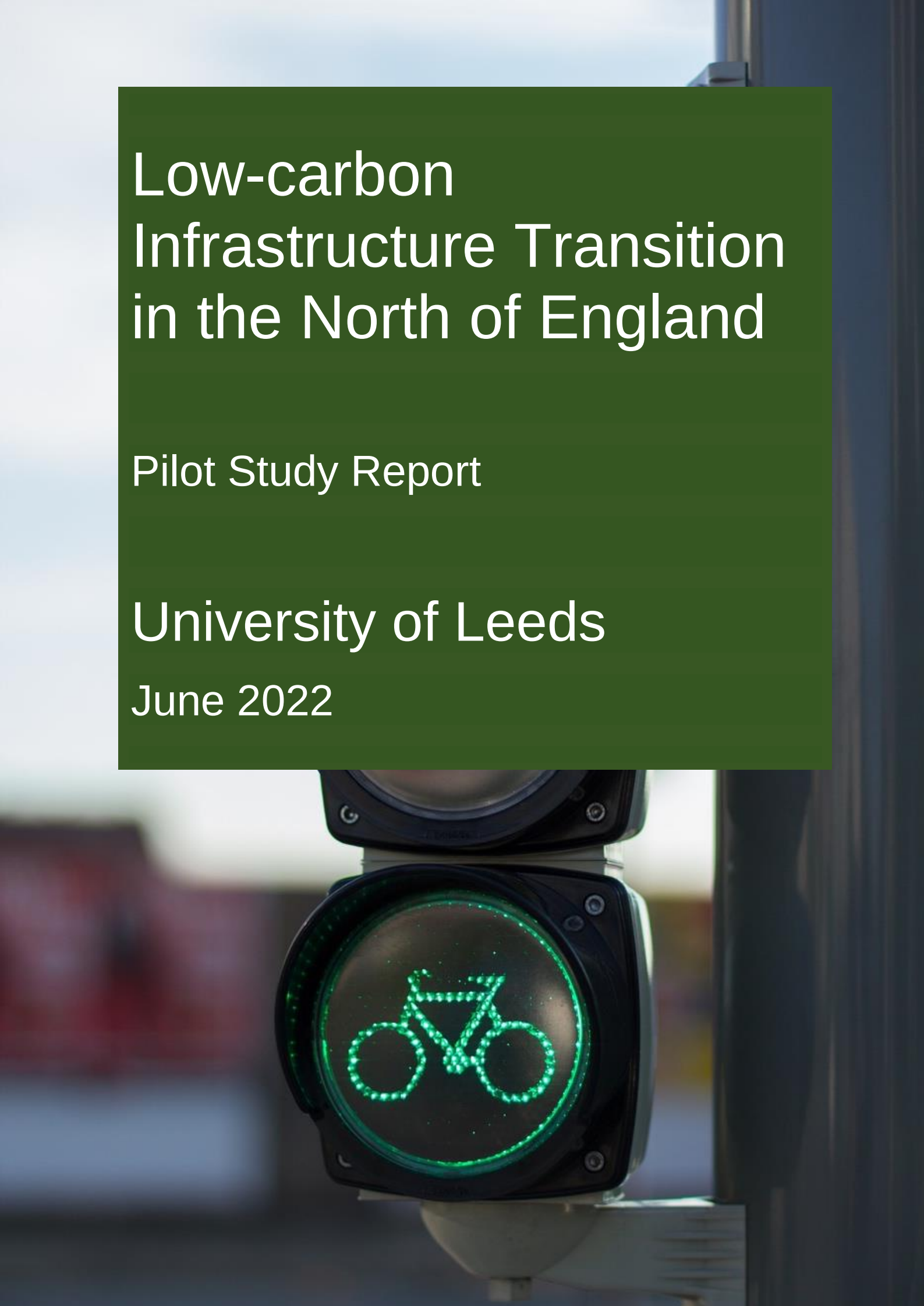
Low-carbon Infrastructure Transition in the North of England

Pilot Study Report

University of Leeds

June 2022



Low-carbon Infrastructure Transition in the North of England - Pilot Study

Report

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A shift to low carbon infrastructure is of vital importance across the North of England. This report outlines the key findings from a pilot interdisciplinary project conducted by Energy Leeds researchers (at the University of Leeds), which focusses on how local councils can facilitate a low carbon infrastructure transition, and the associated socio-economic challenges and opportunities linked to this transition. The project focusses specifically on the northern cities of Leeds, Bradford, and Hull.[1]

The pilot project aims to build an understanding of the benefits of low carbon infrastructure development that will resonate across a range of stakeholders, from local authorities to local business, to people in the street and their communities. Building such an understanding, with its nuance and commonalities across stakeholders, is crucial to addressing the many complex challenges of deploying low carbon infrastructure. This project explores how we can build an understanding of both the wider social benefits (e.g., health, new jobs, improved quality of life, being "good ancestors" to future generations, harnessing innovations to empower local citizens), and the potential obstacles involved in implementing this new low carbon infrastructure. This is not intended to act as a comprehensive report of every project undertaken by the three city councils involved, and further research is expected to build on the findings of this pilot project.

Data from the pilot project (drawn from analysis of low carbon developments in the 3 focus cities, case studies, local authority and stakeholder interviews/workshops, and data from an online citizen discussion platform) revealed a number of key insights into how decarbonisation projects could be implemented locally across the 3 cities. It highlights the core opportunities and challenges that need to be addressed to help facilitate and expedite a transition to low carbon infrastructure, including:

- The presence of a clear appetite for holistic, affordable, resilient and low carbon infrastructure from the public, local communities and business
- The need for more cross-sector dialogue to escape stakeholder siloing and facilitate joined-up thinking

[1] This research was funded by a Pump Priming for Interdisciplinary Research Initiative QR GCRF grant from the University of Leeds.

- The need to involve the public in consultation sessions at the beginning of a new initiative or scheme, especially to improve buy-in from those who are disconnected
- Ensuring that the transition does not create new or continue existing dependencies and/or lead to undesirable technology lock-in (e.g., a transition to EVs should not continue dependency on cars)
- The need to invest in awareness, education, and information initiatives to help citizens understand the significance of the challenge and encourage behaviour change
- The need to have a clearly integrated national-sub-regional and local long-term strategy, with clear milestones, responsibilities, and timelines, that sets out local priorities and funding for the costs and opportunities for transitioning
- The scope for greater proactivity in commercial and civic entrepreneurship
- The need for bigger businesses to champion sustainability, resilience and decarbonisation and support local SMEs in their own transitioning to a sustainable, resilient, and low carbon future

The project identifies key areas which require ongoing research to facilitate a low carbon infrastructure transition in the North, these include:

- The importance of net zero pathway research for specific local contexts (to help councils become intelligence-led with a focus on practical applicability
- The need for joined-up, whole-system (system of systems) pathway research to facilitate a shared understanding of issues and, importantly, the potential impacts of interventions across systems
- The importance of co-produced research (e.g., business cases for clean growth infrastructure, technical feasibility studies)

Low carbon transition case studies from across the country are found in Section 4. Reviewed case studies cover electric vehicle charging, behaviour change incentive schemes, and housing decarbonisation that were deemed relevant to the low carbon transition journeys of the three cities. These findings were complemented by workshops and interviews held with project stakeholders. Key results from this wide-ranging engagement are summarised throughout Sections 5 and 6. Section 7 concludes by providing summarised insight and recommendations across the range of subjects considered and stakeholders engaged in this project.

Contents

1. Introduction

In light of the increasing global climate crisis and the UK presidency of the COP26 held in Glasgow, 2021 has been a focal year in the UK's approach to fighting climate change. Many climate action plans at various levels of government have been published to outline how the country intends to reach its net-zero targets over the coming decades. The UK has generally been ahead of the trend, being the first major economy to legislate net-zero by 2050,[2] with the Net-Zero: Build Back Greener strategy released in October 2021 outlining government plans to achieve net-zero by 2050. This strategy includes for example, using £12 billion to end the sale of petrol and diesel cars by 2030, introducing new green jobs, fair carbon pricing for large polluters and investment in low-carbon tech.[3] However, this national level/central strategy is only a part of the picture when it comes to achieving net zero in the UK. Local authorities play a fundamental and active role in this transition.[4] In order to achieve the targets set out in national policy, local net-zero strategies and climate plans tailored to specific regions are crucial.

This report focusses on the key role of local authorities in the transition to a low carbon infrastructure. It reveals a range of insights into how decarbonisation projects could be implemented locally/potential obstacles at the local level across the 3 cities, drawing to the fore core opportunities and challenges that need to be addressed to realise a low carbon infrastructure transition.

The report begins by setting out the project methodology before moving on to present 4 key elements. First, it outlines findings from research on the current state of the low carbon transition in the North of England, specifically in the three cities Leeds, Bradford, and Kingston upon Hull (herein, Hull). Second, a more detailed analysis of various low carbon infrastructure case studies from across the UK, and the lessons that can be learnt from these, are presented. These case studies are clustered into three overarching themes (which echo the primary focus points of the 3 city councils and research team, i.e. housing decarbonisation, including new-builds and retrofitting, electric vehicle charging, and incentive schemes to encourage behaviour change). Third, an analysis of data drawn from citizen perceptions and preferences in relation to different low carbon transition policies and projects (built from a bespoke online citizen discussion platform) is discussed. Fourthly, the report presents findings from wider stakeholder perceptions relating to the opportunities and challenges involved in the shift to low carbon infrastructure (data drawn from stakeholder workshops).

2. Methodology

During this project, 7 interviews were conducted with various stakeholders across the country, specifically with members from the city councils, as well as project managers of specific low-carbon projects and local businesses to develop an understanding of the state of low-carbon transition in the three cities, Leeds, Bradford, and Hull, and to examine case studies of best practice from different areas of the UK. Furthermore, a virtual citizens' discussion using an online

[2] Net-zero: Build Back Greener 2021

[3] Ibid.

[4] These authorities include county, city, parish, and district councils across the country who receive funding from their residents through council tax and business rates, as well as funding from the national government through grants.

deliberation platform was conducted that also included a survey on electric vehicle charging infrastructure. Finally, three stakeholder workshops were held in Leeds, Bradford, and Hull.

In the context of the virtual citizens discussion, the online democratic deliberation and voting platform LiquidFeedback (https://liquidfeedback.com/en/ hosted through https://yorkshire-climate.org/) was used to gather the thoughts and proposals of citizens in Leeds, Hull, and Bradford. Between 30th September – 12th December 2021, 102 self-selected participants were able to bring in and discuss various low-carbon initiatives within eight subject areas (green spaces, electric vehicle charging, awareness & education, transport, business & economy, housing decarbonisation, renewable energy, and other issues), assessing the benefits and disadvantages of these. Once registered, users were able to create an initiative, and/or add comments to improve initiatives proposed by others. In case of disagreement with an initiative they were able to create a competing initiative. After the deliberation stage users were able to vote for or against initiatives that received sufficient overall support. During the deliberation process experts (selected researchers) were involved to provide expertise and make suggestions, but they did not have voting rights on their own.

Following advertisement of the citizens assembly through project stakeholder networks and on several social media platforms, 102 participants were recruited as users across the three cities. In terms of representation of citizen views, a greater number of participants would have been desirable. However, given this project was a pilot study, the sample provides a strong base for identifying key issues for further validatory and exploratory research. Indeed, one immediate lesson learned from the pilot study is, that advertisement of the citizens engagement platform needs to be stepped up and maintained. Council promotion of the platform, in particular, is key to ensuring engagement with their residents. Of those that participated, many were engaged and generated lots of interesting ideas. Given that participants were self-selecting, the citizen sample is not necessarily representative, and risks being biased towards those who are already involved or interested in climate action. An attempt was made to mitigate this bias by recruiting participants from a wide range of sources. These included city council newsletter and distribution lists, professional and business social media platforms (e.g., LinkedIn), a range of faith-based groups (e.g local churches, mosques, and synagogues), advocacy groups (e.g Our Future Leeds), trade unions, local charities, youth groups, and local climate action groups (e.g Friends of the Earth). However, a robust strategy for recruitment of participants is an area that requires further research.

From the socio-demographic attributes collected from users of the platform, we can observe some representation biases present in the data. In terms of gender, the sample was almost evenly split, with 50% of users being female and 46% male, with the remaining preferring not to provide that information. However, the vast majority of users were either White British (78%) or of Another White Background (12%), with the remainder specifying a Black Caribbean (1%), Asian (3%), Indian (1%) background or preferred not to say. The income distribution among users (excluding 15% who chose not to provide that information) was, however, more varied (see Figure 1), albeit with an overrepresentation (in terms of an average UK wage of £25,000 - £30,000) of those in the £55,000 – £99,999 per year earning bracket. In terms of education background, the sample was skewed towards those with a higher education qualification, with 17.6 % having a PhD, 27% a Masters degree and 38% a Bachelors degree as their highest degree.

The remainder had an A-level or equivalent as their highest educational qualification (5%), a vocational qualification (4%), a medical degree (1%), GCSE (1%) or preferred not to say (5%).

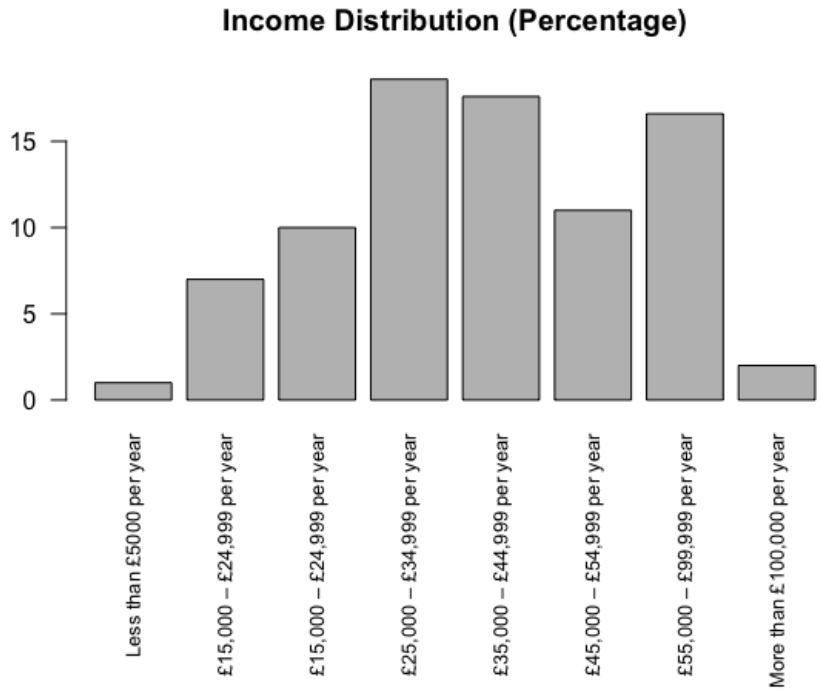

Figure 1: Income distribution among citizen discussion participants

One valuable feature of the Liquid Feedback platform was that participants could be separated into separate units depending on their location, so any discussion and proposals raised would be as relevant as possible to their areas. This also meant we were able to monitor how active participants were in each city unit and which subject areas were most important to them. We were able to send out newsletters and surveys though the Liquid Feedback platform to inform participants of different stages of the discussion, and the different levels of voting/support allowed for participants to provide meaningful justifications for their proposals.

Finally, three stakeholder workshops were conducted in December 2021. These were co-developed with the project's council partners in Leeds, Bradford, and Hull, and included participants from the local authority, private sector, and small and medium enterprises (SMEs), third sector including charities, union representatives and public transport. The variety of participants was vital to achieving a balanced view of how recent council approaches to climate challenges and/or specific action plans, implemented or in preparation,[5] were impacting local stakeholders and what their perspective is on the transition to a low carbon future. The workshops had three primary aims:

1. To bring together different stakeholders from each represented city ,
2. To understand the challenges of a low carbon infrastructure transition for local businesses, communities, and councils,
3. To develop, focus and/or validate council decarbonisation policies.

At each workshop, a representative from the council presented their city's current position regarding decarbonisation targets and the areas where they have implemented successful

[5] E.g. locally (Leeds), regionally (West Yorkshire), nationally (central government)

projects. Participants were then split into groups of 5-6 to discuss successful decarbonisation projects/policies in their sector/within their organisation, the challenges their sector/organisation faces, and what they would like to see in the future.

The three methods of data collection (interviews/case studies, virtual discussion, workshops) delivered a diverse range of views from decision makers and public and private stakeholders, which led to an understanding of the challenges or opportunities of decarbonisation at the local/regional level.

3. State of Low-Carbon Transition in the North of England

Local authorities play a key role in the decarbonisation transition, however in reviewing the state of the low carbon transition, it became clear that their ability to act is often restricted by the availability of funds, as well as by legislation and national policies defining councils' remit. Councils have seen a real-term reduction of 28.6% in their spending power since 2010 and a 49% reduction in government funding along with a growth in demand for key services.[6] This places increasing pressure on local authorities to still fulfil their services to the local community and with the same expectations of quality and frequency despite a reduced budget. Inevitably this will lead to cuts or reductions to some services and frustration among the public. In relation to climate action, a further emerging problem is that it is not always clear (especially to the public) which services fall within the remit of local authorities and what the public can/should expect the councils to do. This lack of clarity also stems from the substantial number of climate action plans being published in the region and understanding of which organisation (West Yorkshire Combined Authority- WYCA, Mayor's Office, Local Authority) is responsible for the various parts of the plans and their execution.[7] Although there are currently multiple separate commissions and plans, there is a recognition that they are acting as a temporary measure/mechanism to contribute/facilitate local level developments which aim to address the global climate crisis. The aim being to embed sustainability and climate-positive ways of production, consumption and living into our society at all levels. The following sections set out in more detail the current state of this ongoing process, and the state of low carbon transitions in each of the three cities (Bradford, Leeds, and Hull).

3.1. City of Bradford

Bradford Council is shaping sustainability ambitions and aims to be the UK's leading clean growth city district and was the 4th UK metropolitan district to declare a climate emergency in January 2019. [8] This was followed by declarations from Hull and Leeds in March 2019, and the West Yorkshire Combined Authority (WYCA) in July 2019.[9] City of Bradford Metropolitan District Council is made up of 30 wards and includes the city of Bradford and major towns Shipley, Bingley, Ilkley, and Keighley, as well as many smaller towns and villages. The district is the 5th largest local

[6] P.4 https://www.nao.org.uk/wp-content/uploads/2018/03/Financial-sustainabilty-of-local-authorites-2018.pdf and https://publications.parliament.uk/pa/cm201719/cmselect/cmpubacc/970/970.pdf

[7] For example, The Yorkshire Climate Action Plan consists of 50 actions which local councils need to respond to. And certain areas of decarbonisation the action plan such as heating, building, housing, and transport will be actioned by Government, across other sectors and/or in collaboration with WYCA due to their larger scope.- Bradford Council workshop 6 Dec 21

[8] https://www.bradford.gov.uk/media/5754/bradford-housing-strategy-2020-to-2030.pdf

[9] https://www.hullccnews.co.uk/05/06/2019/hull-city-council-makes-climate-change-pledge/

authority in England with a population of around 542,000[10] people across the wards supported by 90 elected councillors and currently has a Labour Group administration.[11]

Figure 2: Map of Bradford District

The council's net revenue budget 2020-21 was £385 million[12]. Capital funding was allocated to climate action in 2020-21 (approx. £24 million (6.2%)) of which was reserved for green growth transformational capital projects such as Community led climate action, boosted tree planting, fleet transition to low-carbon, LED smart street lighting and electric vehicle charging infrastructure.[13] These have seen continued progress in 2021-22 and a wider mainstreaming of regeneration and environmental impact management; for example, Transforming Cities Fund investment will see major changes to support walking, cycling and public transport in the City Centre for completion by 2025. The core climate action projects were aimed to enable the council to lead by example and support businesses and residents to work in a more productive and ecologically friendly way. For example, the smart streetlights project began in May 2021 and aims to install round 86,000 lanterns and lampposts at a cost of £45 million. This project received seed funding of £19 million from the Government energy savings fund. This aims to reduce both the city's rising energy costs, by £2 million per year, and its carbon emission footprint, by replacing ageing streetlight columns and the now obsolete orange coloured SOX lamps.[14] Following a contract alteration, the Council now purchases all its electricity from renewable sources (April 2021).

Bradford Council is suffering primarily from a capacity issue when it comes to climate policies. The council has lost £300 million through austerity measures and budget cuts so it is forced to focus on essential and statutory services like child services.[15] Unlike Leeds and Hull, Bradford has

[10] https://ubd.bradford.gov.uk/about-us/population/
[11] https://www.bradford.gov.uk/your-council/elections-and-voting/current-political-composition/
[12] https://www.bradford.gov.uk/your-council/have-your-say-on-the-proposed-financial-plan-and-budget-proposals-for-2021-22/have-your-say-on-the-proposed-financial-plan-and-budget-proposals-for-2021-22/
[13] Bradford executive budget amendment https://bradford.moderngov.co.uk/documents/s32956/Executive%20budget%20amendment%20160221.pdf
[14] https://bradford.gov.uk/transport-and-travel/highways/the-smart-street-lighting-project/
[15] CBMDC Interview

not had a dedicated climate change manager for the last five years due to their stretched budget and limited resources. Instead, as a non-statutory responsibility, climate policies are spread across various departments such as air quality, transport, and planning.[16] This approach seeks to entrench climate policies and broader sustainability ambitions into various aspects of the council's work, requiring attention on governance, data and information sharing and on communication internally and externally to present. Nevertheless, it can be difficult to understand who is responsible and accountable for the different areas of climate/sustainability policy. Generally, the council focuses on combining sustainability initiatives with wider issues such as that of poverty alleviation and future-proofing infrastructure as a complement to any distinct standalone climate action projects. In this way, the council is seeking to mainstream decarbonisation, resilience and more by integrating sustainability as part of core business-as-usual processes, rather than as an add-on or afterthought.

The 2038 Bradford District Local Plan represents this approach, it sets out how the district will grow sustainably over the next 15 to 20 years and what it means for local communities. The plan features new sites for housing and employment, new development and planning policies, building green infrastructure, supporting public transport and active travel, and regenerating places of ecological value.[17]

Bradford Council has faced at times harsh criticism by local climate activists, accused of not adopting more ambitious policies and because many of their actions and policies are 'behind the scenes'. Such actions include efforts to embed sustainability in their corporate practices. For example, reducing GHG emissions from food catering by building a brand new environmentally friendly facility rather than spending money to make the existing inefficient facilities better. A dedicated local infrastructure plan will underpin and support the evidence base, options and plans for infrastructure renewal, maintenance and decarbonisation including supporting the local business case for hospital investment and the aim to build the UK's first low-carbon hospital, investing in a new train station and route to connect Bradford to Leeds, Huddersfield, and Manchester. As an example of public sector supported commercial action, the Beckfoot Multi-Academy School Trust (of primary, secondary and special educational needs schools)[18] received funding from the Energy Accelerator run by the West Yorkshire Combined Authority (WYCA) and the Leeds Enterprise Partnership (LEP). The funding is "designed to help low carbon and energy efficient projects become a reality where they may otherwise not have been completed due to a lack of capacity, expertise or funding".[19] This funding facilitated an energy saving retrofit project at the trust including solar panels, double-glazed windows, and heating.

The council is also waiting for more direction from central government regarding sustainable infrastructure investment and where the funding is coming from and how they can access it. The recently published Net-Zero: Build Back Greener national government plan is subject to criticism for its failure to provide sufficient guidance to local councils. The council stresses the need to focus on the long-term value of investing in clean growth initiatives, which are not always

[16] Ibid.
[17] https://www.bradford.gov.uk/planning-and-building-control/planning-policy/bradford-district-local-plan/#:~:text=Delivering%20our%20net%20zero%20carbon,are%20central%20to%20the%20plan.
[18] Ibid.
[19] https://www.westyorks-ca.gov.uk/all-news-and-blogs/innovative-energy-efficiency-programme-the-energy-accelerator-supports-beckfoot-trust-schools-in-bradford-to-save-over-280-tonnes-of-co2-per-year/

compatible with the one-off time-limited funding pots available from the central government. During the workshop, the council provided an example of receiving £2.5 million funding to insulate homes with foam insulation. However, after the council received the funding, it was decided at the national level that this particular type of insulation could no longer be used due to fire safety issues. The Council was then prevented from using the funding to insulate homes with another insulation technology and had to return the money.[20] This disconnect between the national and local level is an issue that repeatedly arose in our research as problematic.

Geographically, Bradford arguably faces fewer immediate climate risks over the next few decades (when compared to Hull for example). This means they potentially have more time to fully embed sustainability and resilience measures into their policies to future-proof the district. This focus on climate resilience is something that features strongly in the council's approach. Notably however, the district does have two rivers running through it, the River Aire and the River Wharfe, which are vulnerable to fluvial flooding.[21] This could cause some older bridges in Apperley and Cottingley to be permanently damaged, separating the north and south of the district and potentially displacing many inhabitants. The recent storm Arwen has made the council furthermore aware of the vulnerability of its infrastructure to extreme weather events and the need for both immediate and long-term action.

3.2. City of Leeds

Leeds is the 2nd largest local authority in England with a population of 789,000.[22] The Leeds metropolitan region is made up of 33 wards supported by 99 elected councillors and currently has a Labour Party administration.[23] The city's climate emergency declaration in March 2019 kickstarted a new priority for the council regarding the environment. They note "A specific focus on this emergency aims to embed sustainability considerations into all aspects of the authority's decision-making."[24] In their Best Council Plan from 2020-25 they have committed to switching to purchasing all their electricity from renewable sources, increasing the tree canopy, and connecting 1000 homes to a district heating network.[25]

Throughout 2019 Leeds conducted several public information and consultation activities to gain a better understanding of the views and concerns of the local community. This involved The Big Leeds Climate Conversation and a citizens' jury to raise awareness among the general public of climate change policies, and to involve citizens in the development of the climate action plan and associated strategy. The climate conversation lasted for three months and was conducted in the form of an online survey or face-to-face conversation. It involved five themes on food consumption, travel, consumer behaviour, biodiversity, and energy, and questioned residents on several of the council's ideas to reduce the city's carbon footprint.[26] These ideas included the creation of a carbon offsetting scheme, investment in sustainable travel infrastructure, and reducing the carbon footprint of school meals to name a few.

[20] Ibid.
[21] https://www.local.gov.uk/topics/severe-weather/flooding/flood-and-coastal-erosion-risk-management/river-fluvial-flooding
[22] Population Estimates for UK, England and Wales, Scotland and Northern Ireland: mid-2020-april-2021-geography
[23] https://www.leeds.gov.uk/councillors-and-democracy/councillors-and-committees
[24] Ibid. Para 14.3.2
[25] Leeds Best Council Plan https://www.leeds.gov.uk/docs/BCP%202020-2025.PDF
[26] https://news.leeds.gov.uk/news/big-leeds-climate-conversation-begins

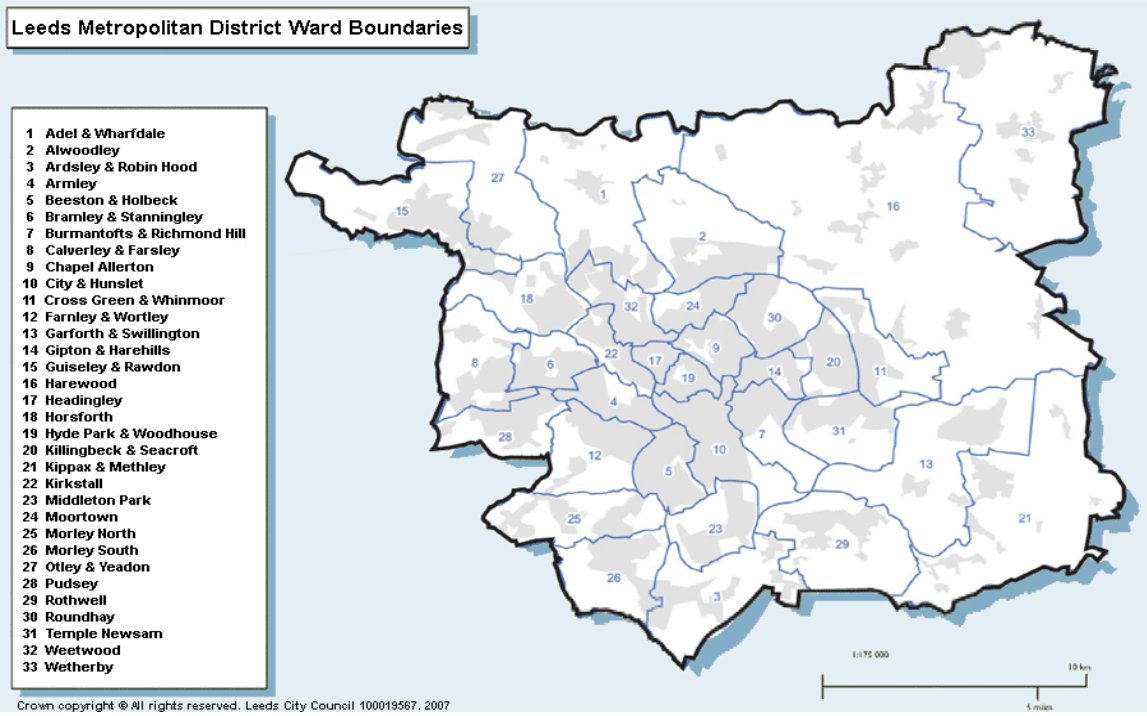

Figure 3: Map of Leeds City Council ward boundaries

The citizens jury organised by the Leeds Climate Commission ran between September and November 2019. 25 jury members were selected by a diverse oversight panel of climate action groups, local authority, academia, and industry, and included an additional 22 experts to ensure jury members had access to information to make informed recommendations to the Climate Emergency Advisory Committee in Leeds City Council.[27] The twelve recommendations spanned five themes and the highest ranked related to providing alternatives to private cars, retrofitting existing houses, and a large-scale communication drive across the city.[28]

Similarly to Bradford, Leeds has the River Aire and has introduced a flood alleviation scheme after the devastating floods Leeds experienced in 2015. The project aims to reduce the flood risk to 0.5% per year which would protect over 1000 homes and close to 500 businesses. The scheme is currently in phase two focussing on making the area between Leeds Train Station and Apperley Bridge less vulnerable to flooding.[29] It uses natural flood management techniques (including creating new woodland and storage ponds) as well as traditional engineering (such as flood defence walls and flood storage areas). The council also pledged to plant three trees for every one removed in the same area to maintain the area's wildlife and vegetation.

Leeds has trialled several high-profile decarbonisation and low-carbon infrastructure projects, such as a district heat network, the electric vehicle trial centre, and the Climate Innovation District, which we will describe in greater detail in the case studies section.

[27] https://www.leedsclimate.org.uk/leeds-climate-change-citizens-jury
[28] https://www.leedsclimate.org.uk/sites/default/files/CJ%20recommendations%20FINAL%20_0.pdf
[29] https://www.leeds.gov.uk/emergencies/flooding-advice/how-were-reducing-the-risk-of-flooding/leeds-flood-alleviation-scheme

3.3. City of Hull

Hull has a population of 260,000 made up of 21 wards represented by 57 councillors, the majority of whom are Labour councillors[30]. The council had a budget of over £10m for renewable energy and transport decarbonisation, while they also invest into the city's district heating network, and housing and corporate property energy efficiency. An example of the showcase of technology includes the Greenpower Hull electric car street race which closed the roads in Hull City Centre in April 2019. The aim of this project was to encourage young people in the city into STEM subjects by designing, building and racing electric cars.[31] These races have demonstrated to local citizens how the electric vehicle technology is progressing year after year.[32] Despite budget cuts and a £130 million reduction of funding since 2010[33] the council has a dedicated climate change manager and set aside funds to employ three further members of staff to create a climate change team.[34] Unlike Bradford city council, this extra funding for staff provides the council with increased capacity for management and focus for their climate action projects and initiatives. These staff members are specialists in buildings and power, mobility, circular economy, and sustainability.

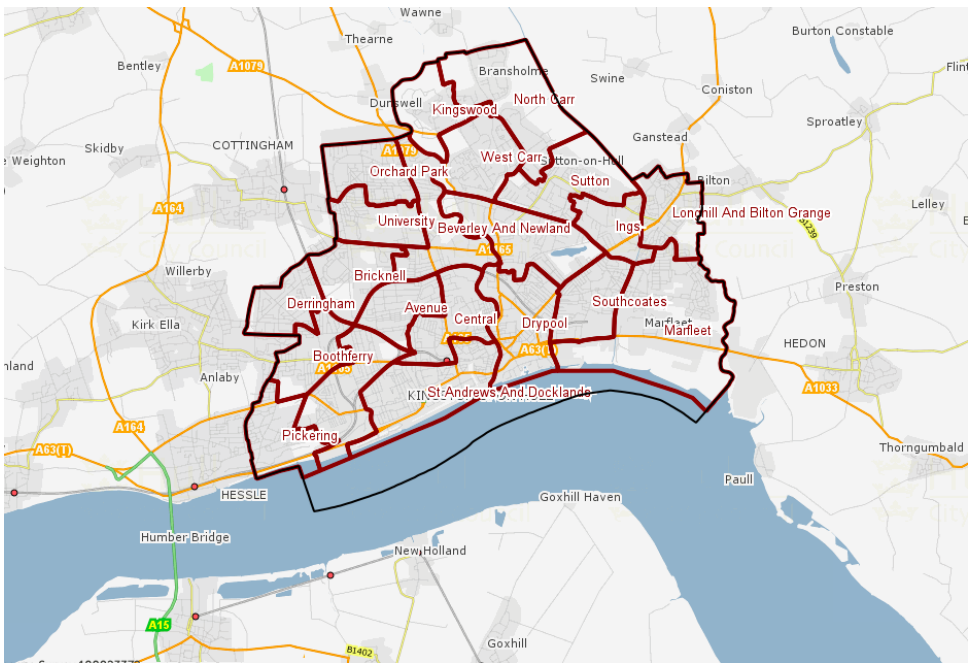

Figure 4: Map of Hill City Council ward boundaries

Hull's 2030 Carbon Neutral Strategy takes the approach of reducing consumption and production emissions and using carbon sequestration to offset the remaining emissions to meet their 2030 targets.[35] Hull's geographical position on the Humber Estuary provides it with a unique set of opportunities and challenges relating to tackling climate change. The city attracted Siemens Gamesa to Hull who, alongside Associated British Ports, developed the renewable energy focussed Green Port Hull, which in 2016 become home to an offshore wind turbine blade

[30] Population Estimates for UK, England and Wales, Scotland and Northern Ireland: mid-2020-april-2021-geography. The council has a Liberal Democrat majority as of May 2022

[31] https://www.greenpower.co.uk/

[32] https://www.greenpower.co.uk/news/uk-first-electric-street-race-coming-hull-next-year

[33] Appendix A (ii) - Leader's Budget Statement 2020 p.10

[34] General Fund Revenue Budget 2020/21 and Medium Term Financial Plan 2020/21 to 2022/23 para. 20

[35] Hull 2030 Carbon Neutral Strategy p.12

factory.[36] This was part of a £310 million investment in Hull's Alexandra Dock and provided momentum for climate change mitigation among residents in the city with direct and indirect creation of over 2000 new jobs. Furthermore, the Ron Dearing University Technical College was opened in 2017, specialising in STEAM (Sciences, Technology, Engineering, Arts and Maths) vocational degrees for students between 14 and 19.[37] There are places for up to 600 students, who can make experience on real-world projects and who can develop skills employer partners in the region and the wider industry require. The focus is on renewable technologies and infrastructure that Hull is developing and has expertise in.

The city's proximity to the Humber also makes it susceptible to flooding. Hull is listed as a flood vulnerable city by the Met Office.[38] Hull is the second most vulnerable city to flooding in the UK after London, it is 90% below sea level at high tide and has suffered from several widespread floods. The most recent of these being in 2013 following a tidal surge that caused significant damage to buildings within the city centre. More notably, however, a pluvial flooding event in June 2007 damaged over 10,000 properties, affected a further 45,000 homes, damaged over 90 schools and had a devastating impact on the local community.[39] This cost the city £40 million in repairs.[40] To help combat these and future threats from flooding, there are a number of alleviation schemes throughout the city to help prevent future flooding events.[41] These include natural drainage in 'aqua greens', which divert water to green spaces during times of heavy rain rather than into people's homes.[42] The Carbon Neutral Strategy includes a £63 million investment from The Environment Agency and £16 million from Yorkshire Water.[43]

3.4 Across Bradford, Leeds, and Hull

Notably, in the North of England, local authorities have, in addition to their own individual plans and policies, opted to support The Yorkshire and Humber Climate Change Commission (an advisory group launched in March 2021 consisting of climate leaders from the private, public and 3rd sector).[44] This commission is supported by a total of 22 councils around the region. It has four primary aims of climate resilience, net-zero, just transition, and nature & biodiversity.[45] Within these aims and targets, the importance of the public's role in the transition is emphasised. As a result, the commission have a community and engagement panel to explore how the public can get actively involved in developing an action plan for the region.[46] The commission's short-term future goals include further public engagement activities focussing on net-zero pathways and building climate resilience, developing green finance to facilitate retrofit of housing as was

[36] https://greenporthull.co.uk/about-green-port
[37] https://www.rondearingutc.com/about-us/
[38] https://www.hull.gov.uk/environment/adverse-weather/flooding
[39] Coulthard, T.J., Frostick, L., Hardcastle, H., Jones, K., Rogers, D., Scott, M. & Bankoff, G. (2007) The 2007 floods in Hull. Final report by the Independent Review Body, 21st November 2007. Hull City Council, 68pp.
[40] https://www.bbc.co.uk/news/uk-england-humber-59208096
[41] https://www.hull.gov.uk/environment/adverse-weather/investigate-significant-local-flooding-incidents and https://livingwithwater.co.uk/projects/sustainable-drainage-systems-suds
[42] Carbon Neutral Strategy https://www.hullccnews.co.uk/11/12/2019/aqua-greens-and-how-hull-is-tackling-flood-risk/
[43] https://www.hullccnews.co.uk/11/12/2019/aqua-greens-and-how-hull-is-tackling-flood-risk/
[44] https://yorksandhumberclimate.org.uk/about-yorkshire-and-humber%C2%A0climate-commission
[45] Yorkshire and Humber Climate Change Commission Question Time event 16 June 21
[46] https://yorksandhumberclimate.org.uk/sites/default/files/Climate%20Action%20Plan.pdf

recommended in the Leeds Climate Change Citizens' Jury, reskilling the workforce in the region to ensure a just transition, and encouraging behaviour change.[47]

4. Case Studies

We conducted several interviews and developed mini case studies in order to understand how other local authorities have implemented low carbon infrastructure projects in their areas. These are separated into themes of electric vehicle charging, incentive schemes to encourage behaviour change, and housing decarbonisation.

4.1. Electric Vehicle Charging

This theme addresses projects focused on increasing and improving the access of public electric vehicle charging stations. Specifically, providing on-street charging stations in areas where residents have limited off-street parking access. Hull, Bradford, and Leeds have many terraced homes which do not have private driveways.

This case study and online survey revealed that:

- Public interest in electric vehicles appears high, but cost and easy access to chargers remain distinct barriers to their uptake
- A perceived discrepancy between existing chargers and promised levels is adding to the already stretched resources of local councils
- The lack of access to off-street parking across the 3 cities is an ongoing challenge
- The majority of survey respondents were not willing to walk more than 5 minutes to a charging hub
- The location of installations needs to ensure fair and equal access and avoid replicating existing social inequalities
- EV charging infrastructure in Yorkshire and the Humber is generally underdeveloped, possessing the lowest ratio of people to chargers in the country
- Public-private partnerships may offer new opportunities for developing EV charging
- Active travel must remain a priority and not be downgraded by efforts to install EV charging

4.1.1. Electric vehicle preferences survey

In the context of this pilot, a short survey was conducted with users of the citizen engagement platform on electric vehicle charging preferences. Although only 20 users participated in this survey, it gives a first impression of potential preferences, though more research needs to be conducted. Firstly, 75% of the respondents said that they would either purchase an EV as their next vehicle or would consider it. Another 10% said they are interested in owning an EV but not as their next vehicle. From the 15%, who said they are not interested in ever purchasing an EV most do not own a car currently and so are unlikely to be interested in car ownership. One of the main barriers to EV ownership according to the respondents is the price of EVs (90%). Another crucial factor is the availability of charging stations in general (75%) and at home (55%). Range anxiety (55%) on the other hand seems to be a lesser issue. 45% of the respondents said that the availability of an EV charging station at their residential street would encourage them to purchase

[47] Yorkshire and Humber Climate Change Commission Question Time event 16 June 21

an EV. Hence, expanding the EV charging infrastructure appears important to ensure EV take-up. In terms of what type of EV charging infrastructure would be welcomed by the respondents, 65% said they would like to have access to "very slow charging at home, in a shared car park or at the workplace (6-8 hours)" usually in combination with an additional access to "fast charging in fast charging stations (15-30 minutes)" (55%). The majority (75%) would be willing to install an EV charging port at their property. However, when it comes to people's willingness to walk to a car park near their residence that would provide access to EV charging, most respondents (60%) are only willing to walk less than five minutes, and another 25% 5-10 minutes. Similarly, people would prefer close by fast charging access, for this 65% would be willing to travel up to two miles, and another 15% up to five miles.

4.1.2 Installing charge points

The UK government has pledged to install 145,000 electric vehicle charging points per year in England by 2030, with the goal of banning the sale of petrol and diesel cars by this date.[48] Across the UK, there has been a 112% increase in pure-electric vehicles between 2019-2020.[49] Recent statistics from the Department for Transport found there were 22,790 public charging points in the UK, 19% of which are rapid chargers.[50] However, this amounts to around 20 charging points per 100,000 people in Yorkshire and Humber compared with 80 per 100,000 in London. This leaves the Yorkshire and Humber region at the second lowest rank in the UK, and the lowest in England.[51] While most of these charging points are privately funded, there are some government grants from the Office for Zero Emission Vehicles (OZEV) to install charging points in residential and commercial areas.

To address the discrepancy between the number of existing chargers and number of expected/promised chargers, local councils have been tasked with increasing the amount of charging points available for their citizens. This has multiple considerations including the availability of the national grid in the region, the location of charging points, and the amount of rapid vs slow chargers to install. Other councils across the country have partnered with private companies such as Siemens and Ubitricity to help them with the charging points rollout and to advise on the best locations. There have also been public consultation sessions with local residents to help inform the councils on areas where chargers are most needed.

The local councils have also experienced increased pressure to manage the availability of chargers. Previously, they were not responsible for the availability, installation, or management of petrol and diesel filling stations as this was a private venture by oil companies. However, the push for increased electric vehicles and charging infrastructure has come from the UK Government and so is expected to be carried out by the councils. This adds to the already stretched resources of local councils who have seen their government funding cut by £15 billion over the last ten years.[52]

[48] https://www.gov.uk/government/news/pm-to-announce-electric-vehicle-revolution. Only petrol and diesel hybrids will be available for purchase by 2030, and fully electric/hydrogen cars from 2035

[49] Field dynamics report

[50] https://www.gov.uk/government/statistics/electric-vehicle-charging-device-statistics-april-2021/electric-vehicle-charging-device-statistics-april-2021

[51] https://www.gov.uk/government/statistics/electric-vehicle-charging-device-statistics-april-2021/electric-vehicle-charging-device-statistics-april-2021

[52] https://www.local.gov.uk/publications/spending-review-2021-submission#introduction-and-executive-summary

The government has tried to ease the strain on resources by providing grants[53] to local residents including OZEV Homecharge scheme, the Plug-in van grant, and the Workplace charging scheme, however long-term "substantial additional public and private financial resources" are needed from central government to drive forward the transition.[54] For example, Leeds City Council has the largest EV fleet in the country with over 380 vehicles.[55] They had challenges installing the required number of charging points in council depots because of the limits to electricity capacity which were too expensive to enhance in all cases. Instead, they installed charging points at council employees' homes so they could charge their vehicles overnight with the council reimbursing the costs of electricity.[56] This means the council can keep increasing the number of EVs in their fleet while also adding charging points to homes. While this is an innovative solution, it relies on the employees having access to off-street parking to install a charging point. On average, around 32% of UK households have no access to off-street parking,[57] and this figure is 29% for Bradford, 25% for East Riding of Yorkshire, and 33% for Leeds.[58]

Electric Vehicle charging does not only relate to smaller private vehicles, but also refuse trucks. Leeds City Council uses a total cost of ownership model rather than just calculating the initial purchase price to establish the business case for buying EVs. This involves calculating how much the vehicle costs to run throughout its lifetime, such as fuel costs and servicing, as well as the initial capital investment. This calculation proves beneficial for smaller vehicles which may have a slightly higher initial purchase price, but the costs are offset by reduced maintenance and lack of fuel costs. However, the initial purchase price of an electric model larger vehicles such as refuse trucks can still be much more expensive than the diesel models even when calculating the total cost of ownership (£400,000 vs £200,000 purchase price). The council has targets to stop purchasing diesel or petrol vehicles by 2025 and to use only alternative fuels by 2030. A new waste depot is planned to support the electrification of the refuse fleet. Planning conditions imposed on new housing developments have created over 3,000 electric vehicle charging points in the Bradford District. As part of a push to reduce Carbon emissions, Bradford Council's planning system requires housing developments to include EV charging points as a condition of granting planning permission for new houses.

4.1.3 On street EV charging

Due to a lack of clear guidance from the Office of Zero Emission Vehicles, none of the three partner councils have so far developed solutions for residents who do not have access to off-street parking. For that reason, we have investigated a case study outside the three councils of focus to explore potential lessons that could be learned from projects trialled by other councils. Islington is for instance one of the few councils in the UK that have experimented with a lamp post EV charging infrastructure. Islington is the second smallest borough in London with a population of approximately 236,000 residents, many of whom have no access to off-street

[53] https://www.gov.uk/government/collections/government-grants-for-low-emission-vehicles
[54] https://www.local.gov.uk/publications/spending-review-2021-submission#priority-4-reaching-net-zero
[55] LCC Interview 17 June 21
[56] https://www.local.gov.uk/case-studies/leeds-fleet-transition-zero-emission-home-charging
[57] Field Dynamics: On-street households report
[58] RAC Foundation: Standing Still Appendix C

parking.[59] In 2014, the council introduced a small number of their own chargers but found them insufficient for the demand of the area. To expand the provision of EV charging facilities, Islington Council have sought funding from Office for Zero Emission Vehicles (OZEV) and Transport for London (TfL) for both fast chargers and slow chargers mainly aimed at on-street residential charging. These included slow 3.5kwh chargers within lamp posts in areas of resident permit parking. These slow chargers proved most suitable for long charging on-street where residents could charge their cars overnight. Following a successful trial in 2020, 60 further charging units have been installed in lamp posts in Islington after requests from residents, making it the first large-scale roll out of the lamp post chargers in the borough. The Lamp post charging points are maintained by Siemens and Ubitricity.

Figure 5: Lamp post charging points in Islington

The council currently have 280 on-street public chargers supplied by a variety of network operators, and aim to install 400 by 2022[60]:

- Ubitricity[61] - 100+ lamp post chargers,
- Source London[62] - 140 7kW chargers (slow charging),
- BP Pulse[63] - 12 50kW (fast charging), and
- ESB[64] - 7 50kW (fast charging).

The Ubitricity charging points can be installed within one hour, and the power supply will still continue even if the streetlight is not on. Lamp post charges up to 25A with 1-phase (up to 5.8 kW) and 3-phase (up to 11 kW).[65] These are categorised as slow charging to ensure there is no excessive power load on the grid.

Islington Council use public consultations to help decide where to install new charging points. The public can suggest a location online and the council will follow-up to conduct site visits to the

[59] https://www.islington.gov.uk/about-the-council/islington-evidence-and-statistics/islingtons-population-evidence-and-statistics/demographics
[60] https://www.islington.gov.uk/roads/electric-vehicles/electric-vehicle-charging-points
[61] https://www.ubitricity.com/
[62] https://www.sourcelondon.net/
[63] https://network.bppulse.co.uk/
[64] https://www.esbenergy.co.uk/ev/charge-points
[65] https://www.ubitricity.com/ubicharge/

suggested areas.[66] While this provides important communication between the local authority and residents, it can be difficult to manage the expectations on the number of chargers they are able to install. Although the public can suggest locations, the final decision lies with the network operators who conduct a site survey and can sometimes have difficulty in getting quotations from the network providers especially considering recent budget cuts by the National Government.[67] The council therefore has the task of balancing the public want vs the network load. There can also be misplaced frustration directed at the council for failing to fix broken chargers, however this is the responsibility of the network provider. Nevertheless, the council maintains it is vital to involve the public in these decisions from the beginning, especially in an online format as they have found consistent demand from the public.[68] This demand increased during the recent fuel crisis as more residents considered switching to electric vehicles given increasing petrol and diesel prices.

While this demand generally comes from all wards of the borough, more chargers have been installed in the South where residents tend to be wealthier. The council aims to install another 80-100 charging points every year; however, this puts a heavy strain on their already stretched resources. A representative from Islington Council indicated resources (budget and team members) specific to procurement, finance, and traffic orders were the most important to manage a successful rollout of electric vehicle chargers.

4.1.4 Maintaining investment in alternative transport

Islington Council are also careful not to prioritise electric vehicle charging over other transport options such as active travel. Low-traffic neighbourhoods and encouraging residents to use alternative travel options for short journeys within the borough remain a priority for the local authority. This includes cycle lanes, widening footpaths, and ensuring charging points do not inhibit pedestrian access in any way, however the council acknowledge this is becoming more difficult. Footpaths and pavements should be primarily for the use of pedestrians and are extremely important to those in wheelchairs or using a pushchair. Therefore, the council need to ensure the presence of electric vehicle charging points and the cables connecting them to the cars to not cause a tripping hazard on the pavement. This can be avoided by using rubber curb ramps which allow the charging cables to pass underneath and pedestrians and wheels to easily step/roll over them. They are also careful not to ruin conservation areas and to reduce the external appearance of chargers fit in the area. For this reason, the lamp post chargers by Ubitricity are of particular importance as they can be installed within existing road infrastructure such as lamp posts and bollards without further upsetting the local area.

4.2. Behaviour Incentive Schemes

This theme addresses initiatives aimed at providing incentives to the public to adopt low-carbon infrastructure and technology and create climate-positive behaviour change. Many councils use the COM-B framework of behaviour change where Capability, Opportunity, and Motivation are all needed for a person to show a certain desired behaviour.[69] More awareness and education are also required when it comes to food and general consumption, as most people underestimate

[66] https://www.islington.gov.uk/roads/electric-vehicles/on-street-ev-charging-point-request-form?status=inprogress&ps=&ref=

[67] https://www.islington.gov.uk/about-the-council/funding-and-spending/how-we-are-funded

[68] IC Interview

[69] https://social-change.co.uk/files/02.09.19_COM-B_and_changing_behaviour_.pdf

the effects these behaviours have on climate change. People need greater support, both financially, and in terms of information to shift to other modes of home heating.

This case study revealed:

- Incentive schemes require extensive collaboration and communication between the council and local communities to ensure local challenges/circumstances are factored into the design of any initiative
- Incentive schemes need to be coupled with education/awareness campaigns
- Trials (such as the Leeds EV trial) play an important role in encouraging early adopters and helping to demonstrate the viability of initiatives to others

Behavioural changes are paramount to making progress on net zero targets.[70] Behavioural change is particularly important in the domains of transport, housing, food, and consumption. The government has already committed to banning the sale of new diesel and petrol cars by 2030 which will inevitably have a knock-on effect on the public's purchasing behaviour. However, behaviour change should go beyond replacing the same number of petrol cars with electric cars, because electric car production itself is ecologically problematic (e.g. lithium mining) and the amount of energy required to charge an increasing fleet of electric cars will add further pressure on the national grid and energy production. Hence, there must also be a concerted effort to direct the public towards forms of active travel such as cycling, walking, and improving public transport provision. Transport is still the largest emitting sector of domestic greenhouse gasses as of 2018, and around 68% of workers commuted by car in 2019, Yorkshire and the Humber had a higher-than-average rate of 74%.[71]

Changing transport and other behaviours will require collaboration and communication between the council and local communities so they can develop programmes and policies that consider the specific challenges local communities are facing when asked to change behaviours. Greater investment in the public transport network to provide a viable alternative to car use will be necessary. In our case study analyses we will focus on projects that encourage the public to stop using their petrol- or diesel-powered vehicles and instead use public transportation or electric vehicles.

4.2.1 Replacing petrol/diesel vehicles

Leeds has the biggest public sector EV fleet in the UK (330 vehicles) which serves a wide range of service areas.[72] An additional 54 EVs are reserved for trials. Specifically, the EV Trial Centre allows businesses to trial an electric vehicle (small vans and cars) for up to two months. This trial centre is part of the city's goal to increase residents and business use of alternatives to combustion engines vehicles. The aim is to increase walking by 33%, rail travel by 100%, bus travel by 130%, and cycling by 400%, while decreasing the use of cars by 30%.[73] This shall help the city to achieve its target of being carbon neutral by 2030.

[70] https://www.local.gov.uk/publications/spending-review-2021-submission#priority-4-reaching-net-zero
[71] Transport Statistics 2020 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/945829/tsgb-2020.pdf
[72] LCC Interview 17 June 21
[73] LCC Interview 17 June 21

The EV trial is free for businesses and each vehicle contains a telematics tracking device to monitor vehicle use and travel distance. At the end of the trial, the centre uses this tracking data to provide a total cost of ownership model and inform the business on the actual costs of replacing their existing vehicles with electric models. The council have worked with a variety of businesses such as Leeds Teaching Hospitals, Horsforth Breweries, and Harewood House Estate. The trial has helped to address misconceptions on owning an electric vehicle such as lack of range, availability of chargers, and time taken to charge. This scheme launched February 2020 and suffered delays and pauses in issuing cars due to the COVID-19 pandemic. It was then extended for six months to run from February 2020 to March 2022.[74]

75% of businesses that signed up for the trial said the experience has encouraged them to purchase an electric vehicle. Participants in the trial can also apply for government funding of up to £350 per charger towards the installation of a charging point.[75] However, there is currently a gap between demand and supply of electric vehicles with customers sometimes having to wait up to 12 months for new vehicles.[76] To increase EV uptake among the public and small businesses in Leeds, the council have provided incentives such as free permit parking in council car parks for eligible vehicles. Such trials are important as they encourage early adopters, who often have the financial means to shift, and these early adopters can then drive decrease in prices and act as role models demonstrating to others the usefulness and practicality of a new technology.

4.2.2 Reducing vehicle ownership

Beyond replacing petrol/diesel cars with electric, there is also a question over whether there is scope to incentivise people to give up private car ownership altogether in favour of alternative transport modes. In a national first, Coventry residents with an older, polluting car can exchange their car for £3000 of mobility credits. The credits can be spent on various modes of public transport, and other transport services such as car clubs, bikeshare, taxis, trains, and bus services. The credits are loaded in a pre-paid debit card and must be used within two years of beginning the scheme.[77] The scheme is funded by the West Midlands Future of Transport Zone, a £22m programme that aims to investigate how new technologies can be used to support people moving around the West Midlands in a more sustainable way - reducing congestion, improving air quality, and tackling climate change.[78]

Prior to launch in March 2021, Transport for West Midlands (TfWM) conducted focus groups to understand the public's expectations of the scheme, decide which modes of transport would be offered, and the value of the credits. Participants of the focus groups indicated the need for private hire vehicles such as taxis and car clubs to be included alongside buses, trains, and cycling. This suggests completely forgoing a car was not a realistic option for many, as a car is still required for occasionally transporting larger items or visiting relatives in areas inaccessible through public transport.[79]

[74] https://www.leeds.gov.uk/campaign/ev-trials
[75] https://www.leeds.gov.uk/business-support-and-advice/trial-electric-vehicles-at-your-organisation/grants-for-charging-points
[76] LCC Interview 17 June 21
[77] https://www.coventry.gov.uk/mobilitycredits
[78] https://www.gov.uk/government/consultations/future-of-transport-regulatory-review-call-for-evidence-on-micromobility-vehicles-flexible-bus-services-and-mobility-as-a-service
[79] CCC Interview

Eligibility requirements were decided based on residents living in the areas of Coventry with the worst levels of air pollution and therefore the most in need of intervention (note Birmingham City Council also introduced a clean air zone aimed at reducing pollution and the high rates of asthmatic children living in this area.)[80] Cars eligible for exchange were liable to charges for entering this clean air zone (Prospective users could also check their eligibility by entering their car registration into a government tool indicating whether they must pay to take their car to a clean air zone)[81] and had to be either a diesel car that is not Euro 6 compliant (pre-2016), or a petrol car that is not Euro 4 compliant (pre-2006).

Figure 6: Car being scrapped and recycled through the Mobility Credits Scheme

The TfWM team needed to make the scheme attractive enough to prospective users to trade-in their cars for mobility credits, rather than selling their cars for cash. The scrappage value of £3000 was decided based on research into average value of older cars and estimated cost of a season ticket for rail journeys for two years.

The scheme was delayed due to covid-19 restrictions. Since its official launch in March 2021, 68 people have registered for the scheme. Early monitoring data shows that most users are spending their mobility credits on taxis and car clubs rather than buses or trains. This may be due to a reluctance to use mass transit vehicles due to the ongoing coronavirus and increased exposure to others on buses and trains. Many people are also working from home with less need to commute to offices. As the pandemic eases and more people begin to work in offices, there may be a change in the modes of transport used with the credits. TfWM have hired a research company to continue monitoring the users of the scheme to understand how users are adapting their behaviour.

Coventry City Council is also investing millions of pounds in their public transportation, walking, and cycling infrastructure to provide a viable alternative to drivers in the city. They are pioneering Coventry Very Light Rail (VLR) electric trams throughout the city which require less infrastructure to build and maintain in comparison to traditional trams.[82] It is hoped that better public transport

[80] Local Government Association Spending Review 2021 https://www.local.gov.uk/publications/spending-review-2021-submission#priority-4-reaching-net-zero
[81] https://www.gov.uk/clean-air-zones
[82] https://www.coventry.gov.uk/info/113/regeneration/3152/very_light_rail

provision will encourage people who trade in their cars for mobility credits to utilise this network (rather than using credits for taxis/car clubs). This is investment in VLR is especially important in a small city of 326,000 people that could not sustain a conventional tram system. The city estimates the costs of installing the rail tracks to be just £10 million per km against the usual up to £100 million per km for conventional tram tracks.[83] The majority of the £16.42 million funding for the VLR came from the West Midlands Combined Authority Devolution Deal.

4.3. Housing Decarbonisation

This theme focusses on schemes led by the public and private sector. These schemes aim to address the different approaches to low-carbon housing including retrofitting existing housing with insulation, solar panels and air heat pumps, and the development of purpose-built housing communities encouraging residents to embrace a new energy-efficient way of living.

This case study revealed:

- Whilst various approaches exist for the retrofitting and future-proofing of old housing stock, these are not always well integrated (a notable exception is the Energiesprong approach used in Nottingham)
- Review of planning regulations relating to retrofitting may help facilitate implementation
- To ensure the quality of new build housing decarbonisation, councils may wish to set specific local standards
- New developments work best when developers consider the impact on the surrounding areas. For example, connecting to the existing local community and incorporating active travel into the everyday lives of the residents

There are a number of exciting new build initiatives such as Citu in the regions. However, these remain comparatively expensive and so are not widely accessible options for many residents.
We consider the successes and challenges of several types of housing schemes in the UK, how they affect their wider communities, and the social issues they raise. These include reducing fuel poverty, making the most of green spaces, and encouraging a lifestyle change among current and future residents. Developers should also consider the existing amenities around the site such as shops, and importantly the quality of schools nearby.

Figure 7: Energiesprong retrofit homes in Nottingham

[83] https://www.coventry.gov.uk/info/113/regeneration/3152/very_light_rail/2

4.3.1. Retrofitting

"47% of the city's carbon footprint comes from heating and powering our buildings, particularly from those that are poorly insulated or heated by oil/gas." – Leeds City Council.[84] 16% of the housing in Leeds is owned by the council and the majority of these are categorised as the third most energy efficient category C. Leeds City Council has developed a 19km district heating network which captures energy from waste to heat almost 2000 homes in the city, primarily in tower blocks. Likewise, they have installed solar panels on 700 homes whose residents are on a low income.[85] Retrofitting public premises and removing planning permission requirements for external wall insulation were some of the most popular initiatives raised by the public during our virtual citizens' discussion. The West Yorkshire Climate Commission stated it is generally easier to develop eco-friendly new-builds rather than retrofit existing homes unless the homes are owned by the city councils. For example, Leeds has committed £100 million over the next 5 years to retrofit local authority houses and improve heating in tower blocks.[86] In Bradford, £71 million is needed to remedy cold, damp, and fall hazards (category one) in the 30,000 housing association owned homes.[87] Incommunities, the major social housing provider for the Bradford District has adopted a sustainability strategy and a budget plan for over £30m to be invested in retrofitting its housing stock. For the 24,500 homes owned by Hull City Council, £9 million per year has been allocated to improve insulation.[88] Furthermore, it is important to incentivise people to use and invest in green options. For example, landlords, who are not responsible for paying energy bills should still be encouraged to make use of the green energy grants that would benefit their tenants.

For retrofitting and future-proofing old housing stock various approaches exist, however usually they are not well integrated, a notable exception is the Energiesprong approach. Nottingham City Homes is the first housing association in the UK to pilot net-zero retrofits using this approach. Nottingham city council have a goal of being carbon neutral by 2028. The first 10-home pilot project was delivered by Melius Homes, designed by Studio Partington and was made possible by funding from the Horizon 2020 REMOURBAN and Transition Zero projects. This pilot, which transformed a mix of terraced houses and bungalows, launched in December 2017. A second 17-home pilot, funded by the INTERREG NWE E=0 project, was completed in Summer 2019, and a third pilot is in progress as of October 2021. It is the first wave of a rollout of Energiesprong to retrofit and future-proof 400 Nottingham homes.[89]

The location of the homes to retrofit was chosen due to existing residents' complaints about bad insulation and freezing homes in the winter. Specifically, many of these homes had unheated garages beneath the living room and narrow staircases with little natural light. The Energiesprong approach, pioneered in the Netherlands, upgrades a home with innovative energy-saving and energy-generating measures, including new highly insulated outside walls and windows, a solar

[84] Andrew Hickford, Leeds City Council

[85] LCC Interview 17 June 21, https://news.leeds.gov.uk/news/low-income-homeowners-in-leeds-can-now-apply-for-free-solar-panels-and-insulation-thanks-to-a-new-scheme-to-help-residents-save-money-and-tackle-climate-change

[86] https://news.leeds.gov.uk/news/leeds-city-council-to-invest-gbp-100m-improving-energy-efficiency-of-council-housing-by-2025

[87] https://www.bradford.gov.uk/media/5754/bradford-housing-strategy-2020-to-2030.pdf , p.19

[88] Hull Affordable Warmth Strategy 2019-23 https://www.hull.gov.uk/sites/hull/files/media/Editor%20-%20Housing/Affordable%20Warmth%20Strategy%202019-23.pdf

[89] https://www.studiopartington.co.uk/nottinghamch2050

roof, and a state-of-the-art low-carbon heating system (a form of air heat pump system). They also involved the tenants in the planning process to ensure small additions such as outside taps for gardening were included in the retrofit process.[90] Similarly to the electric vehicle trial centre in Leeds, Energiesprong uses a total whole life cost model rather than an initial investment cost. This ensured the total energy costs for each tenant would remain under £330 per year compared to the average domestic fuel bills of £1184 per year for the UK.[91] The end result is homes that are almost net-zero carbon and lead to sustainable cost-savings for their residents.

4.3.2. Purpose built/new build housing

An alternative to retrofitting is a purpose-built housing community such as LILAC in West Leeds.[92] It is made of up of 20 homes which are managed by residents through a Mutual Home Ownership Society (MHOS), a pioneering financial model that ensures permanent affordability. Building began in 2012 and the first residents moved in in 2013. There were 50 residents as of 2020. Timber-framed houses in the development are insulated with strawbale, have solar panels, and use a Mechanical Ventilation Heat Recovery (MHVR) system along with high efficiency gas boilers to absorb and store heat in winter and reject heat in summer, keeping the houses at a comfortable temperature year-round.[93] The 2020 LILAC Impact Report states that the carbon footprint of the homes is 65% less than the UK average achieved due to in part to the insulation and the production of energy from the solar panels. On average the Energy Performance Certificate (EPC) rating is 'B' compared to a UK average of 'D'.[94]

Within the MHOS each member has a lease, which gives them the right to democratically control the housing community they live in. Members pay an equity share to the co-operative and retain equity in the scheme. After deductions for maintenance, insurance etc., these payments cover the mortgage. The payment that leaseholders pay each month is set at around 35% of net income. As members leave, existing members can buy more equity shares, and as residents' income levels change their equity share commitments can also change. The company keeps a set percentage of any increase in equity to ensure the sustainability of the project. The community also practice car-sharing, meal sharing, grow their own food using allotments and pool equipment/tools.

Another example of alternative new builds is the £800m development, Climate Innovation District, led by Citu, a housing and community development centred around building new energy-efficient homes close to the city centre of Leeds. The district is built on the banks of the River Aire, which crosses through the South of the city and is comprised of 315 housing plots interspersed with green spaces, pedestrianised roads, and cycle paths.[95] Along with low-carbon apartments and houses, the district makes use of the green spaces and car-free areas to encourage a climate-focused lifestyle that goes beyond housing. Residents currently purchase the houses as leasehold with Citu retaining the freehold for the site while it is still in development. Residents of the Climate Innovation District become members of residents' association and part of a community interest company (CIC) which manages the development. The CIC owns the

[90] https://www.energiesprong.uk/projects/nottingham
[91] Ofgem, Domestic dual fuel bill breakdown over time
[92] https://www.lilac.coop/
[93] http://lilac.coop/wp-content/uploads/2018/07/lilac-briefing-sheet-low-impact.pdf
[94] http://lilac.coop/wp-content/uploads/2021/07/Lilac-Impact-July-2021.pdf
[95] https://civicengineers.com/project/climate-innovation-district/

freehold for the land and infrastructure meaning residents have ownership of their community and the decisions made. Official ownership of the freehold will be transferred to the residents' association upon completion of the whole development.

Figure 8: Climate Innovation District, Leeds

The MVHR filters the incoming air to ensure the quality within the house remains close to what one could expect in the countryside. This is especially important to allergy sufferers and Citu claims their houses have 4 times fewer air particular levels that the average house. The system also captures the residual heat from appliances in the home and combines with the building's insulation to keep warm. The electric radiators powered by renewable energy along with the MHVR system are used to provide extra heat to the homes in winter, removing the need for a gas boiler for heating purposes and can save four tonnes of CO2 per year in each home. The homes are further insulated using triple-glazed windows and a special membrane to keep the house airtight while allowing moisture to escape.

The homes also come with solar panels on the roof which are jointly owned by all residents in the developments. According to Citu these all produce 400,000kWh of energy per year which is shared amongst all the residents to power their homes and electric charging points for vehicles. The excess energy is sold to the grid. The roof is also home to a range of wildlife and vegetation thanks to the green roof. This is reported to improve air quality across the city through air filtration and help with the insulation of the property itself. While some of the townhouses have private roof terraces, the majority of the land and gardens are communal by default. This is very deliberate and in 2020, planters were installed throughout the Climate Innovation District to encourage residents to garden together as a community and grow a range of fruits, vegetables, and herbs.[96]

All of the 178 parking spaces in the development come with electric vehicle charging points as standard, and many of the spaces are in an underground car park. This frees up above-ground space for footpaths, communal gardens, and cycle paths. In future phases of the development, Citu aims to avoid creating additional parking spaces in favour of encouraging residents to use public transport, walking, or cycling instead.[97] The site is built near the river Aire but benefits

[96] https://citu.co.uk/citu-live/gardening-together-as-a-community-at-the-climate-innovation-district
[97] CITU Interview

from the Leeds £50m Flood Alleviation Scheme which significantly reduces flood risk in the area.[98] In addition, the Sustainable Urban Drainage System (SuDS) effectively drains the surface water to mimic natural drainage systems. The lack of tarmacked roads for cars in the developments provides more space for rain gardens, rainwater harvesting, and attenuation ponds.[99]

The Climate Innovation District is financed primarily by private investors, however a small amount of funding comes from Innovate UK grants. The Citu development is geared towards clients that have the financial means to invest in high-tech energy-efficient housing. Current prices range from £170,000 for a one-bedroom apartment in the Aire Lofts to £460,000 for a 4-bedroom terraced house on Solar Avenue.[100] In comparison, as of July 2021, the average house prices in Leeds range from £144,046 for a flat or maisonette to £175,000 for a terraced house, to £394,364 for a detached house.[101] The average cost for a new build house in Leeds is £289,715,[102] much less than the price of a terraced house in the Climate Innovation District. As the project is in its initial phase of building Citu is aware of the higher-than-average costs of their housing. To combat this, Citu reserves 7% of the homes for affordable housing. Notably, the houses are manufactured on-site by Citu Works manufacturing plant in Leeds, which also has capacity to produce more homes in the future for the next stages of the development. It currently produces up to 2 homes per week.

With any new development, the planning process and permission requires an assessment of how the site will impact the existing community. This can include how long building will continue for, any diversions that are put in place to manage the site, and noise levels for nearby residents. Citu are currently building the next phase of the development but are careful to separate the existing residents from the building work and avoid disruption. The lack of family homes in the city centre was a strong focus for Citu as they wanted to encourage families and the older generation to live in the community.[103] Many residents work in the city centre and can avoid a long commute from the suburbs by living in the Climate Innovation District. To facilitate this, Citu built a new footbridge across the River Aire to allow residents easy access to Leeds Docks and Leeds city centre for work or access to the rail network. This is a public footbridge which is also open for non-residents of the Climate Innovation District to use and connects the areas of Cross Green to the city centre more sustainably.

In both the Climate Innovation District and LILAC projects, Leeds City Council played a vital role in granting the planning permission to begin construction on the housing developments. In 2009, LILAC worked with the council to purchase and establish the site and was granted planning permission in May 2011. The council are keen to further the support offered to sustainable community housing in the future to encourage more innovative housing solutions in the city, in line with the climate action plans.[104] In the Bradford district, Keyland Development are

[98] https://www.gov.uk/government/news/50-million-flood-defence-scheme-opens-in-leeds
[99] https://citu.co.uk/citu-live/what-are-sustainable-urban-drainage-systems-and-why-are-they-important
[100] https://citu.co.uk/find-home
[101] https://landregistry.data.gov.uk/app/ukhpi/browse?from=2020-07-01&location=http%3A%2F%2Flandregistry.data.gov.uk%2Fid%2Fregion%2Fleeds&to=2021-07-01&lang=en
[102] Ibid.
[103] There are also future plans to create a multi-generational building including a nursery, primary school, and care home on the development. Citu Interview
[104] https://www.salus.global/article-show/the-leeds-approach-placemaking-for-resilient-communities

progressing a best-in-class sustainable homes development on the Yorkshire Water Esholt site. [105] This development will create 150 homes and 1.08m sq. ft of work space to repurpose the brownfield site. This sits alongside a wider commercial development for a circular economy business park and clean growth test bed.

More broadly, to encourage innovative building practices by all housing developers, councils could look to increase the standards they set in relation to new developments and encourage engagement with local residents to help ensure all new builds have regard to broader factors such as provision of access to public transport, cycling paths, community spaces, and green spaces.

5. Citizen Discussion

Within the virtual citizens discussion held on Yorkshire-climate.org, participants were separated into city units based on their postcode and asked to create initiatives in one of eight subject areas: green spaces, electric vehicle charging, awareness & education, transport, business & economy, housing decarbonisation, renewable energy, and other issues. This led to people developing ideas on potential ways to develop low carbon infrastructure in each of these areas.

Overall, 111 initiatives were created across the subject areas and cities. Most initiatives were created in Hull (44) despite most users were from Leeds. Table 1 provides a summary of various initiatives across the eight subject areas (a list of all initiatives in all subject areas across all three cities with the full proposal text is in the Appendix of this report). However, particularly in the case of Hull and Bradford many initiatives originated from a respective single user in each of these cities, while the contributions in Leeds were much more evenly distributed, with most users creating 1-2 initiatives.

Figure 9 shows the different proportions of initiatives in each subject area for each city. This provides some insight into the types of climate-related issues that are most important to each city's participants. Transport is clearly the area that has received greatest attention among users across the three cities, with most initiatives being suggested in this subject area. Yet, even within this subject area there are also differences across the three participating cities. In Bradford two thirds of initiatives were made in this subject area, compared to Leeds and Hull, where around one third of all initiatives were developed in the transport subject area. In Leeds the subject area receiving second most attention was housing decarbonisation, with 13% of initiatives being made in this subject area, while in Hull it was other issues (18% of all initiatives) and in Bradford it was awareness and education (9% of all initiatives). The other issues subject area initiatives in Hull ranged from a 'Climate assembly for Hull', a 'Low carbon food policy and procurement mechanism', which called for a specific climate action plan for food and farming related emissions, and 'Support clothes swapping events', which included also other suggestions for sewing skills sessions and a combination with social enterprise circular economy initiatives.

[105] https://keyland.co.uk/projects/esholt/

Table 1: Summary of initiatives raised in the virtual citizens' discussion on climate policies (Yorkshire-climate.org)

Subject Area	Leeds (58 participants)		Hull (36 participants)		Bradford (32 participants)	
	Ideas	**Most popular**	**Ideas**	**Most popular**	**Ideas**	**Most popular**
Green Spaces	2	Reclaim abandoned spaces for more green spaces	2	Reclaim abandoned spaces for more green spaces	1	Reclaim abandoned spaces for more green spaces
Electric Vehicle Charging	2	Lamp post electric vehicle charging infrastructure	2	Lamp post electric vehicle charging infrastructure	2	Lamp post electric vehicle charging infrastructure
Awareness & Education	5	Large-scale public information campaigns	5	Public competition for emission reduction project funding	3	Cycling and scooter promotion package
Transport	**15**	Anti-idling campaign for cars	**16**	Smart Intersections	**21**	Promote sustainable freight movement
Housing Decarbonisation	5	Update heating of public amenity buildings	4	Remove planning permission for external wall insulation	2	Retrofitting using local/regional businesses
Business & Economy	2	Car free days	3	Green bond for Hull	0	N/a
Renewable Energy	5	Local and city-region wind energy generation	4	Green energy estuary	2	Installation of publicly owned vertical-axis wind turbines designed for urban spaces
Other Issues	3	Commitment to improve infrastructure around new developments	8	Climate assembly for Hull	2	Open green jobs training centre
Total	**39**		**44**		**33**	

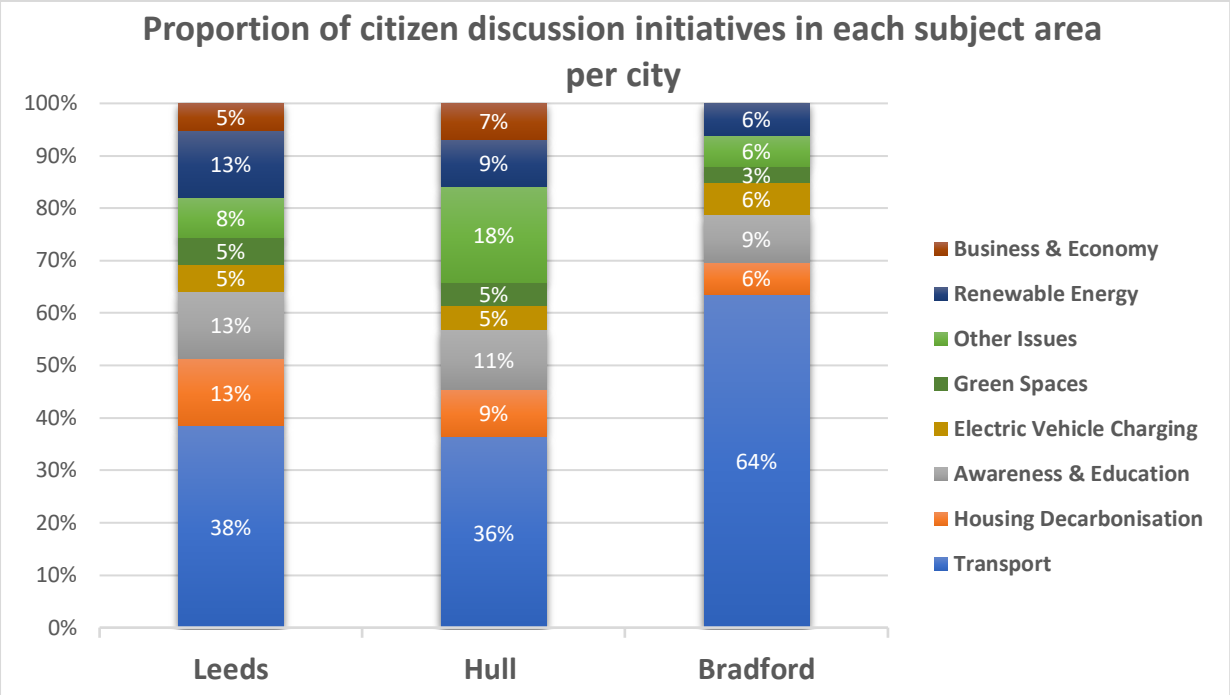

Figure 9: Percentage of initiatives per subject area

Figure shows a bipartite network for the Leeds local unit. The figure shows that most users do not get involved in the deliberation process but only in terms of indicating their support for initiatives and then voting. Some users (e.g., user100, user 30, etc.) create a single initiative and/or make one or two improvement suggestions besides voting and only very few users (user3, user74, user36, user6) are heavily involved, creating several initiatives, and making lots of improvement suggestions. The most successful initiatives (initiative1, initiative57, initiative28, inititiative58, initiative27, initiative6) are not necessarily those created by the most active users, and they usually undergo some improvement process. Initiative1 was for instance proposing a large-scale public information campaign on climate change and what citizens could do to help mitigate climate change. And initiative28 asked for public transport links between Leeds neighbourhoods, not just in and out of the congested city centre.

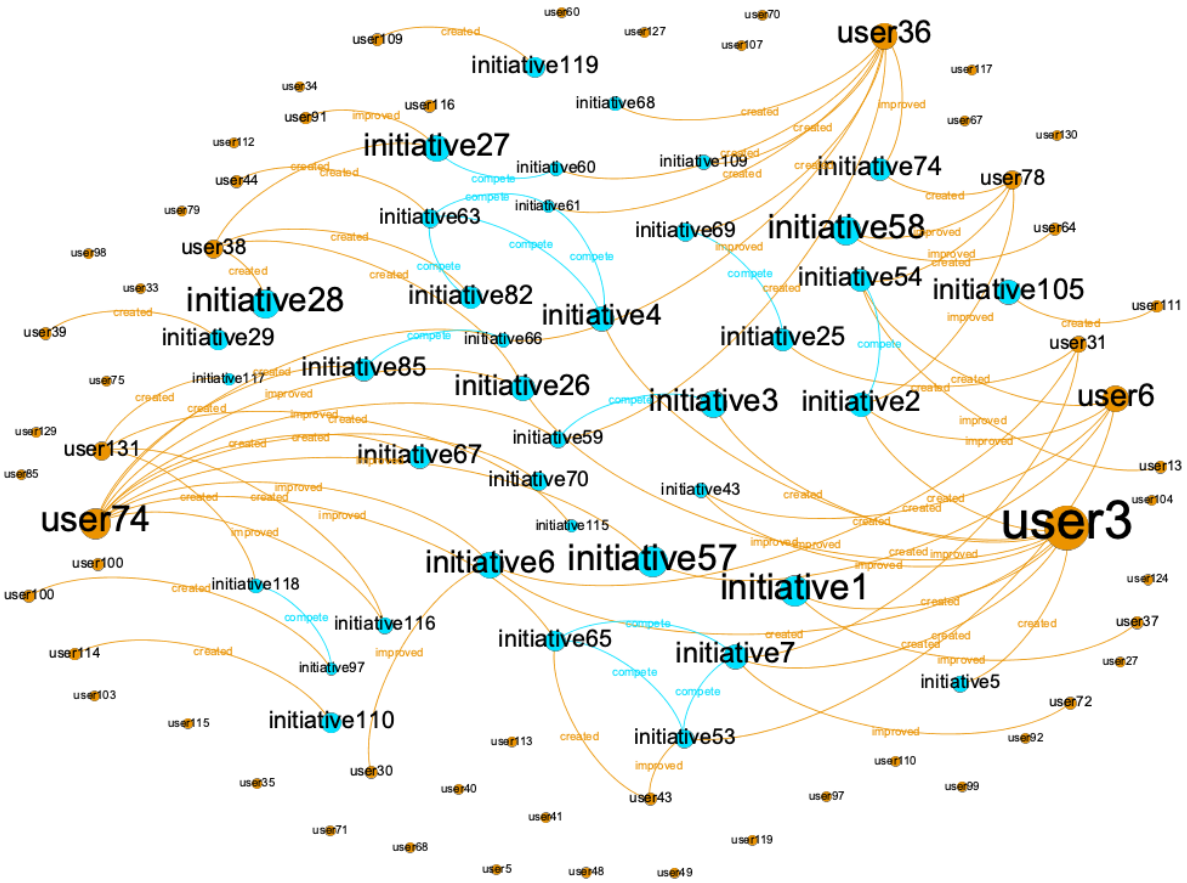

Figure 10: Bipartite network of users and proposed initiatives from Leeds. The orange nodes are users, the blue nodes initiatives. The orange edges link users and initiatives and can be either "created" or "improved". Blue edges indicate competing initiatives. User node size represents how engaged users were (number of created initiatives and/or suggestions). Initiative node size indicate how successful initiatives were in terms of number of supporters.

5.1. Transport

At the start a set of sample initiatives were created to ensure that users, first landing on the platform, were able to see (and support) example initiatives that would help them to formulate initiatives of their own and prompt discussion. The initiatives contained a proposal and a rationale/reason to convince others to support the idea and propose suggestions for improvement. Participants were also able to create competing initiatives if they believed an alternative approach/idea was better suited. For example, within the transport subject area for Leeds, a suggested initiative was an 'Anti-idling campaign for cars' which read as below:

> *"To run an anti-idling campaign. York for example has launched the 'kick the habit' campaign, in Bath the Living Streets campaign (run by volunteers) has received council funding to talk to drivers and encourage use of 'I'm no idler' stickers in car windows.*
> *Rationale*
> *Air pollution is a real problem and given the levels of traffic and idling vehicles a campaign could help reduce levels of air pollution, especially in well-known congested areas"*

A suggestion to improve the initiative by another participant read *"How about more smart traffic lights that change according to the presence of a vehicle? That would remove the need for idling in some cases. Personally, I turned my engine off in a queue of traffic and it failed to start again so I am reluctant to do this."*

However, not everyone agreed this would be enough, with another participant creating a competing initiative of 'Hefty fines for idling' below:

> *"Idling is such a big problem, that I am not sure an information campaign would be sufficient. How about introducing a hefty fine (e.g. 100 Pound) for those who idle and enforcing it, using evidence (e.g. mobile phone video) provided by citizens for enforcement. I bet this would be much more efficient and if the fee is considerable, it would actually also create some revenue for the council that could be used for good (green projects for instance).*
> *Rationale*
> *Air pollution is a big public health problem, but it is not treated as such. If people idle, they essentially make other people sick, contributing to pre-mature death and development problems in children. This is a true crime and should be treated as such!"*

In the end the original campaign attracted more support than the competing initiative but the discussion generating a range of interesting points for consideration.

5.2. Decarbonising housing

Decarbonising housing is one of the big challenges facing the UK on its way to net-zero. Most people still heat their houses with unsustainable gas which contributes to the UK's CO2 emissions. In addition, current housing insulation is often still rather poor. The most popular initiatives within this subject area included 'Update heating of public amenity buildings' (Leeds) specifically by linking to the district heat network or creating additional networks, and 'Provide consultants who can assess what each house needs to do and in what order' (Leeds). This topic also inspired initiatives in Hull albeit to a slightly lesser extent (9% of total) and included ideas such as 'Create a Housewarming Centre where DIYers can get advice and at-cost materials to insulate their homes' and 'Remove planning permission for external wall insulation'. In Bradford the initiative to 'Retrofit using local/regional businesses was the most popular and was a competing initiative to an example initiative we created at the start, suggesting the Energiesprong approach described above in the case study section for retrofitting districts in Bradford.

5.3. Business and Economy

While the Business & Economy category accounted for 5% and 7% of the initiatives in Leeds and Hull respectively, this subject area was not referenced at all in Bradford. Small and medium-sized enterprises (SMEs) are vital to the economy of the region and the UK as a whole, and contribute up to 47% of the country's revenue, so are vital to achieving decarbonisation targets. The government has introduced several funding grants to assist businesses in reaching the net-zero by 2050 target including the Industrial Energy Transformation fund (IETF) and the Heat Network Investment Project (HNIP). Other sources of funding such as the Green Business Fund help SMEs to reduce energy costs and improve their energy efficiency. The lack of initiatives in the subject area in Bradford suggests when considering initiatives relating to decarbonisation in the city, residents of Bradford do not consider how their council can help SMEs to achieve their decarbonisation targets a high priority.

5.4 Awareness and Education

Within the Awareness & Education category calls for a 'Large-scale public information campaign' to show the relevance of climate change to citizens' everyday lives received most support in Leeds, but a similar initiative has been also popular in Bradford and Hull. Suggestions for

improving this initiative included an idea for an exhibition and highlighting the positive future climate action plans in the region, rather than focusing on fear. The Leeds initiative specifically included an additional suggestion to incorporate climate change awareness education within local schools, facilitated by the council in collaboration with civil society to help educate the next generation. There was also a less popular initiative that nevertheless gained some support in this subject area calling for a 'Ban on ads for high-carbon products' like the ban on tobacco product advertisements. This initiative included advertisements by airlines/travel agents, fossil fuel companies and cars (including electric vehicles). In Hull a similar initiative on a large-scale public information campaign included further suggestions such as a city-wide arts campaigns including local artists and performers with hubs in different areas of the city and climate emergency centres.

5.5. Renewable Energy

Within the renewable energy category, the UK has made some progress in moving away from fossil fuel-based energy production (such as coal), but there is still some way to go before reaching net-zero carbon emissions. Some ideas raised in Leeds included 'Local and city-region wind energy generation' suggesting horizontal-axis turbines are more efficient than vertical-axis turbines, and suggestions to deploy water-based turbines at the edge of cities have also received some support. This initiative also suggested more collaborations between rural and city communities as well as the introduction of energy cooperatives. This initiative was a competing initiative, suggested in disagreement with an original example initiative that we created, advocating for urban-design vertical-axis turbines within the city. It must be noted that in particular within this subject area dialogue with experts proved effective in providing up to date technical details and feasibilities of new innovative technologies, helping to develop feasible proposals. For instance, interventions from Dr Agota Mockute from the University of Hull, an expert on wind energy, helped the users to better understand the technical challenges but also potential of various wind energy projects that were suggested. She suggested that while vertical-axis turbines are indeed not as effective in generating energy as horizonal-axis wind turbines, they nevertheless could be experimentally explored in an urban context, which would also help to develop better wind energy technologies to be deployed in urban settings in the future. Expert interventions also occurred in other subject areas, such as housing decarbonisation, where technical expertise is again key for developing feasible and effective proposals.

5.6. Reflections on the Liquid Feedback Platform

The Liquid Feedback platform is designed to encourage deliberative and constructive discussion among citizens. The algorithmic design of the platform leaves little room to engage in anti-social online behaviour. Users do not communicate directly with each other, but through initiatives, which forces them to seek pragmatic solutions. An inbuilt feature of Liquid Feedback requires users for instance to first support an initiative before they suggestions for improve the initiative can be made. This facilitates constructive dialogue. If they disagree, they can create a competing initiative, but they need to make that initiative convincing enough to attract support. Such features act as a safeguard against would-be trolls and help to avoid low-effort comments, online abuse or hate speech that can be observed on social media sites such as Facebook.

However, these features can also act as a deterrent to casual users and result in the platform having a higher barrier to participation than other platforms, even though we found that these features do lead to well-considered proposals from participants. Furthermore, the large number

of features on the platform can act as a deterrent to potential users as it required some time to become accustomed to the platform. Some features, such as delegation were hardly used at all by users. Liquid Feedback implements algorithmically the Liquid Democracy concept where direct and representative democracy elements are combined through optional voting delegation to facilitate optimal collective decision making.[106] Theoretically, users were able to delegate their deliberation and voting ability to other users of their choosing. For instance, if a user was merely interested in the transport domain, they were able to delegate their deliberation and voting abilities in other domains such as housing to a user they perceived to be competent and interested in these other domains. However, this is a feature more suitable for advanced and long-term usage of the platform for collective decision making and it would likely require providing some optional training for users so they can learn how to optimally use the various features of the platform. We therefore believe that the platform is particularly suitable for long-term or even continuous citizen engagements, rather than for short-term digital participation activities.

A variation that we introduced in our trial with the platform was to have expert users, who were meant to assist the citizens with expert knowledge. We introduced this because climate citizen assemblies produced high-quality results where expertise was available to the involved citizens, given that most citizens have often limited knowledge of what constitutes effective and feasible climate mitigation measures. If our study participants felt that they could not assess an initiative, because they lacked technological knowledge of the feasibility for instance, they could ask for expert input. An expert in the field would then get involved and write a comment to help improve the initiative and make its feasibility clearer to other users. Such interventions helped users to understand how valid a proposal was from a technical point of view.

Finally, as mentioned in the Methodology section, more efforts need to go into recruiting diverse users to participate in the collective decision making and it is important authorities have an active interest in the process, otherwhile users will not be persuaded to sacrifice time to develop initiatives. Overall, we believe the pilot shows the feasibility of online climate citizen engagement for climate policies decision making, if designed and implemented smartly.

6. Perspectives from a broader stakeholder circle (workshops insights)

Whilst the citizen discussion platform provided insight into citizens' views on decarbonisation in their cities, the project also sought views from a wide range of stakeholders. These were collected through three stakeholder workshops in Leeds, Hull, and Bradford attended by council officials, union representatives, academics, and business owners from the transport and third sectors. Each workshop was centred around successes and challenges relating to decarbonisation projects in their various sectors, and the opportunities/challenges stakeholders considered important moving forwards.

6.1 Successes

Generally, the participants of the workshops agreed that the characteristics of successful decarbonisation projects irrespective of the sector include:

- those that have a positive impact on the community's mental and physical health

[106] Blum, C. & Zuber, C.I. (2015). Liquid Democracy: Potentials, Problems, and Perspectives. The Journal of Political Philosophy, 24(2), 162-182.

- those that are relevant and visible to all members of the community
- those that are fair
- and those that focus on resilience and resilient changes

6.1.1 Transport

During the workshops, some of the successful decarbonisation projects highlighted included the introduction of electric vehicles by Hull and Leeds City Councils, and consolidation of taxi companies in Hull to optimise pick-ups and reduce journeys with no passengers. Leeds council has also emphasised its solar-powered Park & Ride in Stourton, that utilises solar-power for its buildings, operation and EV charging points and is served by zero-emissions electric buses. A similar project is currently pursued by Bradford. There is a general understanding among carrier companies, such as taxis, as well as public transport providers, that they need to move to a non-fossil-fuel based fleet. First Leeds for instance are now running 20 electric buses and are expanding their charging infrastructure. And Bradford council has new funding of £1.7m available for Bradford taxi owners to help them to switch to electric vehicles, while also working on expanding the EV charging infrastructure in the district. There were also successes with respect to active travel, such as the collaboration between CycHull, a third sector organisation campaigning for cycling, and the Hull City Council to introduce new cycle lanes in the city.

6.1.2 Business & Economy

Most businesses in the three councils feel the pressure to move to post-carbon ways of production and service provision and all three councils are concerned with the question of how they can best help local business to decarbonise. Across the three councils there are encouraging examples of local businesses embracing the decarbonisation challenge, such as the DTP group in Leeds, by providing zero-carbon and circular economy products and a recycling scheme to their customers, replacing business-owned conventional vehicles with electric vehicles, purchasing green electricity etc. Each council harbours local businesses and/or innovation centres, such as Solar Made Simple in Bradford, Solec Energy Solutions in Leeds, or the Aura Innovation Centre in Hull, that explicitly specialise in decarbonisation services and technologies. These can therefore provide potential partners for the councils in moving forward with their decarbonisation plans which support local businesses. Getech, a company which has amongst others a basis in Leeds, has specialist skills and experience and moreover signed a contract for the development of all port-based hydrogen, ammonia, and new onshore wind and solar power generation capacity at the Port of Shoreham, West Sussex. At the Bradford workshop the Resource Efficient Business (REBiz) programme that the Bradford council is partnering with was also highlighted. It provides advice and financial support for small or medium-sized enterprises (SMEs) to become more resource efficient and adopt circular business models and practices.

6.1.3 Third Sector/Citizen Initiatives

In all three councils there are also citizen groups and third sector organisations and initiatives committed to decarbonisation and sustainability at the local level. In Hull the Library of Stuff is for instance a noteworthy project that allows people to borrow things they need temporarily, which reduces overall consumption and consumption-based emissions. Library of Staff wants to discourage their users from picking things up by car and provides some bike trailers that users can borrow to transport items. In the future they plan to also offer cargo bikes that can be borrowed. The director of Library of Stuff goes also beyond and produces DIY videos, including an upcoming video that shows how people can upgrade their bikes to e-bikes. Furthermore,

projects have been introduced in Hull surrounding revitalising the local, sustainable food supply by reducing food waste and improving sustainable farming measured through the Every Mouthful Counts toolkit (Hull Food Partnership).

6.1.4 Housing & Green Spaces

Both Hull and Leeds have undertaken decarbonisation projects of their housing stock, providing retrofit grants for low-income households, while increasing their tree planting and litter picking to benefit local communities. In Hull the council has been working with children to demonstrate the importance of growing vegetables and looking after their environment with hopes to inspire the next generation. This is also combined with making more land available for new allotments, orchards, and community gardens. The Bradford council has limited housing stock (c.400 units), Incommunities and other social landlords have launched their own schemes to retrofit housing stock, for instance through their partnership with Eclipse Energy and Better Homes Yorkshire to deliver Phase 2 of the Local Area Delivery (LAD) of the Government's Green Homes Grant. Bradford is also very active in preserving and expanding green spaces, not only in the urban context, but also with respect to moorlands surrounding it that are vital carbon sinks.[107] It has made a significant investment in the Shipley-Bradford corridor with a new linear country park and over £3m being allocated to de-culvert and open up part of the hidden Bradford Beck.

6.1.5 Infrastructure & Energy

There is some initial exploration of repurposing gas pipes from Northern Gas for hydrogen and building new hydrogen pipelines across the Northeast of England, for that purpose a new concept, East Coast Hydrogen, has been launched by Cadent, Northern Gas Networks (NGN) and National Grid in September 2021. There is the potential for the East Coast Hydrogen to meet 10% of the government's 9,000 hydrogen economy job target. Some controversy arose during the workshop, however, because the project is aimed at supporting both blue (i.e., fossil fuel based) and green (i.e., renewables based) hydrogen production. Bradford council has supported Bradford Community Energy scheme that are crowdfunding affordable, green energy solutions for community facilities, these schemes are meant to make citizens more proactive and directly involved in the decarbonisation efforts and creatively find new sources of funding while also creating new green local jobs, including semi-skilled jobs.

6.2 Challenges & barriers to implementation

However, these successful decarbonisation projects were not without their barriers and challenges. Participants gave examples of difficulties arising when implementing new projects or policies, and how these could be overcome. Some participants looked to local councils for leadership, with stakeholders expressing a loss of faith in the central government's ability to manage the transition. However, given that the councils rely on central government for direction, funding and delegation of responsibilities, this fractured nature of responsibilities for (critical) infrastructure is a substantial barrier. Although there are many successful examples, most are one-off projects and there is a lack of a joined-up strategy, transition, and infrastructure planning. This is accompanied by a lack of clear milestones, defined responsibilities and timelines, something that small businesses would like to see. This is not only true at the local level, but equally true on the national level. Moving beyond incremental changes, large-scale infrastructure

[107] https://whiteroseforest.org/about/actionplan/

projects are required in the sectors of energy production, transport etc. Although a new infrastructure bank, situated in Leeds, has been established to fund such large-scale transition projects, it is currently unclear how loans can be accessed and for what type of infrastructure projects. This lack of clarity is a notable barrier to encouraging development. Finally, a number of stakeholders emphasised their reliance on markets (and their smooth functioning and responsiveness), which is not always given (e.g. several workshop participants noted for instance that they are currently struggling with purchasing electric vehicles (particularly vans and buses)). However, it is worth noting that the role of markets can also offer opportunities, e.g. making effective use of market forces to drive change, e.g. use the rising price of gas to increase uptake of air-source heat pumps instead.

6.2.1 Funding & Regulation

Stakeholders drew attention to the difficulty of showing the economic viability of projects and showing that the policies are beneficial from a cost and key performance indicator (KPI) perspective. This challenge could be lessened by developing metrics for SMEs to demonstrate the benefits of their decarbonisation efforts and providing investment streams that look beyond profit. This development also involves striking a balance between policies and regulations and removing excessive red tape, specifically with planning projects. Some participants felt that because of these challenges, organisations that decarbonise are at a competitive disadvantage to those that do not. Furthermore, it can be difficult to still maintain a USP (unique selling proposition) that relies on global supply chains while being sustainable. Limited budgets mean organisations are forced to decide where to direct resources and in what capacity. For example, should councils insulate a larger number of homes to a lesser quality, or a smaller number of homes to a higher quality? Finally, the shift to low carbon infrastructure is not occurring in a vacuum. Wider social and political factors, such as the recent energy price volatility is impacting on citizens and local businesses, and communities and businesses are continuing to deal with the ongoing COVID 19 pandemic, its uncertainty, and its economic consequences.

6.2.2 Infrastructure & Technology

Switching to electric taxis and buses is currently difficult not only due to costs of purchasing EVs but also because of insufficient EV charging infrastructure. For instance, in Hull EV charging points for public transport buses are challenging to install in existing depots (due to their narrow construction). For taxis, additional to the challenge of costs and insufficient EV charging infrastructure, the lack of confidence in the range of electric vehicles has been a large barrier. Taxi companies cannot necessarily predict customer demands on any given day, with services strongly varying between short-distance and long-distance trips and being requested at short-notice, which makes reliance on EV charging problematic. Further, plug-in charging can be inconvenient for taxis that need to move fast at demand. New wireless charging technologies could be a potential solution here. Generally, the legacy of fossil-fuel systems makes transition difficult, as fossil-fuel dependence is deeply enshrined at all levels. Infrastructure is moreover often still from the 19th century (with large maintenance backlog) and the challenge of a quick transition to an infrastructure fit for 22nd century is immense. When it comes to energy production, concerns were also raised regarding the storage of electricity generated through renewable energy sources. There are currently green electricity supply problems, even if customers subscribe to green energy providers, meaning there is no guarantee that the electricity provided is green.

6.2.3 Political

Political pressure and the political consequences of shifting away from the business-as-usual/familiar ways are also notable. Some participants in Hull felt that their local council tries to keep as many stakeholders happy as possible and others in Leeds and Bradford felt that a lack of clear national direction and resourcing was a main barrier to decarbonisation. In Hull, some participants felt a lack of willingness from the council to sign up to certain plans such as the Glasgow Food and Climate Declaration and make the Carbon Pathways Action Plan a priority. Specific projects such as the layout of city railway lines that limit traffic, cycle and bus lanes have been criticised for causing bottlenecks and congestion in Hull. This suggests having accompanying awareness/education associated with climate related actions could be beneficial to facilitating change, and acceptance of such change. Transition is always disruptive at first and there needs to be some acknowledgement that some time is needed for readjustment before the benefits of new projects can be felt.

6.2.4 Social behavioural change

There is a wider challenge of how to manage the different priorities of members of the public. Those who are already active in climate action will have different priorities to the wider community, and councils are often facing the difficult task of managing divergent expectations across the community. Work is needed to improve the reputation of local, regional and national climate projects and initiatives and encourage people to change their behaviour to recognise the climate emergency. People do not always have the knowledge to make climate-responsible decisions. There is also a persistent negative image of environmental-friendly lifestyles as they are seen to be in direct opposition to traditional markers of success in our society (e.g. multiple cars per household, overseas holidays, consumerism etc). Projects for public education at the local level are hence needed. The use of alternative methods of public communication/engagement will be key here e.g. the use of storytelling to prompt behavioural change. People also need more specific guidance, the initiative suggested by citizens on our online platform, to have advice points where people can get reliable information on steps to take for retrofitting their homes, including contact to reliable contractors, shows that the public demand for information does exist. Councils should work with local businesses to look at ways to provide accessible information and support to their citizens.

7. Conclusion

In each of the three cities, this project found a range of factors which influence the success of the low-carbon transition. These include different geographies, immediate effects of climate change such as flooding, and the different budgets and resource allocation for climate action. Ultimately, the success of the low-carbon infrastructure transition in the north of England will be dependent on a range of stakeholders, investment, policy decisions, and collaboration with the public.

The case studies from other areas in the UK, in particular Coventry and Islington illustrate how important it is that the public are included in decision making right from the start of project development.

It is important to show that finding a balance between social, environmental, and economic impacts is the recipe for a good sustainable development model. During the workshops participants were asked how they can help and be helped by the council to deliver

decarbonisation in their areas. Although some of these are specific to Leeds, Bradford, and Hull, many are relevant to other areas of the country.

What do businesses need from the council?

- More infrastructure (e.g. EV charging points)
- Increased promotion of decarbonisation activities to make low-carbon the norm rather than the exception
- To encourage bigger businesses to champion decarbonisation and support SMEs
- Clear action plans with milestones and timelines
- The provision of resources for SMEs to support their transition
- Increased lobbying of central government to support certain sectors and decarbonisation activities particularly on a large-scale
- Upskilling and reskilling of the workforce to bring more people into the renewable energy industry – with increased collaboration between local business, education sector and trade unions to achieve this
- Further support at local, regional and national level

How can businesses help the council?

- Greater willingness to engage with council decarbonisation efforts
- Sharing best practice and relay this information to their customers and other local businesses
- Be receptive to challenges and plan ahead
- Councils should use the networks of green businesses around the city to support their work
- Be more proactive, including developing initiatives and business plans
- Councils would also like to see more proactive civic entrepreneurship

The key learnings from case studies & workshops:

- More cross-sector dialogue is needed to escape siloing, and facilitate joined-up thinking
- Involve the public in consultation sessions from the beginning of a new initiative or scheme, especially those who are disconnected (this would also help to improve buy-in from the public).
- Consider the impact on neighbouring communities when planning for new housing developments or retrofit projects.
- Be careful to ensure the transition does not create new or continue existing dependencies and lock-ins (e.g. transition to EVs shouldn't continue the current car dependency)
- Invest in awareness, education, and information initiatives to help citizens understand the significance of the challenge and encourage behaviour change through a range of formats
- Have a clear long-term strategy, with clear milestones, responsibilities and timelines that sets out local priorities and funding for the costs of the transition
- It is important to emphasise that if investment is made into decarbonisation this investment should also be an investment into better, more resilient homes, infrastructures, economy etc.

Future Research Recommendations

- Net-zero pathway research needs to be available for specific local contexts (to help councils become intelligence-led clients), with a clear focus on practical applicability
- Joined-up, whole-system (system of systems) pathway research is needed to facilitate a shared understanding of issues and potential impacts across systems of interventions
- Further research is needed on the sustainability and potential role of (green) hydrogen in local communities and the appropriateness of its use across industrial sectors and in specific areas
- Much of the UK's infrastructure was constructed during the Industrial Revolution and evolved to support this revolution, rather than ecological resilience. Further consideration is needed of what 21st Century UK infrastructure should look like, and the associated mindset/underpinnings required
- Exploration of place-based opportunities for developing and adopting new and existing renewable energy technologies, including local storage, are required
- Move to co-produced research (e.g., business cases for clean growth infrastructure, technical feasibility studies), with increased emphasis on working with stakeholders to acquire funding

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Appendix

List of all citizen initiatives