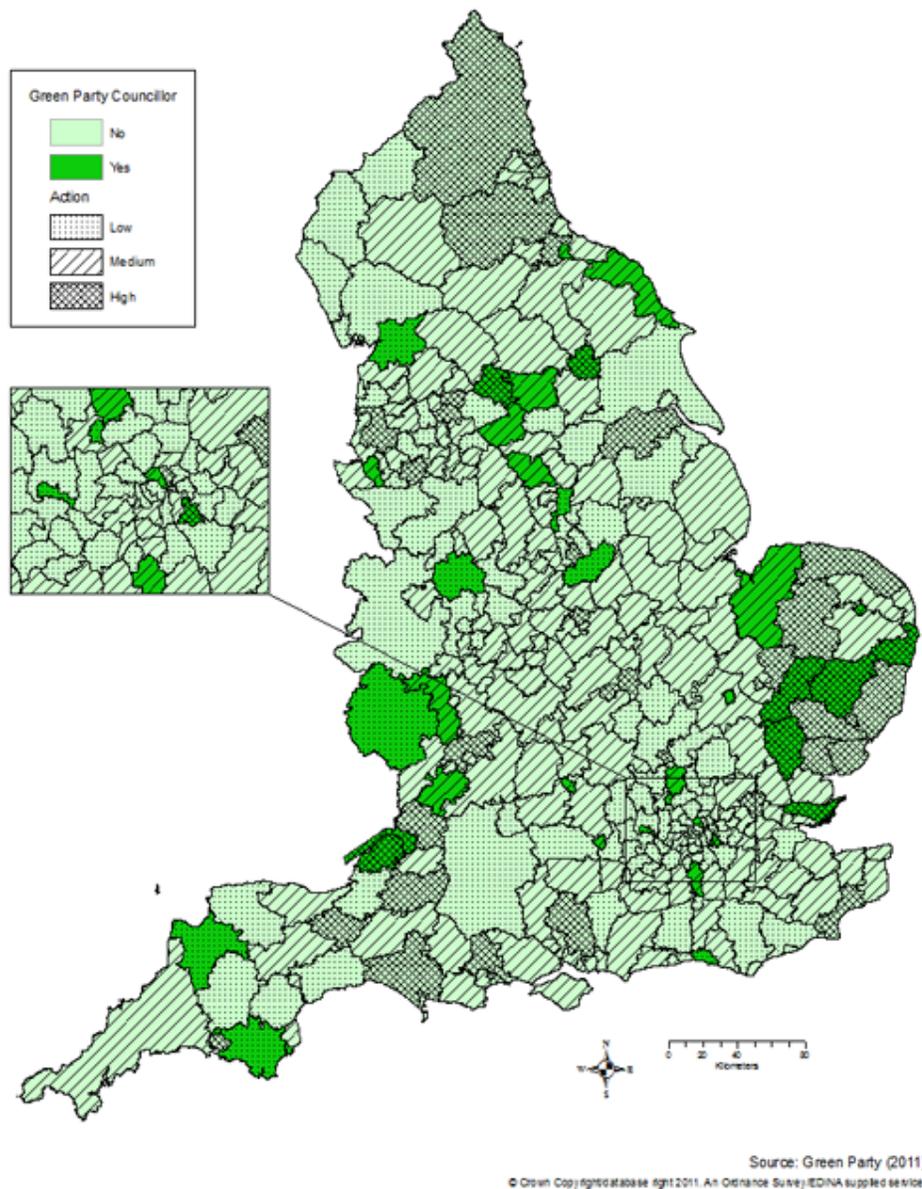
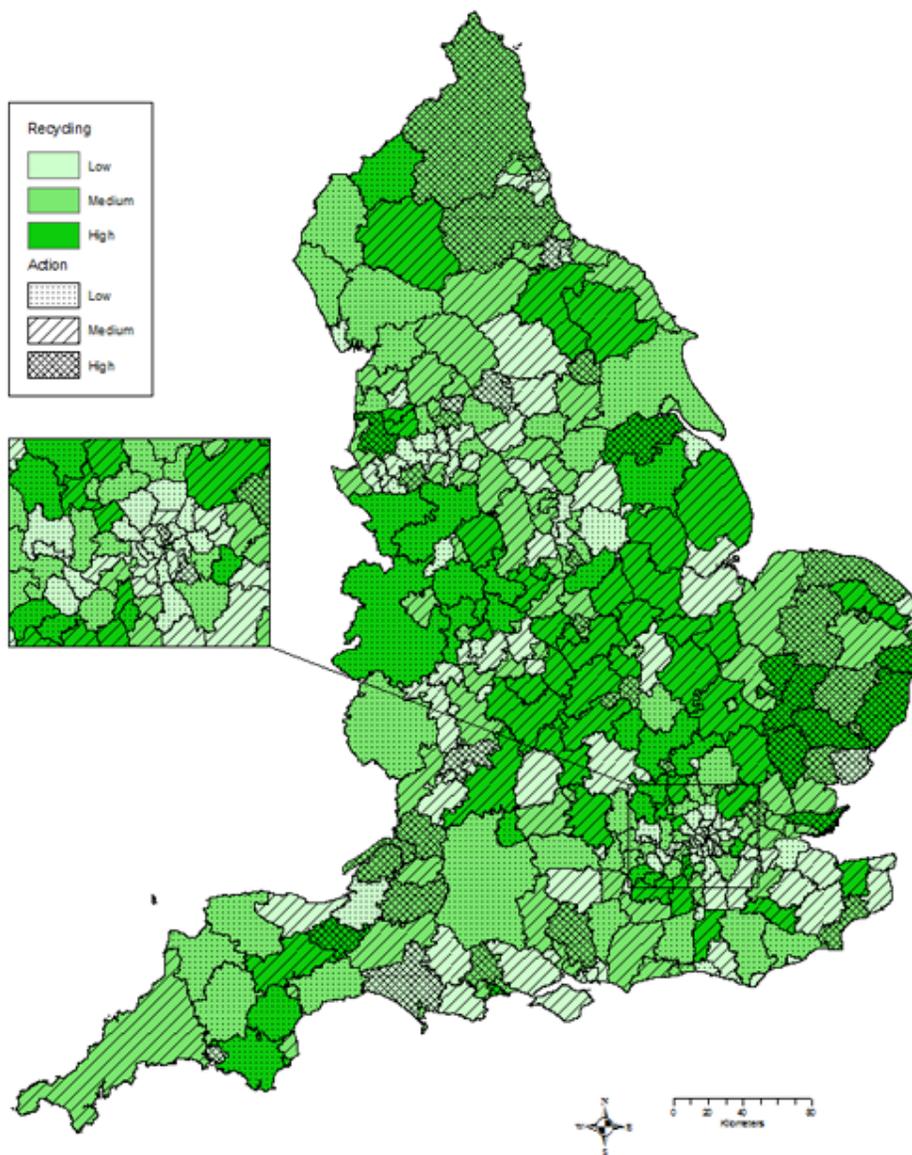


Figure 14: Presence of green party members on the council in England in May 2011 (*Green councillor*). The data sources used are outlined in Table 2. Areal unit of study is local authority. Councils with a green party councillor are more than twice as likely to score highly for mitigative action than would be expected with no relationship.



Source: Department for Environment Food and Rural Affairs (2011)
 © Crown Copyright/database right 2011. An Ordnance Survey/EDINA supplied service.

Figure 15: Amount of household waste sent for *Recycling*, reuse or composting as a percentage of the total household waste generated. The data sources used are outlined in Table 2. Areal unit of study is local authority.

Type of Indicator	Variable	Description	Data Source	Weighting
Mitigation M1	NI 186: CO ₂ emissions trends 2005-2008	Percentage change in CO ₂ emissions between 2005 and 2008, as reported in National Indicator 186, per capita CO ₂ emissions reductions in the local authority area. Scored -1 for an increase, 0 for reductions to 5%, 1 for reductions between 5-20%, 2 for reductions over 20%	Department of Energy and Climate Change (2010a)	25%
Mitigation M2	NI 186: CO ₂ emissions reduction targets 2008-2011	CO ₂ emissions reduction targets published under NI 186 for the period 2008-2011. Scored 0 for targets under 10% (likely to be met with national government initiatives already in place) and 1 for targets 10% and over (requiring additional local effort).	Energy Saving Trust (2011c)	8.3%
Mitigation M3	Medium term CO ₂ emissions reduction targets	Emissions reduction targets for 2020 or equivalent rated according to whether they are stringent enough to meet national targets (i.e. 40% or more by 2020, in line with 80% by 2050 - Bows et al, 2009). Scored 0 for no target, 1 for inadequate target, 2 for adequate target	Friends of the Earth (2011b)	16.7%
Adaptation A1	NI 188 scores for 2009 and 2010	Scores received on scale of 0-4 for work related to National Indicator 188, Preparing to Adapt to Climate Change for the years 2009 and 2010	Communities and Local Government (2010a)	33.3%
Adaptation A2	NI 188 in LAA	Measure of whether National Indicator 188 was included in 2008-2011 Local Area Agreement. 0 for no, 1 for yes	Energy Saving Trust (2011b)	8.3%
Adaptation A3	NI 188 progress	Measure of progress related to National Indicator 188. 0 for no progress 2009-2010, 1 for improved scores	Communities and Local Government (2010a)	8.3%

Table 1: Variables and data sources used in the construction of the Action Index of local authority commitment to climate change. The weightings used are explained in the text.

Variable	Description	Data Source	Sign
<u>Physical Vulnerability</u>			
Area on flood plain	Local authority area on the flood plain as a percentage of the total land area	Environment Agency (2007)	+
Property at risk	Number of properties at significant risk of flooding (greater than a 1 in 75 probability in any year) as a percentage of the total properties in the local authority area – takes into account local flood defences.	Environment Agency (2011a)	+
Summer flood 2007	Measure of whether a local authority was affected by the floods of 2007. Defined as local authorities who assumed 1% or more of the total costs.	Environment Agency (2011b)	+
Coastal	Measure of whether the local authority area is on the coast	EDINA (2011)	+
Summer temperature	Projected likely summer temperature change to 2050 under medium emissions scenario with a 33% probability (66% probability the changes experienced will be greater than those generated by the projections)	UKCP09 (2011)	+
Summer precipitation	Projected likely summer precipitation change to 2050 under medium emissions scenario with a 33% probability (66% probability the changes experienced will be greater than those generated by the projections)	UKCP09 (2011)	+
Winter precipitation	Projected likely winter precipitation change to 2050 under medium emissions scenario with a 33% probability (66% probability the changes experienced will be greater than those generated by the projections)	UKCP09 (2011)	+
SSSIs	Local authority area designated	Natural England	+

	as a Site of Special Scientific Interest as a percentage of the total land area	(2011a,b)	
<u>Economic Structure</u>			
Population density	Number of people per km ² (calculated in ArcMap)	Office for National Statistics (2011)	+
Carbon employment	Number of people aged 16-64 employed in agriculture, utilities, manufacturing, construction and transport and communication as a percentage of the total population aged 16-64	NOMIS (2011)	-
CO ₂ per capita	Tonnes of CO ₂ emitted per person from industrial sources in the local authority area	Department of Energy and Climate Change (2010b)	-
Domestic energy consumption	Domestic gas and electricity used per consumer in KWh	Department of Energy and Climate Change (2010b)	-
Travel to work	Number of people aged 16-64 who travel to work via car or van as a percentage of the number of working people aged 16-64	Office for National Statistics (2011)	-
<u>Social Capacity</u>			
Higher education	Number of people aged 19 to retirement age with a first degree or higher as percentage of the total population age 19 to retirement	Communities and Local Government (2010a)	+
Young people	Number of people aged 20-24 as a percentage of the total population of the local authority area	Office for National Statistics (2011)	+
Income	Proportion of residents in a local authority area suffering deprivation as a result of low income	EID – Communities and Local Government (2010b)	-
Employment	Proportion of people suffering deprivation as a result of being involuntarily out of work	EID – Communities and Local Government (2010b)	-
Skills	Proportion of people aged 25-54 suffering deprivation as a result of having no or low skills	EID – Communities and Local Government	-

		(2010b)	
Health and disability	Proportion of people suffering deprivation as a result of poor health or disability	EID – Communities and Local Government (2010b)	-
Barriers to housing and services	Proportion of people suffering deprivation as a result of shortages of affordable housing or lack of access to services	EID – Communities and Local Government (2010b)	-
Crime	Proportion of people suffering deprivation as a result of high crime rates	EID – Communities and Local Government (2010b)	-
Living environment	Proportion of people suffering deprivation as a result of poor housing and environmental conditions	EID – Communities and Local Government (2010b)	-
Political control	Political party in control of the local government in the election cycle to May 2011	PPS Group (2010)	
Green councillor	Presence of member(s) of the Green Party on the local council	Green Party (2011)	+
Recycling	Amount of household waste sent for recycling, reuse or compositing as a percentage of the total household waste generated	Department for Environment, Food and Rural Affairs (2011)	+

Table 2: Independent variables analysed to investigate local authority action on climate change. Sign indicates the direction of the relationship with the Action Index expected from previous research, as discussed in the text.

	Action on Mitigation	Action on Adaptation	Action Index on Climate Change
Physical Vulnerability			
Area on flood plain	3.49	7.31	4.53
Property at risk	6.17	2.95	1.37
Summer flood 2007	2.06	0.10	2.30
Coastal	1.84	4.43	7.06**
Summer temperature	10.17**	7.46	11.15**
Summer precipitation	2.96	7.38	0.69
Winter precipitation	4.27	2.15	2.34
SSSIs	7.33	3.87	5.45
Economic Structure			
Population density	2.56	6.43	5.44
Carbon employment	2.81	8.29*	1.56
CO ₂ per capita	4.82	2.45	2.26
Domestic energy consumption	13.58**	2.32	5.48
Travel to work	6.18	15.12**	7.11
Social Capacity			χ^2
Higher education	3.29	1.84	4.60
Young people	17.13**	13.68**	4.97
Income	8.61*	9.55**	2.91
Employment	3.53	2.87	2.91
Skills	11.17**	5.19	10.53**
Health and disability	4.05	6.15	4.00
Barriers to housing and services	4.98	9.67**	9.72**
Crime	1.50	6.88	8.15*
Living Environment	7.22	4.93	3.16
Political control	14.88*	10.52	11.40
Green councillor	10.52**	0.52	8.64**
Recycling	8.91*	14.43**	4.53

Table 3: Statistical relationships using Chi Squared (χ^2) between the dependent variables Action on Mitigation; Action on Adaptation and Action Index on Climate Change and the various independent variables shown below. Stars indicate those relationships that were statistically significant at **95% (p<0.05) and *90% (p<0.1).