



**ZERO
WASTE
SCOTLAND**

Energy and Low Carbon Heat Support

A review of activities and
learnings 2013-17



EUROPE & SCOTLAND
European Regional Development Fund
Investing in a Smart, Sustainable and Inclusive Future

1 Foreword from Iain Gulland, Chief Executive

Zero Waste Scotland has proudly been supporting the Scottish Government’s low carbon heat ambitions through the Resource Efficient Scotland programme since 2013. This report serves as a reflection on some of the collaborative work carried out by our Low Carbon Heat Team.

The Scottish government established the Resource Efficient Scotland Programme with the ambition of supporting businesses, public and third sector organisations to increase productivity, create new opportunities and reduce Scotland’s environmental impact, by using resources more efficiently.

In 2015 the Low Carbon Infrastructure Transition Programme commenced with aims to further support and fund Scotland’s transition to a low-carbon economy.

Working closely with partners, Zero Waste Scotland’s Low Carbon Heat Team has provided strategy support and technical expertise to help accelerate the uptake of heat networks in Scotland. Crucially we have helped build confidence with clients by identifying opportunities for district heating and supporting project feasibility and business case development.

I hope this report provides an insight into the work undertaken in the early years from 2013-2017. Zero Waste Scotland provides a centre of expertise to support low carbon projects that look to optimise heat recovery or create heat networks. I’d like to thank our partners for their participation to date and look forward to furthering our collaboration.




Iain Gulland
Chief Executive
Zero Waste Scotland



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Early and thorough stakeholder engagement is an essential part of strategy and project development.

2 Executive summary

Zero Waste Scotland's Low Carbon Heat Team has been delivering support to identify and develop district heating and waste heat recovery opportunities since 2013. This has involved both one-to-one consultancy support to public and private sector organisations as well as one-to-many support via workshops, webinars, online guides and tools.

Local authorities and other public sector organisations have received support with low carbon heat strategies and projects, while energy intensive industries have received focused interventions to identify opportunities to become more energy efficient and recover waste heat from industrial processes.

This summary report has been produced as a review of the activity undertaken between April 2013 and March 2017, to consider the impact of the support and to gather learnings from the programme to inform future delivery. The programme continues to deliver support beyond March 2017, adapting to Scottish Government's policy needs and building on the learnings of the programme to date.

It should be noted that while it is possible to quantify total identified carbon savings from Zero Waste Scotland support, quantifying impact and attribution is more difficult. Projects often take several years to complete and may involve many layers of government

agency support to fully develop. Additionally, a lot of the support aims to build intangibles such as knowledge, skills and confidence. In this report the qualitative value of support is derived from a sample of case studies collected from both recipients and agency partners.

Feedback from support recipients reported that competency and confidence around low carbon heat has increased as a result of Zero Waste Scotland input. Clients highlighted the fast pace of change, that there is always more to learn and that they continue to look to Zero Waste Scotland's experienced team for advice. As a trusted and impartial advisor to local authorities, Zero Waste Scotland is considered to have a vital role by "creating an intelligent client" in the delivery of low carbon heat projects.

Some of the key learnings in relation to progressing low carbon heat opportunities in local authority areas:

- Early and thorough stakeholder engagement is an essential part of strategy and project development, both internally and externally
- Each local authority is unique, with its own set of policy drivers and appetites for investment, and therefore requires bespoke support rather than a generic template approach.
- It is essential that the executive management of



the council be the main driver if the strategy is to become embedded across all relevant departments.

- Completed low carbon heat strategies identify appropriate projects and inform the scope of the feasibility studies.
- Feasibility studies are essential for determining whether time, resource and capital should be invested in a project
- Follow-up support, to interpret findings and build confidence in recommendations through impartial and independent advice is considered a very important part of the support offering.

Opportunities to make energy savings through improved process efficiencies and waste heat recovery at energy intensive industrial sites require robust business cases. Barriers to waste heat recovery include:

- Location of waste heat in relation to domestic properties
- Industrial process efficiency opportunities can offer a greater gain than supplying a district heating system.

- Focus on core business.
- Preference to drop heat into a network when available – can't be provided on demand.
- Payback periods too long compared to alternative investment options.
- Complicated collaborations and partnerships with risky investment requirements.

Zero Waste Scotland recognise and highlight the importance of the collaborative approach to the progress being made on the low carbon heat agenda. Scotland's support agencies all contribute different elements and expertise to the over-arching Scottish Government programme and together are creating an impact that could not be achieved by one agency alone.

The findings and learnings detailed in this report have informed current delivery of the programme and such learnings will continue to influence delivery as it continues to adapt with the changing landscape.

3 Introduction



A significant proportion of all the energy consumed in Scotland is used to heat or cool homes, offices and public buildings and is the largest contributor to the country's energy emissions. The Scottish Government has ambitions to largely decarbonise the energy system by 2050 and heat is at the centre of the move to a low carbon economy.

In 2013 Zero Waste Scotland launched the Scottish Government funded Resource Efficient Scotland (RES) programme, whose objectives were to work with organisations to reduce their environmental impact by becoming more efficient with energy, water and waste. One strand of the programme focussed on Scotland's low carbon heat opportunities and how these could be progressed. Since then the Low Carbon Heat team has grown and the remit and objectives have adapted to meet the needs of recipients and fill the gaps in the support landscape. As policy has changed (and continues to do so) the programme continues to adapt.

This report is the first in-depth review of the Low Carbon Heat programme and has been created to demonstrate the activities undertaken up to the end of March 2017, review the learnings and impacts of

the programme and describe the support landscape that has been created overall.

This report is intended as a narrative, telling the story of the value of Zero Waste Scotland support to beneficiaries and partners. It is not intended to be a quantification exercise calculating the total savings and assessing the impact of the investment as a numerical figure. A comprehensive quantification exercise is not appropriate at this time for a number of reasons. Firstly, projects in this area can take a long time to move from conception to implementation – and not all will complete the journey in the originally imagined form. It's therefore still too early to say how every supported project will turn out. These long lead-in times are also associated with a multi-actor and evolving support landscape. Zero Waste Scotland has been a key partner and it would be inappropriate to attribute change solely to our work, which is why this report focuses on understanding our contribution, rather than quantifying it. Finally, some of the benefits from our work (such as increased capabilities in local authorities to support low carbon heat projects) are qualitative rather than quantitative in nature.



4 Low carbon heat in Scotland

Policy Background

The Low Carbon Heat Agenda is driven by Scottish Government’s ambition to have net zero greenhouse gas emissions by 2045. The Scottish Government has amended its Climate Change Bill to set new targets for emission reduction so that by 2040 greenhouse emissions are 90% lower and by 2045 are net zero. To achieve this, emissions from heating our homes and buildings will need to be near-zero and emissions from industry will need to be reduced, wherever feasible. Approximately 50% of non-domestic buildings use electric heating as their main source of heat.

For industry in Scotland the demand for heat varies widely across sectors and production lines in relation to specific processes, but there are many essential requirements for heat which could be met from renewable or recovered (or a combination of the two)

sources, as well as many opportunities to utilise ‘excess’ heat flows either on-site or off-site.

Reducing Scotland’s energy demand is a key component of the energy transition. Smarter energy systems, combined with more energy efficient homes with more knowledgeable consumers who have greater control their energy, will be large factors in achieving a net zero economy.

Support Delivery

Low carbon heat support is offered and delivered as part of a joint programme led by the Scottish Government, with contributions from Zero Waste Scotland, Scottish Enterprise, Energy Savings Trust and Scottish Futures Trust. Each organisation contributes its specific expertise and provides a different support function, as shown in Table 1.

Table 1: Expertise and support functions within Scotland

Organisation	Expertise	Support Function
Scottish Government	Policy and leadership	Low Carbon Infrastructure Transition Programme (LCITP) capital funding for low carbon projects.
Zero Waste Scotland	Technical expertise Market & stakeholder knowledge	Early stage opportunity and technology appraisals and feasibility studies.
Scottish Enterprise	Industry knowledge Development of projects Economic opportunities	Business support Low Carbon Infrastructure Programme (LCIP)
Scottish Futures Trust	Investment and procurement	Develop a feasibility study into a successful business case
Energy Saving Trust	Domestic Energy Efficiency /heating Fuel poverty	District Heating Loan Fund

Figure 1 shows how a district heating opportunity might progress through the support landscape and which agency may provide support at different stages. The delivery approach has evolved over time and the diagram shows what is currently considered the best practice approach to project delivery. The timescales shown are indicative of these types of projects, but

are dependent on the internal driving force of the project team and external factors such as access to funding and competing priorities. It is expected that a project could take up to four years to develop before construction can commence, even on the fastest of timelines.

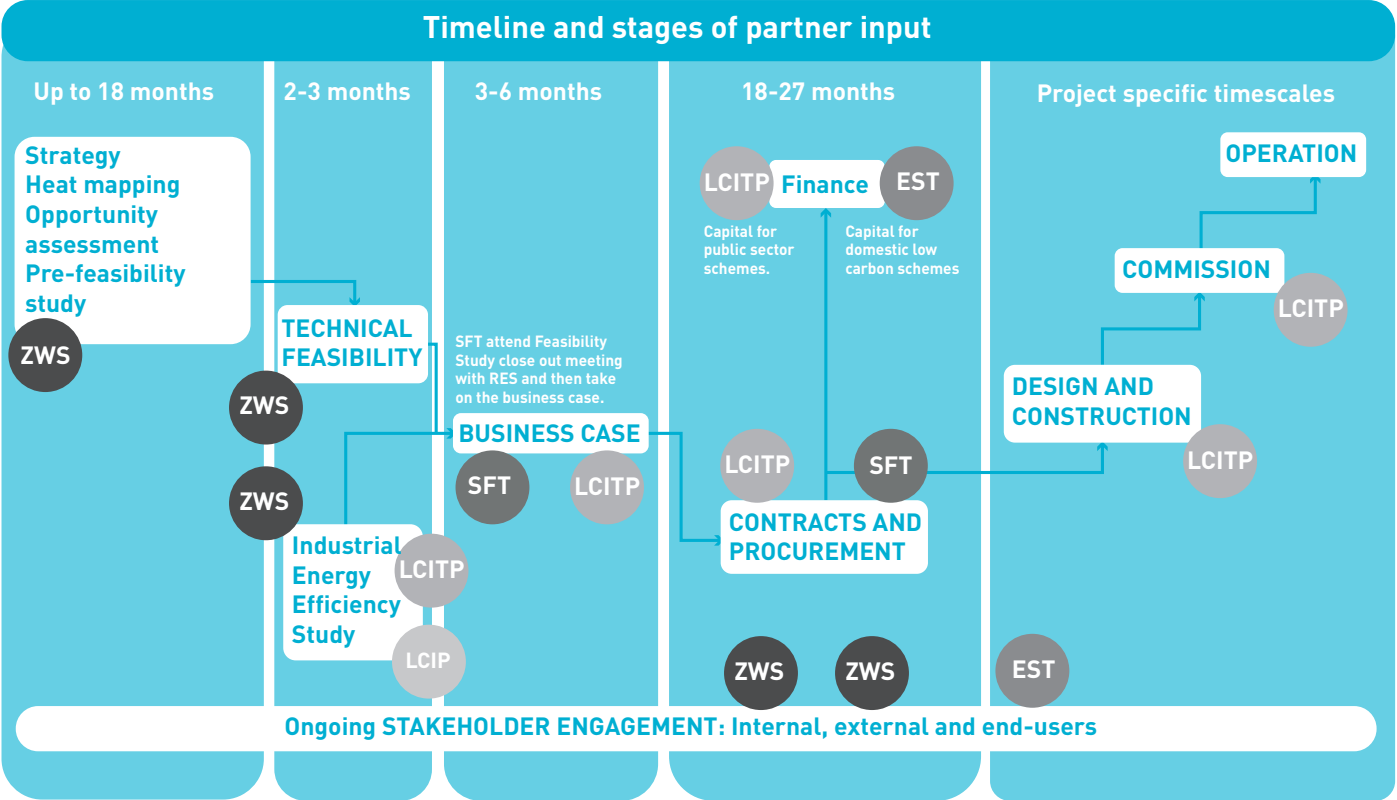


Figure 1: Delivery of low carbon heat projects using Scottish Government’s support programmes

Low Carbon Infrastructure Transition Programme Partners Group

The Scottish Government’s £60 million Low Carbon Infrastructure Transition Programme (LCITP) aims to provide a Scotland wide low carbon project development unit operating across the public, private and community sectors where significant potential for decarbonisation and enterprise growth exists. The focus includes low carbon and community renewable electricity, heat generation, energy efficiency and materials recycling and re-use.

All four support agencies contribute to the LCITP by pipelining and signposting organisations to the fund and by assessing applications for development and capital support – each partner considers different aspects of an application based on its expertise as listed in Table 1.

Specifically, the Zero Waste Scotland team sits on the LCITP Partners Group offering support to appraise applications and oversee project development and capital support administration. Zero Waste Scotland’s early support identifies and pipelines opportunities to LCITP funding once projects have been deemed technically and economically feasible.

Heat Network Partnership

The Heat Network Partnership (HNP) aims to boost

the uptake of low carbon heat technologies in Scotland and co-ordinate the efforts of each of the existing support agencies. Secretariat responsibility was previously assumed by Zero Waste Scotland but has more recently been undertaken by Scottish Government. Support is provided as technical advice, project development funding and as capital investment and covers activities from early stage technology appraisals, to building a business case and construction. Recipients of support include local authorities, universities, the NHS and energy intensive industries, covering district heating schemes, low carbon technologies such as water source heat pumps, and energy efficiency and heat recovery.

As well as providing direct support to private and public sector organisations as detailed in Figure 2, the HNP have also worked together to deliver a website that houses a number of resources and to produce the HNP database which feeds both the Heat Map and the HNP website’s projects map. This database was the first example of an inter-agency resource, drawing information from all of the partners and was the key starting point for district heating development in Scotland. The Heat Map was developed by Zero Waste Scotland on behalf of Scottish Government – it is a key element of the low carbon heat agenda and Zero Waste Scotland are developing proposals to expand its functionality.

5 Zero Waste Scotland activities, up to March 2017

5.1 The role of Zero Waste Scotland

Zero Waste Scotland has been supporting the Scottish Government’s low carbon heat ambitions through the Resource Efficient Scotland programme since 2013. The Low Carbon Heat activity within the RES programme aims to deliver tangible, inspirational and incremental change to the way heat is delivered in the non-domestic sectors in Scotland. The objectives of the programme are to develop a pipeline of investment-ready projects that will contribute to Scotland’s ambition for a low carbon heat sector by supporting local authorities to develop district heating strategies, undertake feasibility studies and other technical support, building a library of data and information on technologies and identifying and developing potential heat recovery projects. By providing support at the early stages of a project, an organisation can determine where to focus resource and which opportunities to progress (or discount if found not to be viable). Once a strong feasibility study has been developed, the Zero Waste Scotland team work with other Heat Network Partnership (HNP) agencies to help move the project to the next stage of development. Zero Waste Scotland will, if required, continue to support the organisation as the project progresses, for example with stakeholder engagement.

The Low Carbon Heat Team at Zero Waste Scotland has evolved and now includes engineers and heat mapping experts that have the diverse skills required to deliver support of a high quality. The team is able to build confidence with clients about low carbon heat opportunities and support the scoping, contract management and interpretation of feasibility studies. Zero Waste Scotland has become recognised as an authority and centre of expertise for the low carbon heat agenda by partners and the Scottish Government.

Delivery of the programme has also evolved since its beginning in 2013. Initially, feasibility studies for local authorities were undertaken on an adhoc basis however it became clear that a more strategic approach to district heating was required and so the team began working with local authorities to develop Local Area District Heating Strategies.

As part of this approach it was also recognised that local authorities must engage with internal and external stakeholders throughout a district heating project.

Figure 2 reflects Zero Waste Scotland’s Low Carbon Heat work flow (as at the end of March 2017), showing where strategy, technical and industrial



support is offered. It outlines how a local authority should approach the development of low carbon heat opportunities using the support on offer from Zero Waste Scotland. This has evolved since 2013 and continues to do so. Further detail about each level of support can be found later in this section.

Energy and low carbon heat support map

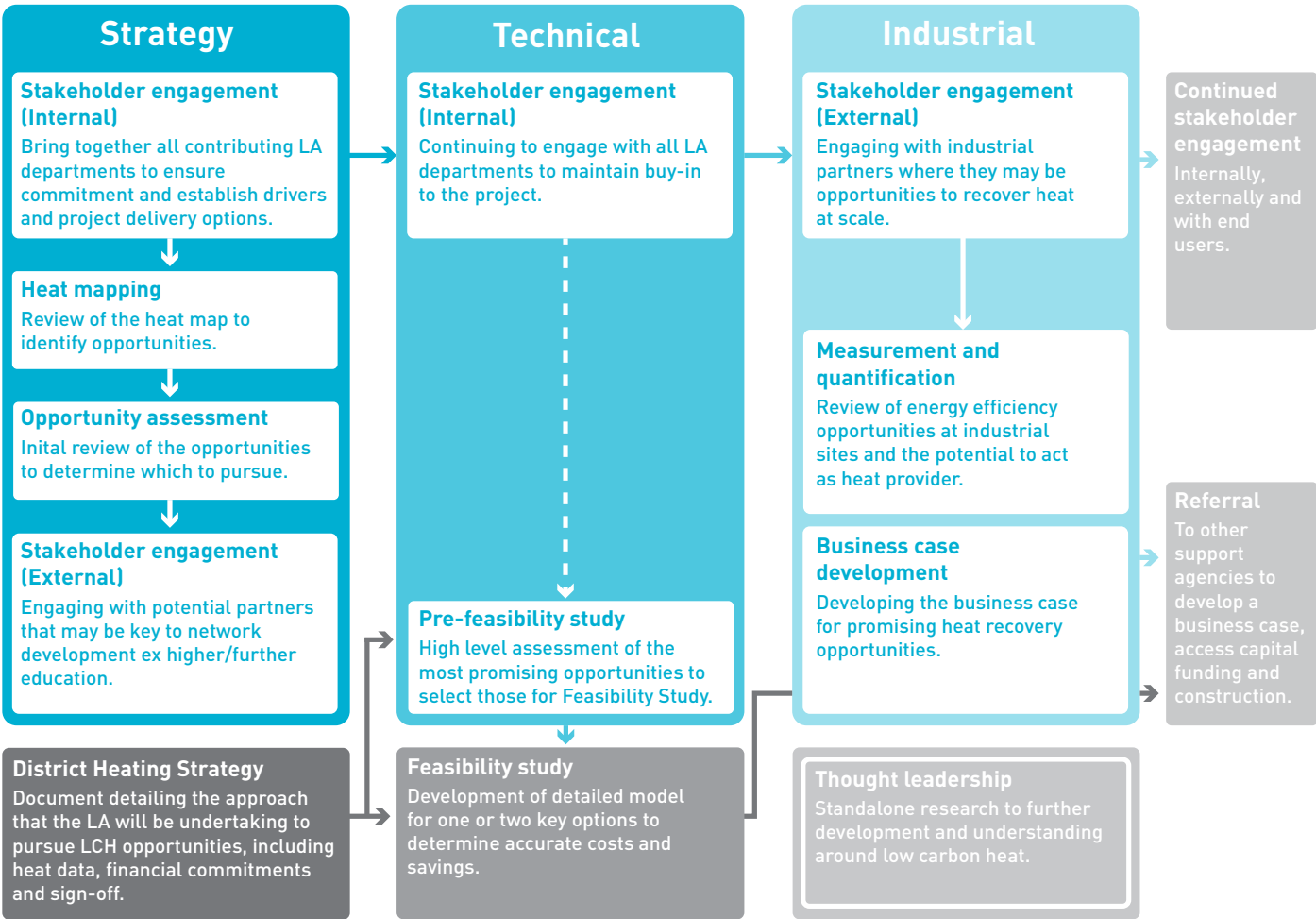


Figure 2: Flow chart showing delivery of Zero Waste Scotland supported low carbon heat projects (LA = local authority)

5.2 Direct project support

Zero Waste Scotland has provided one-to-one support to a range of public and private sector organisations, reviewing low carbon heat and energy efficiency opportunities and providing recommendations for further investigation or investment. Further detail about the support provided is included in this section.

5.2.1 Industrial technical support

Since early 2014, the programme has been providing support to industrial companies looking to become more energy efficient and recover waste heat. From 2015 onwards, industrial support was delivered as a measurement and quantification (M&Q) report, whereby the company is informed about process energy flow and where significant energy inefficiencies occur. Heat loss can occur because of extended pipe lengths, unlagged pipe or equipment not operating at optimum efficiency. Generally, significant heat recovery opportunities arise from process heat rejection. The M&Q report maps out energy flow from beginning to end

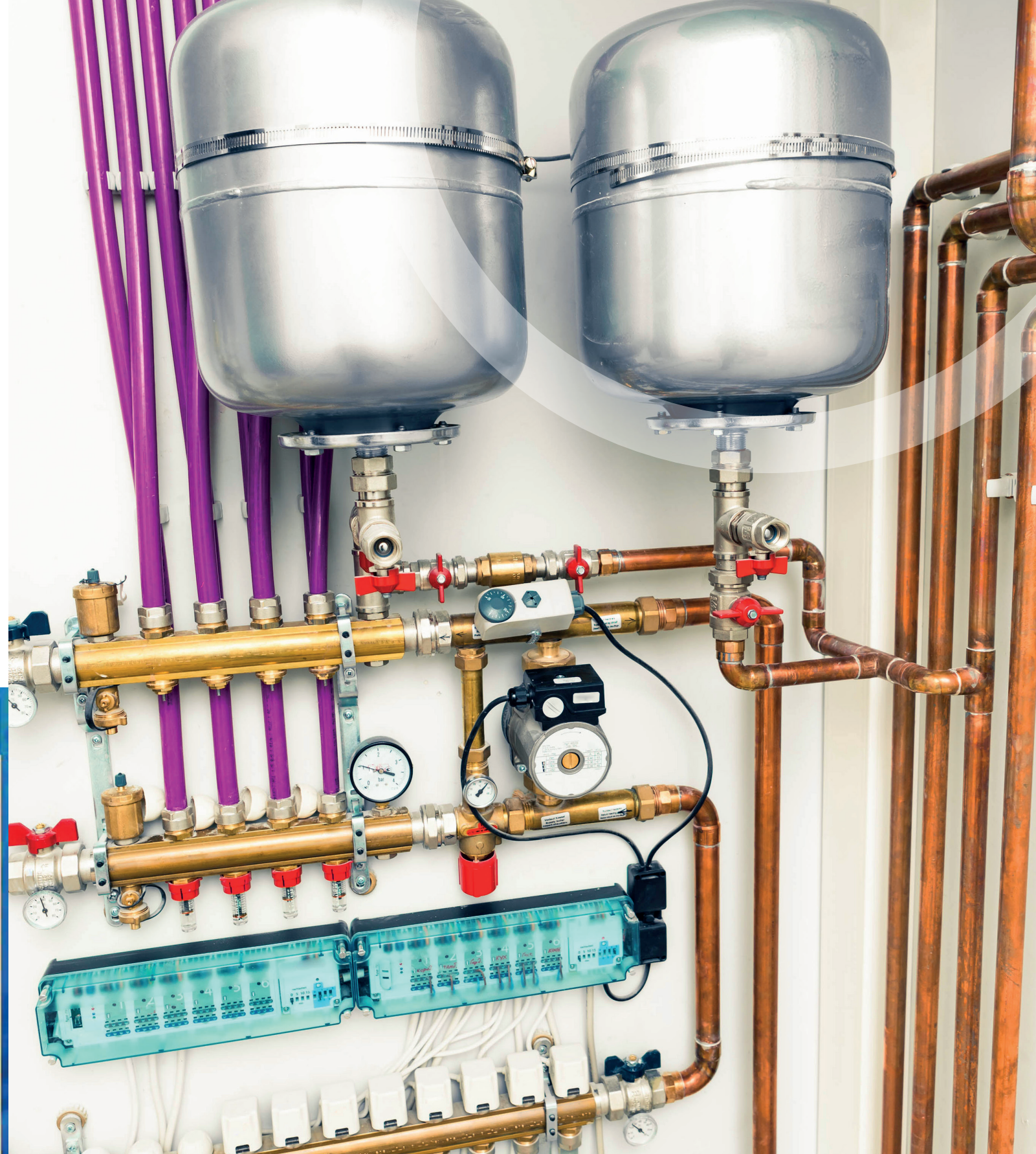
through a Sankey diagram to provide a picture of opportunities to intervene and evaluate potential savings from different interventions. Five companies received M&Q reports in 2015/16 and another three in 2016/17 identifying total savings opportunities of 84.98 GWh. The detail behind the calculation of this figure is not provided to protect the anonymity of the organisations supported.

5.2.2 Public Sector support

Zero Waste Scotland's Low Carbon heat team supports the public sector to identify and assess opportunities for district heating networks. Support covers both the technical feasibility of an opportunity and the development of a strategy and stakeholder engagement plan.

5.2.2.1 Technical support – feasibility studies

The programme has been contracting feasibility studies on behalf of local authorities and universities to technically assess district heating scenarios since 2014. As previously described, the programme has evolved to move away from delivering feasibility



studies upon request to delivering feasibility studies as a result of early strategic considerations. Supported organisations are required to make a 50% contribution towards the cost of the study.

Feasibility studies focus on a shortlist of low carbon heat supply options and provide projects with

projected financial performance metrics such as net present value and internal rate of return, capital costs, projected incomes and environmental savings to allow investors to assess a business case. Eleven projects received technical support up to March 2017, quantifying district heating potential of 154 GWh.

Queen's Quay district heating network

One of the first low carbon district heating schemes in Scotland is being developed on the site of the former John Brown shipyard on the River Clyde. A collaboration between West Dunbartonshire Council and developer Clydeside Regeneration Ltd, the project will provide low carbon heat to a new waterside community, with 1000 homes plus various commercial and public buildings.

From mid-2014, Zero Waste Scotland has helped guide the council through the complexities of planning a district heating scheme, and ultimately identify a unique opportunity for generating low carbon heat at this iconic site.

Initially, the district heating scheme planned to utilise a gas-fired Combined Heat and Power unit until the council decided to review further options. With support from the Low Carbon Heat Team, the council undertook a new opportunity assessment which identified an option that had not yet been considered: a water source heat pump on the Clyde.

The opportunity assessment led on to a more detailed feasibility report being commissioned which confirmed that a water source heat pump was both a better low carbon option and financially viable. The feasibility report generated real momentum, making it much easier for the council to get buy-in from all relevant departments and, ultimately, the Chief Executive.

Given the lengthy timescales and multiple stakeholders involved, planning the district heating scheme was challenging, requiring complex modelling considering future heat demands and energy costs. After several years and following a detailed business case and design brief for the district heating system, work began on the project in August 2017 which will see the installation of two 2MW water source heat pumps, with space to expand to four in the future.

"Part of the proof of how good the service was from Zero Waste Scotland is that we're delivering, this isn't just a great report that's sitting on the shelf. We're actually doing it." John Sanders, (former) Energy Advisor, West Dunbartonshire Council.



5.2.2.2 Supporting a strategic approach

Opportunity assessments and pre-feasibility studies

Having recognised the need for a strategic approach to the low carbon heat agenda, Zero Waste Scotland began to provide more support to help public sector organisations determine which projects had most potential for success prior to a more in-depth feasibility study. This was delivered through opportunity assessments and pre-feasibility studies in which several options and scenarios can be quickly reviewed including high level costs and estimated plant sizing, with the most promising prioritised for a full feasibility study. These review processes seek to save local authorities money and resource by eliminating unnecessary detailed studies early on.

Opportunity assessments and pre-feasibility studies have been delivered for local authorities, universities and other Non-Departmental Public Bodies. Fifteen projects were delivered up to March 2017, reviewing over 100 scenarios and identifying maximum district heating potential of 250GWh. The detail behind the calculation of this figure is not provided to protect the anonymity of the organisations supported.

Stakeholder engagement plans

The opportunity assessments supported a more strategic approach and included reference to the importance of engaging various internal and external stakeholders in delivering a successful low carbon heat project. Over time it became clear that more emphasis needed to be placed on the importance of stakeholder engagement and so in 2016, support was delivered to four local authorities to develop standalone Stakeholder Engagement Plans. These included the mapping and ranking of stakeholders and scheduled communication activities.

Developing local area District Heating Strategy documents

In 2017, district heating strategy documents were created with two local authorities, testing two different delivery mechanisms and creating a blueprint for other councils to use in the development of their own district heating strategies. One approach involved a Zero Waste Scotland project manager working with the council to develop the strategy, while the other utilised an external contractor to deliver the District Heating Strategy on behalf of the local authority. The merits of the two different approaches are discussed later in Section 6 and the Highland Council strategy is reviewed in the case study below.



A strategy for Highland West Plan

When planners at Highland Council began writing a local development plan for the West Highlands and Islands, the council's energy team was consulted on whether it could focus its own strategic identification and analysis of district heating network opportunities on the WestPlan area first.

With this geographical steer, the council brought in Zero Waste Scotland's Low Carbon Heat Team to work on a robust appraisal of the potential for district heating networks within the settlements in the WestPlan area. The process involved six months of intensive work, with the resulting assessment document incorporating much of the detailed heat mapping and strategy development that the council's energy team had already worked on for the previous two years.

"Quite quickly, our work with the Low Carbon Heat team suggested that district heating was just not going to be viable in many places due to the lengthy pipe runs needed to connect buildings," recalls Jackie Sayer, an engineer with Highland Council's Energy and Sustainability Team. But the assessment also highlighted where district heating schemes could be viable in some settlement areas, as well as additional opportunities to create smaller-scale heating networks at specific sites.

It's solid progress and there is a strong belief that Highland Council's work with Zero Waste Scotland will stand it in good stead for the future. The added value of working with the Low Carbon Heat Team was evident in the engagement and strengthening of an already strong relationship between the energy team and planners.



Informal support

In addition to technical reports, Zero Waste Scotland's Low Carbon Heat team support public sector organisations by offering adhoc advice relating to the reports that are produced. If staff at local authorities and universities have questions or queries about reports or advice previously received, they can contact staff at Zero Waste Scotland. Stirling Council's Forthside Renewable Heat project is an example, where Zero Waste Scotland offered advice and support through early stage concept through to project commissioning.

5.3 Knowledge creation and one-to-many support

Heat is a relatively recent addition to the focus areas of carbon reduction in the public sector. As such there is a gap in the skills and expertise of local authority staff to understand and deliver low carbon heat projects. Part of Zero Waste Scotland's remit is to increase the knowledge and the capacity of local authorities and other public sector organisations. This capacity support has been delivered through the development of online tools, templates and guides, workshops, webinars and a formal advice service. This section contains a brief overview of these activities.

Heat Network Partnership (HNP) workshops were delivered in 2015 providing a series of best practice, guidance and knowledge-sharing workshops covering the HNP's core themes of Leadership, Procurement, Technology, Planning and Finance. Zero Waste

Scotland led on the standardisation and technical workshops, with other partners leading on their area of expertise.

The HNP website was created and developed by Zero Waste Scotland in partnership with the Scottish Government and is used by all HNP partners to communicate and disseminate materials and resources. Much of the content has been created by Zero Waste Scotland, with significant contributions from other partners such as Scottish Futures Trust. Zero Waste Scotland also takes responsibility for keeping the news and events section of the site up to date. The website houses many of the resources described below as well as acting as a gateway to the online enquiries service which is managed by Zero Waste Scotland.

Enquiries can be made via the HNP website, and a range of questions have been fielded from vendors, local authority personnel, academics and developers. A query submitted by an online form generates an email to all HNP partners and the HNP inbox which is administered by Zero Waste Scotland. The Low Carbon Heat Team respond to requests immediately and direct queries to the most appropriate partner. Phone enquiries are also fielded by the team. The nature of the enquiries could be simple and answered quickly, could require some time and research to answer or could lead on to full projects. Advice can range from funding options (such as LCITP, local and private options) or involve introducing individuals or organisations that are ideally suited to work together.

5.3.1.1 Supporting local authorities to develop their own district heating strategies

The Zero Waste Scotland team has also provided one-to-many light touch support through online resources and workshops to support local authorities in the creation of their own low carbon heat strategies. Support provided by Zero Waste Scotland to end March 2017 includes:

- **HNP District Heating Strategy Sessions:** In June and September 2015, modular training sessions were delivered to local authority staff in Inverness, Glasgow and Edinburgh. The sessions covered stakeholder engagement, opportunity assessment of district heating loads, policy, planning, business models and project development. 28 local authorities were represented at these events.
- **Scotland Heat Map:** Public Sector Analysis, January 2015: identified and quantified opportunities for District Heating networks associated with the public sector estate. The methodology used could be transferred and utilised by others.
- **HNP District Heating Strategy Factsheets:** Developed from existing Resource Efficient Scotland resources previously developed for the public sector, five technology fact sheets have been published regarding heat recovery, combined heat and power, biomass, heat pumps and infrastructure.
- **HNP District Heating Strategy Template:** The strategy template document has been produced as a guide to district heating strategies and provides model text and guidance for creating bespoke content.
- **HNP District Heating Strategy Support:** The District Heating Strategy Support document describes a systematic approach to producing a local authority district heating strategy that will provide a framework for the identification and strategic appraisal of opportunities for district heating schemes, and encourage and support the delivery of projects.
- **Knowledge Hub:** In 2017, Zero Waste Scotland set up a knowledge hub for local authorities that are working on their strategies which is accessed through the Public Sector Portal.

5.3.1.2 Helping local authorities to develop their own opportunity assessments

Heat Map Training was delivered as part of the HNP workshop series referred to above and delivered to 28 of 32 local authorities. This support enables them to have better insight into the use of the relevant sections of The Scotland Heat Map and allows them to assess project opportunities independently.

In addition to training sessions, a range of online resources were produced prior to March 2017 to help local authorities assess local opportunities, including:

- **Scottish District Heating Opportunity Assessment Tool:**

This tool was developed for the purpose of carrying out an initial high level appraisal of the potential for individual district heating schemes in a region. The tool uses the Scotland heat map as the data source to produce a dashboard report, with key project indicators. The reports can support a strategic approach to prioritising potential opportunities for further investigation. The dashboard report is not intended to be used for investment decision making.

- **Opportunity Assessment Tool Use webinar:** A webinar to guide users through the use of the Opportunity Assessment Tool which has been recorded and can be accessed through the HNP website.



5.3.1.3 Knowledge creation to inform support agencies

Zero Waste Scotland has developed resources, guidance and research to support Scottish Government and partners in the delivery of support to local authorities. Three examples are described below:

- **Heat Demand Profiles:** These provide templates that include daily and seasonal use profiles for 14 different classes of building and feed into the development work for conducting pre-feasibility assessments. .
- **Skills gap analysis:** Scottish Cities Alliance undertook a study to determine the capacity of local authorities with regard to low carbon heat and whether every council should have their own in-house experts or whether it may be more efficient to create a central resource that can be accessed by all councils. As experts in the field, Zero Waste Scotland supported Scottish Cities Alliance by scoping the project and drafting the tender. The output provided evidence to the Scottish Government about resource and levels of expertise within local authorities ahead of energy policy formation.

- **Industrial Decarbonisation and Energy Efficiency Roadmaps:**

Scottish Assessment. Zero Waste Scotland contracted a Scottish focused follow-up assessment of the UK Government's decarbonisation roadmaps, identifying that industry investment in energy efficiency, grid decarbonisation and sustainable access to renewable energy are all key to reducing Scotland's carbon emissions and informed future work through Scotland's Manufacturing Action Plan.

5.3.1.4 Advisory support

In addition to the activities undertaken that produced specific outputs, such as project reports and knowledge building guidance, Zero Waste Scotland have also undertaken a significant amount of activity that has supported the delivery of the low carbon heat agenda more generally. For example, supporting Scottish Government by contributing to tender panel assessments and in the development of consultations, working closely with the HNP and acting as a centre of expertise by providing technical advice to partners. In addition, the team present and exhibit at conferences with partners, run workshops and have actively engaged in learning journeys to increase knowledge and their own expertise.

6 What we've learnt

Since the start of the programme in 2013, the Low Carbon Heat Team at Zero Waste Scotland have been continuously learning through the delivery and outcomes of the programme and adapting it based on previous experience. Goals and objectives have changed based on past learnings and the changing environment. The evolution of the programme is described earlier in this report, and this section will now focus on what has been learnt to inform the programme to date and for the future.

Continuing Improvement

Zero Waste Scotland's Low Carbon Heat Team has supported Stirling council's district heating scoping and opportunity assessment development since 2015. During this time the council has progressed to the point where it has now approved its first low carbon district heating scheme.

The work has proven to be instructive for both the council and Zero Waste Scotland. Key lessons included the need for internal stakeholder engagement for the development of strategies. This required the involvement of key council departments including planning, energy, finance and the office of the chief executive. The work also required Zero Waste Scotland to take on new skills in GIS mapping and develop techniques for the use of heat mapping techniques tailored for the development of low carbon heat strategies.

The journey has paved the way for Stirling Council to undertake similar projects in the future. It also enabled Zero Waste Scotland to hone its own capacity-building process so that more local authorities can benefit from the team's knowledge in the future.

6.1 Assessing impact

The support that Zero Waste Scotland provides through its Low Carbon Heat Programme contributes to:

- Reduction in wasted heat across Scotland
- Increase in the number of district heating networks
- Increase in the number of homes receiving affordable and reliable heating
- Reduction in carbon emissions
- Increase in renewable energy production
- Increase in low carbon heat production
- Capacity building in client organisations such as local authorities
- Scottish Government policy development
- Stimulating the market for the low carbon sector

It is difficult to assess and quantify the full and specific impact of Zero Waste Scotland support because support is focused at early phase project development, with later phases supported by a number of other agencies. The long lead-in times for these types of projects means that several years will pass before savings are realised, even if projects proceed directly. However, feedback from partners highlights the importance of this early stage support to stop projects stalling before they get started and provide a pipeline to other support mechanisms.

As described previously, Zero Waste Scotland is one of several partners working in this area, and the wider partnership is a key component of delivering the government's low carbon heat strategy. Thus there are many contributory factors to any changes achieved in this area, and these are likely to be synergistic, not additive. Zero Waste Scotland and the rest of the HNP have all contributed across the entirety of the partnership work, and not just to the specific projects they have led on. The extent to which impacts should be attributed to Zero Waste Scotland is complex and will be best determined alongside that of other partners – we will have contributed to their projects, and they to ours. It seems likely that the HNP contributions are synergistic, and that a crude division of relative contributions would be misleading. In order to better evaluate the impact of low carbon heat policy and support in Scotland, the progress towards targets and the attribution of progress to the Scottish Government funded support programmes, it

When things don't go to plan – East Dunbartonshire case study

When East Dunbartonshire council embarked upon their first district heating and low carbon heat assessment project they discovered that there are times when it just doesn't make sense. As described previously, the council had been receiving support to increase understanding and knowledge of district heating and low carbon heat and in 2017 undertook their first feasibility assessment through Zero Waste Scotland. It considered the potential of installing a district heating network in the centre of Kirkintilloch that would connect several public buildings, including the council offices on the banks of the Forth and Clyde canal. The study examined several combinations of routes connecting heat demands, along with multiple low carbon heat technology options.

The study found that the chosen network configurations did not stack up financially. There was no option that would deliver on all the expected objectives and within the council's budget. While perhaps disappointing, there were positive outcomes, not least of which was to show the importance of undertaking due diligence. It saved spending large amounts of public money on developing and ultimately constructing a project that would not break even.

The results of the feasibility assessment have resulted in the council deciding to put greater effort into developing a low carbon heat strategy allowing them to look at different low carbon heat technologies across the whole local authority area and develop delivery models for identified solutions. The council are keen to stress how important the support from Zero Waste Scotland has been and continues to be, 'having a friendly accessible person at the end of a phone really makes dealing with such a new area of work a lot easier because none of us have had any experience or training in energy. It gives us a lot more confidence that there are people out there that do know it inside out. The support we've had from Zero Waste Scotland has been invaluable' Sylvia Gray, Sustainability Policy Team Leader, East Dunbartonshire council.



may be more appropriate to assess the impact of the whole Scottish Government programme as one entity.

It is particularly challenging to quantify the value of light touch support, such as developing online resources, answering adhoc queries and providing technical advice to Scottish Government and other partners. Feedback obtained in the course of preparing this report and during normal operational delivery, suggests such support offers are highly valued, and can be a key part of progressing infrastructure investments in this area.

Finally, consideration needs to be given to how an impact value be assigned to a feasibility study that recommends that an opportunity should not be pursued or progressed. A programme that provides expertise should be judged on the value of that expertise, and sometimes advice that a project does not progress further is the right outcome. In these cases, while the supported organisation may not install a low carbon technology or a district heating scheme, they have saved the time, resource and capital that may have gone into progressing a project that would not be the most appropriate solution, either environmentally or economically. In addition, these projects may build relationships with the partner, not least by enhancing the technical credibility of recommendations offered, and so lead on to better engagement and the development of a more strategic approach to low carbon heat, as described in the East Dunbartonshire case study. Section 6.1.2 attempts to provide some quantification of energy efficiency savings and district heating potential identified through the direct support projects that were delivered up to 2017 and associates these values with the current likelihood of the savings being achieved. It should be recognised that these values are estimates and that the likelihood to being implemented are subjective and only applicable at the time of writing. The savings potential is likely to underestimate the true impact and value of Zero Waste Scotland support to the whole low carbon heat agenda. This qualitative, narrative evaluation is intended to help demonstrate the intangible benefits provided by Zero Waste Scotland.

6.1.1 2015 Resource Efficient Scotland evaluation findings

In 2015 an evaluation of the whole Resource Efficient Scotland programme was conducted to understand the impact of the support provided to organisations since 2013. A small section of this study focussed on

the Low Carbon Heat activities. When assessing the impact of the programme the evaluation stated that impacts would only be realised in the future and benefits were not reviewed as they were identified rather than actual at that time. The evaluation suggests that an identified saving should be considered an actual saving at the point it was confirmed that the project was going ahead. This definition of an actual saving has been applied in Section 6.1.2, where we attempt to quantify the energy efficiency and district heating potential of the direct project supports to date.

At the time of the 2015 evaluation none of the seven projects that had been directly supported by RES were classified as operational and no actual savings had been achieved, but the opportunities at Queen’s Quay are now progressing, with construction underway in some locations. Three of the seven projects have not progressed either because the potential networks are only viable with levels of capital support and/or government subsidy that are unavailable or there was a failure to obtain stakeholder agreement. One project has not progressed due to unrelated changes to the business so that the identified opportunity was no longer relevant.

One water source heat pump installation which did look likely to go ahead is currently on-hold until the existing elements of the district heating system are being fully utilised and the seventh project is on hold while the local authority develop their strategy for low carbon heating.

6.1.2 Consideration of the identified opportunities Scottish Government have set an ambitious target to deliver 1.5 TWh of Scotland’s heat demand through district heating and to have 40,000 homes connected by 2020. Quantification reviews undertaken by Zero Waste Scotland have focussed on the economic and environmental implications of developing a district heating network. In addition, the number of domestic connections are tracked through the HNP database which, as of June 2018, includes projects totalling 10,413 connections that are operational and another 17,131 that are in development. It should be noted that these totals are not all attributable to Zero Waste Scotland support and include contributions and projects from other HNP partners.

Table 2 summarises the maximum potential district heating opportunities that have been identified, broken down by the perceived likelihood

of implementation. Up to March 2017, Zero Waste Scotland projects had identified approximately 0.40 TWh of district heating potential through feasibility studies, pre-feasibility studies and opportunity assessments. Of these savings, 0.15 TWh are on the way to being achieved, although a further 0.13 TWh are under discussion and may be achieved over time (correct in July 2018).

It should be noted that at the opportunity assessment and pre-feasibility study phase, these values are approximated as an indicator of potential and do not accurately calculate the heat supply that could be distributed through district heating. It is also

important to note that the numbers below show the total value of the projects Zero Waste Scotland has contributed to, not the value of our contribution alone. Many projects that received Zero Waste Scotland support are progressing with funding from other programmes including Low Carbon Infrastructure Transition Programme, Non-Domestic Energy Efficiency Framework, Scottish Energy Efficiency Programme Pathfinder projects, Warm Homes Fund; District Heating Loan Fund and Energy Saving Trust, and may have received support from agencies such as Scottish Enterprise, Scottish Futures Trust and Energy Saving Trust, therefore it is inappropriate to break down the partnership totals beyond this point.

Table 2: Identified District Heating potential through projects co-delivered by Zero Waste Scotland

Status	District Heating Potential identified in feasibility studies (MWh)	District Heating Potential identified in opportunity assessments and pre-feasibiltiy studies (MWh) ¹
Project underway	88,076	62,500
Discussions ongoing	9,477	119,500
Project on hold	32,324	28,100
Unlikely to progress	24,270	40,454
Total	154,147	250,554

Status	Energy savings identified in industrial M&Q reports (GWh) ¹
Achieved	-
Project Underway	19.30
Discussions ongoing	44.73
Unlikely to progress	20.95
Total	84.98

Table 3: Identified energy efficiency opportunities through Zero Waste Scotland M&Q studies

The M&Q studies conducted by Zero Waste Scotland at industrial sites up to March 2017 have identified total potential energy efficiency savings of 0.08 TWh. As detailed in Table 3, 0.02TWh of the identified savings at the industrial sites are expected to be achieved, which will in effect contribute towards the 1.5 TWh target by reducing the available waste heat. Again, these savings cannot be fully attributed to Zero Waste Scotland support, as any changes will result from the interplay of support from different partners, in this case primarily Scottish Enterprise. Most of the beneficiaries are account managed by Scottish Enterprise, have gone on to receive further support from Scottish Enterprise, or are progressing opportunities using Scottish Enterprise’s Low Carbon Infrastructure Programme (LCIP) fund.



¹Opportunities have been assessed at a high level and can be speculative. Savings should be considered only as an indicator of potential.

6.1.3 Qualitative evidence of benefit
 In order to determine the benefit and the perceived impact of the support provided, Zero Waste Scotland’s Research and Evaluation Team have surveyed a selection of seven support beneficiaries including local authority and university sustainability, energy and estates staff. The support received by the interviewees ranged from strategy development and heat mapping, through feasibility studies to adhoc support.

The nature of the questions asked were a mix of multiple choice and open-ended to allow the support recipients to provide comparative responses with additional qualitative detail. Responses are summarised within this section.

Respondents generally report finding feasibility studies and opportunity assessments the most useful element of one-to-one support but do highlight the importance of the follow up adhoc support that could be accessed through phone calls and emails to the Low Carbon Heat Team at Zero Waste Scotland. In addition, most organisations had accessed some type of light-touch or one-to-many support, such as templates and factsheets, with workshops being reported to be the most useful resource.

Figure 3 shows how strongly interviewees agreed with statements about the benefit of Zero Waste Scotland support. Although the support from Zero Waste Scotland was not paramount to the delivery of low carbon heat projects, everyone agreed that it did move things along more quickly and gave the recipient more confidence.

“They made the process easier and quicker and our knowledge in that area was limited so we were able to access specialised advice.” (Local authority)

When asked how the projects would have progressed without Zero Waste Scotland support, beneficiaries generally reported that the project would have gone ahead anyway and that the organisation would have had the ability and confidence to procure the studies, interact with the contractors and interpret the results. However, although most report an increase in understanding and knowledge of district heating and low carbon heat technologies, they do not feel that their organisation has enough expertise and competency to progress future projects without external support.



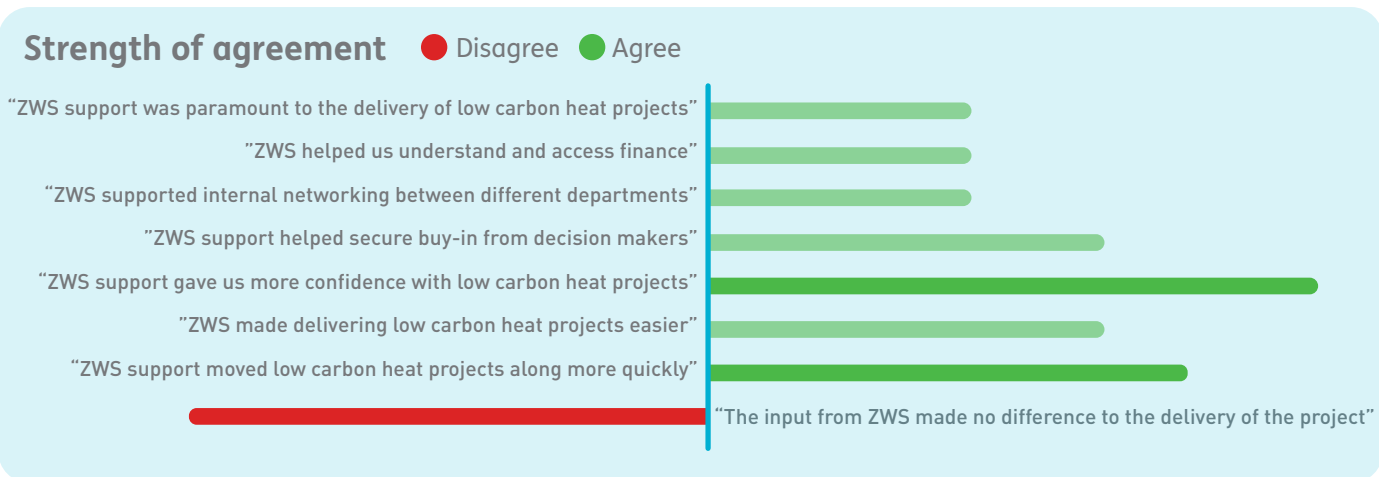


Figure 4: Strength of agreement or respondents with statements about Zero Waste Scotland support

"Every department has been involved in this – we are more competent, and the lessons learned log has about 50,000 things logged in it! But we would still look for support...with future low carbon heat projects" (Local authority)

On the whole the supported organisations report an internal change with regard the low carbon heat agenda, with an increased awareness and more engagement from senior members of staff, as well the agenda becoming a higher priority in some cases due to changes in councillors.

A representative from East Dunbartonshire Council was included in the study, to understand the importance of a feasibility study that finds a proposal is not viable. Throughout the interview, the respondent was very positive about the support provided and the Low Carbon Heat Team. It was highlighted that the initial feasibility study would not have progressed without Zero Waste Scotland support and that this has led to the development of an over-arching strategy

"We are now taking a step back – wider approach through development of a strategy. Number of different options across whole of area and potential different approaches we're going to take. Gives us a better grounding than trying to move forward with one project in the absence of a strategy." (East Dunbartonshire Council)

When asked about the value of online resources such as templates, factsheets and webinars, it was clear that when they were used, they were found to be useful. In many cases, however, these resources had not been accessed, particularly webinars and factsheets. On the other hand, workshops had been attended by six of the seven beneficiaries and all of

them found them to be very useful.

During the interviews, all beneficiaries reported Zero Waste Scotland to be very helpful and have the knowledge and expertise they required. All said they would recommend the support to other similar organisations and some even reported that they had already done so. In addition, the partner organisations reported finding Zero Waste Scotland very easy and pleasant to work with as well as bringing value to the support landscape.

"I've always found everyone I worked with in the team to be very professional and very helpful and go out of their way to try and find solutions and answer questions." (University)

6.2 Supporting industry

In most measurement and quantification studies, opportunities to feed waste heat from industrial processes into a district heating network have been identified, but, implementation is likely to be delayed or shelved because the companies:

- may not be sited in close enough proximity to potential heat users.
- are often focussed on core business rather than entering into the heat supply market.
- would rather drop heat into a network when they can, but can't provide it on demand (the district heating scheme would have to be very large for this approach to work).
- require shorter payback periods than is possible with waste heat recovery schemes.

As part of the evaluation survey work, we have spoken to a large organisation that received support from Zero Waste Scotland in 2015. They reported



that implementing these types of opportunities can be complicated by the inclusion of multiple organisations, and difficulties around ownership and demarcation and suggest that receiving support about how to manage this part of the project would be useful.

"Because multiple organisations will need to be involved, ownership and demarcation could be a potential barrier - there needs to be an overall owner for the project and currently it is not clear how this would work. Without commitment and detailed understanding there would be a big risk to any of the individual parties making investments. Something that can mitigate this risk would be beneficial."

"Most support focuses on technical and economic feasibility but more support may actually be required to look at the wider management and commercial issues of such a system, particularly at later stages of the project once technical and economic feasibility have been fully established."

Zero Waste Scotland have also recognised this barrier and, in association with Scottish Enterprise, will be beginning to engage with small companies in the coming year to stimulate the market and support organisations to broker these kinds of deals.

6.3 Supporting the Public Sector

6.3.1 Expertise in local authorities

Capacity of local authorities has been increased through cascading knowledge, providing online tools

and delivering training to increase awareness and understanding and build confidence. By building capacity local authority personnel are able to hold informed discussions with future contractors and are better placed to interpret outputs from future projects. Competency and resource can be seen to be improving both through the improved understanding experienced by Zero Waste Scotland project managers during day to day delivery but also evidenced during the evaluation survey where all seven of the beneficiaries interviewed reported some increase in the understanding and awareness of district heating and low carbon heat technologies. The support is not, however, intended to train the local authority on how to scope, instruct, manage and interpret their own feasibility studies. Local authority staff are unlikely to have the time to undergo such intensive training on a topic that will only be a small part of their job role, never mind keep up to date with the changing landscape. Instead centralised expert support from Zero Waste Scotland can fill the gap in expertise and experience.

"The adhoc advice and discussions between the Council and Zero Waste Scotland colleagues have played an invaluable part of allowing progress to be made with low carbon project development, particularly when resources are strained internally. The relationships we've built over time have meant we have the confidence to rely on the expertise and knowledge and can call on that quite quickly which adds effectiveness to the service Zero Waste Scotland provide." (Local authority)

The beneficiaries interviewed through the survey generally felt unsure about whether the competency

and expertise at their organisation had reached a level that they could progress further opportunities without additional external support. Whilst they feel more confident in their understanding across the organisation, they still feel that further support is beneficial, especially considering that things are always changing.

“I think that Zero Waste Scotland plays a really important role and, compared to similar experiences of other sustainability agendas, I don’t think there will come a point where we can do without external support. We would prefer to see it made available in the longer term rather than just the short term” (Local authority)

6.3.2 Building a project team

Low carbon heat opportunities require a collaborative approach from the outset, both internally between different departments of the same organisation and externally with a variety of different partners. Zero Waste Scotland has seen examples of projects that have not been successful, not because the projects weren’t feasible or achievable, but because the project team did not have the strength, drive and support required to deliver the project. Within the project team, an internal project champion is critical for driving projects. Without this drive, it can be difficult for a project to gain momentum and reach implementation. If the champion is at a senior level it can really help.

Within the local authority, it is necessary to engage with a range of teams including energy, housing, planning, asset, finance and others. All key stakeholders should be engaged before strategies and feasibility studies begin, to ensure buy-in across the organisation and momentum after the documents have been produced. As an external independent body, Zero Waste Scotland can help to bring local authority staff together and act as a catalyst internally. Additionally, Zero Waste Scotland has provided support to engage senior management and decision makers which can help to drive low carbon heat projects but can also take time to develop. Interviewees reported that the low carbon heat agenda had become more embedded in their organisation and with senior members of staff, and five of the beneficiaries interviewed felt that Zero Waste Scotland had helped to engage senior staff and decision makers.

“The added value was the engagement and strengthening of the relationships between the

energy team and planners that this exercise provoked” (Local authority)

“There already was a commitment within our local development plan to promote the renewable and low carbon heat agenda but I think as result of Zero Waste Scotland input we’re a bit clearer about what that needs to actually look like. And a bit readier to actually take things forward on that front.” (Local authority)

6.3.3 Bespoke project support to local authorities

The complexity of the subject and the competing priorities of the local authority has limited the impact of coaching and mentoring local authorities on how to implement a low carbon heat strategy. In addition, local authority areas vary considerably geographically, socially, politically and industrially. Local authorities also have complex internal political environments and this is an additional factor to consider when delivering support. It is necessary therefore to consider each local authority individually and provide bespoke support rather than a generic template approach.

The support required by local authorities is quite in-depth and bespoke and it takes time and resource to build a strategic vision and gain commitment to the agenda. To begin with contractors were the most suitable providers of this support, however as the policy landscape rapidly evolves it is becoming more appropriate to provide this support through in-house delivery. The experience and expertise of the Low Carbon Heat Team has grown, making it possible to achieve this. This maintains the relationships and the knowledge that is being built rather than losing it as contracts change, and also reduces the time involved in bringing new contractors up to speed on the subject as they too need to adjust to policy development.

6.3.4 Local area district heating strategy development

A district heating strategy is an essential first step to move to a local low carbon heat economy. To support local authorities to take a more strategic approach, Zero Waste Scotland developed a strategy template. However strategies are more complex and take considerably longer to finalise than expected as the local authorities:

- Need experience and expertise that may not be available.
- Need input from a lot of different teams.

- Need to consult with stakeholders.
- Need a variety of data which creates data sharing issues.
- Have competing priorities that can distract, side-line and impede progress.
- Need sign off from senior elected officials and corporate managers because of the size of the potential investments and because of the political risk to councils of getting it wrong.

In 2016/17, two strategies were developed and tested using different methodologies. In the first case, a contractor produced a heat strategy for the local authority, and although the strategy was well-received, the local authority couldn’t match the timescale of the contractor schedule and therefore didn’t fully input to the work. This highlights how the production of a strategy has to be undertaken with full view of senior staff at the council and with timescales appropriate to council processes. Meanwhile a different local authority received support with the development of their strategy from a Zero Waste Scotland project manager. Although this approach was more resource intensive for Zero Waste Scotland, by working with the local authority rather than for them, the council understood the strategy and it could be fully embedded.

6.3.5 Feasibility studies

Feasibility studies should be delivered following the development of a strategy, undertaking relevant stakeholder engagement and reviewing and appraising different opportunities. Zero Waste Scotland support to focus the scopes of feasibility studies result in better outcomes and more informed investment of capital funds, such as LCITP.

Feasibility studies are essential for determining whether time, resource and capital should be invested in a project. Follow-on support to interpret findings and build confidence in recommendations through impartial and independent advice is essential to give the local authority the confidence to build a business case and invest in a project. As reported by Scottish Futures Trust, Zero Waste Scotland creates an “intelligent client” who can then progress the project.

District heating is not always the solution. Feasibility studies need to consider social, environmental and economic factors and where district heating isn’t feasible or sustainable, then consider other low carbon heat alternatives that may be more suitable for the area. The programme is now developing

methodologies for incorporating alternative low carbon heat solutions into their work.

As mentioned in the “Assessing impact” section of this report, every feasibility study has value, even if the opportunity is assessed as non-viable – such an outcome saves time, money and resources and builds trust with the local authority. The East Dunbartonshire case study is a good example of this.

6.4 Partnership working

As part of this evaluation activity, Zero Waste Scotland has sought feedback from a selection of individuals at partner organisations to understand how the programme is perceived externally and how the partners could work together to increase impact. Four interviews were conducted with key members of staff at Energy Saving Trust, Scottish Futures Trust and Scottish Enterprise. The nature of the questions asked were open-ended to allow the partners to provide detailed and relevant feedback. A brief summary of the responses follows and the question sets can be provided upon request.

The partners agree that the low carbon heat agenda needs a well-coordinated holistic approach as there are many stakeholders (including private, public and domestic) that need to be considered and supported. Each of the partners has a different support offering and these can work well together if knowledge and information is shared freely and openly. After five years working together this collaborative approach has become stronger and is embedded throughout delivery. The partners regularly signpost and refer organisations to the correct support mechanism when this is appropriate. For example, Zero Waste Scotland involves Scottish Futures Trust (SFT) in the “Next Steps” phase of feasibility studies, with SFT attending the final project meeting with the local authority. Scottish Futures Trust then continues engagement with the local authority to help define a route toward a full business case. Zero Waste Scotland will maintain contact, following the progress of the project and supporting with stakeholder engagement.

The feedback from agencies was positive about the part that Zero Waste Scotland plays in the HNP and the Energy Intensive Industries Forum. The team are seen to bring valuable and credible technical expertise, advice and market knowledge to the table. This is considered to complement others’ understanding of businesses and stakeholders

and how to manage these types of projects. The experience and independence of the team are also believed to provide confidence in the technical assessment of LCITP applications as well as enable interesting and valuable discussions at partnership meetings.

Scottish Futures Trust highlighted the importance of Zero Waste Scotland’s role in creating an “intelligent client” by supporting inexperienced local authorities (who don’t otherwise have the expertise or capacity) to scope feasibility studies and interrogate results. The development of the Opportunity Assessment Tool and the ability to run models and conduct heat mapping exercises in-house were also highlighted as key contributions to the low carbon heat agenda.

As well as working with support agency partners, it is also necessary to engage with a wider range of stakeholders to raise awareness and build confidence in low carbon heat opportunities across the supply chain. Stakeholders that need to be engaged include end-users of low carbon heat systems, large landowners, commercial property developers and housebuilders, the industrial heat recovery supply chain, and the Planning and Housing Departments at local authorities.

Partner Feedback

“The relationship between Scottish Enterprise and Zero Waste Scotland has strengthened over the years... a more open relationship helps us understand how the support we each provide can be complementary ... This strengthens the appeal of Zero Waste Scotland and Scottish Enterprise to the business base, showing we are aligned, joined up and aware of what each organisation is delivering – this can be a real benefit.” **Sustainability Team, Scottish Enterprise**

“Scottish Enterprise and Zero Waste Scotland work closely on the low carbon heat programme in general, the interaction is positive and the technical contribution is valuable. We value the partnership.” **Business Infrastructure, Scottish Enterprise**

Zero Waste Scotland support “makes a terrific impact on the early-stage development of heat network opportunities, and as a result a lot of projects are significantly further ahead than they would have been, or have been screened out as not being feasible. This initiative really helps local authorities to focus finite resources on feasible opportunities.” **Scottish Futures Trust.**

7 Next steps

Zero Waste Scotland’s Low Carbon Heat support programme has and will continue to deliver and adapt based on the experience of delivery and learnings detailed within this report. To support policy priorities, we will pro-actively develop targeted interventions that support organisations within specific sectors, geographies or programmes. In addition, we will support Scottish Government policy development through robust programme monitoring

& evaluation and the provision of expert and technical advice.

At the end of the 2017-20 period, we will re-evaluate and provide an update to this report. Changes to support activities during the period include a move to widen the focus from district heating to all low carbon heat opportunities and an emphasis on strategic stakeholder engagement.





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