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# Local government capacities to support net zero: Developing comprehensive heat and energy efficiency strategies in Scotland

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## ABSTRACT

An overhaul of existing strategies for low carbon heating and energy efficiency is critical to delivering international commitments to limit climate change. This will require innovation in the institutions governing retrofit, including local governments. This paper studies one such proposed innovation: Scottish Government's Local Heat and Energy Efficiency Strategies (LHEES), which have recently been piloted. LHEES are intended to establish comprehensive area-based, costed and prioritised plans for improving the energy efficiency of all buildings and decarbonising heat supply. As a proposed statutory duty, LHEES represents a form of potential institutional innovation, or a change in the rules governing local authority action. However, at this stage, it is unclear whether this will become a lynchpin for whole building stock retrofit, or another minor adjustment in local governance institutions. A capacities framing is used to explore how local authorities may differentially mobilise around this proposed innovation. Interviews with local government actors delivering, and analysis of reports resulting from, the LHEES pilots provide insight into six forms of capacity: responsibility; political authority; finance; personnel capacity; knowledge and; energy materialities. The results demonstrate strong inter-dependencies and tensions between these capacities, which shape the efficacy of LHEES as a new tool of governance for systemic innovation. These findings are important for policy makers looking to enhance local governance for low carbon heat and energy efficiency.

## 1. Introduction

Global greenhouse gas emissions need to reach net zero by mid-century to give any chance of limiting warming to 1.5 °C, as agreed in the 2016 Paris Agreement [1]. In response, several governments, including those of the United Kingdom (UK) and Scotland, have set targets for reaching net zero emissions by 2050 or earlier. Tackling energy use in buildings is essential to achieving these targets; in fact, the European Commission recognises the need for a near-complete decarbonisation of the building sector [2]. This includes substantial improvements in the energy efficiency of building envelopes (to reduce the need for energy) alongside a switch to low emissions heat sources [3]. With current policies on track to reduce building emissions by only 30% by 2050 [2], there is a need for 'an overhaul of the approach to low-carbon heating and energy efficiency' for all buildings ([3], p.34). Such transformations in systems of energy supply and use will require effective co-ordination and co-operation between central and local government [4]. Central governments have unique powers to enable and

enforce action, for example, by setting legally-binding national climate targets, introducing energy efficiency standards into Building Regulations, and providing funding and reward packages. These mechanisms can all help to provide certainty and predictability, enabling market actors to mobilise and support economies of scale [5]. However, strategies for implementing energy efficiency and heat decarbonisation can be more successful when they are customised to local circumstances [6]. Local authorities are therefore in principle well-placed to design and deliver energy efficiency and heat decarbonisation strategies tailored to the local context, including the building stock, geographical and spatial features, and existing technology infrastructures. However, local authorities' self-determining powers to enact this can be limited.

Innovation in the institutions underpinning retrofit work is therefore likely to be a prerequisite for effective coordination and cooperation across scales of government. Institutions can be understood as the historical rules and contexts that shape potential policy options [7]. They are typically long-standing, relatively stable, and encompass central and local governments and their interactions. However, institutional change

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can emerge through incremental shifts, such as when new rules are added into existing frameworks [8]. In the UK, a proposed institutional innovation is Scottish Government's 'Local Heat and Energy Efficiency Strategies' (LHEES). The proposal represents a new rule, creating potential for innovation in local authority institutions. However, it also reflects the structural tension between central and local government powers: Scottish Government proposes the introduction of a new local statutory duty, in the form of LHEES, which can simultaneously be interpreted as constraining local strategic autonomy over policy and allocation of resources. Evaluating the likely effectiveness of this proposed institutional innovation depends on understanding its interaction with local authority capacities. Thus, this paper asks:

How do local authority capacities interact with potential institutional innovations in governing for energy efficiency and heat decarbonisation in buildings?

With a focus on the governance of area-based planning for energy efficiency and heat decarbonisation, the following sections explore institutional change and innovation in more detail. First, the local governance of energy efficiency and heat in Scotland is outlined, before introducing institutionalism and the capacities framework that has informed data analysis. The methods section details the semi-structured interviews used for data collection; local government perspectives on LHEES are then presented. The results explore how different capacities enhance or constrain local authority responses to this proposed new responsibility. The discussion summarises the interconnectivities and tensions between capacities, and the efficacy of new rules of governance. The findings are used to inform the future conceptual development of the capacities framing and provide new insights into the foundations for supporting and enabling institutional change. The conclusions identify recommendations for policymakers developing new tools to accelerate local authority action in the transition to clean energy and net zero emissions from buildings.

## 2. Scottish energy efficiency and heat policy

UK policy for heat and energy efficiency in the past decade has been uneven, with well-designed programmes being modified, reduced in scale or even cancelled [9]. Reflecting this, the UK Government's main measure to encourage local authority action on area-based energy efficiency, the Home Energy Conservation Act (HECA) 1995, was diluted to voluntary reporting and has received no new resource since being established [10]. However, devolution of government is resulting in a degree of divergence from this trend.

The UK has three layers of governance: 1) central UK government; 2) the devolved governments of Scotland, Wales and Northern Ireland; 3) local and regional governance. Powers over housing, local government and economic development are devolved to Scottish Government, but budgets remain disciplined by UK Treasury. Despite this, available powers, combined with continuity in political power, have resulted in relative stability in energy efficiency policy and support for local programmes in Scotland (for example, see [11]). This creates the opportunity to explore how institutional innovations in local governance might take place amidst a relatively stable policy landscape.

Since 2001, Scottish local authorities have been obliged to produce Local Housing Strategies<sup>1</sup> detailing measures to reduce fuel poverty [12], and to ensure that their housing stock meets Scotland's Energy Efficiency Standard for Social Housing (EESH). This is coupled with ongoing funding for local authorities to implement energy efficiency and heat decarbonisation measures, including the Home Energy Efficiency Programme: Area Based Schemes (HEEPS:ABS; since 2013) and the District Heating Loans Fund (since 2011).

In 2015, following cross-party consensus in Scottish Parliament, energy efficiency was designated a National Infrastructure Priority. This

declaration was supported by establishment of a new 20-year national energy efficiency programme, intended to "ensure long-term stability for energy efficiency and heat funding and policy" and encourage private and public sector investment ([13], p.17). The programme's initial phases included testing a proposal for mandatory 'Local Heat and Energy Efficiency Strategies' (LHEES). This would require all local authorities to develop comprehensive, area-based plans for systematically improving the energy efficiency and decarbonising the heat supply of all buildings (public, private and commercial properties) in their area. This approach recognises the diversity of Scotland's building stock and reasonable interventions for decarbonising heat, with large differences between urban, rural and island communities. Between 2016 and 2020 the Scottish Government provided funding for a series of pilots to test local authority capacity for developing LHEES.

Thus, Scottish Government have been developing long-term policies to support heat decarbonisation and energy efficiency. Together, these could enhance local government capacity and support innovations in local governance for decarbonising the built environment. Discourses of localism have been pervasive in the UK over the past 20 years, but, despite devolution, local authorities continue principally to be subordinate, administrative arms of the respective central governments [14]. Thus there is a structural tension between centrally-defined local statutory duties, which allocate administrative authority to local government [15], and local authorities' ambition and ability to act, amidst diminishing budgets from central government [16]. This is evident in local authorities' uneven progress in energy and climate plans to date [17], and highlights the need to investigate how local authority capacities interact with, and shape potential for, institutional innovation. This paper uses the case of LHEES to explore how such capacities are negotiated and renegotiated, in the context of proposed institutional change.

### 2.1. Local Heat and Energy Efficiency Strategies (LHEES)

LHEES is positioned as a critical anchor for achieving the ambitions of the Scottish *Heat in Buildings Strategy* [18], which envisages LHEES as:

- Forming the basis for local public engagement and involvement in decision making.
- Supporting planning for energy networks over time and providing an evidence base for electricity Distribution Network Operators and the Gas Distribution Network
- Acting as an investment prospectus at both the national and local level, and signalling potential areas of investment to market actors

The Scottish Government have proposed to introduce LHEES as a statutory duty for local authorities. Statutory duties allocate responsibilities and some administrative authority to local governments [15]; duties may be compulsory, meaning that local authorities must undertake certain activities, or discretionary, meaning that there is flexibility over implementation [19]. The *Heat in Buildings Strategy* proposes that an LHEES should be in place for each Scottish local authority by the end of 2023.

Over three funding rounds, LHEES have been piloted in all 32 local authority areas in Scotland. Local authorities are expected to follow six steps to produce a strategy to be delivered over 20 years [20]:

**Stage 1:** An assessment of existing local and national strategies and data availability.

**Stage 2:** Authority-wide assessment of the existing building stock's energy performance and heat supply.

**Stage 3:** Authority-wide setting of aggregate targets for heat demand reduction and decarbonisation of buildings – short and long term.

**Stage 4:** Socio-economic assessment of potential energy efficiency and heat decarbonisation solutions.

**Stage 5:** Selection of areas/ prioritisation of opportunities leading to the designation of zones.

<sup>1</sup> Introduced in the Housing (Scotland) Act 2001.

**Stage 6:** Costing and phasing of delivery programmes.

For the pilots, there was no guidance on the time frame of these steps or, for example, the financial resource that should be committed to each stage. Instead, the exact process was left to the discretion of local authorities. The LHEES proposal is thus a unique opportunity to explore how local authorities respond to potential governance innovations, using a conceptual framing rooted in institutional theories.

**3. Changing institutions for the delivery of energy policy**

Existing institutional arrangements and practices have not delivered the energy system transformations needed to meet stringent climate targets, suggesting the value of research on processes of institutional change and innovation to support faster transitions [21]. Institutional theory frames policy making as a process contingent on historically-embedded networks of actors [7]. Institutions are interpreted as ‘the rules of the game’, which have developed out of political contests, and are infused by particular beliefs and values. They include regulative, normative and cultural-cognitive elements; together these provide stability and meaning to social interaction [22]. The institutional context constrains policy options and shapes the possible and acceptable ways of delivering new policy, although always with scope for political contest to effect innovation. Thus processes of institutional change and their outcomes are always subject to indeterminacy.

Crucially, the outcomes of any attempt to enact institutional change are a product of the relationships between actors and their context, and the uneven distribution of power between them [23]. Local factors can shape national strategies for institutional change and vice versa (see [24,25]). A multi-layer perspective that observes processes of change at both central and local levels [25] is hence a means of gaining insights into the interactions of institutions and processes [26]. At the local level, authorities find different ways to meet particular needs; the link between the volume and nature of funding and potential outcomes cannot be presumed [25], opening up scope for gradual shifts in institutions over time [8]. Distinctions can be drawn between four types of incremental change associated with introducing, replacing and removing institutions: displacement, layering, drift and conversion [27]. Such changes might be expected to emerge ‘in the ‘gaps’ or ‘soft spots’ between a proposed institution and its interpretation or enforcement’ ([8], p.14). Neither the processes for developing, nor the exact outcomes of, LHEES have yet been clearly defined. This creates an ideal opportunity for empirical research to analyse how local authority capacities for governing energy efficiency and heat decarbonization may shape the formation, interpretation and contestation of this new institutional rule.

Of particular relevance for analysing the processes of establishing LHEES is the notion of layering, which ‘occurs when new rules are attached to existing ones’ ([8], p.16). LHEES can be understood as a proposed new layer in the landscape of local authority responsibilities for energy efficiency and heat decarbonization in Scotland (outlined in Section 2); the full potential of innovation is still being defined. Such layering can result in substantial change if amendments ‘alter the logic of the institution’ and small changes can accumulate, leading to big change overall ([8], p.17). If LHEES becomes an anchor for whole building stock retrofit it would become a critical element of the framework of rules guiding local authority action. However, at this stage, LHEES could also translate into another minor adjustment in local governance institutions, with few effective mechanisms for implementation.

The capacity of local authorities to engage with this type of institutional innovation can be over-estimated in the context of energy transitions [24]. Indeed, the constrained capacities of UK local authorities [28], the restrictive impacts of declining financial resources [15], and limitations imposed by rules advocating the use of contracting and outsourcing services [29] have all been documented. Thus, local authority capacities may intersect with experiments in institutional

change, with material consequences for energy transitions. However, there are scant conceptual frameworks for understanding how local authorities may differentially mobilise around such institutional innovation; for this, we apply the capacities framework developed by Kuzemko & Britton [15].

**3.1. Capacities framework**

Kuzemko and Britton's capacities framework, introduced in this journal [15], is used because of its foundations in institutional theory applied to local governance. Here, capacity is defined as ‘the ability to take political decisions in pursuit of agreed public policy goals’ ([15], p. 2). This is ‘about having access to, and using, the various resources and skills available, whilst recognising that they may change over time’ ([15], p.2). The authors identify six forms of capacity crucial to local authorities' ability to deliver energy policy: responsibility; political authority; finance; personnel capacity; knowledge and; energy materialities (each of these are defined in Table 1). Critically, these capacities are inter-linked and situated within broader contexts including institutions of central government.

*Responsibility*, defined by Kuzemko & Britton [15] as the duty of local governments to implement policies in specific areas, provides the starting point for this analysis. The authors suggest that statutory duties should, in turn, result in local resources and skills being dedicated to that area. However, this is not always the case. A new statutory duty is not always accompanied by additional finance [30], and reduced public funding has led to the prioritisation of statutory duties at the expense of non-statutory policy areas (see for example, [31]). Thus, it is crucial to explore how LHEES as a proposed *responsibility* intersects with, and creates the potential need for re-alignment amongst, the other capacities.

*Finance* refers to access to capital via public and private channels, local taxation, and property and land resources. The allocation of LHEES as a statutory duty could mean that local authorities prioritise this activity within their allocation of available finance. In turn, finance could powerfully influence other capacities, including personnel capacity (for example the retention of staff) and subsequent political authority. However, UK authorities are reliant on the state for the majority of their income. Scottish local authorities receive roughly 80% of their income from Scottish Government [32]. Between 2010/11 and 2018/19, this funding fell by approximately 10% in real terms ([33], p.15). Reductions in public finance have resulted in fewer staff and increased churn (which may impact the accumulation of knowledge). Thus, although authorities may in theory be well placed to plan area-based energy efficiency and heat decarbonisation, the impact of local authority finances on the potential efficacy of LHEES is unknown.

According to Kuzemko and Britton [15], the *political authority* of local government to operate independently, and manage and respond to local tensions can be crucial for taking action aligned to local circumstances. Additional formal responsibility could enhance political authority.

**Table 1**  
Description of different types of capacity.

Capacity type	Description
Responsibility	Statutory duties; defined administrative authority; often assigned by central government and/or national constitution
Political authority	Policy discretion; ability to make policy decisions in relation to the locality, rather than contributing to national policy
Finance	Financial resources; local tax raising abilities; capital assigned from central government; land
Personnel	Personal capital; number and quality of staff capable of making and implementing energy policies
Knowledge	Experience; access to specific forms of knowledge; sustainable learning and innovation
Energy materialities	Proximity to energy resources; low carbon energy assets; local infrastructure

Source: [15].

However, such authority can only be achieved when local governments have the capacity to act as ‘genuinely independent centres of decision-making, with sufficient own financial revenues and policy autonomy to be able to make meaningful choices on behalf of their citizens’ [34]. Thus, political authority could also be restricted by other capacities, not least finance. Scottish Government has acknowledged the importance of clarifying where political authority for LHEES lies, stating, ‘it will be necessary to put in place a clear framework for [the energy efficiency programme], making clear who is responsible for setting the policy and targets, and who is responsible for delivering the Programme, at both the national and local levels’ ([35], p.20). However, whether this will translate into realised political authority, and how this may be shaped by other local authority capacities, for LHEES is not yet clear.

*Energy materialities* is intended to capture existing energy infrastructures and proximity to natural resources, for example [15]. The most appropriate approach to building decarbonisation depends upon a variety of local factors, including the nature of the building stock, building density, local energy network configurations, and the presence of local energy opportunities, such as waste heat [36]. However, rather than energy materialities themselves, it is *knowledge of energy materialities* that is intrinsic to the development of LHEES, which focuses on documenting the existing building stock and identifying opportunities for low carbon heat. For example, whilst district heating may be a viable solution for low carbon heat in densely built areas, this is less likely to be the case in rural communities. It is the case that local authorities have a long-term commitment to a region [37], and are likely to accumulate knowledge about such local infrastructures and resources. However, it is crucial to consider how such knowledge of energy materialities interact with finance and personnel capacities.

*Personnel capacity* addresses the quantity and quality of available personnel; Kuzemko & Britton [15] highlight that having individuals dedicated to analysis and decision-making is crucial for sustainable energy. However, the available data on the size of energy teams in UK local authorities suggests that only a small number have in-house teams [17]. This lack of dedicated personnel can mean that energy projects are spread across different departments, and not prioritised [17]. There is thus a clear connection between personnel capacity and the accumulation of *knowledge*. Crucially, a lack of knowledge capacity and siloed working structures can result in policy failure at local level [38]. Furthermore, lack of in-house skills and expertise means that outsourcing to private and third sector organisations has become the norm for the delivery of public services. This financial model can mean that knowledge and skills accumulate outside the local authority, and reinforce a dependence on contracting consultants [39].

Thus, the different local authority capacities have the potential to both enhance and restrict one another. Some may be more important than others for the development of LHEES, and the institutional innovation this represents. It is thus essential to explore the inter-play between different local authority capacities to gain insight to the potential for institutional innovation. The following section details the method used to collect data before the results are presented in Section 5.

#### 4. Method

To date, Scottish Government have funded three phases of pilots to establish delivery mechanisms for large scale energy retrofit, including the development of LHEES. The analysis presented in this paper stems from an evaluation of this programme, which included the phase 1 and 2<sup>2</sup> LHEES pilots (see: [40,41]).

Across Phases 1 and 2 of the pilots, 23 local authorities were each awarded funding to trial the development of LHEES. The funding available and specific focus of the pilots varied across the two phases, as

detailed in Table 2. For both phases, local authority applicants developed a proposal detailing the scope and aims of the LHEES. Scottish Government specified that the pilot funding should be used to ‘support staff time or consultancy costs to gather information and develop the LHEES’ [42]. Scottish Government assessed proposals according to: their rationale; the project team and governance structure identified; consideration of existing strategies and datasets; allocation of funding and any match funding commitments made. Scottish Government sought to ensure that all 32 local authorities had the opportunity to trial LHEES ahead of its potential introduction as a statutory duty. Thus, any local authorities successful in Phase 1 were prohibited from applying to Phase 2, and so on. For Phase 1, Scottish Government also centrally procured a consultant to support with the collation and analysis of data; the consultant worked on nine of the 12 LHEES pilots. Phase 2 did not include a centrally procured consultant, but the majority of pilot teams

**Table 2**

Summary characteristics of the Phase 1 and Phase 2 LHEES pilots. Pilot approach, aims and focus are all as specified in pilot application materials prepared by Scottish Government.

Characteristic	Phase 1	Phase 2
Number of pilots	12	11
Participating authorities	Aberdeen City, Clackmannanshire, Dundee, Dumfries & Galloway, City of Edinburgh, Glasgow City, Highland, Perth & Kinross, Renfrewshire, Scottish Borders, Shetland, Stirling	Aberdeenshire, Argyll & Bute, East Lothian, Falkirk, Fife, Inverclyde, Midlothian, North Lanarkshire, Orkney Islands, South Lanarkshire, West Lothian
Funding available	£50,000–70,000	£30,000–60,000
Dates from – to	September 2017 – March 2019	May 2018 – December 2019
Pilot aims	Testing the development and implementation of LHEES for defined areas within or across councils	Test and develop methods for creating LHEES Identify relevant sources of data (and any data gaps) Gain a fuller understanding of the resources and capabilities required to deliver an LHEES Final pilot outputs should suggest the content, timescales, cost, funding and appropriate vehicles for a delivery programme in one of the specified pilot focus areas.
Pilot approach	Area-based	Sector-based. Authority-wide or within specific urban, suburban or rural settings.
Pilot focus	Development of Local Heat & Energy Efficiency Strategies for council areas or discrete areas Methodology and evidence base to support zoning, and phasing of areas for energy efficiency delivery programmes, and for appropriate heat decarbonisation delivery programmes Delivery of LHEES for designated area	Energy efficiency in: privately owned domestic/ non-domestic properties; domestic private rented sector; Small and Medium Enterprises (SMEs); public sector buildings Identifying opportunities to establish or support energy efficiency and low carbon heat supply chains Identifying low regrets opportunities for the decarbonisation of heat supply

Sources: [43,44].

undertook their own procurement to work with a consultant.

<sup>2</sup> The Phase 3 LHEES pilots were evaluated by a separate team and are not included in this analysis.

This paper draws on in-depth semi-structured interviews with 22 of the local authority pilot teams.<sup>3</sup> For Phase 1, interviews were conducted both at the beginning and end of the pilots; the Phase 2 LHEES pilots were added into the broader evaluation work after they had already commenced, so interviews were only conducted at the end. The interviews lasted between 30 and 90 min and were primarily conducted in local authority offices; three interviews were conducted remotely, because of distance and time limitations. Local authorities were required to participate in these interviews as a condition of pilot funding. Local authority project leads were identified through application materials and approached for interview. These individuals then asked colleagues involved in the project to join them at interview; in some cases these included the consultants who has supported the pilots. Consequently, most interviews included between one and three local authority officers, one included four. The officers were primarily in energy and climate change, or housing, roles (see [Appendix A](#)).

Interviews are a useful method for in-depth discussions about the perceptions and experiences of public sector actors. In particular, they have been utilised to explore local authorities' engagement in, and modes of governing, energy initiatives [37,45]. The local authority interviews considered: scope and content of the pilot; activities involved in developing an LHEES; and the skills and resources required. The same interview schedule was used for both phase 1 and 2 pilots; this is included in [Appendix B](#). All interviews with local authority officers were completed on condition of anonymity, and interview quotes are not assigned to individuals.

The interviews were transcribed verbatim and stored and coded using NVivo 11.4. Data analysis followed a process of reviewing all of the interview transcripts followed by a detailed reading which identified emergent themes. Through consultation amongst all of the paper's authors, these themes were narrowed (to prevent repetition) and categorised according to Kuzemko & Britton's [15] capacities framework. Emergent codes for each of Kuzemko & Britton's six forms of capacity are included in [Appendix C](#). Certain themes had aspects relevant to multiple capacities; these themes are therefore listed under more than one capacity (for example, local authority officers' discussion of 'resource availability' spanned both *finance* and *personnel capacity*). Interview data has been supplemented with evidence from the LHEES reports generated through the pilots (see [Appendix D](#) for a summary of the scope and outcomes of each pilot). The following data is presented according to four capacities: *political authority*; *finance*; *personnel capacity* and *knowledge*. The role of LHEES as a potential new *responsibility* and knowledge of *energy materialities* are incorporated as part of the discussion around these four capacities.

## 5. Results

### 5.1. Political authority

Positioning LHEES as a statutory duty is a means to transfer power for the planning of energy efficiency and heat decarbonisation, thus potentially enhancing different local authorities' political authority to act. There are different layers of political authority, namely: LHEES could act as a tool to garner political commitment from executive and elected council members; LHEES could also enable local authority officers to engage a range of non-public sector stakeholders.

There was a wide range in the level of political commitment across different local authorities. For example, one officer noted:

To date anything, whether it's our sustainable energy action plan or our energy team...work that we do, we have no problems cross-party

politically we always had support on that and climate change. (Local Authority Officer – Phase 1)

This high level of support from executive and elected members provided the political authority needed to encourage engagement in the LHEES pilot from across council departments. However, other council officers reported little to no engagement from senior council members:

Internally this has not gone to chief officers and it's not gone to elected members because the questions they will ask me [are]: is this a statutory duty? What is exactly required of us? When do we need to do it by and what are the penalties if we don't comply? (Local Authority Officer – Phase 1)

This officer felt that elected members would not be interested unless LHEES became a statutory duty. As a result, the pilot remained a standalone activity that was not discussed with senior management. Without formal responsibility in place, there is a lack of political commitment which could lead to LHEES relegated down the list of council priorities.

Acknowledging this, local authority officers universally supported LHEES becoming a statutory duty and highlighted that formal *responsibility* for LHEES could provide them with the *political authority* to deliver it:

I see LHEES as a tool...to give our leadership role that we're supposed to have in public sector to put something in place so non-domestic buildings and domestic buildings that aren't owned by public organisations or housing associations get a handle on where they want to be (Local Authority Officer – Phase 1)

Thus, a statutory duty could give local authority officers the power to lead on delivering LHEES, particularly through influencing stakeholders across different sectors. At present, local authorities typically hold data about public sector buildings but are reliant on voluntary engagement of private organisations and individuals in energy programmes; having LHEES as a statutory duty may provide the political authority to engage with the range of stakeholders whose support is needed for this cross-sector strategy development.

The LHEES pilots offered the opportunity to explore whether this was indeed the case. With a focus on stages 1 and 2 of the LHEES process (see [Section 2.1](#)), one local authority in Phase 2 sought to establish a database of local Small and Medium Enterprises (SMEs). Initial data analysis identified roughly 8500 SMEs in the local authority area. The project team then sought to gather detail from these SMEs on: the types of buildings inhabited; the validity of existing data; and potential energy efficiency interventions. A survey sent to 400 businesses received only 28 responses. The team consequently undertook more labour intensive 'light touch' site surveys where they wrote to SME addresses and then visited for brief on-the-spot assessment of the properties. Following this exercise, the authority's LHEES report critically notes:

We recommend that it is fundamentally reconsidered whether local authorities should be required to gather data on SMEs for the purposes of LHEES development. It does not seem reasonable to expect individual authorities to establish reliable baseline data for such a diverse sector without any mandatory powers to do so (Local authority LHEES report – Phase 2)

Thus, any political authority established through the pilot is not sufficient on its own (in this case, *personnel capacity* and *knowledge* are needed to engage SMEs). In addition, existing political authority is not strong enough to garner engagement from the majority of SMEs. Here, the local authority notes that *responsibility* through the statutory duty is a prerequisite for the *political authority* to engage SMEs. Without this, and the ability to acquire and collate accurate data about non-domestic buildings, the efficacy of LHEES could be compromised. As one officer noted: 'you can't apply [energy saving estimations] if you don't know

<sup>3</sup> One of the local authority teams ignored requests for interview, and the consultant they collaborated with was interviewed.

what type of building it is...[non-domestic are] wildly different buildings' (Local Authority Officer – Phase 1). Encouraging compliance from broader stakeholders was also highlighted. For example, one officer mentioned concern around housing developers, who could be important for supporting future designated low carbon building zones. The officer emphasised that LHEES is 'only guidance and advice. [New] housing developers can quite easily come back to us and say: 'No, we're not doing that' (Local Authority Officer – Phase 2).

## 5.2. Finance

There are two ways in which financial capacities were instrumental to the LHEES pilot processes: first in relation to development and second in relation to delivery.

With regard to development, finance enabled hiring, retaining or allocating personnel to coordinating and managing the LHEES process. The pilot funding was primarily used to fund staff time within the council, or to pay external consultants to complete aspects of the work (for example data collation, analysis and GIS mapping). A very small portion of pilot funding (circa 10%) was used to support data collection (such as funding a mail-out questionnaire to householders), hosting stakeholder events, and for travel & subsistence (for example, when visiting small business premises). Many local officers then concluded that additional resource would be needed to develop LHEES in future. Specifically, *finance* was necessary to employ one (or more) full time officers, long-term, to lead and coordinate cross-departmental development of LHEES. In addition, amidst financial pressures and competing responsibilities, it was deemed essential to mandate LHEES to ensure that resource could be allocated to this task:

If it's not a statutory obligation with the financial pressures on councils it won't get taken forward. We feel quite strongly that it should be a statutory obligation (Local Authority Officer – Phase 1)

Thus, finance and how it is allocated has an inextricable connection to *personnel* and *knowledge* capacities, and the implications of this are discussed in the following two sections.

Finance is also critical for the potential delivery of LHEES. Several pilots developed detailed costings and undertook financial planning for proposed energy efficiency and low carbon heat interventions. These costings often focused on a specific building sector, or geographical area (i.e. a town or village). For example, one Phase 2 pilot completed all 6 proposed stages for public sector buildings, and developed costed scenarios for interventions in a series of case study areas, one of which was an industrial site (see Table 3). Council-wide extrapolation of the case study areas allowed the team to estimate that it would cost the council £2.2 million per year over the next 25 years to decarbonise all public sector buildings. Their LHEES report states that this is 'above the council's current budget of £1-1.5 million per year for energy efficiency measures'. High delivery costs were identified across the LHEES pilots

**Table 3**

Financial costs and projected carbon savings for energy efficiency and heat decarbonisation scenarios<sup>a</sup> for high emitting buildings in an industrial area.

Option	Business as usual	Energy efficiency (EE)	Low carbon heat network + EE	Local low carbon heat + EE	Local low carbon heat	Hydrogen + EE
Capital cost	£0	£9.5million	£41 million	£16.7 million	£7.3 million	£16.7 million
Revenue cost change	+£130,000	+£180,000	+£150,000	+£30,000	+£320,000	TBC
Lifetime energy cost	£26.9 million	£18.1 million	£26.1 million	£23.3 million	£29.9 million	TBC
Total energy costs	£26.9 million	£27.6 million	£67.1 million	£40.1 million	£37.2 million	TBC
2032 carbon saving	41%	63%	89%	86%	81%	69%
2045 carbon saving	46%	67%	95%	94%	92%	97%
Cost per kg carbon saved	£1.61	£0.68	£1.57	£0.67	£0.67	TBC
Targets met	No	No	Yes	Yes	No	No

<sup>a</sup> Scenarios considered are: Business as usual - no changes to buildings or heat supply; Energy efficiency – LEDs; control optimization; building fabric improvements; energy efficiency and a heat network supplied by heat pumps and biomass; energy efficiency and individual heat pumps for heating ('local low carbon heat'); local low carbon heat without energy efficiency and; energy efficiency with hydrogen heating.

(see Appendix D), with many local authority teams sharing concern over how these costs would be met given their constrained finances. In this case, the LHEES report suggested that it would be financially viable to implement some decarbonisation measures, while using carbon offsetting to meet the shortfall. Thus, LHEES testing revealed the implications of constrained local authority finance for potential reduction in the number of buildings treated and reliance on carbon offsetting. The latter is controversial and its ability to meet carbon targets effectively and equitably is contested [46].

## 5.3. Personnel capacity

Only three local authorities used the majority of pilot funding to specifically hire or re-allocate a full-time member of staff in-house to manage and coordinate LHEES development for the duration of the pilots. Creating this dedicated capacity was only the beginning of a process of learning, testing, and adapting to the requirements of LHEES. Whether staff were in dedicated roles or not, the majority of pilots sought to develop new working groups or informal collaborations across several departments. This served as an opportunity to build personnel capacity, in part through identifying the value of different skills to LHEES:

We found working with [Economic Development] really interesting because [they] know the people in the businesses and [they] know what they want to hear and [they] know when to let them make a decision. That kind of business relationship is a useful skill (Local Authority Officer – Phase 2)

Having dedicated personnel for this work proved valuable. In one Phase 1 pilot, a new officer was hired to manage the pilot and was then able to build momentum around LHEES development, using stakeholder workshops to help establish priorities. The workshops were attended by representatives from diverse council teams, including: energy; sustainability; carbon management; environmental services; housing and regeneration; planning; legal services; transport planning. This officer's efforts were buoyed by support from elected council members (and the *political authority* this brings), who also attended the sessions. In turn, this officer developed detailed knowledge of sustainability strategies across the council, and the priorities and potential contributions of different departments, which could be hugely valuable in the future implementation of LHEES. However, limited pilot funding meant that the officer's role was fixed-term; they later moved to a different post in the council, potentially losing momentum for future LHEES.

The remainder of pilots primarily used funding to harness external consultancy support, and allocated internal staff time using existing council budgets. In these cases, the task was added to an officer's existing role, which constrained their ability to engage. In one Phase 1 pilot, the lead officer for LHEES noted that they had 'not been able to give as much time to the project as [they] would have liked'. They listed a number of

other energy efficiency initiatives that they were responsible for, some of which were only confirmed after competitive bidding. This highlights the limitations of short-term competitive funding for allocating and maintaining personnel capacity – when dearths and gluts of projects can occur. This pilot focused on developing guidance for creating LHEES, and the officer noted that they ‘would have struggled’ had they been trying to go further. Even within this limited objective, the work was further narrowed down:

it was an objective... to do some kind of tailored engagement with selected businesses... I tried with Economic Development colleagues who have got closer links to business but again it just came down to resourcing. I couldn't really invest the time that was needed to follow up with different business groups and so in end we just left it [out] (Local Authority Officer – Phase 1)

Thus, lack of personnel capacity limits the scope of LHEES. Across other pilots, engagement in cross-departmental collaborations was informal and voluntary. Several officers explained that it was difficult to engage people because this was not a core priority or *responsibility*. For example, one interviewee believed that data on floor sizes and characteristics for non-domestic buildings would be available from the Property Division. However, repeated attempts to engage produced no response. This was attributed to the lack of time to ‘sit down and pull all that information out’ (Local Authority Officer – Phase 1). In terms of the capacities framing, without dedicated personnel to coordinate across departments, analyse data, and make decisions, local authorities will struggle to progress with sustainable energy [15].

Officers commented that they were reliant on informal favours, for example, ‘pulling a member of our team off her job’ (Local Authority Officer – Phase 1), and ‘a lot of goodwill’ from colleagues to get the pilots delivered. Such voluntary cross-departmental working was unstable. For example, one participant noted that her post ‘disappears at the end of the month’, and there would no longer be a ‘sustainability function’ within the council (Local Authority Officer – Phase 1). The precarity of officers' involvement, coupled with this outsourcing of aspects of LHEES development to consultants (see Section 5.4) could further contribute to the marginalisation of LHEES. Ad hoc, poorly-resourced management models are insufficient for achieving radical policy goals: in this case, reliance on volunteers, coupled with uncertainty in future resources, is unlikely to sustain the capacities needed to support the long-term aims. If not institutionalised as a formal *responsibility*, and supported by increasing *personnel capacity* within local authorities, LHEES is vulnerable to repeated disruption and an associated loss of momentum and significance.

#### 5.4. Knowledge

The range of knowledge required for developing LHEES was evident:

It's a multitude of different skill sets. You need... understanding about energy, energy usage, energy bills. You need... building survey skills... understanding of how planning works... influencing policy and strategy in the council... that skill of taking a strategy through to implementation... it's a co-ordination role in project management (Local Authority Officer - Phase 1)

Strategic thinking and project management related to both how an LHEES would be developed (for example, the types of knowledge available in-house and which aspects would need to be outsourced), but also to involving officers across the council and considering how to engage senior executives and councillors.

In addition, a critical aspect of the pilots was identification, sharing, and analysis of relevant data. Fig. 1 is reproduced from one Phase 2 pilot report, which focused on establishing a picture of the building stock occupied by SMEs in the region. This indicates the breadth of data sources used for just one building sector (other LHEES pilots were cross-

sector and subsequently drew on additional datasets – see Appendix D). *Knowledge* required for this aspect of LHEES is threefold: 1) awareness of available datasets; 2) ability to harvest and analyse data from these; 3) ability to collate and overlay datasets to identify potential heat and energy efficiency interventions. The extent to which local authority teams felt capable of delivering this in-house varied significantly, and there is an emerging pattern of distributed knowledge for LHEES development.

A small number used in-house expertise for data checking and analysis, particularly citing the contribution of those with skills in Geographical Information Systems (GIS). However, institutional knowledge for data analysis was recognized by the majority of local authority interviewees as lacking, often attributed to a lack of *personnel capacity* amongst those in data analysis and GIS departments. This was the primary form of knowledge outsourced to consultants.

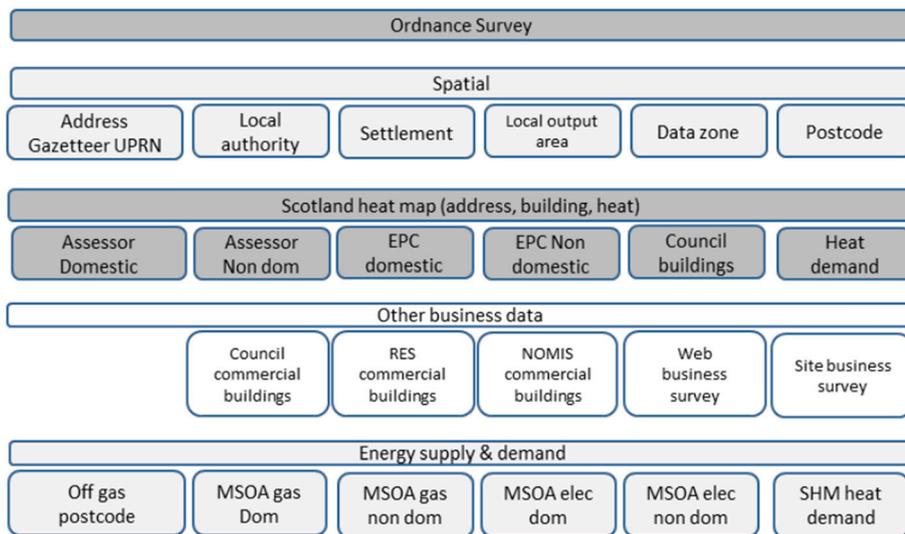
For the Phase 1 pilots, Scottish Government centrally procured an external consultant. The consultant completed data collation, analysis and prioritisation of potential energy efficiency and heat decarbonisation activities for nine of the 12 Phase 1 pilots. Officers from these councils reported that the use of a centrally-procured consultant resulted in an LHEES less tailored to their locality, particularly failing to incorporate their knowledge of local *energy materialities*. For example, one participant discussed the incompatibility between the consultant's specification for air source heat pumps and the poorly insulated Victorian and pre-Victorian buildings in the area, noting that: ‘had [the consultant] visited then it would be different’ (Local Authority Officer – Phase 1). Other local authorities, especially those in rural and island areas, highlighted the consultant's focus on district heating networks, which they felt were inapplicable. Centrally procured consultancy, combined with a lack of in-house personnel capacity, hence presented challenges for ensuring that LHEES were developed using the institutional knowledge within localities. However, the majority of local authority officers recognized that they would need to access some external expertise to develop LHEES, and several Phase 2 projects procured their own external consultant. Local knowledge was regarded as crucial here:

One of the reasons why we chose [the consultant] was that they had an office in [the local area], they sent the CVs and names of who they were going to subcontract, they were all local and it was very much that [we] need someone who understands [the local area]. (Local Authority Officer – Phase 2)

These authorities reported more positive experiences, developing closer working relationships with consultants or engaging those they had existing partnerships with. However, some officers expressed concern about the lack of in-house skills emerging. In the long term, outsourcing models could erode opportunities for the accumulation of learning within local authorities, which is essential for developing knowledge capacity [15]. In addition, outsourcing is often more expensive than maintaining activities in-house [29], thus limited in-house knowledge capacity could place additional strain on already restricted financial capacities.

Further, knowledge for LHEES is distributed across a series of tools, each of which have been developed through different stakeholders. Examples used during pilots include the Scotland Heat Map<sup>4</sup> and the

<sup>4</sup> The Scotland Heat Map was developed by Scottish Government to enable estimations of heat demand at building and area level, and subsequent planning for district heating. A framework agreement is in place to enable full access for all Scottish local authorities. See: <https://www.gov.scot/publications/scot-land-heat-map-documents/>



**Fig. 1.** Data sources used for the development of Phase 2 LHEES pilot focused on SMEs (Data sources identified include: Ordnance Survey; Scotland's Address Gazetteer (a land and property database maintained by local authorities) to the level of Unique Property Reference Number (UPRN); Scotland Heat Map (a Scottish Government-commissioned resource for assessing heat demand and supply opportunities across Scotland); Energy Performance Certificate (EPC) databases; energy consumption data (to the level of Middle Layer Super Output Area (MSOA)).). Reproduced from a Phase 2 pilot report.

Place Standard Tool.<sup>5</sup> In addition, Scottish Government commissioned the Carbon Trust to develop a socio-economic analysis tool (see Appendix E) to fulfil stage 4 of the LHEES process<sup>6</sup>; this constitutes an influential form of knowledge that directly informs local authorities' prioritisation of energy efficiency and heat decarbonisation measures. In particular, the socio-economic assessment tool places equal one third weighting on carbon emissions and fuel poverty, with factors like finance, resilience, local economic and environmental conditions (such as air quality) combined to create the remaining third. Officers highlighted that this weighting did not align with council priorities, particularly financial payback from energy interventions and creation of jobs and economic prosperity in the local area. This mis-alignment of knowledge could mean that such tools lose efficacy, or are marginalised in favour of local knowledge and priorities.

## 6. Discussion

Scottish Government's relatively stable political support for coordinated local-national action on energy efficiency and heat decarbonisation has potential to effect institutional innovation for systematic retrofit of the building stock. The capacities framing has been a valuable means to understand the potential for institutional innovation, in the form of LHEES, to take hold. The LHEES proposal represents an expansion in existing local responsibilities; however, other required local authority capacities are lacking. For example, constrained personnel capacity within local authorities meant that completing an effective LHEES pilot was reliant on informal management structures, and voluntary involvement from colleagues. Without additional finance, personnel capacity, and a clear line management authority to allocate roles, LHEES is unlikely to offer a model for local leadership in systematic area-based planning and action for building stock retrofit.

While Kuzemko and Britton [15] comment on the interlinkages between local authority capacities, the degree to which these capacities are

interdependent, with consequences for effective institutional innovation, has not previously been emphasised. In this case, conferring formal responsibility for LHEES created a lynchpin around which all other local government capacities could align. In particular, local authority officers suggested that having this statutory duty in place could provide the organisational certainty needed to support the development of financial, personnel and knowledge capacities needed for LHEES. In fact, and reflecting years of diminishing local budgets, and subsequent prioritisation of existing statutory duties (for example, [31]), officers highlighted that positioning LHEES as a statutory duty would be the only way that the necessary mix of capacities could be developed.

These interdependencies also mean that there are tensions between capacities. At present, the capacities framing does not capture the dynamic interactions between different capacities. In this case, some of the knowledge needed to develop LHEES was available within councils, particularly that associated with project management skills and knowledge of local energy materialities. However, knowledge such as data analysis and GIS was either non-existent, or there was insufficient personnel capacity for those with this knowledge to participate in the pilots. Scottish Government and local authorities employed a familiar outsourcing model to fill this gap, leading to knowledge development outwith local authorities. Thus, in the existing framework of rules, the capacity to finance outsourcing could damage longer term local authority knowledge capacity, which is critical to governing substantive change in the building stock. The capacities framing could consequently be enhanced through development of a matrix, capturing the direction of influence between different capacities, with consideration of the extent to which they may reinforce or undermine one another. Table 4 shows an example matrix completed for the LHEES case.

**Table 4**

Example capacities matrix for LHEES. Captures how capacities listed in the left-hand column influence capacities listed along the top row. Key: ++ strong positive influence; + mild positive influence; / little to no influence; - mild negative influence; - strong negative influence.

	Responsibility	Political authority	Finance	Personnel	Knowledge	Energy materialities
Responsibility		++	+	-	+	/
Political authority	/		+	+	+	/
Finance	/	+		-	-	++
Personnel	/	+	/		++	/
Knowledge	/	+	/	/		++
Energy materialities	/	+	/	/	+	

<sup>5</sup> The Place Standard Tool is a framework to support stakeholder engagement in the development of places. The tool was funded by Scottish Government and developed through collaboration between Scottish Government, NHS Scotland, Architecture & Design Scotland and Glasgow City Council. See: <https://placestandard.scot/>

<sup>6</sup> The reach of such an approach is potentially broad: Scottish Government have proposed that socio-economic analysis would be a statutory requirement at three levels: of LHEES (strategy level), of district heating developments (project level) and for use during mediation for connecting individual buildings [20, p.20]

In this case, *responsibility* is shown to have had a negative influence on *personnel*, because the majority of councils added this task to existing officer workloads, or outsourced aspects of it. The outsourcing model also resulted in new *finance* having a negative influence on *personnel* and *knowledge* capacities. Conversely, it had a strong positive influence on *energy materialities*, because available financial resources shaped the feasibility of energy efficiency and heat decarbonisation interventions. This also indicates an element of directionality for the different capacities. For example, although new *responsibilities* shape other capacities, *political authority*, *finance*, *personnel*, *knowledge* and *energy materialities* all have little to no influence on the attribution of responsibility, which is largely determined by central government.

Acknowledging the connection between capacities and the potential for action, the definition of capacities could also be further developed. In particular, Kuzemko and Britton draw on ideas from public policy to define capacities as ‘the ability to take political decisions’ ([15], p.2). However, local authority officers are influenced by managerial and political decisions (indeed, support from both sources has been shown to influence political authority and personnel resources allocated to LHEES). Thus, local authority officers are caught in the struggle over resources, local powers and the subsequent alignment of capacities. This analysis has emphasised that, amongst local authority officers, capacity might usefully be defined as ‘the ability to deliver political objectives’, rather than focusing on decisions. This also connects specifically to the definition of political authority, which is suggested as the ‘ability to make policy decisions with regard to locality’. Analysis here has shown that political authority encompasses engaging not only those within the council (elected members and cross-council colleagues), but also local stakeholders. The definition of political authority could hence be developed to capture government officers’ ability to harness support for policy decisions and actions.

This paper explored the piloting of LHEES; however, assessing the progress and delivery of the programme would need a longer timeframe. It is not yet clear how or whether any of the plans developed through LHEES will translate into energy improvements or heat decarbonisation. Future research could focus on delivery mechanisms, including detail of financing to cover the integrated costs of intervention identified here. In addition, the allocation of LHEES as a statutory duty has been challenged by the Convention of Scottish Local Authorities (COSLA), the organisation which represents Scottish local politicians in negotiations with Scottish Government. COSLA’s challenge is rooted in the political rejection of any new statutory duties without additional local authority resource, in the form of finance. Thus, higher level political discussions are ongoing. This paper has focused on the perspectives of local authority officers; however, these are perhaps the least powerful actors involved. Officers implement the programmes and priorities of senior management and political leaders, whilst Scottish Government and COSLA also shape potential outcomes. This emphasises the need to ensure that future studies of local authority capacities incorporate the broader political context. Further, Pierson ([47], p.14) highlights that ‘policies which appear to effect radical change when witnessed at close hand may prove to have a relatively limited effect on institutions when reviewed with adequate hindsight’. Thus, it is only through re-visiting the development of LHEES on a longitudinal basis that it will become possible to understand whether the policy will generate genuine innovation in local governance for heat and energy efficiency.

## 7. Conclusion

Over the past decade, Scottish Government have been developing a portfolio of policies for local authority involvement in energy efficiency and heat planning. The centre of these is LHEES, or the proposed statutory duty for local authorities to develop 20-year costed and phased plans for decarbonising all buildings. LHEES has the potential to trigger innovation in existing local governance institutions, and a capacities framework has been used to explore the negotiations and tensions at play as local authority officers respond to this. There are limitations in certain capacities; for example, the results identified limited knowledge within local authorities for complex data analysis, and a lack of personnel capacity to engage. There are also interdependencies between capacities. In particular, additional responsibility acts as a cornerstone around which other capacities can develop and align. Thus, different local authority capacities are inter-connected, and it is the interplay between these capacities that ultimately influences the form that institutional innovations can take.

It is crucial to acknowledge and incorporate these interdependencies in the development of LHEES and, more broadly, in future efforts to support innovation in local governance. In particular, if central government policy makers are looking to local authorities to play a more substantial role in energy transitions, they need to consider all capacities together. This is a significant shift from the current focus on responsibility per se, and on a model of assigning statutory duties without commensurate increases in finance, or support for resource and knowledge capacities needed to deliver envisaged changes. Further, such policy considerations need to account for interdependencies between capacities that may be detrimental to the long-term delivery of energy transitions. This is especially true of the way in which a model of short-term, competitive support for financial capacity reinforces the ‘quick fix’ of outsourcing of knowledge. This risks a greater long-term erosion of local government knowledge capacity to plan and implement energy retrofitting strategies with the scale and comprehensiveness needed to meet climate targets. This could be addressed through ensuring that additional finance from central government is accompanied by a holistic review of the framework of rules governing the allocation of powers and responsibilities between central and local governments. Central government policy makers need to enhance capacities in the round in order to deliver the institutional innovation needed to ensure that local governments can fulfil their role in energy transitions.

### Declaration of competing interest

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

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## Appendix A. Team and role of local authority participants, as described by interviewees

Local authority	Interviewees
1	1. Corporate Asset and Energy Manager 2. Energy Officer (with housing responsibilities)
2	1. Sustainable Development Team
3	1. Development and Environmental Services
4	1. Carbon Management Team 2. Energy Efficiency Officer 3. Energy Manager (public and commercial) 4. Community Officer
5	1. Energy & Sustainability 2. Sustainable Development Officer
6	1. Sustainability & Climate Change Manager 2. Building Services Team (responsible for District Heating strategy)
7	1. Housing Strategy Officer 2. Consultant - data analyst
8	1. Sustainable Development Manager
9	1. Affordable Warmth Team 2. Housing and Regeneration Service
10	1. Sustainable Development Team 2. Sustainable Development Manager
11	1. Engineer (Energy and Sustainability) 2. Energy and Sustainability Manager
12	1. Planning officer within Local Development Plans Team 2. Strategy and Policy Manager
13	1. Team Lead – Sustainability and Climate Change
14	1. Project Officer – LHEES 2. Manager of Energy Service Team
15	1. Officer within Affordable Housing Department 2. Sustainable Energy and Climate Change Officer
16	1. Lead officer for Climate Change
17	1. Environment Strategy Officer – Environmental Arms Length Management Organisation (ALMO) 2. Lead Officer – Environmental ALMO 3. Officer from Economic Development
18	1. Carbon Reduction Officer 2. Lead Consultant 3. Consultant
19	1. Energy Coordinator
20	1. Project Officer – LHEES 2. Lead Officer – Fuel poverty & energy efficiency
21	1. Investment Officer 2. Pilot Strategy Coordinator 3. Head of Property Services
22	1. Energy and Climate Change Manager

## Appendix B. Interview schedule

### 1. Outcomes

What has been achieved through the LHEES pilot?

- What has been the most valuable aspect of the work for the Local Authority?
- Have any aspects of the work not been valuable for the LA?

Which of the original objectives of the project have been achieved?

- Did any objectives change over time?
- Were any objectives not achieved? Why?
- Were there any unexpected outcomes?

### 2. Delivery

Who has been involved in delivering the LHEES pilot?

- What role has the LA played?
  - o How has the project been resourced within the LA?
  - o Was the available resource sufficient?
- Was the planned LHEES budget used in the time available?
- What role have delivery partners and/or consultants played?
  - o Who has taken the lead in delivery?
- Were any particular processes or structures put in place to manage the delivery partnership?

[added for Phase 2 pilots]: Which of the 6 process/ steps did you follow?  
How has data been used to develop the LHEES?

- What data have been used? How was this sourced? From where?
- What challenges were there with data access, accuracy and analysis?
  - What are the main data gaps which need to be addressed?

To what extent have stakeholders and/or the public been engaged in the pilot?

- What form has this engagement taken?
- Who has led the engagement process? (LA? Partners?)
- What has been the outcome of this engagement?
- What challenges have there been in engaging with stakeholders/public?

### 3. Skills and Expertise

What skills have been needed to deliver the pilot?

- Where were these available?
  - In-house? Via consultants?

Were there any missing skills that provided a challenge for completing the pilot?

- How have these been developed through the pilot?

What opportunities have you had to share experiences and/or knowledge between pilot projects?

- Was this useful? How?

### 4. Political leadership and support

To what extent does the LHEES feel locally-owned?  
What kind of support has the LHEES pilot had across the LA?

- What has enabled or prevented this?
- What kind of response has there been from elected members of the council?
- What is the process for reporting back to the LA?
  - Are progress updates reviewed by a council committee?
  - What effect has this had on LHEES development?

What kind of support did you receive from Scottish Government for the implementation of the pilot?

### 5. Next steps

How will you be taking the LHEES forward from here?

- Are there planned actions within the LA?
  - Developing a wider strategy? Covering broader area?
- What mechanisms or council structures would you use to deliver this?
  - Same as in the pilot or something different?

What are your views on the current Energy Efficient Scotland Routemap proposals for LHEES?

- What do you think to the ongoing discussion of LHEES being positioned as a statutory duty for LAs?
- What aspects of LHEES should LAs be responsible for?
  - Who else should take a share of which responsibilities or tasks?
- What support and/or resources would you need to deliver the energy saving and low carbon heat objectives of LHEES?
- Can you envisage LHEES activity becoming self-financing over time?

## Appendix C. Emergent analytical codes according to each of the six capacities from Kuzemko & Britton (2020)

Responsibility

- Local Authority existing powers
- Local Authority existing responsibilities

- LHEES as a statutory duty
- Scottish Government support for creating LHEES
  - o Guidance vs. instruction

Political authority

- Local ownership
- Showing Local Authority leadership
- Executive level support
- Strategic – linked to other Local Authority schemes
- Leveraging future funding

Finance

- Creating LHEES – Resource required
- Resource availability

Personnel capacity

- Resource availability
- Working across departments
  - o Challenges
  - o New ways of working
- Coordinating across different local authorities

Knowledge

- Innovation – involving different stakeholders
- External consultation for knowledge tasks
- Creating LHEES – data
- Creating LHEES – resource required

Energy Materialities

- External consultation for knowledge tasks
- Creating LHEES – tailored vs. generic approach

**Appendix D. Overview of scope and outcomes for local authorities participating in phase 1 and 2 pilots<sup>a</sup> (adapted from [42])**

Local authority	Sector	Scope	LHEES stages completed (for study area)	Recommended measures	Cost estimations
1	Small and Medium Enterprises (SMEs)	Case study -	Primarily stages 1 and 2. Stage 3 restricted by limited data availability. Stages 4 and 6 not carried out.	Air-source heat pumps (ASHP) for retail zones and high street shops. Replacement lighting (LEDs), ASHP, 7-day heating controls, solar PV and electric radiant heating systems all suggestions with feasible payback periods for council-owned workshops	Not costed
2	Cross sector <sup>b</sup>	Case study - urban	All 6 stages completed	Recommended focus on 8 areas of highest index of deprivation, covering 4033 households: 1016 suitable for some form of insulation, 179 suitable for solar thermal and/or ASHP. Additional 12 zones covering 5400 properties: 3354 suitable for some form of insulation; 205 suitable for solar thermal and/or ASHP. Potential expansion of city's current district heating network, with potential for one additional new heat network – capital costs and payback periods are provided for these.	For recommended measures across the 8 priority areas using area-based grant schemes <sup>c</sup> - £2.3 m for insulation measures; £839,000 for solar thermal and heat pumps. For measures across 12 'self-funded' zones <sup>d</sup> - £10.2 m for insulation; £1 million for solar thermal and ASHP.
3	Cross sector	Case study – rural	Stages 1–3 completed. Data presented and scenarios costed, but no prioritisation	For 19 areas with highest index of deprivation, covering 7139 households: 4176 suitable for some form of insulation; 1436 suitable for solar thermal and/or ASHP. Additional 22 zones covering 6924 households: 4163 suitable for some form of	For recommended measures across 19 priority zones using area-based grant schemes and grants to homeowners: £7.2 m for insulation; £5.9 m for solar thermal and ASHP. For measures across 22 'self-funded' zones: £8.4 m for insulation and £8.9 for

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Local authority	Sector	Scope	LHEES stages completed (for study area)	Recommended measures	Cost estimations
				insulation; 2162 suitable for solar thermal and/or ASHP. <sup>e</sup> Sufficient data available for only 55% of non-domestic buildings 3 potential district heat networks identified	solar thermal and ASHP District heat networks costed at £2.7–5.5 m depending on size and heat source.
4	Cross sector	Case study - urban	Stages 1–3; 5 and 6	The analysis area covered 22 data zones, including 9245 domestic properties. 56% (5143) properties identified as unsuitable for insulation and heating upgrades. 35% (3341) properties suitable for loft and/or wall insulation. 18% properties suitable for solar thermal; 10% suitable for ASHP Analysis identifies three potential heat networks. Report notes sufficient data for only 40% of the non-domestic stock.	Domestic: report estimates £17 million to install all measures in suitable properties, including heat decarbonisation (through home-owner investment or grants). Heat network installation costs vary from £1.3 million - £4.8 million depending on size, fuel type and location.
5	Cross sector	Case study - rural	Stages 1 and 2, elements of stages 5 and 6.	The analysis area included 533 properties. For 59% (393) properties suitable loft and/or wall insulation measures identified; 27% (145) properties suitable for biomass boiler; 18% suitable for ASHP (using model criteria; 47% if this is relaxed); 36% properties suitable for solar thermal. Developed guidance for how to do an LHEES. Explored building type and heat consumption for 3716 domestic and 272 non-domestic properties in study area. Suggested priority measures for domestic buildings include: energy efficient lighting; loft and cavity wall insulation; draught proofing. Completed heat density analysis in study area, and identified potential for a heat network.	For all feasible measures across 533 domestic properties: £5.7–6.4 million invested by home owners or through grants.
6	Cross sector	Case study - urban	Report focuses on stages 2 and 4	The LHEES included two case study areas; area 1 included 20 non-domestic buildings; area 2 included 10 non-domestic buildings. The LHEES applied different energy efficiency and heat decarbonisation scenarios to these buildings to establish the most cost effective way of meeting carbon targets. This was then projected to entire council-area to establish estimated costs. LHEES highlighted the need to prioritise high emitting buildings for energy efficiency and heat decarbonisation measures (including heat pumps, biomass, and hydrogen), and concluded that the council would need to include some carbon offsetting to meet Council's net zero by 2030 target cost effectively.	Not costed
7	Council-owned stock	Case study - suburban	All 6 stages incorporated; prioritisation of buildings rather than designation of zones.	Recommendations to support future data collection and engagement with businesses, including:	To decarbonise all public buildings in the local authority area will require a capital investment of £2.2 million per year (over the next 25 years), and additional £28,000 per year invested in carbon offsetting (for the next 8 years) to meet 2030 target.
8	SMEs	Case study – rural	Primarily focused on stage 2 – engaging businesses and assessing data availability. Stages 3, 4, 5 and 6 were not completed	<ul style="list-style-type: none"> <li>• Developing skills in sales and energy efficiency;</li> <li>• Effective times of day and strategies for engaging businesses;</li> <li>• Developing existing business energy support services;</li> <li>• Role for Scottish Government in developing Community Planning Partnerships and Business Improvement Districts</li> </ul>	Not costed
9	Cross sector	Council-wide - urban	Stages 1–6 completed	Broad strategy developed which acknowledges earlier Council strategies and identifies 5 zones for prioritisation alongside e.g. potential funding sources. Analysis of measures at individual building level not provided.	Not costed
10	Domestic	Case study – urban	Stages 1, 2, 5 and 6 completed	The analysis area included 21,353 domestic properties; 13,604 of these had a complete set of data. 31.5% (6732) of domestic properties in study area	For recommended measures across 13 priority zones using area-based grant schemes and grants to homeowners: £9.2 m for insulation (1790 installs);

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(continued)

Local authority	Sector	Scope	LHEES stages completed (for study area)	Recommended measures	Cost estimations
				recommended for loft and/or wall insulation; 40% (8615) suitable for solar thermal; 14% (2910) suitable for ASHP. High heat retention heaters also suggested in some cases. Sufficient data available for only 15% non-domestic buildings. 6 potential heat networks identified using different technologies: water source heat pumps; ground source heat pump; ASHP biomass	£14.1 m for solar thermal and ASHP (2737 installs). For measures across remaining 'self-funded' zones: £19 m for insulation (5979 installs) and £41 m for solar thermal and ASHP (8790 installs) Heat networks costed between £2.5 m – 43 m depending on size and heat source.
11	Public sector buildings	Council-wide – suburban	Addressed all 6 stages apart from socio-economic assessment (Stage 4) because it focuses on public sector buildings.	For council-owned buildings: create Buildings Energy Efficiency and Renewable Heat Plan. Building-by-building measures are provided. For council-owned buildings operated by third parties: Review the use of green leases; ensure compliance with Building Regulations. For non-council owned public buildings: Set up LHEES working group; encourage sectors to develop carbon management plans; share findings of heat network studies with public sector; create supplementary guidance for Local Development Plans; ensure compliance with Building Regulations.	Human resource (ongoing): £45,000 for an Energy Manager and £40,000 for a Building Standards Officer. Capital works: £180,000 for automatic meter reading; £1–1.5 million for low carbon heating. Two potential heat networks costed at £11.5 million (wide area) and £4 million (reduced area). Report also costs capital works on per-building basis. Unclear how many buildings total costings apply to.
12	Cross sector	Council-wide – rural	Elements of all 6 stages are included.	Out of approximately 39,500 domestic properties across the council area, 31% domestic properties suitable for wall insulation, 56% suitable for solar thermal, 4% suitable for ASHP. 82% (of 3217) privately rented properties (PRS) suitable for energy efficiency or low carbon heating.	£59 m and £11 m for fabric and heating upgrades, respectively, across all suitable buildings. In the PRS: £8.1 m and £8.5 m for fabric and heating upgrades
13	Cross sector	Council-wide	Elements of all 6 stages, with a focus on stages 1–4.	Highlights semi-detached houses as a key focus area; flats have the highest average EPC rating, and encouraging habitual behaviour change is recommended for this sector. The most common non-domestic building type is retail/ financial/ professional services and these often use electric heating - they are recommended for prioritisation. This LHEES is council-wide with detailed socio-economic analysis on exemplar areas (urban, suburban on-grid, and rural off-grid)	Estimated for 3 exemplar areas. Urban: £18.9 m for a District Heat network; £978,000 - £28.5 m depending on insulation type being installed. Suburban: £920,500 - £29 m depending on insulation type being installed; £2.1 m for gas combi boilers; £8.1 m for biomass boilers. Rural: £1.5 m - £46.3 m depending on insulation type being installed; £9.2 m for ASHP and £4.2 m for GSHP. Unclear how many buildings these costings are for.
14	Domestic	Council - wide	Elements of all 6 stages were included. Stage 6 with the costing and phasing of delivery programmes was unclear.	Recommendations: further research into the best ways to decarbonise heating; develop a strategy for engaging with the non-domestic sector; enhance provision of advice for households; ensure coordination of various energy efficiency programmes already underway; collaborate with Scottish and Southern Energy Networks to ensure grid readiness for decarbonisation.	Estimated costing for individual technologies per property included, but costings not provided on an aggregate level.
15	Cross sector	Case study -	Stages 2, 5 and 6	The analysis area included 1955 domestic properties; 44% (864) had potential loft and wall insulation opportunities; 30% (384) are suitable for solar thermal; 8% (165) suitable for ASHP. Four potential heat networks identified	To install all insulation and heating measures in the buildings identified as suitable, more than £3 m would need to be invested by either homeowners or through grants. Heat networks costed at £2.6 - £21 m depending on size and heat source.
16	Domestic (PRS; social housing; privately owned)	Case study	Focuses on Stage 1	Tested a data processing tool previously used by some English councils. Identified key data gaps and explored the veracity of existing data. Report identifies 49 different datasets, and evaluates their quality and value to developing LHEES. Highlights significant differences in results between the data processing tool and existing data sources (e.g. for case study area, the tool suggests 43% more private	Not costed.

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Local authority	Sector	Scope	LHEES stages completed (for study area)	Recommended measures	Cost estimations
17	Cross-sector	Case study - town	Elements of all 6 stages included	properties are suitable for solar PV than existing datasets suggested). 4382 properties included in the case study analysis; 60% (2611) properties had potential glazing, loft and wall insulation opportunities; 23% (989) are suitable for solar thermal; <1% (19) properties considered suitable for heat pumps where gas was the main existing fuel (heat pump suitability increases to 17% when analysis criteria altered) Report notes limited data on non-domestic properties. Suggests 40% non-domestic properties suitable for ASHP, based on EPC recommendations alone.	For all insulation and low carbon heat in areas eligible for area-based grants and grants to householders (1929 properties): £5.7 m For all insulation and low carbon heat in self-funding properties (2206) in the case study area: £8.7 m. Non-domestic not costed.
18	Cross-sector	Case study – rural off-gas grid	Focus on stages 1–3, and 6	Analysis considered 512 domestic properties; 50% (255) properties had potential loft and wall insulation opportunities; 46% (236) are suitable for solar thermal hot water; 25% (130) considered suitable for ASHP (this increases to 94% when the analysis criteria are altered). Limited data for non-domestic; analysis only possible for 29% non-domestic properties.	For all insulation and low carbon heat measures, the LHEES reports that more than £3.8–6.3 million would need to be invested by home owners or through grants.
19	Private rented sector; PRS and rural off-gas grid settlements	Council-wide; detail on PRS and specific off-gas areas	Stages 1 and 2 completed. Stages 3 and 4 not completed. Some prioritisation of off-gas grid areas (Stage 5) and costing of delivery programmes (Stage 6).	63% of the entire PRS stock (over 15,000 properties) was identified as being suitable for energy efficiency or low carbon heating interventions. 25% of domestic properties in the region are off-gas – ASHP and solar PV considered to be the most effective way of reducing carbon and fuel costs for these properties. 9 potential district heating opportunities identified for the council's 71 public buildings that operate in high enough heat density areas; these would mostly centre on primary schools in the area that have recently installed biomass boilers.	All potential upgrades within the PRS would cost £38 million. Some properties suitable for HEEPS:ABS- with an estimated potential of up to £8.6 m for both private rented and owner occupier tenures. Suggested improvements across all off-gas areas in the council area would cost £39 million
20	Cross-sector	Case study areas	Completes stages 1–3, 5 and 6	Domestic: for 59% (2037) properties in the case study areas no suitable insulation measures or heating upgrades were identified. 34% (1169) properties identified for potential loft and/or wall insulation. 13% suitable for solar thermal; 7% suitable for ASHP (properties connected to mains gas were not considered suitable for ASHP in this analysis). Report identifies three potential heat networks Notes only 10% and 18% of non-domestic properties with available data on building type and fuel type in the two case study areas.	Domestic: report estimates more than £8 million to install all measures, including heat decarbonisation (through home-owner investment or grants). Estimates for heat network installation range from approximately £1.5 million - £6.8 million, depending on size, fuel type and location.
21	SMEs; public sector; off-gas domestic properties	Case study – off-gas grid	Elements of all 6 stages are included.	For the 2736 properties considered across four off-gas case study areas: 27% domestic properties are suitable for wall insulation; 60% suitable for solar thermal; 13% are suitable for ASHP (this increases to 52% if analysis criteria are altered). Socio-economic analysis identified a priority area for energy efficiency measures.	£3.1 million for all possible fabric upgrades and £11.4 million for all low carbon heating upgrades. Costing only provided for domestic sector.

<sup>a</sup>LHEES reports for two local authorities were unavailable at the time of writing.

<sup>b</sup> Cross-sector incorporates Domestic (owner-occupied, private rented sector (PRS) & social housing) and non-domestic (council-owned, other public-sector and privately owned) properties.

<sup>c</sup> Areas deemed suitable for the Scottish Government's existing grant schemes targeting areas of multiple deprivation and fuel poverty, for example the Home Energy Efficiency Programmes for Scotland: Area Based Schemes (HEEPS: ABS).

<sup>d</sup> 'Self-funded' is used by Scottish Government to indicate finance from owner occupiers and private landlords, who are deemed to have sufficient income to support such action (for example, this excludes those in areas of multiple deprivation).

<sup>e</sup> Several of the LHEES pilots utilised the same Home Analytics database & modelling tool. At the time of the pilots, this prioritised cost of fuel and so domestic properties connected to the gas grid were usually deemed unsuitable for Air Source Heat Pumps (because electricity is more expensive than gas). This means that suitability for ASHP tended to be low in the pilots. More information on Home Analytics is available here: <https://energysavingtrust.org.uk/service/home-analytics/>

## Appendix E. Summary of the socio-economic methodology developed for LHEES

The socio-economic methodology<sup>7</sup> follows 5 stages:

1. Define the problem, generate alternatives and establish criteria
2. Assign criteria weights
3. Construct the evaluation matrix
4. Apply scoring to assess projects
5. Rank the alternatives

Within the methodology, recommended criteria to consider and their weightings, have been provided (see Table). For a given project, each criterion then receives a score. The score is between 1 and 5 (between 1 and 3 = detrimental impact, 3 = no changes, between 3 and 5 = positive impact). Within this methodology, teams developing LHEES can then apportion their own scoring to different potential interventions. The aim of this exercise is to establish the suitability of energy efficiency and heat decarbonisation measures for achieving carbon targets alongside broader economic and social goals.

Criteria	Weighting
Carbon emissions	0.30
Fuel poverty	0.30
Financial	0.08
Local economic	0.08
Local environmental	0.08
Social	0.08
Resilience	0.08
Total	1.00

Criteria and weightings that feature in the socio-economic assessment

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