

Heat Network Skills Initiative

Project Report



April 2021

Report produced by Ramboll and Nordic Heat

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1. Introduction

Heat networks are a critical part of the energy infrastructure needed to support decarbonisation of heat in buildings. The Scottish Government’s draft Heat in Buildings Strategy sets out that “we must rapidly scale up deployment of zero emissions heating systems, such as heat pumps and heat networks, more than doubling installations each year so that by 2030 over 1 million homes and around 50,000 non-domestic buildings are converted to use these systems”¹. The Heat Networks (Scotland) Bill² set specific heat network supply targets, including:

- Scotland’s combined supply of thermal energy by heat networks should reach 2.6 terawatt hours (TWh) of output by 2027 and 6 terawatt hours of output by 2030.
- This must include domestic connections, with the Bill setting out the total number of connections required to meet 2.6 TWh target between now and 2027 should be equivalent to approximately 120,000 homes. The number of connections required to meet 6TWh target by 2030 should be equivalent to approximately 650,000 domestic properties.
- The Bill also sets a duty on the Scottish Government to set a further target for 2035 in regulations no later than October 2023.

Successful rapid scale-up of heat networks in Scotland will rely on upscaling of the supply chains that support the design, construction, operation and maintenance of networks. Previous research in heat network skills provision in Scotland has highlighted that there are already a range of skills gaps creating challenges in the sector, covering areas of project management, heat network design, installation and optimisation, as well as technical operation and maintenance. Supporting the development of skills to support the growth of heat networks is therefore crucial to being able to meet these ambitions.

This report sets out the activities undertaken by Ramboll and Nordic Heat as part of the Heat Network Skills Initiative, a project funded by the Scottish Government and managed by Energy Saving Trust. The project aimed to support the development of a skilled workforce able to meet the employment needs of the growing Scottish heat network sector.

¹ Scottish Government (2021) ‘Draft Heat in Buildings Strategy’ (p3)
<https://www.gov.scot/publications/heat-buildings-strategy-achieving-net-zero-emissions-scotlands-buildings-consultation/>

² The Scottish Parliament (February 2021), Heat Networks (Scotland) Bill
<https://www.parliament.scot/bills-and-laws/bills/heat-networks-scotland-bill>

The project, which ran between December 2020 and the end of March 2021, has drafted a portfolio of four focussed short courses and online Masterclass programmes, in partnership with Scottish academic institutions, the heat network industry and supply chain. The courses are designed to address key skills gaps identified by the industry, sowing the seeds for further development and growth of heat network skills training in Scotland.

This report sets out a brief background to the project activities (Section 2); details the course development approach and work undertaken during the project (Section 3); then sets out key details of the drafted courses (Section 4). A number of challenges were discussed with stakeholders during the project in relation to the uncertainty of student demand. Some of the identified key issues and reflections are discussed in Section 5. The report concludes with a summary of the project and makes recommendations for how to support further development of heat network skills in Scotland in the future (section 6).

2. Background

This project builds on previous work commissioned by Energy Saving Trust and the Scottish Government. A workshop to discuss heat network skills gaps was held in November 2019, bringing together over 40 heat network practitioners including product suppliers, energy companies, local authorities, consultancies and public sector organisations. The workshop outputs highlighted a range of skills gaps already creating challenges in the sector, covering areas of project management, heat network design, installation and optimisation, as well as technical operation and maintenance. Following this, Energy Saving Trust and the Scottish Government commissioned research that provided a more in-depth analysis of the skills gaps experienced by practitioners working in the Scottish heat network sector and assessed the potential for developing training provision within colleges and universities to fill these gaps.

This project builds on the findings from this previous work, with insights provided through stakeholder interactions as well as drawing on the experience of Ramboll, Nordic Heat and the Heat Academy. This section provides a brief summary of the existing skills development picture in Scotland, presenting findings from the previous heat network skills projects mentioned above, as well as independent thinking from the project team, to provide the background evidence used to focus engagement activities with colleges, universities, heat network operators and supply chain actors.

2.1 Required skills to support heat network development, construction, operation and maintenance

Workforce competences in the Scottish DH supply chain

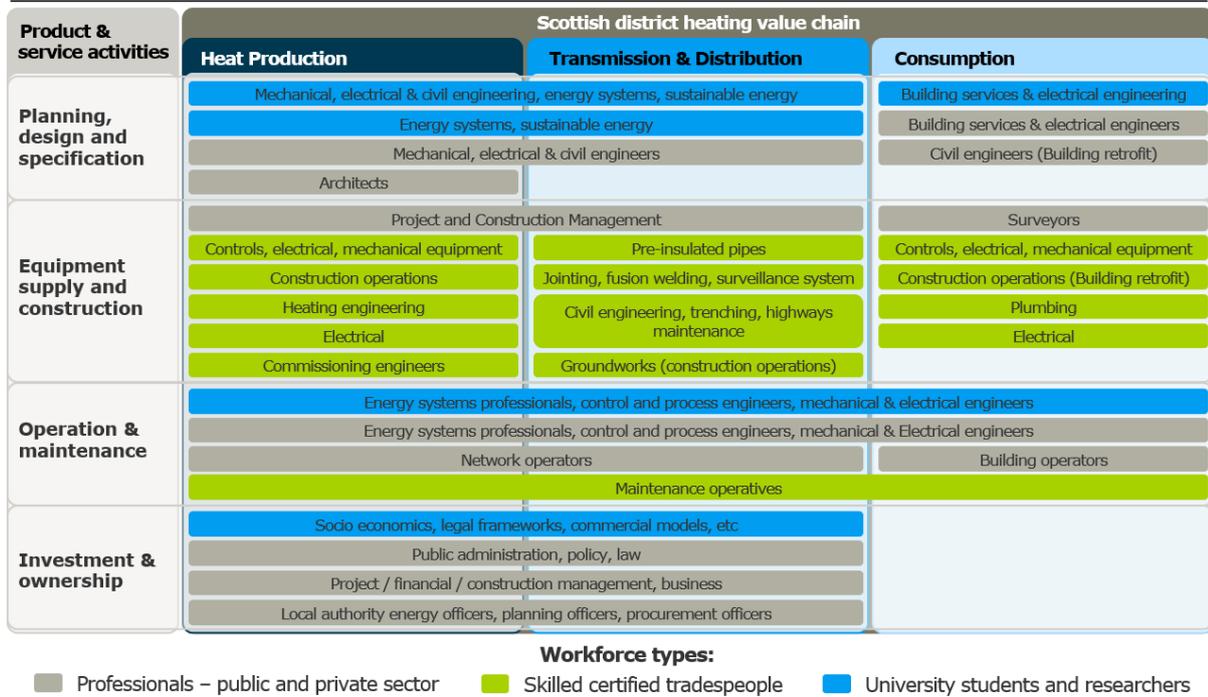


Figure 1: Workforce skills required across the Scottish district heating 'value chain'

Figure 1 visualises the workforce skills required across the district heating 'value chain', categorised by workforce type. At present, the Scottish district heating sector relies on a small number of specialist contractors to deliver new distribution networks, and it is often necessary to import these contractors from outside of Scotland. Overall, the core competences for an ideal DH value chain already exist in the Scottish workforce within vocational professions such as gas engineering, plumbing, electrical and mechanical engineering, heating engineering, building management and construction. However, these existing competencies need specialising and adapting for application to heat networks.

2.2 Heat network training needs in Scotland

Research conducted for Energy Saving Trust and the Scottish Government in spring 2020 highlighted a range of skills gaps that currently exist and the specific types of training that were required to support the growth of the sector. **Table 1** summarises these identified course topics highlighted by the research.

Table 1: Summary of training needs of the Scottish Heat network sector according to the 2020 study conducted for Energy Saving Trust³

<p>Skilled tradespeople and post-16 students in colleges</p> <ul style="list-style-type: none"> • Customer journey and engagement • Heat network design principles • Installation of: <ul style="list-style-type: none"> ○ Low ambient temperature networks ○ Heat pumps (large and modular) with waste heat sources ○ All types of pipe installation including leak detection systems ○ Smart / digital technologies ○ Internal building wet heating systems for low temp networks, including hydraulic interface units (HIUs) • Operation and control of low temperature heat networks (including ambient loops) 	<p>University students and researchers</p> <ul style="list-style-type: none"> • Design of low carbon heat networks including: <ul style="list-style-type: none"> ○ low temperature systems, ○ Use of low carbon heat, ○ Building design / retrofit requirements, ○ Digitalised networks <hr/> <p>Professionals – public and private sector</p> <ul style="list-style-type: none"> • Project management of heat network development • Business case preparation • Commercial delivery models and procurement • Quality management • Non-technical ‘introductory’ training for board members, financial managers, planning officers, procurement officials, legal advisors.
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The report recommended that a range of actions could be taken to support heat network skills development and training provision in Scotland. These included providing ‘train-the-trainer’ continual professional development (CPD) opportunities for college and university lecturers; greater collaboration between the heat network industry (operators and supply chain) and academic institutions to shape course content and support course sustainability by providing a steady student demand into courses; and the development of one or two specialist heat network training centres within colleges and universities to pool resources and student demand as the sector grows from its existing small base.

This project has used these recommendations and list of course topics to inform the focus of the

³ Ruth Bush (2020) Report for Energy Saving Trust, ‘Heat network Skills in Scotland’
<https://energysavingtrust.org.uk/wp-content/uploads/2020/10/Heat-Network-Skills-Analysis-for-Scotland.pdf>

project, making adaptations and adjustments to suit the practicalities of developing courses in practice. The next section sets out the approach used by the project team to course development.

3. Approach to course development

3.1 The Heat Academy Approach

Nordic Heat's 'Heat Academy' model of training provision was used as the basis for course development within the project.

The approach to vocational training, which has already been used to create course provision at Stoke College (England) and Bridgend College (Wales), creates initial short courses in partnership with colleges that build on existing course provision. Colleges are linked up with supply chain actors to integrate the companies' existing skills and training materials into college teaching. In Stoke, for example, the addition of a heat pump to the College's teaching resources (donated by a private sector partner) enables students on electrical and plumbing courses to learn specific competences that develop previously learned core skills, thereby enlarging their career opportunities and employment prospects.

The courses are accredited by the private sector partners. Typically, qualifications offered by respected private sector organisations are highly valued because they are a market-led endorsement of competence. This approach ensures that course delivery is grounded in the existing practice in the industry and connected with heat networks and enables faster course delivery as course content and 'train-the-trainer' facilities can be adapted from existing materials. As the short courses develop and expand, they could develop into longer courses of study accredited by one of the examination or trade bodies such as City and Guilds. In this way the course viability would be established before colleges or universities need to commit resources for full time programmes.

3.1.1 Selection of private sector supply chain partners

The nature of this partnership approach with private sector supply chain actors means that specific companies are selected for the purposes of vocational course development with colleges. Ramboll and Nordic Heat do not have an existing affiliations or preferences while facilitating the establishment of these partnerships. Supply chain actors were selected based upon their interest in participating in course development and the equipment used by the local heat network operator (thereby ensuring a local market for contractors undertaking the training). There are a relatively small number of supply chain actors currently active in the Scottish Market. Over time, it will be important to encourage the development of more Scottish-based training opportunities with other supply chain actors not yet engaged.

3.1.2 Heat Academy Masterclass

The Heat Academy also uses a format of Masterclasses (both online and in groups) to offer continuous professional development focusing on topics related to decarbonising heating and cooling to practitioners working in heat network sectors across the world. The Masterclasses are often organised in collaboration with different partners – institutions, colleges, universities, energy operators, industry organisations and representatives from the supply chain. Examples of partners are the Association of Decentralised Energy, UK Government Department for Business, Energy and Industrial Strategy, UK Government Department for International Trade, The Coal Authority, Uniper, The Swedish Research institute, local authorities, colleges, universities and suppliers in the UK and beyond.

3.2 Project objectives

The Heat Network Skills Initiative had the objective of working with colleges and universities to develop a minimum of four courses.

- In colleges, the objective was to develop initial short courses as add-ons to existing college provision, working in partnership with companies in the heat network supply chain to contribute to course content and create practical teaching facilities.
- In universities, the objective was to develop online masterclasses, as well as facilitate links between university researchers, undergraduate and Masters students and the heat network industry to support use of real data in teaching and research.
- ‘Train-the-trainer’ needs are also identified to ensure quality course delivery.

In practice, the project has had to adapt its approach to working with colleges on course development due to challenges and uncertainties experienced by college course directors..

3.3 Project activities

Figure 2 shows a summary of the process undertaken by the project team in order to develop the courses.

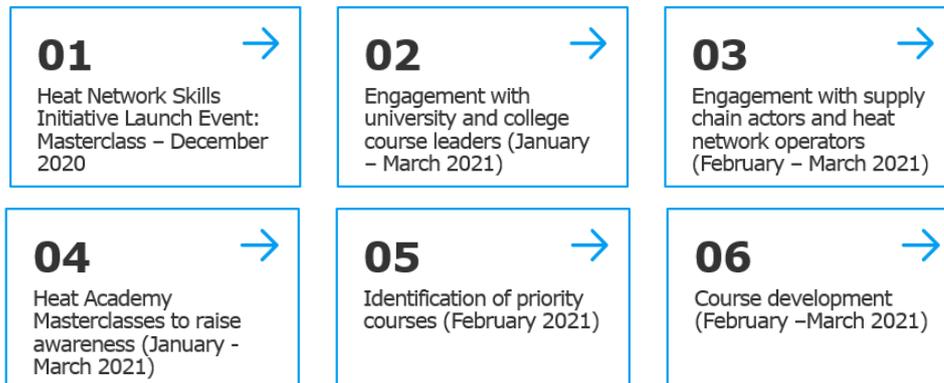


Figure 2: Summary of project activities over the four months of the project (December 2020 – End of March 2021)

Targeted one-to-one engagement was undertaken with the aim of establishing interest and, where possible, commitments in supporting course development and delivery. College and university engagement was targeted initially at the institutions highlighted by the previous research report, with additional institutions added as wider stakeholder engagement led to promising opportunities. A list of all of the stakeholders contacted as part of the project is included in Appendix, including details of the engagement activities with academic institutions.

Alongside this, the project ran a number of online Heat Academy Masterclasses to raise awareness and gain commitment to the aims of the project from Scottish academic institutions, heat network operators and key supply chain actors. The following section summarises the details of these masterclasses.

3.3.1 Delivered Heat Academy Masterclasses

Five Heat Academy Masterclasses were held to support the Heat Network Skills Initiative in Scotland over the duration of the project. These events aimed to raise awareness and gain commitment to the aims of the project from Scottish academic institutions, heat network operators and key supply chain actors. The Masterclasses are summarised below. Agendas, speaker details, and links to recordings of each of these workshops are also included within the summaries.

Net-Zero Ready – Decarbonising Scotland – Skills Agenda

15 December – Online Workshop

The recording of the session is available here: <https://we.tl/t-QHAVdiuFAI>

Event Summary

This session marked the launch of the **Heat Network Skills Initiative in Scotland** –setting out a vision for the Heat Network Sector to become ‘Net Zero Ready’ and the steps we will take to get there.

The overall objective was to mobilise all the key stakeholders to this mission of making sure we have the skills and the capacity required for Scotland’s ambition to reach net-zero by 2045.

The session featured representatives from universities, colleges, city councils, district energy operators, the local supply chain and other organisations, all determined to translate the climate emergency into action. The list of speakers included:

- **Louise Broatch** – Energy Saving Trust
- **Michael Jenkins** – Bridgend Council
- **Jeremy Crooks** – The Coal Authority
- **Nicky Cowan** – Star Renewable Energy
- **Kirsten Brown** – University of Strathclyde
- **Kevin Christie** – Aberdeen Heat and Power

Implementing Heat Networks – Overview of Skills Required

11 February – Online Workshop

The recording of the session is available here: <https://www.dropbox.com/t/rCqTEPmJY7g4Jwjf>

Event Summary

As cities accelerate investments in decarbonising heating, the demand for skilled people has become critical. But, what exactly are the skills required to take a project from vision to operations? And, how can training institutions and the local supply chain gear up to meet the needs?

Decarbonising heating is a top priority in Scotland to reduce CO2 emissions by 50% by 2030 and to hit net-zero by 2045. Heat networks combined with energy efficiency retrofit will be critical components in making this possible. Significant investment programmes are currently underway across Scotland to multiply the market share for heat networks in coming years.

There is an urgent demand for trained professionals in the heat network sector. Implementation of the solutions to decarbonise heating will require thousands of skilled professionals active in a broad range of areas. There is also a need to rapidly develop the capacity in the local supply chain of systems and services.

The aim of the session was to highlight the technologies and the professional and vocational skills required to take a heat network project from vision to operations. Representatives from Energy Saving Trust, Scottish Enterprise, SSE and a range of suppliers of technologies and services described skills required to take a heat network project from vision to operation, and initiatives currently underway to address the skill gaps.

University of St Andrews – BioHeat

25 February – Online Workshop

The recording of the session is available here: <https://www.dropbox.com/t/vwlpD6epnOqtiG7s>

Event Summary

The Eden Campus Energy Centre is central to the University of St Andrews' strategic drive to become the UK's first energy carbon neutral university. A state-of-art biomass heat network is only the start.

The University of St Andrews aims to become net zero by 2035. Energy efficiency retrofit combined with district heating are central components in this strategy.

In 2017 the university commissioned a biomass district heating network at the Eden campus. Since the launch, Eden Campus has reduced 20% of the University's carbon footprint through biomass and solar energy. The investment also aims to turn the university into a living lab and a hub involving private companies where low-carbon technologies are demonstrated in real life.

At the up-coming session the team leading the energy transformation of the University will present the net-zero strategy and share their experiences from preparing, delivering and operating the system. They will also describe the opportunities for expansion, and the challenges to overcome. The session will also involve speakers representing the Scottish government and Scottish Enterprise, as well as suppliers involved in the delivery of the heat network. The financial sector will be represented by Sir Roger Gifford, SEB, addressing the critical topic of how to finance decarbonisation.

Q&A session

Implementing Heat Networks – Overview of Skills Required

26 February – Online Workshop

This session provided attendees of the session of the 11th February (of the same title) an opportunity to ask speakers detailed questions and discuss key issues and ideas arising from the workshop.

Heat Networks – Best Practice

11th March 10:00 – 12:00 UK Time – Online Workshop

The recording of the session is available here: <https://www.dropbox.com/t/d7JZgLv095j27yr>

Event Summary

Introduction to technologies and strategies for designing, installing, operating and maintaining sustainable, affordable and reliable heat network solutions of different types and size

This session highlighted technologies and solutions related to storage and distribution of heat, involving speakers representing a range of companies – **Polypipe/ Terrendis, Rehau, Powerpipe, Midroc and Comsof**. Speakers included **Dave Pearson, Star Renewable Energy**, sharing his observations of heat networks from a heat pump perspective. **Dr Roddy Yarr, Strathclyde University** sharing experiences made from implementing a heat network at the campus. Other speakers included **Pilar Rodriguez, Energy Saving Trust** and **Jack Welch, Vattenfall**.

4. Course Development

4.1 Selected courses for development within the project scope

Four course topics were selected for development based upon the indicated priority areas in the ‘Heat Network Skills in Scotland’ report⁴, the team’s experience working with the Scottish heat network supply chain, and feedback received from heat network operators and contractors during project stakeholder engagement. The courses are intended to be delivered close to existing or planned heat networks in need of skilled workforce. This will support the development, operation and maintenance of the heat network, as well as reduce the student demand uncertainty for uptake of the courses.

The following courses have been drafted within the scope of the project:

- Vocational Course 1: Heat network pipe installation (fusion welding)
- Vocational Course 2: Heat network pipe installation (plastic pipe installation)
- Professional course 1 – Introduction to heat networks: Why heat networks work
- Professional course 2 – Introduction to heat networks: How heat networks work

The courses proposed here are intended to act as a catalyst and demonstrator for further expansion of heat network skills training in Scotland. To meet the needs of the sector, they will need to evolve and grow quickly over the coming years.

4.2 Vocational Course 1: Heat network pipe installation (fusion welding)

Table 2: Summary of Vocational Course 1: Heat network pipe installation (fusion welding)

	Details
Course summary	The Mittel TSC training course will enable trainees to become qualified in connecting Powerpipe/Mittel district heating pipework. This will enable them to secure work opportunities with Powerpipe/Mittel approved contractors.
Course host	NESCOL
Supply chain partner	Powerpipe/Mittel ⁵

⁴ Ruth Bush (2020) Report for Energy Saving Trust, ‘Heat network Skills in Scotland’ <https://energysavingtrust.org.uk/wp-content/uploads/2020/10/Heat-Network-Skills-Analysis-for-Scotland.pdf>

⁵ Note: Powerpipe do not currently have Scottish-based accredited installers, indicating contractors from elsewhere in the UK are currently being used to undertake installations. Creating Scottish-based opportunities for Powerpipe accredited training will therefore likely support additional Scottish job creation.

Local heat network information	Aberdeen Heat and Power support the focus of the course. They have a framework agreement with Powerpipe, so the course can support the use of local contractors.
Course learning objectives	<p>Understand how the Mittel TSC jointing system works</p> <p>Understand Mittel TSC system applications</p> <p>Safely and accurately use Mittel TSC welding machine</p> <p>Safely and accurately use Mittel TSC extrusion machine</p> <p>Safely and accurately use Mittel TSC welding and extrusion machines and other necessary equipment to complete a Mittel joint to the required standard</p> <p>Safely and accurately use Mittel TSC welding and extrusion machines and other necessary equipment to repair a damaged joint to the required standard</p> <p>Understand how the Nordic Leak Detection System works</p>
Target audience	<p>Existing Installers requiring re-certification</p> <p>Skilled workforce e.g. plumbers/welders, retraining to also work in the heat network industry</p> <p>College students on full or part time courses in, for example, plumbing and HVAC looking to access opportunities for work in the heat network industry</p>
Course duration	3 days, targeted to take place during the summer to make use of workshop space when other course teaching is paused.
Course delivery model	<p>Supply chain partner to provide the course programme</p> <p>College teaching staff member completes a 'train the trainer' course with Powerpipe / Mittel before delivering the course. (Course materials initially delivered by Powerpipe until train the training can be provided)</p> <p>Training will be delivered through practical workshops - Tuition followed by practice followed by assessment and certification</p>
Course equipment and resource requirements	<p>Workshop – free from other use for duration of the course/s</p> <p>Storage space for course materials – pipes and connections</p> <p>Storage space for machinery</p> <p>Basic workshop tools</p> <p>Resources provided by Powerpipe/Mittel</p> <ul style="list-style-type: none"> • Welding and Extrusion machines • All other specialist equipment • Course materials (pipe, joints etc.)
Accreditation?	<p>Accreditation provided by Powerpipe/Mittel (Note: Trained installers also have to work for a company that is also accredited by Powerpipe/Mittel)</p> <p>Validity: 3 years⁶</p>
Course costs	<p>Fusion welding equipment – supplied at no cost for Year 1</p> <p>Course materials supplied at discount cost</p>

⁶ After three years, contractors are required to undertake additional training to gain re-accreditation. This ensures quality standards are maintained for the supplier and heat network operators, but also provides sustainable student demand for colleges offering accredited training courses.

'Train the Trainer' training free for College member of teaching staff (expenses for teaching staff required)

Engagement of Mittel trainer until 'Train the trainer' completed – charged

First course/s to be delivered by Mittel

The course content is designed as follows:

1. Introduction to HDPE welding and thermoplastics philosophy
2. Introduction to different types of joints
3. Teaching the importance meeting Powerpipe/Mittel quality standards
4. Use of Mittel Welding equipment
5. Use of Extrusion Machines and Longitudinal Extrusion Welding
6. Demonstrating the standard of jointing required to meet Powerpipe/Mittel standards
7. Practice at making joints that meet Powerpipe/Mittel standards
8. Assessment of trainee jointing technique and quality of joints
9. Presentation of Certificates for trainees meeting the quality standard

4.2.1 Vocational Course 1: Train the Trainer

Table 3: Summary of Vocational Course 1: Train the trainer

Train the trainer	Details
Course summary	Two-part course - Training experienced trainers to deliver the Mittel TSC training course to the required standard including assuring that certificated trainees meet Powerpipe/Mittel standards
Course host	Powerpipe/Mittel
Course learning objectives	<p>Understand how the Mittel TSC jointing system works</p> <p>Understand Mittel TSC system applications</p> <p>Safely and accurately use Mittel TSC welding machine</p> <p>Safely and accurately use Mittel TSC extrusion machine</p> <p>Safely and accurately use Mittel TSC welding and extrusion machines and other necessary equipment to complete a Mittel joint to the required standard</p> <p>Safely and accurately use Mittel TSC welding and extrusion machines and other necessary equipment to repair a damaged joint to the required standard</p> <p>Understand how the Nordic Leak Detection System works</p> <p>Understand how to assess trainees work to meet the required standard</p> <p>Demonstrate effective training methodologies</p>
Target audience	Experienced college trainers looking to expand college provision to include district heating pipe connection course
Course duration	4 days (part 1) 3 days (part 2) - 3 days – duration of a course for trainees

Course delivery model	Classroom and Practical workshop Tuition followed by practice followed by assessment and certification
Course equipment and resource requirements	All resources provided by Powerpipe/Mittel: <ul style="list-style-type: none"> • All Tuition • Workshop • Welding and Extrusion machines • All other specialist equipment • Course materials (pipe, joints etc.)
Accreditation?	Accreditation of trainee trainer provided by Powerpipe/Mittel if trainee trainer passes Parts 1 and 2 Validity: 3 years
Course costs	Part 1: Expenses for Trainer Expenses for Trainee Part 2: Cost of Mittel Trainer – supervising trainee trainer Expenses for Mittel Trainer

Course Content – Part 1 (in Sweden, travel restrictions permitting)

- Introduction to HDPE welding and thermoplastics philosophy
- Introduction to different types of joints
- Teaching the importance meeting Powerpipe/Mittel quality standards
- Use of Mittel Welding equipment
- Use of Extrusion Machines and Longitudinal Extrusion Welding
- Demonstrating the standard of jointing required to meet Powerpipe/Mittel standards
- Practice at making joints that meet Powerpipe/Mittel standards
- Assessment of trainee jointing technique and quality of joints
- Presentation of Certificates for trainees meeting the quality standard

Course Content – Part 2 (In trainer's college)

- Supervision of Trainee Trainer delivering the Mittel TSC training course

4.3 Vocational Course 2: Heat network plastic pipe design and installation

Three courses have been developed under this topic, to enable flexibility to contractor and local heat network requirements.

Table 4: Summary of Vocational Course 21: Polypipe Design Course for District Heating using Plastic Pipes

Polypipe Design Course for District Heating using Plastic Pipes	Details
Course summary	The Polypipe training course will enable trainees to become qualified in designing district heating schemes using plastic pipes. This will enable them to secure work opportunities with Polypipe approved contractors.
Course host	Engagement undertaken with a range of colleges in relation to this course, but no specific host partner was finalised.
Local heat network information	Clyde Gateway heat network
Course learning objectives	<p>Understand the capabilities and characteristics of the Polypipe heat network piping system</p> <p>Understand the features and benefits of low temperature heat networks</p> <p>Understand the principles of 5GDHC – integrating heating and cooling within a heat network</p> <p>Understand how to bed Polypipes in trenches</p> <p>Understand which Polypipe fixtures and fittings to use in all applications</p> <p>Understand the hydraulic and temperature limits for Polypipe pipes and fittings</p>
Target audience	<p>District heating designers looking to specify plastic pipes</p> <p>District heating designers developing low temperature networks e.g. 5GDHC</p> <p>College students on full or part time district heating design courses looking to extend their opportunities for work in the low temperature heat network industry</p>
Course duration	2 days
Course delivery model	<p>Classroom based tuition</p> <p>Tuition followed by practice followed by assessment and certification</p>
Course equipment and resource requirements	<p>Workshop – free from other use for duration of the course/s</p> <p>Storage space for course materials – pipes and connections</p> <p>Storage space for machinery</p> <p>Basic workshop tools</p> <p>Resources provided by Polypipe</p> <p>Specialist machinery</p> <p>All other specialist equipment</p> <p>Course materials (pipe, joints etc.)</p>
Accreditation?	<p>Accreditation provided by Polypipe</p> <p>Validity: 2 years</p>
Course costs	<p>Trainer – from Polypipe (to be agreed)</p> <p>Expenses for Trainer</p>

Course Content

- Introduction to low temperature heat network design and applications using plastic pipes
- Introduction to Polypipe pipes and fittings

- How to size plastic pipes for both heating and cooling networks
- The importance of meeting Polypipe quality standards
- Demonstrating the standard of jointing required to meet Polypipe standards
- Practice at making joints that meet Polypipe standards

Table 5: Summary of Vocational Course 2.2: Polypipe Plastic Pipe Installation training

Polypipe Plastic Pipe Installation training	Details
Course summary	The Polypipe training course will enable trainees to become qualified in connecting Polypipe district heating pipework. This will enable them to secure work opportunities with Polypipe approved contractors.
Course host	Engagement undertaken with a range of colleges in relation to this course, but no specific host partner was finalised.
Local heat network information	Clyde Gateway heat network
Course learning objectives	<p>Understand how the Polypipe jointing system works</p> <p>Understand Polypipe system applications for heating and cooling</p> <p>Understand how to bed Polypipes in trenches</p> <p>Safely and accurately use Polypipe pipe jointing fittings and equipment</p> <p>Safely and accurately use Polypipe equipment and fittings to complete Polypipe joints to the required standard</p> <p>Safely and accurately use Polypipe equipment and fittings to repair a damaged joint to the required standard</p>
Target audience	<p>Existing Installers requiring re-certification</p> <p>Skilled workforce e.g. plumbers/welders, retraining to also work in the heat network industry</p> <p>College students on full or part time courses in, for example, plumbing and HVAC looking to access opportunities for work in the heat network industry</p>
Course duration	2 days
Course delivery model	<p>Practical workshop</p> <p>Tuition followed by practice followed by assessment and certification</p>
Course equipment and resource requirements	<p>Workshop – free from other use for duration of the course/s</p> <p>Storage space for course materials – pipes and connections</p> <p>Storage space for machinery</p> <p>Basic workshop tools</p> <p>Resources provided by Polypipe</p> <p>All specialist equipment</p> <p>Course materials (pipe, joints etc.)</p>
Accreditation?	<p>Accreditation provided by Polypipe</p> <p>Validity: 2 years</p>
Course costs	<p>Trainer – from Polypipe (to be agreed)</p> <p>Expenses for Trainer</p>

Course Content

- Introduction to low temperature heat networks including 5GDHC
- Introduction to different types of Polypipe joints
- Teaching the importance meeting Polypipe quality standards
- Use of Polypipe equipment and fittings
- Demonstrating the standard of jointing required to meet Polypipe standards
- Practice at making joints that meet Polypipe standards
- Assessment of trainee jointing technique and quality of joints
- Presentation of Certificates for trainees meeting the quality standard

Table 6: Summary of Vocational Course 2.3: Rehau Pipe Installation training

Rehau Pipe Installation training	Details
Course summary	The Rehau training course will enable trainees to become qualified in connecting Rehau district heating pipework. This will enable them to secure work opportunities with Rehau approved contractors.
Course host	Engagement undertaken with a range of colleges in relation to this course, but no specific host partner was finalised
Local heat network information	Clyde Gateway heat network
Course learning objectives	<p>Understand how the Rehau jointing system works</p> <p>Understand Rehau system applications</p> <p>Understand how to use Shroud options (heat shrink & Generation II)</p> <p>Safely and accurately use Rehau jointing equipment and fittings</p> <p>Safely and accurately uses Rehau equipment and fittings to complete a Rehau joint to the required standard</p> <p>Safely and accurately use Rehau equipment and fittings to repair a damaged joint to the required standard</p> <p>Understand how to backfill trenches</p> <p>Understand how to pressure test pipes and joints</p>
Target audience	<p>Existing Installers requiring re-certification</p> <p>Skilled workforce e.g. plumbers/welders, retraining to also work in the heat network industry</p> <p>College students on full or part time courses in, for example, plumbing and HVAC looking to access opportunities for work in the heat network industry</p>
Course duration	3 days
Course delivery model	<p>Practical workshop</p> <p>Tuition followed by practice followed by assessment and certification</p>
Course equipment and resource requirements	<p>Workshop – free from other use for duration of the course/s</p> <p>Storage space for course materials – pipes and connections</p> <p>Storage space for machinery</p>

	<p>Basic workshop tools</p> <p>Resources provided by Rehau</p> <p>All specialist equipment</p> <p>Course materials (pipe, joints etc.)</p>
Accreditation?	<p>Accreditation provided by Rehau</p> <p>Validity: 2 years</p>
Course costs	<p>Trainer – from Rehau (to be agreed)</p> <p>Expenses for Trainer</p>

Course Content

- Introduction to REHAU – RAUVITHERM & RAUTHERMEX product overview
- Maximum coil sizes and bending radii
- Introduction to REHAU EVERLOCTM joints and RAUTOOLS
- Using accessories (end caps/wall penetrations/fixing brackets)
- Teaching the importance meeting Rehau quality standards
- Use case studies to demonstrate good practice
- Demonstrating the standard of jointing required to meet Rehau quality standards
- Practice at making joints that meet Rehau standards
- Assessment of trainee jointing technique and quality of joints
- Installation training including back-filling and pressure testing
- Presentation of Certificates for trainees meeting the quality standard

4.4 Professional Course 1 – Introduction to heat networks: Why heat networks work

Implementing District Heating
Introductory Courses – From Vision to Operations



Target Audience

The training courses are intended to serve as an introduction to the district heating sector addressing various stake holder groups having an interest in the sector – students aiming to specialise on topics related to heating and cooling, professionals looking for re-skilling opportunities, and the local supply chain having an interest to understand what technologies and services will be in demand thereby positioning them as local suppliers as investments in decarbonisation expand.

Description of courses

The training package consists of 3 separate courses, each consisting of 2 modules. The two universities involved will run one course each. The third course will be delivered jointly.

Course 1 - Why Heat Networks Work

Summary Outline why heat networks in combination with energy efficiency retrofit are critical to decarbonising heating, thereby enabling net-zero by 2045.

MODULE 1 – Decarbonising Heating – Why Heat Networks Work (2 hours)				
Why decarbonizing heat Drivers for change – push and pull	What are the options Opportunities and Experiences	Why Heat Networks What are they and how do they work	How to do it Solutions, Strategies and Skills	Whereto next The broader agenda
MODULE2 – Stakeholder Management – Selling Heat (2 hours)				
Politicians Infrastructure, benefits and skin in the game	End-users Affordability, convenience and shaping the future	Developers Becoming Net-zero ready. Now.	Investors Risks, Returns and Responsibilities	Broader Public Communicate, Involve and Drive

University University of Strathclyde 

Reference case University of Strathclyde – Campus Heat Network

- Learning outcomes*
- Outline the environmental need for district heating
 - Discuss the financial / environmental benefits.
 - Political requirements
 - Outline the social benefits associated with heat networks (fuel poverty and retraining)
 - Demonstrate the Strathclyde DH network and expansion capacity.
 - Future plans for Strathclyde and decarbonising the Climate Neutral
 - Innovation District (focus on social inclusion).

- Speakers*
- Representatives from
- University of Strathclyde
 - Other national and international universities and training institutions
 - Political institutions
 - Energy operators
 - Supply chain
 - Investors and Banks

4.5 Professional Course 2 – Introduction to heat networks: How heat networks work

Course 2 - How Heat Networks Work

Summary Outline the technologies and solutions involved, and the key steps required to bring a heat network project from vision to operation

MODULE 1 – The Value Chain of Heat – Starting with the End-user (2 hours)

The need for heat
Determining the demand

Building Efficiency
Reducing the demand

Connect & Control
Becoming part of the network

Distributing Heat
Getting the pipes in the ground

Sourcing Heat
Start where you are, Use what you have

MODULE 2 – Programme Management – Taking the Lead (2 hours)

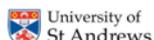
Process
From A to Z

Progress
Avoiding the Valley of Death

Performance
On time, on Budget, on Scope

Partners
Leadership, Competence, Capacity

Practical
Execution Intelligence

University University of St Andrews 

Reference case University of St Andrews – Eden Campus Heat Network

Learning outcomes

- How to establish a relevant demand profile of buildings to connect
- Solutions to reduce the need for external heat supply
- Heat sourcing – alternative solutions
- Technologies to store, distribute and connect & control heat supplies
- Designing and right sizing the system
- Digital solutions to reduce costs and improve performance
- Procurement and supply chain management
- Up-front costs vs. Life Cycle Costs

Speakers

Representatives from

- University of St Andrews
- Other national and international universities and training institutions
- Political institutions
- Energy operators
- Supply chain
- Investors and Banks

4.6 Professional Course 3 – Introduction to heat networks: How we made it work

Implementing District Heating
Introductory Courses – From Vision to Operations



Course 3 - How We made it Work

Summary Sharing first hand experiences and best practice from installing and operating heat networks at St Andrews and Strathclyde

MODULE 1 – Strategy – Bringing heat underground (2hours)				
Objective Building a market place for heat	Opportunity Framing Securing anchor load and organic growth	Solutions Best practice – technologies and processes	Making it affordable Managing risks and life cycle costs	Expansion How to grow as you go
MODULE 2 – Execution Intelligence – Collaborate and Replicate (2hours)				
Avoiding Perfection Best is the Enemy of Good	Overcoming barriers Avoiding the classic traps	Failing forward Accepting mistakes – Inaction is worse	Replicate Secure close collaboration with colleagues	Have it done. Now. Time is not on our side

University University of St Andrews, University of Strathclyde  

Reference cases University of St Andrews – University of Strathclyde

- Learning outcomes*
- Developing a realistic strategy
 - Business planning and financial modelling
 - Visions are nice, decisions are necessary, execution is everything
 - Selling the concept – overcoming resistance
 - Accepting mistakes
 - Programme management – leadership
 - Selecting partners
 - The barriers along the route, and how to overcome them

- Speakers*
- Representatives from
- University of St Andrews
 - Other national and international universities and training institutions
 - Political institutions
 - Energy operators
 - Supply chain
 - Investors and Banks

4.7 Additional opportunities identified during the project

A range of other opportunities including other course topics were explored during the project but could not be taken forward due to the short timescales of the work. We list them here for future colleagues who are seeking to support further expansion of heat network skills provision in Scotland:

4.7.1 Link with The UK Geoenergy Observatory (UKGOS) and the British Geological Survey

The UK Geoenergy Observatory (UKGOS) developed by the British Geological Survey (BGS) in Glasgow is exploring ways of working with the Heat Academy to spread the learning from its new facilities.

The UKGO consists of 12 boreholes up to 200m deep filled with over 300 sensors enabling scientists and engineers to learn more about the geology and behaviour of the subsurface, particularly aiming to enhance the opportunity to use warm water contained in former mine workings to provide decarbonised heat to homes, businesses and public buildings.

Many areas of the UK, including the central belt of Scotland, have flooded abandoned mines. BGS and the Heat Academy are exploring opportunities to develop professional and vocational course programmes that support the growth of mine energy schemes by using learnings from UKGO to reduce risks, and therefore costs.

4.7.2 Additional Vocational Course Topic: Connect and Control

The 'Connect and Control' course topic was an opportunity identified during the project but was not taken forward due to time constraints. There was interest from the supply chain actor Cetetherm, the Joint Venture heat network operator in South-East Edinburgh (Midlothian Council / Vattenfall), and Heriot-Watt University. The key attributes of the course were as follows:

- Supply Chain Partners – Cetetherm, Kamstrup,
- HN partner – Midlothian Council / Vattenfall
- Target audience – Building services / renewables courses
- Academic partner – Heriot-Watt University (with the potential to also link into Edinburgh College)

4.7.3 Fuel change initiative

The project team have had some discussion with Fuel Change (<https://fuelchange.co.uk/>) who are developing programmes to bring together apprentices to work on climate challenges set by industry. There is an opportunity to explore how the heat networks industry could connect with apprentices taking vocational training courses to offer hands on practical experience to apprentices alongside their wider training programme.

5. Report on stakeholder feedback – lessons for supporting heat network skills in the future

Over 60 stakeholders were engaged in one-to-one and round table discussions during the project, representing colleges, universities, heat network developers and operators, and the heat network supply chain (including both local contractors and technology suppliers). The ultimate aim of these engagement sessions was to establish commitments to run and contribute to the four courses focused on as the project outputs. There were a number of wider issues discussed that are summarised here to inform Energy Saving Trust and the Scottish Government in any future work they undertake on heat network skills.

5.1 The challenge of creating certainty of demand for courses

A key message from all stakeholders was that skills development needs to be underpinned by market confidence, deriving from societal demand to decarbonise as well as policy, regulation and financial mechanisms to support investment. These two aspects are intertwined in a form of 'skills development cycle'. The market needs to have confidence that the pipeline of projects and investment in new heat networks will sustain the demand for training new apprentices and employees. Without this market confidence, there is a reluctance for supply chain actors to invest in training their workforce and correspondingly a reluctance for training providers to invest in new course development. Figure 3 illustrates our understanding of an ideal skills development cycle, where there is a clear established demand from the supply chain, which enables training provision (through both taught courses and practical experience) to be developed to meet the growing needs of the sector.

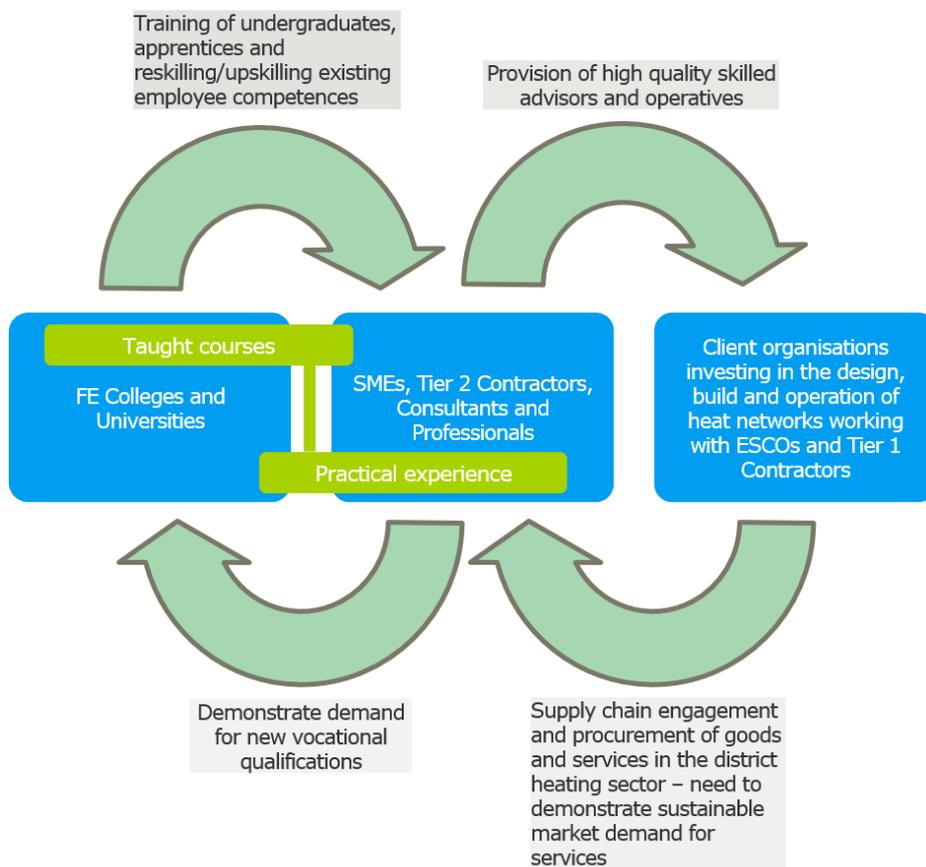


Figure 3: Illustration of the skills development cycle for the Scottish district heating sector

In the college sector, certainty of demand was not well established. Comments received from colleges and contractors during project discussions indicated that this market confidence was not well-established in some locations:

- “There needs to be a visible route to jobs or contractor opportunities” (Contractor considering the need for a vocational course in their area).
- “We are not receiving requests from local tradespeople in relation to heat network skills” (College course director)
- “Plans that exist in our region for district heating systems are either small in scale or at such an early stage of development that timing is not right to develop new training provision. Our courses needs to be matched to workforce requirements on a “just in time” basis: there’s no value for us, or the groups we work with, to train for jobs that may exist at some point in the future, or where we can anticipate a significant gap between completion of a course and the start of employment. Our stakeholders need and expect smooth transition into the workforce”. (College Vice Principal)

In contrast, there was more certainty of demand in the university sector. Low carbon energy courses were receiving large numbers of applicants and there was a desire to ensure that low carbon heat technologies were well represented. This was reflected by the project's success in establishing agreements and partnerships with two universities to host the 'Introduction to Heat Networks' courses and more universities also showing interest in being involved in future initiatives.

Ultimately, investment in training of apprentices and professionals needs to happen ahead of demand to enable a sustainable, local supply chain to emerge. We recommend that investment in skills development should be targeted both at the college sector, but also at SMEs, Tier 2 Contractors, Consultants and Professional Employers who will provide a sustainable student demand for courses.

5.2 Fuel change initiative

Stakeholders highlighted the need to raise awareness about the growing heat network sector (and low carbon energy in general) amongst potential students, as another factor that could overcome demand uncertainty for new courses. For example, NESCOL highlighted how people in Aberdeen were not signing up for engineering courses because they saw it as linked with the oil and gas sector, which is currently struggling. They saw a need to raise awareness of renewables opportunities and to inspire young people to target the sector for training and jobs. Multiple stakeholders mentioned the opportunity to link the skills agenda with outreach into schools to establish a greater awareness of heat networks amongst students and the growing opportunity that they provide in the Scottish job market.

5.3 Challenge of developing courses within the context of the Coronavirus Pandemic

The event of a new full COVID national lockdown during the timeframe of this short project, understandably, had an effect on the capacity of college institutions to engage regarding course development. This meant that course leaders did not engage with the project who had previously expressed interest in developing teaching related to heat network skills during the previous Scottish Government / Energy Saving Trust research.

One college that did engage with the project for several months cited the impact of the lockdown on the college's staff resources as a contributing factor to their decision not to commit to hosting a course:

"As you might imagine, we are fully engaged in trying to move forwards our existing programmes of training, education and support for our business partners, as we all try to recover from the chaos that the coronavirus pandemic has brought. Staff availability through to the end of this college year is practically non-existent" (College representative, 09/03/21).

Given this challenging context, it is likely that more development time is needed to establish the new courses within interested colleges.

5.4 Developing the right skills mix for future industry needs

Stakeholder engagement was undertaken with a range of heat network operators and their local contractors during the project. There was general support for the course topics proposed within this project scope, and the following areas were highlighted as needing longer term development as the industry matured:

- **Developing people with a blend of vocational and professional skills:** Stakeholders highlighted a need for operational managers of heat networks to develop a good understanding of the whole heat network system – both the network and the energy centres. They suggested this would require multi-level training in both vocational and professional-focused courses, with a connection between college and university training.
- **Increasing awareness of heat networks amongst contractors:** During stakeholder engagement discussions, heat network operators also highlighted how a broad range of contractors need to develop an awareness of heat networks. This would create an understanding of the growing commercial opportunity in the heat networks sector and likely increase uptake of vocational course offerings from contractors with relevant skill sets. One example given was in relation to new build developers that typically use multi-utility contractors to provide the energy infrastructure needs for a site. These providers will be required to deliver heat networks as part of their offering in future, including low temperature heat networks and building level heating systems (transitioning from 85 degrees to 55 degrees centigrade). At present, these providers do not typically offer district heating as an infrastructure option, and construction contractors are not necessarily familiar with the requirements for lower temperature systems. It was suggested that the 'Introduction to HNs' course be useful for raising awareness amongst local contractors about what is needed, and the 'Introduction to Heat Networks' course should be connected into college teaching as well as universities.

6. Conclusions and Recommendations

Four courses have been identified and drafted over the course of the Heat Network Skills Initiative: two vocational courses and two professional courses. These are intended to act as exemplar courses and catalysts for further expansion and development of new courses in Scotland. In addition, five Heat Academy Masterclasses have been run, aiming to increase understanding and awareness of the skills needs and skills demands from the heat network sector; as well as bringing together interested parties to enable collaboration.

Over 60 stakeholders have engaged with the project from colleges, universities, heat network developers and operators, and the heat network supply chain. There was interest and support across the board, and particular success establishing partnerships with universities to co-design and run the 'Introduction to heat networks' courses. However, there was also a hesitancy to commit to running courses from the college sector due to uncertainty around student demand and the speed of growth of the sector (as well as workload constraints created by the Corona Virus Pandemic lock-down).

The project team make the following recommendations based upon our experience delivering this project and engaging with stakeholders across the sectors:

6.1 Short term recommendations

The Heat Network Skills Initiative ran for only three and a half months (December 2020 – March 2021) and, given the extraordinary circumstances of a national lockdown at the end of December 2020 and the additional burden this placed on academic staff, it was challenging to get early engagement from college course leaders in particular. Despite this, the private sector were forthcoming in their support for course development and were prepared to commit to running vocational courses in partnership with colleges and universities. The project team have developed the courses as far as possible in the timeframes, but we were unable to establish full commitments from the college partners in all cases. We recommend the following steps are prioritised to ensure that the momentum from the Initiative is not lost and the courses are successfully set up:

1. The investment in training of apprentices and professionals ahead of demand is essential to enable a sustainable supply chain to emerge. There may be a need for

funding to support colleges (and to some extent universities) in undertaking the initial investment to set up and expand courses (e.g. funding to support staff to undertake ‘train-the-trainer’ courses with suppliers) since colleges perceive significant uncertainty about the resulting student demand.

- a. One approach to funding these investments into heat network training longer-term could be to require heat network developers to ringfence a percentage of the heat network project funding they receive to support training of their contractors and staff. This will create a clear signal of student demand to colleges and universities and generate momentum and certainty to invest in courses.
2. Work should be undertaken as a priority to mobilise the local supply chain contractors to make them aware of the market opportunity and the training opportunity offered by heat networks.
 - a. One suggestion was to encourage contractors to participate in the ‘Introduction to Heat Networks’ course and link this course into college teaching more generally. This will be important in raising awareness amongst local contractors about the opportunity offered by the heat networks industry and provide a level of understanding to support investment in specific training courses.
 - b. There is also an opportunity to work with NESCOL and Aberdeen Heat and Power to share an exemplar of what can be achieved with the local supply chain – reduced costs, higher quality works, creation of local jobs.
 3. Nordic Heat and the Heat Academy will continue engagement with NESCOL, Glasgow Kelvin College, University of Strathclyde and University of St Andrews to support them in establishing the courses ready for the summer / next academic year. However, there is a need for a long-term facilitator to support the strategic development of heat network skills development, supporting colleges, universities and working with the heat networks sector to ensure their evolving and growing skills needs are met locally as much as possible.
 - a. A range of additional course opportunities have been highlighted in this report that have the potential for development in the near future. The role of a long-term facilitator for the sector should be appointed as soon as possible to ensure that these opportunities are not missed.

6.2 Longer term recommendations to achieve a development of the sector

The team make the following recommendations about how to support heat network skills development in Scotland longer term:

4. The administrative costs of updating and maintaining courses should not be underestimated. Once developed and launched, content will need to be regularly updated and additional 'train-the-trainer' undertaken where necessary (e.g. in the case of the vocational courses partnered with specific suppliers). The 'Introduction to District Heating' course will need regular updates to content to ensure that it remains relevant to a fast developing sector. We recommend that this is considered by the Scottish Government and whilst the sector is still small and course business cases are marginal, it would be beneficial to allocate funding to support universities and colleges to ensure that course provision continues beyond the first round of delivery.
5. Replicating and expanding courses - Sustainability of courses:
 - a. Heat network skills development will be a long-term process that would benefit from long-term support and development from an organisation with a dedicated resource and responsibility. This project has begun to develop relationships with the right people and establish connections between academic course leaders, heat network operators and developers, and the supply chain. However, there is a need for a longer-term facilitation role to set in place a sustainable network to enable courses to grow and replicate into the future. This could be from a public sector body such as Energy Saving Trust or other publicly funded organisations such as the Energy Skills Partnership.
 - b. Over time, it will be important to encourage the development of more Scottish-based training opportunities with other supply chain actors that do not yet have Scottish-based training provision. Diversification of certified training options will maximise local job creation and support development of a competitive supply chain by ensuring heat network operators can utilise multiple products and local contractors within their networks.
6. There is an opportunity to develop pathways for students to progress from vocational courses through to university-level training (meeting the needs highlighted by the heat network operators to develop personnel with a mix of vocational and professional skills for managing the whole heat network system).

Appendix I: Stakeholder Engagement

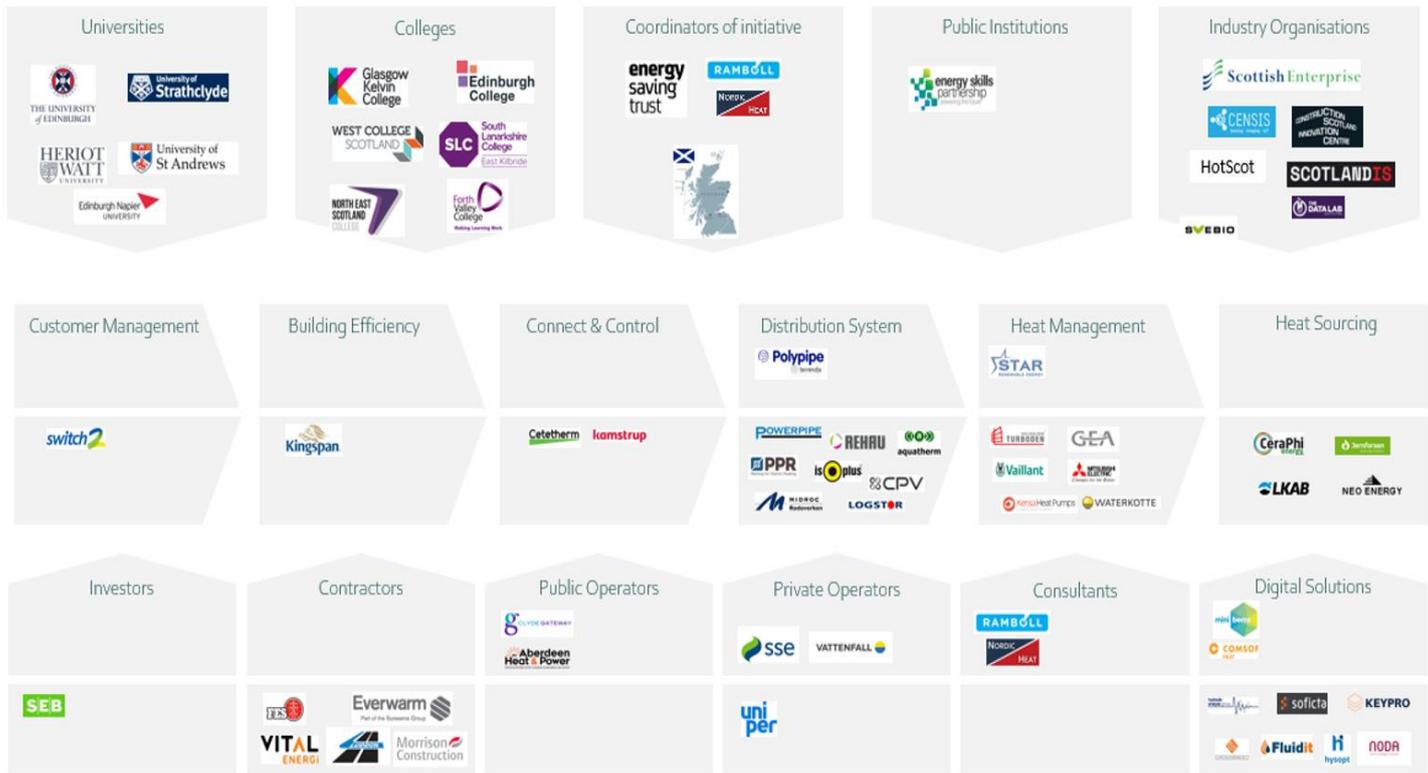


Figure 4: Contacted stakeholders as part of the Heat Network Skills Initiative