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Increasing wellbeing through energy demand reduction for net zero: Citizen perceptions of co-benefits of local measures

Giulia M. Mininni [a,b], Timothy J. Foxon [a,*], Claire Copeland [a,c], Beatriz Aguirre Martinez [a], Donal Brown [a,d], Marie Claire Brisbois [a], Gerardo A. Torres Contreras [a], Siobhan Stack-Maddox [a], Max Lacey-Barnacle [a], Christian Jaccarini [e]

[a] Science Policy Research Unit, University of Sussex, UK
[b] Department of Social Sciences, University of Naples Federico II, Italy
[c] Department of Engineering, Durham University, UK
[d] Ashden Climate Solutions, UK
[e] New Economics Foundation, UK

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ABSTRACT

Energy demand reduction options can make an important contribution to a Net Zero transition for climate change mitigation, and also offer multiple social, economic, and environmental 'co-benefits'. However, these co-benefits are often insufficiently accounted for in policy making, which tends to focus on direct economic costs and benefits. Applying Multi Criteria Mapping and survey methods, the paper investigates how citizens in two UK regions value a range of energy demand reduction options in relation to indicators of wellbeing. This analysis shows that citizens place high value on a range of co-benefits of energy demand reduction options, whilst also valuing fairness including environmental intergenerational concerns and accepting the need for some restrictions on individuals' lifestyle choices. This provides support for recent analysis, based on evaluation of expert opinion, that demand-side mitigation measures are consistent with high levels of citizens' wellbeing, and suggests that energy policy assessment needs to take these co-benefits into account in decision-making processes. This is consistent with moving towards a wider 'wellbeing economy' approach, compared to a narrower assessment based only on economic costs and benefits.

1. Introduction

As in many other countries, challenges relating to the use of energy in the United Kingdom (UK) have been profoundly affected since 2020 by two unexpected shocks: the Covid pandemic, and energy price increases due to higher international oil and gas prices following the Russian invasion of Ukraine. This reinforces the need to address affordability and maintain citizens' wellbeing and quality of life alongside energy security, whilst addressing the need to transition to Net Zero carbon emissions. In the UK, these challenges have been exacerbated by inequalities in households' ability to afford energy services, leading to fuel and transport poverty [1] and increasing concerns about dependence on costly imported gas supplies in relation to affordability and energy security [2].

Recent studies have argued for the critical role of measures leading to final energy demand reduction in meeting climate targets while ensuring quality of life, at global [3] and UK [4; 5] scales, alongside measures to promote low carbon energy supply options. Practical approaches to tackling climate change also emphasise the significant potential for improving people's lives and wellbeing [6]. Creutzig et al. [7] argued that these energy demand mitigation options can enhance living conditions and quality of life for citizens while decreasing energy use and GHG emissions. This is due to the potential for multiple social, economic, and environmental benefits, or 'co-benefits', of demand-side mitigation options, such as increased energy security, diminished poverty and inequality, and greater low-carbon jobs market development [8], as well as reducing the scale of low carbon energy supply needed to meet Net Zero goals [4]. However, as the analysis by Creutzig et al. [6] largely relies on expert judgement of the value of these co-benefits, further research is needed to see how this aligns with public views of the value of these co-benefits. Recent empirical analysis in the UK showed that citizens perceive that climate action is likely to result in

* Corresponding author at: Science Policy Research Unit, University of Sussex Business School, Jubilee Building, Falmer, Brighton, BN1 9SL, UK.
E-mail address: t.j.foxon@sussex.ac.uk (T.J. Foxon).

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co-benefits to individuals, local communities and the nation, and are supportive of these benefits, including improved air quality and health outcomes and homes that are more affordable to heat. However, the literature suggests that awareness of some co-benefits is relatively low [9]. In this paper, we build on this work to provide further empirical evidence of how UK citizens value a range of co-benefits of energy demand reduction measures, including applications to the delivery of power, heating and mobility services.

This is important as, though the case for incorporating these co-benefits into national policy making is increasingly been recognised in official analysis for government there is limited evidence for these co-benefits actually being assessed in decision-making processes. For example, the Treasury Net Zero review in 2021 recognised that "a successful and orderly transition [to net zero] for the economy could realise more benefits – lower household costs, improved resource efficiency for businesses, wider health co-benefits – than an economy based on fossil fuel consumption" [81]. In particular, the UK Government Office for Science emphasised that "in scenarios where societal changes reduce energy demand, health co-benefits are higher" and hence that "emphasising the health co-benefits associated with a net zero transition should benefit citizens and, in so doing, bolster support for the transition itself" [5], though it was made clear that their report was not a statement of government policy. Indeed, a recent review showed that many of the energy demand reduction measures in these scenarios were not part of official government policies and projections, and argued that "recognising the co-benefits of energy demand reductions and potential for value creation from these measures would make energy demand reduction policies both more politically viable and socially acceptable" [82]. However, a recent review argued that these co-benefits are not usually incorporated in policy analysis due to a lack of standardised definitions and the need to overcome difficulties in their quantification [8].

As many of these co-benefits accrue at a more local level, compared to the global benefit of climate mitigation, it has been argued that cities and local and regional authorities are often best positioned to incorporate co-benefits into decision-making, as they have responsibility for local outcomes and oversee related budgets [9]. However, this raises questions regarding decision-making processes at the local/regional level and the challenges of meeting competing priorities of citizens' needs and social, economic and environmental goals. In this paper, we explore the extent to which citizens value wider wellbeing benefits of demand-side mitigation measures, and how citizens compare different potential measures and assess trade-offs between different goals. This aims to inform further work on useful approaches to incorporating citizen assessment of co-benefits of energy demand reduction measures into policymaking. The need for such research and the value of such approaches is reflected in the literature highlighting the importance of public acceptance of policy measures to a successful net zero transition [46].

This research also contributes to ongoing debates questioning the ability of policies grounded in conventional economic approaches to deliver Net Zero and other social and environmental goals [10]. Conventional economic approaches are largely used to support environmental and economic benefits of supply-side technological options for Net Zero, including expansion of renewables, nuclear power and carbon capture and storage. Some demand-side mitigation options, and especially those focused on efficiency and flexibility (e.g. heat pumps, battery storage), also perform well in traditional cost-benefit analyses [76,77]. However, many demand-side measures, and particularly those that reduce consumption through behaviour and culture change, do not provide obvious economic benefits and can be more politically contentious among citizens so often struggle to get political support [78,79]. Alternative economic approaches that explicitly value environmental and social benefits alongside economic benefits, such as the Carnegie "SEED" (Social, Economic, Environmental, Democratic) model [11] and Raworth's [12,42] 'Doughnut Economics', could help to enable fairer comparison between demand-side and supply-side options, whilst recognising that political contentions would remain.

In the UK, increased climate change threats helped to convince the national government to commit the UK to becoming a Net Zero economy by 2050 [13]. Around 70 % of local and city-region authorities have declared a climate emergency and begun to develop and implement low-carbon energy plans [14], operating at different speeds and within constraints on their ability to act [15]. Meanwhile, rising economic instability and unemployment have led to calls for investment in new job opportunities and skills development across the UK. Several local authorities (LAs) have adopted Green New Deal (GND)-type policies to achieve these objectives with wide ranging climate actions including transport emissions reduction, decarbonisation of buildings, increasing 'green' skills and businesses [16].

To help inform how citizens value the types of demand-side mitigation measures that could be introduced as part of Local Green New Deals [17,18], we undertook a comparative empirical study of citizens' views in two UK regions: North of Tyne and Greater Brighton, using mixed methods of citizen surveys and focus groups. The latter applied multi-criteria mapping (MCM), a research method widely used for the appraisal of diverse perspectives on policy and strategic issues [19]. These regions both have large populations of around 1 million people, with large cities and rural areas, including parts with significant social deprivation. Greater Brighton has higher average economic prosperity, being located in the more affluent south of England. They also have diverse political arrangements. The North of Tyne Combined Authority, bringing together three local authorities in the north of England, has an elected Mayor and devolved powers in some areas, including on energy efficiency.[1] The Greater Brighton Economic Board brings together representatives of seven local authorities to co-ordinate activities across the region, though with few direct powers. Both regions have adopted Green New Deal-type policies.

The paper analyses how residents value energy demand mitigation measures that could contribute to their wellbeing whilst stimulating economic opportunities. Section 2 introduces energy demand mitigation options, co-benefits and wellbeing criteria. Section 3 reviews factors affecting citizens' views on energy demand reduction measures. Section 4 presents the case studies of Greater Brighton and North of Tyne regions. Section 5 outlines the research design and methods. Section 6 analyses the quantitative and qualitative results from the survey and the focus groups. Section 7 discusses the main findings in relation to the literature on climate change mitigation and wellbeing. Finally, section 8 concludes, reflecting on the relevance of energy demand mitigation options for wellbeing.

2. Energy demand mitigation options, co-benefits and wellbeing

As in other industrialised countries, UK policy to promote a transition to Net Zero carbon emissions has largely focused on investment in new and emerging energy supply technologies, such as offshore wind, nuclear power and carbon capture and storage [20]. Public support for these technologies is often justified in terms of economic benefits, particularly job creation and local economic regeneration [21]. Meanwhile, UK energy efficiency policies have been relatively unsuccessful [22] and though other energy demand reduction measures, such as low-traffic neighbourhoods (LTNs), have been promoted by some local authorities, they remain politically contentious [23]. It is argued that more explicit recognition and valuation of the co-benefits of both supply-side and demand-side climate mitigation measures could help to motivate action [24,25,26], whilst recognising that identifying co-benefits raises

[1] As noted below, in May 2024, the North of Tyne Combined Authority was merged with five other local authorities to form the North East Combined Authority. The analysis in this paper relates to the former North of Tyne Combined Authority region.

political and institutional challenges [27].

In a recent review of the literature, Finn and Brockway [8] identified 86 separate co-benefits of energy demand reduction measures, across five categories: health (e.g., reduced air pollution, increased physical activity); energy security (e.g., greater energy sovereignty, reduced load management); economy (e.g., higher employment, greater productivity); social (e.g., reduced fuel poverty, greater thermal comfort); and environment (e.g., improved urban environments, ecosystem and biodiversity preservation). The majority of studies focus on air quality and health co-benefits, and the authors suggest there are barriers to incorporating wider co-benefits in policy analysis due to a lack of standardised definitions and the need to overcome difficulties in their quantification, and hence that "greater efforts are needed to take co-benefits to policymakers" [8]. Similarly, in a review of health co-benefits of climate mitigation action, the Lancet Pathfinder Commission found that more work is needed to incorporate health co-benefits, as only 30 % of Nationally Determined Contributions (NDCs) under the Paris Climate Agreement identify health co-benefits, and only 10 % quantify or monitor these co-benefits [80].

Barrett et al. [4,28] have developed and analysed low energy future demand scenarios for the UK, incorporating a range of demand-side mitigation measures, as a constituent part of the UK's pathway to Net Zero. They argue that, rather than compromising citizens' quality of life, these can achieve large co-benefits, including air quality improvement, healthier and active lifestyles, and enhanced work-life balance, though they do not attempt to quantify these co-benefits.

Drawing on an extensive literature review and expert judgements, Creutzig et al. [7] argue that demand-side solutions to climate change mitigation are consistent with high levels of wellbeing. Their work identifies 18 dimensions of wellbeing, including environmental, health, social, political and economic factors, which relate to achievement of the UN Sustainable Development Goals.

Raworth's Doughnut Economy framework provides an approach to restructuring current economic development strategies and policy-making around wellbeing principles that is being adopted by some local authorities around the world, such as Amsterdam and Cornwall, UK [40,41]. As Turner and Wills point out, the Doughnut Economy represents "one of the latest manifestations of long-standing efforts to shift socioecological systems towards sustainable outcomes" [43,1].

However, the absence of unified metrics of wellbeing, and the complexity of its measurement, constitute major challenges for its use in informing and justifying energy demand reduction policy options. This complexity often leads to economic cost-benefit analysis being used as the sole measure of wellbeing [29,30,31]. However, the focus on the monetisation of wellbeing measures, where possible, ignores its multiple features and their broader impact [7]. On this point, Stiglitz et al. [32] call for more comprehensive metrics which also include social and environmental perspectives, as income and spending capture only one dimension of wellbeing. Creutzig et al. [7] argue that "the IPCC's Special Report on Global Warming of 1.5 °C provides evidence that energy demand solutions have more synergies and fewer trade-offs with sustainable development goals than energy supply-side solutions" [33].

3. Factors affecting citizens' views on energy demand reduction measures

This study was developed in the context of the Covid 19 pandemic, which profoundly affected the UK with impacts on health, education, training, employment and wage inequality, leading to calls to 'build back better', i.e., for wider social and environmental factors to be incorporated into economic regeneration plans [34,35].

It is recognised that understanding the factors that can lead to a greater acceptability of climate policies is crucial for policy action, and studies have begun to examine the question of how different individuals perceive and support climate action [36,37]. Faure et al. [38] conducted large-scale surveys in Italy, Poland, Sweden and the UK of citizens' perceptions of energy efficiency options. This work identifies two crucial factors that could increase the acceptability of energy efficiency: trust in government and environmental identity. The first element concerns the idea that trust in the government will increase the acceptability of more coercive policies, such as per capita taxes on consumption or CO_2 emissions, compared to less coercive policies like information or standards. The second element shows how citizens' environmental identity (expressed in terms of beliefs, values and identity) is connected to the acceptability of those policies with higher energy consumption reduction targets. While energy efficiency is seen as the most cost-effective short to medium-term measure to achieve greenhouse gas emission targets, this shows that it is essential to better understand factors relating to trust in government and environmental identity that could lead to the greater acceptability of these policies. In effect, interlinking the co-benefits of climate action to wider issues that resonate with the public can help decision-makers prioritise decarbonisation arrangements that increase the likeliness of public support and a just transition [9].

Concerning citizens' perceptions of energy demand reduction in the UK, Jennings and Paterson [46] show that the co-benefits of climate action and energy efficiency are highly valued by people in the UK. Understanding such perceptions can help guide efforts and resources to enable climate change responses to deliver their messages more effectively to different audiences. They identified eight co-benefits of climate action: Homes that are affordable to heat; Improved energy security; Improved air quality and health; Reduced Inequality; Connecting with nature; Reduced risk of flooding/extreme heat; Stronger communities; and Job creation. They argued that two are particularly salient for energy efficiency and energy demand reduction: 'homes that are more affordable to heat' and 'improved energy security'. In their analysis, 76 % of the respondents considered 'warmer homes that are more affordable to heat' very important to them, 76 % said that it was very important to their local community and 86 % perceived this to be very important to the UK. Jennings and Paterson [46] illustrate a few reasons why people support this co-benefit. Some participants, for instance, argued that warmer homes are a crucial element that the UK government should provide to their citizens. Other participants in the same vein highlight the importance of this co-benefit by stressing the impact of the cost-of-living crisis on their ability to keep their homes warm and the difficult choices that more and more families faced between heating and eating (see also [1]). Jennings and Paterson [46] show that those who worry more about affording their energy bills were more likely to perceive this co-benefit as important or very important. Concerning the second co-benefit, 'improved energy security', 74 % of the respondents considered this to be important or very important to them, 66 % of respondents perceived it to be important for the local community and 83 % perceived this co-benefit to be important for the UK. People considered this co-benefit to be important because there is a need for the UK to be more self-reliant to help alleviate the cost-of-living crisis. The importance of this co-benefit is coupled with recognising the impact of the Russian-Ukrainian war on energy prices. In effect, many people perceived that reducing dependence on imported oil and gas could both reduce their expenditure on energy and improve national energy security. Overall, as Jennings et al. [9] show, it is essential that the co-benefits of potential policies are adequately considered and valued to avoid making suboptimal decisions, relating to climate change mitigation. To this end, local-level governments are best placed to incorporate citizens' perceptions of co-benefits into policy-making because it is at this scale that these are most clearly manifested and where interventions can be more effective [9].

4. Case studies

Delivering climate action and economic recovery will need coordination at local level, between local authorities and other public, private and third sector organisations, such as retrofit agencies, and energy

cooperatives, as this is the appropriate scale for many demand-side mitigation options, though local authorities have relatively limited powers in some of these areas. However, policy delivery remains contested. National austerity policies in the UK mean that local authority budgets have shrunk substantially since 2010 [48]. Policy instruments like low traffic neighbourhoods (LTNs), cycle lanes and vegetarian diets are politically charged and flashpoints for populist protest [23]. Under the Public Services (Social Value) Act 2012, UK local authorities have a duty to consider how the services that they commission and procure can improve the economic, social and environmental wellbeing of their area, but this has largely been used to focus on social aspects, such as jobs or skills [39]. With few resources, a need to deliver objectives across housing, transport, social services, economic and environmental sectors, and a contentious decision-making environment, local authorities need to better understand how the potential co-benefits of energy demand reduction policies would be viewed by their citizens, and therefore which policies have stronger chances of successful implementation. In order to provide empirical evidence on citizens' views of how energy demand reduction measures could contribute to their wellbeing, as a result of this range of co-benefits, we undertook an empirical study of citizens' view in two UK regions: Greater Brighton and North of Tyne.

4.1. Greater Brighton

The Greater Brighton City Region is in the south east of England and comprises seven local authority areas in East and West Sussex: Adur, Arun, Brighton & Hove, Crawley, Lewes, Mid Sussex and Worthing, with a combined population of around 1 million people. The Greater Brighton Economic Board (GBEB) is formed by representatives of these 7 local authorities, and local businesses and universities. However, the GBEB does not have formally delegated powers, unlike some other city-regions, including North of Tyne.

The largest city in the region is Brighton & Hove, which has a population of over 270,000, and is known for its diversity, lifestyle qualities, a vibrant economy with flourishing small businesses, and as a hub for innovation and enterprise [49]. The city is also recognised for the City Council's commitment to sustainability. The latter declared a climate emergency in 2018, and after democratic consultations through their Climate and Youth Assemblies in 2020, developed a Carbon Neutral 2030 Programme [50]. The Council also unanimously adopted a motion to support a GND in 2020. Brighton & Hove City Council's aim is to tackle poverty and inequality concerns also regarding energy and climate change, while promoting decarbonisation initiatives [50].

The Greater Brighton Economic Board (GBEB) also plays a key role in fostering sustainability and addressing climate change. The Board organised a Climate Summit in October 2021, developed a Blue/Green Governance and Investment Plan as part of a Transition to Net Zero Action plan, and aims to bid for central government funds for key actions, as there are limited resources at regional level [51,52]. However, while the Brighton & Hove economy is based on a growing qualified and prosperous population, the city is one of the lowest performing cities regarding equality across the UK. Challenges include housing affordability, skills and barriers to employment by population sets, and infrastructure constraints, including the road and rail networks [53]. Such constraints might impact the adoption of energy demand mitigation options.

4.2. North of Tyne

The region represented by the mayoral North of Tyne Combined Authority (NTCA) is part of the North East of England. NTCA was formed following a devolution deal in 2018 between the UK government and three constituent councils: Newcastle City Council, Northumberland County Council and North Tyneside Council. The wider North East region was in the 19th century considered the "*workshop of the world*" as it led the global economy in coal, steel and engineering [54]. However, since the 20th century Great Depression, the region suffered from industrial decline, exacerbated by the 1980s collapse of the coal industry, and austerity measures [55,56]. Attempts to regenerate the region have not established the same levels of economic activity and social, spatial and health inequality has worsened. The region has had a historical reliance on support from local authorities and the state after the demise of the coal industry [57] that continues today [55].

The devolved powers are more limited than some other devolution deals in England and relate to funds for regional economic growth and jobs, and funding for adult education to develop local skills, though it does have a directly elected Metro Mayor elected in 2019. In his manifesto, Mayor Driscoll pledged to take action to keep wealth generated within the region, stimulate a green industrial revolution, create community hubs, build affordable homes, and provide meaningful adult education [58]. A local Green New Deal was part of delivering on these commitments with ambitions to be a "Zero carbon, zero poverty" region, and a plan to achieve this vision was developed [44,59].

Despite the pandemic, the NTCA initiated a range of projects and programmes including a Green New Deal Fund; Climate Change, Energy and Green Growth Blueprint; Technology, Innovation and Green Growth for Offshore Renewables (TIGGOR) Programme and held a Citizens Assembly. The North of Tyne Green New Deal Fund is a fund for low carbon project support in the form of loans, equity and grants for SMEs, public sector organisations and community groups. The aim is to obtain matched funding to double investment in the area while saving carbon emissions. The region has also implemented a wellbeing framework based on the Carnegie SEED model [11] that comprises three layers: a vision, outcomes and indicators. A series of roundtables were held to understand local citizens' priority issues and feedback was used to develop a bespoke version of the SEED model working with Carnegie UK and the Centre for Thriving Prices to develop the indicators [44].

While a devolution deal has been made for the whole North East region, including four other councils, with central government at the end of 2022 [60] the data gathered and analysed in this paper relates to NTCA region, this being the devolved authority in the region at that time.

5. Research design and methods

To investigate citizens' attitudes to demand-side mitigation measures and their relation to wellbeing indicators, we undertook a survey and focus group in each case study region. For the survey, respondents were asked the extent of their approval or disapproval of their local authority investing in 14 demand-side mitigation measures, selected and adapted from those in the low energy demand scenarios developed by Grubler et al. and Barrett et al. [3,4] (see Table 1), which discuss how the adoption of energy demand reduction measures potentially addresses mitigation concerns, without compromising citizens' lifestyles. They were asked to choose their top three measures contributing to overall wellbeing, based on a set of 20 wellbeing indicators (see Table 2), and to give their preferences for different funding options. These wellbeing indicators were drawn from those in the Creutzig et al. work [7] and the applications of the Doughnut economy model to the City of Amsterdam [40] and the UK county of Cornwall [41], based on access to social foundations within planetary boundaries [12].

The survey was conducted in two phases between June and September 2022. In the first phase from June to July, two researchers conducted the survey face-to-face with randomly selected residents in Brighton, gathering 46 responses. To gain a higher number of responses, a second phase with random stratified sampling was conducted using a market research company to generate a range of online responses in the Greater Brighton and North of Tyne regions. The population sample was segmented by gender, geographical area (urban and rural), and by age. Both samples were combined in the analysis. The second survey generated a further 566 respondents aged between 18 and 65+, giving a combined total of 621 respondents, of which 343 were in the Greater

Table 1
Demand-side mitigation measures for the survey.

Demand-side mitigation measures
1) Household energy efficiency improvements (e.g., walls insulation, double glazing)
2) Use of sustainable/recycled construction materials
3) Car-free zones
4) Car-sharing options
5) Active travel (e.g., cycling, walking)
6) Affordable public transport
7) Dedicated cycling networks
8) Park and ride options (parking areas and public transport facilities)
9) Mobility hubs (e.g., cycle hire, station, parking and travel info point)
10) Plant-based diet
11) Extend of lifetime of food/products and materials
12) Active community engagement in local decision-making
13) Nature-based solutions (e.g., green areas)
14) Place-based solution (focus on the local area)

Table 2
Wellbeing indicators for the survey.

Wellbeing indicators
1) Access to affordable and high-quality sources of food
2) Access to safe and clean water
3) High local air quality
4) Access to good health services
5) Access to affordable energy
6) Access to affordable housing
7) Availability of safe and affordable forms of mobility
8) Access to high-quality education
9) Access to communication networks
10) Ability to manage social and economic risks
11) Ability to participate in local decision-making processes
12) Safety from crime
13) Being part of a supportive local community
14) Enhancing equality of opportunity and access for all
15) Good governance processes
16) Access to high-quality jobs
17) Access to material goods
18) A safe and clean local environment
19) Enhancing diversity of plants and animals
20) Tackling climate change

Brighton region and 269 in the North of Tyne region. The segmentation resulted in a diversity in responses. In Greater Brighton, the mix was 53 % female, 47 % male; 76 % urban, 24 % rural; and 39 % under 55 years, 61 % 55 and over years; and in North of Tyne, the mix was 60 % female, 40 % male; 75 % urban, 25 % rural; and 39 % under 55 years, 61 % 55 and over years. The samples were thus a reasonable representation of the population mix in these regions, though with an over-representation of older people.

From the findings of the survey, six mitigation measures were selected to be discussed in more detail in the focus groups – the two most preferred, two mid-range and two least preferred measures, as shown in Table 3. In the focus group, participants were asked to score a range of measures according to their contribution to a (reduced) set of six well-being criteria, and then to weight those criteria, using a version of a multi-criteria mapping (MCM) method [19]. This provided empirical evidence to support the claim that demand-side measures would be seen as more beneficial when assessed in relation to wider wellbeing criteria, rather than being assessed on purely economic benefits [7].

For each focus group, 25 participants were selected by the market research company, using random stratified sampling to ensure diversity in terms of gender, ethnicity, rural/urban location, employment and political party support [61]. They were first introduced to the six demand-side mitigation measures as options that their local authority could undertake. A brief description of the action relating to each measure was given (see Table 3). In order to make the options broadly comparable, the scale of each action was designed to relate to how much could be achieved if the local authority spent £10 million on that option (though a detailed costing was not undertaken). Participants were asked to discuss these options in groups and to raise potential benefits and challenges relating to implementing the options, providing qualitative insights. They were then asked to score individually (with a brief justification) each of the six mitigation measures in relation to six wellbeing criteria, and to weight the importance of each wellbeing criteria. The score (from 0 to 100) reflected the participant's view of how helpful that measure is in achieving that criterion. The weighting (from 0 to 100) reflected the participant's view of how important that criterion is, based on "subjective values rather than technical judgements" [62]. This was used to give a weighted score for each measure for that participant. This provided quantitative insights into their relative preferences for different mitigation measures, as well as further qualitative insights into factors influencing participants' responses from the justifications given for the scoring. The wellbeing criteria were selected based on the literature to include two social criteria, two economic criteria and two environmental criteria. A brief description of the potential benefits associated with each criterion was given (see Table 3). The focus groups were held in accessible locations in Brighton in December 2022 for the Greater Brighton case study, and in Newcastle in February 2023 for the North of Tyne case study.

The focus groups allowed the triangulation of the data since participants contributed specific insights that could not be investigated in the survey [63]. As described, due to time constraints of the participants, an

Table 3
Energy demand mitigations options and wellbeing criteria for focus groups.

Options	Actions
Home energy efficiency	2000 houses retrofitted to the UK Energy Performance Certificate C.*
Affordable public transport	50 % bus fare reduction
Active travel	Significant expansion of cycle-hire and bike lanes
Car-free zones	Extensive car-free zones to restrict driving through the town center
Plant-based diet	All public building and school meals vegetarian and dairy free
Nature-based solutions	Substantial rewilding of local countryside, new nature reserves

Criteria		Description
Social	Health benefits (mental and physical)	Improved physical and mental health
	Being part of a safe and supportive community	Increased community resilience and connection, improved protection from crime, access to community services for all
Economic	Value for money	Optimising net social costs and benefits, increased benefits for all from public investment, public investments that considers both economic and social benefits, managing social and economic risks
	Quality jobs creation	Creation of good quality, flexible and long-term jobs, fair pay and working hours, increased equality, diversity and inclusion, flexible and long-term opportunities to satisfy people's working and life needs
Environmental	Safe and clean local environment	Increased safety in local areas, improved cleanliness of the local environment, access to safe, clean, green spaces for living, leisure and outdoor play
	Tackling climate change	Reduce CO_2 emissions through reduced fuel and energy consumption, public and active transit, buying local products, increasing building energy efficiency, reducing consumption and recycling, reusing and upcycling

* The UK EPC provides a property with an energy efficiency rating from A (most efficient) to G (least efficient) with a validity of 10 years.

adapted version of MCM was used as "an interactive appraisal method for exploring contrasting perspectives on complex strategic and policy issues" [64].[2] The tool aims to help "'open up' technical assessment by systematically 'mapping' the practical implications of alternative options, issues, uncertainties and values" [64].

To analyse the data, the MCM scoring of the options and weighting of the criteria was used to provide quantitative insights. A thematic analysis [65], using NVivo, of the qualitative data collected during the workshop was conducted to allow the identification of key themes and patterns "for extraction of meanings and concepts from data and includes pinpointing, examining, and recording patterns or themes" [66,34]. The data was analysed using a deductive approach to highlight how respondents framed issues relating to social, economic and environmental planetary boundaries. Key codes include 'fair', 'accessible, 'happy', 'less meat', 'long-term', 'less emissions', 'clean' and 'future generations'.

The results are analysed as follows: section 6.1 reports the survey data; section 6.2 analyses the scoring of the options against the criteria in the MCM; section 6.3 analyses the weightings of the criteria; 6.4 highlights the key themes that emerged from the thematic analysis of the data from the focus group conversations and justifications of scoring given by the participants.

6. Analysis of results

6.1. Survey findings

The first part of our survey focused on people's prioritising of Local Authorities' investment in demand-side mitigation measures.

As shown in Fig. 1, 13 out of the 14 demand-side mitigations measures (see Table 1) had significantly higher strongly approve/approve ratings than disapprove/strongly disapprove ratings in both locations. The one exception was plant-based diets, which had similar approval and disapproval ratings in Greater Brighton, and higher disapproval than approval rating in North of Tyne. The most approved and strongly approved options were the same in both locations: affordable public transport: 314 (out of 343 responses) in Greater Brighton, and 243 (out of 269 responses) in North of Tyne; sustainable/recycled construction materials (205 in Greater Brighton, and 190 in North of Tyne); and home energy efficiency (293 in Greater Brighton, and 234 in North of Tyne).

The second part of the survey investigated preference for funding sources to support implementing the selected measures. Participants were invited to select as many options as desired from a) an increase in direct funding from central Government to Local Authorities; b) funds from central Government that Local Authorities need to bid for; c) an increase in Council Tax levied by Local Authority; and d) Community Municipal Bonds (CMB),[3] backed by the Local Authority, which residents have the option to invest in. The proportion of respondents selected each option for the two regions is shown in Figs. 2 and 3.

Most participants in both locations selected the option of increasing direct funding from central Government to Local Authorities, followed by funding from central Government that Local Authorities need to bid for, and Community Municipal Bonds backed by the Local Authority, which residents have the option to invest in. The least selected option was council tax increase by the Local Authority. We can speculate that residents are more aware of, and hence resistant to, increases in local taxation compared to national taxation going towards central Government funding. Given that Community Municipal Bonds are not yet a widely known form of funding, this also suggests that such forms of direct funding by local participants deserve greater attention in the UK [67,68,69].

Thirdly, respondents were asked to rate the importance of the 20 wellbeing indicators (shown in Table 2). All 20 indicators were rated as important or very important by over 80 % of respondents in both locations.

Finally, we asked participants their top 3 preferences for demand-side measures, from the set of options indicated in Fig. 1, in terms of contribution to overall wellbeing, as shown in Figs. 4 and 5.

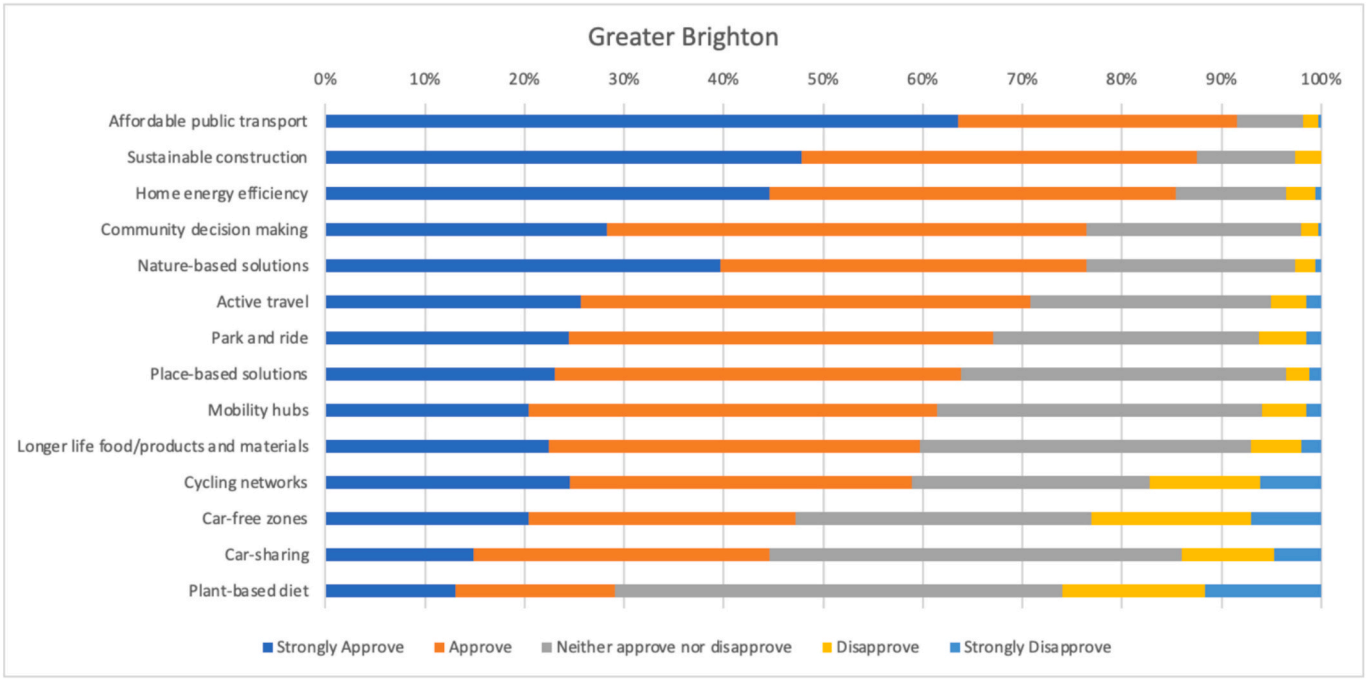
The most favoured options in both locations for contributing to overall wellbeing were home energy efficiency, affordable public transport, and community engagement in local decision-making. The least preferred were car sharing, plant-based diet, and mobility hubs.

6.2. Focus group rankings

Six demand-side mitigation options were selected to be assessed in more detail in the focus groups, in relation to six wellbeing criteria (two social, two economic and two environmental criteria), as shown in Table 3.

[2] MCM is conceived as a tool to be used for individual or small group interviews where participants define their own criteria. Given the number of participants in the workshops, the criteria here were predefined by the research team.

[3] A CMB is "a fundraising tool for local authorities, to fund renewable energy projects. [CMBs] allow councils to raise money directly from residents" [68].



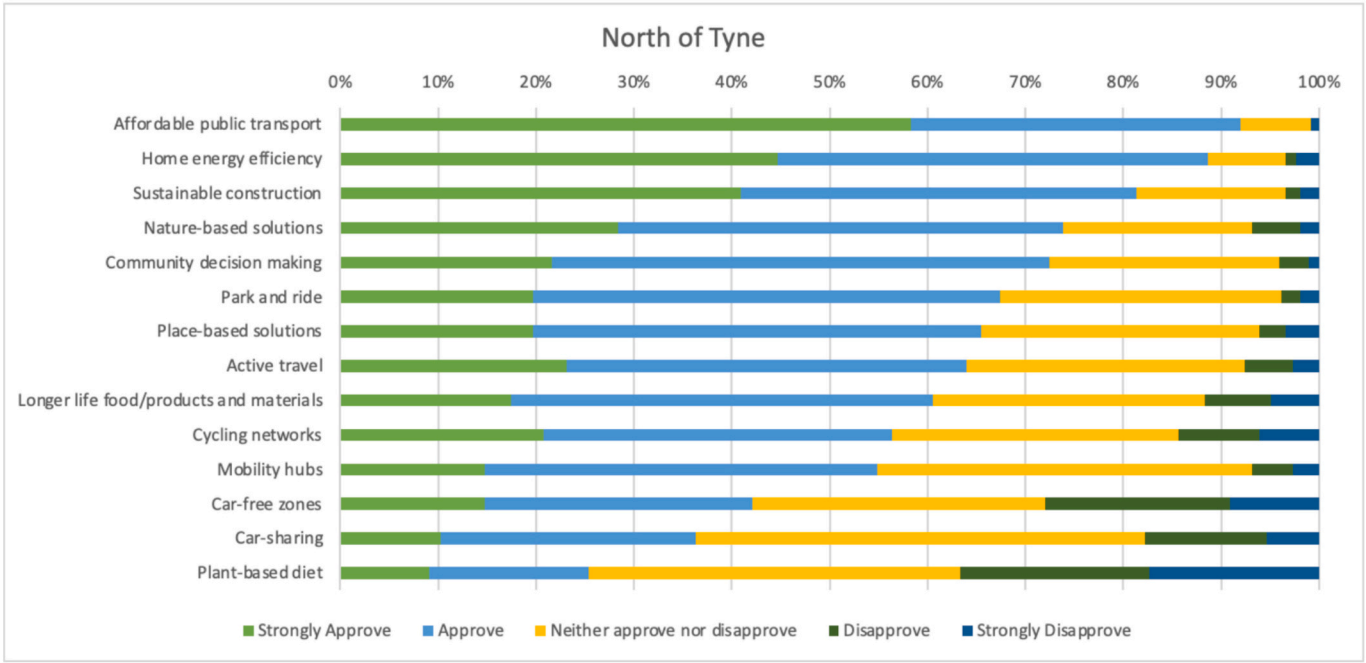


Fig. 1. Approval of demand-side mitigation options from surveys in two regions.

Fig. 6 presents the weighted average of the scores that each participant in the workshops gave to each option in Brighton.[4] It was obtained by multiplying each person's score for that option times the weight attributed to each criterion, summing up the results and dividing this by the sum of the weights. Among the options, affordable public transport, nature-based solutions and active travel received the highest scores. The average score for all six options was favourable (higher than 50 out of 100), but there was considerable variation between participants.

Fig. 7 shows the weighted average of the scores for North of Tyne. Affordable public transport, home energy efficiency and nature-based solutions were respectively ranked highest. Most options had a slightly higher average positive score, compared to the Brighton group, except for plant-based diets, which had a low average approval rating of 47.9 out of 100.

6.3. *Weighting of the criteria*

Fig. 8 presents the participants' weightings of the criteria in Brighton. This shows that all six criteria were weighted highly on average, though some participants found some criteria less relevant than others, as further explored in section 6.4. Tackling climate change, value for money, and health benefits received the highest weighting.

[4] In the figure, the box shows the lower and upper quartile values, including the median value, and the whiskers show the lowest and highest values (except for outliers identified separately). The cross indicates the mean value [70].

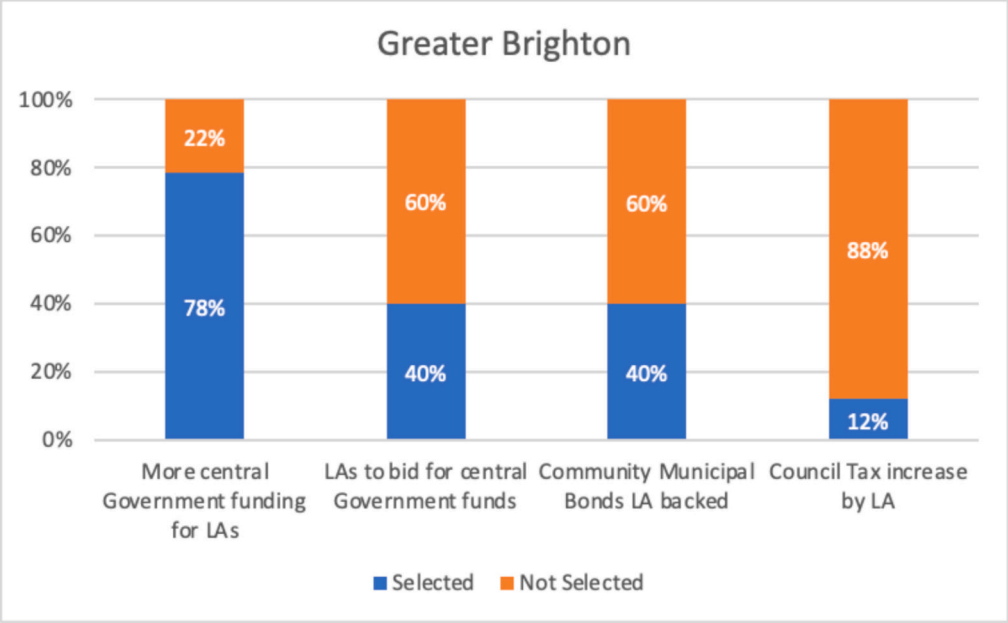


Fig. 2. People's preference for funding sources- Greater Brighton.

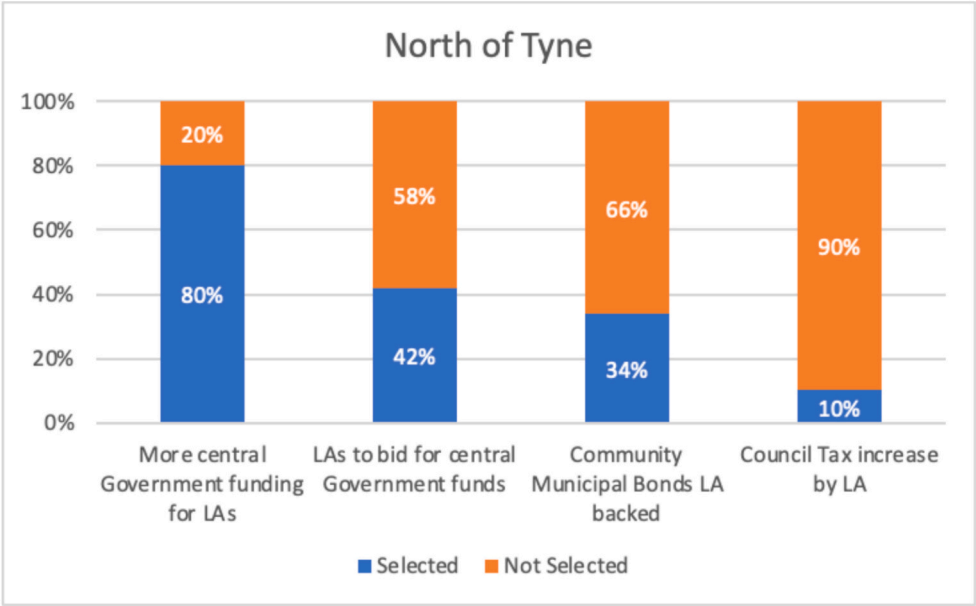


Fig. 3. People's preference for funding sources- North of Tyne.

Participants in the Newcastle workshop weighted all six criteria highly, with average weights of over 80 (out of 100). Safe and clean local environment, tackling climate change and quality jobs creation received the highest weights in Newcastle, as shown in Fig. 9.

6.4. *Thematic analysis*

While the presented options are generally viewed favourably, how they are implemented matters in terms of what participants value for their and their communities' wellbeing. This section analyses critical themes that emerged from the qualitative insights from participants' group discussions and written comments in both locations. Key themes identified are: fairness, including distribution and access; affordability and reliability of services; physical and mental health; and, environmental protection. Other themes identified are safety; sense of community; education and freedom of choice; and leisure and happiness. Some themes interlink with one another (e.g., affordability and reliability of services), or have sub-themes (e.g., a sub-theme of health is improved air quality).

6.4.1. *Fairness– Distribution and access*

The first theme identified was fairness in delivery of benefits across the population of the region. Participants expressed concerns over issues of distribution of resources and opportunities, access to services and resources, and, regarding employment opportunities, inclusion, duration and better-quality jobs compared to current employment opportunities.

Fair distribution and accessibility, also due to disability issues, were discussed regarding active travel as segments of population could be excluded from using cycling and walking facilities either due to physical

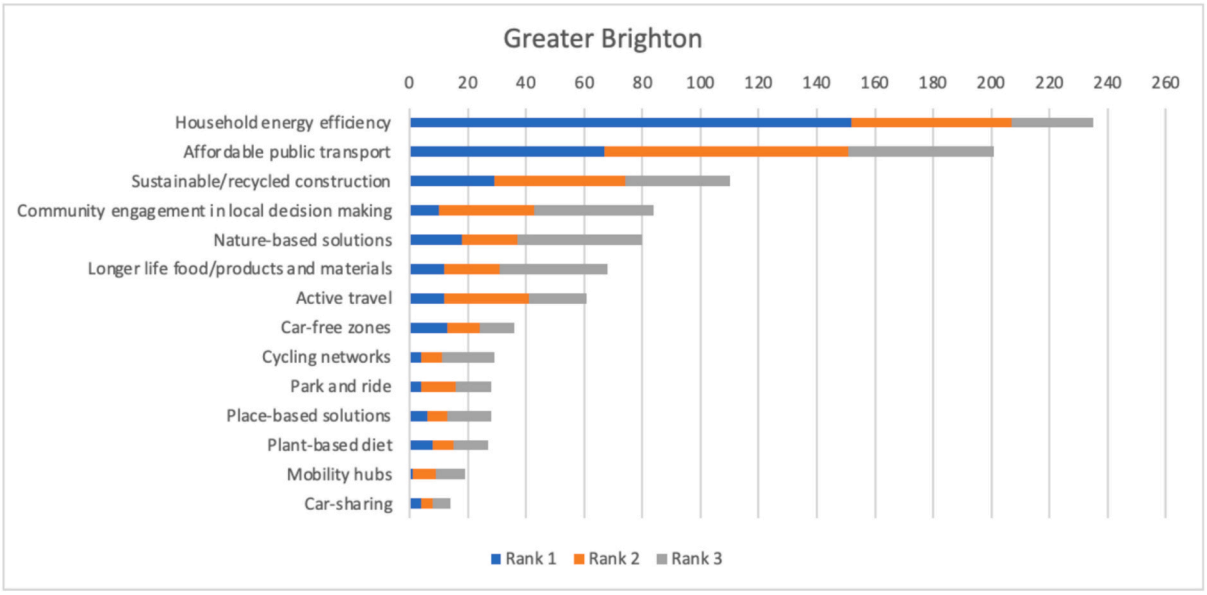


Fig. 4. Count of Participants' top 3 preferences for demand-side measures- Greater Brighton.

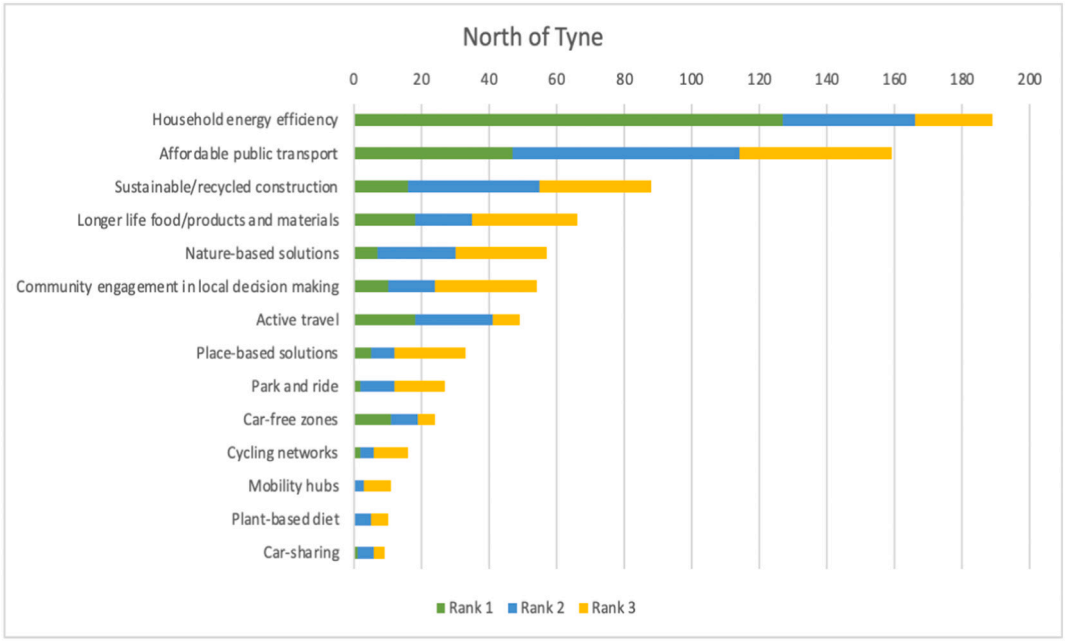


Fig. 5. Count of Participants' top 3 preferences for demand-side measures- North of Tyne.

and mental abilities, or due to their location. A participant in Brighton said that active travel "favours the few able bodies", while another commented that cycle lanes are "great if you live centrally but not for suburbs where people with lower income live". Two participants in Newcastle mentioned how cycle lanes in cities abroad, such as in Amsterdam, are better integrated in the transport system. Similarly, limitations of car free zones related to the distribution of co-benefits; a participant in Brighton said that they, "may help with less pollution in some areas, but push it to other areas instead".

The proposed scenario on household energy efficiency schemes (see Table 1) was also seen as limiting in terms of *fair distribution* of resources retrofitting of 2000 homes. It "[is] literally a drop in the ocean", a participant in Newcastle commented, indicating that this would represent a small number of homes. Accounting for everyone's needs was also highlighted as important in promoting safe and supportive communities.

In both workshops, quality job creation was perceived as important. Some participants discussed that climate mitigation interventions could represent opportunities for job creation; however, most pointed to the limited duration of interventions and the need to ensure *fair* pay. In Brighton, some voiced concerns around a limited qualified workforce, specifically in energy efficiency. A participant highlighted the need for "sustainable jobs for an area that is expensive to live in, with traditionally proportionately low pay". Similarly, another commented that, "better jobs with better pay and job satisfaction help people to be better and more productive members of society". Another said, "I will be surprised if [quality jobs] ever happens. In an ideal world yes, but at present the country is going backwards".

6.4.2. *Affordability and reliability of services*

The second theme identified is affordability of delivery of these

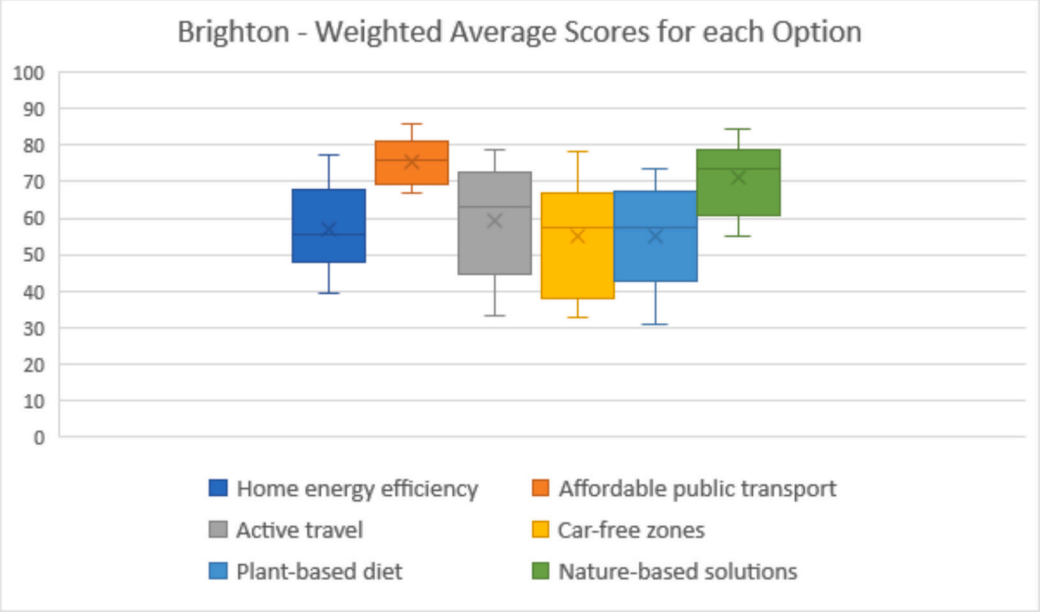


Fig. 6. Weighted average of the scores-Greater Brighton.

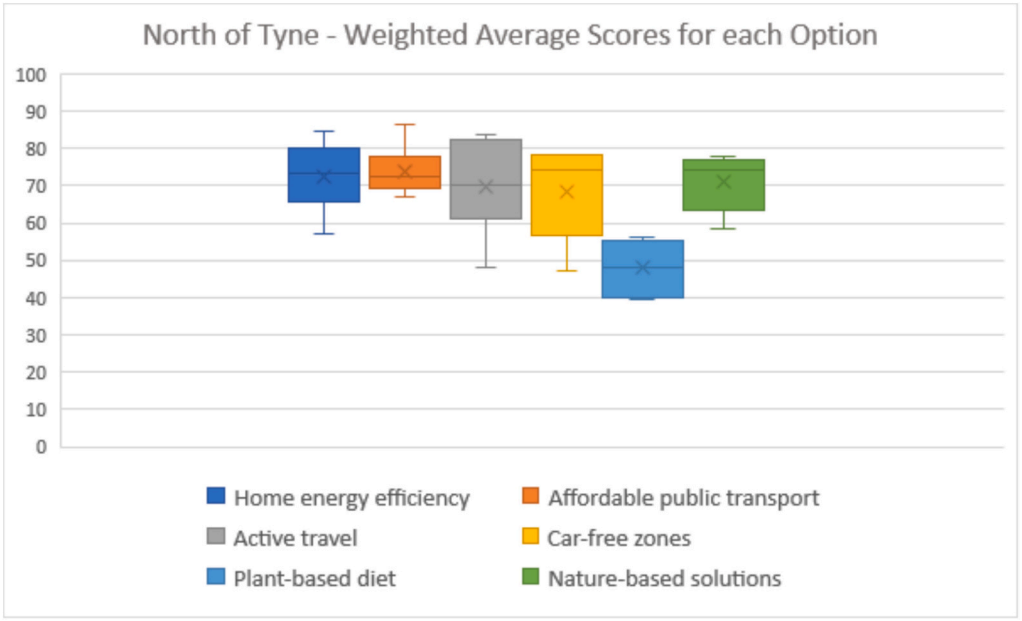


Fig. 7. Weighted average of the scores-North of Tyne.

measures by local and regional authorities, as well as reliability of delivery of the services themselves.

Affordability of buses was recognised in both locations as a constraint on the use of public transport as current fares are considered too expensive and unaffordable by those with low-income. Although a lower fare was introduced in both locations due to the cost-of-living crisis, some participants were concerned about the duration of such initiatives. Participants in both locations called for affordable parking combined with park and ride services and reliable public transport.

The analysis highlights that *affordability* (value for money) of local authorities' initiatives and services is central to policies. A few participants highlighted the importance of containing the cost of services, and that people should be able to *afford* them especially given the current cost of living crisis. Co-benefits deriving from public expenditure involves responsible use of finances. For example, a participant in Brighton noted that, "if the cost outweighs the benefits, people won't be so keen to make changes". A participant from Newcastle said that investments with "[…] the best cost/benefit ratio would be preferable however I would also prioritise those with communal benefits" (fairness).

Household energy efficiency initiatives were seen as very important due to the current energy crisis. Some participants mentioned how cheaper bills due to increased energy efficiency could help. However, most participants outlined that the initial cost might be prohibitive. Solar panel grants for those living in the Southeast were perceived as solutions for the energy crisis that enable caring for the environment and increasing property value. However, government support is regarded as insufficient, as a participant Brighton commented: "the government is never going to effectively pay for you to upgrade your house by an amount that's going to make a massive difference. Whatever they put in

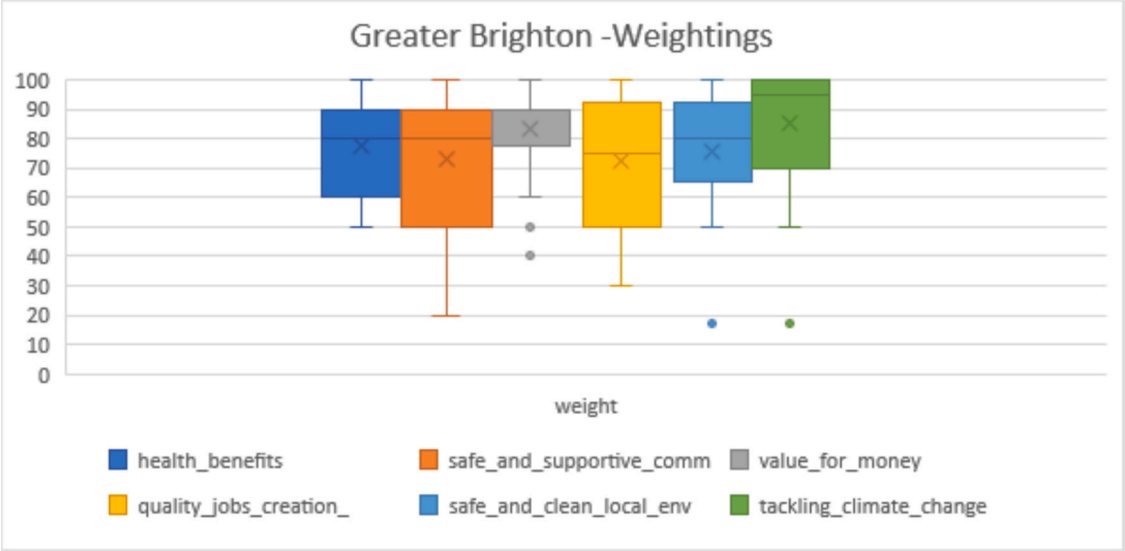


Fig. 8. Weightings of the criteria-Greater Brighton.

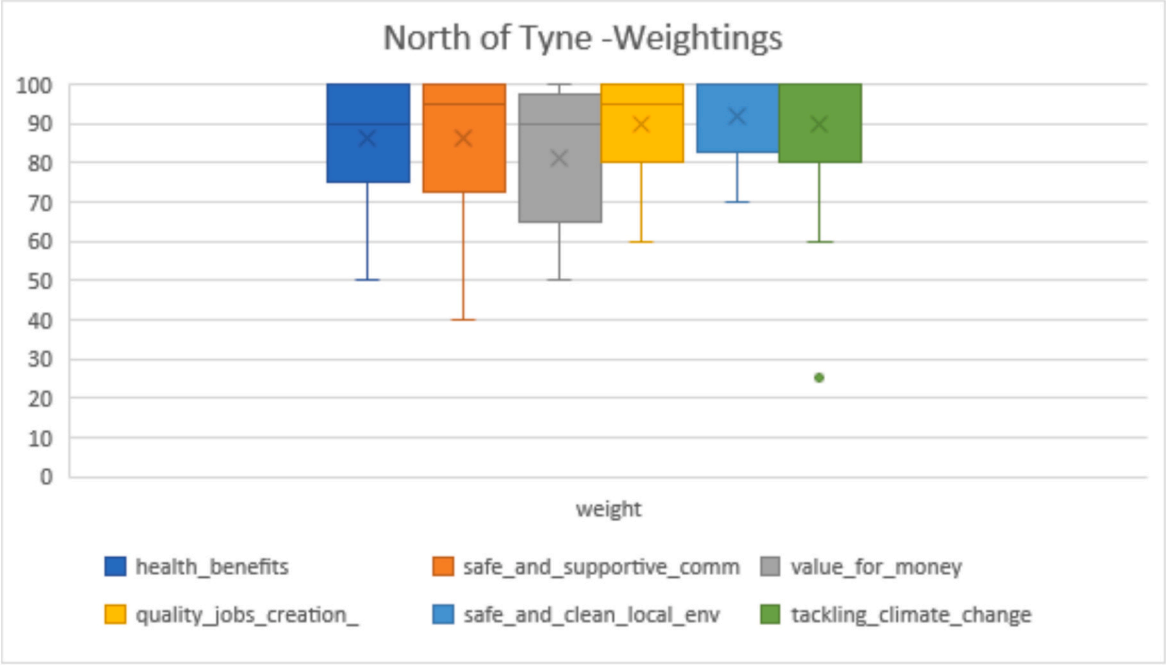


Fig. 9. Weightings of the criteria-North of Tyne.

[you will have to contribute and] you're only going to get out of it the amount you put […] in". Another in Newcastle commented that at the "end of day [it is] us who has to pay for this".

A few participants discussed issues around types of properties benefitting from household energy efficiency schemes and population segments affected (fairness, distribution). Homeowners and landlords were seen as benefitting from such schemes, while tenants bear the cost of energy inefficiency. Old building stock in both locations also was perceived as a constraint on the installation of heat pumps.

Investment in nature-based solutions was considered as co-beneficial by many. A Brighton participant said that they present "great value for the money, [given] the other benefits it brings (health, mental, clean, jobs, etc.)". In both locations people felt lucky to be surrounded by natural parks and able to easily access the countryside.

In both locations, participants highlighted that initiatives aiming at encouraging the use of buses would be undermined without reliable services. Improving the transport system was seen as a priority by participants in Brighton with a participant calling for more "cycle [lanes] and public [transport], and a different attitude towards it", while another would like trams to be brought back.

6.4.3. *Health – Physical and mental*

A third theme identified relates to the impact of measures on *physical and mental health*, contributing to communities' wellbeing. Two participants, one in each location, pointed to the importance of investing in health-related options as they could lessen the strain on the National Health System (NHS).

Active travel is perceived as enhancing people's mental and physical health, as 13 participants in Brighton perceived this as also contributing to being active and losing weight. Likewise, 2 participants in Newcastle

commented on the health benefits of affordable public transport; one said, “healthy mind = healthy body.”

Twelve participants in Brighton commented that affordable public transport has health benefits due to less pollution. Eight participants confirmed this in Newcastle, where two participants referred to increased mental health benefits due to the lower cost of fares and two to improved mood due to opportunities to *socialise*.

Car-free zones were perceived by 10 participants in Brighton as contributing to health due to increased walking and cleaner air (*improved air quality*). Six participants in Newcastle viewed car-free zones as improving health, of which three mentioned increased exercise.

The health benefits of household energy efficiency were pointed out by eight participants in Brighton, including due to increased thermal comfort, mould reduction and decreased stress associated with the energy crisis. Increased comfort, good mood and improved quality of life were among the health benefits identified by 13 participants in Newcastle. One said that household energy efficiency measures “will give mental health benefits due to reduced stress”.

Mental health benefits of quality jobs were also identified by participants in both workshops. A participant in Newcastle said that quality jobs “impact mental health, better quality pay = motivation”. Likewise, a few participants in Brighton recognised that quality jobs contribute to mental health and wellbeing.

Four participants in Brighton recognised nature-based solutions as contributing to clean air (*improved air quality*), and five to mental and physical health, two of which due to opportunities to exercise. A participant, for instance, said, ““nature is health”. Nine participants in Newcastle attributed mental and physical health benefits to nature-based solutions; six also referred to the benefits deriving from increased clean air (*improved air quality*).

Contrasting opinions emerged regarding the health benefits of plant-based diets due to the *quality of products;* a participant said, “only if there are fresh and not processed options” will these be healthy. Balanced diets were also seen as better than plant-based ones by some. Regarding the scenario in Table 1, some thought that if the school meal is the main meal, a plant-based one would not be as nutritious as a meat-based one. Similar concerns were raised by others for meals in hospitals where some participants were worried that hospitalised patients may find it difficult to recover with a vegetarian diet.

6.4.4. Environmental protection, leisure, and feeling happy

A fourth theme identified *environmental protection, leisure,* and *feeling happy*. *Intergenerational co-benefits* were recognised regarding tackling climate change.

Nature-based solutions, access to a safe and clean local environment and tackling climate change were perceived by the majority of the participants as critically contributing to communities' wellbeing. Among the co-benefits of nature-based solutions there were enhanced biodiversity, increased wildlife, wetlands restoration, CO_2 emissions reduction, and improved air quality. Both Brighton and Newcastle are well positioned in terms of their proximity to the countryside; in Brighton the vicinity to the South Downs National Park and the beach were also appreciated. Brighton & Hove City Council is also involved in restoring kelp vegetation for carbon capture; “the kelp project is huge and so, so important”, a participant said. A couple of participants also called for greater awareness raising for public engagement. These themes were seen as contributing to *leisure* and *happiness*. A participant in Newcastle said that a safe and clean local environment “is a key element of leading a fulfilled life”.

Among the benefits of household energy efficiency for the environment, participants mentioned energy demand reduction and reduced CO_2 emissions. Regarding household energy efficiency installation, a participant in Brighton said, “it might make people feel happier and more content if they think they're doing more for the environment” (*happiness*).

The discussion around a plant-based diet was controversial as it centered on the dilemma between animal protection and the impact of the move to plant-based diets on farmers. For some, plant-based diets would help end animal cruelty, while also encouraging local food production. For others, it could negatively affect the income of farmers during the shift from cattle-based to a vegetable-based farming. A participant in Newcastle mentioned that adopting a vegetarian diet could contribute to people's *happiness*.

Tackling climate change was the criterion most highly scored in both workshops. It was recognised as “the most important issue of all” by a participant in Newcastle, and “the most important, as if this fails nothing is worth doing anyway” by a participant in Brighton. Another two participants in Brighton commented that tackling climate change is “a serious and urgent issue”, and that “We only have one chance to get this right. We need to act now. This has got to be the most important”. Another participant in Newcastle said, “this is a must, and a real plan of action is needed to make this happen”, calling for effective strategies. In both workshops the *intergenerational co-benefits* of climate action were also highlighted. Five participants in Newcastle mentioned that tackling climate change is needed for future generations. Likewise, a few participants in Brighton recognised the critical role of tackling climate change for the current and future generations. One said, “this is so important for the future for our children and grandchildren”.

6.4.5. Other themes: Safety, sense of community, education and freedom of choice

Other themes identified are safety, sense of community, education and freedom of choice. *Safety* concerns were raised particularly regarding active travel. Two participants in Newcastle commented on how cycling (active travel) abroad is totally different as cyclists have the right of way, while in the UK “they are in the way”, one said. Another added that the roads conditions in Newcastle “are terrible”. In Brighton, a few participants commented that “people prefer walking to cycling due to safety issues” and that “lots of cyclists don't use cycle lanes, they cycle on the road or on pavements”. A person added that the cycles to hire don't work. Another commented that lanes in rural areas are too small, therefore raising safety concerns.

A *sense of community* was identified particularly regarding active travel, affordable public transport and nature-based solutions. Three participants in Brighton saw it as enhancing community spirit. A participant said that active travel “increases sense of community due to social interactions” (*socialising*). Similarly, in Newcastle, a participant pointed out that active travel can “help the community to connect together”. In Newcastle, affordable public transport was seen by six participants as supporting people to go out and *socialise*. A participant commented that affordable public transport helps to “meet neighbours; more people having a stake in the community”. A participant in Brighton also mentioned that affordable public transport “increases social interaction, which feels more like a community” (*socialising*). In Newcastle, nature-based solutions were seen by five participants as spaces for *socialising*, while three participants linked nature-based solutions to *community feeling*. In Brighton, seven participants relate nature-based solutions to places where to *socialise* and for *community building*; a participant commented, “nature brings people of all backgrounds together”. However, another seven participants did not see any connection between nature-based solutions and a *sense of community*.

Education and *freedom of choice* were perceived as important in relation to energy efficiency and plant-based diets. Intergenerational co-benefits were also highlighted in relation to plant-based diets.

A few participants in both locations mentioned that the lack of knowledge and information on household energy efficiency technologies and on the cost of the installation and running of equipment can deter the switch to energy efficiency options. For instance, a participant in Newcastle said, “I would change from a gas boiler to a heat pump but is it viable and what's the cost?”

Several participants in both locations mentioned the need for *education* programmes on vegetarian and plant-based diets. While two

participants, one in each location called for a campaign to promote such options, one in Newcastle said that a campaign "will be waste of money. It's not a meal without a bit of meat!".

Education to inform choice of plant-based diets, and *freedom of choice,* rather than a top-down approach imposed by local authorities, was raised as a concern by most of the participants in both workshops. Some believed that children would refuse to eat only vegetables, therefore undermining such initiatives. A participant in Brighton, for instance, said, "great idea but you can't force people to eat vegan". Others thought that having weekly vegetarian meals could be a good way to introduce change. Several participants mentioned that health education should be for young generations to then promote a cultural shift for future generations, recognising *intergenerational co-benefits*.

7. Discussion

Addressing the current energy and climate crises are significant challenges which require technological advancement alongside meaningful shifts in consumption patterns. These crises, together with the cost of living, have been affecting people's wellbeing, including their health, finances, and employment, highlighting strong inequalities across regions and population sets. Low energy demand pathways are argued to be needed to reach Net Zero targets, whilst providing significant co-benefits to citizens [4]. However, the transition towards Net Zero is still in its infancy as broader transformative change across different institutions, infrastructure, sectors and social practices, is yet to be addressed [3; 4; 10]. Further, the Net Zero transition in the UK is falling behind its fair share of global climate targets, as set out in the Paris Agreement, to preclude critical climate collapse [71], enhancing the case for more serious consideration of energy demand reduction measures.

Our empirical evidence from the two case studies shows that citizen preferences for these energy demand reduction measures needs to be understood in reference to how citizens value the wider (co-)benefits of these energy demand reduction measures. It is also influenced by perceptions of restrictions on individuals' lifestyle choices and expectations of fairness, including environmental intergenerational concerns. However, it should be noted that, though introducing the cost of actions was meant to ensure that the scale of different actions was broadly comparable by participants, this may have affected the findings, as some participants may have expected more money to be spent on e.g. household energy efficiency measures than on other measures.

In turn, these preferences can be related to the role of culture in fashioning people's values. Cultural value, by influencing people's way of life, their relationships, values and attitudes "has [both] the potential to bring about change in [or to constrain the] behaviour and attitude needed to ensure the achievement of sustainable [goals]" [72,48]. Conventional economic approaches tend to ignore that value to society is shared and that individual preferences are induced by socialisation and by "the environmental impact that individual behaviour has on others" [73, p87]. Such approaches may be blind to collective meanings; on the contrary, deliberative models to the valuation and appraisal of environmental and wellbeing options, such as the multi-criteria mapping approach used here, seek to incorporate multidimensional aspects of value in decision-making processes [73].

Scarce information was particularly evident regarding the benefits and constraints on the adoption of a plant-based diet. The lack of access to appropriate information often represents a constraint on the adoption of pro-environmental options [74]. Among the proposed solutions, participants suggested an information campaign. These kinds of strategies are commonly used to promote pro-environmental behavioural change [74]. Our findings suggest that policy on energy demand reduction measures should be catered towards a more in-depth understanding and better incorporation of what citizens value as contributing to their wellbeing, which goes beyond economic growth and stability, though these elements are also perceived as critical.

These findings raise challenges for how local authorities and national governments should assess the benefits of energy demand reduction measures in relation to citizens' wellbeing. Our results not only show that citizens do indeed value wider social, economic and environmental benefits of these measures, but also that they are aware of potential trade-offs with values relating to fairness and freedom of choice. Our approach also supports the importance of wider culture in framing people's values, and the potential for the use of deliberative spaces, like those in the MCM process, to help people to move away from polarised positions and facilitate meaningful conversations about the possibility of more transformational changes.

Nevertheless, our findings indicate that there is potentially a high level of public support for energy demand reduction measures, despite these measures being seen as politically controversial, particularly if the co-benefits of these measures are articulated and used to inform decision-making processes. This suggests that the use of wellbeing economy frameworks [45,47], such as the Doughnut economy model [41,42] or the SEED framework [11], by incorporating broader socio-environmental factors, compared to frameworks based on 'economic efficiency', could better capture what people value as contributing to their wellbeing at the local level. Whilst additional public engagement in policy-making processes to assess how citizens value these co-benefits and their contribution to wellbeing would require additional resources, this process could enhance the political feasibility of these measures and chances of their successful implementation [79]. This would help to create political space for the adoption of Local Green New Deal-type policies, including these energy demand reduction measures, as discussed elsewhere [18].

8. Conclusions

Energy demand reduction is argued to be crucial to realising pathways to Net Zero that also enhance citizens' quality of life. So far, energy demand policies have been based on conventional economic models, overlooking other values. Political concerns around actions which could be seen as undermining economic growth, restricting individuals' lifestyle choices or adversely affecting the less well-off, have largely restricted or prevented inclusion of energy demand reduction measures in Green New Deal or 'build back better' approaches.

Our surveys and focus groups found that home energy efficiency, affordable public transport and nature-based solutions were highly valued by participants in relation to indicators of wellbeing, and active travel and car-free zones were also relatively highly valued, whilst there was more scepticism about the value of moving to plant-based diets. Our findings suggest while citizens do value freedom of choice, better articulation of the social, economic and environmental impacts of these energy demand reduction options, together with the use of deliberative approaches, could support challenging assumptions and the acceptance of these measures as part of the transition to Net Zero.

Some local authorities have started adopting Green New Deal-type of policies, and 'doughnut' and wellbeing approaches for decision-making within their resources remits. However, beyond-GDP approaches are not yet widely adopted, and there are appeals for better integrating wellbeing frameworks in policy making, including at the local level [75]. Increased power and funding for local authorities could encourage a move to more integrated approaches to energy demand reduction and wellbeing, given the important role of local-level action for Net Zero policy implementation and communication [18]. Ensuring public engagement and an understanding of what citizens value is also critical to inform wellbeing-centered policy. Further research should explore webs of institutions at the local level that can support such a shift.

CRediT authorship contribution statement

Giulia M. Mininni: Writing – original draft, Formal analysis. **Timothy J. Foxon:** Writing – review & editing, Supervision,

Conceptualization. **Claire Copeland:** Writing – review & editing, Formal analysis. **Beatriz Aguirre Martinez:** Writing – review & editing, Formal analysis, Data curation. **Donal Brown:** Writing – review & editing. **Marie Claire Brisbois:** Writing – review & editing. **Gerardo A. Torres Contreras:** Writing – review & editing. **Siobhan Stack-Maddox:** Writing – review & editing. **Max Lacey-Barnacle:** Writing – review & editing. **Christian Jaccarini:** Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

The data for this paper has been archived in the UK Data Service Reshare repository at https://doi.org/10.5255/UKDA-SN-856851

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