
Pathways to engagement with low carbon heat: an industry perspective

March 2022

About this report

This report has been developed through collaboration between Scottish and Northern Ireland Plumbers Employer's Federation, Construction Scotland Innovation Centre, Energy Saving Trust and the University of Edinburgh. It explores the different routes to engaging in low carbon heat and installer experiences of training and certification for this.

About SNIPEF

The Scottish and Northern Ireland Plumbing Employers' Federation (SNIPEF) is the principal trade association for plumbing and heating businesses based in Scotland and Northern Ireland. Since 1923, SNIPEF have represented the best interests of the plumbing and heating industry, from sole traders to large-scale businesses. SNIPEF Training Services are also a managing agent for plumbing apprentices in Scotland.

About CSIC

Construction Scotland Innovation Centre (CSIC) was launched in October 2014 to deliver transformational change in the Scottish construction sector. CSIC is an industry-led, demand-driven Innovation Centre linking businesses, universities, and the public sector in collaboration to support increased innovation and productivity. Currently, CSIC is majority funded by the Scottish Funding Council, Scottish Enterprise and Highlands and Islands Enterprise. Our renewed focus on accelerating the delivery of net zero 2045 has moved us to look at the delivery of four main programmes of work.

- Retrofit
- Sustainability
- Digital Transformation
- Modern Methods of Construction

About EST

Energy Saving Trust is an independent organisation dedicated to promoting energy efficiency, low carbon transport and sustainable energy use. We aim to address the climate emergency and deliver the wider benefits of clean energy as we transition to net zero. We empower householders to make better choices, deliver transformative programmes for governments and support businesses with strategy, research and assurance – enabling everyone to play their part in building a sustainable future.

About the author

Dr Faye Wade is a Chancellor's Fellow at the University of Edinburgh. Faye is a sociologist who focuses on knowledge and expertise amongst the construction professionals and organisations responsible for delivering the buildings and infrastructure needed to tackle climate change.

How to cite this report

Wade, F. (2022) Pathways to engagement with low carbon heat: an industry perspective. Scottish and Northern Ireland Plumbers Employer's Federation/ Construction Scotland Innovation Centre/ Energy Saving Trust.

Acknowledgments

We would like to thank all of the plumbing and heating engineers that took part in this research. They generously took time out of their busy schedules and shared their expertise with good humour and kindness. Thanks also to colleagues from SNIPEF, EST and CSIC for their contribution to this work. In particular: Martyn Raine at SNIPEF; Pilar Rodriguez at EST and Alan Johnston, Anne-Mari Gillespie, Emma Church and Ross Muir at CSIC.

Executive Summary

All buildings must use zero emissions heating by 2045

Scottish Government anticipate almost all buildings in Scotland must be using a zero emissions heating system by 2045 in order to meet ambitious net zero targets.

Heating installers are crucial to delivering this: existing workers will need to re-train, and all new entrants need to be equipped with skills for installing low carbon systems. This transition needs to be made rapidly, but the heating industry is traditionally slow to change.

Through mapping low carbon training routes in Scotland, and interviewing both traditional and low carbon heating installers, this report explores installer barriers to and experiences of low carbon training and certification.

It identifies the skills needed for low carbon delivery, and installers' concerns about training for new entrants and existing workers. Through this, the report identifies a series of recommendations for different stakeholders responsible for ensuring the uptake of low carbon heat:

- **Scottish Government**
- **Skills Development Scotland**
- **Standards and Certification Bodies**
- **Representative bodies**
- **Manufacturers**



The recommendations

For Scottish Government...

- Create a level playing field by providing ongoing funding which prioritises micro/SME businesses for training for e.g. achieving MCS certification.
- Continue to provide funding to colleges to increase the number of low carbon training centres and support in recruiting tutors with low carbon experience.
- Encourage more apprentices through low carbon pathways.
- Provide clear policy trajectory and procurement frameworks to guarantee future pipeline of work to create confidence for businesses to invest in new skills and staff.
- Consistent consumer incentives including a replacement for the Renewable Heat Incentive, increasing capacity in advisory bodies for householders and businesses.
- Provide awareness campaigns to highlight advisory bodies and stimulate the marketplace. Incentives to be promoted and easy to navigate.

For Representative Bodies...

- Encourage more apprentices through low carbon pathways, and continue to support apprentice employers.
- Make conventional plumbing and heating installers aware of opportunities arising from installation and maintenance of low carbon heating systems.
- Develop strong signposting and awareness campaigns - collaborate with experienced low carbon installers.
- Provide information about householder/SME funding (e.g. HES Loan) to installers.
- Build better relationships with manufacturers and energy advice organisations to identify collaboration opportunities.
- Consult with installers to ensure that training is meeting the needs of the industry.

For Skills Development Scotland...

- Raise awareness of apprenticeships through webinars and social media campaigns.
- Encourage more apprentices through low carbon pathways.
- Work with schools to introduce and encourage low carbon as a rewarding and prosperous career.
- Highlight support available for installers with low carbon apprentices.

For Standards and Certification Bodies...

- Emphasise availability of MCS experienced worker route to existing installers.
- Simplify administrative aspects of certification so it is more accessible for businesses to work on delivery programmes and other framework requirements.
- Make sure installers are aware of benefits of adhering to consumer protection through consumer codes bodies and MCS.

For Manufacturers...

- Expand provision of low carbon training courses, ensuring that they are accessible to all including delivery in rural locations.
- Work closely with skills and advisory bodies to ensure installer training aligns with industry requirements.
- Continue principle of support for first install: certification & extended warranties for trained installers.
- Prepare for anticipated demand, invest in stock and ensure that supply chains are ready to deliver in all regions of Scotland.

Contents

- 1** The importance of installers in delivering net zero (p. 9)
 - 1.1** Report outline (p. 9)
- 2** The future of low carbon heat (p. 11)
 - 2.1** The size and technology mix of the market (p. 12)
 - 2.2** Skills for low carbon heat (p. 12)
- 3** Literature review: installer barriers to fitting low carbon heat (p. 15)
 - 3.1** Installer characteristics (p. 16)
 - 3.2** Awareness of low carbon heat and willingness to re-train (p. 17)
- 4** Mapping Training Routes (p. 18)
 - 4.1** What do current training structures look like? (p. 19)
 - 4.2** Training routes in Scotland (p. 19)
 - 4.3** Proposals for new routes to demonstrate competency (p. 21)
- 5** Method (p. 23)
- 6** Installer training experiences (p. 25)
 - 6.1** Installer understandings of low carbon (p. 26)
 - 6.2** Skills for low carbon (p. 28)
 - 6.2.1** Business models for multiple skills (p. 28)
 - 6.3** Networks to support knowledge exchange (p. 30)
 - 6.4** Training for new entrants (p. 31)
 - 6.5** Training for existing installers (p. 33)
 - 6.5.1** Manufacturer training & support (p. 34)
 - 6.6** Microgeneration Certification Scheme (p. 35)
 - 6.7** Demand for low carbon (p. 37)
- 7** Conclusions (p. 39)
- 8** References (p. 41)
- 9** Appendices (p. 43)

List of acronyms used throughout

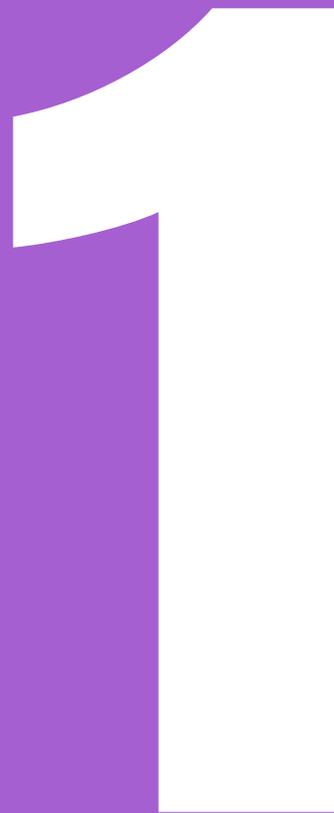
ASHP	Air Source Heat Pump
BEIS	Department for Business, Energy & Industry Strategy
CCC	Climate Change Committee
CIBSE	Chartered Institute of Building Services Engineers
CITB	Construction Industry Training Board
CSIC	Construction Scotland Innovation Centre
EST	Energy Saving Trust
FIT	Feed-In Tariff
GSHP	Ground Source Heat Pump
HEEPS	Home Energy Efficiency Programmes for Scotland
HES	Home Energy Scotland
HPA	Heat Pump
HVAC	Heating, Ventilation and Air Conditioning
MCS	Microgeneration Certification Scheme
RHI	Renewable Heat Incentive
SEA	Sustainable Energy Association
SNIPEF	Scotland & Northern Ireland Plumbing Employers' Federation
SVQ	Scottish Vocational Qualifications

Pathways to engagement with low carbon heat: an industry perspective

© SNIPEF

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without permission in writing from the publisher.

The importance of installers for delivering low carbon heat



Introduction

1 The importance of installers in delivering net zero

Scottish Government have set a legally binding target to achieve net zero greenhouse gas (GHG) emissions by 2045.

Reducing GHG emissions from buildings is a crucial component of this: dwellings alone account for 15% of Scotland's total emissions. A significant majority of Scotland's homes are heated using mains gas, oil, LPG or solid fuels. At present, only around 11% of households have a renewable or low emissions heating system (Scottish Government, 2021a: 12). Scottish Government's recent Heat in Buildings Strategy (2021a) outlines plans to decarbonise heat from homes. To meet their ambitious targets, Scottish Government anticipate that **almost all buildings must be using a zero emissions heating system by 2030, with over 1 million households converted (Scottish Government, 2021a).**

This represents change on a massive scale. Currently, approximately 3,000 low carbon heating systems are installed in Scotland per year; this needs to scale to 200,000 low carbon systems per year by the late 2020s (Scottish Government, 2021a: 16).

This will require a huge effort to increase consumer awareness of low carbon heating systems, and ensure ongoing financial support mechanisms to encourage uptake. However, these targets will not be met without support from the heating industry and installers responsible for fitting systems in homes. Low carbon heating technologies, like heat pumps and hydrogen systems, can have very different installation requirements to fossil fuel powered systems.

The current installation workforce will need to learn new skills and new entrants will need to be recruited to meet demand. Despite this, policy and research still rarely engages with the installers operating at the coal face of this transition, and mechanisms to support them are lacking. This report captures the experiences and challenges that installers face in delivering low carbon heat. Through this, the report provides a series of recommendations for industry and policy makers seeking to deliver on the Heat in Buildings Strategy.

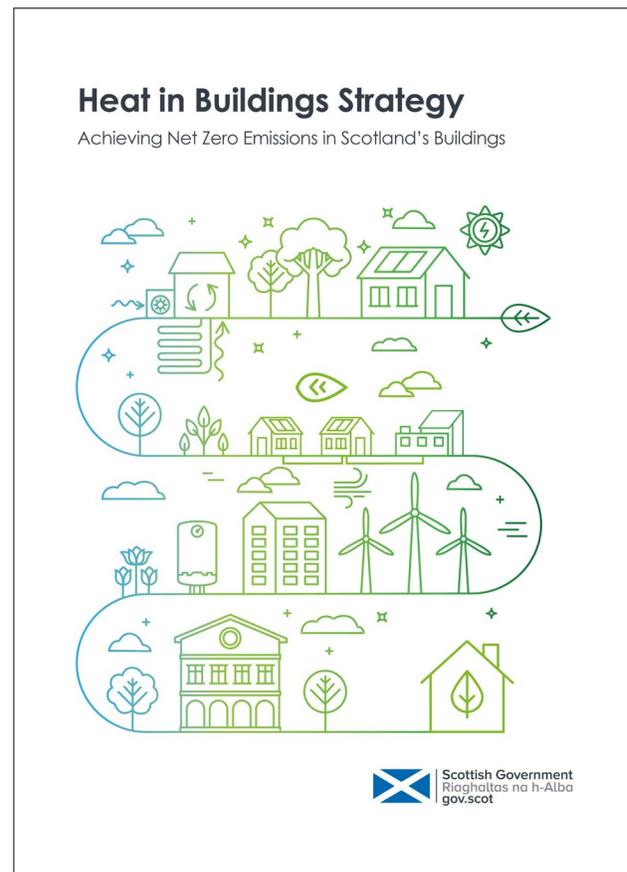
1.1 Report outline

Section 2 details projections for the future low carbon heat market and the skills needed to engage with this.

Section 3 explores installer barriers to engaging with low carbon heat, in particular, barriers to and complexities of installer training.

Section 4 outlines different training and certification routes to installing low carbon heat in Scotland.

Sections 5 and 6 outline the method used for interviewing practitioners and the results of this. The report concludes with a series of recommendations for policy makers and practitioners to support the transition to low carbon heat.



Heat in Buildings Strategy, Scottish Government



Domestic housing, Edinburgh Scotland

The future of low carbon heat

2

2.1 The size and technology mix of the market

The market for low carbon heat is set to grow.

Policy and industry bodies are coalescing around a future scenario in which domestic heat is primarily provided by heat pumps (both air source and ground source) and heat networks. Specifically, the Climate Change Committee's (CCC, 2020) latest scenario mapping suggests that by 2030, low-carbon heat installations in homes could represent around 80% of sales. Of these low carbon heat installations, the CCC (2020: 115) propose:

- 75% are heat pumps (including hydrogen hybrids)
- 1% are low carbon heat networks
- 5% are other flexible electric heating with space heat storage or solar thermal

Reflecting this, Scottish Government's Heat in Buildings Strategy (2021) continues to focus on 'low regrets'¹ heating solutions, particularly district heating and heat pumps. Additional low carbon technologies include biomass and hydrogen. Biomass must be from net zero compatible and sustainable sources in order to fulfill net zero requirements; this has led to a reduction in its overall projected contribution to future low carbon heat scenarios. Hydrogen may also fulfil some heating needs; however, it has been suggested that this is most suitable where electrification is less feasible (CCC, 2020). Scottish Government's latest Heat in Buildings Strategy does, however, note ongoing support for hydrogen demonstration and innovation (Scottish Government, 2021a).

Data collected by UK Government's Department for Business Energy and Industrial Strategy (BEIS) suggests that around 50% of people have some awareness of low carbon heating systems, but a significant proportion do not really know what they are (see Figure 1). There are similar awareness levels in Scotland, with 51% of 1,000 Scottish residents surveyed aware of heat pumps, but understanding of the devices is better here (41% of those who have heard of heat pumps stated they have good understanding) (HES, 2021). Energy Saving Trust (2017) have highlighted that Scottish Government's strategic focus will continue to cascade through to buyer requirements, however, heating installers can also be a crucial source of information and advice – potentially encouraging householders to install low carbon systems. Installer skills for low carbon heat are discussed in the following section.

51%
of Scottish people have some level of awareness of low carbon heating systems.

Awareness of renewable heating systems

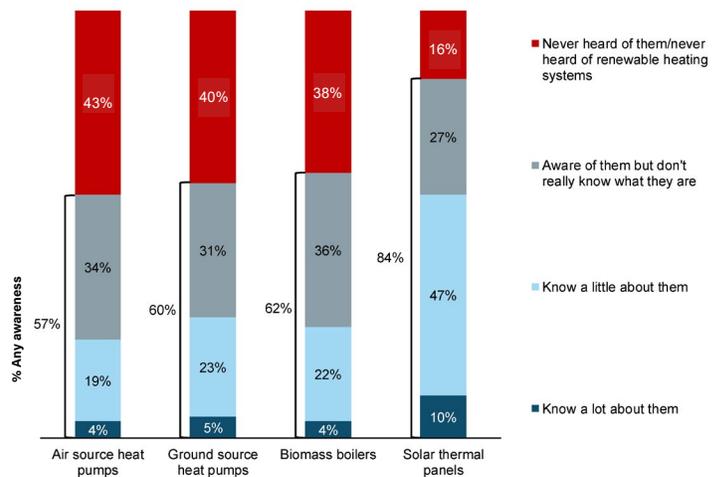


Figure 1: Consumer awareness of specific renewable heating systems. Based on responses from representative panel of 4,022 UK householders, Dec 2020 (Source: BEIS, PAT, 2020)²

1. 'Low regrets' is the term used by the Climate Change Committee to denote retrofitting measures that 'are sensible regardless of the longer-term path' (CCC, 2016: 8). This means those that will deliver carbon emissions reductions and energy efficiency improvements regardless of choices made about larger, system-wide interventions such as incorporating hydrogen into the gas network. 2

2. Based on response to questions: 'How much would you say you know about solar thermal panels? ...And now thinking about three different types of renewable heating system...how much, if anything, do you know about...air source heat pumps/ ground source heat pumps/ biomass boilers?'. Image reproduced here with permission from BEIS Public Attitudes Tracker team.

2.2 Skills for low carbon heat

Using the CCC's future heat scenario, the Construction Industry Training Board (CITB) have estimated that an additional **4,300 plumbers and HVAC workers** will be required in Scotland, primarily for the installation of heat pumps, by 2028 (CITB, 2021). This rapid increase is also reflected in the Heat Pump Association's (HPA) projections for the number of installers needed across the UK to 2035 (see Figure 2). Meeting projected targets is also reliant on involvement of the existing workforce, who will need to be trained to install low carbon heat. The challenge of increasing the number of installers is also compounded by the construction industry's changing demographic. Despite more workers being needed, it is anticipated that the construction industry will experience a 20-25% decline in the available labour force over the next 5-10 years (Farmer, 2016). This reduction in capacity is a result of an aging workforce and low levels of new entrants.

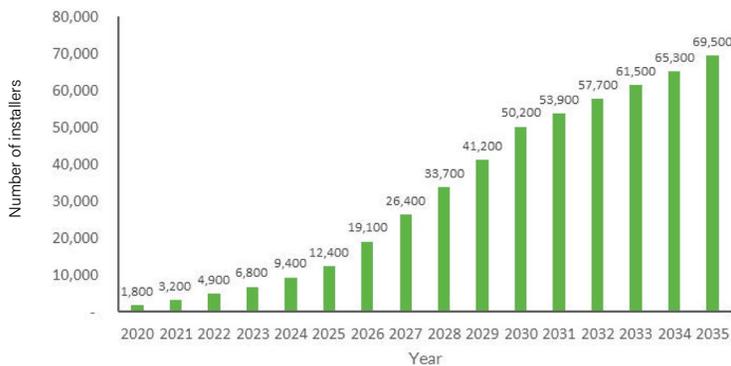


Figure 2: Projected cumulative number of heat pump installers needed to 2035 (Reproduced with permission from: HPA, 2020a: 7)

The three main technologies identified in low carbon heat scenarios all require distinct skill sets to those needed for fitting combustion appliances. The potential skills required for heat pumps, hydrogen and district heating are each now outlined, and summarised in Table 1. Installer barriers to engaging are then reviewed in Section 3.

Heat Pumps

Heat pumps are more complex than gas boilers, and more sensitive to errors in design (Gleeson, 2016). Specific skills needed to install and maintain heat pumps are highly sophisticated (CITB, 2021). These are likely to include: heat loss calculations, hydraulic balancing, flow temperature calculations, and heat system sizing (CITB, 2021). The Scottish Modern Apprenticeship requires training to SVQ Level 3 which incorporates these skills for combustion appliances (with optional courses in low carbon).

In addition, some heat pumps use hydrofluorocarbon refrigerants, the handling of which requires a specific F-gas qualification. Many domestic units are pre-charged during the manufacturing process and so F-Gas is not required for installation; however, this may be a future gap for maintenance. Heat pumps also require 32-amp electrical supplies, the installation of which requires someone with electrical qualifications. These skills are currently lacking amongst the UK heating installer workforce, although plumbing and heating businesses may liaise with electrical contractors for this type of work.

Hydrogen

The major gas boiler manufacturers are already developing hydrogen-ready versions. Although additional skills will be needed for working with hydrogen, this technology is the most similar to existing boilers and will most readily fit onto existing heating systems. It is anticipated that those already trained and registered with Gas Safe will be in a strong position to undertake this work (CITB, 2021).

Heat Networks

Heat networks are a type of major infrastructure, and so the skills needed are quite different.

In particular, skills will be needed at the strategic or systems level, with the recruitment of project planners, engineers, developers, design engineers and control system specialists.

A number of transferable skills, including mechanical and electrical engineering, plumbing, and pipe welding have also been identified (Bush, 2020: 13; EST, 2020). Domestic installers will likely only work on the internal sections of heat networks, rather than the large-scale infrastructure, so there will be more similarities with a traditional heating system.

Timeframe	Hydrogen skills summary	Heat pumps skills summary	Heat networks skills summary
1-4 years	Existing gas installers will be able to re-train and install hydrogen-ready boilers, with an additional 200 Full-Time Equivalent (FTE) per year on average	[HPA estimated around 900 heat pump installers in the UK in 2019]. A rapid increase in training will be required, of around 7,500 installers a year. This is within the capacity of existing training facilities.	Significant additional training capacity, 9500 average additional FTE per year, including predominantly specialist and technical skills.
5-10 years	Existing gas installers can continue re-fitting with hydrogen-ready boilers and begin conversion as hydrogen becomes available. 1,500 additional FTE per year average.	An increase in the rate of training, up to a peak of around 15,000 a year. Towards the end of this period, this will exceed existing training capacity but increasing this within this period is manageable.	Reduction in rate of training to 866 average additional FTE per year
10 years +	Continuation of re-fit and conversion programmes until all connected properties are converted. Workers then employed in maintenance. Steady reduction in numbers required - 500 FTE average	Ongoing work for the workforce, with a gradual reduction in the requirement for installers, as new installations give way to maintenance work. Limited ongoing training requirement.	Reduction in numbers required - 1200 FTE per year
Summary	Any hydrogen pathway could be accommodated within the existing workforce for installation. As part of a balanced pathway, deployment of hydrogen will form only part of the overall solution, so skills and training requirements would be reduced.	The skills required to install them effectively are sophisticated, and quite different from those required to install conventional heating systems. [Heat pumps] are also more efficient when installed alongside improved energy efficiency, distribution and management systems, so a familiarity with these disciplines among heat pump installers would be an advantage.	Significant deployment of heat networks will require a sharp increase in training, as the sector is currently under-staffed and skills required are typically technical, requiring existing experience and long training courses.

Table 1: Summary of projected skills requirements for low carbon heat. (Adapted from CITB, 2021 – tables on pages 34-42)

Installer barriers to fitting low carbon heat

3

Literature Review

3.1 Installer characteristics

Scottish Government estimate that there are around 13,000 people employed in the energy efficiency and low carbon or renewable heat sector in Scotland, with the sector having an annual turnover of £2.4billion (Scottish Government, 2021b: 3).

Available data on types of businesses operating in the sector is largely aggregated for the construction or microgeneration sector in general, rather than heat. However, the majority of businesses operating in the construction sector (inclusive of heating and plumbing) are sole traders and small and medium enterprises (SMEs). The UK Government's latest construction statistics suggest that 49% of Scottish construction firms have one employee or less, whilst a further 48% have under 35 employees (ONS, 2019a).

This trend has continued with the installation of newer renewable and microgeneration technologies, including solar photovoltaics and air source heat pumps. A survey of 317 installers registered with the Microgeneration Certification Scheme (MCS) showed that over 50% have 5 employees or less (Hanna, Leach & Torriti, 2018).

In addition, more than half of these businesses were 4 years old or less (Hanna, Leach & Torriti, 2018). Sole traders may be even more dominant in the heating sector, specifically, with over 70% of those registered with Gas Safe to install domestic gas appliances operating as sole traders (GSR, 2011).

These characteristics are important for two reasons. Firstly, self-employed workers and SMEs can be locked into an 'earn or learn' cycle (BIS, 2013), whereby they are reluctant to undertake new skills training that would mean being away from work for extended periods.

The knock-on effect on labour availability on sites can mean that employers are motivated to sign staff up for short courses of a few hours, rather than any longer time commitment (Killip, 2020).

Secondly, these organisations often rely on word of mouth and referral from existing clients for their work (Wade, Hitchings & Shipworth, 2016). For example, around 40% of 80 suppliers surveyed by the Energy Saving Trust did not use promotional websites and were not registered with online procurement portals (EST, 2017: 5). This word of mouth business model could limit awareness of different products and access to different types of jobs.

This could also restrict the type of products that installers recommend to customers. This is particularly important because customers are often reliant on the knowledge and advice provided by heating installers to decide what systems to fit (CITB, 2021; Wade et al., 2016).

In addition, heating installers have been shown to be reluctant to change. A desire to demonstrate expertise can lead to heating installers fitting the products most familiar to them (Wade, Hitchings & Shipworth, 2016). Strong brand loyalties can also lead installers to fit a limited selection of devices (Wade, Shipworth & Hitchings, 2016). The challenges and time commitment of installing newer low carbon heat could also impact installers' willingness to adopt them. For example, the HPA estimate that eight working days would be needed to install a heat pump in an existing property, compared to approximately four days for a conventional boiler (HPA, 2019).

The challenges and time commitment of installing newer low carbon heat technologies could impact installers' willingness to adopt them

3.2 Awareness of low carbon heat and willingness to re-train

These characteristics may all contribute to a reluctance to engage in installing alternative, low carbon heating technologies. A recent survey, coordinated by low carbon heating industry member associations, identified that 74% of 827 fossil fuel installers did not rate themselves as 'very confident' in recommending and choosing the best low carbon options to their customers (SEA, 2019). In the same survey, 59% of participants noted that they did not really understand what moving to low carbon technologies meant for them or their job (SEA, 2019).

In addition, installers may not be familiar with funding models that support their customers in paying for energy efficiency and heat decarbonisation measures in the home. For example, of 80 survey respondents working in private households in Scotland, 20% were unaware of Home Energy Efficiency Programmes for Scotland (HEEPS) equity or Home Energy Scotland (HES) renewables loans. This is despite these suppliers offering installation services (including low carbon heat) that would be eligible for such loans (EST, 2017). Installers knowing about funding support for their customers could both bolster their business, and increase consumer awareness of different low carbon technologies available.

Further, installers have reported a lack of confidence in the market for low carbon heat. Of 827 fossil fuel installers surveyed, 37% stated that customers rarely ask them about low carbon heating, renewable energy or carbon emissions (SEA, 2019). Further, there is a clear link between policy action to support the market, and installer engagement. To date, installers have been dependent on government financial incentives for householders to guarantee business in a particular sector and thus justify the costs and commitment of training and certification. For example, the number of solar photovoltaic installers joining and leaving MCS is strongly correlated to government changes in the Feed-In Tariff: a reduction in the FIT resulted in fewer installers joining MCS, and an increase in the number leaving the scheme (Hanna, Leach & Toritti, 2018).

For low carbon heat, the UK Government's Renewable Heat Incentive (RHI) has, to date, been more consistent and there has been more stability in the number of MCS-registered heating installers. However, current plans to end the domestic RHI in 2022³ could result in similar patterns to those seen with the FIT. Such uncertainty in market value and the volume of associated work can make it hard for installers to justify the ongoing costs of training, and lead people not to acquire relevant certification at all (EST, 2017). Reflecting this, the CITB (2021: 80) explain:

The absence of policy direction in how our buildings will be heated and insulated will result in a delay in businesses investing in skills and training needed to achieve net-zero

In addition to a clear policy direction, the most important factors influencing an installer's decision to re-train are (SEA, 2019):

- Obligatory training for organisation membership
- New mandatory installation standards
- Future mandatory installation standards
- Demand from customers

This information is from the SEA's 2019 survey of fossil fuel installers. Beyond this, efforts to engage with practitioners and understand their training routes to low carbon heat are limited. However, in a recent survey of 300 people across the construction industry, over 70% believed that they knew the skills they needed to contribute to the decarbonisation of the built environment. In addition, 90% stated they would be willing to re-train, as demand for new roles and skills changes in the future (CITB, 2021). This survey was not specific to the heating industry, but suggests a general willingness to undertake new training.

90% of people surveyed stated they would be willing to re-train, as demand for new roles and skills changes in the future.

3. The UK Government has suggested that this will be replaced with a Boiler Replacement Scheme (BUS) (see: <https://www.ofgem.gov.uk/environmental-and-social-schemes/boiler-upgrade-scheme-bus>). This will only be in England and Wales; Scottish Government decided not to participate and have suggested that they will introduce a new scheme early in 2022.

Mapping Training Routes

4

4.1 What do current training structures look like?

There is a lack of standards and consistency in installer training routes. The current low carbon skills landscape is fragmented, open to interpretation and often provided by non-accredited training providers (Scottish Government, 2021b: 2). For example, 216 microgeneration installers surveyed had used 116 different training providers between them (Hanna, Leach & Torriti, 2018).

This was reflected in a recent study of heat network practitioners in Scotland, who identified a lack of formal skills and reliance on informal training routes (Bush, 2020). The training sources used by participants included: shadowing contractors responsible for design; manufacturer training courses; technical workshops by trade groups (Continuing Professional Development courses); workshops run by the Scottish Heat Network Partnership; CIBSE guidance and news articles (Bush, 2020). In addition, few UK installers have formal heat pump qualifications at National Vocational Qualification (NVQ) Level 3, and heat pump Vocational Education and Training (VET) is generally through short-course provision (Gleeson, 2016). It has been suggested that this training is largely unregulated with no strict adherence to a common syllabus or a detailed training centre specification (Gleeson, 2016). This lack of formal training and skills is likely to be problematic for the delivery of heat pumps in particular, which are reliant on correct installation to function effectively.

Is the current training structure too fragmented?

216

surveyed installers had used:

116

different training providers

4.2 Training routes in Scotland

Training in the heating industry is very complex. There is one regulator in Scotland, the Scottish Qualifications Authority (SQA), and various awarding bodies, including, for example, SQA Awarding, LCL, City & Guilds, BPEC, EAL, NICEIC and ProQual. These awarding bodies have gained recognition from the Regulator to say that their qualifications are 'fit for purpose.' In turn, training can be provided by a variety of organisations (e.g. private sector and college courses). The following provides an overview of routes to entry to operate as a plumbing and heating engineer, and install low carbon technologies. This includes consideration of the availability of low carbon heating courses in Scotland (see Appendix 1 and Figure 3).

The most conventional route for new entrants into the industry is to follow an apprenticeship. The only industry recognised route to become registered and graded as a plumbing and heating engineer in Scotland is the Modern Apprenticeship in Plumbing and Heating. The apprenticeship takes four years to complete; this includes 3 years to fulfil the competency training and an additional year of full time work. The apprentice is in employment with a plumbing and heating business throughout, and takes time out of work to attend college. Apprentices will complete a competency based qualification (SCQF 7 in Plumbing & Heating), and core skills modules.⁴ They must also meet the minimum standards for at least one of the following disciplines: Gas; Oil; Solid Fuel; Emergent Technology (which incorporates low carbon systems) (see: BSE, 2020). All apprentices are required to complete the 'Working Principles' component of the Emergent Technologies route, and so should have a basic understanding of low carbon systems. However, only those following the Emergent Technologies Route will have detailed knowledge of those systems.

Scotland's colleges are increasingly offering specific courses that cover low carbon heating technologies. There are fifteen colleges now offering dedicated courses on Ground and Air Source Heat Pumps and four specialising in Biomass (see Appendix 1 and Figure 3). The number of low carbon training facilities needs further expansion to fulfil the increased number of workers needed in this space in the immediate future.⁵

4. The core skills modules are: communication; numeracy; working with others; problem solving; and information and communication technology

5. Work is in progress here: The Green Economy Fund, provided by Scottish Power Networks, provides funding to colleges in regions where they own the grid (primarily central belt and south of Scotland - see <https://energysavingtrust.org.uk/programme/green-economy-fund/>). There is also a Capital Investment Fund, provided by Scottish Government, which is providing similar finance for colleges in the north of Scotland. Both of these are being administered by Energy Saving Trust Scotland

By law, all gas engineers must also be on the Gas Safe Register. To register, installers must demonstrate competence by completing qualifications through the Accredited Certification Scheme (ACS). Category 1 assessments apply to existing gas operatives, who are required to renew their ACS certification every 5 years; Category 2 assessments are for new entrants who hold a vocational qualification; Category 3 assessments can be completed by new entrants who do not hold the relevant vocational qualifications, but have on-the-job experience or have undertaken alternative training programmes (including a minimum number of hours on-the-job).

To fit low carbon, an installer may also wish to become certified with the Microgeneration Certification Scheme (MCS), although this is not a requirement (see Figure 4). MCS is a standards organisation that certifies low-carbon products and installations of technologies used to produce electricity and heat from renewable sources. MCS was first developed to support the UK Government’s Carbon Emission Reduction Target (CERT), and was then a mandatory component of installations under the Feed-in-Tariff. For householders to access government funding for low carbon heat (e.g. RHI and Home Energy Scotland Loan) it is a requirement that they use an MCS certified installer. This creates a competency and quality mechanism to ensure that work receiving government funding is completed by a trained and competent installer.

To get MCS certified, an installer would have to demonstrate competence through completing MCS-approved courses (specific courses are listed in the MCS Competency Guidance – see MCS, 2019). These courses can be ‘Regulated’ (audited by SQA) and ‘Unregulated’ (not audited by SQA, but mapped from National Occupational Standards (NOS)); both routes currently allow holders to register with MCS.

However, there is no requirement to use an MCS certified installer for e.g. entirely privately funded domestic works, and there are currently no checks in place to ensure that this work is performed competently (other than a potential fall back to Local Authority Building Control but this is under-resourced and would not necessarily be aware of this work taking place since planning permission is not needed for many low carbon technologies). Thus, workers that have not followed the formal training routes outlined above could still potentially complete low carbon installations.

There are also intermediate routes. For example, installers may attend manufacturer training courses: usually short 2-day to 1 week courses on a specific manufacturer’s technology. An installer will sometimes be required to demonstrate competence (e.g. show their ACS qualifications) to attend these sessions. Following training, and often an initial install checked by the manufacturer, the installer would be allowed to fit that manufacturer’s product (following the non-MCS, privately funded route). In some cases, manufacturers form part of the MCS ‘umbrella scheme’ and so can support installers to fulfil MCS requirements without the installer having to register with MCS themselves.

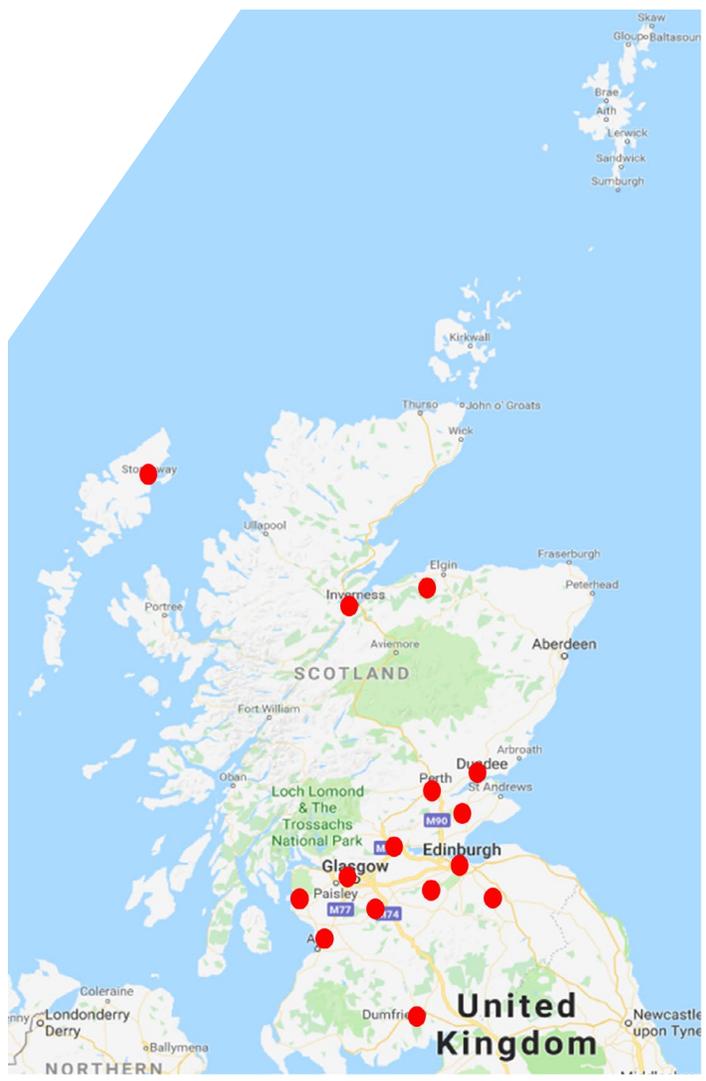
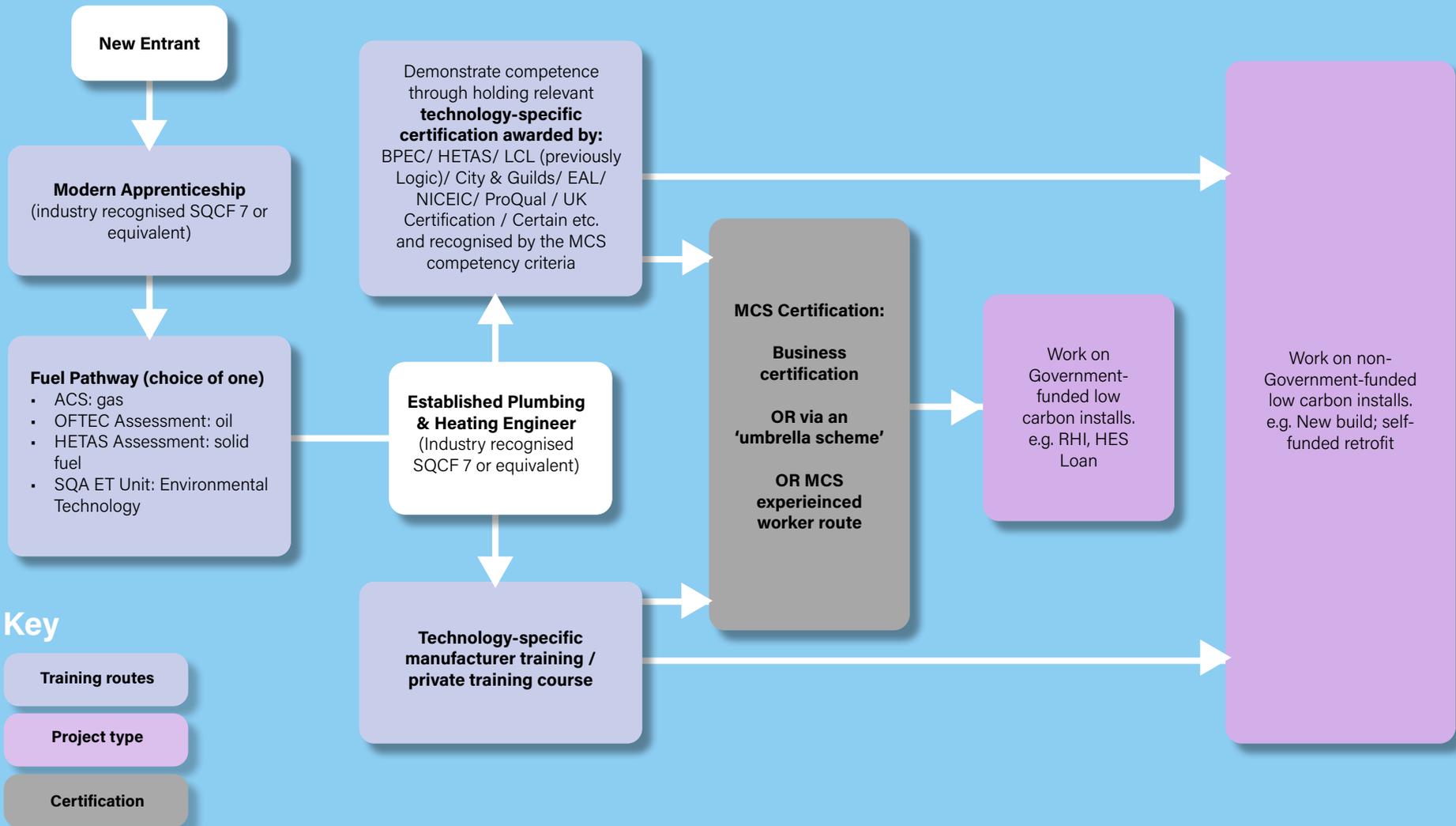


Figure 3: Colleges across Scotland with some provision of courses in low carbon heating technologies

Figure 4: Recommended routes to installing low carbon heat (for industry recognised plumbing and heating engineers in Scotland)



Industry recognised routes - recognised by the Scottish and Northern Ireland Joint Industry Board (or equivalent scheme operator)

4.3 Proposals for new routes to demonstrate competency

This fragmentation and inconsistency has led to proposals for new approaches to skills and training for the installation of low carbon heat systems.

In particular, Scottish Government have developed a 'skills matrix' which identifies specific training courses and certification required to install particular low carbon heat technologies in Scottish delivery programmes (see Appendix 2). Scottish Government's current proposal is to integrate the skills matrix within PAS 2030 and MCS, initially as a guide but with a view to becoming mandatory for those working under Scottish Government-funded schemes (Scottish Government, 2021b).

Meanwhile, the HPA are proposing a Low Temperature Heating and Hot Water Qualification, that all installers would be required to take before specialising in particular technologies (HPA, 2020b). Such a course would include heat loss calculations, heat emitter sizing and hydraulic balancing; it is proposed that this would take two days to complete, followed by a three day heat pump course (HPA, 2020b).

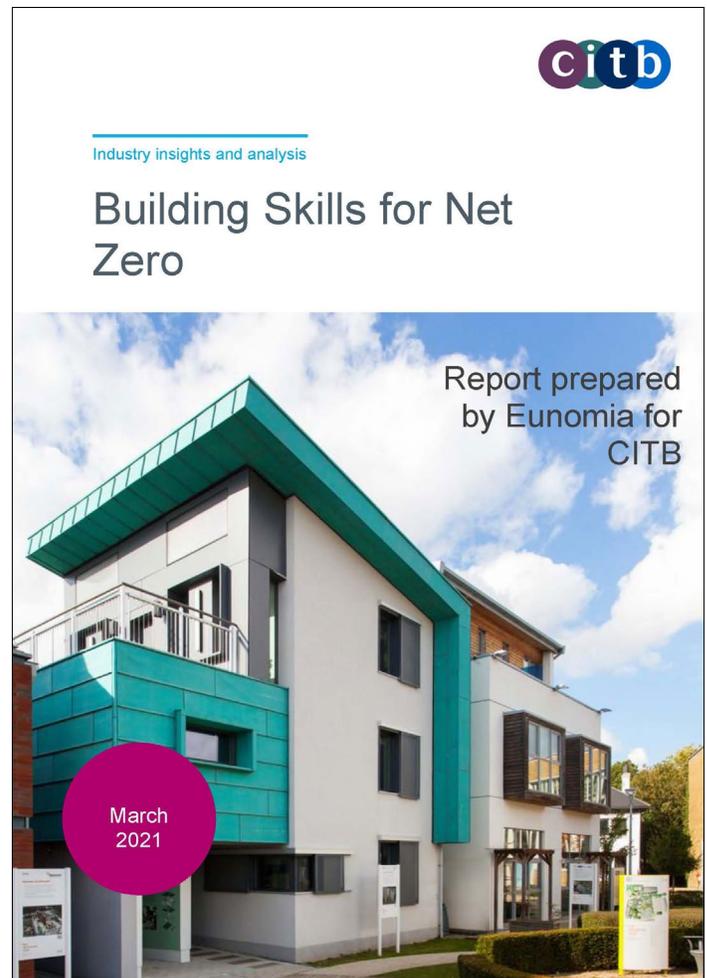
The CITB (2021) estimate that roughly 40 hours of re-training will be required, to include: a broad renewables heating training course; a general heat pump training course; manufacturer-specific training courses (this does not account for specialist skills e.g. F-Gas). The HPA also highlight that well-trained educators will be essential for ensuring that installers possess the necessary skills.

However, at this stage, it is unclear what training structures will emerge to support the delivery of training for low carbon heat, and there is limited knowledge of what is already in place. To begin to address this, the following sections explore installer experiences of low carbon training.

CITB estimate that

40

hours of re-training will be required, including: a broad renewables heating training course; a general heat pump training course; manufacturer-specific training courses.



Building Skills for Net Zero, CITB

How the research was conducted

5

Method

5.1 Method

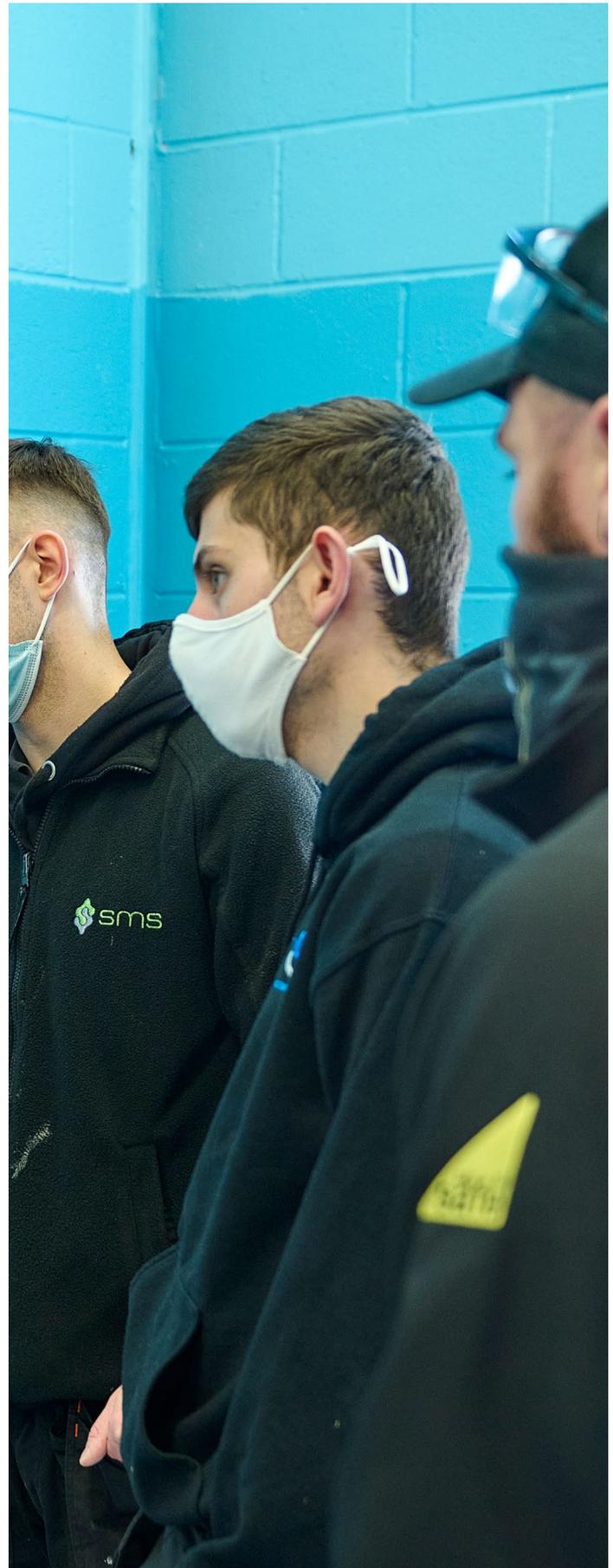
Semi-structured interviews have been used to gather installer perspectives and experiences of low carbon heat.

The interviewees were asked to participate through a short survey sent to all SNIPEF members. There were 11 interviewees in total; these are mix of those installing low carbon and those installing fossil fuel systems. All of the interviewees are members of SNIPEF; the characteristics of each company are detailed in Appendix 3.

The interviews were all conducted over the phone, audio recorded and transcribed. The interview schedule was developed to focus on routes into low carbon and experiences of training. The questions varied slightly depending on whether an installer was already fitting low carbon or not. The questions for both those installing low carbon and not installing low carbon are included in Appendices 4 and 5.

It is essential to gather experiences of low carbon heat from the installers themselves.

Therefore we interviewed a mix of 11 people installing low carbon and fossil fuel systems.



College students in lecture on installation, photo courtesy of Energy Saving Trust

Installer training experiences

6



Students practicing installation, photo courtesy of Energy Saving Trust

6.1 Installer understandings of low carbon

Key findings

- Varied understandings of what low carbon is amongst the installer workforce.
- Some mis-understandings of low carbon amongst those not yet installing these technologies.

Recommendation

- Work is needed to develop clear messaging around low carbon and consistent understandings amongst installers.

When asked how they would define 'low carbon,' installers used broad definitions, referring to fuel sources and environmental benefits:

Anything that's replacing fossil fuels. (Liam)

Something that will have low impact on the environment but it's still meeting the requirements of the end user effectively. (Adam)

An efficient manner of heating your property or gaining heat from other sources at a lower cost or using lower carbon. (Connor)

However, other installers noted that they did not have a clear understanding of low carbon. For example, Gavin said: 'I don't really understand an awful lot about [low carbon technologies]... boiler manufacturers [are] talking about hydrogen but that doesn't seem feasible for a while yet.' Other installers also identified specific technologies in their definition of low carbon. This related to both individual perceptions of suitable technologies, and also insights into how policy and industry were directing efforts towards certain technologies:

We know hydrogen works so they're trialling it. I mean why not just build these hydrogen plants and start blending the hydrogen in? (Alan)

When someone says low carbon heat to me they are basically talking heat pumps. Biomass has died a death. Solar's a great technology but because of the way our MCS and RHI is set up it's not as popular (Aaron)

Thus, varied technologies were identified in relation to low carbon heating. Generally, installers understood different options, especially those already installing low carbon heat. However, there were also some misunderstandings apparent amongst those not installing low carbon heat, like Gavin, who explained:

I would expect that most of these units are coming as a complete package and you basically have to just pipe them in.... I would imagine the ground source or the air source heat pumps would be along the same lines [as the earlier introduction of mains pressure hot water cylinders]. It's basically a unit you strap to the side of the building (Gavin – not installing low carbon heat)

The suggestion that a heat pump is a 'unit you strap to the side of a building' is potentially problematic because, to operate effectively, heat pump systems have to be carefully and appropriately sized. This design aspect of heat pump installation was described by others as being quite distinct to current ways of working. These sometimes confused understandings did not always mean a lack of interest; some installers highlighted that they were interested in low carbon but 'didn't know where to start.' Thus, although some participants had a very clear understanding of low carbon heat, others were less certain. The types of technologies deemed appropriate and understandings of these vary across the industry. Work is needed to ensure consistent and up-to-date understandings of low carbon heat, and support myth-busting.

6.2 Skills for low carbon

Key findings

- Low carbon systems require a greater time commitment for initial survey and administrative work.
- Micro-firms and smaller SMEs will particularly struggle to accommodate increased administrative work.

Recommendation

- Need to ensure that installers have appropriate design and sizing skills for low carbon systems.
- Provide tailored support to micro-firms and SMEs for the design and administrative aspects of surveys for low carbon systems.

When discussing the skills needed for low carbon, most of the interviewees referred to the process of fitting heat pumps. There was no discussion of the skills needed for alternative low carbon technologies, like solar thermal or biomass.

Installers with experience fitting heat pumps highlighted the need for these systems to be correctly designed in order to work effectively. Experienced heat pump installers expressed concern that some of those currently operating in the gas industry did not have all of the necessary skills, particularly because current gas boilers can still operate effectively without such detailed design work:

The boiler manufacturer made it easy. You could pick a boiler bigger than you actually need, stick it on the wall, pipe it up and the boiler will do all the work for you, because it's range rated. It works on the return temperature coming back so therefore it'll take the gas out of it and run it but a heat pump doesn't...it has to be sized properly. (Connor)

In keeping with Connor's comment, several participants highlighted the need for training in system design, pipe and radiator sizing. The importance of the awareness of electrical work and F-Gas were also noted. One experienced low carbon heat installer also highlighted that he can remotely monitor and diagnose problems with heat pumps through the analysis of available data; analysis of sensor and temperature data is another skill set that not all existing heating engineers will have.

6.2.1 Business models for multiple skills

The additional skills required to effectively design and install a heat pump led one installer to highlight that heat pumps represent a larger time commitment than gas boilers:

I'm going out and doing a survey and then doing a quote and we're generally going back and doing a second survey...You've got to think about electricity and water mains, you've got to think about the whole house...and now you've got installation.... At the back of it we've got all the registrations, the MCS side of it, the paperwork, getting [customers] set up for their loans and their RHI, so you've got this whole process... Your standard gas boiler might take one or two man days, now we're up to maybe ten man days to do a heat pump... (Aaron)



Inside low carbon heated home, photo courtesy of CSIC

Thus, there are several stages to accommodate in the design, installation, commissioning and registration of a heat pump, and this can represent a significant workload. Several of the low carbon installers interviewed discussed working in a larger team to manage this. In particular, those in organisations above 5 employees had distributed specific skillsets amongst different workers. For example, one installer explained that his company had 'changed their model' of operating. Their new model included one heat pump expert supervising the whole process, overseeing employees with skills in pipework and fitting, and communicating with employees who would separately manage the administrative aspects. The installer reflected:

You have a critical mass [of people] in a successful heat pump company... because the time you put [into] a marketing structure, an administration structure, that's quite a big overhead. You have to have such a turnover to meet that and it looks like it's about the ten/twelve body mark for it to be successful. You either have two or three people or ten or twelve otherwise the business doesn't work very well. (Aaron)

Here, Aaron highlights that larger teams may be helpful for delivering heat pumps. Indeed, another installer emphasised the challenges for sole traders, especially the labour involved in developing quotes that may not translate into jobs:

It's a lot of hassle for a sole trader to go down this route because you've got to do room by room calculations and assess the heat loss for the whole house. It is quite labour intensive for a job that you're not always guaranteed to get... (John)

This investment in time on quotes, coupled with the need for multiple additional skills, could act as a barrier to sole traders and smaller firms working on low carbon technologies. Such organisations could be supported externally, for example, some participants noted that they work with manufacturers on the sizing of heat pumps, whilst one explained that he works in partnership with a company well-versed in the MCS registration process.



Air source heat pump, photo courtesy of Energy Saving Trust

It's a lot of hassle for a sole trader to go down this route ... It is quite labour intensive for a job that you're not always guaranteed to get. (John)

6.3 Networks to support knowledge exchange

Key findings

- **Membership organisations provide a crucial network for information and knowledge exchange.**
- **Combustible installers may miss 'low carbon' events if these are deemed irrelevant, and so miss learning opportunities.**

Recommendations

- **Mainstream low carbon in communication – for example, showcase low carbon technologies alongside combustible systems at every event.**
- **Membership organisations to build better relationships with stakeholders to identify opportunities for information sharing.**

Membership organisations have a clear role in sharing messages about low carbon technologies. All of the installers interviewed were members of SNIPEF. Several named SNIPEF as an important source of information & training. For example, one installer highlighted that, through SNIPEF, they realised the importance of moving into low carbon heating:

I've obviously been a member of SNIPEF and [low carbon] was being talked about more and more and everybody was saying well it's going to be the way forward. (John)

The frequency of conversations about low carbon left this installer feeling like it was 'the way forward' for his business. Similarly, Callum highlighted one of SNIPEF's awareness days as a good opportunity to 'speak with people with a range of experience'. Other participants felt that SNIPEF was there to help installers, provide training, and create opportunities to learn from experts. This included taking a more formal role in leading the transition to low carbon, and facilitating exchange with experienced installers:

We want SNIPEF... to influence our members...we've got about a thousand members, company members but we've got all the plumbing employers that are there. The gas industry's not going to do it so we have to stand up for it. (Connor)

In particular, the Low Carbon Forum was mentioned a number of times. With experienced low carbon installers as members, the Low Carbon Forum holds a lot of expertise.

This could be a way to attract installers new to low carbon. However, Connor noted that they struggled to get new members to engage, because they are 'not interested in renewables'. He highlighted that, unless someone is already interested in renewables, they will not come along to a standalone Low Carbon Forum event. As a result, it is difficult to share messages about low carbon to those least aware. This could potentially be overcome by mainstreaming low carbon. For example, all events should include low carbon heating technologies as everyday heating technologies, rather than including them only in separate 'low carbon'-branded events. In addition to training and information, other interviewees felt that SNIPEF could play a role in managing quality. For example, SNIPEF membership could be used to demonstrate eligibility to access financial support and particular training programmes:

If you're going to be funding training then it needs to be through people who...are legit, who are with SNIPEF or something like that. You don't want every man and their dog you know just claiming training benefit and then going on these courses. (Alan)

Here, Alan highlights that membership with SNIPEF could be one way to ensure that only appropriately qualified and experienced installers have access to training programmes. Similarly, John suggested that making SNIPEF membership a requirement to access funding for training could help to prevent 'any Tom, Dick or Harry' from taking part.

6.4 Training for new entrants

Key findings

- **Combustible heating technologies still prioritised in modern apprenticeships & college training facilities.**
- **Modern apprentices employed by combustibles firms will be encouraged to train in combustibles.**

Recommendations

- **Support colleges to develop and maintain high quality low carbon training facilities.**
- **Include more content on Emergent Technologies earlier in the apprenticeship curriculum.**
- **Encourage more apprentices to follow the Emergent Technologies route.**
- **Provide specific financial incentives for low carbon installers to take on apprentices and thus encourage them to follow the Emergent Technologies route.**
- **Recruit experienced low carbon installers to support college education.**

A lot of the installers interviewed agreed that it was positive that low carbon heat had been added in to the modern apprenticeship in Scotland. Although apprentices may receive a brief introduction to low carbon technologies early in their training, they only go into detail on these devices in their third or fourth year, where they choose specific courses in low carbon heat or gas appliances. This means that teaching resources are split across the different technologies:

[The apprentice] has got his plumbing and his entry level gas but he can't do gas and renewables, he can either do gas or renewables ...because the majority of them'll take gas most of the time is spent on gas. You ask them to do renewables they don't have a lot of knowledge on it from the college. (Connor)

Connor highlights that a lot of resource within colleges is still used for training on gas appliances, which can mean that those taking the low carbon route gain limited knowledge. Other participants suggested that running renewables courses was not profitable for colleges because of insufficient demand; as a result there were few institutions specialising in renewables across Scotland. One suggestion was to have a dedicated college in Scotland that focuses on renewables.

Another interviewee, Callum, noted that apprentices were still being taught techniques they would not need:

Some of the things they're teaching the boys now it's the same I got taught thirty year ago...we're teaching plumbers lead and how to do lead and unless for instance you're in Edinburgh you'd never use lead. (Callum)

A couple of other participants also mentioned sheet lead, noting that apprentices could spend up to six weeks on a lead module, despite the material rarely being used in homes now.



Lecture on installation, photo courtesy of Energy Saving Trust

Installers recognised that it was important for apprentices to be aware of lead, but that this was actually a specialist skill that would likely be outsourced and so did not need to be within the core remit of heating courses.

The importance of experienced teachers was also emphasised. Connor highlighted that a lot of college tutors are ex-gas engineers, and this meant that a lot of on-the-job experience could be shared at colleges. However, colleges lacked tutors with on-the-job experience installing low carbon heat. When asked who should train low carbon apprentices, Connor explained:

A specialist...somebody who came from the industry, somebody who understood thermodynamics, understood the importance of heat pumps. We need somebody who's worked on a heat pump, who's installed a heat pump, who's had to go back and fix a heat pump...They're out there somewhere but not all the colleges that do plumbing can afford to put a specialist instructor on. (Connor)

Connor also explained that him and his colleagues would be prepared to deliver training and seminars but felt that there were few opportunities to do so. This suggests that work is needed to establish and support partnerships between experienced installers and colleges. This may include an intermediary organisation, like SNIPEF or the Energy Saving Trust, coordinating contacts, and it may also encompass financial support for colleges to host experts.

Other participants recognised the potential for mutual benefit through working with apprentices. In particular, existing installers could learn some of the most up-to-date technologies and ways of working where apprentices are taught about these in college:

Sometimes an apprentice will put us straight and we've had it before, you're doing it the old way, [the apprentice says] 'this is how it should be done' and he shows us it in the book and we can't argue with him. (Matt)

Other installers similarly recognised that it was valuable to work with apprentices. However, and understandably, combustibles installers may encourage apprentices to follow the combustibles route in order to contribute effectively to their business. This means that fewer apprentices are being encouraged to take the low carbon route, and leads to the continuation of a cycle of training in traditional technologies. In addition, it can cost money for the installer and can be time consuming to teach apprentices, particularly in the early years of their training. Consequently, a number of participants discussed the value of additional financial support to take on apprentices.

This was especially highlighted for taking on older apprentices, who had perhaps already worked in a different profession. Several participants recognised that it would be necessary to reach people from other professions to fill the skills gap in the industry.

Examples included people from the armed forces, mechanics and others who had jobs working with tools. This could be beneficial as established workers have existing skills and experience in the work environment. However, these workers would likely be older and so require higher pay, which would come at a higher cost to the employer.



Low carbon heat installation, photo courtesy of Energy Saving Trust

6.5 Training for existing installers

Key findings

- Installers are familiar with ongoing training and incorporate training as part of their job.
- Some installers are not sure where to start with low carbon training, or uncertain about the future of low carbon and reluctant to invest in training.
- The training burden is particularly high for microfirms and SMEs.
- Low carbon installers rated manufacturer training and support highly.

Recommendations

- Industry and government messaging needs to provide clarity and reassurance about which low carbon technologies will be supported in the long term.
- Provide additional financial support for sole traders and SMEs to undertake low carbon training.

The heating installers interviewed all recognised training as a part of their job. All gas heating engineers are required to renew their ACS gas certification every 5 years, and are familiar with the training and assessment associated with that. For Craig, this meant that 'every day's a school day'. A lot of training is led by installers themselves, who choose to attend tradeshows, training courses and network events to keep up-to-date with changes in the industry:

We do a lot of networking from Scottish Enterprise, SNIPEF, we're on the Low Carbon Heat Forum. We're in talks with the manufacturers so your Mitsubishis, your Vaillants. There's news articles from certain publications...so we're just trying to pull all sources from all different avenues and try and collate it to see where and when the shift's moving to. (Adam)

Here, Adam highlights that by paying attention to information coming through membership organisations, manufacturers, and trade magazines, he can be aware of potential changes in the industry. Several participants mentioned similar sources of information which could help in gathering information about low carbon. However, most of those already installing low carbon had a very clear entry point, or first low carbon job that led them to train in this area. Established low carbon installers explained their first low carbon installation:

It was the customer's choice was that he wanted this heat pump put in a new build and we had to go and learn about it before we could. (Connor)

The first job was for an M & E consultant who had seen [heat pumps] commercially and wanted one in his own house that he was building. ... 'cause the client was well educated [on low carbon technologies], he sponsored us to go and get training from the manufacturer. (Aaron)

[It was] a low cost housing for a housing association and they had specified that they wanted air source heat pumps. So we then had to get training... and find out more about it in order to install them for the main contractor. (John)

In all of these cases it was the customer (both private clients and housing association contracts) that initiated the installer's engagement with low carbon heat. For some, this even extended to the customer paying for the installer's initial training. Alternatively, the installer explained that he paid for the training, on the understanding that he would be able to make the money back through future low carbon installations.

Other installers showed a willingness to train in low carbon heat, but they were uncertain on how to go about it:

We're going to get involved because it's the future but we don't know how to make that first step. (Gavin)

Other participants also explained that they weren't sure how to get started in low carbon. For some, previous experience led them to be highly skeptical of undertaking new training:

I showed my commitment before. I went to Newcastle for five days to do solar PV. I went to Dundee to do solar hot water panels. I travelled to Blantyre to a training facility there. I've got to sacrifice man-hours, earning potential to go on these courses and at the end of the day if I can't work profitably at those things then there's not any point. (Craig)

In this case, Craig highlighted his experience with solar, which had involved a lot of training and been profitable but declined in popularity since changes to the Feed-In-Tariff were introduced. This concern is especially heightened for small companies and sole traders, where the cost of ongoing training can be significant:

It's such a small company, I've just gone through all my ACS [gas qualifications]. That's a week off work each time plus the money. (Matt)

Time spent training equates to lost income for small companies and sole traders. This led some to recommend ringfencing financial support for training for smaller organisations.

6.5.1 Manufacturer training and support

The vast majority of those interviewed cited manufacturers as a main training route (rather than through a certification body, for example). Those installing low carbon and fossil fuel systems all had good relationships with manufacturers. Some installers outlined the kind of training they gained from heat pump manufacturers:

...module two was a two and a half day course and module three was a two and a half day course. Module one was an introduction to heat pumps, it told you how a heat pump worked. It didn't give you any real details on installation it just told you how it worked, what the range of products were, what applications they had. ...To even to get on the course you had to have a gas qualification as minimum. (Connor)

It's just going back to basics... it's physics - understanding the collection of heat and the transfer of it and so on, and what works and what doesn't work and, and for instance... the first thing we were told: 'there's only three things you need to know about heat pumps: circulation, circulation and...circulation.' So that's the circulation of collecting energy, then the heat pump in the middle of it all and then the circulation to deliver the energy. (Martin)

These are manufacturer training courses that take place over several days. Both Connor and Martin highlight that there is an initial general introduction to heat pumps, before a manufacturer details the specifics of their device. Attendance at these courses usually requires the installer to demonstrate their existing competence (for example, GasSafe registration), and so they are 'top-up' courses for experienced installers. The level of detail covered and time commitment to these manufacturer training sessions led one installer to query whether attendance at these might be a route to certification for installing low carbon. However, one sole trader explained that, with multiple manufacturers, it could be difficult to keep up with all of the different training options.

[I completed] a three or four day course...and the fact that I've got a five day F-Gas course as well which means I can handle refrigerating systems...as far as I'm concerned I've got all the qualification necessary to install heat pump technology...but when you speak to manufacturers: 'you need to sit this course, this course, this course, this course and do this course.' I've no' got time to do that. (Alan)

Thus, it can be difficult to keep up with the different courses available. However, alongside training, a lot of manufacturers also provide support for the first few installs. Several of the low carbon installers interviewed explained that this was especially valuable:

The fear factor's been taken away because [the manufacturer has] given you a schematic drawing to do, he's told you the pipe sizes, he's told you the lengths, if you take shortcuts you're going to have a problem. So he comes out or he sends the engineer out you pay for it. He comes out and he goes through and he tells you before you get your warranty you need to correct that and that and that. You do that, he comes back out again...he then says that's okay and he passes it. (Connor)

Several interviewees discussed these initial site visits as being particularly important for learning. Those not currently installing low carbon also highlighted their strong relationships with manufacturers and sales representatives. In particular, Gavin described learning about a new product from a gas boiler manufacturer who had a 'mobile trade show'. The manufacturer travelled to different parts of Scotland with their product set up in the back of a van so that installers could see the unit installed, and interact with it. This could be an effective way to reach installers in remote locations, and discuss low carbon technologies with them.

6.6 Microgeneration Certification Scheme

Key findings

- **Installers agree that a scheme like MCS is important for ensuring competency.**
- **MCS-approved training does not include enough hands-on training from experienced low carbon installers.**
- **MCS-registration places a heavy time and administrative burden on microenterprises and SMEs.**

Recommendations

- **Ensure that MCS-approved training courses are fit-for-purpose and deliver hands on installation expertise.**

Installers that were MCS certified noted that the scheme is positive for ensuring competency and high quality installation of low carbon systems. However, experienced low carbon installers highlighted that the MCS-approved training courses provided a general overview of the relevant technology (e.g. heat pumps), but they did not provide enough specific detail to enable system installation:

It was all theory based. There's no drive for it. There's no hands-on. These products are almost like a sixty/forty split it's all installation but then design in the background so you're getting no hands-on practical experience with these units and the installation of them and understanding how they've been designed round the house. (Adam)

Adam highlights the focus on theory and lack of practical training for installing heat pumps.

This was echoed by other low carbon installers, who also felt that they had more installation experience than those delivering the training. The importance of recognising existing certification and alternative training routes was also highlighted by Craig:

I'm registered with SNIPPEF. I'm a Gas Safe registered engineer and I'm an associate for Select which is the electrical contractors association. That's three bodies I'm under so why do I need any more? (Craig)

In addition, low carbon installers highlighted a limitation in the remit of MCS, which provides certification for low carbon installers and products, but does not extend to commissioning and thoroughly checking systems after installation:

There needs to be a better control on commissioning... We've got control on design because we've got MCS that's auditable but are we auditing the commission? Probably not. (Aaron)

Here, Aaron highlighted that the way low carbon systems are set up is especially important, but does not receive any external checks. This also highlights a gap in the current installation of low carbon systems. All combustion heating systems have to be registered with Gas Safe. This creates a system whereby any installation could potentially be checked and monitored following installation. At present, low carbon heating systems that do not receive government funding (e.g. entirely privately funded works) are not MCS registered. Consequently, low carbon systems could be installed without any knowledge of an external quality assurance body. This gap will need to be filled rapidly, especially as the cost of installing low carbon comes down, and customers increasingly self-fund the works.

Several installers who were not fitting low carbon highlighted MCS as a barrier to entry. In particular, those running smaller businesses felt that MCS was a large burden:

I don't have an office administrator I am my own office administrator. I sell my own jobs, I install my own jobs, I organise my own jobs, I meet sales reps, I meet customers, I have to go and do the training as and when required whether it's to be Gas Safe registered or OFTEC ...And a lot of guys with similar business models to mine all feel the same way, they think MCS was brought in as a way of preventing small companies like ours from getting into renewables because they only wanted large corporations to be doing these jobs. (Chris)

In this case, Chris explained that he had completed a five day BPEC Certificate for heat pumps, but he did not feel he was a 'suitable candidate' to be MCS certified because he did not have employees 'sitting in an office providing all the paperwork'. This was echoed by Callum and Craig who both felt that they did not have the resource to pursue MCS certification, and bigger companies were better positioned for this. This highlights the challenge for microenterprises and SMEs.

John had worked around this by employing an external company specifically to help with the paperwork aspect of MCS. This helped him to 'do the groundwork' and receive support for the administrative aspects of the initial application, such that he could become MCS certified. Similarly, Alan suggested that something like an MCS Heat Pump Design App could help people through the process.

I sell my own jobs, I install my own jobs, I organise my own jobs, I meet sales reps, I meet customers ... and a lot of guys with similar business models to mine all feel the same way, they think MCS was brought in as a way of preventing small companies like ours from getting into renewables. (Chris)



Air source heat pump, photo courtesy of Energy Saving Trust

6.7 Demand for low carbon

Key Findings

- **Low carbon installers are experiencing increased customer awareness of low carbon systems.**
- **Combustibles installers reported little interest in low carbon amongst their customers.**
- **Cost can be a barrier to low carbon for customers; installers find that the process for customer funding schemes is complex.**
- **Inconsistent government funding schemes leads to fluctuations in demand which installers find difficult to manage.**

Recommendations

- **Develop broader information campaigns to ensure that householders are aware of low carbon.**
- **Government funding needs to be easy to navigate, long-term and consistent to provide certainty for installers to invest in training.**
- **Membership organisations could provide information to ensure that installers are aware of funding available for householders.**

A lot of the low carbon installers interviewed felt that there was increasing awareness of the environment and low carbon amongst their customers.

For fifteen years I never sold a heat pump based on the environment but now the majority of heat pumps I sell are based on the environment. (Aaron)

Aaron highlights that the environment is becoming a justification for installing a heat pump, where before customers had been concerned about, for example, recouping their financial investment. This was echoed by Martin who suggested that 'the word is spreading' about heat pumps. He suggested that there could be a regional aspect to this. Some of his work is in the Highlands and Islands where, Martin suggested, customers without a heat pump are 'the odd one[s] out.' Adam agreed with this, noting that many of his rural customers had switched from solid fuel, oil or LPG heating systems to heat pumps.

Low carbon installers also highlighted that customers who were interested in low carbon heating would take the time to learn about the systems.

For Aaron, this meant that they were often 'already convinced' about the system and understood what would be involved in the installation process. Adam agreed, noting:

The clients [that] are approaching us about low carbon heating, these are also ones that are aware of the funding and grants that are available. They've already done research before approaching us. (Adam)

Part of this increased awareness was a greater variation in the types of customer buying low carbon. For example, Martin highlighted younger people who were buying their first house. He emphasised the significance of financial support and the loan scheme from Scottish Government for enabling work amongst these customers.

These low carbon installers have had a positive experience and many of them noted that demand for low carbon was rising and they were extremely busy. However, this was not the case for all participants. Several of the installers who were not fitting low carbon suggested that customers were not asking for low carbon systems.

Indeed, this perceived lack of demand was one of the reasons they had decided not to add low carbon into their work. This was highlighted by Callum:

There isn't an uptake just now so I don't see why I need to go out and do it just now [because] nobody's asking me about it. (Callum)

Those that had experienced limited demand highlighted that the cost of low carbon systems was a major barrier for customers.

I find it hard sometimes when you tell [customers] 'you're paying for a [gas] boiler and it's fifteen hundred pounds,' they're like 'wow, we didn't expect that much...without then saying to them we're going to put an air source in however you need to lift all your carpets, you need to move all your furniture, we're going to have to upgrade all your pipework now. So your five or six thousand pound install will become ten thousand pounds ...I can't see people spending that. (Callum)

Although installers recognised the financial support available for customers, some felt that the complexity of the Scottish Government's loan scheme was a problem. As a result, some of the installers suggested that low carbon heat was still only really being requested by wealthier customers who had the funding available. A couple of participants highlighted that installers and the heating industry could play a bigger role in making sure that customers were aware of the different funding schemes available. For this, installers need a clear understanding of the different funding schemes available. Connor highlighted that membership organisations, like SNIPEF, could play a role in training their members on the different schemes available:

I wanted to try and get SNIPEF more involved that they could put a, a step-by-step guide on this [funding scheme] to say, 'as a member of SNIPEF we can get you grants to go that way or along that line, you need to follow this, this and this' (Connor)

Government funding schemes can be important for encouraging more people to fit low carbon technologies; however, inconsistencies and changes in these schemes can lead to fluctuations in demand and make it difficult for installers to manage their mid- to long- term business planning:

The Government's great at creating these bubbles because [short-term funding schemes] create a huge demand and then a dip. So what do I do? I'm looking at the business and I want to take on five new people right now and I might have a dip in April [when the RHI closes]. I've got to sell [heat pumps] but it'll become a harder sell because RHI usually covers a big shortfall [in customer funding] that'll be a much harder sell. (Aaron)

Government's great at creating these bubbles because [short-term funding schemes] create a huge demand and then a dip. (Aaron)

Funding needs to be easy to navigate, long-term and consistent.

7

Conclusions

There are already installers who are highly knowledgeable and experienced in installing low carbon heat. These installers are experiencing growing awareness of low carbon amongst their customers. They have found manufacturer training to be especially valuable and harnessed knowledge available through membership organisations and networks to enhance their awareness. However, they have also found formal training for MCS-certification to be lacking necessary detail, and noted that there are not enough new entrants coming into low carbon heating to fulfil increasing demand.

In addition, there are installers who have not yet engaged with low carbon at all and feel it is not for them. These installers were primarily sole traders or micro-firms who were discouraged by the time and administrative burden of seeking additional training and MCS-certification. In some cases, these installers had misconceptions about low carbon heat and how to install these systems.

Work is needed from Government, regulators, colleges, Skills Development Scotland, membership organisations and manufacturers to encourage more existing installers to retrain and ensure that new entrants are following Emerging Technologies apprenticeships. These changes are crucial and must be implemented now in order to have enough trained and certified installers to fulfil ambitions for low carbon heat in nearly every building by 2045. The overarching recommendations for key stakeholders are as follows.

Recommendations

For Scottish Government...

- Create a level playing field by providing ongoing funding which prioritises micro/ SME businesses for training for e.g. achieving MCS certification.
- Continue to provide funding to colleges to increase the number of low carbon training centres and support in recruiting tutors with low carbon experience.
- Encourage more apprentices through low carbon pathways.
- Provide clear policy trajectory and procurement frameworks to guarantee future pipeline of work to create confidence for businesses to invest in new skills and staff.
- Consistent consumer incentives including replacement for Renewable Heat Incentive, increasing capacity in advisory bodies for householders and businesses.
- Provide awareness campaigns to highlight advisory bodies and stimulate the marketplace. Incentives to be promoted and easy to navigate.

For Representative Bodies...

- Encourage more apprentices through low carbon pathways, and continue to support apprentice employers.
- Make conventional plumbing and heating installers aware of opportunities arising from installation and maintenance of low carbon heating systems.
- Develop strong signposting and awareness campaigns – collaborate with experienced low carbon installers.
- Provide information about householder/ SME funding (e.g. HES Loan) to installers.
- Build better relationships with manufacturers and energy advice organisations to identify collaboration opportunities.
- Consult with installers to ensure that college courses are meeting the needs of the industry.

For Skills Development Scotland...

- Raise awareness of apprenticeships through webinars and social media campaigns.
- Encourage more apprentices through low carbon pathways.
- Work with schools to introduce and encourage low carbon as a rewarding and prosperous career.
- Highlight support available for installers with low carbon apprentices.

For Standards and Certification Bodies...

- Emphasise availability of MCS experienced worker route to existing installers.
- Simplify administrative aspects of certification so it is more accessible for businesses to work on delivery programmes and other framework requirements.
- Make sure installers are aware of benefits of adhering to consumer protection through consumer codes bodies and MCS.

For Manufacturers...

- Expand provision of low carbon training courses, ensuring that they are accessible to all including delivery in rural locations.
- Work closely with skills and advisory bodies to ensure installer training aligns with industry requirements.
- Continue principle of support for first install: certification & extended warranties for trained installers.
- Prepare for anticipated demand, invest in stock and ensure that supply chains are ready to deliver in all regions of Scotland.

References

Bush, R. (2020). Heat network skills in Scotland (Issue May). Energy Saving Trust

BEIS (2020). BEIS Public Attitudes Tracker: Wave 36 – Key Findings. UK Government Department for Business, Energy & Industrial Strategy. Available at: <https://www.gov.uk/government/statistics/beis-public-attitudes-tracker-wave-36>

CCC, (2020). The Sixth Carbon Budget: The UK's Path to Net Zero. Climate Change Committee.

CITB. (2021). Building Skills for Net Zero (Issue March). Construction Industry Training Board. Available at: https://www.citb.co.uk/media/kkpkwc42/building_skills_net_zero_full_report.pdf

BIS, (2013). UK Construction: An economic analysis of the sector. UK Government Department for Business, Innovation & Skills. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/210060/bis-13-958-uk-construction-an-economic-analysis-of-sector.pdf

BSE Skills Ltd, (2020). A Modern Apprenticeship in Plumbing & Heating SCQF Level 7: Framework Document for Scotland. Available at: <https://www.skillsdevelopmentscotland.co.uk/media/33293/ma-framework-plumbing-and-heating-at-scqf-level-7.pdf>

EST. (2017). Energy Efficiency and Low Carbon Market Research. Energy Saving Trust. Available at: <https://energysavingtrust.org.uk/wp-content/uploads/2020/09/Energy-Efficiency-Low-Carbon-Research-Exec-Summary-Oct-2017.pdf>

Farmer, M. (2016). The Farmer Review of the UK Construction Labour Model: Modernise or Die – Time to Decide the Industry's Future. Available at: <https://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2016/10/Farmer-Review.pdf>

Gleeson, C. P. (2016). Residential heat pump installations: The role of vocational education and training. Building Research and Information, 44(4), 394–406. <https://doi.org/10.1080/09613218.2015.1082701>

GSR, (2011). Gas Competence Review. Gas Safe Register. Available at: <https://www.euskills.co.uk/sites/default/files/Gas%20Safe%20Competence%20Review%20Report%202011-2012.pdf>

Hanna, R., Leach, M., & Torriti, J. (2018). Microgeneration: The installer perspective. Renewable Energy, 116, 458–469. <https://doi.org/10.1016/j.renene.2017.09.023>

HES (2021). Heat pump awareness in Scotland: Survey commissioned for Energy Saving Trust and Home Energy Scotland. June 2021. Available at: <https://www.homeenergyscotland.org/energy-saving-trusts-new-research-finds-51-of-scots-residents-have-heard-of-heat-pumps>

HPA. (2019). Delivering net zero: a roadmap for the role of heat pumps. Heat Pump Association. Available at: <https://www.heatpumps.org.uk/wp-content/uploads/2019/11/A-Roadmap-for-the-Role-of-Heat-Pumps.pdf>

HPA. (2020a). Building the installer base for net zero heating (Issue June). Heat Pump Association. Available at: https://www.heatpumps.org.uk/wp-content/uploads/2020/06/Building-the-Installer-Base-for-Net-Zero-Heating_02.06.pdf

HPA. (2020b). Retrofitting homes for net zero heating regulatory change. November. Heat Pump Association. Available at: <https://www.heatpumps.org.uk/wp-content/uploads/2020/11/HPA-Retrofitting-Homes-For-Net-Zero-Heating-Final.pdf>

Killip, G. (2020). A reform agenda for UK construction education and practice. Buildings and Cities, 1(1), 525–537. <https://doi.org/10.5334/bc.43>

References

MCS, (2019). MCS Guidance Document – Competency Guidance. Available at: <https://mcscertified.com/wp-content/uploads/2019/09/MCS-Competency-Guidance.pdf>

ONS, (2019a). Construction Statistics Annual Tables, 2019. Office for National Statistics. Available at: <https://www.ons.gov.uk/businessindustryandtrade/constructionindustry/datasets/constructionstatisticsannualtables>

ONS, (2019b). Low carbon and renewable energy economy, 2019. Office for National Statistics. Available at: <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2019>

Scottish Government (2021a). Heat in Buildings Strategy: Achieving Net Zero Emissions in Scotland's Buildings. October 2021. Available at: <https://www.gov.scot/publications/heat-buildings-strategy-achieving-net-zero-emissions-scotlands-buildings/documents>

Scottish Government. (2021b). Consultation on Scottish skills requirements for energy efficiency, zero emissions and low carbon heating systems, microgeneration and heat networks for homes. February.

SEA. (2019). Installer Survey Results - October 2019 (Issue October). Sustainable Energy Association. Available at: <https://www.heatpumps.org.uk/wp-content/uploads/2019/11/Installer-Skills-Survey-Summary.pdf>

SOSE. (2021). Powering Change: Calling the South of Scotland to Action. South of Scotland Enterprise.

Wade, F., Hitchings, R., & Shipworth, M. (2016). Understanding the missing middlemen of domestic heating: Installers as a community of professional practice in the United Kingdom. *Energy Research and Social Science*, 19, 39–47. <https://doi.org/10.1016/j.erss.2016.05.007>

Wade, F., Shipworth, M., & Hitchings, R. (2016). Influencing the central heating technologies installed in homes: The role of social capital in supply chain networks. *Energy Policy*, 95, 52–60. <https://doi.org/10.1016/j.enpol.2016.04.033>

Appendix 1

Modern apprenticeships and low carbon heat courses offered across Scotland's colleges. Data has been compiled from [ESP Scotland Directory](#) and may not represent a complete list.

Training Facility	Modern Apprenticeship	Low Carbon Heat Courses Offered
Ayrshire College	SVQ Level 3 Plumbing & Heating (SCQF Level 7)	Ground Source Heat Pumps (Short course) Air Source Heat Pumps (Short Course) Solar Thermal (Short course)
Borders College	SVQ Level 3 Plumbing & Heating (SCQF Level 7)	Ground Source Heat Pumps (Short course) Air Source Heat Pumps (Short Course) Solar Thermal (Short course)
City of Glasgow College		HNC Renewable Energy Technologies
Dumfries & Galloway College	SVQ Level 3 Plumbing & Heating (SCQF Level 7)	Solid Biomass (SCQF Level 7; Short course) Solar Domestic Hot Water SCQF Level 7 (Short course) Ground Source Heat Pumps (Short course) Air Source Heat Pumps (Short Course) Solar Thermal (Short course)
Dundee & Angus College	SVQ Level 3 Plumbing & Heating (SCQF Level 7)	Ground and Air Source Heat Pumps Certificate Renewable Energy (SCQF Level 5) Ground Source Heat Pumps (Short course) Air Source Heat Pumps (Short Course) Solar Thermal (Short course)
Edinburgh College	SVQ Level 3 Plumbing & Heating (SCQF Level 7)	Ground Source Heat Pumps (Short course) Air Source Heat Pumps (Short Course) Solar Thermal (Short course)
Fife College	SVQ Level 3 Plumbing & Heating (SCQF Level 7)	F-Gas Refrigerant – Mobile Air Conditioning (Short Course) Ground Source Heat Pumps (Short course) Air Source Heat Pumps (Short Course) Solar Thermal (Short course)
Forth Valley College	SVQ Level 3 Plumbing & Heating (SCQF Level 7)	Ground Source Heat Pumps (Short course) Air Source Heat Pumps (Short Course) Solar Thermal (Short course)
Glasgow Clyde College	SVQ Level 3 Plumbing & Heating (SCQF Level 7)	
Glasgow Kelvin College	SVQ Level 3 Plumbing & Heating (SCQF Level 7)	Ground Source Heat Pumps (Short course) Air Source Heat Pumps (Short Course) Solar Thermal (Short course) Refrigeration, Air Conditioning & Heat Pump Systems (SCQF Level 2) F-Gas and ODS Regulations (Short Course)
Inverness College UHI	SVQ Plumbing & Heating (SCQF Level 7)	Solid Biomass (SCQF Level 7; Short course) Solar Domestic Hot Water SCQF Level 7 (Short course) Ground and Air Source Heat Pumps (Short Course)
Lews Castle College UHI		PDA Renewable Energy Systems (SCQF Level 8)
Moray College UHI	SVQ Level 3 Plumbing & Heating (SCQF Level 7)	Solid Biomass (SCQF Level 7; Short course) Solar Domestic Hot Water (SCQF Level 7; Short course) Air Source Heat Pumps (Short Course)
MSIP Skills Academy		Solar Thermal; Renewable Energy Certificate (SCQF Level 6) Ground and Air Source Heat Pumps
North East Scotland College	SVQ Level 3 Plumbing & Heating (SCQF Level 7)	Ground Source Heat Pumps (Short course) Air Source Heat Pumps (Short Course) Solar Thermal (Short course)
Perth College UHI	SVQ Level 3 Plumbing & Heating (SCQF Level 7)	Ground Source Heat Pumps (Short course) Air Source Heat Pumps (Short Course) Solar Thermal (Short course)
South Lanarkshire College	SVQ Level 3 Plumbing (SCQF Level 7)	Ground Source Heat Pumps (Short course) Air Source Heat Pumps (Short Course) Solar Thermal (Short course) Environmental Technologies (SCQF Level 7) Solid Biomass (SCQF Level 7) Solar Photovoltaic Systems (SCQF Level 7) Mechanical Ventilation Heat Recovery (SCQF Level 7) Awareness of Environmental Technologies (SCQF Level 5)
West College Scotland	SVQ Level 3 Plumbing & Heating (SCQF Level 7)	Ground Source Heat Pumps (Short course) Air Source Heat Pumps (Short Course) Solar Thermal (Short course) Solar Photovoltaic Systems Awareness of Environmental Technologies

Appendix 1

Scotland's Colleges Energy Efficiency & Microgeneration Training

	Ayrshire College	Borders College	Clyde College	Dumfries & Galloway College	Dundee & Angus College	Edinburgh College	Fife College	Forth Valley College	Glasgow Kelvin College	Lewis Castle College	Moray College	NESCOL	Perth College UHI	South Lanarkshire College	West College Scotland	West Lothian College
Level 3 Award in Energy Efficiency Measures for Older and Traditional Buildings																✓
Air Tightness	✓	✓					✓							✓		✓
Thermal Imaging	✓	✓					✓	✓								✓
SMART Control systems	✓	✓	✓				✓	✓							✓	
Internal Wall Insulation					✓	✓								✓		✓
External Wall Insulation					✓	✓								✓	✓	✓
Battery Storage	✓	✓	✓			✓		✓							✓	
Ground Source Heat Pumps	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	
Air Source Heat Pumps	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	
Solar Thermal	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	
Solar Photovoltaic		✓	✓	✓		✓		✓						✓	✓	
Rainwater Harvesting			✓			✓		✓								
Mechanical Ventilation Heat Recovery		✓				✓										
Grey Water System						✓		✓								
Electric Boiler								✓								
Electric Vehicle Charging			✓	✓	✓					✓					✓	
Solid Biomass				✓												

✓ Under Development

Appendix 2

Scottish Government's proposed skills matrix for low carbon heat installers (source: Scottish Government, 2021b: 20-24). Skills matrix developed by Energy Skills Partnership (ESP); Scottish Government 2021 consultation proposes that skills matrix is fully integrated into PAS 2030

Technology	Proposed Training Route
Air Source & Ground Source Heat Pumps	<p>Career path:</p> <ul style="list-style-type: none"> - SVQ 3 Domestic Plumbing And Heating at SCQF Level 7 or equivalent <u>OR</u> - SVQ 3/SCQF 6 Install, Commission And Maintain Refrigeration Systems <u>OR</u> - SVQ 3/SCQF 6 Install, Commission And Maintain Air Conditioning Systems <p><u>AND</u> must complete the following units/qualifications:</p> <ul style="list-style-type: none"> - Install And Commission Fuel Systems: emergent technologies SQA (heat pump option) <u>OR</u> - Heat pump installer course (MCS recognised) <u>AND</u> - Water Byelaws/Regulations* - Domestic Vented And Unvented Hot Water Storage* - <p><u>AND</u> (only if working on pre-1919 buildings)</p> <ul style="list-style-type: none"> - SQA Level 3 Award in Energy Efficiency Measures for Older And Traditional Buildings
Biomass	<p>Career path:</p> <ul style="list-style-type: none"> - SVQ 3 Domestic Plumbing And Heating at SCQF Level 7 or equivalent - SVQ 3 Heating And Ventilating: Industrial And Commercial Installation <p><u>AND</u> must complete the following units/qualifications:</p> <ul style="list-style-type: none"> - Install and Commissioning Fuel Systems: Solid Fuel (SQA) <u>OR</u> - Solid Fuel Installer (MCS or HETAS (wet systems) recognised) <u>AND</u> - Vented/Unvented Hot water - Water Byelaws/Regulations <p><u>AND</u> (only if working on pre-1919 buildings)</p> <ul style="list-style-type: none"> - SQA Level 3 Award in Energy Efficiency Measures for Older And Traditional Buildings
Hydrogen Ready Boilers	<p>Career path:</p> <ul style="list-style-type: none"> - SVQ 3 Domestic Plumbing and Heating at SCQF Level 7 <u>or equivalent, OR</u> - Level 3 Diploma in Gas Engineering <u>OR</u> - Gas Engineering Competence Based Qualification <u>OR</u> - Accredited Certification Scheme (ACS) gas qualification <p><u>AND</u> must complete the following qualifications:</p> <ul style="list-style-type: none"> - Water Byelaws - Central Heating & Water Training & Assessment (CENWAT) - Liquid Petroleum Gas Changeover - Domestic Vented and Unvented Hot Water Storage <p><u>AND</u> (only if working on pre-1919 buildings)</p> <ul style="list-style-type: none"> - SQA Level 3 Award in Energy Efficiency Measures for Older and Traditional Buildings
Solar Thermal	<p>Career path:</p> <ul style="list-style-type: none"> - SVQ 3 Domestic Plumbing And Heating at SCQF Level 7 Or equivalent - SVQ 3 Heating And Ventilating: Industrial And Commercial Installation <p><u>AND</u> must complete the following units/qualifications:</p> <ul style="list-style-type: none"> - Install And Commission Fuel Systems: emergent technologies (SQA) (solar thermal option) - Installation and Maintenance of Solar Thermal Hot Water Systems (MCS recognised) - Water Byelaws/Regs - Vented/Unvented Hot water <p><u>AND</u> (only if working on pre-1919 buildings):</p> <ul style="list-style-type: none"> - SQA Level 3 Award in Energy Efficiency Measures for Older And Traditional Buildings

*Water Byelaws/ Regs and Vented/ Unvented Hot Water courses are built into Domestic Plumbing and Heating SVQ Level 3, so those with the existing qualification will not be required to repeat these courses.

Appendix 3

Participant characteristics

Pseudonym	Company size (no. employees)	Technologies installing	Years in industry	Region	Sector
Aaron	11-15	ASHP; GSHP; Solar Thermal	15-19	Central – but working across Scotland (inc. Outer Hebrides)	Domestic - private; social housing
Callum	1-5	Gas; previously fitted ASHP	25+	Central belt	Domestic - private
Gavin	6-10	Gas; Electric Storage Heating	25+	Aberdeen	Domestic - private & privately rented
Connor	6-10	Heating and ventilation; GSHP, ASHP, Solar Thermal, Gas	25+		Domestic – private; social housing
Martin	6-10	ASHP; GSHP; Solar PV, Solar thermal	25+	Aberdeenshire; Highlands & Islands	Domestic - private
Alan	1-5	Gas & oil boilers; Air Conditioning (HP qualified; not currently installing)	20	Fife	Domestic & commercial
Craig	1-5	Gas & oil. Has training in low carbon but not MCS certified	25+		Domestic & non-domestic – private; social housing
Adam		Gas boilers; ASHP, GSHP (qualified on GSHP, not yet fitted)	15-19		Domestic & small commercial
John	16+	Gas; ASHP; Hybrid	25+	North Scotland	Private domestic; commercial
Matt	1-5	Oil; Gas; Solid Fuel	10-14		Domestic and commercial
Liam	1-5	ASHP; GSHP; PV; Solar Thermal; Battery Storage	20-24	Inverness	
Chris	6-10	Gas Boilers; ASHP	15-19	East Lothian	Domestic

Appendix 4

Installer interview schedule – installing low carbon

About you & your work

1. How long have you been operating in the industry?
2. What kind of company do you own/work for?
 - Number of employees
 - Types of property working in (domestic; non-domestic)
 - Types of client (private owners, public sector, social landlords?)
3. What kind of heating technologies do you install?
 - Over time, have you changed the heating technologies you fit?
 - Do you fit products from particular manufacturers?

Learning to fit low carbon

1. What do you understand about low carbon heat? (definition; particular technologies?)
2. Why did you decide to train in low carbon heat?
 - Advice from other tradespeople?
 - Manufacturers?
 - Trade association?
 - Consumer demand? [Type of client – public/ private sector]
3. What training did you take part in for [low carbon heating technology]?
 - College/ FE
 - Short term (private sector) training course
 - Manufacturer training
 - Combination of these
4. What was your experience of the training?
 - What did you learn? technical system operation; regulations; customer engagement/ customer service
5. How did you hear about the training?
 - Local informal networks
 - Manufacturers
 - Personal research/ other

Installing low carbon

1. Did you feel confident to install [X low carbon heating technology] after training? Why/ Why not?
2. Have there been any challenges on the job that weren't addressed in training? What are these?
3. Is there any support that you think would be helpful following training? Please detail (e.g. mentorship)

Policy & financial support for training

1. How have you funded your training for low carbon heat?
 - What more might be needed to support those looking to undertake training?
2. What do you think to the provision of training in Scotland?
 - National qualification frameworks: are these sufficient?
 - What's missing?
3. Are schemes like MCS helpful for supporting the installation of low carbon heat?
 - Why/ Why not? (e.g. help structure customer support)
 - Are there any barriers to getting involved in these schemes? What?
4. Are you aware of recent policy around low carbon heat? Please explain.
5. Energy Efficient Scotland? Heat in Buildings Strategy? Skills consultations?

Customers

Do clients approach you about low carbon heating?

- Do you suggest it to them?
- Are you aware of funding for customers?

General

Any other questions/ comments?

Appendix 5

Installer interview schedule – not installing low carbon

About you & your work

1. How long have you been operating in the industry?
2. What kind of company do you own/work for?
 - Number of employees
 - Types of property working in (domestic; non-domestic)
 - Types of client (private owners, public sector, social landlords?)
3. What kind of heating technologies do you install?
 - Over time, have you changed the heating technologies you fit?
 - Do you fit products from particular manufacturers?

Learning to fit low carbon

1. What do you understand about low carbon heat? (definition; particular technologies?)
2. Have you thought about training to fit low carbon heat? Why/ why not?
 - What technologies/ courses have you considered?
 - What challenges are there with getting involved?
 - What would encourage you to undertake training?
3. Where would you look for advice about training to fit low carbon heat?
 - Manufacturers?
 - Trade association?
 - Local informal networks?
4. What type of training would you seek?
 - College/ FE
 - Short term (private sector) training course
 - Manufacturer training
 - Combination of these
5. What types of things would you like to see covered in this training?
 - Technical system operation; regulations; customer engagement/ customer service
6. Is there any further support that you think would be helpful following training? Please detail (e.g. mentorship).

Policy & financial support for training

1. How would you fund training for low carbon heat?
 - What more might be needed to support those looking to undertake training?
2. What do you think to the provision of training in Scotland?
 - National qualification frameworks: are these sufficient?
 - What's missing?
3. Are schemes like MCS helpful for supporting the installation of low carbon heat? Why/ Why not? (e.g. help structure customer support)
4. Are you aware of recent policy around low carbon heat? Please explain.
5. Energy Efficient Scotland? Heat in Buildings Strategy? Skills consultations?

Customers

- Do clients approach you about low carbon heating?
- Do you suggest it to them?
 - Are you aware of funding for customers?

General

Any other questions/ comments?

We would like to thank all of the plumbing and heating engineers that took part in this research. They generously took time out of their busy schedules and shared their expertise with good humour and kindness. Thanks also to colleagues from SNIPEF, EST and CSIC for their contribution to this work. In particular: Martyn Raine at SNIPEF; Pilar Rodriguez at EST and Alan Johnston, Anne-Mari Gillespie, Emma Church and Ross Muir at CSIC.

If you have any questions about the contents of this report, please email hello@cs-ic.org.