Department of Energy & Climate Change

Renewable Heat: Standards and training

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Executive summary

Employer First, working in collaboration with the Renewable Energy Association and the Wood Heat Association, was commissioned to conduct this research by the Department of Energy and Climate Change (DECC). It examines and describes the current standards and training landscape so far as this relates to renewable heat and specifically the non-domestic sector. It provides evidence-based options for where changes to the current landscape may be beneficial.

Background, objectives and research methodology

The non-domestic Renewable Heat Incentive (RHI) was launched in November 2011 to provide financial support to incentivise the roll out of renewable heating technologies. DECC is examining what actions will enable the RHI scheme to deliver its full potential and has commissioned this research project to provide information in relation to the development of the supply chain. In particular this research sought to address questions relating to the existing standards and training landscape as follows:

- What current standards exist that relate to renewable heat and specifically for the technologies supported by the non-domestic RHI? What associated standards exist which address aspects that are considered essential to the correct installation of renewable heat technologies, particularly those supported by the RHI e.g. heat metering? Additionally, what can we learn from international standards?
- What is the current training provision for renewable heat and specifically for the technologies supported by the non-domestic RHI? What training exists for the RHI scheme and application process and heat metering?
- In both cases, what is the nature, quality and accessibility of the current provision?

The research was designed to gather evidence through three phases:

Phase 1 - Desk-based research which aimed to explore and describe the current standards and training landscape in so far as this relates to renewable heat. Additional searches into international best practice were conducted.

Phase 2 - Opinion from an expert working group which sought to garner the views of a range of experts from the renewable heat sector on the current standards and training landscape.

Phase 3 - Qualitative interviews which sought to explore the experiences of stakeholders within the renewable heat sector relating to the current standards and training landscape. Those interviewed represented all of technologies supported by the non-domestic RHI.

The rest of the executive summary presents the headline findings from this study, drawing on all three phases. All percentages reported are from Phase 1.

Standards

The British Standards Institute's definition of a standard refers to it being "an agreed way of doing something"[1]. Working group members in turn acknowledged that a degree of confusion currently exists within the renewable heat sector regarding standards. What are considered by some within the sector to be standards were shown through this research to in fact be guidance and vice versa. This overall lack of clarity was reflected in the research findings which highlighted that standards do exist and are a valued source of information which serve a useful end purpose. There is also a commonly held view that more might be done to improve knowledge of and access to them, and to make these more specific to the non-domestic market.

The research identified that a large number of standards exist in different formats and are produced by various organisations. It was clear from this research that those standards which are specific only to renewable heat were not always well developed. For example, standards relating to health and safety and building regulations were not specific to renewable heating technologies, rather these related to all types of construction.

The research identified existing government-led schemes whose intent is to establish minimum standards in heating, though their focus was on all types of heating technologies and not solely renewables. The domestic market (<45kW sized plants) is governed by the Micro-generation Certificate Scheme which is designed to ensure the quality and safety of heating installations. No similar non-domestic scheme for larger installations was identified.

The phase 1 research identified 36 separate organisations that between them had produced 164 guidance type documents linked to renewable heat technologies. Further analysis of these 164 documents identified common references to three main categories of documentation: regulations, standards and guidance.

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[1] http://www.bsigroup.com/en-GB/standards/Information-about-standards/what-is-a-standard/

- 68 regulations were identified of which 65 were found to be general construction regulations which did not relate specifically to renewable heat;
- The research identified 88 documents which were classified simply as ‘guidance’ on aspects of renewable heat technologies produced by the sector, for the sector. Of these, 56 were shown to contain general content, in that they are applicable across both renewable and non-renewable heat installations;
- A detailed examination of 19 guidance documents and regulations identified 139 standards. Only 14 of these standards related specifically to renewable heat with the remainder providing detail of standards for general construction and installation practices. No standards were found which related to the whole of the renewable heat project cycle (e.g. from design through to operation); and
- The research failed to identify any standards for some areas, notably biomass fuel stores and hydraulic system and controls design.

Training provision

The position relating to training was found to be similarly unclear. A wide variety of training was identified, with a large number of organisations developing training materials.

- The research identifed 192 separate training courses that are currently available and which have content that can be attributed to non-domestic renewable heat technologies;
- The research identified concern that the content and detail of the training was not always at the right level to support the industry. For example, only 43 (22%) of the 192 training courses contained material that specifically referenced the RHI scheme;
- There was also concern amongst interviewees that those tasked with designing and delivering the training may lack sufficient experience of the renewables sector;
- The data showed that 99 (52%) of the courses identified are not specific to any one renewable heat technology, and no specific courses were identified for biomethane and geothermal technologies;
- There was evidence of demand for training on how to design systems across all renewable heat technologies which is not being matched by the supply side, with only 19% of courses categorised as relating to ‘design’ (compared to 44% of courses categorised as being relevant to installation);

- The research highlighted a lack of awareness of the training that is currently available, and uncertainty as to where to go to find out definitive information about the training provision for renewable heat technologies as a whole;
- The geographical location of the training and when it started varied greatly. For example, it was identified that training provision was concentrated in major population centres such as cities such as Birmingham, Manchester and London; and
- Interviews identified a common issue relating to the affordability of training – from both a financial and a "time out of the business" sense.

International examples

The research examined the approach to standards and training in other countries, using published literature and learning from experts in the industry. The purpose was to learn more about other countries' approaches to these issues and to highlight any key learning. The success of the international renewable heat programmes which were examined can be attributed to a combination of one or more of the following:

- effective and timely government intervention;
- well communicated quality standards;
- industry-led inspection regimes; and
- a nationally, and in some cases, internationally recognised training programme for renewable heat.

It is not been possible to draw a clear set of conclusions from this work as the positions which have been identified are in some part unique to the countries themselves. It was noted however that the UK participates in the European heat pump installer training course 'EUcert'. This delivers identical training and examination material (in local languages) for all trainees throughout Europe and has enabled the development of a comparable qualification that is accepted by different participating countries. The research did not identify any UK training providers who are currently offering the EUcert qualification however.

Options

Building on the evidence gathered, the research has explored a number of possible options that could potentially improve or enhance the existing standards and training landscape. These are summarised in the table below and are discussed in detail in the final chapter.

These can be divided into three key categories which may aid future consideration:

Table 1: Summary of categories into which the options can be placed

Leadership	Regulation	Accessibility
Suitable and strong leadership across government and industry may drive change	Better regulation may drive up the quality of standards and training and stimulate demand	Improving accessibility of training and clarifying standards may drive change

Table 2: Summary of potential options

Category	Potential options
Leadership	Explore how the non-domestic renewable heat sector can come together to work more collaboratively so as to share knowledge; develop new and maintain existing guidance that references relevant standards; and improve access to guidance.
	Explore ways in which improved market intelligence regarding the renewable heating sector, the RHI and eligible technologies can be developed, shared and maintained so as to provide a clearer picture of the market. This clarity may stimulate further demand for renewable heat technologies, and training.
Regulation	Explore how a minimum quality for the installation of each type of non-domestic renewable heat technology could be developed by extending existing standards or placing these on a firmer footing.
	Identify ways in which to develop new or existing standards that are deemed critical to each renewable heat technology, so that these are appropriate, clear and more easily accessible.
Access	Explore ways to reduce the cost to industry of developing standards and guidance documents, and/or the cost of accessing these, to encourage experts in the industry to adopt these (and thus share knowledge).
	Consider ways in which to simplify and/or better co-ordinate the manner in which existing and new training materials for each type of renewable heat technology are maintained and developed. Ensure expert industry involvement in this process.
	Consider ways in which clearer information about renewable heat training for each type of renewable heating technology might be disseminated and accessed.

Introduction

This report provides details of industry-led research undertaken into the current existence, quality and accessibility of non-domestic renewable heat related standards and training. The report contains analysis of the research and provides conclusions and evidence-based options for where changes to the current landscape may be beneficial.

Background

A significant amount of the energy used in the UK is used to heat space and water, for cooking and catering and in industrial processes. In 2013, heat accounted for almost half of the UK's final energy consumption (46%). The proportion of heat derived from fossil fuels is large, with 87% of heat generated from oil and gas appliances in the domestic sector and 65% for the commercial sector[2], whilst renewable heat contributed to only 2.6% of heat consumption[3]. In 2011 the Government recognised that heating and cooling account for almost half of the UK's carbon dioxide (CO_2) emissions and that the decarbonisation of the heat supply chain was instrumental to achieving the UK's carbon reduction targets[4].

The UK government has taken steps to ensure that those targets are achievable. DECC's primary mechanism for supporting the uptake of renewable heat in industry, businesses and public sector organisations is the Renewable Heat Incentive (RHI). The RHI is an innovative policy and the renewable heat sector has experienced growth partly in response to the incentives offered by this and other DECC schemes. For example, when the non-domestic RHI was first introduced in November 2011 there were no full-scale biomethane to grid plants in operation; there are now 24 accredited systems of which 22 have so far received payments for over 300GWh of renewable heat generated. Nearly 14,000 full applications to join the scheme have

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[2] DECC. 2014. Energy Consumption in the UK – Overall Data Tables, 2014 update. Available at https://www.gov.uk/government/collections/energy-consumption-in-the-uk

[3] DECC. 2014. Renewable sources used to generate electricity and heat and for transport fuels (DUKES 6.6). Available at https://www.gov.uk/government/statistics/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes

[4] DECC. 2011. Planning our electric future: a White Paper for secure, affordable and low-carbon electricity. Available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48129/2176-emr-white-paper.pdf

been received since it was launched, with a combined capacity of over 2.2GW, and by end of June 2015 over 4000GWh of renewable heat had been generated and paid for[5].

DECC is examining what actions will enable the RHI scheme to deliver its full potential across these sectors to ensure quality future roll out of renewable heat technologies.

Renewable heat technologies:

Different renewable heat technologies can be used to produce heat from renewable sources. As of February 2015, the technologies eligible under the RHI include: solid biomass, biogas and biomethane injection, ground source heat pumps (GSHP), water source heat pumps (WSHP) and air source heat pumps (ASHP), deep geothermal, renewable combined heat and power (CHP) and solar thermal systems.

These technologies have different technical specifications and their markets are at different stages in development, resulting in diverse levels of provisions for standards and training. In addition, the technologies and projects vary substantially in terms of project size and complexity. Some are simple installations, whereas other are substantial construction projects.

A 2010 report described workforce skills and training as inadequate for solar thermal, GSHP, biogas and biomethane[6]. It also highlighted the need to support training for heating engineers in bioenergy. It was anticipated that the launch of the RHI, as well as the development of National Occupational Standards for renewable heat technologies by Sector Skills Councils, would encourage additional training and research and development in the renewable heat industry[7].

Aims and objectives

The objective of this 10-week research project was to provide a high-level overview of the current situation relating to standards and training, rather than an extensive analysis. DECC wanted to learn more about the provision in these areas and gain a clearer understanding of how the different elements of standards and training fitted together. It was also interested in the impact that they might be having on the perceived quality and performance of installations in the non-domestic RHI. DECC commissioned this research to explore the nature, quality and accessibility of the

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[5] https://www.gov.uk/government/statistics/rhi-deployment-data-june-2015

[6] http://storage.globalcitizen.net/data/topic/knowledge/uploads/2011071916152533.pdf

[7] DECC. 2011. Renewable Energy Roadmap. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48128/2167-uk-renewable-energy-roadmap.pdf

current standards and training landscape, as well as the demand for both areas from the industry.

The aims of this research were to determine if action in this area might be useful or indeed identify whether further work might be beneficial. For example, by gathering evidence on the training which is available and being accessed, and the relevant existing standards that relate to the renewable heat market, DECC might then be in a position to decide if further research or improvements could benefit those in the supply chain and users of the technologies. Table 3 below provides an overview of the main aims and objectives of the research, and how they relate to each other.

Additionally, this research contributes to DECC's thinking in three areas:

- **Provide evidence to inform potential changes to renewable heat policy**. The schemes that DECC offer may need to adjust as new information becomes available and as the market evolves. This project could provide DECC with scheme-specific evidence on standards and training provision for renewable heat which may also be relevant to wider heat policy;
- **Add to DECC's understanding of interventions of this type.** Evidence gathered from the RHI scheme administrator, the Office of Gas and Electricity Markets (Ofgem), and independent evaluation provides a greater understanding of the impacts non-domestic RHI has had on the renewable heat market and the quality and performance of installations in the non-domestic RHI scheme[8]. The provision of appropriate quality standards and training in renewable heat can play a key role in helping to upskill the sector, which in turn can help to achieve optimal performing technologies; and
- **Help ensure that DECC policy can conform to the important principles of accountability, transparency and openness to scrutiny.** The RHI entails a cost to taxpayers. It is important that DECC can make information on its effectiveness available to the public.

[8] DECC. 2014. Evaluation of the Renewable Heat Incentive: interim report - the non-domestic scheme. Available at: https://www.gov.uk/government/publications/evaluation-of-the-renewable-heat-incentive-interim-report-the-non-domestic-scheme (11/03/2015)

Table 3: Aims and associated objectives of the research

Aim of the research	Associated objectives
To understand more about how the different elements of standards and training arrangements fit together	1. Identify which standards currently exist for renewable heat, including standards associated with the correct installation of renewable heating technologies, and examine international best practice. 2. Identify what training currently exists for renewable heat technologies supported by the RHI; the RHI application process; and associated areas e.g. heat metering.
To understand more about how current standards and training impact on the overall quality and performance of non-domestic RHI installations	3. Identify the gaps in the overall provision or content of renewable heat standards and training.
To identify what potential options for longer-term government and industry action exist	4. Identify options for potential intervention to improve or enhance the existing situation relating to standards and training 5. Investigate the types of activities that could be undertaken to facilitate the sharing of knowledge and information relating to renewable heat.

Methodology

To answer the research objectives described above, DECC proposed an approach consisting of three different, but complementary activities.

Table 4: Research activities and associated objectives.

Activity	Objectives (see Table 3)	Summary
Desk-based research	1 and 2	Online research collating information about standards and training which relate to renewable heat and the RHI. Additional searches examining the approach in other countries were also conducted.
Semi-structured Interviews	3, 4 and 5	Interviews conducted with 31 stakeholders to explore their experiences relating to the current standards and training landscape. Those interviewed represented all of the technologies supported by the non-domestic RHI.
Working group	1 to 5	Two meetings with experts from the renewable heat industry and relevant skills and training organisations to provide input and feedback on the research and findings and suggest options.

The methodologies used for each activity are summarised below. Further and fuller details of the methodology are provided in Annex A.

Desk based research

Standards

The research into standards included a focus on formal standards published by the British Standards Institute, the International Organisation for Standardisation and European Standards. This identified thousands of possible standards which it was not possible to record in the timeframe allocated for this project. To refine the search, the advice of the working group was to focus the research on organisations that had produced documents that could be attributed in some way to renewable heat. Information collected was categorised as follows: publication year; organisation who produced it; technology supported; geography; type (regulation, guidance or standard); and cost. The full detail is shown in the excel table in Annex B.

Training

The research into training began with a thorough examination of the Ofqual register - the national register of all regulated qualifications. Further searches were conducted of websites of accreditation bodies. The project sought to identify how wide spread the coverage of heat related training was across the UK and each course was categorised geographically. In order to find non-accredited training (i.e. non-regulated), searches were conducted using web search engines such as Google and Bing, as well as the websites of relevant professional bodies, training providers and trade associations. The information collected was reported under several categories such as numbers of providers offering the courses identified; duration; accreditation body (if applicable); renewable technologies covered and cost. The full detail is shown in the excel table in Annex C.

Interviews

Qualitative data on the nature (content), quality and accessibility of renewable heat standards and training was collected, along with information on how such knowledge was currently shared. This was collated from 30 telephone interviews and 1 face-to-face interview with stakeholders from the renewable heat sector including training providers, professional bodies and renewable heat design and installation type businesses.

The interview sample was drawn up using multiple sources to ensure that it included representatives from all RHI-eligible technologies. The respondents were selected to ensure that various sizes of businesses were included, i.e. micro (less than 10 employees), small (10-50), medium (50-250) and large (250+). A detailed account of the interview sample is provided in Table 8 in Annex A. The interviews were transcribed and analysed thematically using a "pragmatic iterative approach" (Tracy 2013)[9] methodology using RQDA[10].

Working group

As part of the research an independent working group was convened composing of 12 members from the non-domestic renewable heat sector, relevant professional bodies, trade associations and training bodies. Members were selected to represent all RHI eligible technologies. Organisations and individuals were also chosen to ensure representation was available from all sizes of business. A detailed view of the composition of the working group is given in Table 9 in Annex A. DECC were present to confirm the requirements of the project and to support and challenge understanding of the objectives of the research.

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[9] Tracy, S. J. 2013. *Qualitative research methods: Collecting evidence, crafting analysis, communicating impact*. (John Wiley & Sons), Blackwell Publishing.

[10] More information on RQDA at http://rqda.r-forge.r-project.org/

The functions of the working group were to discuss and suggest alternative approaches to the proposed methodology used to conduct this research; to critically challenge and add to the findings from the above activities; and to feed into the potential options set out in the final chapter. Two meetings were convened on the 11 February and 11 March 2015.

International good practice

Working group members and interviewees contributed case studies of international good practice including information on the situation in Austria, Germany, Italy and Sweden. Information on the heat pump market in Sweden was gathered through web searches, using Geotrainet and ProHeatPump[11].

[11] More information on http://www.geotrainet.eu/ and http://www.proheatpump.eu/

Standards for renewable heat technologies

This chapter examines the findings from the research in to the available standards for the renewable heat market. It explains the difference between regulations, standards and guidance and provides a snapshot of the availability and appropriateness of each in relation to renewable heat. There are examples of government-led schemes that ensure safe and compliant heating installations but at the same time the evidence shows the complexity of the UK standards landscape. There are examples of industry collaboration to produce good quality guidance and standards although the research also revealed that the cost of producing and accessing standards is a major barrier to progress in this area.

What is a standard?

The British Standards Institute defines a standard as "an agreed way of doing something"[12]. Working group members identified a potential path for the development of standards. This can start with an Act of Parliament, which then leads into regulations that are in turn used to establish standards, which might finally be reflected in guidance. In the specific case of the RHI, Ofgem guidance references various standards that are deemed critical to the RHI.

The impact of this lack of a clear definition, coupled with the various stages which may be involved in the production of standards, was reflected through the interviews with stakeholders which identified some ambiguity about what they consider a standard to be. Three main accepted meanings of this term emerged:

- Standard practice i.e. the standard way of doing something in their industry whether accredited by a scheme or not;
- Documents published by organisations within their sector containing information about how to do something; and or
- The legal requirements associated with renewable heat projects.

[12] http://www.bsigroup.com/en-GB/standards/Information-about-standards/what-is-a-standard/

The evidence clearly showed a degree of confusion exists within the industry regarding standards. What are considered by some within the industry to be standards were shown through this research to in fact be guidance, and vice versa.

This unclear landscape affected the approach taken to identify the different types of standards. The research involved a desk-based search for organisations that had produced any documents that could be attributed in some way to renewable heat technologies. This process identified 36 UK-based organisations and 164 different guidance documents and regulations. These are detailed in Annex B. Further analysis of these 164 documents was carried out to determine the nature of these documents, which enabled these to be categorised as regulations, standards or guidance. This chapter looks in detail at the analysis of the 164 documents from these three perspectives.

Regulations

Within the sample of 164 documents identified, 68 separate regulations were referred to that applied to renewable heat installations. 65 of these were classified as "associated standards", meaning that they apply to all general heating projects and not just renewable heat technologies. These associated standards include:

a) areas relating to Health and Safety legislation;

b) building regulations and related standards; and

c) areas which relate to environmental controls e.g. ground water or air quality.

Nearly all of the 65 regulations classified as associated standards are general construction industry regulations and do not specifically relate to renewable heat. However, renewable heat installations need to comply with these during the building process, but it was not established by this research how much compliance actually occurs.

Health and Safety Regulations

Health and safety legislation is strictly controlled in the United Kingdom by the Health and Safety Executive (HSE) which has powers to enforce standards. HSE legislation applies by law to all construction and non-domestic heating projects including all renewable heat projects[13] e.g. health and safety regulations that relate to working at heights, working in confined spaces and electrical safety apply equally to renewable heat projects as they do to other building or heating projects. The HSE also releases

[13] http://www.hse.gov.uk/enforce/index.htm

formal bulletins which can directly relate to renewable heat technologies, for example carbon monoxide in biomass fuel stores[14].

Building Regulations

Respondents who were interviewed provided a useful insight in to how building regulations themselves might be improved so as to support the renewable heat industry:

"There is no regulation covering installations above 45 kilowatts, and so MCS[15] doesn't get involved, and it's a free for all" (respondent 10, business, heat pumps).

The research examined the building regulations, which are owned by the Department for Communities and Local Government (DCLG)[16]. These are legally binding regulations for all types of heating installation that are included in buildings, and therefore apply equally to renewable heat technologies. These include, for example, Part B Fire Safety; Part L CO2 emissions; and Part P Electrical Safety.

The research identified the existence of two government schemes or guides relevant to renewable heat technologies. The first is a DCLG approved "competent person" scheme managed by the Heating Equipment Testing and Approval Scheme (HETAS)[17] which is directly applicable to domestic biomass heating installations. Individuals are required to complete training to become certified to install biomass. In addition, their company processes must be certified by HETAS to demonstrate that they understand how the building regulations above are relevant to wood fuelled boilers. This allows the company to approve domestic installations without reference to local building control. Although some interviewees and working group members stated that some field engineers who install and commission non-domestic biomass boilers have HETAS certification, it is not a legal requirement.

The second government scheme identified is the UK Government's "Non-domestic Building Services Compliance Guide"[18] which provides a source of guidance on complying with building regulations for space heating and hot water systems, mechanical ventilation, comfort cooling, fixed internal lighting and renewable energy systems. This guide makes reference to areas relating to efficiencies and controls for heat pumps, solar thermal, biomass and CHP heat (but not biomethane, renewable CHP, deep geothermal or biogas as they are not included in buildings). The Compliance Guide covers these areas in relatively limited detail, for example

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[14] http://www.hse.gov.uk/safetybulletins/co-wood-pellets.htm

[15] Micro-generation Certification Scheme http://www.microgenerationcertification.org/

[16] https://www.gov.uk/government/policies/providing-effective-building-regulations-so-that-new-and-altered-buildings-are-safe-accessible-and-efficient

[17] http://www.hetas.co.uk/

[18] http://www.planningportal.gov.uk/buildingregulations/approveddocuments/partl/compliance

there are only 6 pages (of 72 total) covering heat pumps (mainly efficiency definitions), 3 pages covering CHP (no reference to renewable CHP) and a third of a page covering biomass heating.

Conclusion 1 – The research identified examples of government-led building regulations, guides and competent person schemes, which are designed to ensure the quality and safety of heating installations. Regulations and legislation can provide a clear framework for compliance but there are currently no health and safety or building regulations specifically for non-domestic renewable heat technologies.

Standards

The research identified a large number of standards relating to the current construction and building services sector, but only a small proportion of these were found to specifically relate to renewable heat or fuel. For example, a detailed examination of 19 guidance documents and regulations identified 139 formal British Standard (BS) or European (EN) standards and only 14 of these relate specifically to renewable heat or fuel, with the remaining 125 providing detail of standards for general construction and installation practices. Furthermore, none of the 14 standards relating to renewable heat could be mapped to the key deployment phases common to almost all renewable heat technologies (see Annex D for further details). Interview respondents acknowledged this finding with many reporting that there was a lack of installation standards for their technology. This was a concern for respondents from the biomass sector but was also particularly emphasised by respondents from the heat pump industry:

"There is nothing…there are no standards, no UK based standards for non-domestic installations" (respondent 31, business, heat pumps).

The research did not identify any standards that relate to the whole of the renewable heat project cycle for any of the RHI eligible technologies. The majority of the standards identified relate to installations covered by the Microgeneration Certification Scheme i.e. the domestic side of the market.

To illustrate this issue in more detail, the AM15 Biomass guidance, produced by the Chartered Institute of Buildings Services Engineers (CIBSE)[19] was examined. This is an industry recognised applications manual designed to help readers understand biomass boiler systems to a level where they can make knowledgeable decisions on system design. Within this guide, 40 formal standards relevant to biomass are listed.

Whilst this guidance document has a focus on the design of biomass systems, it also covers other key project stages such as installation. However, some interview

[19] http://www.cibse.org/AM15 - This Applications Manual concentrates on biomass systems with biomass boiler outputs in the range of 50 kW to 5 MW burning woodchips or wood pellets

respondents and working group members stated that the AM15 guidance does not cover all of the areas necessary to design a system which works reliably

In addition, the research failed to identify any standards for some important areas, notably biomass fuel stores, hydraulic system & controls design (although these are covered by AM15 guidance, below). For other areas, a large number of standards were identified meaning it is difficult to identify which are the most important e.g. in the AM15 guidance there are 20 formal standards which relate specifically to flues.

This interview respondent articulated the confusing nature of standards:

"A cornucopia of standards really. I think the industry would benefit hugely from a reduction in numbers and in trying to bring some uniformity to the industry in terms of accreditations and qualifications" (respondent 14, business, renewable heating).

RHI standards

The research examined two documents produced by Ofgem, which is the body responsible for delivering the RHI (see Annex B for detail). Ofgem produce two RHI specific documents[20]:

i. Volume One describes the eligibility requirements of the RHI and how applicants can become accredited or registered as applicable; and

ii. Volume Two describes the on-going requirements for RHI participants, information on how periodic support payments are calculated and paid, and Ofgem compliance and enforcement powers.

Together they cover certain areas in detail including RHI eligibility; heat metering; thermal insulation of underground pipes; biomass boiler flue emissions; and biomass fuel sustainability requirements. The documents refer to 15 formal standards which must be adhered to and are considered by DECC to be critical to the correct application of the RHI, although it should be noted that this guidance alone is not sufficient to guarantee the quality of renewable heat installations in all areas.

Conclusion 2 – The current standards market is complex and confusing for the sector as a whole. A large number of standards exist but only a small number have been produced specifically relating to renewable heat technologies. Ofgem have published the list of standards deemed by DECC to be critical to the RHI however these do not cover all aspects of the project cycle.

[20] https://www.ofgem.gov.uk/publications-and-updates/guidance-volume-one-two-and-fuel-measurement-and-sampling-guidance

Guidance

The research identified 88 documents classified as providing guidance on aspects of renewable heat technologies. Of these, 56 are classified as containing general content in that they are applicable across both renewable and non-renewable heat installations. 21 of these general documents are published by CIBSE.

Of the 88 guidance documents, only 32 were found to be technology specific, of which 13 related all or in part to biomass heat, 9 to GSHP, 11 to gas powered CHP, 4 to solar thermal and 4 to water source heat pumps, 3 to air source heat pumps, 3 to biogas, 4 to biomethane and 1 to deep geothermal. It was not possible to establish that technology specific guidance documents were always accepted as being sufficient by industry, or had been approved.

The research identified that the Ground Source Heat Pump Association (GSHPA) has developed 3 industry standards covering the system design and installation for: Vertical Borehole Standard for closed loop borehole systems; Shallow Ground Source Standard for shallow horizontal systems; and Thermal Pile Standard for installations which use foundation piles to collect, reject or store heat. These have been produced using the resources of the GSHPA and its members only i.e. without input from other organisations. Their objective was to improve standards within the nascent industry at a time when the established plumbing & heating industry foresaw no problems.

Two further industry standards, the Open Loop Standard and the Thermal Transfer Fluid Standard are in development. The GSPHA (as a member of the working group) advise that the new documents will shortly be issued for peer-led review and the old standards subsequently updated. The GSHPA is also working in conjunction with CIBSE, the Heat Pump Association and DECC on a Code of Practice for Water Source Heat Pumps which is evidence of positive and proactive sector-led action.

Some working group members indicated that guidance (where it existed) was the best source of information for people responsible for designing and installing non-domestic renewable heat technologies. This was because the guidance included reference to the appropriate and relevant standards.

However, it is notable that both the interviews and working group highlighted that there is a general problem with awareness and knowledge sharing of guidance within the sector. One interview respondent from the heat pump sector stated:

"The GSHPA has begun to establish some standards… I'm going to say they're informal….for ground source. They're not a BSI, they're not an EN but they are better than nothing" (respondent 31, business, heat pumps).

The research examined the CIBSE Heat Networks Code of Practice as recommended by the working group as a good example of guidance (heat networks

may be fed from renewable heat). This guidance covers all project stages and was written in conjunction with the Association of Distributed Energy, a leading heat networks trade association, and has a broad peer review list.

The working group commented that further such guidance documents, collaboratively produced by a number of stakeholders, may be a good way forward to assist the renewable heat sector as whole to better share knowledge and understanding and therefore apply minimum standards.

This point was illustrated by the following interviewee, who also identified the need for such guidance documents to be maintained and updated:

"The AM15 [biomass guide] is a big step forward, from CIBSE, so it's the right thing to do…but who's responsible for making sure that it's correct? Who's responsible for making sure it's updated?" (respondent 2, business, biomass).

In response to this CIBSE, who attended the working group meetings, provided clarification that their quality assurance processes required peer review by three reviewers and that the AM15 will be further developed once the industry has been using it for a while.

Proprietary guidance

The interviews and working group meetings identified that some leading renewable heat companies had developed their own comprehensive internal guidance or standards documents. The research into these documents identified that they cover regulatory and RHI standards together with external and internal good practice and are largely designed for their own staff. This point was reaffirmed by some interview respondents:

"I think the standards are set by each installer and what standards they set their install to be" (respondent 15, business, biomass).

"We've written our own course in installation, maintenance and design of renewable heat technologies" (respondent 21, training provider).

It was also indicated by the working group that companies which had taken the time to develop such material did not necessarily make it widely available outside of their own company, with the suggestion that this was done so as to avoid compromising any competitive advantage.

Conclusion 3 – The qualitative research identified that guidance documents are seen as a popular and useful resource amongst stakeholders. However, the current availability of guidance documents is inconsistent with some RHI eligible technologies having had more guidance documents produced than others. Additionally, some of the guidance documents that have been produced appear to

be in need of an update. The best examples of guidance have been produced through collaboration.

Cost

It was clear from the research that cost is a key issue in the context of standards. The issue was succinctly explained by this interviewee:

"It's getting enough people interested to make it worthwhile. People can buy standards from BSI, but they're very expensive. I think somebody needs to show that there's a need for BSI to fund the standards, and this is the big problem we have in the non-domestic market, if you talk to BSI about writing a standard, they want to have a business plan and to know… how many copies of the standard they're going to sell and how big the market is, [in order for them] to make it, and then see if it's worthwhile doing" (respondent 20, professional body, engineering).

Cost of producing standards

The research identified 36 different organisations that had produced guidance or standards documents. It was acknowledged by most of the interview respondents that professional bodies and trade associations play a key role in leading initiatives to develop standards as shown by this example:

"I always [tell] people to refer to whatever professional organisation they're members of, who are signposted through those organisations to another source" (respondent 14, business, heating supplies).

It was however suggested by some members of the working group that the cost implications of developing standards often deter organisations from undertaking work in this area, especially if there was little if any commercial benefits to be had. This results in an over-reliance on industry goodwill to produce standards. For example, the interviews revealed that the GSHPA has been extremely pro-active in producing guidance and standards for their sector despite the fact they are receiving no income or funding for their work.

Cost of accessing standards

The quantitative research examined the cost of accessing UK standards. Where the information was available it was noted that prices ranged from £45 to £280. Using CIBSE's AM15 Biomass guidance as an example, to purchase details of all 40 standards included in the guidance would cost £6,700. Some interviewees and members of the working group stated that these kinds of costs were prohibitive.

The cost of the 139 standards referred to in Annex B is estimated to be £19,300.

Cost of complying with standards

It was noted by many of the interview respondents and the working group that compliance with standards had an adverse impact on installation costs. Those organisations costing projects that did comply with standards may be losing out on business to organisations that disregarded standards in order to deliver a more competitive price. However, the extent to which this was true could not be quantified through this research.

The issue linked to compliance with standards was also considered by some interview respondents to extend to larger renewable heat schemes, e.g. district heating and biogas systems, which are likely to be delivered through a supply chain. They explained that the main contractor's procurement processes were vital and their specifications should include details of the necessary standards their suppliers should deliver to. However it was suggested that this was not always the case:

"Bearing in mind, when we're trying to choose a...district heating [scheme] we don't have a lot of choice we...basically have to accept the best standards that can be offered by the limited availability" (respondent 24, business, biomass).

Conclusion 4 – Standards are costly to produce and this is reflected in the price at which they are offered to industry. Organisations that do pay to access the standards report that they often therefore need to charge more for their work than those that do not.

Content, accessibility and quality of renewable heat training

This chapter examines the findings from the research into the available training for the renewable heat market. It provides a snapshot of the type of training available and how it matches the identified demand both from a technology specific and a project phase perspective. It explores who designs the training and how and where it is delivered. This section also studies the availability of information regarding training options for the industry. There is evidence to suggest that the current training provision is complex and that it would benefit from greater industry input. The research also identified that the non-domestic renewable heat industry was perceived to be small and that this may be deterring training providers from investing in new solutions for the sector.

Content (and scope) of training

The research sought to identify how relevant the type and content of the training provision was to renewable heat and the RHI. The desk-based study identified 192 separate training courses (see Annex C) that are currently available throughout England, Wales and Scotland which had full or partial content that can be attributed to renewable heat technologies.

When mapped against these technologies, the data show that 99 (52%) of the identified courses are not specific to any one renewable heat technology. By way of example ABC's "Level 2 Certificate in Heating and Ventilation Studies" has relevance to biomass, biogas and heat pump technologies.

31 (16%) of identified courses are linked to solar thermal, 29 (15%) each to biomass and heat pumps (all types) and 4 (2%) of courses were found to be linked to CHP specifically. There were no specific courses identified for biomethane and geothermal.

Training Specific to the RHI

The content of the training identified was scrutinised for any reference or context to the RHI scheme.

- A total of 43 (22%) of the 192 courses identified contained material that specifically referenced the RHI scheme. For example, Narec have run Renewable Heat Incentive Breakfast Seminars which "offers delegates an opportunity to gain the latest information with regards to the RHI";
- 26 of the 43 courses linked to the RHI scheme and its application process were non-accredited, that is they were not associated with any formal qualifications (see Figure 1), whilst 17 were accredited;
- Only 3 courses were identified that solely focused on awareness of the RHI and its requirements, and which were not only focussed on the domestic scheme. For example, Logic have designed a one day course – the "Level 2 Award in the Principles of Heat Metering for Renewable Heat Installations"[21];
- Only 6 courses, all accredited, were identified which looked at heat metering. 4 of these focussed solely on the correct installation of heat meters; and
- Of the 43 courses, only 5 lasted more than 3 days including REA's UK Anaerobic Digestion Operating and Engineering Course (5 days) and Cranfield University's Heat Transfer Course (5 days). The vast majority (70%) lasted one day or less.

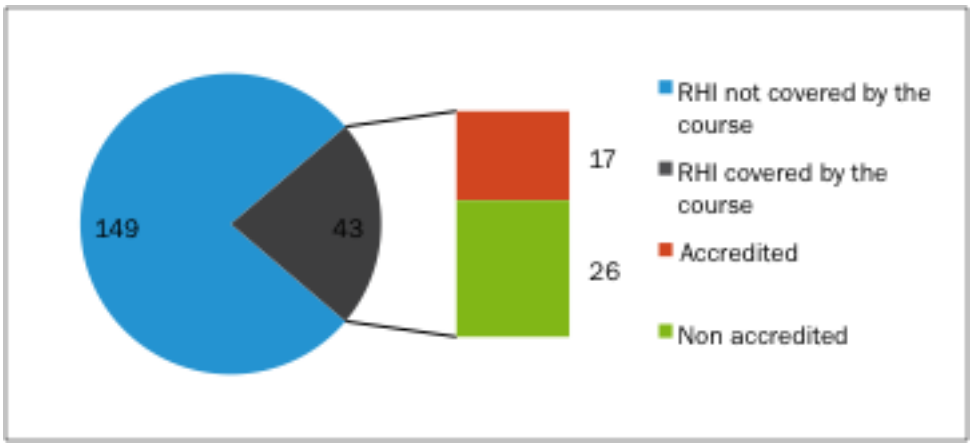

Figure 1 Proportion of courses that have content associated with the RHI and its application process, and the number of accredited and non-accredited courses that covers RHI and are accredited.

Origin and relevance of the training

The research identified that 114 (60%) of the 192 courses identified were accredited which is the process in which a training course is certified and approved by an accrediting body. Once accredited, a course can then be logged with the Qualifications and Credit Framework (QCF) which is an integral part of the UK's skills funding and categorisation system. The mapping exercise identified 28

[21] Heat metering is an essential eligibility requirement for the non-domestic scheme.

different awarding bodies and 15 different universities that were involved in accrediting the114 courses.

Of the 78 (40%) of training courses that were not accredited 22 (28%) were provided by manufacturers including Baxi, Windhager, Euroheat, Worcester Bosch and Daikin. This emphasises the role that manufacturers are playing in training people who work with their products. The reliance on this type of training was identified by the following interview respondent:

"Much of the training in the technology has [involved] taking existing heating engineers and getting them… doing manufacturer training" (respondent 7, business, biomass).

Many of the respondents who referred to manufacturer's training also reported that the quality varied considerably. A number of interviewees indicated that the training provided by manufacturers was insufficient for the sector and focused on familiarisation of the manufacturer's specific products rather than a more rounded overview of a system's design or installation. This interviewee succinctly explained the issue:

"They [the trainer] only know a certain amount, [about] the manufacturer [and], the producer. The installation is not their expertise" (respondent 2, business, biomass).

Comments made by the working group identified that one of the key challenges faced by the renewable heat sector related to their finding time to support the training sector to develop new and more relevant qualifications. They explained that colleges and training providers need industry input to ensure their training provision is relevant, but that sector does not necessarily have the time to fully engage as they focus their efforts more on establishing their businesses.

In addition, a number of respondents identified a common concern that many of the most experienced and specialist engineers, for example time-served gas and heat pump engineers, were choosing to stay on in industry. It was suggested that the reason for this was that individuals were able to enhance their earning potential by remaining in the renewable heat market, rather than their taking up teaching and lecturing posts. One respondent who commented reflected this:

"You're not going to generate adequate training in the short term, because there just aren't folk that have the expertise, who will choose to spend their lives offering the training" (respondent 10, business, heat pump).

Some respondents explained that there was also a need for more hands-on training. Current courses have been reported to sometimes only consist of *"days and days of Powerpoint"* (respondent 19, professional body, heating engineering) and lack the necessary practical application.

A small number of the working group mentioned that there were linkages between the issues identified through this research and those being addressed through the broader training and skills agenda. The research thus examined the UK Commission for Employment and Skills[22] (UKCES) which is a business-led Non-Departmental Government Body that is working closely with the Department for Business Innovation and Skills (BIS) to drive forward "Employer Ownership of Skills". This key policy initiative is seeking to create quicker and more efficient ways in which businesses can support the development of skills solutions that properly meet their needs. Furthermore, BIS's Apprenticeship Unit are currently driving forward their Apprenticeship Trailblazers[23] initiative which is providing further space for employers with common skills needs' to collaborate to design new (and simpler) apprenticeship standards. During the course of this research BIS announced the latest round of successful Trailblazers which includes their intention to support the development of new apprenticeship standards for biomass installation engineers.

Type of Training

In order to determine the appropriateness of the training courses identified, in so far as they contain content relevant to renewable heat and or the RHI, the courses identified were categorised against a list of deployment phases common to almost all of the technologies supported by the RHI (see Annex D).

This showed that 85 (44%) of all the identified available renewable heat training courses are in some way relevant to the 'Installation' phase which means that they may cover other phases as well; 42 (22%) to 'Operation'; 36 (19%) to 'Design'; 29 (15%) to 'Specification' and 17 (9%) to 'Construction'. In fact in some instances it was possible to attribute a course to more than one of the above phases. For example, LOGIC's Level 3 "Award in the Installation and Maintenance of Solar Thermal Hot Water Systems" has been classified as 'Installation' and 'Commissioning' as the course content covers both of these areas.

The majority of courses (111 or 58%) however were mapped to one deployment phase only. Figure 2 below shows that where courses only related to one phase they were mostly specific to the Installation, Operation or Construction phases.

Many interview respondents highlighted there was a need for training on designing systems across all renewable heat technologies and cited these as being crucial, largely for safety and efficiency reasons. This point was raised by the following interview respondent:

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[22] https://www.gov.uk/government/organisations/uk-commission-for-employment-and-skills/about/our-governance

[23] https://www.gov.uk/government/publications/future-of-apprenticeships-in-england-guidance-for-trailblazers

"The heating system issue is with people not understanding about boiler sizing and integration within the existing heating systems, so the boilers that are installed are then very inefficient, because of how they are plugged in" (respondent 26, business, biomass).

As can be seen in Figure 2 below, only 5% of the training identified in the research was solely focused on design.

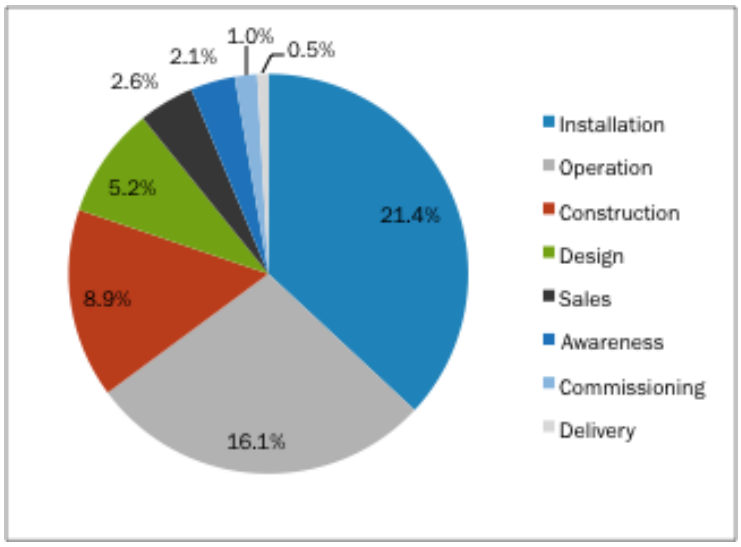

Figure 2 Composition of training courses which are relevant to only one phase, in % of total courses.

Conclusion 5 – The existing training provision for non-domestic renewable heat technologies is unclear, with a confusing number of organisations involved in the development of training materials. There is concern amongst the industry that some of those tasked with designing and delivering the training may lack sufficient renewable heat sector experience. Furthermore, there was strong evidence of demand for training on how to design systems across all renewable heat technologies.

Accessibility of the training provision

Awareness and access to information

The research examined how accessible existing training was i.e. not just geographical location, but also accessibility when measured against the awareness of what was actually available.

The interviews identified a common theme of a lack of knowledge sharing and awareness amongst the industry of the training which was currently available. Indeed, many interview respondents, when asked to give their opinion on training in the renewable heat industry, reported that they were not aware of any non-domestic training for their technology and some of them even stated there was no relevant training at all:

"I'm not actually aware of any training courses. There may be, but I'm not aware of any" (respondent 24, business, biomass).

Whilst this respondent represented the biomass industry, similar testimonies have been collected for the heat pump and biomethane industries.

When questioned on this issue many of the interview respondents stated that they had developed their own training courses in-house and other on-the-job training schemes as a means to address this perceived training gap.

It was suggested by respondents that the onus was therefore on the training providers themselves to market the courses they have, but the research failed to provide any definitive evidence that this supply-led approach provides the industry with what is needed.

When asked about sources of information on training, a number of respondents reported they did not know where to start looking. They advised there were no obvious organisations or websites to go to for sharing knowledge with businesses or individuals interested in undertaking training for non-domestic renewable heat technologies.

"On biomass training, I'm not sure there are any channels, not that I've come across" (respondent 20, professional body, engineering).

Geographical location of renewable heat training

The research identified the availability of the 192 courses geographically.

- 102 courses were identified as being available in various locations throughout England only, of which 71 are only available in specific geographical locations (i.e. in one to three cities, or one or two regions). It was suggested by a working group member that this was due in part to the restrictions within the skills funding system;
- 12 courses were identified as being available only in Scotland. Almost half of those courses (5) are delivered by Construction, Design Management (CDM) Scotland, the Scottish branch of CDM. 5 courses found in the research are available only in Wales;
- 73 training courses were identified as being available to anyone anywhere in the UK. Typically participants would be required to travel to a training centre to undertake courses which respondents advised immediately presents accessibility challenges for some; and
- The geographical location of the training and when it started varied greatly, for example cities such as London, Birmingham and Manchester were common destinations for training.

Frequency of training

The research into training included an examination of their start dates in an attempt to determine how frequently courses were offered throughout the year. This showed that the opportunity to access courses throughout the calendar year varied significantly. Most accredited courses follow the academic year with only one or two opportunities to subscribe during the year. Other courses are purely demand led, for example, ExExperience deliver a one day course on working in an explosive environment which they run every time they have sufficient learners (minimum 8 per course). Overall, the research did not identify any consistency and no discernible pattern.

Cost of training

The cost of undertaking training was also examined to explore what impact this may have on their accessibility. The interviews identified a common issue of affordability of training – from both a financial and a "time out of the business" sense. To illustrate this point a comment made by an interview respondent is of interest. This person highlighted an absence of training for heat pumps in Norfolk, meaning that their engineers had to travel sometimes as far as 200 miles to attend training:

"It's a week out of their [job], because if it's a four day course and they've got to get there the night before they start the course. [It's] pretty much 200 miles, [which] is not a realistic distance" (respondent 25, business, heat pumps).

This is a particular case and cannot from the evidence available be said to apply to the industry as a whole, but it gives an insight into the potential increased cost of undertaking training for companies based in more remote areas of the UK.

Conclusion 6 – It is clear from the research that people did not know where to go to get definitive information about the training provision for renewable heat technologies. The geographical location of the training, how much it cost and frequency of start dates varied greatly and this may impact on the demand for training within the industry.

Demand for training

How big is the non-domestic renewable heat market?

Many respondents stated that the non-domestic renewable heat market was currently perceived to be small and that this was felt by some to be a major reason why the training sector was not responding i.e. the demand was deemed not to exist.

It has not been possible through this research to prove this sentiment or to define the size of the market due to the lack of readily available data or labour market intelligence. For example, whilst RHI uptake evidences clearly that demand for biomass boilers has grown significantly over the last few years the research failed to

identify any publicly available data that illustrates the typical make up of this sector in terms of the total number of employees, the skills levels held by those in the sector or the types of jobs (e.g. designer, installer, maintenance).

In attempt to analyse this issue, researchers examined the current and long established national coding system used for businesses and jobs. The Office for National Statistics use Standard Industry Classification (SIC) and Standard Occupational Classification (SOC) codes[24] to categorise business and job types. All UK businesses are required to categorise themselves using this system when registering with Companies House. This data is then stored on a centrally available database from which a large range of intelligence is drawn by a broad array of stakeholders. This data should be able to provide a sense of the scale of the renewable heating sector.

The SIC and SOC code system however does not yet allow for new technologies to be recognised. For example, if a well-established gas engineer business that already has a SOC code assigned to it is now only trading in renewable heat technologies it will still be classified as a gas engineer business as there is no requirement, or easy way, in which to update the coding.

Market Uncertainty

The final element to this research on training revealed a sentiment held amongst some interview respondents and members of the working group that the fluctuating policy position regarding the RHI scheme may act as a disincentive for the industry to commit to training. A small number of working group members suggested that renewable heat businesses felt uncertainty about the longevity of the scheme. This uncertainty, it was suggested, was one reason why interviewees and working group members found it hard to justify investing time and money in training themselves and their staff thus not generating any demand for it.

Conclusion 7 – The research did not find evidence that training providers are currently developing or delivering sufficient training courses to meet the needs of the non-domestic renewable heating sector. The evidence pointed to a widespread perception that the non-domestic renewable heat market is relatively small, which may explain the underprovision of training. This is exacerbated by a lack of market intelligence showing the true size of the sector, due in part to the current manner in which renewable heating businesses are categorised through the SIC and SOC code system. There is also a sentiment of uncertainty about the longevity of the RHI. It is as yet unclear to what extent these factors may be deterring training providers from developing training tailored to this particular market.

[24] http://www.ons.gov.uk/ons/guide-method/classifications/current-standard-classifications/soc2010/index.html

International case studies

To support the research into standards, an examination of the approaches adopted in Austria, Germany and Italy was carried out to highlight any key learning. These countries were chosen as they had either seen successful deployment in renewable heat technologies, or were flagged by members of the working group. This study identified practices affecting training as well as standards and so both areas are reflected in this chapter.

The success of the international renewable heat programmes discussed in this chapter can be attributed to a number of cross cutting themes that have been identified. The evidence points to:

- effective and timely government intervention to support the renewable heat sector. Sustained subsidy and incentive schemes exist that support the development of key renewable heat technologies. In some cases authority to deliver this support has been devolved to regional authorities;
- clear and well communicated standards which relate to the quality of installs. Both installers and consumers are provided with information concerning their obligations;
- industry-led inspection regimes which are reinforced through punitive and legislative measures for non-compliance; and
- a commitment to training the renewable heat sector exists, in particular in Sweden, where a programme for training drillers for the heat pump sector has been implemented, and in Germany where there is a defined training "routeway" for people who wish to work as independent inspectors in the biomass industry.

This research identified that the UK participates in the European heat pump installer training course EUcert that delivers identical training and examination material (in local language) for all trainees throughout Europe. This scheme has enabled the development of a comparable qualification that is accepted by different participating countries. However, the research did not identify any UK-based training providers who are currently offering the EUcert qualification.

Austria

Biomass

Total heat production from biomass has increased rapidly in the last 10 years in Austria, from less than 4,000 GWh to 10,000 in 2012[25]. The following information about Austria has been collected by a member of the working group in February 2015 – more details can be found in Annex A.

The Biowärme-Installateur[26] programme is a training and certification scheme for domestic and non-domestic biomass heating engineers. This was designed and is now managed by the Austrian Biomass Association with financial support from the state, and covers heating systems of all sizes. This programme includes annual Continuous Professional Development and technical update training sessions with leading industry specialists, as well as information provided electronically to members by Biowärme-Installateur throughout the year.

Before being certified under the scheme heating engineers who enrol in the programme must complete theoretical and practical seminars and complete rigorous written assessments. They must also demonstrate that they meet the required practical skills levels following their participation. The installer must have completed a minimum of 5 installations in the previous three years, and provide written and photographic evidence (in the form of a portfolio) of these installations in order to be accepted on to the scheme. Those holding the status of Biowärme-Installateur must attend refresher sessions at least every 3 years.

Heating engineers who subsequently design and install biomass boilers are required to provide a signed certificate to the local authority which states that they have followed all the applicable standards relating to the system. The heating engineer is then considered legally liable for the quality of the system and adherence to standards, and in the event of having failed to meet these standards, would be pursued by the equivalent of the UK Trading Standards authority.

[25] http://observer.cartajour-online.com/barosig/Fichiers/BAROSIG/Valeurs_indicateurs/ST_Austria-ang.htm

[26] http://www.microsofttranslator.com/bv.aspx?ref=SERP&br=ro&mkt=en-GB&dl=en&lp=DE_EN&a=http%3a%2f%2fwww.biomasseverband.at%2f

Solar Thermal

Austria has become one of the leading solar thermal regions in the world, with solar thermal now a standard solution for the housing sector, as well as recreational and tourism buildings.[27]

The Austrian state of Upper Austria has used a comprehensive plan, called “Carrots, Sticks and Tambourines” to drive the development of its domestic and non-domestic solar thermal market since 1994. The O.O. Energiesparverband, the state agency for energy efficiency and renewable energy in Upper Austria, is in charge of implementing this programme.

The policy has been developed along three axes:

- The “Carrot” is a set of financial incentives to install solar thermal systems, mostly in the form of investment grants;
- The “Stick” aspect is more regulatory. It is formed by a combination of renewable heat use obligations, minimum quality requirements and inspection of the installations. For example, all new or renovated buildings must use a renewable source of heat; and
- The “Tambourine” relates to advice, education and awareness of solar thermal. Each year, O.O. Energiesparverband provides 15,000 face-to-face energy consultations to homeowners and public agencies and businesses. It also runs information campaigns and “solar leagues”, which are competitions between municipalities to determine which has the most solar thermal capacity installed. O.O. Energiesparverband also manages the Energy Academy, which offers more than 30 technical training seminars each year, many of which cover solar thermal[27].

Germany

The production of heat from solid biomass in Germany, for non-domestic purposes, has grown six times through the 2000s, from 3 GWh of heat produced in 2000 to more than 20 in 2013[28]. The following information on the situation in Germany has been collected by a member of the working group in February 2015 – more details can be found in Annex A.

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[27] Egger, C. et al. 2011. Carrot, Sticks and Tambourines: How Upper Austria became the world’s leading solar thermal market. Available at: http://www.oec.at/fileadmin/redakteure/ESV/Info_und_Service/Publikationen/Solar-publ-eu.pdf

[28] Federal Ministry for the Environment, Nature Conservation and Nuclear Energy, 2014. *Time Series for the Development of Renewable Energies in Germany.* Available at http://www.erneuerbare-energien.de/EE/Redaktion/DE/Downloads/zeitreihen-zur-entwicklung-der-erneuerbaren-energien-in-deutschland-1990-2013.pdf?__blob=publicationFile&v=14 (01/04/2015)

Biomass

Examination of the German biomass industry revealed an approach to regulation similar to the Austrian one, whereby installers of domestic installations must provide a signed form on completion of the installation, stating that the system is fully compliant with the applicable standards. The system is then inspected by an official referred to as a "Chimney Sweep" who carries out an independent inspection of the installation and flue before the customer is allowed to operate their boiler. The name "Chimney Sweep" has different connotations in Germany, as it is regarded as a highly technical role in the biomass industry. All Chimney Sweeps:

- complete a programme of college training and apprenticeship lasting 2-3 years;
- then work for a Chimney Sweep company for a period of years;
- with further training, they are then able to set up on their own; and
- are contracted by the local authority to inspect the quality of installations in their region.

The costs for the independent inspection and sign-off are met by the customer.

Within the German state of Bavaria the process for supporting investment in biomass systems is administered by CARMEN[29] (translates as the Central Agricultural Commodity Marketing and Energy Network).

CARMEN forms part of the Bavarian state administration, charged with supporting the growth of the indigenous biomass industry. Their role includes the provision of information, training and technical seminars, and making direct support payments in the form of grant aid to domestic and non-domestic biomass energy projects.

A small technical team with hands-on experience of the biomass sector sit within CARMEN and deliver a range of support to the industry and biomass customers. CARMEN has an objective, neutral position and will verify the fundamentals of each project on behalf of the German government.

Italy

Biomass[30]

Inspection plays an important role in ensuring the correct functioning of all heating appliances. For biomass boilers in particular, combustion tests must be performed every two years for heating plants between 35 and 116 kW. For plants generating

[29] http://www.coach-bioenergy.eu/en/cbe-network/project-partners/carmen-ev.html

[30] *Servizio Impianti Termici* website: http://www.sviprore.it/impiantitermici/

between 116 and 350kW, these controls must be performed every year, and for plants generating more than 350kW, every 6 months. Regular maintenance must be performed every year regardless of the size of the installation.

Any biomass heating systems with a heat generation capacity of 35 kW and above are subject to control by an official body, delegated by the relevant province to perform the checks and log service records. This occurs at least once every two years with costs being met by the person responsible for the system (the system manager). Following the completion of maintenance and combustion tests, the system manager is required to send the corresponding form, completed by the heating engineer, to the local official body in charge of logging the records. System managers can be fined if they fail to meet their obligation to maintain the equipment, or if the combustion checks are not consistent with their installations (e.g. where carbon emissions are higher than is permitted).

Sweden

Heat pumps

The heat pump[31] market in Sweden is well established, with over 1,000,000 installations having been sold before 2013. 96% of these have been installed in single-family homes[32], with approximately 40,000 installed for larger usages. This compares with the UK, where approximately 20,000 units were installed in 2012 across all technologies and sectors, with the majority of those being domestic air-to-water heat pumps[33].

The market has been established through government intervention, dating back to the 1980s and 1990s when research funding on alternative sources was made available. Then, in 1993 in order to encourage the deployment of heat pumps, the Swedish government launched a technology procurement programme. This invited manufacturers to enter a competition with their prototype heat pump models provided these met a set of defined specifications. The successful model was guaranteed sales of 2000 units through a pre-formed 'buyers group'. This programme was combined with financial incentives, information campaigns and followed testing and certification trials showing the benefits of heat pumps. This

[31] This includes all kind of air, ground and water source heat pumps.

[32] Swedish Energy Agency 2015. Värmepumparnas roll på uppvärmningsmarknaden - Utveckling och konkurrens i ett föränderligt energisystem (The role of heat pumps in the heating market - Development and competitiveness in a changing energy) Available at: https://energimyndigheten.a-w2m.se/Home.mvc (17/04/2015)

[33] Frontier Economics. 2012. Pathways to high penetration of heat pumps. Available at: http://www.theccc.org.uk/wp-content/uploads/2013/12/Frontier-Economics-Element-Energy-Pathways-to-high-penetration-of-heat-pumps.pdf (17/04/2015)

combined approach boosted the demand for heat pumps, which doubled between 1995 and 1996.[34]

Feedback provided by a technical expert at Svenskt Geoenergicentrum (the Swedish Centre for Shallow Geothermal Energy) provided a useful insight into the Swedish experience. This highlighted that the majority of installers and designers of larger renewable heating systems are believed to be either senior researchers who were previously involved in the development of the technology in the 1980's and 1990's, or consultants who have completed relevant training that is available nationally. Courses relevant to renewable heat technologies, in particular the design and installation of GSHPs, have been offered since the 1980s[35]. It is generally believed that most installers and drillers have received specific in-house training from their companies, and/or from heat pump manufacturers.

Additionally, the Swedish Heat Pumps Association (SVEP) run an accreditation scheme that is intended to ensure that all installers are able to demonstrate required competence levels. In order to be certified, installers must pass the European heat pump installer training course EUcert[36]. This course delivers identical training and examination material for all trainees throughout Europe and has enabled the development of a comparable qualification that is accepted by different participating countries. The UK participates in this programme, but the research did not identify any training providers who are offering the EUcert qualification. This qualification has been developed with domestic installers in mind but may still be relevant to non-domestic, bigger installations.

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[34] Kiss, B., Neij, L. & M. Jakob (2012). *Heat Pumps: A Comparative Assessment of Innovation and Diffusion Policies in Sweden and Switzerland. Historical Case Studies of Energy Technology Innovation* in: Chapter 24, The Global Energy Assessment. Grubler A., Aguayo, F., Gallagher, K.S., Hekkert, M., Jiang, K., Mytelka, L., Neij, L., Nemet, G. & C. Wilson. Cambridge University Press: Cambridge, UK.

[35] For example, Luleå University has offered an engineering course in renewable energy, which includes the design of GSHP systems, every year since the end of 1980's. Swedvac, the Swedish equivalent to CIBSE, began offering a course in the design of large GSHP systems from 2000 to 2013 – this has now been taken over by Svenskt Geoenergicentrum. Since 2014, a course for designers and installers, with a focus on the HVAC side of GSHP systems, has also been given by STF.

[36] Nordman, R. 2009. Heat pumps for heating and cooling in Sweden – market experiences and lessons learned. Available at: http://www.proheatpump.eu/Events/Varna_Conference/HP%20Sweden%20Nordman.pdf (23/03/2015)

Summary of conclusions and some potential options for intervention

This research was conducted to enhance DECC's understanding of the current standards and training landscape so far as this relates to renewable heat. Using the evidence obtained this chapter explores a number of potential options that could potentially improve or enhance the existing landscape.

The options presented are informed by the evidence gathered through the project and are not intended to be exhaustive or absolute. They do however provide for the first time an evidence base which can be considered by government and industry alike when determining any appropriate next steps in this area.

Seven conclusions have been identified through this research discussion as set out in the previous chapters. These are not mutually exclusive. The options are high-level and would need to be considered further in terms of their suitability to the different technologies and levels of expected deployment i.e. a variation to the approach suggested may be appropriate for small but high volume projects (i.e. biomass, heat pumps, solar thermal) and for larger but lower volume projects (i.e. geothermal, biomethane injection).

Table 6 at the end of this chapter identifies the research conclusions (column 2) and sets out a series of high-level options for taking those forward (column 3). During the analysis phase of the research it became apparent that there were three key categories into which the majority of findings and conclusions could be allocated. The right hand column (column 4) shows this categorisation. These are also illustrated in Table 5 below. Grouping each of the potential options in to one of these categories may provide some further insight in to how to approach any implementation of future actions.

Table 5: Key categories for categorising findings

Leadership	Regulation	Accessibility
Suitable and strong leadership across government and industry may drive change	Better regulation may drive up the quality of standards and training and stimulate demand	Improving accessibility of training and clarifying standards may drive change

The first column (on the left hand side) in Table 6 provides a means of identifying the conclusions against one of the three key research aims:

- Training;
- Standards; and
- Knowledge Sharing.

In some instances the conclusion relates to more than one of these aims.

In addition to the options shown, a number of cross cutting themes were identified from the international research, detailed in the previous chapter. These could be considered alongside the options presented in Table 6:

- The evidence pointed to effective and timely government intervention to support the renewable heat sector. Sustained subsidy and incentive schemes existed that supported the development of key renewable heat technologies. In some cases, authority to deliver this support had been devolved to regional authorities;
- The Austrian, German and Italian examples all evidenced clear and well communicated standards which related to the quality of installs. Both installers and consumers were provided with information concerning their obligations;
- There is evidence of industry-led inspection regimes which were reinforced through punitive and legislative measures for non-compliance; and
- A commitment to training the renewable heat sector was found to exist, in particular in Sweden where a programme for training drillers for the heat pump sector has been implemented, and in Germany where there is a defined training “routeway” for people who wish to work as independent inspectors in the biomass industry.

Table 6: Summary of Conclusions and Potential Options

Area of Research	Conclusions from this research	Potential Options	Theme
Standards and Training	The research identified examples of government-led building regulations, guides and competent person schemes which are designed to ensure the quality and safety of heating installations. Regulations and legislation can provide a clear framework for compliance but there are currently no health and safety or building regulations specifically for renewable heat technologies.	Different ideas were shared about how to regulate the industry, but a majority of interview respondents suggested that making RHI payments conditional upon certain standards for design and installation being met could help solve some of the issues identified. Interviewees argued that such an approach would incentivise commercial installers and designers to seek relevant training. Consideration could therefore be given to identifying ways in which a minimum quality for the installation of each type of non-domestic renewable heat technology could be developed by extending existing standards or placing these on a firmer footing. This could be measured and enforced through standards for example, which may in turn aid the development of the training provision.	**Regulation**

Standards and Knowledge Sharing	The current standards market is complex and confusing for the sector as whole. A large number of standards exist but only a small number have been produced specifically relating to renewable heat technologies. Ofgem have published the list of standards deemed by DECC to be critical to the RHI however these do not cover all aspects of the project cycle.	Consider identifying ways in which to develop new or existing standards that are deemed critical to each renewable heat technology and each stage of the project cycle, so that these are appropriate, clear and more easily accessible. Identifying a straightforward way to promote the standards developed by a variety of organisations in the renewable heat sector. For example this could be achieved through a dedicated website accessible to anyone. This could act as a source for collating current information about the different technologies and their benefits, the RHI and how to apply for it, as well as current standards in the sector.	**Regulation**
Standards and Knowledge Sharing	The qualitative research identified that guidance documents are seen as a popular and useful resource amongst stakeholders. However, the current availability of guidance documents is inconsistent with some RHI eligible technologies having had more available guidance documents than others. Additionally, some of the guidance documents that have been produced appear to require updating. The best examples of guidance have been produced through collaboration.	Explore how the non-domestic renewable heat sector can come together to work more collaboratively so as to share knowledge; develop new and maintain existing guidance that references relevant standards; and improve access to guidance work. Building on Option 2, a dedicated marketing team could be in charge of maintaining the website and developing marketing campaigns to raise awareness of: 1) Renewable heat technologies for the general public, as well as public agencies; and 2) Current guidance and standards for the non-domestic renewable heat industry.	**Leadership**

Training and Knowledge Sharing	The research did not find evidence that training providers are currently developing or delivering sufficient training courses to meet the needs of the non-domestic renewable heating sector. The evidence pointed to a widespread perception that the non-domestic renewable heat market is relatively small, which may explain the underprovision of training. This is exacerbated by a lack of market intelligence showing the true size of the sector, due in part to the current manner in which renewable heating businesses are categorised through the SIC and SOC code system. There is also a sentiment of uncertainty about the longevity of the RHI. It is as yet unclear to what extent these factors may be deterring training providers from developing training tailored to this particular market.	Explore ways in which improved market intelligence regarding the non-domestic renewable heating sector, the RHI and eligible technologies can be developed, shared and maintained so as to provide a clearer picture definition of the renewable heat market. This clarity may stimulate further demand for renewable heat technologies, and in turn training. The options detailed in Options 2, 3 and 7 in this table could provide support in forming a clearer definition of the non-domestic renewable heat market which may stimulate further demand for renewable heat technologies. This in turn may give the training sector more confidence in the longevity and sustainability of the renewable heat sector and could result in more appropriate courses being developed.	**Leadership**
Standards	Standards are costly to produce and this is reflected in the price at which they are offered to industry. The price may be discouraging organisations from accessing standards.	Explore ways to improve knowledge sharing and reduce the cost to industry of developing standards and guidance documents, or the cost of accessing these, to encourage experts in the industry to adopt these.	**Accessibility**

Training	The existing training provision for non-domestic renewable heat technologies is complex with a confusing number of organisations involved in the development of training materials. There is concern amongst the industry that some of those tasked with designing and delivering the training may lack sufficient renewable heat sector experience. Furthermore, there was strong evidence of demand for training on the process of designing systems across all renewable heat technologies	Consider ways in which to simplify and or better co-ordinate the manner in which existing and new training materials for each type of renewable heat technology are maintained and developed, and ensure expert industry involvement in the process (e.g. integrating renewable heat and design training in to existing curricula (e.g. for plumbing and heating engineers), and/or increasing the amount of practical "hands on" experience as part of someone's training portfolio)	**Accessibility**
Training and Knowledge Sharing	It is clear from the research that people did not know where to go to find definitive information about the training provision for renewable heat technologies. The geographical location of the training, how much it cost and frequency of start dates varied greatly and this may impact on the demand for training within the industry.	Consider ways in which clearer information about renewable heat training for each type of renewable heating technology might be disseminated and accessed. The development of a new website and dedicated marketing team, as suggested in Options 2 and 3 in this table, could also provide suitable options for addressing this particular issue	**Accessibility**

Annex A – Methodology

Research design

To answer the research objectives described above, DECC proposed the following approach consisting of 3 different but complementary activities. This approach was designed to gather as much data as possible whilst ensuring a breath of research and avoid a situation where the findings might be based on too small a sample:

Table 7: Research activities and associated objectives

Activity	Objectives	Summary
Desk-based research	1. Find which standards currently exist for renewable heat, including standards associated with the correct installation of renewable heating technologies. 2. Find which training currently exists for renewable heat, including training for the Renewable Heat Incentive (RHI) application process and heat metering.	Online research collating information about standards and training which relate to renewable heat and the RHI. Additional searches examining the approach in other countries were also conducted.
Semi-structured Interviews	3. Find the gaps in overall provision or content of renewable heat training and standards. 4. Identify options for potential intervention to improve or enhance the existing situation relating to training and standards. 5. Investigate the types of activities that could be undertaken to facilitate the sharing of knowledge and information relating to renewable heat.	Interviews conducted with 31 stakeholders to explore their experiences relating to the current standards and training landscape. Those interviewed represented all of the technologies supported by the non-domestic RHI.
Working groups	1 to 5 described above	Two workshops with experts from the renewable heat industry and relevant skills

	and training organisations to provide input and feedback on the research and findings and suggest options going forward
International case studies	Undertaken to complement the options presented in the final section of the main report.

The methodologies used for each activity are described below.

Desk based research

A desk-based research was conducted to investigate the quality, accessibility and nature of standards and training relevant to non-domestic renewable heat technologies eligible for the RHI, associated areas such as heat metering, and the RHI application process. Additionally, the research explored international examples of good practice in standards and training.

The results from this research are presented in Annex B and C.

Standards

The research into standards followed a top down approach of examining publicly available sources. This research identified a large proliferation of relevant standards running into the thousands, the volume of which prevented a full interrogation of each of these. This research focused on formal standards published by the British Standards Institute, the International Organisation for Standardisation or European Standards.

Further research identified some ambiguity about the meaning of the word "standard". The British Standards Institute defines a standard very widely, as "an agreed way of doing something"[37]. In order to better understand what could and could not be considered as a standard for the purpose of this research, whilst guaranteeing a breadth of coverage, advice was received from the first working group (a group composed of sector experts – more information next page). The group agreed there was a critical path) that linked legislation to the development of standards (see below). The research used this pathway to identify and define the standards relevant to renewable heat technologies and associated areas such as heat metering.

[37] http://www.bsigroup.com/en-GB/standards/Information-about-standards/what-is-a-standard/

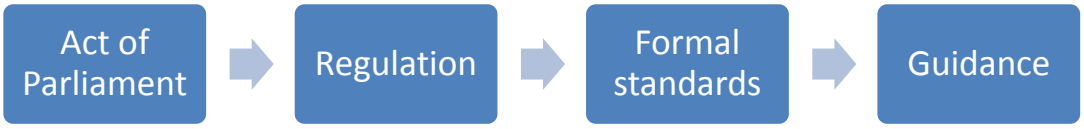

Figure 3 Critical path for the creation of standards

This focussed the research on organisations that had produced guidance documents that could be attributed in some way to renewable heat technologies. The working group members provided some guidance documents to the supplier, which complemented the sample of other guidance documents found through independent web searches. The web searches focused on guidance documents only, and not formal standards, and yielded a manageable amount of information.

The data are available in the spreadsheet presented in Annex B.

Training

The research into training followed a top down approach of examining publicly available sources, starting with a thorough examination of the Ofqual register - the national register of all regulated qualifications. Further searches were conducted of websites of accreditation bodies. The keywords “heat”, “wood”, “solar”, “hot water”, “drilling”, “plumbing” and “thermal” were used to search for qualifications in the Ofqual register, which yielded 43 relevant regulated qualifications. The websites of the bodies accrediting these qualifications were searched in order to obtain an indication of the number of training providers offering those qualifications, as well as their geographical location.

The project sought to identify how wide spread the coverage of heat related training was across Great Britain and each course was categorised geographically.

In order to find non-accredited training (i.e. non-regulated), searches were conducted using web search engines such as Google and Bing, as well as the websites of relevant professional bodies and trade associations.

The data are available in the spreadsheet presented in Annex BC.

Interviews

Qualitative data on the availability, quality and accessibility of renewable heat training and standards was collected via 30 semi-structured telephone interviews and 1 face-to-face interview with stakeholders of the renewable heat sector including training providers, professional bodies and renewable heat design and installation type businesses.

The interview sample was drawn up using multiple sources:

- A director from the Renewable Energy Association gave access to 10 business leaders;

- The contractor provided access to 5 of its members – 3 businesses and 2 training providers;
- DECC suggested 15 potential respondents, from various sources, of which 8 accepted to be interviewed;
- 5 experts from the working group accepted to be interviewed, they provided access to 2 additional interviewees; and
- 1 respondent was found through cold calling heat-metering companies.

This ensured that the working group included all of the renewable heat technologies eligible for the RHI as well as associated areas such as heat metering. The respondents were also selected to ensure that various sizes of businesses were included, i.e. micro (less than 10 employees), small (10-50), medium (50-250) and large (250+).

A balance of two thirds businesses for one third training providers and professional bodies or trade associations was achieved. 5 training providers were interviewed and 5 professional bodies or trade association with the term "professional body" used in the table below to identify these three sectors for the sake of simplicity.

None of the solar thermal companies who were contacted responded to the request to participate in the interviews. To mitigate this, a time-served solar thermal installer known to Employer First was invited to the working group to represent the views of his industry. He was subsequently interviewed, but the outcome could not be included in the interview analysis because the interview took place after the analysis was completed. The themes from his interview were however compared with those that came out of the analysis phase and common themes were noted.

Table 8: Respondent ID number, associated with the respondent's type and industry.

Respondent	Type	Industry
1	Business	Heat pumps
2	Business	Biomass
3	Business	Anaerobic digestion, biogas & biomethane, CHP
4	Business	Heat pumps
5	Business	Heat metering
6	Training provider	Heat metering
7	Business	Biomass

8	Professional body	Housing
9	Business	Biomass
10	Business	Heat pumps
11	Training provider	Anaerobic digestion, biogas & biomethane
12	Professional body	Heat pumps
13	Business	Biomass
14	Business	Sector stakeholder
15	Business	Biomass
16	Business	Biomass
17	Business	Sector stakeholder
18	Training provider	Sector stakeholder
19	Professional body	Heating engineering
20	Professional body	Heating engineering
21	Training provider	Sector stakeholder
22	Business	Biomass
23	Training provider	Sector stakeholder
24	Business	Biomass
25	Business	Heat pumps
26	Business	Biomass
27	Business	Heat pumps
28	Professional body	Building engineering
29	Business	Building engineering
30	Business	Anaerobic digestion, biogas & biomethane
31	Business	Heat pumps

Working groups

A working group was organised in order to discuss the methods used to conduct the research and the findings from the activities set out in Table 7, as well as to feed into the report's options section. Two meetings were convened with the first meeting taking place on the 11 February and the second on the 11 March 2015.

The working group was composed of 11 members from the non-domestic renewable heat sector, relevant professional bodies and trade associations as well as representatives from skills and training bodies.

The first step involved making contact with all relevant trade associations, in order to seek high-level representation of each of the technologies. The Renewable Energy Association, being inclusive of all renewable heat technologies eligible to the RHI, was able to put forward different experts in the technologies for which no trade association accepted to participate.

Members were selected to represent all RHI eligible technologies and their uses in a non-domestic environment. Organisations and individuals invited to attend the working group were chosen to ensure representation was available from all sizes of business.

Table 9: The composition of the Working Groups.

Company	Representing
Wood Heat Association	Biomass small, medium and large
Ground Source Heat Pump Association	Ground Source Heat Pumps
Heat Pump Association	Heat Pumps
Renewable Energy Association	All renewable heat Technologies including Biogas, CHP
Wolseley	Large heating and plumbing manufacturer
IDHEE	Heating and Environmental Engineers
CNG Services Limited	Bio-Methane Injection
CIBSE	Professional Body
Association of Colleges	Further Education and Apprenticeships
Summit Skills	Sector Skills Council

Energy Institute	Professional Body
Sasie Limited	Solar Thermal
DECC*	Government
Employer First	Renewable Energy employers and training providers

*DECC were present to confirm requirements of project and to support and challenge understanding of the objectives of the research.

International Good Practice

In addition to the research and consultative exercises detailed in the above sections, a further piece of international research was undertaken to make full use of international data which emerged through the research. Working group members and interviewees also contributed case studies of international good practice. These references were explored further and the main findings from which are included in this report.

Information on Austria and Germany was gathered during two separate visits by one of the project team to Wels in Austria and Bavaria in Germany as an adjunct to business trips.

Information on the Bavarian experience was obtained from a visit by a representative of the Wood Heat Association who accompanied Christian Letalik, Project Manager with C.A.R.M.E.N. e.V., on two verification visits to grant-funded biomass installations in the Regensburg area of Bavaria on 6 February 2015. Information was gathered from Christian throughout the day, and subsequently verified through email exchanges.

Further information on the Austrian and German experiences was obtained through a one hour semi-structured interview with Christian Malecz, Export Technical Sales Manager with ETA Heiztechnik in Austria. The interview was undertaken while one of the project team was attending the World Pellet Conference in Wels, Austria, on 26 February 2015. The project team member has an established business relationship with ETA, who as a leading manufacturer of wood-fired boilers, supplying to global markets, are highly knowledgeable about the standards and quality schemes applied in the countries into which their products are sold.

Information on the heat pump market in Sweden was gathered through web searches, using Geotrainet[38] and ProHeatPump[39], two European projects

[38] http://www.geotrainet.eu/

[39] http://www.proheatpump.eu/

respectively for the dissemination of best practice in the design of heat pump systems and the promotion of information about GSHP.

How data were analysed and synthesised

Analysis of interview data

The interview data were analysed using a *"pragmatic iterative approach"* (Tracy 2013)[40] methodology, which alternates between emergent readings of the data through coding and reflection upon interests and priorities of the research. The data was analysed using RQDA[41], qualitative data analysis software, along the three research axes corresponding to the research questions detailed in the main body of the report.

This approach was used so as to ensure that the study's findings from interviews are robust and focused around the research questions. Interview quotations are included in the report to support findings where appropriate. Pauses and hesitations in speech have been deleted to ensure ease of reading. Additions to the verbatim quotes have been inserted in square brackets to aid the reader's understanding only.

Evidence synthesis across all strands

The evidence gathered from the interviews and desk-based research was subsequently synthesised from three different perspectives linked to DECC's research objectives shown in Table 1.

What is the nature of the standards and training that are available? This looked at:

- who in the supply chain the standards and training landscape was aimed at (eg designer, installer or operator);
- which renewable heat technology they covered; and
- whether the standards and training courses were refreshed or renewed.

How accessible are the standards and training that are available? This looked at:

- The cost of standards and training courses (where data was available);
- Who had developed the standards and training courses, and who had accredited them; and
- Which organisations provided the standards and training courses and their geographical location.

What is the demand for standards and training? This explored:

- What the uptake was for standards and training courses; and

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[40] Tracy, S. J. 2013. *Qualitative research methods: Collecting evidence, crafting analysis, communicating impact*. (John Wiley & Sons), Blackwell Publishing.

[41] More information on RQDA at http://rqda.r-forge.r-project.org/

- Industry perceptions of the currently available standards and training landscape.

Quality Assurance

The findings produced through this research were all subjected to internal review and quality assurance by the supplier and consortium members. All the main partners involved in delivering the project were selected to ensure they were able to represent industry overall rather than any single or small group of businesses.

In terms of mitigating bias within the research itself, several key controls were deployed in line with the key tasks: secondary research was taken from official, verifiable sources and evidence, with full citations and standard referencing; the data from the mapping and research stages was checked by a senior executive from Employer First to ensure they did not overly represent any one single industry or that it was not manipulated to favour one or more industry; businesses involved in interviews and the working group were deliberately sampled to represent a cross section of the renewable heat industry. Qualitative interviews were guided by an agreed topic guide and seven of these were observed, with the consent of the interviewee, by a member of the project team who was not conducting the research in order to monitor quality.

Furthermore, the working group provided a peer review function to ensure the integrity and trustworthiness of the report and its recommendations

Limitations of the research

The research was designed and implemented to ensure the best data collection, analysis and interpretation possible within the project scope.

The following limitations exist as a result of the methodology:

The desk-based research relied on interrogating websites containing publicly available data. Should there be any errors in that data these will also be reflected in the research outcomes.

The interview sample is small (31) meaning that the findings cannot be regarded as representing the views of the whole sector. They do however provide a flavour or indication of a range of views on these topics.

It was not always possible to find information on course uptake and how the training has been kept up to date. To mitigate this, information on how often a course is offered, as well as its next starting date, has been included where this data was available.

Annex B – Standards spreadsheet

Please refer to the excel document entitled “Annex B – Standards”.

Annex C – Training spreadsheet

Please refer to the excel document entitled “Annex C – Training”

Annex D – Deployment phases

The research examined the nature and content of the mapped standards and training. In order to determine their relevance to the RHI and renewable heat these were categorised against a list of deployment phases common to almost all of the technologies supported by the RHI:

1) **Specification** – whether courses provided training in how to correctly define the renewable heating need;
2) **Design** – whether courses provided training in how to correctly interpret the specification;
3) **Construction** – whether courses provided training on general building regulations applicable to the installation of renewable heat technologies;
4) **Installation** – whether the courses provided training in how to correctly install the renewable heating plant;
5) **Commissioning** – whether the courses provided training in how to correctly determine that the renewable heating plant was ready to be turned on; and
6) **Operation** – whether the courses provided training in how to correctly use the renewable heating plant.

The research into training identified other related phases that are important but may not relate to all projects:

Awareness can be considered as a project phase that happens before the specification phase, when the developer, contractor or business gather information about different types of renewable heat technologies and their application before moving towards the specification phase of a renewable heat project.

Sales relate mainly to training aimed at helping installers of renewable heat technologies to sell them effectively to the consumer.

Additionally, the research into training found one particular course for lorry drivers who deliver bulk materials. This has been associated to another additional phase, **Delivery**, which relates directly to the correct delivery of bulk material, such as fuel for biomass, biogas and bio-methane installations.

Figure 4 shows a typical renewable heat delivery map which identifies projects phases and which types of people are involved in projects. For a large construction project (e.g. a new hospital), it is most likely that each of the roles is carried out by a different person.

For a small commercial project (e.g. biomass boiler retrofit to a school) the biomass heating designer and Mechanical and Electrical Engineer may be the same person.

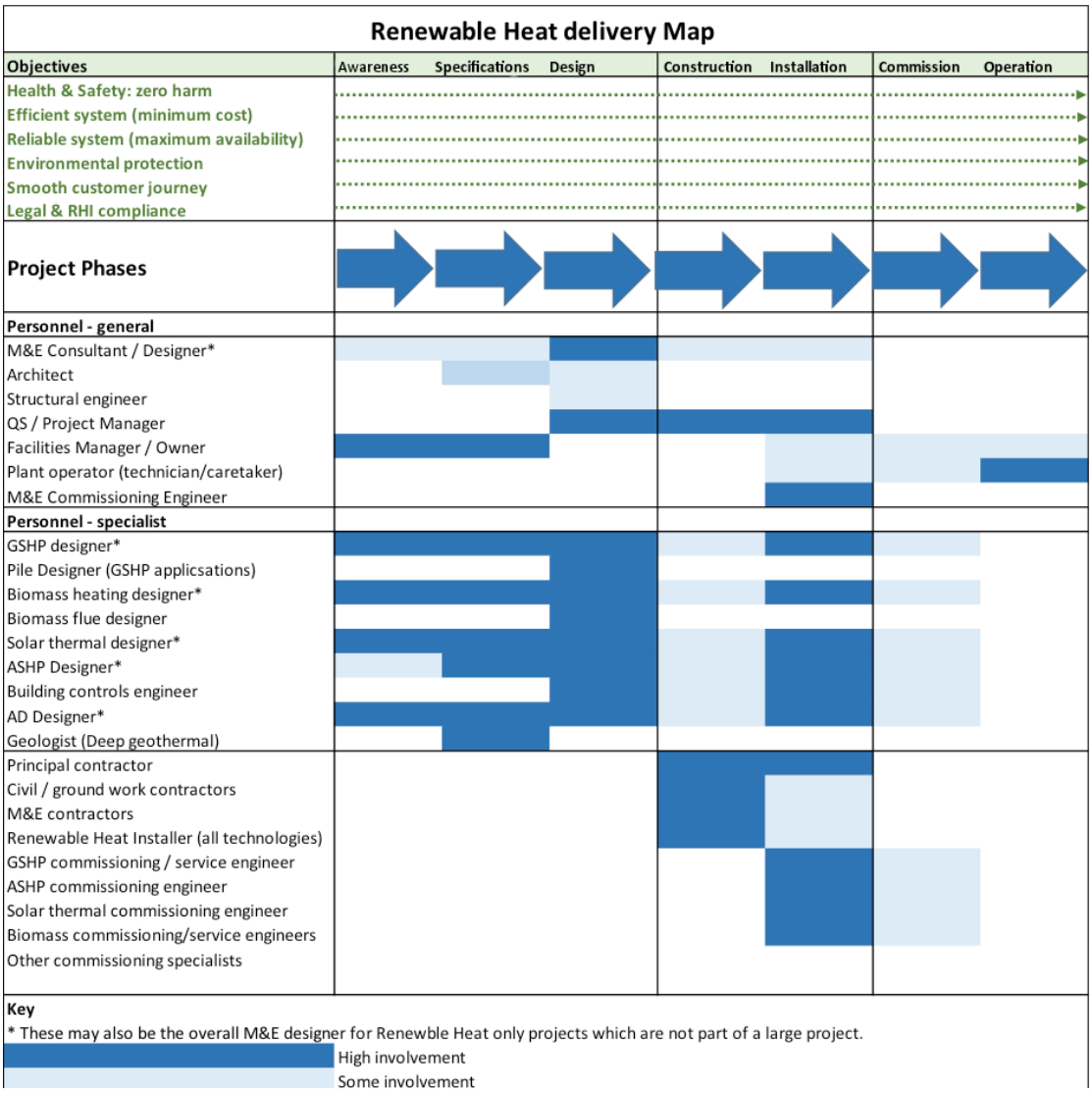

Figure 4: The renewable heat delivery map - typical project phases of a commercial renewable heat project.

Annex E - Terminology

- **Respondents** are individuals who took part in the interviews conducted as part of this research.
- **Kilowatt (kW)** is a measure of electrical power, representing a thousand Watt. Kilowatts are commonly used to represent the output power of engines, machines or heaters. In the UK, an average household uses 0.53 kW of energy per year, 50% of this for space heating[42].
- **Renewable Heat Incentive (RHI)** is the government's principal scheme providing financial support to incentivise the roll out of renewable heating technologies in order to contribute to the UK's 2020 renewable energy target. There are two schemes: the non-domestic RHI was launched in November 2011 followed by the Domestic RHI in April 2014.
- **RHI eligible technologies** are the technologies currently eligible for support under the non-domestic Renewable Heat Incentive:

Solid biomass boilers	Burn wood biomass to heat hot water, which is then used to heat building and provide hot water, or in some cases to provide steam for manufacturing.
Heat pumps	Extract heat from three sources: **Ground source heat pumps** extract heat from pipes buried in the ground; **Water source heat pumps** extract heat from pipes laid underwater; **Air source heat pumps** extract heat from the air. The heat is then absorbed by a fluid, which then releases it to heat water. The pumps are driven by electricity.
Solar thermal installations	Use tubes or collectors to capture heat from the sun to heat water, which is then used for space heating or providing hot water.
Biogas installations	Use anaerobic digestion (i.e. a set of processes by which micro-organism break down biodegradable material) to produce gas,

[42] Nakagami, H., Murakoshi, C., & Iwafune, Y. 2008. *International comparison of household energy consumption and its indicator.* Proceedings of the 2008 ACEEE Summer Study on Energy Efficiency in Buildings, 8, 214-224.

	which is the used to fuel a gas engine. This produces heat, which is used for space heating, hot water or industrial processes.
Biomethane injection	The gas resulting from anaerobic digestion can also be treated further to comply with the gas regulations and be injected in the grid
Deep geothermal installations	Extract heat at depth where temperatures are hotter than the surface, at least 500m beneath the surface of solid earth. This can then be used for space heating or the provision of hot water
Combined heat and power	Also called cogeneration, refers to the use of a heat engine to simultaneously provide heat and electricity. The technology used is either geothermal, biogas or biomass

- The **renewable heat sector** refers to installers, designers, manufacturers, contractors, training providers and customers of:
  - Any of the technologies described above;
  - Associated areas directly relevant to the successful installation of those technologies, i.e. heat metering, pipe insulation, plumbing, planning and construction, etc.;
- **Renewable Heat Technologies (RHT)** refers to all types of this technology, including those not currently supported by the RHI; and
- **Working group** refers to experts from the renewable heat industry and relevant skills and training organisations who came together to provide input and feedback on the research and findings and suggest options going forward (the list of members is available at Annex A).

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