

Local Heat and Energy Efficiency Strategies: Phase 1 Pilots

Technical Evaluation Report

September 2019



Scottish Government
Riaghaltas na h-Alba
gov.scot

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Abbreviations

ABS: Area Based Scheme
AQMA: Air Quality Management Area
BDR: Baseline Data Reporting
BEIS: Department for Business, Energy and Industrial Strategy
DHN: District Heating Network
EE: Energy Efficiency
EPC: Energy Performance Certificate
EST: Energy Savings Trust
HDC: Heat Decarbonisation
HEED: Homes Energy Efficiency Database
HEEPS: Home Energy Efficiency Programmes for Scotland
LHEES: Local Heat and Energy Efficiency Strategies
LLP: Limited Liability Partnership
MCA: Multi Criteria Analysis
PfG: Programme for Government
SAP: Standard Assessment Procedure
SHCS: Scottish Housing Condition Survey
SEEP: Scotland's Energy Efficiency Programme
SEPCR: Scottish Energy Performance Certificate Register
SIMD: Scottish Index of Multiple Deprivations
SME: Small and Medium Enterprise

1. Introduction

1.1. Background

The Scottish Government designated energy efficiency as a national infrastructure priority in June 2015, covering energy efficiency and heat decarbonisation of both domestic and non-domestic buildings. The subsequent publication of the 'Infrastructure Investment Plan 2015' gave a commitment to multi-year funding of Scotland's Energy Efficiency Programme (SEEP), which was substantiated in the 2016 Programme for Government (PfG), confirming Ministers' commitment to a minimum of £0.5 billion over the next four years, to support the initial phase of the programme. This programme has now been rebranded as Energy Efficient Scotland and has a dual focus, namely:

- Removing poor energy efficiency as a driver for fuel poverty
- Reducing greenhouse gas emissions through more efficient buildings and decarbonising our heat supply

In developing Energy Efficient Scotland, the Scottish Government is now considering the introduction of a statutory duty for local authorities to develop Local Heat & Energy Efficiency Strategies (LHEESs). LHEES would be the link between long term targets and national policies and the delivery of energy efficiency and heat decarbonisation on the ground. They would allow local authorities to prioritise and target work, whether that is supporting owner occupiers and Small and Medium Enterprises (SMEs) to installing energy efficiency measures or encouraging the development of district heating or other low carbon heat.

In advance of the introduction of any statutory duty for LHEES the Scottish Government is funding local authorities to pilot approaches and build capacity. In these pilot projects, local authorities have been asked to develop plans that are long term (20 years) including targets covering all buildings (domestic and non-domestic).

1.2. LHEES Stages

The Scottish Government has consulted twice on LHEES and the second consultation proposed the following six broad stages of development:

- Stage 1: LHEES Preparation – assessment of existing local and national strategies and data availability
- Stage 2: Local authority-wide assessment of existing building stock's energy performance and heat supply.
- Stage 3: Local authority-wide setting of aggregate targets for heat demand reduction and decarbonisation of buildings – for the short-term strategy period and for the long-term duration of Energy Efficient Scotland.
- Stage 4: Socio-economic assessment of zoned energy efficiency measures and potential heat decarbonisation solutions.
- Stage 5: Selection of areas / prioritisation of opportunities for heat demand reduction and decarbonisation of buildings leading to the designation of zones within the LHEES for energy efficiency and heat decarbonisation.
- Stage 6: Costing & phasing of delivery programmes that consider:
 - Requirement to prioritise delivery programmes in time-limited phases
 - Designation of area-based delivery programmes using zoning powers if needed
 - Designation of demand-reduction based energy efficiency delivery programmes

1.3. External Consultancy Support Scope

The Scottish Government is funding local authorities to pilot the preparation of an LHEES to understand the processes of data gathering, objective setting, and the design and prioritisation of local delivery programmes. The pilot projects are providing evidence on appropriate methodology and approach as well the required resources and capacity.

Atkins (and sub-contractors including Changeworks, Carbon Trust and Resource Efficient Solutions LLP) have provided technical support to nine of the twelve local authorities successful in obtaining funding to pilot LHEES through the SEEP (Energy Efficient Scotland) Phase 2 Pathfinder Fund. Each of these local authorities, and the details of the LHEES pilot are summarised in the list below:

- **Aberdeen** – The Ward of Tillydrone, Seaton and Old Aberdeen. The area is mixed use including both social and private housing, primary and secondary schools, community buildings, health services and some small retail and commercial development. Part of the University is also included in this area.
- **Clackmannanshire** – Alloa & Tullibody. The pilot area includes a mix of social tenure, private rented and owner occupied domestic properties with high levels of social deprivation. The town of Alloa contains over half of the top 20 buildings with the highest heat demand in Clackmannanshire. Tullibody contains two major non-domestic heat loads in the form of GlenOchil Prison and Lornhill Academy.
- **Dumfries and Galloway** - The settlement of Glenluce and surrounding Data Zone contains 529 properties, 314 of which are in Glenluce itself. The area is off gas grid with the majority of properties heated using electric, oil or solid fuel heating systems. The area suffers from a high degree of fuel poverty.
- **Highland** – Inverness Central, Inverness Millburn and Culloden and Ardersier wards combined have approximately 34,122 residents across 15,403 households. There are a number of non-domestic buildings within the area including a hospital, university campus and 2 retail parks.
- **Dundee** – Lochee Local Community Planning Partnership Area is situated towards the west of the city and includes 11 distinct community areas as well as a District Centre, retail, leisure and industrial areas.
- **Glasgow** – LHEES pilot study covering the whole of the Glasgow City Council area, building upon existing strategic documents and datasets.
- **Perth and Kinross** – Located to the North and West of Perth City the pilot area includes areas within all but not the complete areas of the following Council Wards: Perth City Centre; Perth City North; and Strathlay. The pilot area has approximately 4,167 residents across 1,864 households and includes residential, commercial and public sector building stock.
- **Shetland** – The Island of Yell has a population of 966 and covers an area of 212.1 km². It has 506 houses, while commercial buildings consist of shops, shore bases and rural buildings.
- **Stirling** – Stirling Central (excluding City Centre area) and connecting part of Stirling North (Raploch). This covers the areas of Braehead and Broomridge (including Forthside), Torbrex, Raploch, which have community councils with a resident population of 6,835. There are a number of small shops and business units throughout the areas and some larger businesses.

A key feature of the pilot schemes is that, whilst they are all targeted at improving the energy efficiency and decarbonisation of heat, the focus, and indeed the nature of the technical support, was somewhat different for each local authority area. For Aberdeen, Dundee, Highland, Stirling and Perth and Kinross the pilot areas were similar – being urban areas with a mixture of residential properties and business premises but with none of these pilot areas being directly in the city centres. Whilst not a city, the Clackmannanshire pilot was similar in nature also. In contrast, the Shetland and Dumfries and Galloway pilots were in very rural areas without mains gas supplies. Glasgow was something of an outlier in terms of focus as rather than one or more small areas the pilot covered the full city, but the scope of work focussed on socio-economic analysis of already identified options rather than the first principle option identification carried out elsewhere.

Impacts of energy use for transportation and electrical supply were not included. Whilst this is consistent with the scope of LHEES, in practice it is not possible to develop a robust LHEES without due consideration of these adjoining sectors. In particular, electrification of heat and adoption of electric vehicles will both place additional requirements on the electrical network – particularly the ‘last mile’ elements of the distribution network. Going forward, it will be important that the potential impact on the grid is assessed as part of any LHEES development.

In addition to the pilots listed above, further pilots for Edinburgh, Renfrewshire and Borders were also funded as part of the phase 1 LHEES pilots. Whilst Atkins did not provide support to these pilots we have consulted with those councils and incorporated lessons learned and feedback from those pilots into this report. As a general point, this was very consistent with the findings from the work that Atkins supported.

1.4. Scope of document

The success of Energy Efficient Scotland and the implementation of LHEES will depend on the learning from past and present experiences of delivering heat and energy efficiency programmes. As such, evaluation of the pilots is taking place alongside the delivery with the aim of capturing lessons to inform the design of the overall programme. This work is being led by University of Edinburgh but it was also a requirement of the external consultancy support to provide a technical review and evaluation of the LHEES phase 1 pilots.

This document summarises that review and evaluation and includes:

- An evaluation of the availability and usability of existing data sets;
- An evaluation of tools and methodologies used;
- An evaluation of the methodologies suitable for the socio-economic assessment of the measures identified in LHEES;
- An evaluation of the replicability of methodological approaches for area-based assessments for zoning and socio-economic assessments;
- A review of the six broad stages of LHEES development (see section 1.2);
- An evaluation of the quality of the pilot LHEES;
- Recommendations for the future development of LHEES.

As noted above, the University of Edinburgh is leading the work to capture general lessons learned and therefore our commentary / review in this report is restricted to the technical elements of the LHEES delivery. Specifically, we have not made comment on issues such as resourcing or funding – instead, the Atkins view on these has been provided separately to University of Edinburgh for incorporation into the overall lessons capture.

2. Data requirements

2.1. Data sets utilised

We have provided a summary of the data sets used in Appendix A.

2.2. Commentary

It may seem obvious, but the right data is needed for the right purpose, so choice of data is critical. Access to the right quality data, at the appropriate level of detail, is essential for the delivery of a high quality and robust LHEES. However, collecting and maintaining data sets is a resource intensive (and hence costly) exercise and as part of the learnings from this assignment we have reflected on how we used each data source and the relative merits of each. This analysis is presented in Table 2-1 and should be helpful when considering which data sets are most worthy of further effort and investment.

From our experience in delivering the pilots, in selecting the data sets to be used we would recommend that a number of factors be considered:

- **Policy and data**
 - Policy is a key driver in deciding what data is needed to support evaluation of opportunities, and subsequent monitoring and review. We undertook an initial policy review and prioritisation to guide the data sought.

- **Expertise and approach**
 - Different local authorities have different levels of expertise and may wish to use different approaches. For example, only some have specialist expertise in data processing or capability for using geographic information systems. Nor is there consistency in preferred software to be used. In the pilot programme we generally attempted to deploy a standardised approach across the different authorities but this might not be the most appropriate decision going forward in all cases.

- **How the data will be used**
 - Data can be better suited to some use cases than others. For instance, the generic information on building heat use is helpful in terms of identifying potential anchor loads for district heating networks but is not sufficiently accurate at the level of definition needed to actually determine the feasibility of a district heating network and significant further information would be required to actually progress the design of any scheme.

- **Data quality and potential conflicts**
 - In any data driven approach, the quality of the data is critical in terms of ensuring robust conclusions. There can be a perception that data that is generated and owned locally is of 'better' quality than national datasets but it is important to note that this is not always the case. Some of the data sets include a 'confidence' measure

The process highlighted a number of lessons that could improve the data in future:

- The data available for domestic properties is much more comprehensive than for non-domestic properties. This was a significant inhibitor in terms of preparing an LHEES for the non-domestic sectors and is discussed further in section 2.3
- In order for data to be used it requires the consent of those who control a particular data set not just to provide it which can be a time consuming process in terms of obtaining necessary consents. It is also important that the consents do not constrain the intended use (for example, being able to make the

data public to justify conclusions / recommendations) and that the data is either provided in a suitable format or in a form that can be readily manipulated to fit the data structures employed.

- It would be worthwhile giving further thought to how data sharing could be facilitated to give data controllers the confidence to share data for these projects even when energy and climate change isn't the primary focus of the initial data collection
- The work highlighted the value of public sector data, and central collation of key datasets such as the Scotland Heat Map and Home Analytics.
- Some authorities highlighted issues where local data had not been collated into national data sets in time to allow them to be used in one of the Scotland wide datasets. Ideally data collection can be synchronised to minimise this risk.
- The Scottish public sector collects a wide range of data. This data has proved very valuable in revealing building energy opportunities through the LHEES work. It is important that the public sector continues to collect and maintain this data and expansion of the data collected (particularly in terms of the non-domestic properties) will improve the ability to deliver future LHEES.
- Local knowledge and data can be used to check and validate data and add greater depth. It can only really be used in the long term if it is turned into data that can be integrated with the baseline, preventing loss where someone leaves

A point to note, from both the Atkins supported pilots and others, is that the baseline data collation and manipulation into the right format to be used for subsequent analysis was quite time consuming. It is therefore important going forward that, where possible, standardised approaches are adopted to avoid the inefficiencies that would be created by each council developing their own bespoke methodologies and tools.

Data Set	What did we use it for?	Which councils / types of areas was it particularly useful for?	How important is it? How good was the quality / accuracy?
Scotland Heat Map	Used if individual council data sets were not provided for data needed as per below. Also used as the main property list if council data was not provided.	Where councils did not provide a full list of properties in study area with heat demand, archetype, and age	If council data did not exist, vital to the study. This is a useful back-up to data held at local levels by the councils and was essential in the cases where particular councils did not have (or were unable to provide) equivalent data sets. For example, two councils provided full address lists, with another two providing address lists only for public or council owned buildings.
<ul style="list-style-type: none"> Heat Demand 	In the fuel poverty analysis to estimate energy bills at Data Zone level, Also, in the EE and HDC analysis, heat demand allows us to identify potential DHN, and cost for new technologies.	For all councils	Very important – the bulk of our EE and HDC costing would not be able to take place without it. Similarly, with comparing the heating performance to the industry benchmarks. Confidence level 5 is taken from billing data, however the majority are lower confidence levels and are calculated using various assumptions and benchmarks. Having more billing data to contribute would make the heat demand, as a whole, more accurate. The challenge is that it constantly needs updating as things change.
<ul style="list-style-type: none"> EPC data 	Not used separately, but is partly used within the domestic heat demand dataset. EPC data is almost exclusively domestic, as many non-domestic buildings are not currently required to provide and EPC.		Home Analytics includes the EPC dataset. However, it is noted that it doesn't give a separate estimate of annual heat demand. Instead it gives total energy demand which includes space and water heating but also electricity for lighting and ventilation (pumps, fans). EPC data in the heat map includes an estimate of annual heat demand. It is also important to note that Home Analytics only covers the domestic sector.
Information from councils	(As part of the BDR data) Identifying opportunities for domestic energy efficiency (wall and loft insulation) and low carbon heating upgrades (solar thermal and heat pumps).		
<ul style="list-style-type: none"> Housing stock 	Address list, tenure, sometimes additional information like archetype, age, construction, EE measures etc – councils hold different information	For all councils	Adds to tenure information which is needed for the weighted spatial analysis. Properties more favourable for works if owned by the council
<ul style="list-style-type: none"> Local development plan(s) 	Local development plan.	For all councils.	Can be helpful to know where new developments are coming, might be able to install decarbonised heat options, rather than retrofitting – not essential for analysis but useful for decision making and understanding potential future loads.
<ul style="list-style-type: none"> Project register 	Energy consumption information and EE measures.	Very rarely supplied	Varies council to council. Home Analytics data used, for domestic properties, when this did not exist. A lot of the data was based on areas and not properties, and could not be tied to the property without a UPRN. If it did have UPRN attached, then it gave information on EE measures and energy consumption for a property.
<ul style="list-style-type: none"> Assessor domestic 	Property age, property archetype, floor area.	For all councils	These are essential to be able to identify opportunities and compare heat usage to benchmarks.
<ul style="list-style-type: none"> Assessor non-domestic 	Property age, property archetype, floor area.	For all councils	These are essential to be able to identify opportunities and compare heat usage to benchmarks.
National datasets			
<ul style="list-style-type: none"> Fuel poverty information 	A number of data sources were used. Primarily the Changeworks fuel poverty map together with Data Zone level SIMD income deprivation and Council Tax Banding A-C for ranking areas suitable for domestic area-based granting schemes (i.e. HEEPS:ABS).	For all councils	A single approach to this could be helpful. The Changeworks fuel poverty map is dated as it was created a few years ago. Particularly in areas where fuel prices have come down the last years (i.e. with many households on oil) the rates will be a bit lower. Nonetheless, the relative differences between the areas make it useful to rank Data Zones for recommending domestic area-based granting schemes (i.e. HEEPS:ABS), and will change with the new fuel poverty definition (this is highlighted in the fuel poverty analysis report). There is currently no housing costs data available to update the fuel poverty map to the new definition.
<ul style="list-style-type: none"> Home Analytics 	Identifying opportunities for domestic energy efficiency (wall and loft insulation) and low carbon heating upgrades (solar thermal and heat pumps). In the fuel poverty analysis, the EE-bands were used to do a rapid assessment of how many properties with no identified upgrade that have an EE-band of D or lower. Also includes a modelled estimate of fuel poverty likelihood.	For all councils	This dataset is a collation of several other datasets. Accuracy depends on the amount of data from the feeder datasets such as HEED and EPCs that the address level data is based on. We identified some errors between address level data in Home Analytics and corresponding EPC certificates (internal brick walls on EPCs ended up in Home Analytics as external walls, rather than cavity walls). EST have been informed and mentioned their methodology will be adjusted. This was not a systematic check though. Vital when councils did not provide any information. Most of the information would be blank without this dataset. The Home Analytics is a useful coordination of several domestic datasets. However, as a combined dataset this does constrain some use of the data, for example to ensure it is not combined with another dataset in a way that double counts data. Having the separated feeder data provided in addition, as with the Scotland heat map would allow more flexibility with the use of this data.

• Scottish Federation of Housing Associations	Tenure	For all councils	Additional tenure information if not supplied by council. Information only partial. Came from original heat map dataset. Does not include Council Housing.
• National BEIS data	In the fuel poverty analysis to estimate energy bills at Data Zone level, together with heat demand data.	For councils for which a fuel poverty analysis is undertaken	The good thing about BEIS data is that it is real consumption rather than modelled energy consumption, which we know can differ substantially. The electricity consumption per meter, however, should not be confused with household level consumption as some properties will have more than one meter. An adjustment of the BEIS data to contain average consumption per household would be a major improvement. The BEIS data is already used to scale the domestic heat demand estimates in the Scotland heat map. It is noted that the BEIS consumption data only covers gas and electricity (although these are the dominant fuel types for most of the pilot areas). It is also only available down to a data zone level rather than for individual buildings.
• Non-domestic EPC	EPC rating, age, fuel and archetype where it didn't exist elsewhere.	For all councils	Most of the time non-domestic EPC data did not exist anywhere else
• Listed buildings Scotland	Constraints	For some councils	Highlight properties that may be constrained on works to be done
• Conservation areas Scotland	Constraints	For some councils	Highlight properties that may be constrained on works to be done
• Gardens and designated landscapes	Constraints	For some councils	Highlight properties that may be constrained on works to be done
• Scheduled monuments	Constraints	For some councils	Highlight properties that may be constrained on works to be done
• Ancient woodland	Constraints	For some councils	Highlight properties that may be constrained on works to be done
• Census 2011 data	Using the Census geo-demographic area classifications for raking Data Zones that are more likely to be 'able to pay' than others.	For all councils	This data is domestic only. It is getting more dated per year, as the Census is only repeated every ten years and the last one stems from 2011. Census data does hold information on heating type. Alternatively, Mosaic data from Experian could be purchased (though some of the relative Mosaic data is based on census data), with the drawback of it being another cost to the project. Used for sense check only.
• Scottish Index of Multiple Deprivation	Using the SIMD income deprivation (together with fuel poverty and Council Tax Banding A-C at Data Zone level) for ranking areas suitable for domestic area-based granting schemes (i.e. HEEPS:ABS)	For all councils	From the SIMD, the income domain, rather than the overall index, is the more useful one recommending areas for area-based schemes. The housing domain of the SIMD is currently not very relevant to LHEES production, as it is based on overcrowding and central heating data, not energy efficiency. Unable to feed in to weighted spatial unless another indicator of deprivation is sourced.
• Special protection area	Constraints	For some councils	Highlight properties that may be constrained on works to be done.
• District heat networks	To identify if there were current DHN.	For some councils	Important when looking at other district heating options, options to consider expanding the current networks or improving on them. This came from the Scotland Heat Map or local authority.
• Environmentally sensitive areas	Constraints	For some councils	Highlight properties that may be constrained on works to be done.
• Site of special scientific interest	Constraints	For some councils	Highlight properties that may be constrained on works to be done.
• Special areas of conservation	Constraints	For some councils	Highlight properties that may be constrained on works to be done.
• Council tax data at Data Zone level	Using Council Tax Banding A-C at Data Zone level (together with the SIMD income deprivation and fuel poverty data) for ranking areas suitable for domestic area-based granting schemes (i.e. HEEPS:ABS)	For all councils	Alternatively, council tax data from the council can be used, or summarized address level data from Home Analytics. This is the underlying data for the Scotland Heat Map. Data is provided by Assessors to Councils. The Council tax band is used as a proxy to target different housing types by some Councils.
• Gross household income distribution estimates at Data Zone level	The spread in weekly income at Data Zone level, together with the estimated energy bills and projected savings through energy efficiency installs, was used in the fuel poverty analysis to estimate potential fuel poverty alleviation through installing domestic upgrades.	For councils for which a fuel poverty analysis is undertaken	Gross household income distribution estimates at Data Zone level are dated as they were created in 2014. However, they are the most recent publicly available income estimates at Data Zone level, so favoured over income related data from the Census 2011.

Table 2-1 - Data set commentary

2.3. Data for non-domestic properties

In general, there is better national data for domestic properties than non-domestic. This reflects ongoing programmes to support energy measures in the domestic market.

In general, there is relatively good data for domestic properties. However, for non-domestic properties, it was a general finding of the pilot that there was insufficient data to enable a robust LHEES to be developed for the non-domestic sector. In particular, the following issues were common across all the local authorities in the pilot:

- It was not possible to quantify the carbon emissions that the non-domestic properties were responsible for (and hence not possible to quantify the savings) as fuel type for non-domestic properties is largely unavailable. Clearly, this data does exist within the energy supply companies. However, there are challenges as the data is by meter. This means there will be places where there is more than one meter in a building, and also more than one building supplied by one meter. An exercise of matching meters to Unique Property Reference Numbers would need to be undertaken. We would recommend that the potential for making this available to the local councils is investigated.
- Assessor data provided valuable information for the largest number of non-domestic buildings, although this was not as complete as the Assessor domestic data. Assessor data was not always available for every local authority or every building. A significant (30% to 60% depending on council area) portion of non-domestic properties did not have an allocated building type, generated as part of the Scotland heat map within the Assessor Non-domestic dataset. We understand this dataset is incomplete due to limits to the UPRN matches within the Assessor Non-Domestic data when it was first incorporated into the Scotland heat map. The lack of the Assessor Non-domestic data made identification of potential measures more difficult.

The ideal outcome would be a range of data that provided more complete information on non-domestic buildings similar to that available for domestic buildings. The public sector data was good and is managed and controlled by the public estate so maintaining and updating public data should not be resource intensive. The public sector data is valuable but only accounts for a small proportion of the total non-domestic buildings.

There are a number of options for improving business data:

- Updating the Assessor data within the Scotland heat map, assuming the UPRN match is improved.
- All buildings could be physically surveyed. This would require a significant resource. A process of updating the data regularly would be required as change of business is reasonably regular.
- In broad terms a refresh of data within the existing Scotland heat map would be useful where the data has changed or been improved sufficiently to justify this work. Clearly utilising existing data that has already been collected by the Scottish Government or its agencies or using its funding is the lowest cost option. Enabling this approach and supporting bodies to supply data and understand and manage liabilities will be critical to this approach.
- The Scottish government has now funded a further round of Local Heat and Energy Efficiency Strategy pilots. A number of the other pilots, beyond this one, have included or focussed on business data. Understanding the data used and the processes from these would likely help understand the options for the Scottish Government.

An approach investigating a range of data sources that together provide an improved cohesive dataset for business is a potential approach. Scotia Gas Networks provide data to the Energy Saving Trust for domestic energy modelling. As such Scotia Gas Networks could be approached to enquire if they could provide data to the Scottish Government on both domestic and non-domestic. This may also open up opportunities for the Scottish Government to talk with electricity utilities regarding provision of data which could also include key information such as peak load demand requirements for business that could be used to help differentiate demands /zones across Scotland.

We would also note the following additional points:

- Some local authorities collate business data. It is not known how wide spread this data is across Scotland. There is unlikely to be a standard approach to data collection. The data does reveal that a significant number of businesses are in domestic buildings, which has potential impacts on the different Energy Efficient Scotland programmes which could include targeting buildings that are both domestic and non-domestic.
- The Scottish Government fund a wide range of activities. Consideration should be given to collection of data linked to public funds, where this would be valuable in the energy transition. For example, the Energy Efficient Scotland area work could be used to collect data on building structure and use, as well as collating any improvements in a way that can be used in a Scotland wide dataset. Scottish Water licence companies who place warm / hot water into the sewer system, and this would be valuable information showing where potential opportunities for unused heated water that is currently a waste product. Resource Efficient Scotland run programmes that provide support for business around energy measures that would be ideal information for this work.
- The Scottish Government manages regulatory functions which also have the potential to provide data. Good examples of this would include: SEPA pollution regulatory functions, local authority for air quality and environmental regulatory roles, Local authority for development plan and planning function roles.
- Some national datasets do exist, but these are currently provided in area-based formats and not down to building level. For example, the NOMIS dataset which identifies business size (ie SME or other) and Standard industry Categorisation (SIC). NOMIS is mainly available at intermediate zone.
- Ordnance Survey/Address Base may provide some information on building use. However, we understand that only Assessor data currently provides floor areas.

The Scottish Government may give consideration for how data is collected and for what purpose, as this could enable more data to be easily shared for public benefit. Strong data systems and approaches will be needed to ensure confidence in data sharing. This links clearly to the Scottish Government stated approaches to public data and open data. It is noted however that this is not within the direct control of Scottish Government and compelling controllers to provide data may not be possible without specific legislation in that regard.

We note that a useful enhancement for the data sources would be to develop a confidence measure such that those using the data know its limits and the reliability of any conclusions drawn from it.

Making the base data open, or available under licence, is also a potentially good strategy that would allow others to explore options for using the data in different ways and coming up with new approaches that support the Scottish Government agenda.

For the councils participating in the pilot, the lack of data for non-domestic properties is perhaps the single biggest frustration and issue in preparing a LHEES. If the data sets for these properties could be improved this would very significantly improve the quality and robustness of the LHEES. This is a significant opportunity for the future.

However, we would note that in terms of achieving the aims of the LHEES (lowering carbon emissions and removing poor energy efficiency as a driver of fuel poverty) improving the data is only one aspect. Actionability of measures for the private non-domestic sector (which is the vast majority of non-domestic buildings) is an issue. Most properties are rented (with many being small businesses) and there is a lack of alignment between the cost of investments in improving energy efficiency (which would be borne by the landlord) and the benefits of that investment (which would be realised by the tenant). We would recommend that work be undertaken to determine how to improve the actionability of measures in parallel to any investment in improving the quality / completeness of the data.

3. Socio-economic assessment

3.1. Socio-economic assessment conducted in the pilot

Of the councils participating in the LHEES pilot, support for socio-economic assessment of options was provided for Glasgow and Highland.

Under a separate consultancy contract with the Scottish Government, though across very similar timescales (April-December 2018), the Carbon Trust has been developing draft methodologies for socio-economic assessments; one methodology for LHEES and another for the consenting process for proposed district heating developments.

The Carbon Trust developed the draft methodology for LHEES concurrently with providing support to Glasgow and Highland in the application of the methodology during their pilot LHEES programmes. This allowed the initial iterations of the draft methodology to be tested and refined in practical 'real world' settings. Slightly different 'work in progress' versions of the methodology were used with Glasgow and Highland. With Glasgow in particular, where the consultancy engagement occurred in the spring of 2018, it was an earlier, less well developed version of the methodology which was utilised, and this process helped to inform some refinements to the methodology and the criteria, impacts and indicators on which it focuses.

3.2. Multi-Criteria Analysis

The purpose of conducting a socio-economic assessment is to identify and analyse the direct and indirect impacts of a given strategic intervention, relative to its closest alternative. In contrast to technical and financial analyses, socio-economic analysis estimates the impacts of a project or programme beyond those directly involved in the formulation and negotiation of the content and scope of what is being delivered. In particular, socio-economic assessments of energy projects allow consideration of impacts on fuel poverty and decarbonisation on a like-for-like basis with financial and technical viability assessments.

Multi-Criteria Analysis (MCA) has been identified as the most appropriate method for appraising the socio-economic impacts of LHEES.

MCA can be defined as a socio-economic decision-making tool that establishes preferences based on an explicit set of pre-defined objectives. All impacts are assessed, whether they can be monetised or not, through the development of a scoring system. This translates into a final value which can be used to rank and identify the most attractive intervention(s).

The benefit of adopting the MCA approach for socio-economic analysis stems from its ability to consider appropriately a wide variety of project impacts and outcomes, which can then readily be taken into consideration by decision-makers. The MCA methodology offers a formal approach yet with greater flexibility than other forms of socio-economic assessment. It allows either a single preferred option or a list of potential options to be appraised and prioritised by consideration of a range of different expected impacts, some of which can be monetised and some of which cannot, drawing on a diversity of numerical data and qualitative assessments.

A key outcome from the pilots was the development of the criteria that would be used for the socio-economic analysis. The key to determining the criteria is to develop measures that directly relate to the aims and objectives of LHEES whilst also having clear indicators that enable quantitative assessment.

The table below shows the criteria, impacts and indicators used in the pilot studies where socio-economic analysis was undertaken. Further guidance is provided on the Scottish Government web-site¹.

¹ <https://www.gov.scot/publications/guidance-strategy-level-socio-economic-assessments-draft-methodology/pages/3/>

Criteria	Impact	Indicator
Carbon emissions (30% weighting)	Carbon emissions	GHG Emissions (tonnes CO ₂ e)
Fuel poverty (30% weighting)	Fuel poverty	Risk of fuel poverty within an area
		Change in unit cost of heat (£ per kw)
		Change in average EPC rating
Financial (8% weighting)	Project costs	Capital costs
		Operation & Maintenance costs
		Fuel costs (£)
Local economic impacts (8% weighting)	Jobs supported	Number of jobs supported
	Skills	Skills supported and developed
	Regeneration	Regeneration level
Local environmental impacts (8% weighting)	Air quality	Volume of pollutants (tonnes of nitrous oxide, particulate matter, sulphur oxide and ammonia)
	Noise	Change in noise level (decibel)
	Built environment & local heritage	Quality of built environment
	Biodiversity & ecosystem services	Proportion of green field sites / woodland/ wild habitat
Social (8% weighting)	Health and wellbeing	Improved thermal comfort
	Time available	Time available to work
	Community	Proportion of recreational community space
	Consumer acceptance	Acceptance of proposed intervention
Resilience (8% weighting)	Local energy security	Reduction in imported fuel - national vs international sourcing of fuel
	Alignment with current regulation	Meets current legislation / regulatory requirements
	Energy demand	Reduction in demand

Table 3-1 - Criteria, Impacts and Indicators used for LHEES pilots

3.3. Methodology

3.3.1. Identification of projects / opportunities

The first step was to identify the projects / opportunities for consideration in the socio-economic analysis. These should be selected by the responsible council and can be informed by the analysis and options appraisal work described elsewhere in this report.

3.3.2. Data preparation

A project owner is needed to take responsibility for ensuring that there is sufficient understanding of and data about each project proposed for inclusion in the MCA process for LHEES. If the project owner is clearly identified from an early stage they can oversee the development of the project and ensure that, as far as possible, this development process addresses the requirements for the data needed to feed in to the MCA.

For the pilot process, the Carbon Trust was heavily involved in this data preparation but it would be anticipated that in future LHEES this would be an activity led from within the council.

3.3.3. Workshop

Following preparation of the project / opportunity list to be considered and compilation / development of the required supporting data, the next step is to hold a workshop to score the different projects / opportunities against the framework presented in Table 3-1. The workshop presents an opportunity not just to inform a selection decision in an auditable and robust manner but also to ensure that stakeholders from across the council have the opportunity to contribute and get involved. Therefore, it is very important to the success of the process that the right people are invited and that sufficient notice is provided to maximise attendance.

3.3.4. Write-up and results

The outputs from the workshop are documented as a record of the meeting. This provides a semi-quantitative audit trail for project / opportunity prioritisation and, due to the involvement of multiple stakeholders, obtains and records buy-in for the outcomes from beyond the immediate LHEES project team.

For both Glasgow and Highland councils, the socio-economic analysis process was well received and considered to be of significant value. We feel that the process should be a key tool that is made available to, and recommended to be used, councils preparing LHEES.

4. Options appraisal

4.1. Alignment with council policy priorities

Once the baseline data for the areas under consideration has been agreed and established, the next step in developing the LHEES was to assess the options for energy efficiency and heat decarbonisation.

The starting point for this should always be the policy priorities for the local authority and, as has been noted, these were taken into account prior to commencing data collection. The key local authority level documents that were considered for the pilot projects included:

- Local Outcomes Improvement Plan
- Local Development Plan
- Local Housing Strategy
- Fuel poverty strategy
- Sustainability, energy and Climate Change Strategies

The LHEES overlaps with a number of areas of council responsibility and it is important that the options appraisal is consistent with council priorities.

4.2. Energy efficiency opportunities

4.2.1. Fabric first

In determining the LHEES, priority is given to so-called 'fabric first' options – that is, improvements to the energy efficiency performance of the building that reduces the overall energy requirements. This can be seen as a low regrets option as, regardless of any subsequent heat decarbonisation, reducing energy demand will always assist in meeting the goals of the LHEES.

4.2.2. Domestic properties

For every building in the area under consideration we evaluated the potential for the following:

- Loft insulation
- Wall insulation (cavity, internal and external)

Information on glazing was available for some of the local authorities but energy savings potential was not assessed for this measure as adding double glazing tends to not increase the SAP score much², and is not effective unless there is wall and loft insulation also installed. It is also very difficult to make a generic assessment of glazing requirements for a particular property.

Installation costs, and savings in annual running costs and CO₂ emissions per insulation measure were based on property type, using data from the Energy Saving Trust (EST) (last update April 2018).

² <https://www.gov.scot/publications/developing-regulation-energy-efficiency-private-sector-housing-reeps-modelling-improvements-target-stock-main-research-report/>

4.2.3. Non-domestic properties

Analysis of the non-domestic properties is more complex than the domestic. This is due to the much wider range of building types, nature of ownership, and, primarily, the limited data on the non-domestic stock. In the development of the pilot LHEES we evaluated the potential for the following:

- Roof insulation
- External wall cladding
- Improved controls
- Improved user behaviour
- Air tightness improvements
- Glazing improvements
- HVAC insulation
- Boiler replacement
- Heat recovery
- Low-flow hot water
- Destratification

For the, very small, number of buildings with swimming pools we also considered pool backwash optimisation.

Non-domestic buildings which had a building type assigned to them had their types pushed into the CIBSE TM46 building categories. This was not possible for non-domestic building where the building type was unknown. There are 29 typical building types and by sorting the buildings into these categories, the energy performance of the building can be benchmarked. Unfortunately, this approach is limited by the number of buildings that had an assigned type. On average across the eight study areas for which Atkins carried out the Options Appraisal, only 41% of non-domestic properties had an assigned building type, for the individual areas these range from 15% - 66%. It is worth noting that the original Assessor's data may have better information on building types than the Scotland's Heat Map data used as the basis for these pilots. When the Scotland's Heat Map data was originally populated from the Assessor's data the lack of linkage to UPRN meant it was not possible to fully incorporate the building type data that had been collected. Revisiting this could prevent the need to re-survey in order to close the data gap for non-domestic building types.

4.2.4. Commentary

For the domestic properties, there was good information available in the data sets which enabled a robust analysis of energy efficiency opportunities. However, for many councils, the 'low hanging fruit' of loft insulation has already been undertaken and for social housing it is often the case that cavity wall insulation measures have also been undertaken. As LHEES progress other measures, such as External Wall Insulation may need to be considered for a wider group of properties.

Unlike domestic properties available data-sets do not typically provide sufficient information on non-domestic fabric and services nature / condition / age to support the same level of confidence in the analysis. Broad averages have to be applied across the building stock, based on the perception of the typical condition and servicing solution of different types of buildings.

Reflecting the greater complexity of non-domestic buildings, and the fact that many buildings are not owned by the business that occupies them, controls measures and user behaviour interventions have been considered to be the priority measures across most building types, along with fabric measures, on the basis that it can be much more expensive and challenging to add fabric efficiency measures to non-domestic buildings, and controls measures can be effective in reducing energy wastage.

As noted in section 2.3, the data analysis and measure identification for non-domestic buildings is significantly constrained by the available data sets. We consider that the methodology that has been developed could be very useful for councils to form strategies in an efficient and auditable manner but only if significant improvements in the available data are made.

In the pilot studies, Dumfries and Galloway council physically surveyed the buildings which enabled building types to be assigned. However, that area was a small village with only about 100 properties – for larger areas the time required to perform such a survey would be significant. Even having carried out the survey, we were still unable to fully assess energy efficiency improvements for about half of the properties as the fuel type was not known (see section 2.3 for commentary on this).

It is worth noting that due to extensive and ongoing government supported programmes, to improve domestic building energy use, this has provided a valuable source of energy related data. Consideration could be given to investigate if more use can be made of existing datasets to model energy options where data is not available. More analysis is suggested to consider opportunities to create potential links between domestic and non-domestic datasets such as where building characteristics are likely to be similar; an example would be where a small shop is below a flat and thereby within the same building.

Additionally, more work is encouraged to find ways of using more granular non-domestic data while balancing concerns of business sensitivity and national climate targets.

4.3. Heat decarbonisation options

4.3.1. Measures for individual buildings

As with energy efficiency measures, we divided our analysis into domestic and non-domestic sectors. For the domestic sector we considered the following measures:

Heat pumps

The property type (houses, not flats) and main fuel type (all but mains gas) were used to assess if a heat pump would be a possible heat decarbonisation measure for a property. Properties that were listed buildings were excluded from this selection. Given the likely heat load of a single domestic building and the space requirements for installation of Ground Source Heat Pumps the heat pump analysis for domestic buildings was predicated on Air Source Heat Pumps. Given that the analysis was predicated on an individual building basis there is a question in terms of how communal heat pumps should be considered. This was done in the pilots for blocks of flats but not for, say, a grouping of detached properties.

Solar thermal

Although solar thermal technology does not usually provide space heating, it will reduce the demands for domestic hot water. Solar PV was excluded from this analysis as the (present) focus of LHEES has been directed away from the generation and storage of electricity by householders. However, given the strong synergies with the core focus of LHEES it is recommended that solar PV and electricity storage is considered as part of LHEES development in the future.

For the non-domestic sector, the following individual building measures were considered:

Heat Pumps

Heat pumps achieve significant decarbonisation by using electricity from a decarbonised grid in lieu of natural gas or heating oil, and by providing a far superior efficiency compared to conventional electric or electric storage heating. Three different types of heat pump system were considered for deployment for the larger non-domestic buildings:

Air Source Heat Pumps (ASHP)

Air Source Heat Pumps are available in smaller sizes than the other two options, thus making them the best match to smaller heat demands, with a minimum peak heat demand of 4 kW. As this heat pump is exposed to ambient temperatures, it does not suit particularly exposed areas where the temperature frequently drops well below zero or locations near the coast with saline-laden air.

Water Source Heat Pumps (WSHP)

Water Source Heat Pumps must be located near a water source. The cost for this technology increases the further away from a water source the heat demand is. Suitability for a WSHP was based on a peak load of 350

kW or over, and within 200 m of a river source. This is a rule of thumb suitable for initial screening but further analysis would be required to properly determine viability.

Ground Source Heat Pumps (GSHP)

This technology requires space near-by for the ground loops or boreholes. This can exclude city centre areas that are densely populated and, even for detached properties with a decent sized surrounding green space, installation would be highly disruptive. A threshold was been set of a minimum peak heat demand of 50 kW required for this technology to be considered.

Biomass

This technology requires space for a woodchip / wood pellet store and room for deliveries to be made. As such, localised installations in dense high streets are much more challenging. It is much less likely to be possible to locate in an Air Quality Management Area (AQMA).

Solar Thermal

Solar thermal is theoretically an option for non-domestic buildings, producing hot water. However, it is noted that market trends suggest that where there is space on a roof to mount solar panels, it is more economically sensible to install solar PV for electricity generation. Taking this into account in conjunction with the comments made relating to solar thermal for domestic properties, solar thermal was not considered for non-domestic properties in the analysis.

4.3.2. District heating

4.3.2.1. Methodology

There are two key steps when identifying a potential district heating network; identifying anchor loads and assessing the heat density of the area.

Anchor Loads

Anchor loads are significant heat demands that have high potential to be one of the first connected demands on a network; these are critical to making a network economically viable. For the majority of councils in the pilot we set a minimum anchor load heat demand of 100 MWh/a (based on experience from other studies and projects that Atkins has been involved in) and a further requirement that the building be publicly owned. The minimum heat demand is somewhat arbitrary but serves as a sensible initial screening level. In terms of building ownership, the drivers for looking at public buildings were:

- A district heating network predicated on publicly owned buildings is far more easily 'actionable' than a network that relies on private sector buildings. It means that public sector buildings or social housing can provide revenue certainty for any developer of a heat network which is a critical consideration in terms of actually getting a scheme implemented. There is good support for this approach if one considers that the majority of district heating schemes in the UK were initially supported by public sector anchor loads even if some have now grown significantly from that base.
- Typically, the data available for public buildings is more complete than for private buildings enabling better analysis to be conducted.

Linear Heat Density

Linear heat density is a measure of heat load per meter of district heating pipework. In short, this is an approximation of how much revenue a branch of a network can generate for a given capital cost. This is a useful approximation for identifying areas where a district heating network may be viable. The linear heat densities chosen to be reviewed are 4 MWh/m and 7 MWh/m. Any areas where there are overlapping or large radii for the 4 MWh/m should be considered for a district heating network, with the areas covered by the 7 MWh/m being of particular interest. The lower threshold of 4 MWh/m has been chosen due to this being the typical lowest value for a network to be economically viable, as the heat sales over the lifetime period (20+ years) need to payback the CAPEX investment of the infrastructure.

The linear heat density radii have been applied to the anchor loads, an example is shown in the figure below for the Dundee study area of Lochee. Where a pipe route can intersect multiple radii, this would generate a network with relatively high linear density.

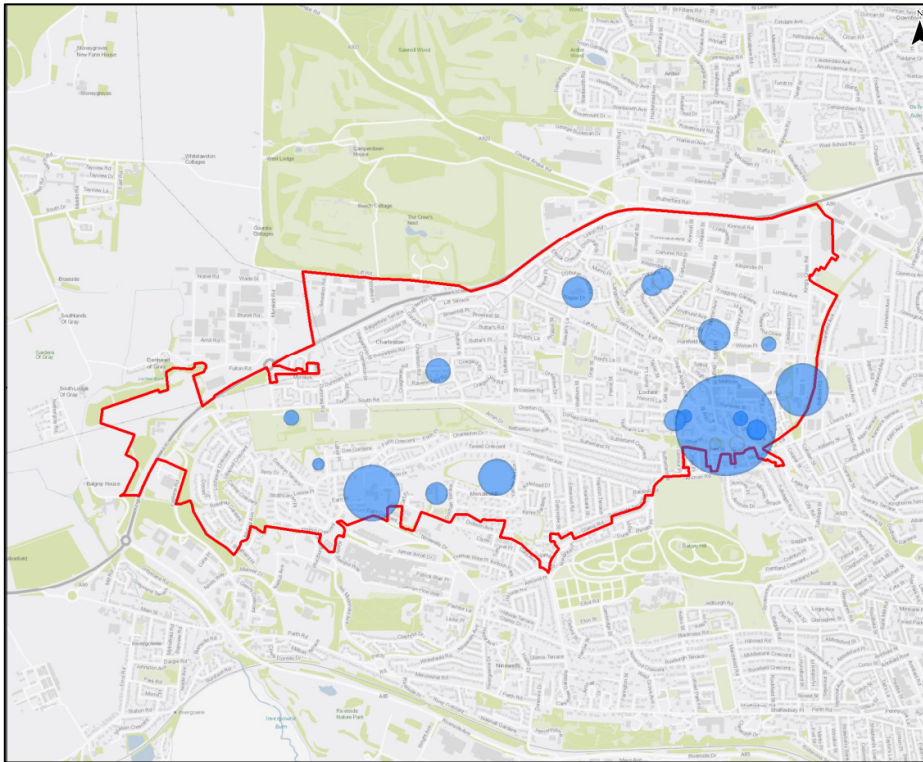


Figure 4-1 - Linear heat density analysis example

Network Identification and Routing

By using the linear heat density of the anchor loads, it is possible to draw an initial network boundary and pipe route. In this study, the pipes have been routed along the roads to limit disruption to houses and gardens. An identified network for the Lochee area, Dundee is shown below.

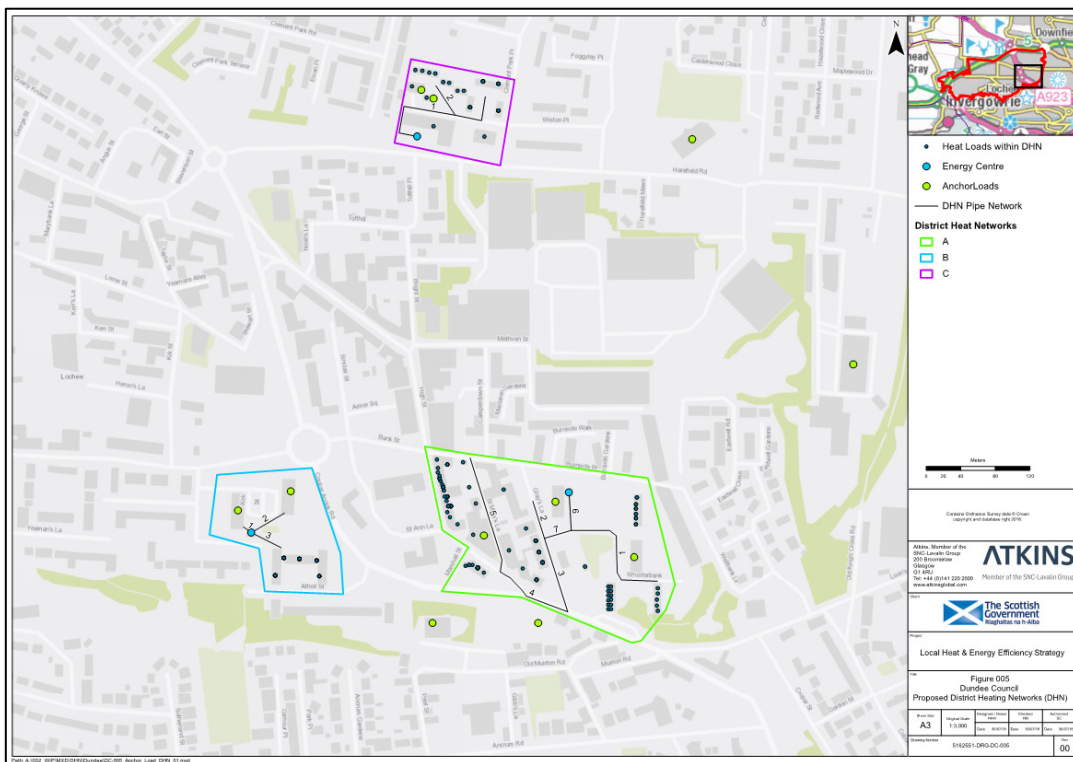


Figure 4-2 - Network identification and routing example

4.3.3. Commentary

In terms of the analysis for individual buildings, and for the non-domestic sector in particular, we again observe that the methodology developed should be beneficial but that development of an LHEES with robust consideration of heat decarbonisation options for all individual buildings will only be possible with improved data on the non-domestic side.

It is interesting to note that across all of the pilots, we did not identify any immediately implementable district heating networks by employing the core methodology outlined above. However, by considering a large private sector heat consumer we were able to identify a potential network in Clackmannanshire and we were also able to identify an opportunity for an expansion to the existing heat network in Aberdeen.

A key reason for this is that we looked at district heating from the perspective of a carbon reduction measure and therefore did not consider gas fired CHP as a fuel source for district heating even though, in many cases, this would be the most economic option. There is an argument that district heating could be developed initially using gas fired CHP and then transitioned to lower carbon fuel options but this was not the approach employed in this particular work.

It could be argued that the areas selected for the pilots were not necessarily the most likely to generate opportunities for district heating. In general, the pilot areas were either very rural (and hence lacking the heat density to make a heating network viable) or mains gas connected (and thereby not priority in terms of Scottish Government policy). District heating has been proven to be a strong option for tower blocks and campus schemes (for example, hospitals and universities) but the pilots either did not include these features or, where they did, the district heating opportunities had already been realised.

Notwithstanding the above, we would observe that a significant driver for viability of a district heating scheme is the availability of existing unused heat such as a waste heat source (for example from an Energy from Waste or Industrial facility). The key reason for this is that for retrofit district heating projects it is hard to make the economics work (in comparison to mains gas) if one has to generate all the heat required – a source of free / low-cost heat is a significant advantage. As the methodology we used was driven purely from a heat demand standpoint these potential heat sources were not considered. We would recommend that, for future LHEES, that analysis of district heating is driven not just from the demand side but also from the heat supply side. This is likely to be a more robust methodology and more successful in identifying potential district heating opportunities.

Clearly improvement of the building fabric and the amount heat demands are reduced can materially impact heat required in any district heating system. This is important to consider in the evaluation and options stages of developing an LHEES, and in future regular revisions.

4.4. Tools and techniques

For the pilots, we utilised both Excel for data storage and processing and Geographic Information System (GIS) for spatial analysis, with some data analysis using Feature Manipulation Engine to assist in the interpretation and explanation of the data. All were required to create and analyse the data. Having different ways of analysing and understanding the data is important. Both data and images aid understanding. Many of the councils also have some level of GIS capability. This approach was generally well received by the councils but one council with a particular strength in GIS noted that they would have preferred a more spatially driven approach. This approach would likely take longer to initially set-up but would likely allow better visualisation of options and would work well with a zonal approach to implementation. It does however require specialist software and resource with the ability to use that software.

From our experiences on the pilot, we would observe that the work was much faster where Scottish Government enabled coordination of the underlying data, such as the Scotland Heat Map and Home Analytics. The work has highlighted further areas where data could be improved. It would be useful if Scottish Government could look at further opportunities for central coordination of data and data sets, coordinating national collection and integration of data. This could add efficiencies to the time of data collection for LHEES and enable standardised tools and approaches to be developed. National coordination of data also releases

local capacity for performing the data analysis and interpretation and for more delivery based work. There are ongoing local skills challenges that government could consider supporting; for example even within the subset of councils taking part in the phase 1 pilot, there was significant disparity in their preferences in terms of software and their capability and resourcing in the use of specialist software such as GIS.

5. Area prioritisation and zoning

5.1. Focus of LHEES

There are two aspects of area prioritisation / zoning in terms of an LHEES:

- Establishing district heating zones to enable coordination between building owners, heat network developers and public authorities around an agreed long-term plan for district heating development.
- Identifying priority areas for the implementation of energy efficiency measures.

However, since in the pilot projects we struggled to identify viable heat networks (as discussed in section 4.3.3) the concentration for the area prioritisation and zoning was on the energy efficiency improvements that could be implemented. The analysis looked at both the aims of heat decarbonisation and of alleviation of fuel poverty.

5.2. Methodology

In terms of area prioritisation, we based our analysis around Data Zones. This is the preferred standard spatial data area identified by the Scottish Government. Using this spatial data area enables policy agendas such as alleviation of fuel poverty to be used in work such as Multi Criteria Analysis. As such the Data Zone is the key small-area statistical geography in Scotland. The Data Zone geography covers the whole of Scotland and the Scottish Government and its partners undertake work to ensure that these nest within other public sector controlled spatial data boundaries, such as Intermediate Zone and local authority. Data Zones are built up from groups of 2011 Census Output Areas and have roughly standard populations of between 500 and 1,000 household residents. Where possible, they have been made to respect physical boundaries and natural communities. They have a regular shape and, as far as possible, contain households with similar social characteristics. This makes them particularly suitable to use for the purposes of identifying LHEES prioritisation areas.

To determine which Data Zones would be most appropriate to concentrate on those that link to the policy objectives of the Council and Scottish Government, In this study we considered the following data sources:

- Council Tax bands
- The Scottish Index of Multiple Deprivation (SIMD)
- The Changeworks Fuel Poverty map

Some local authority staff expressed a preference for either SIMD or the Changeworks fuel poverty map. The Scottish Government could take the opportunity for developing the current work around fuel poverty to review the spatial mapping of fuel poverty. In general, a Data Zone was considered to be 'prioritised' in terms of addressing fuel poverty if the majority of the following arguments held true:

- Fuel poverty rates are higher than the average in the local authority
- The income deprivation in the data zone is higher than the local authority average
- The council tax band A-C ratio is higher than the average for the local authority

We would note that the data zone driven approach does risk missing residents living in fuel poverty within generally affluent data zones.

Of course, the scope of an LHEES is wider than just fuel poverty so we also considered zoning prioritisation for the self-funded (commonly referred to as 'able to pay') sector. For this we utilised the following measures:

- High level of owner-occupied properties
- Demographics for the zone based on the 2011 OA Classification³

The data gathered from the options appraisal stage (in terms of where the greatest opportunities for improvement lie) can then be overlaid with the zoning assessment to identify particular areas where a council might prioritise the implementation of measures.

5.3. Commentary

In terms of the area prioritisation exercise, this was fairly straightforward to achieve and there is reasonably robust data to allow this for short term measures.

In terms of driving the first stage of an LHEES, it is a useful exercise as it enables a focussed approach to be taken. For instance, a council might seek to utilise a grant based scheme to alleviate fuel poverty in one zone whilst pursuing a 'door-knocking' engagement scheme with owner-occupiers in another. The methodology employed can be considered suitable to enable councils to make informed decisions in terms of where the greatest initial impact can be made in terms of addressing fuel poverty. However, as noted above an area based approach will not necessarily identify those living in fuel poverty within otherwise affluent areas. Identification of these individuals would require analysis on an individual building level which would create difficulties with both data privacy and the level of work involved.

However, longer term measures will need improved data and inclusion of longer term energy constraints and prices to justify investments. Few investments were identified for the middle or latter stages of the 15-20 year proposed LHEES initial period. This area needs further work.

It is difficult to identify longer term solutions because there are two distinct (and not entirely mutually complimentary) routes that heat supply could go down in the future, one is a decarbonised electric grid (with everyone being supplied by heat pumps or equivalent), the other is a decarbonised gas grid. It's important to not create barriers to either one at this point because. Another factor playing into this is the extent of the uptake for electric vehicles is going to be, as this will add strain to the electric grid and could therefore inhibit the ability of the grid to support electrification of heat as well.

Currently the majority of measures identified for the short term are 'low regret', such as improved energy efficiency measures as these do not depend on how the heat is generated, the heat loss and therefore energy saving will be the same. District heating is also a low regrets option, due to the heating source being possible to change after time, and it does not depend on which route heat supply will go down as technically district heating is the supply/return pipes in the ground.

A key risk is that a lot of time and money is spent on transferring properties (both domestic and non-domestic) to electric heating with heat pumps, but then the gas grid is decarbonised which would either make that decarbonisation less effective or create a regret spend in terms of the investment in heat pumps.

A further constraint to long term planning is an understanding of what the longer term financial assistance programmes might look like and where funding might be available to local authorities. As it stands, relatively few heat decarbonisation options are economically viable without additional public sector support in some form and this creates an environment where long term planning becomes very dependent on perceived future government policy intentions. Hence, in the pilot studies, longer term measures tended to be restricted to identification of viable technical options that could be progressed should the policy / economic climate be favourable to that option in the future.

³ Details of system at [Office for National Statistics](#)

6. Delivery planning

For the pilot LHEES, there was a different approach between the various councils but, in general, the following documentation was produced during the development of the LHEES:

- Baseline data report, including policy review and prioritisation, and associated collated data set
- Options appraisal report and associated evaluation spreadsheet
- Outcomes from socio-economic analysis – only for Glasgow and Highland in pilot but would be recommended as an output for future LHEES
- Zoning report
- Implementation plan

These deliverables were supported by various meetings and discussions, including presentations to stakeholders both internal and external to the responsible councils.

The deliverables roughly correspond to the stages of the LHEES set out in section 1.2 and this staged approach has been helpful in understanding how an LHEES might be put together. However, for future LHEES, we would suggest that the process be slightly modified such that it would consist of the following phases:

- **Data gathering and collation phase resulting in a collated data set.** Provision of a report and spatial imagery is useful to communicate the information to a wider audience and is likely to be important in the democratic process for approving LHEES in the same way as with Local Development Plans.
- **Options appraisal phase.** This is likely to be the most labour intensive part of the process and the spreadsheet developed in the pilots should be a useful aid to councils looking to carry out this exercise. It is important to understand that during the options appraisal phase, decisions are not being taken – instead, it should be thought of as developing sufficient information in the right format to enable the right strategy to be determined.
- **Zoning and area prioritisation.** We would suggest that this is best done prior to any socio-economic impact assessment as the information from the area prioritisation is key input data for any multi component analysis that might be carried out.
- **Target setting.** This was a challenge for many local authorities. At a higher level is the need to reflect national targets, such as those set out in the Climate Change Plan and Energy Strategy. At a very local level targets could be influenced by what could be delivered in terms of buildings under the council's own control (including public buildings, some business estates and council housing), buildings where partnership approaches were considered (such as with social housing) and those where enabling and support was proposed (such as where areas were identified to target housing improvement programmes). Further discussion about target setting with local authorities would seem to be useful to understand approaches and consider guidance.
- **Socio-economic analysis.** It is inevitable that there will be multiple potential opportunities and measures but that it will only be possible to implement some of them. We consider that socio-economic analysis provides a useful tool to inform which options are implemented in a robust and auditable manner.
- **Consultation (potential).** Again it is important to consider useful ways to communicate the information to a wider audience and is likely to be important in the democratic process for approving LHEES in the same way as with Local Development Plans.
- **Implementation plan.** Going forward, we would anticipate that this will effectively be the official LHEES submission should it become a statutory duty.

We would note that whilst the above process is presented sequentially, in reality there will be iteration required in order to produce the best quality LHEES.

Appendices



Appendix A. Data sets utilised

Data Set	Description	Source	Publicly Available	Free of Charge
Ordnance Survey Master Map	The definitive and authoritative source of highly detailed geographic data of Great Britain. This is a core foundation for spatial data mapping. It is provided under licence through Ordnance Survey (OS). The Scottish Public Sector can access and share OS data free of charge through the One Scotland Mapping Agreement (OSMA).	https://www.ordnancesurvey.co.uk/business-and-government/products/mastermap-products.html	Yes	No
One Scotland Gazetteer	The national address gazetteer brings together address information from local authorities and Ordnance Survey to create a 'national address gazetteer database', providing one definitive source of accurate publicly-owned spatial address data for the whole of the public sector. To deliver this, the Local Government Group and Ordnance Survey have entered into a joint venture partnership, 'GeoPlace™', from which address products have been created. This provides the building Unique Property Reference Number, often shortened to UPRN, that is the anchor for allowing all building data to be linked and thereby be used in this work. This is made publicly available through the One Scotland Gazetteer - an address database made up of all 32 individual local authority gazetteers. All addresses are created in accordance with the national standard for addressing, BS7666:2006 and the Scottish Gazetteer Conventions. Key features include: Spatially referenced address records and Property lifecycle details.	https://data.gov.uk/dataset/national-address-gazetteer	Yes	Commercial license required. Available to OSMA members.
Built and Historic Heritage Data	Such as Listed Buildings, Conservation Areas, Gardens and Designated Landscapes, Scheduled Monuments.	https://www.historicenvironment.scot/	Yes	Yes
Natural Heritage	Protected under the Sites of Special Scientific Interest.	https://www.nature.scot/information-library-data-and-research/snhi-data-services	Yes	Yes
Scottish Census 2011	Provides a snapshot of the Scottish population to guide future planning and provision of services. Census output area is the lowest level of geography for which statistical outputs from Scotland's Census 2011 are generally available. A census output area averages around 50 households and 100 residents.	http://www.scotlandscensus.gov.uk/	Yes	Yes
Scottish Index of Multiple Deprivation (SIMD)	The Scottish Government's official tool to identify areas of multiple deprivation in Scotland. The Scottish Index of Multiple Deprivation (SIMD) identifies small area concentrations of multiple deprivation across all of Scotland in a consistent way. It allows effective targeting of policies and funding where the aim is to wholly or partly tackle or take account of area concentrations of multiple deprivation. SIMD ranks small areas (called Data Zones) from most deprived (ranked 1) to least deprived (ranked 6,976). People using SIMD will often focus on the Data Zones below a certain rank, for example, the 5%, 10%, 15% or 20% most deprived Data Zones in Scotland. SIMD provides a wealth of information to help improve the understanding about the outcomes and circumstances of people living in the most deprived areas in Scotland.	http://simd.scot/2016	Yes	Yes
Scotland Heat Map	A framework of data provided both as separate linked datasets and as collated layers and combined datasets showing existing heat demand in Scotland. The Scotland Heat Map contains data on Scotland's circa 2.8 million buildings (covering both domestic and non-domestic), energy generation and supply opportunities, district heat networks, geothermal energy and social housing. It is owned, created and updated by the Scottish Government. A building level version of the dataset is provided under agreement to all Scottish local authorities. This data can then be used or sub-licensed to enable planning for energy and heat. A public interactive web version of the Scotland Heat Map is also available.	Scottish Government	No	Yes
Home Analytics	Provided by the Energy Saving Trust through funding from the Scottish Government. It provides a profile of the domestic building stock, with data regarding energy efficiency, micro renewable technologies and alleviation of fuel poverty. It is available under agreement to named public bodies. A significant portion of the dataset is based on modelled or extrapolated data.	http://www.energysavingtrust.org.uk/scotland/businesses-organisations/data-services/home-analytics	No	Yes
Energy Performance Certificates	The Scottish Energy Performance Certificate Register (SEPCR) is the data repository for energy performance data used in the production of Energy Performance Certificates in Scotland. This data is lodged to the SEPCR by registered Energy Performance Certificate (EPC) Assessors registered with one of the Approved Organisations appointed by Scottish Ministers.	https://www.scottishepcregister.org.uk/ https://www.gov.scot/epc	Yes	Yes

Data Set	Description	Source	Publicly Available	Free of Charge
	<p>A basic dataset containing key environmental data from all current lodged EPCs is now published and available in csv format on the Scottish Government website. This contains each element of energy and environmental information presented in the current EPC and Recommendations Report formats taken from a full data extract made in May 2017. A separate dataset is published for domestic EPCs and for non-domestic EPCs.</p> <p>More detailed data was made available for the purposes of this project through a data sharing agreement with the Scottish Government.</p>			
Assessor Data	This is data collected for assessing council tax and business rates. It is the most comprehensive set of building data held by the public sector in Scotland.	From local authority heat map data (not provided through national heat map dataset).	No	Yes
Local Authority	There are a wide range of datasets collected and managed by the local authorities themselves. These can in some cases have significantly more detailed information than national datasets. Coverage of data may be limited and not always cover the whole authority boundary or interests. Data may be only collected once and not subsequently available as updates in future years. The data can be made available under agreement. Data is likely to only be shared in a non-personal data format.	To be requested from the relevant local authority	No	Yes
Changeworks Fuel Poverty Map	<p>The Changeworks Fuel Poverty Map was produced using data from the Scottish House Condition Survey (SHCS) and the Census 2011. The variables from the SHCS were analysed to see which of them were best in predicting fuel poverty. From this we found that, in order of their weighting, the following variables would predict fuel poverty levels best:</p> <ol style="list-style-type: none"> 1. Unemployment status (highest income householder is under 60 and unemployed) 2. Households with single pensioners (households with one adult resident aged over 65, if a man, or over 60, if a woman) 3. Number of properties with an EPC lower than D 4. Long-term illness of householders (highest income householder) 5. Households looking after family members (highest income householder) 6. Central heating system other than gas or electricity. 	To be requested from Changeworks	No	No



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EH1 3DG

ISBN: 978-1-83960-123-1 (web only)

Published by The Scottish Government, September 2019

Produced for The Scottish Government by APS Group Scotland, 21 Tennant Street, Edinburgh EH6 5NA
PPDAS618070 (09/19)

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