Heating and Hot Water Pathways to 2020

Report by the Heating and Hot Water Taskforce

Full report and evidence base

31st March 2010

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Contents

Report written by the Heating and Hot Water Taskforce
Taskforce facilitated by the Energy Efficiency Partnership for Homes
Documented and edited by Purple Market Research Ltd

1. Executive summary

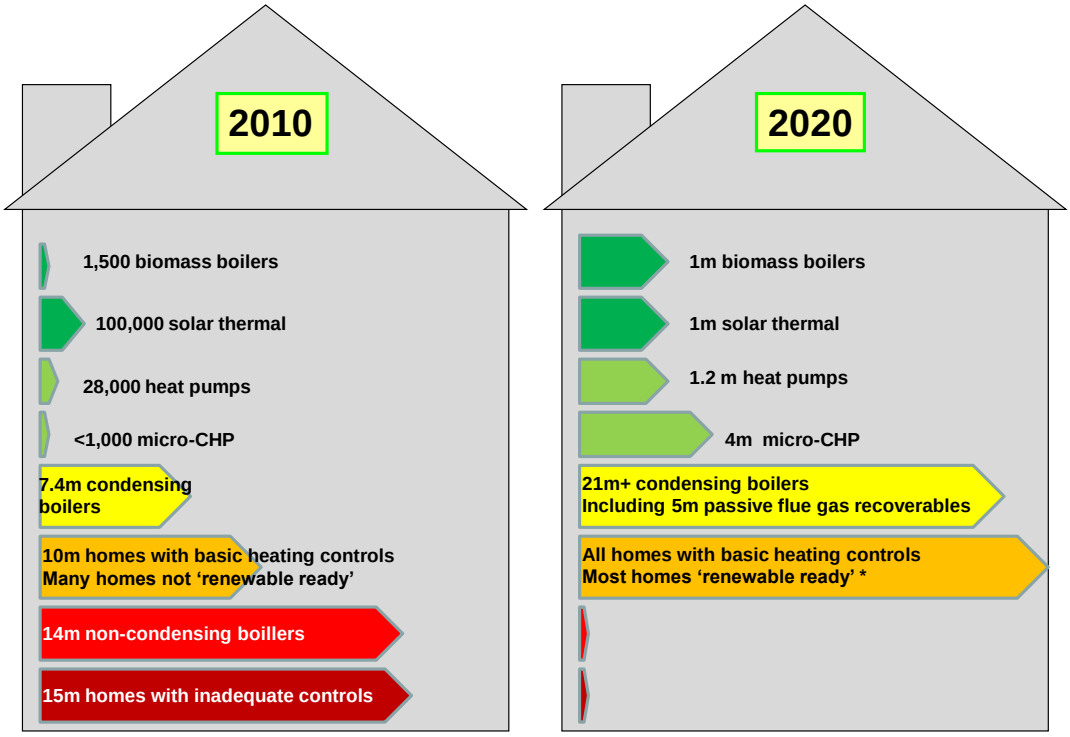
1.1. Pathways to 2020 – our vision

Government targets for the reduction of greenhouse gas emissions cannot be met without an improvement of the energy efficiency of the UK housing stock, which accounts for around 27% of all UK emissions. In turn, heating and hot water account for an estimated 84% of domestic energy consumption and 71% of CO2 emissions. It is clear, therefore, that the domestic heating and hot water sector has a significant and critical role to play.

It is one of the strengths of the heating and hot water industry that there are a number of different solutions available to enhance the energy efficiency of domestic heating systems, and the future heating sector is likely to comprise a range of solutions including both traditional boiler-based systems and newer microgeneration technologies such as solar thermal, heat pumps, micro-CHP and solid fuel heating systems. In addition installation and correct use of heat and hot water *controls* represents an opportunity to increase the energy efficiency of all heating systems.

Although the sector has driven some major successes (almost all new or replacement boilers are energy efficient condensing ones), the heating and hot water industry has the potential to make an even greater contribution towards meeting Government targets. However the fact is that in 2010 the majority of UK homes do not have adequate energy efficient heating technologies installed. The heating and hot water industry has a vision of how the sector can address that situation and thereby make a major contribution towards Government targets, initially focusing on 2020. That vision offers a 2020 landscape that is very different where we are today, with the great majority of UK households having energy efficient heating technologies in place.

The domestic heating and hot water sector – 2020 vision



* With space for hot water storage

In greater detail we envisage the following landscape by 2020.

Technology	By 2020
Condensing boilers	All non-condensing boilers will have been replaced by energy efficient ones 5m high water-efficiency technologies (passive flue gas recoverable units) will have been installed
Hot water storage	Building regulations (from 2013 onwards) will mandate that all new and replacement hot water systems will be 'renewable ready' (i.e. will have space and capacity available for the installation and integration of renewable technologies)
Controls	Building regulations (again from 2013 onwards) will mandate that homes should use the best available controls technology, with an interim aim that all UK homes should have the minimum controls standards as specified in the Building Regulations from 2010 mandate Integrated controls with smart meters will be available
Solar thermal	1m installations will have been completed in total and the annual installation rate will be 175,000
Heat pumps	1.2m installations will have been completed in total and the annual installation rate will be 200,000
Micro-CHP	4m installations will have been completed in total and the annual installation rate will be 500,000
Solid fuel	1m biomass boiler installations will have been completed in total and the annual installation rate will have reached 150,000 Also 150,000+ stoves will be installed per year (more if RHI covers wood-burning stoves in addition to biomass boilers)

Many of the above energy efficient technologies are competing for the same business and therefore represent alternative solutions. However some technologies have the potential to work in tandem, for example combining traditional boiler-based systems with newer renewable technologies.

Some of these heating products, notably controls and hot water storage, straddle the systems discussed above and are both crucial to maximising the energy saving and efficient operation of heating systems.

Our vision, as outlined above, is realistic and achievable but a number of barriers need to be overcome before it can be realised. Barriers include the prohibitive cost of installing heating technologies, installer capacity (a shortage of trained installers or microgeneration technologies), a lack of consumer awareness of the range of solutions available and their benefits, a shortage of financial incentives, shortcomings of SAP and nationally accepted dwelling performance measures and inadequate installation and use of heating controls.

In order to meet Government targets a 'business as usual' approach will *not* be sufficient, and an acceleration of activities is required both in the installation of energy efficient condensing boilers and effective controls, and also in the installation of microgeneration technologies.

For our vision to be realised a number of actions need to be taken with considerable urgency.

Actions required to achieve the 2020 vision

Action	In detail
Installer capacity	A five year plan to be developed from 2010 to ensure that the market has the capacity to delivery both sufficient numbers of new and replacement installers and the skills required to install and offer consumer advice on energy efficient technologies
Building Regulations	2013 Building Regulations should mandate • Best practice controls required in homes • Minimum water-efficiency for boilers • That heating systems should be 'renewable ready'
Energy supplier obligation	Supplier obligations should incorporate targets for heating systems in existing homes, notably for condensing boilers and controls
SAP	A review of SAP should ensure that there are policy specific calculation methodologies that provide appropriate credit to heating and hot water control and communication technologies
EPCs	Robust EPC standards for technical building systems (EPBD) should drive the most efficient heating systems
Consumer messages	Industry should have full engagement in the development of strategic consumer messages relating to increasing awareness and the promotion of energy efficient heating technologies
RHI	The potential market for renewable heating technologies is predicated on the introduction of the RHI and a payback period of five years or less and so it is essential that commitment to this initiative remains firm
Electricity network	A network risk review is required up to 2020 to ensure that the network can accommodate the number of installations, particularly heat pumps, estimated in our vision

In order for the contribution of the heating industry to meeting Government targets not to be jeopardised, all of these activities need to be underway in the next 2-3 years and planning needs to begin *immediately*.

The heating and hot water industry welcomes the opportunity to work with Government to ensure that our vision is realised, but is concerned about Government's apparent lack of commitment to efficiency gains in heating and hot water, where policy focus is directed largely at improved insulation and the installation of renewables.

We therefore look forward to Government's response to our proposals and to increased collaboration to ensure that heating and hot water makes an appropriate contribution to meeting Government targets.

1.2. Current installed base of technologies and practical potential towards 2020

The domestic heating market is currently dominated by traditional boiler-based systems, with renewable technologies estimated to account for under 1% of the installed base.

Almost all new and replacement boilers are condensing ones, representing around 1.5m installations per year. In comparison all renewable technologies are estimated to account for less than 100,000 installations per annum at present.

Looking towards 2020 the Heating and Hot Water Taskforce has estimated the practical potential for each technology, as summarised in the following table.

Technology	Estimate of current installed based	Current installation rates per annum	Estimate of practical potential by 2020
Condensing boilers	7.4m gas condensing boilers out of 21.6m gas boilers 100,000 condensing oil boilers out of 1.4m oil boilers	1.5m	21m condensing boilers installed out of 25m boilers 1.5m per annum installed
Solar thermal	100,000	25,000	1m installed in total 175,000 per annum installed
Heat pumps	28,000 (approx. 50% ground source)	13,000 (mainly air source)	1.2m installed in total 200,000 installed per annum
Micro-CHP	<1,000	<500	4m installed in total 500,000 installed per annum
Biomass boilers	1,500	4,000	1m installed in total 150,000 per annum

Other products, such passive flue gas recoverable units are in the early stage of development and account for few installations at present. In the right circumstances this technology has the potential to take significant market share, perhaps as much as 1m installations per year.

Other key heating technologies straddle the systems discussed above, notably heating and hot water controls and hot water storage. These are both crucial to maximising the energy saving and efficient operation of heating systems.

It is estimated that between 16m and 19m UK homes have some form of hot water storage. Hot water storage is required by many renewable heating technologies, and so it is of some concern that many installations of 'combi' boilers do not include a hot water storage cylinder, and also much house building and repair, maintenance and improvement (RMI) activity does not allow the space for hot water storage.

Heating and hot water controls also have a crucial role in maximising the energy efficiency of heating systems. Controls are essential to ensure that all heating technologies work together cohesively to deliver energy efficient and environmentally friendly solutions. While many renewable technologies are unlikely to be widely adopted in existing homes by 2020 it is still important that control solutions are developed, both for new low and zero carbon homes but also for the successful adoption of any technologies with immediate wider deployment potential (such as solar thermal) and to facilitate future integration in existing homes.

Although the majority of homes with central heating systems have some kind of controls, work carried out by TACMA (The Association of Controls Manufacturers) with the Energy Saving Trust has identified that:

- Nearly 8m UK homes with a boiler don't have a room thermostat.
- Over 70% don't reach the minimum levels of controls in the 2010 building regulations.
- Eight hundred thousand homes with a boiler have no controls at all.

This is clearly an important area and there is considerable potential to increase the use of effective controls. As a basic requirement the Taskforce believes that, by 2020, the majority of UK homes could (and should) have controls installed that at least meet minimum standards.

1.3. Barriers inhibiting sector growth

Installation rates for energy efficient technologies are currently insufficient to meet Government targets. The installation of condensing boilers (and to a certain extent more sophisticated controls) tends to be restricted to new homes and when the boiler needs replacing in existing homes, although the Boiler Scrappage scheme has had some impact in this area. Sales of microgeneration technologies are currently low and so there are few economies of scale that would be associated with mass-market products.

In order to sustain and accelerate installation of energy efficient heating measures and ensure that Government targets are met, a number of barriers to adoption need to be overcome.

Market barriers by technology

Technology	Main market barriers
Condensing boilers	Cost and payback time Resilience of old, inefficient boilers and ability / willingness of consumers to repair old technology rather than investing in new technology Lack of consumer awareness of technologies available and benefits of new boilers Disruption to the household of installing new boiler Insufficient push under current Government schemes

Hot water storage	Popularity of instantaneous 'combi' boilers and lack of space for hot water storage Trend in new homes and repair, maintenance and improvement (RMI) activity not to provide adequate space for water storage EuP directive imposing excessive insulation thicknesses, leading to products being unacceptably large for fitting in existing UK properties Lack of clarity on Legionella risk and management strategies.
Controls	Lack of consumer awareness and understanding of technology Potential expense of installing more sophisticated zone controls in existing homes Lack of recognition of benefits under SAP
Solar thermal	Cost and payback time Hot water storage issues (see above) Perceptions of which properties fit the technology Installer capacity and skills Perceived onerous nature of the Microgeneration Certification Scheme Lack of push under Government schemes
Heat pumps	Cost and payback time Supply chain constraints (limited manufacturers) Installer capacity and skills Perceived onerous nature of the Microgeneration Certification Scheme Lack of push under Government schemes May be appropriate only for homes off the gas grid
Micro-CHP	Cost and payback time Lack of consumer awareness and understanding Installer capacity and skills Lack of recognition under SAP Perceived onerous nature of the Microgeneration Certification Scheme
Solid fuel technologies	Cost and payback time Installer capacity and skills Inconvenience to household Fuel storage space issues Perceived as appropriate only for homes off the gas grid

There are clearly a number of common themes, and the Taskforce has identified a number of barriers restricting growth in use of energy efficient technologies which straddle the specific technologies, as follows.

Market barriers in summary

Issue	Barriers
Installer capacity	This is a key issue for all heating technologies with the exception of traditional boiler-based heating systems. There are few heating engineers installing microgeneration solutions, mainly due to the low consumer demand. As demand increases there will need to be a corresponding increase in the number of trained installers. The Taskforce believes that the Microgeneration Certification Scheme has an important role to play but that it needs to be reformed, as it is currently too onerous and expensive for installers. Installers also need to be mobilised to advise on the use of controls.
Manufacturing capacity	The Taskforce believes that manufacturers in the heating and hot water sector can ramp up production to meet an increase in consumer demand. However for technologies at an earlier stage of development, such as micro-CHP, passive flue gas recovery and advanced controls, manufacturers will require greater certainty on future market scenarios to aid planning on product development.
Consumer buy-in	Consumer awareness of the range of solutions available, and the applications and benefits of those solutions, is low. There is a need to stimulate consumer demand for newer heating measures and indeed the accelerated adoption of more energy efficient traditional heating systems (including controls). It is also important that there is consistency of messages delivered to consumers.
Shortage of financial incentives	The heating industry welcomes schemes such as CERT and the Boiler Scrappage scheme, but they are currently insufficient to drive the acceleration of product development and installation required to meet Government targets. Few heating measures have been conducted under CERT and the Boiler Scrappage scheme is a short term measure and only likely to replace less than 1% of inefficient boilers installed in UK homes.
Performance measures and calculation method	SAP and nationally accepted performance measures are generally designed for traditional technologies. They often do not easily accommodate new products and technologies and often do not fully credit and reward the performance and savings delivered – this is the case for micro-CHP and for more advanced heating controls. Given that most policy approaches use SAP to determine suitability of technologies, then this is a significant barrier to adoption.

Controls not used effectively	There is a considerable amount of work to be done to ensure that UK homes have appropriate heating controls and that householders are instructed on how to use those controls effectively. A qualitative research study conducted by MTP ('*Use of Heating Controls*') has indicated that a significant proportion of householders do not set or use their controls correctly (or at all). Furthermore research carried out by industry with the Energy Saving Trust indicates that 70% of homes do not meet minimum standards for controls, so addressing the installation of appropriate technologies must be a priority
Hot water and system integration	One of the essential 'enabling technologies' to help fully utilise low and zero carbon technologies is hot water storage. However new boiler installations have often not included a hot water cylinder and new building design often does not factor in space for hot water storage, something which may inhibit the future installation of energy efficient technologies such as solar thermal or heat pumps. The issue of system integration also relates to the combining of different technologies and it is entirely feasible that multiple technologies will be used in tandem within a property – this again has implications for system design and building regulations.
Energy supply mix	The domestic heating industry will need a clear view of the likely energy supply mix to homes from 2020 in order to make investment decisions on which products to develop and bring to market - product development may be inhibited without this kind of insight.
Cost	The cost of replacing an old inefficient boiler (which is essentially a distress purchase) remains a barrier. The expense and disruption may encourage householders to retain their older, less efficient boilers for as long as it is possible to repair them. It is indeed the oldest, poorest performing boilers that tend to survive longest with continual repairing. Without financial incentives, the cost of installing newer microgeneration technologies also inhibits sector growth. Industry representatives believe that householders are reluctant to commit to capital expenditure on energy efficient measures that require longer than five years to pay back.

1.4. Overcoming the barriers to market growth

In order to overcome the barriers which restrict the growth of energy efficient technologies, the Taskforce recommends a number of solutions and actions that need to be undertaken in order for the market potential to be realised.

Issue	Actions required to address issue
Building installer capacity	Providing guidance for installers to allow existing, skilled engineers to up-skill into new technology areas e.g. developing a course on how to up-skill, developing a web portal explaining how to up-skill (and search a live training database to find current courses)

	Incentivising the attendance of skills courses and/or encouragement to joint suitable industry scheme to improve the competency of installers or switch them from current heat practice (i.e. gas/oil boiler or electric heating installation) Reviewing the MCS to make it less onerous and expensive for small installer firms and ensure it is consistent with schemes for other (traditional) technologies *Co-ordination of industry and Government-funded bodies to prioritise and align skills development plans*
Consumer buy-in	Raising awareness of the range of heating technologies available and promoting the benefits of installing more energy efficient heating technologies, including payback on investment Informing consumers on financial assistance available for the installation of energy efficient heating technologies Improving consumer behaviour and usage of heating technology, particularly heating controls, to maximise the energy efficiency of that technology *Ongoing industry co-ordination on Government-funded consumer advertising and funding initiatives (e.g. Act on CO2 campaign)*
Financing installation	Financial incentive schemes; Providing additional funding for the successful Boiler Scrappage Scheme and promoting heating measures under Government schemes such as CERT and future energy supplier obligation programmes If a payback period for the installation of a heating technology exceeds five years, then a financial mechanism such as PAYS should be promoted (i.e. one that links investment to the home rather than the individual) The reduction of VAT for the supply of energy efficient heating technologies by qualified and registered installers
Performance measures and calculation method	The basis of SAP calculations should be reviewed to ensure that energy efficiency measures recognise, for example, the use of controls and the use of solid fuel technologies when integrated with gas or oil heating technologies or when used as secondary heating Making performance measures and calculation methods more flexible in order to bring new products to market more quickly, and support funding for manufacturers to get new products into Appendix Q of SAP Greater promotion of tools such as SAP and EPCs to the general public in order to raise awareness and setting a target date for when all homes will have an EPC and when all homes will have to have specified improvements made to enable people to sell or let their properties *Co-ordinate industry and Government work to align performance measurement (SAP) requirements and develop programmes for the existing housing stock (in particular for heating)*

Communications and controls	Government to commit to upgrading controls by 2020 in the Home Energy Management strategy alongside insulation, as it is a comparatively cost effective measure The basis of incentives for energy suppliers obligations post 2013 needs to be reviewed Industry develops cohesive marketing and works with the supply chain to deliver practical solutions to consumers *Industry to develop a strategic group to identify appropriate solutions to fit the contextual policy timeline and ensure that these are market ready as required and Government to commit to this group to guide development of SAP, building regulations etc.*
Other product development	Industry to continue developing energy efficient technologies e.g. passive flue gas recoverables, micro-CHP Field trials to provide evidence on applicability to dwellings and performance of technologies
Hot water and system integration	It is vital that the heating products installed now and in the near future are 'future proof' so that renewable technologies can be easily integrated at a later date (e.g. fitting hot water cylinders that are 'solar ready' and ensuring that when combi boilers are installed they are solar compatible) - this is perhaps not an 'easy win' but rather is sound preparation for the future Formal guideline on Legionella for dwellings and objective evidence of risk of Legionella Technology development to reduce standing heat loss without cost or space implications Industry has encouraged the formation of a Renewable Energy Systems Integration Group, which has developed a website advising consumers, installers and specifiers on the integration of low and zero carbon fuels and energies, and on the displacement of higher carbon fuel use by integrating low and zero carbon systems with existing higher carbon systems. Industry bodies are currently resourcing and funding this initiative although it would be more effective and quicker if more investment were available to support the group's activities, including the development and promotion of the website
Renewable Heat Incentive (RHI)	The potential market for renewable heating technologies is greatly dependent on the introduction of the RHI and so it is essential that commitment to this initiative remains firm
Electricity network	*A network risk review is required to ensure that the network can accommodate the number of heat pumps estimated in our vision*

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Further work on our vision beyond 2020 would be contingent on robust scenarios emerging for the decarbonisation of the electricity and gas networks.

In the rest of this document we expand on these observations and proposals and present the evidence base behind our conclusions.

2. The Heating and Hot Water Taskforce

For the successful delivery of the Government's Low Carbon Transition Plan and for associated targets for the reduction in greenhouse gases to be met, a significant contribution must come from the UK heating industry. In particular significantly greater energy efficiency is required from domestic heating systems.

"…Meeting the UK's 2020 and 2050 carbon reduction targets will require a big contribution from heat."

Hergen Haye, Defra - Energy Efficiency Partnership for Homes Annual Conference 2008

The heating industry and Government believe that the contribution of domestic heating to the reduction of greenhouse gases will be based on a combination of accelerated growth in the use energy efficient traditional heating systems and the introduction of renewable technologies where they are appropriate and likely to be effective.

The Department of Energy and Climate Change (DECC) and the heating industry are working closely together to ensure that domestic heating makes a significant contribution to the fulfilment of Government policy. The key objective is close collaboration between the heating industry and Government on policy development relating to domestic heating and hot water. To that end a new Taskforce for Heating and Hot Water has been established.

The Heating and Hot Water Taskforce comprises industry representatives of all sectors of the supply chain, including manufacturers and installers. Consultation with other bodies (such as SummitSkills, the Energy Retailers Association and Energy Saving Trust) has been sought as and when required. Government is represented by DECC, CLG and other departments, again as required. The Taskforce is facilitated by the Energy Efficiency Partnership for Homes, a network of over 575 organisations from the public, private and voluntary sectors that work together to reduce the energy consumed by UK households.

This report has been written by the following members of the Taskforce from the heating and hot water industry.

Organisation	Representative
British Electrotechnical and Allied Manufacturers Association (BEAMA)	Kelly Butler
Heating and Hotwater Industry Council (HHIC)	Roger Webb
HETAS	Bruce Allen
Hot Water Association (HWA)	Martyn Griffiths
Institute of Domestic Heating & Environmental Engineers (IDHEE)	Peter Thom
Solar Trade Association (STA)	Howard Johns
The Association of Controls Manufacturers (TACMA)	Colin Timmins

The report has been collated and edited by Trevor Wilkinson of Purple Market Research (www.purplemr.co.uk) in collaboration with the Energy Efficiency Partnership for Homes (www.eeph.org.uk).

The Heating and Hot Water Taskforce has two main aims:

1. To ensure that Government strategy and policy for carbon saving includes a realistic assessment of the potential contribution from domestic heating and hot water;
2. To allow industry expertise to inform policy on heating and hot water, specifically to contribute towards the setting of realistic targets and ensuring that a suitable infrastructure is in place to deliver those targets.

This will be done by seeking solutions to target trajectories, market development, capacity of the supply chain and skills development.

On of the first outcomes planned for the Taskforce's first year is a Technology Review to inform DECC's Microgeneration Strategy. This Review has now been submitted (as of early February 2010).

Other key outcomes planned for the Taskforce's first year are:

- To propose technology pathways to 2020 and beyond for heating and hot water which enable the delivery of the Renewable Energy Strategy (RES) and the Household Energy Management (HEM) programme (formerly called the Heat & Energy Saving Strategy or HESS);
- To provide a critical review of all relevant policies working towards this strategy to ensure that appropriate opportunities to achieve the technology pathway are being taken;
- To identify key infrastructural barriers to the technology pathway with proposals for action by industry and Government to overcome those barriers.

In this document we outline the key Government targets for a reduction in emissions and discuss the contribution that the heating sector is currently making and can make in future to ensure that Government targets are met.

3. The policy context

3.1. Government policy

The UK Government's White Paper 'The UK Low Carbon Transition Plan,' released in July 2009, outlines the targets set for the reduction in greenhouse gas emissions.

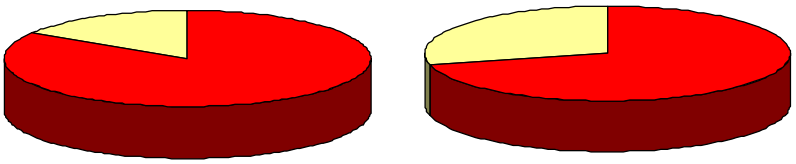
The longer term aim (by 2050) is to cut emissions by at least 80% against 1990 levels, with an interim target to cut emissions by 34% by 2020. This will require emissions falling by 1.4% per year (a significant acceleration from the 1% year on year fall recorded since 1990).

Five-year 'carbon budgets' have been introduced to monitor progress and keep developments on track. The carbon budgets are legally binding.

> *"…The Government has put in place the world's first ever legally binding target to cut emissions by 80% by 2050…By 2020 UK emissions will be 18% below 2008 levels and over one third below 1990 levels."*
>
> *The UK Low Carbon Transition Plan*
>
> *July 2009*

Government targets cannot be achieved without improving the energy efficiency of the UK housing stock, which accounts for about 27% of all UK CO_2 emissions. In particular it is crucial to address heating and hot water, which account for a significant proportion of household energy consumption and CO_2 emissions.

Heating and hot water: energy consumption and emissions



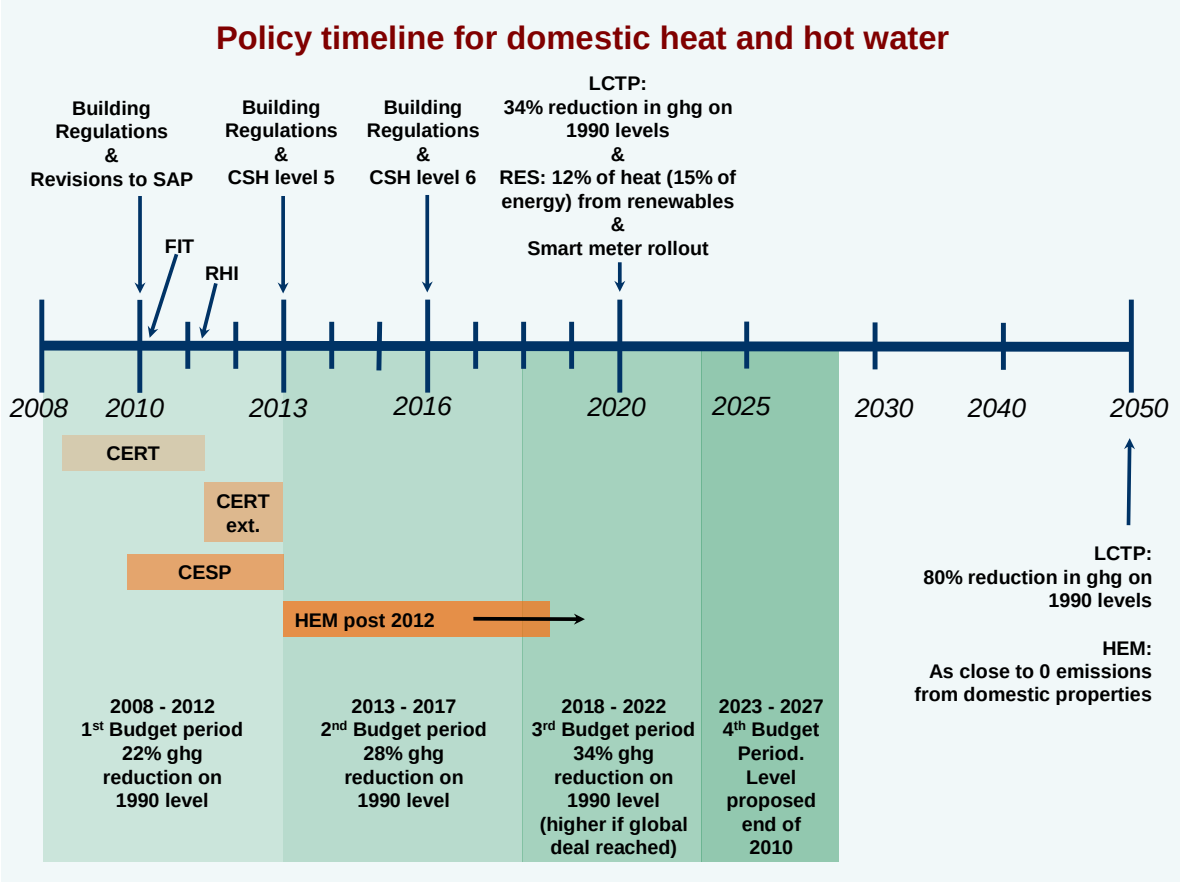
Heating & hot water: 84% of domestic energy consumption

Heating & hot water: 71% of domestic CO2 emissions

Source: BRE

It is therefore difficult to envisage Government targets being met without a significant contribution from the domestic heating and hot water industry. To meet their targets for a reduction in emissions the Government has launched a number of initiatives.

In diagrammatic form, those initiatives and associated targets (focusing in particular on those that are relevant to the heating sector) are summarised below.



Key

Abbreviation	Policy / initiative
LCTP	Low Carbon Transition Plan
CSH	Code for Sustainable Homes
RES	Renewable Energy Strategy
CERT	Carbon Emissions Reduction Target
RHI	Renewable Heat Incentive
FIT	Feed in Tariffs
CESP	Community Energy Saving Programme
HESS / HEM	Heat and Energy Saving Strategy (renamed the Household Energy Management programme from January 2010)

Further detail on these and other policies and initiatives are given in Appendix A of this report.

3.2. Sources of information on Government policy

Topic	Sources
Government policy	Department for Energy and Climate Change: 'The Low Carbon Transition Plan 2009' and 'Renewable Energy Strategy' plus information on CERT, CESP and SAP (http://www.decc.gov.uk/en/content/cms/publications/lc_trans_plan/lc_trans_plan.aspx) Climate Change Committee: http://www.theccc.org.uk/reports/progress-reports Department of Communities and Local Government / CLG (www.communities.gsi.gov.uk) Building Research Establishment / BRE (www.bre.co.uk) Energy Saving Trust: www.energysavingtrust.org.uk

4. The UK housing stock and energy use

4.1. Significance of base data on housing and energy use

The domestic sector accounts for almost one third of total national energy consumption. Any discussion of the impact of the domestic sector in terms of energy use and emissions therefore needs to take into account demographic factors such as population, the size and characteristics of the UK housing stock, domestic energy usage in addition to trends and projections of all of these metrics.

In this section we summarise that base data, together with references to sources of more detailed data.

4.2. UK population and housing stock

Number of people and households in the UK

As of 2008 the UK population stood at approximately 61.5m and the number of households was estimated at 26.8m.

There are around 0.5m dwellings in the UK in addition to the 26.8m households. In 2004 (the most recent date we have been able to find data for) there were around 320,000 homes in the UK that had been vacant for 6 months or more, equivalent to 1.5% of the housing stock. In addition, there were an estimated 230,000 second homes in the UK (not counting those held as an investment and rented out), equivalent to around 1% of the housing stock.

To some extent those figures are balanced out by the fact that around 1.5% of the UK population lives in communal establishments.

The net result is that the number of dwellings in the UK exceeds the number of households by around 3%.

England accounts for 84% of the UK's population and 83% of households, with the percentage of the population in each country roughly the same as the division of households.

UK population and number of households 2008

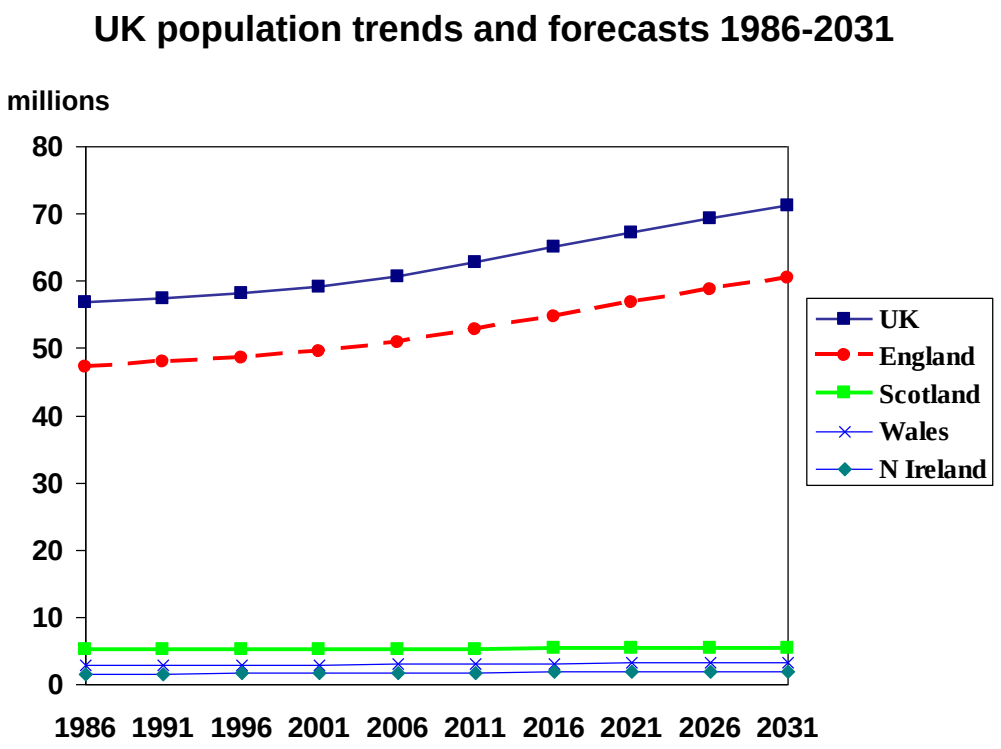
	UK population		UK households	
	m	%	m	%
All UK	**61.5**	**100**	**26.8**	**100**
England	51.5	84	22.4	83
Scotland	5.2	8	2.4	9
Wales	3.0	5	1.3	5
Northern Ireland	1.8	3	0.7	3

Source: Office for National Statistics (www.statistics.gov.uk)

Trends

The UK population grew by 7% between 1986 and 2006 at an average annual growth rate of 0.3%. It is forecast to have grown by a further 9% by 2026 through natural growth (the number of births exceeding the number of deaths) and also through net immigration. The UK population is expected to peak in the middle of this century although long-term predictions are uncertain.

England accounts for most of the population growth, with the population of Scotland, Wales and Northern Ireland only demonstrating slight growth over the last twenty years.



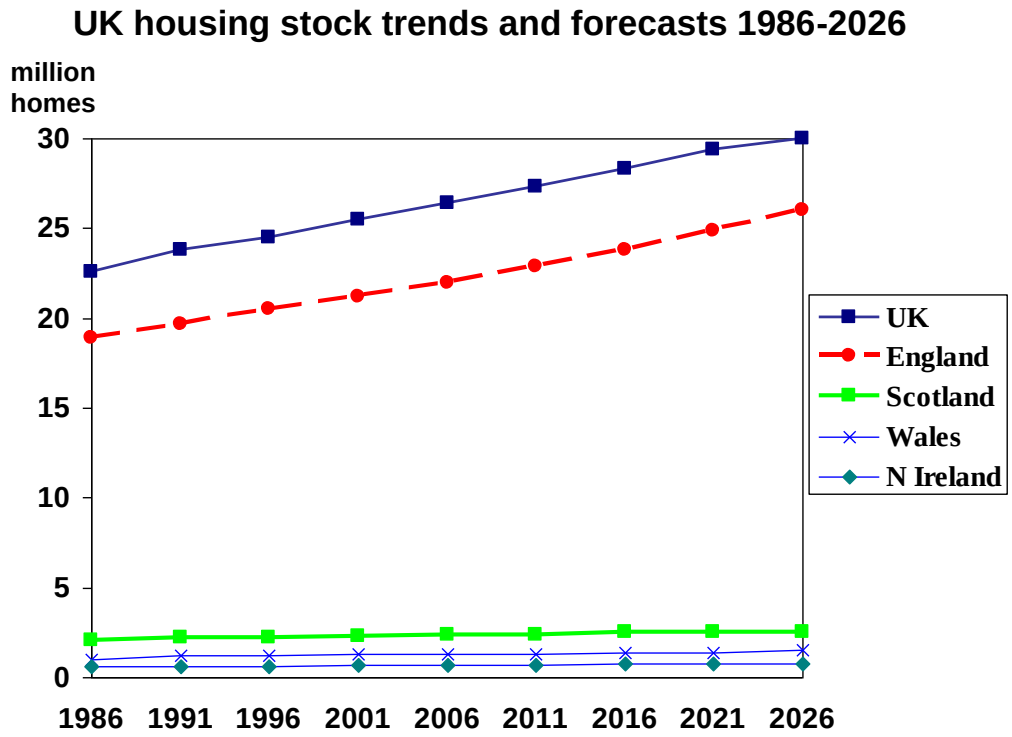
Million people

	1986	1991	1996	2001	2006	2011	2016	2021	2026	2031
UK	**56.7**	**57.4**	**58.2**	**59.1**	**60.6**	**62.8**	**65.0**	**67.2**	**69.3**	**71.1**
England	47.2	47.9	48.5	49.5	50.8	52.7	54.7	56.8	58.7	60.4
Scotland	5.1	5.1	5.1	5.1	5.1	5.2	5.3	5.3	5.4	5.4
Wales	2.8	2.9	2.9	2.9	3.0	3.0	3.1	3.2	3.2	3.3
N. Ireland	1.6	1.6	1.7	1.7	1.7	1.8	1.9	1.9	2.0	2.0

Source: Office for National Statistics (www.statistics.gov.uk)

Another key trend is the increasing average age of the UK population, with the percentage of people over 65 set to increase from 16% in 2006 to 23% by 2031. By 2050 it is likely that over 25% of the UK population will by over 65 years of age, with many of these living alone.

The UK housing stock grew by 4.2m in the 20 years up to 2006, and is forecast to grow by another 4.3m in the following 20 years up to 2026, taking the housing stock up to just over 30m by 2026.



Million households

	1986	1991	1996	2001	2006	2011	2016	2021	2026
UK	**22.6**	**23.8**	**24.5**	**25.5**	**26.4**	**27.3**	**28.3**	**29.4**	**30.0**
England	18.9	19.7	20.5	21.2	22.0	22.9	23.8	24.9	26.0
Scotland	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.5
Wales	1.0	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.5
Northern Ireland	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8

Source: CLG Housing Research & Statistics
(http://www.communities.gov.uk/documents/housing/xls/table-101.xls)

Up to 2007 around 200,000 new homes per year were being built. However due to the current recession the rate of growth has slowed.

CLG reports that housing completions (in England) numbered 168,000 in the year 2007/8. In that same year there were approximately 20,500 demolitions, so that the net result was a gain of around 150,000 homes. CLG anticipates that the net additions to the housing stock in 2008/9 will be even lower than in 2007/8.

The Construction Products Association in their 'Construction Industry Forecasts 2009' forecast falls in housing completions in 2009 with only modest growth in 2010.

Housing completions 2008 - 2013

	2008 actual	2009 forecast	2010 forecast	2011 forecast	2012 projection	2013 projection
Private housing completions in 000s (and annual % change)	139 (-24%)	80 (-42%)	82 (+2%)	104 (+27%)	130 (+25%)	152 (+17%)
Public housing completions in 000s (and annual % change)	30 (+15%)	25 (-16%)	26 (+1%)	26 (+2%)	26 (+1%)	26 0%)

Source: Construction Products Association 'Construction Industry Forecasts 2009'

Private housing has been particularly badly affected, although public housing completions are also expected to have fallen in 2009.

The Association comments:

> "*The construction industry entered 2009 with the sharpest falls in output and new orders since 1980 and 1983 respectively. Expectations for the year ahead are bleak with the industry in 2009 anticipated to endure its worst fall in construction output on record…Significant growth is only expected in 2012*…"

Looking beyond 2026, and assuming an annual net rate of growth of 150,000 home per year, we would expect an additional 6m homes to have been built between 2026 and 2050, taking the UK housing stock up to around 36m. Precise numbers are, however, difficult to predict.

Repair, maintenance and improvement projects (RM&I) also represent a significant opportunity to improve the heating system. It is estimated that UK councils process 650,000 small planning applications per year (although that figure includes some commercial property) and there are significantly more lower level RM&I projects carried out on UK homes. The Office for National Statistics estimates that repair and maintenance activity accounts for 45% of all work in the construction industry.

The Construction Products Association forecasts private housing RM&I activity falling by 15% during 2009 and a further fall of 5% in 2010, as the deteriorating economy and increasing unemployment lead to lower consumer confidence and spending.

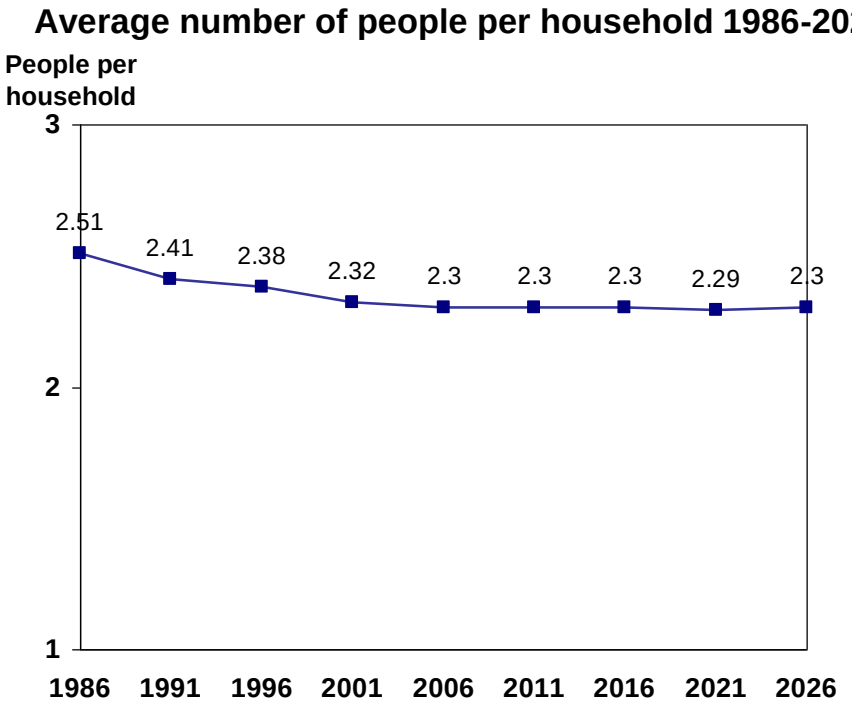
High levels of public borrowing have constrained spending on public housing RM&I and the Association expects modest growth of 3% in 2009 following by a fall of 45 in 2010 with the end of 'Decent Homes.'

The Federation of Master Builders reports in their 2009 Q3 'State of Trade Survey' that new build and repair, maintenance and improvement (RM&I) activity in both private and social housing has declined quarter on quarter in 2009, albeit at a slightly lower rate for Q3.

Any recovery is likely to occur only after an upturn in the economy and falls in unemployment, during the second half of 2011.

Size of households (people per household)

Although both the UK population and housing stock have grown over time, the rate of growth in the housing stock has been slightly higher than the population growth, with the result that the average number of people per household has fallen. In 1986 there were, on average, 2.51 people per UK dwelling, but that figure dropped to 2.3 people in 2006.



Source: Office for National Statistics / Communities & Local Government

CLG expects the average number of people per dwelling to fall to around 2.1 by 2050.

The number of single-occupant households is rising due to increasing divorce rates, people increasingly likely to live alone anyway and the ageing of the population over time. It is estimated by the Office for National Statistics that 70% of the expected increase in the number of UK households between 1996 and 2016 can be attributed to single person households (with half of those occupied by people over 65 years of age).

The falling size impacts on the types of dwelling required, with flats accounting for an increasing proportion of the housing stock over time and detached properties declining as a proportion of the housing stock (as discussed below).

Consequently the average amount of space occupied per person *increased* from an estimated 38m2 per person in 1991 to 43m2 per person in 2001.

There is an inverse correlation between the amount of space available per person and energy consumption: the fewer the number of people per dwelling (and the correspondingly greater space taken up by each person), the greater the energy consumption per person.

4.3. Characteristics of the housing stock

Types of building

The energy efficiency of a dwelling varies by *type of building* and there have been significant changes in the types of building being provided. In 2006 an estimated 21% of new builds were detached properties, almost half the level recorded in 2002. On the other hand, flats and maisonettes represent almost half of new builds compared to only 31% in 2002.

UK new housing builds by type of dwelling

Type of dwelling	2002	2003	2004	2005	2006
Detached	38%	31%	27%	22%	21%
Semi-detached	14%	13%	13%	14%	13%
Terraced	18%	19%	18%	19%	18%
Flats and maisonettes	31%	36%	42%	45%	48%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Source: ONS / CLG's Housing Statistics 2006'

Ownership

There has been a significant increase in owner-occupiers in the UK in recent years. The number of *owned* homes has risen by more than two million since 1995 to a point where they account for 70% of the UK's 26 million homes.

UK Housing stock over time (m dwellings)

	1995		2000		2005	
	m	%	m	%	m	%
Owner occupied	16.2	67	17.4	69	18.4	70
Rented privately	2.5	10	2.5	10	2.8	11
Rented from RSL	1	4	1.5	6	2.2	8
Rented from local authority	4.7	19	3.9	15	2.8	11
Total	**24.3**	**100**	**25.3**	**100**	**26.2**	**100**

Source: ONS /CLG

The corollary is that the proportion of homes *rented* has fallen, with those rented from local authorities demonstrating a particularly decline between 1995 and 2005 from 19% to 11%.

Energy efficiency of housing

This latter fact is significant as social housing generally tends to be more energy efficient than private housing. This is illustrated in the following table (for England only), which summarises the energy efficiency of homes in 2007, based on EPC ratings.

EPC Ratings of Properties in England 2007

	Whole stock		Owner Occupied		Private rented		Social sector	
	000s	%	000s	%	000s	%	000s	%
Band B (81-91)	47	0.2	5	0.0	8	0.3	34	0.9
Band C (69-80)	1,699	7.7	634	4.1	256	9.8	809	**20.6**
Band D (55-68)	6,683	30.4	4,265	**27.6**	691	**26.4**	1,727	**43.9**
Band E (39-54)	8,995	40.9	6,942	**45**	963	**36.9**	1,091	**27.7**
Band F (21-38)	3,657	16.6	2,993	**19.4**	446	**17.1**	218	5.5
Band G (1-20)	909	4.1	603	3.9	248	9.5	58	1.5
Total	**21,989**	**100**	**15,442**	**100**	**2,611**	**100.0**	**3,936**	**100**

Source: Survey of English Housing 2007

Social sector homes are on average much more energy efficient than those in the private sector (average SAP rating of 57.4 compared to 46.8 respectively) and are improving at a faster rate. Social sector homes are more likely to have an EPC band D or higher compared to the privately rented homes and owner occupied (36% and 32% respectively).

Age of dwellings

There is also a correlation between energy efficiency and *age of dwelling*. Across all of the UK 38% of the housing stock is estimated to have been built before 1945 and is therefore at least 60 years old. This fact has significant implications on energy efficiency as, broadly speaking, the older a property is, the less energy efficient it is.

UK housing stock by age of dwelling 2006

Year	England	Wales *	Scotland *	N. Ireland *	All UK
Pre-1919	19%	34%	18%	18%	20%
1919-1944	19%	12%	14%	11%	18%
1945-1964	22%	15%	24%	20%	22%
1965-1984	26%	23%	26%	25%	26%
1985+	14%	15%	18%	27%	15%
Total	100%	100%	100%	100%	100%

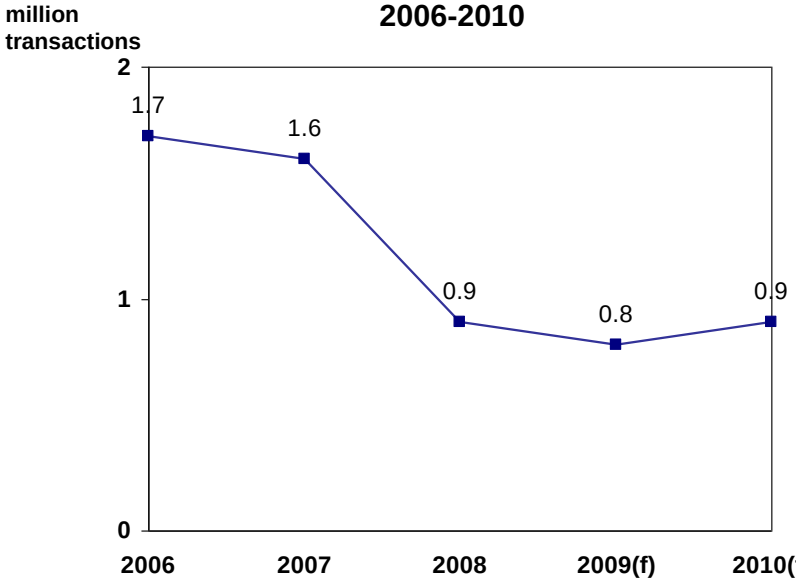
Source: ONS / Department of Communities and Local Government's 'Housing Statistics 2006' / Welsh Assembly / Scottish House Condition Survey / Northern Ireland Housing Executive
** Indicates our estimates where year ranges given in official statistics do not correspond*

There are some variations by country, with Northern Ireland tending to have the newest housing stock (72% built since 1945) and England and Wales the oldest stock (only 60% built since 1945).

4.4. Property transactions and home improvements

A home changing hands represents an opportunity to upgrade some or all of the home's heating system. Whereas up to 2007 the number of new homes built has averaged at around 200,000 the number of residential property transactions has averaged over 1.5m. Although, as the chart below illustrates, the number of residential property transactions has declined since 2007 (largely due to the economic recession) the number of property transactions remains far greater than the number of new builds.

UK residential property transactions and forecasts 2006-2010



Source: Office for National Statistics / Council for Mortgage Lenders

The decline in property transactions has been accompanied by virtual doubling of the number of home repossessions, from 26,000 in 2007 to a forecast 50,000 in 2009.

4.5. Energy usage

Domestic energy consumption by fuel 2008

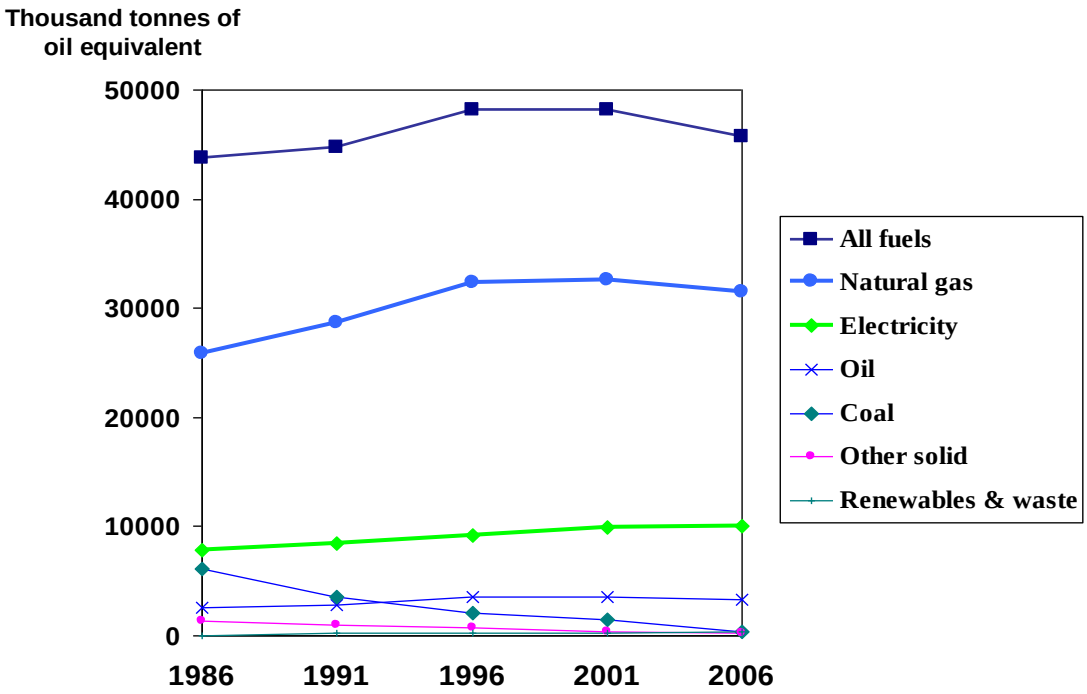
Fuel used	000 tonnes of oil equivalent	% of all fuels
Gas	31,239	68%
Electricity	10,132	22%
Oil	3,033	7%
Coal	515	1%
Other solid fuel	239	0.5%
Renewables & waste	430	1%
All fuels	45,642	100%

Source: ONS / DECC 'Digest of UK Energy Statistics 2008'

Natural gas accounts for around 68% of the UK's domestic energy consumption (as of 2008), with electricity accounting for 22%. Of the remaining 10%, oil is the main fuel used, with renewables and waste accounting for just under 1% (albeit growing, as indicated above).

Looking at this data over time, the amount of energy used overall and the amount of gas used appears to have reached a peak early in the current decade and has started to fall slightly. Industry sources attribute that fall to a combination of more energy efficient technology installed and warmer temperatures in the UK post-2000.

Domestic energy consumption by fuel 1986-2006



	`1986	1991	1996	2001	2006
All fuels	43,700	44,768	48,120	48,178	45,771
Natural gas	25,797	28,721	32,317	32,625	31,457
Electricity	7,892	8,436	9,244	9,917	10,013
Oil	2,590	2,825	3,518	3,527	3,251
Coal	6,121	3,582	2,084	1,461	425
Other solid	1,300	995	717	376	216
Renewables & waste	0	209	241	240	358

Source: ONS / DECC 'Energy Consumption in the UK 2009 Update'

In terms of applications, space and water heating account for over 80% of energy use (and 97% of gas usage).

Domestic energy consumption by fuel and application 2007
(thousand tonnes of oil equivalent)

Application	Gas	Electricity	Oil	Solid fuel	All fuels
Space heating	20,762	1,201	2,123	524	24,610
Water heating	8,900	1,391	750	153	11,194
Appliances	3	5,154	0	0	5,157
Cooking	682	587	4	3	1,276
Lighting	0	1,559	0	0	1,559
All applications	30,347	9,892	2,877	680	43,796

Source: ONS / DECC 'Digest of UK Energy Statistics 2008'

An estimated 84% of homes are gas connected, with homes in remote and rural areas less likely to be gas connected.

Currently most homes rely on gas for heating (gas accounts for 84% of the fuel used for space heating and 80% of the fuel used for water heating. In the Low Carbon Transition Plan the UK Government has indicated a commitment to fully utilising the gas network in the immediate future.

"*…The UK remains heavily dependent on gas and so the Government is helping to ensure that the UK has reliable supplies*."

The UK Low Carbon Transition Plan 2009

Traditional gas heating systems are therefore a key part of the future landscape for the UK domestic heating sector.

4.6. Sources of information on demographics, housing and energy usage

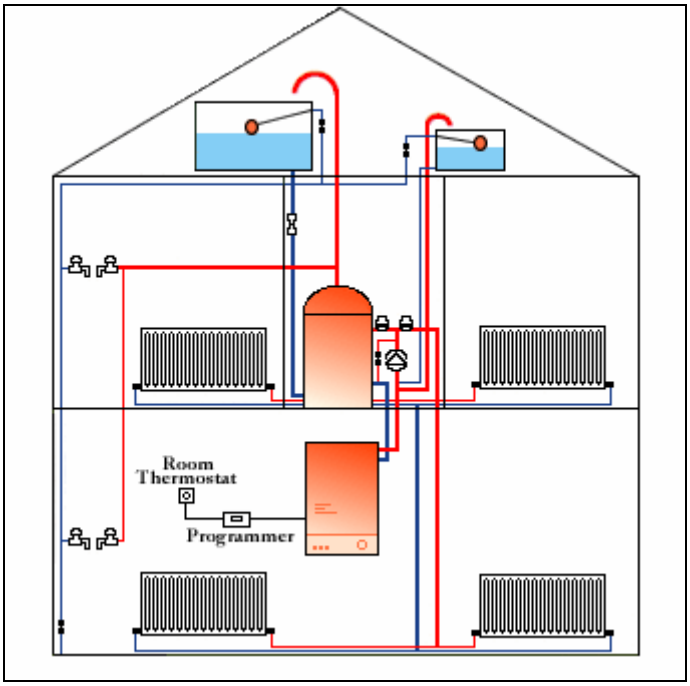
Topic	Sources
Population statistics	Office for National Statistics / ONS: www.statistics.gov.uk & their 'Population Trends'
Analysis of dwellings	Department of Communities and Local Government / CLG (www.communities.gsi.gov.uk) – 'Housing Statistics 2008' ONS / Scottish Government 'Scottish House Condition Survey 2008' (www.scotland.gov.uk) National Assembly for Wales 'Household Estimates for Wales 1991-2007' (www.wales.gov.uk/statistics) Northern Ireland Department for Social Development / DSDNI 'Northern Ireland Housing Statistics 2008-9 (www.dsdni.gov.uk/index/stats_and_research.htm) Office for National Statistics (www.statistics.gov.uk) The Council of Mortgage Lenders (www.cml.org.uk)

	BERR 'Construction Statistics Annual 2007' Federation of Master Builders 'State of Trade Survey Q3 2009' (www.fmb.org.uk) Oxford University's Environmental Change Institute: '40% Project' (www.eci.ox.ac.uk/research/energy/40house)
Energy usage	'Domestic Energy Fact File 2008' – BRE / Energy Saving Trust / DECC (this report in turn sources data from GfK Home Audit, Digest of UK Energy Statistics and BREHOMES / English House Condition Survey DECC 'Digest of UK Energy Statistics 2009' (DUKES) Office for National Statistics / DECC 'Energy Consumption in the UK 2009 Update'

5. Condensing boilers and passive flue gas heat recovery

5.1. Definition

The majority of UK homes have traditional central heating systems in place, by which a boiler heats water (sometimes but not always stored in a hot water tank or cylinder) and the hot water is then circulated around the home through pipes and radiators.



5.2. Current installed base

There are approximately 24m homes in the UK using wet central heating systems (utilising boiler technology), so that the penetration of central heating is estimated at 93%. Gas central heating dominates the market, installed in 78% of GB homes with an 85% share of the central heating market (i.e. share of all homes with central heating installed).

It is mandatory that condensing boilers must be used in new installations (with just a few exceptions). Condensing boilers capture more usable heat from the fuel used by extracting heat from the exhaust gases that would otherwise escape through the flue. Most condensing boilers use gas or oil, although some use other fuels.

As of early 2009 the Heating and Hot Water Industry Council (HHIC) estimates that there were 21.6m gas boilers in UK homes, of which just over 6m (27%) are condensing boilers.

OFTEC estimates that there are around 1.4m oil fired boilers in UK homes, of which just under 100,000 (7%) are condensing boilers (although there is some uncertainty about the precise penetration of oil fired condensing boilers).

The Heating and Hotwater Industry Council (HHIC) estimates that 1.52m domestic gas boilers were sold in the UK in 2009 and 99% of these were condensing boilers. The recession has some impact on sales which peaked at over 1.6 million in 2007.

As of the *end* of 2009 the number of condensing boilers is estimated to have risen to 7.4m.

Projected number of gas-fired condensing boilers in UK homes

Time	Non-condensing boilers	Condensing boilers	Condensing boilers as a % of total
End of 2008	15.5m	6.1m	28%
End of 2009 (estimated)	14.2m	7.4m	34%
End of 2010 (projected)	13m	8.6m	40%

Source: HHIC

The corollary is that over 14m UK homes still had inefficient non-condensing boilers as of the beginning of 2010. HHIC and other industry sources estimate that these include over 4m G-rated boilers and 2m F-rated boilers still in use, with many householders opting to repair these inefficient boilers rather than installing a new energy efficient one.

5.3. Installation trends

Central heating

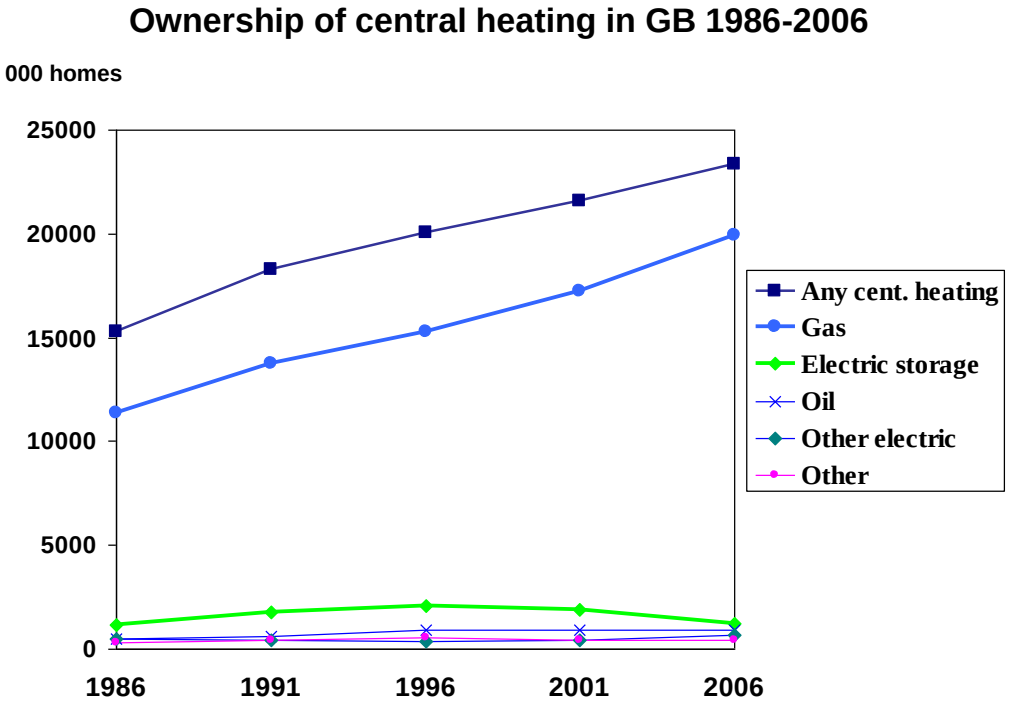
There has been a significant increase in central heating ownership from the 70% penetration recorded in 1986.

Ownership of central heating in GB

	`1986	1991	1996	2001	2006	2008*
Number of GB homes	22.0m	23.2m	23.9m	24.8m	25.7m	26.1m
GB homes with central heating	15.3m	18.3m	20.0m	21.6m	23.4m	23.5m
% of GB homes with central heating	70%	79%	84%	87%	91%	93%

Source: ONS / DECC 'Energy Consumption in the UK 2008'
** Industry estimate for 2008*

Gas central heating systems have accounted for most of the growth in the penetration of central heating systems in GB households.



	`1986	1991	1996	2001	2006
Any central heating	15,269	18,271	20,049	21,583	23,360
Natural gas	11,363	13,761	15,311	17,220	19,921
Electrical storage	1,149	1,798	2,073	1,908	1,207
Oil	487	619	897	927	919
Other electric	363	412	383	419	651
Other	289	420	561	456	451

Source: ONS / DECC 'Energy Consumption in the UK 2009 Update'

5.4. The technical potential

The technical potential exists to ensure that all boilers in UK homes in 2020 are energy efficient condensing ones through installation in new homes and replacement of inefficient boilers in existing homes.

5.5. The practical potential

Most installations are replacements, in that they occur in existing homes when the boiler needs replacing. The main reasons for an old boiler to be replaced (in order of volume) are:

- Distress purchase i.e. the boiler has broken down and cannot be cost effectively repaired;
- Advice from an installer that the boiler is likely to fail or may require an expensive repair;
- When carrying out other work in the house, such as an extension or home improvement;

- To reduce fuel bills and carbon emissions.

Even at an installation rate of 1.5m per year, it will take over ten years to replace all old non-condensing boilers. It is also worth noting that the average life of a condensing boiler is around 15 years (similar to non -condensing products which dominated the market pre 2005 but shorter than the lifespan of very inefficient boilers) and that boilers replaced in 2008 and 2009 are likely to need replacing themselves before 2025.

Looking forward to 2020, HHIC forecasts that the installed base of gas condensing boilers will be around 19.3m out of a total of 23.6m boilers (83%). Without major market intervention, the likely end result is therefore that in 2020 over 4m homes are likely to still have non-condensing gas boilers.

Forecast installed base of gas boilers in 2020

Band	Number (000s)	%
A	14,918	64%
B	4,374	19%
C	26	-
D	1,669	7%
E	717	3%
F	711	3%
G	1,190	5%
Total	**23,605**	**100%**

Source: HHIC

In addition, based on market data compiled by OFTEC, we estimate that approximately 40,000 oil fired condensing boilers were installed in 2008. Without a major acceleration in installations, by 2020 it is therefore likely that less than half of oil fired boilers will be condensing ones.

The main driver of the installation of condensing boilers is regulation, with condensing boilers mandatory in almost all new build or replacement installations.

The Heating and Hot Water Taskforce welcomes the Boiler Scrappage Scheme, launched in January 2010. Members of the Taskforce have been actively involved in discussions with Government during the inception and development of the scheme and believe that is will help stimulate the replacement of old inefficient boilers. However the scheme will only replace 125,000 boilers, some of which would have been replaced anyway by 2020. That is less than 1% of all the inefficient non-condensing boilers estimated to be currently installed in UK homes.

Other market drivers include:

- The health of the economy and consumer spending;
- The development of more energy efficient heating technologies such as passive flue gas heat recovery.

Installers are also an important driver of installation of energy efficient products and systems, with responsibility for safe installation of heating technologies and also a key role as advisers to home owners.

To sustain and accelerate installation of condensing boilers a number of barriers to adoption need to be overcome:

- Cost – the considerable cost of what is essentially a 'distress purchase;'
- Disruption – installation is likely to be disruptive to a household;
- Lack of consumer awareness of the benefits of more energy efficient technology and the use of advanced controls;
- Insufficient 'push' under current Government schemes such as CERT and PAYS.

The expense and disruption may encourage householders to retain their older, less efficient boilers for as long as it is possible to repair them. It is indeed the oldest, poorest performing boilers that tend to survive longest with continual repairing.

5.6. Required policy and market interventions to achieve the practical potential for condensing boilers

The Taskforce believes that there is potential to remove all band F and G boilers from the market by 2020. Policy interventions that the Taskforce believe would help to deliver this include the following:

- Financial incentives such as an extension to the scrappage scheme or a similar incentive delivered through a supplier obligation (such as CERT).
- Promotion of efficient boilers as a cost effective carbon and energy saving measure within other Government policy measures affecting the heating industry such as HEMS and PAYS.
- The reduction of VAT to 5% for the supply and installation of A-rated boilers by suitably qualified and registered installers.

5.7. Passive flue gas heat recovery technology

Looking at technology developments, **passive flue gas heat recovery technology** is in the early stages of development.

This technology provides additional system efficiency by re-cycling flue gas heat which would normally be wasted and expelled to the atmosphere. Virtually all the energy from the incoming gas supply is extracted and reclaimed energy is stored in the unit before being used to pre-heat the incoming cold water. The result is extra domestic hot water efficiency, lower gas consumption and lower running costs. Sales are currently running at about 9,000 units per annum (source: HHIC and manufacturers).

Savings from passive flue gas heat recovery are typically 30% of gas used for hot water. (50% in winter and 12% in summer). Overall gas savings in winter are estimated at 12.5%. Carbon savings are typically 0.5 tonnes of CO2 per annum. Payback time is estimated to be five years.

The potential for passive flue gas heat recovery is also considerable in that this technology can be used in most properties in the UK. Potential sales are in excess of 1m per annum.

The main barriers to adoption of passive flue gas heat recovery are:

- Market / consumer awareness and understanding of the technology
- Cost – typically £500 which householders have in a distress purchase situation even though this pays back in 5 years. As a result current sales are mainly in new build and social housing
- Size and space requirements – manufacturers are now working on integrating the technology into the boiler itself and these should be available in about 12 months
- Benefits are currently capped in SAP at a level below that actually delivered. This is because of limitations of SAP and methodologies used by BRE.
- Currently only available from three boiler manufacturers.

These barriers are likely to inhibit the market potential in the short term.

5.8. Required policy and market interventions to achieve the practical potential for passive flue gas heat recovery

Although the barriers listed above limit the practical potential for passive flue gas heat recovery in the near future, market potential is considerable once the products enter the mainstream.

Policy and market interventions required to deliver the potential for passive flue gas heat recovery technology include:

- Campaigns to raise consumer awareness of passive flue gas recoverable technologies.
- Financial incentives through schemes such as a supplier obligation (such as CERT).

5.9. Sources of information on condensing boilers and passive flue gas heat recovery

Sources
Office for National Statistics / Department for Energy and Climate Change 'Energy Consumption in the UK 2008' and '2009 Update'
Heating and Hot Water Industry Council / HHIC
OFTEC
Defra / TNS 'Public Attitudes and Behaviours towards the Environment 2009' (www.defra.gov.uk)
Defra / MTP / BRE 'Domestic Heating & Hot Water Consultation 2008' (Bruce Young)
DECC / Energy Saving Trust / BRE Domestic Energy Fact File 2008

6. Hot water storage systems

6.1. Definition

One of the essential 'enabling technologies' to help fully utilise low and zero carbon technologies is the use of hot water storage. In this context we are using Hot water Storage as an all embracing definition to include both its use for domestic hot water and for space heating systems. It should also be noted that alternative heat storage products to water, such as phase change materials, may also be used in future.

In the majority of current UK Housing stock the provision of domestic hot water is still based on some form of hot water storage system.

6.2. The installed base

It is difficult to be precise about the current population of hot water storage systems but despite the popularity of combination boilers which now account for around 80% of all gas boiler sales, it is believed that between 16 and 19 million homes still have some form of hot water storage system whilst the installed population of combis is around 11 million.

The actual *number* of GB homes with a hot water tank has not increased significantly over the last twenty or so years, with the estimated number installed in 2008 almost the same as in 1986). However the number of homes in GB has grown in that time and so the *percentage* of homes with a hot water tank has actually declined. In 1986 around 90% of GB homes had a hot water tank, but in 2006 the equivalent number was 71%.

In that same period combi boilers have become increasingly popular, usage rising from 2% of homes in 1986 to over one third of GB homes in 2006. HHIC estimates that 74% of gas boilers sold in the year to October 2009 were combi boilers and that combi boilers have represented over 70% of all gas boiler installations for a number of years.

Ownership of hot water tanks and combi boilers in GB

	`1986	**1991**	**1996**	**2001**	**2006**	**2008***
Number of GB homes	22.0m	23.2m	23.9m	24.8m	25.7m	26.1m
GB homes with a hot water tank	19.2m	20.2m	19.4m	18.4m	19.1m	19.1m
% of all GB homes	91%	90%	84%	77%	74%	73%
GB homes with a combi boiler	0.4m	1.3m	2.7m	5.2m	9.0m	11.0m
% of all GB homes	2%	6%	12%	22%	35%	42%

Source: ONS / DECC 'Energy Consumption in the UK 2008' / HHIC
** HHIC estimate*

The statistics are complicated by some homes having a ‘split’ system using both a combi and a hot water storage system , and some combis having a built in hot water storage tank. Ten years ago it was possible to identify a direct correlation between increases in combi boiler sales and reductions in hot water storage systems. This no longer seems to be the case, probably because any ‘displacement’ of storage by combis is now on a small scale with first and second generation replacement combis accounting for a significant proportion of the current combi sales.

The currently installed hot water storage systems can be broadly categorised into three types, namely vented copper cylinders, unvented systems and thermal stores.

Most of the installed population will still be traditional vented copper cylinders fed from a cold feed cistern which is normally in the roof space but might, particularly in small properties and apartments, be integrated with the hot water cylinder as a copper combination tank (not to be confused with a combination boiler).

In newer properties, typically built in the last 15 years the most likely product is a mains fed hot water storage system. The majority of these mains fed systems are unvented (secondary) systems but there are also thermal storage systems which store primary water used as a heat bank to produce hot water by means of either an internal or external domestic hot water heat exchanger. Dependant on heating system design the thermal storage systems also have the ability to act as a buffer tank for the space heating load and are a convenient means of integrating several heat sources as required.

6.3. The practical potential

The current high sales volume of instantaneous combi boilers bears witness to the fact that producing hot water on demand is perfectly feasible and generally acceptable to the consumer. Hot water efficiencies from these products are generally perceived to be good but the combis are currently categorised using their SEDBUK efficiency which is effectively a measure of their space heating as opposed to water heating efficiency.

A change to this situation is imminent due to the European EuP legislation when hot water efficiency will have to be declared separately.

The obvious and well marketed advantage of a combi boiler over storage is the lack of standing heat loss from a hot water cylinder. This potential advantage is in practice significantly diluted by the fact that a combi boiler has to fire up every time there is a demand (however small) for hot water which brings into play additional heat losses from the boiler itself.

The EuP directive will also apply to hot water storage systems so eventually there will be a more direct means of comparison. It is the view of the HWA as borne out by SAP comparisons, that there is little difference between the installed efficiency of a well designed instantaneous system and a well designed hot water storage system.

On this basis the main advantage of the instantaneous combi is that it avoids the space implications required for a hot water storage cylinder.

Whilst instantaneous combis are suitable for gas and to a certain extent oil, the other fuels have always required hot water storage due either to the lack of suitably high heat outputs and/or control response. In continental Europe, notably Germany, three phase electricity is available in the home allowing instantaneous electric water heaters with outputs above the circa 22 kW threshold generally required for a ‘whole house’ hot water performance that is acceptable to the consumer.

In the UK the vast majority of domestic water heating from electricity, oil and solid fuel is done using a hot water storage system.

Most electric water heating is via a 3kW immersion element typically using directly heated cylinders of around 200 litres capacity to make maximum use of lower cost and potentially lower carbon 'off peak' electricity. Cylinder sizes for solid fuel and oil are far more variable depending on house size and appliance output.

By far the most popular installed cylinder has a capacity of around 120 litres and is indirectly heated from the gas central heating boiler.

If we look towards the future then by far the main reason for using hot water storage will be its unique ability to 'harvest' and store the energy from low and zero carbon heat sources such as solar, biomass and heat pumps which generally share the characteristics of relatively low heat outputs which particularly in the case of solar, may not be available on demand.

At this stage it should also be noted that the need for hot water storage does not spell the death knell for combination boilers, they will however eventually need to be used in conjunction with hot water storage. Many 'hybrid' semi storage combis are beginning to emerge as are combis capable of taking feed water preheated by solar energy and/or flue gas heat recovery systems.

What are the potential obstacles?

The first and obvious problem is that the UK trend in the RMI sector to get rid of hot water storage needs to be reversed and even if a hot water cylinder is currently in place the chances are that future technologies will need a larger storage capacity with associated space constraints.

In the new build situation this space requirement can generally be accommodated at the design stage but many existing properties will present a significant challenge.

As mentioned earlier the EuP directive will shortly apply to all hot water systems, the details will depend on the type of appliance and its fuel.

In simple terms then if the water is heated directly by gas, oil or electricity a minimum appliance efficiency rating will apply. For indirect cylinders sold without a heat source then product labelling will be based on standing heat loss.

For electric water heaters the factor that will have the most impact on appliance efficiency will still be heat loss as is the case perhaps to a slightly lesser extent for the other fuels.

The net effect of the above is that the insulation thicknesses on hot water storage vessels of all varieties will have to be significantly increased which magnifies any space problems associated with the existing housing stock. By way of an example then a 'typical' UK home with a gas boiler has a factory insulated 120 litre indirect copper cylinder to BS 1566. This cylinder would be circa 930 mm in height and 500 mm in diameter.

To meet the likely first phase EuP requirements then either the diameter has to be increased to around 600 mm where it will not be suitable for the popular 500mm airing cupboard aperture or the height increased to above 1300mm to maintain an acceptable diameter. If we then factor in solar, then to meet Building Regulation and other similar guidance the capacity will typically have to be increased by an additional 100 litres and we have the situation where either the cylinder no longer fits the cupboard or fills it completely.

There will be situations mainly in existing properties where an informed choice will have to be made between meeting the EuP requirements and the potential benefits of adding renewables such as solar. Our concern is that the current EuP proposals are a 'blunt instrument' which in some circumstances may have a negative effect.

The UK (and Eire) is unique in its adoption of the airing cupboard and similar space restraints tend not to exist elsewhere. It is, in our view, the net effect in the carbon footprint of the house that should prevail but we see no such flexibility in the current proposals for storage cylinders.

One possible, albeit expensive, solution is of course to fit a second cylinder possibly in the roof space but this requires the use of a mains pressure system and often in older houses this creates a water supply problem due to small diameter feed pipes.

The second area of potential concern is that of microbiological growth, notably legionella. A change in the design of our hot water storage systems to utilise solar gain and other renewables can in some circumstances increase the amount of water being stored at temperatures known to support legionella growth. Whilst the risks and control procedures are well documented for public and commercial premises (HSE L8) there has been little or no published work carried out to assess the situation in typical UK domestic premises. For normal domestic installations the L8 design recommendations are clearly over onerous and the management procedures are unenforceable.

UK Industry is working on an installation guidance document covering the risk assessment of hot water storage systems and whilst the general view coming out of continental Europe is that there is no appreciable increase in risk we feel that some more 'official' formal work is required. There was a proposal by DEFRA/DWI last year to commission some work but we understand that this is no longer going to take place.

6.4. Required policy and market interventions to achieve the practical potential

From a hot water storage perspective the future looks bright with a hot water storage system likely to be at the 'hub' of most domestic hot water and heating systems.

The main short term challenge for industry is to develop better means of reducing standing heat losses without too much cost and/or space penalty. At present the typical 'stock' 120 litre cylinder has a heat loss of around 2.4 kWh/day as opposed to the somewhat 'challenging' 1.2 kWh/day (60 watts) proposed under phase 1 of the EuP Directive.

Hot water storage cylinders (whether secondary or primary) are being developed with the means to integrate several heat sources. Typical of the initiatives under way is the preparation of a guidance web site by organisations including HETAS, HHIC, HWA, OFTEC, STA and TEHVA[1]. This is likely to be launched at the ECO Build Exhibition in March and concentrates on how renewables can be added on to existing systems.

Hot water storage systems will be developed with far more sophisticated and 'smart' controls to control the optimum input of best available energy sources and react to optimise energy input in response to actual consumer demand for heating and hot water.

[1] www.resintegration.co.uk

Other solutions already in limited use elsewhere in Europe involve the use of alternatives to hot water as all or part of the heat storage medium. These include such technologies as phase change materials which have a greater thermal storage 'density' than water.

Finally where combi boilers are still the preferred option they should ideally be solar compatible to allow the easy future addition of a solar system.

Summary Points

- Need to reverse the current trend away from storage
- Space and increased cost implications which will arrive sooner rather than later due to EuP
- Advice on legionella guidance for domestic premises needs formalising
- Possible incentives for the fitting of solar (or other renewable) compatible cylinders
- Combi boilers should preferably be solar compatible to allow the future addition of a solar heated cylinder
- New build housing should be designed with a suitable space for a hot water storage system either on a single dwelling or possibly a communal basis in the case of apartments.

6.5. Sources of information on hot water systems

Sources
Office for National Statistics / Department for Energy and Climate Change 'Energy Consumption in the UK 2008' and '2009 Update'
Heating and Hot Water Industry Council / HHIC
Hot Water Association
OFTEC
Defra / TNS 'Public Attitudes and Behaviours towards the Environment 2009' (www.defra.gov.uk)
Defra / MTP / BRE 'Domestic Heating & Hot Water Consultation 2008' (Bruce Young)
DECC / Energy Saving Trust / BRE Domestic Energy Fact File 2008

7. Heating and hot water controls

7.1. Definition

The efficient operation of a home's central heating system can be enhanced through the use of controls. Heating controls comprise a time programmer and room thermostat or a combined programmable room thermostat, plus a cylinder thermostat if appropriate and thermostatic radiator valves (TRVs), although only a minority of homes have *all* of those elements.

7.2. The installed base

BEAMA has compiled statistics on the installed base of heating controls, based on Energy Saving Trust Home Energy Check data and housing stock data from the English Housing Condition Survey. Most homes with central heating have some kind of control technology in place, although in most cases it is less than the recommended level.

	Homes with non-condensing boilers		**Homes with condensing boilers**		**All homes with a boiler**	
	m	%	M	%	M	%
No controls	0.69	4	0.08	2	0.77	4
TRV (V) only	1.74	10	0.31	8	2.05	10
Programmer (P) only	2.34	14	0.24	6	2.60	13
P+V	2.00	12	0.44	12	2.41	12
Room thermostat (T) only	2.31	14	0.27	7	2.59	13
P+T	2.88	17	0.42	11	3.30	16
T+V	0.72	4	0.23	6	0.95	5
P+T+V	4.12	25	1.79	47	20.56	29
Total	16.78	100	3.78	100	20.56	100

Source: BEAMA analysis of EST HEC data and EHCS

This analysis suggests that, of homes with a boiler, 38% do not have any room thermostats, 45% have no TRVs and 71% are missing one or more control type.

	Homes with non-condensing boilers		**Homes with condensing boilers**		**All homes with a boiler**	
	m	%	m	%	m	%
No room thermostat	6.75	40	1.07	28	7.82	38
No TRVs	8.23	49	1.01	27	9.24	45
Missing one or more control type	12.66	75	1.99	53	14.65	71

Source: BEAMA analysis of EST HEC data and EHCS

Homes with condensing boilers installed are more likely to have controls installed (although over half of these still have at least one type of control missing), but homes with non-condensing boilers are particularly likely to have controls missing (75% have at least one type of control missing).

A key factor limiting the impact of heating controls is consumer *knowledge* and *behaviour*. There is evidence that many consumers do not use their heating controls efficiently, often because they do not understand how to use them.

7.3. The technical potential

The role of controls is to satisfy occupants' desire for comfort while using the least amount of energy. The technical potential for reducing the energy used in homes through heating and hot water controls, and allied communications technologies, can be delivered through the following:

Closer matching of heat delivery and hot water provision to actual usage requirements

For heating this would largely be through a greater focus towards zone control, allowing householders to only heat the parts of the house they require at a particular time (for example this might be only bedrooms, bathroom and kitchen in the morning yet most systems will currently heat the whole house.) With this principle established, additional control technologies can be applied to optimise the delivery of heating requirements in these zones, e.g. optimum start, load compensation / Time Proportional Integral (TPI) control, zone synchronisation, presence detectors etc.

For hot water control the challenge is to only produce the hot water that will be required at particular times of day. This can be done with technologies that learn demand patterns and focus on satisfying these only, rather than a common current situation where the boiler heats a hot water cylinder, irrespective of whether that hot water will be used.

The barriers to closer matching with usage requirements are as follows:

- The application of best practice zone control in existing homes is usually expensive due to the complicated changes to pipework that can be required. Such an approach is not even required for new systems in the 2010 building regulations so there is also likely to be a lack of installer knowledge to set and implement appropriate zones.
- There will need to be a more detailed interface to allow householders to set and manage zones. While suitable technologies are emerging there is a need for clarity on what such technologies will need to deliver and customer demand for such technology needs to be clarified – this would ideally be alongside the roll out of smart meters.
- Control management of hot water demand is complicated by system specifications. Combination boilers can deliver hot water on demand, but at the expense of boiler efficiency. Renewable technologies are likely to increase the requirement for hot water storage in the future, but customer expectations mean that there would almost certainly be a requirement for hot water 'on demand' so an efficient back up would be required alongside an intelligent control approach to deliver hot water at any time. Further industry work is needed to understand future system specifications and therefore develop the most effective control strategy.
- It is not possible to calculate the energy benefits of the control approaches described above using the current calculation methodology (SAP), although the fact that there will be savings from heating, say, 25% of a home in the morning rather than 100% should be self evident. Given that most policy approaches use SAP to determine suitability of technologies then this is a significant barrier.

Full interoperability of building services and micro-renewables

The likely trend for low carbon homes will be the adoption of a number of technologies to deliver a comfortable internal environment and services. This will include heating systems comprising a number of technologies, integration of different sources of heating (e.g. heating system, passive sources, ventilation), and combinations of fossil-fuelled and renewable heat sources. Controls are essential components to ensure that these technologies work together cohesively to deliver environmental solutions for the least energy use and carbon intensity. While many of these technologies are unlikely to be widely adopted in existing homes by 2020 it is still important that control solutions are developed, both for new zero carbon homes but also for the successful adoption of any technologies with immediate wider deployment potential (e.g. solar thermal) and to facilitate future integration in existing homes. There are a number of barriers to the development of suitable control solutions by 2020:

- It is not possible to calculate the energy benefits of the control approaches described above using the current calculation methodology (SAP.) This raises the possibility that the developmental and policy focus will be on development and application of appliances rather than effective 'system' solutions.

- There are potential conflicts in respect of control with appliances which increasingly have their own intelligence but necessarily assume that they will operate in isolation. The application of 'smart' controls with 'smart' applications can lead to operational conflicts. While it may be unreasonable for appliances to be 'dumb' and controls 'smart' there is a need for industry to develop open communication protocols and agreed operational parameters so that a 'plug and play' implementation is possible.

- The most likely application of such control solutions is through a 'smart home' approach facilitated by smart meters which will mean that most homes will have the opportunity for sophisticated control and communications technologies for their home. It will be necessary for industry to establish the role of heating controls as part of whole house control including security systems and also connection with the grid to select technologies depending on tariffs and carbon content of grid electricity at any particular time. This means that solutions will only be realised through the widest possible industry interaction (e.g. the BEAMA Smart Homes Association.)

Limiting of comfort levels to reduce individual 'behavioural waste'

It has been established that increasing internal temperatures are a significant contributing factor to increasing home energy use in the UK. It would be technically possibly to introduce control systems that limit internal temperatures to, for example, 20^{o}C and didn't allow the temperature to go higher, or to restrict the amount or temperature of hot water available in any given period. These measures would reduce the amount of energy used by the controlled heating system but there would be significant barriers:

- The market for controls that effectively restrict the choice of the occupants would be very limited. It is unlikely that manufacturers would see any market for such controls unless there was legislation for maximum temperatures/hot water usage.
- The principle of allowing consumers to choose their comfort conditions and make their own behavioural decisions is firmly embedded in UK culture and, indeed, in the policy approach for climate change.
- Even if forced to live with limits to internal temperatures it is likely that some customers would try to overcome this through system changes or use of portable heaters. The net effect is likely to be counter productive both in terms of actual energy consumption and public opinion regarding climate change policy.

The overall technical potential for controls by 2020 is very difficult to estimate given the uncertainty in deployment of other technologies at this stage and the aforementioned inability of SAP to make such assessments.

However, based on the potential from existing technologies outlined in section 1 above industry would confidently predict that full deployment could see a reduction in domestic energy use for heating and hot water of 30%.

7.4. The practical potential

Up to 2020, there are two significant areas that could be practically addressed to achieve energy savings through heating and hot water controls:

Bringing all existing homes up to the minimum standards for controls as specified in the 2010 building regulations (programmer, room thermostat and TRVs)

Work carried out by TACMA (The Association of Controls Manufacturers) with the Energy Saving Trust has identified the following:

- Nearly 8m UK homes with a boiler don't have a room thermostat.
- Over 70% don't reach the minimum levels of controls in the 2010 building regulations.
- Eight hundred thousand homes with a boiler have no controls at all.

This equates to a potential UK annual carbon saving of 4.3 $MtCO_2$ – about the same as the identified potential for loft insulation and a significant energy saving opportunity for Government. The bulk of these savings are from the application of room thermostats. SAP calculations currently assign very little savings to TRVs and none to programmers, although there is anecdotal evidence of people without programmers leaving their heating on all night so that the house is warm in the morning.

DECCs Home Energy Management Programme should focus on ensuring that all homes have a room thermostat and programmer by 2020. These are low cost, cost effective measures (a new room thermostat would typically cost £300 installed, with a two year pay back and, with a boiler interlock, achieves about the same annual savings as cavity wall insulation.)

Such a focus could also promote the easy replacement of older room thermostats with more efficient modern versions (such as TPI room thermostats) and encourage the use of programmable room thermostats. The expected annual savings by 2020 would be about 4 $MtCO_2$.

Actions required to achieve this are:

- Government to make a specific commitment in the HEM strategy to all homes achieving minimum levels of controls;
- Industry to develop customer messages and work with installers and energy suppliers to deliver easily accessible solutions.

Increasing the controls requirements in the 2013 building regulations to require best available technology in zone control

This would encompass the technology outlined in the section on technical potential for all new and replacement boilers installed. The impact by 2020, over and above the current building regulations requirements, would be considerable.

Actions required in this area are:

- Industry to specify suitable, achievable control solutions that can be appropriately applied for new systems and replacement boilers under the 2013 building regulations;
- Government to agree the final specifications for the 2013 building regulations.

7.5. Required policy and market interventions to achieve the market potential

Key areas in which policy and market intervention can help to stimulate the installation and use of controls are:

- It should be a target under the DECC Home Energy Management Programme for all existing homes to have a cost effective upgrade to their heating and hot water controls up to the minimum level in the 2010 building regulations.
- The current calculation methodology needs to be reviewed to more effectively calculate the benefits of controls. In the shorter term, 'bonus' scores for controls could be introduced in CERT and CESP to encourage the provision of incentives.
- Industry and Government should work together to provide more prominent and compelling communications on the benefits of controls to consumers.
- Installers need to be mobilised to advise on control solutions and to support greater uptake by their customers. They could be supported through more independent validation of the benefits and even through a fee paid to accredited installers to provide an advice survey. This could be tied in with the CLG advice package for heating systems and funded out of existing advice budgets.
- A suitable controls specification must be agreed between industry and Government and implemented for the 2013 building regulations.
- There is also still a considerable amount of work to be done to ensure that householders are instructed on how to use those controls effectively.

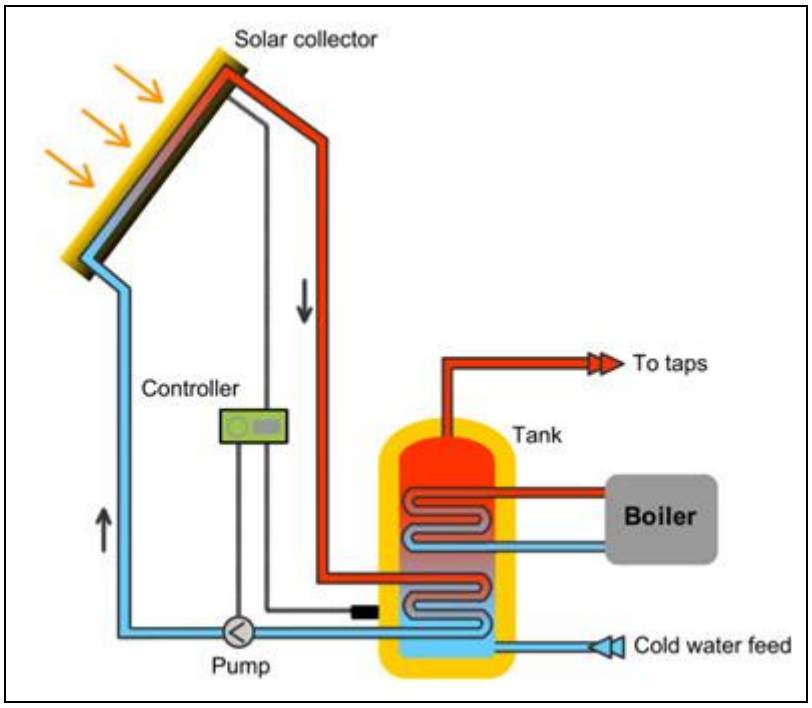
7.6. Sources of information on controls

Sources
Office for National Statistics / Department for Energy and Climate Change 'Energy Consumption in the UK 2008' and '2009 Update'
BEAMA
TACMA
Defra / MTP / BRE 'Domestic Heating & Hot Water Consultation 2008' (Bruce Young)
DECC / Energy Saving Trust / BRE Domestic Energy Fact File 2008
Energy Saving Trust Home Energy Checks (HECs) 2008/9

8. Solar thermal

8.1. Definition

The main domestic heating microgeneration technology that has been utlised to date in the UK market is solar thermal. Solar thermal technology converts sunlight to heat, usually in order to heat water.



Source: Solar Trade Association

8.2. Current number of installations

Solar thermal technology accounts for the majority of microgeneration installations to date. Consultancy *Element Energy* estimates that, as of 2008, the total cumulative installed units of solar thermal technology units in the UK numbered around 90,000, equivalent to 90% of an estimated 100,000 microgeneration installations installed in total (*Source: Element Energy 'Growth potential for microgeneration 2008'*).

Annual sales are low, and Element Energy estimates the number of units installed in 2007 to be only around 5,000 - 6,000 (*Source: EEPH 'An assessment of the size of the UK household energy efficiency market 2008'*).

HHIC and the STA believe that this analysis dramatically underestimates the number of solar thermal installations per annum. Based on manufacturers' sales data, the total volume of solar panels sold is as follows, noting that the standard method of expressing sales of these products in Europe is in square metres of panel (aperture area).

Solar thermal sales (m2)

	2007 Q3 – 2008 Q2	2008 Q3 – 2009 Q2
Flat plate collector	27,207	36,267
Vacuum collector	5,170	5,111
Total aperture area (m2)	32,377	41,378

Source: Heating and Hot water Industry Council

On average each domestic installation requires approximately 3.75 square metres of panel. On that basis we might estimate that the industry sold enough solar thermal panels for 8,600 homes in the year 2007/8 and 11,000 in the year 2008/9. The HHIC figures do not currently include all of the STA manufacturer or importer company totals, so are therefore only representing the share of the market that is covered by the traditional boiler companies. This is in the process of being rectified, however it is likely that the true figures are much higher than even the HHIC data suggests.

Some industry sources estimate that 25,000 to 30,000 systems are being installed each year. It is known that a large part of the solar thermal industry is operating outside of the various trade bodies such as the STA and the HHIC, and are therefore not included in the above figures. This missing part could be equivalent to that being counted, as all of the direct sales companies which are the most active in this area are not included.

The main supplier of solar controllers into the UK market sold some 10,000 controllers during the 2008/9 period. This supplier estimates that they have an approximate 40% market share. If this market share is correct, it would indicate 25,000 units per annum and the STA submits figure similar to this for annual sales to its European sister association ESTIF (www.estif.org) who publish this data annually on their website.

The LCBP Phase 1 programme funded the installation of 5400 solar thermal systems up to September 2009, with a total area of 20,000m2. In excess of 80% of these installations were carried out using products not currently monitored by HHIC for data collection purposes. There may be a lag between the sale of products by manufacturers and the installation in homes.

Nevertheless, in light of controller sales, an estimate of around 25,000 home installations in 2008/9 does not seem unreasonable.

8.3. Technical potential

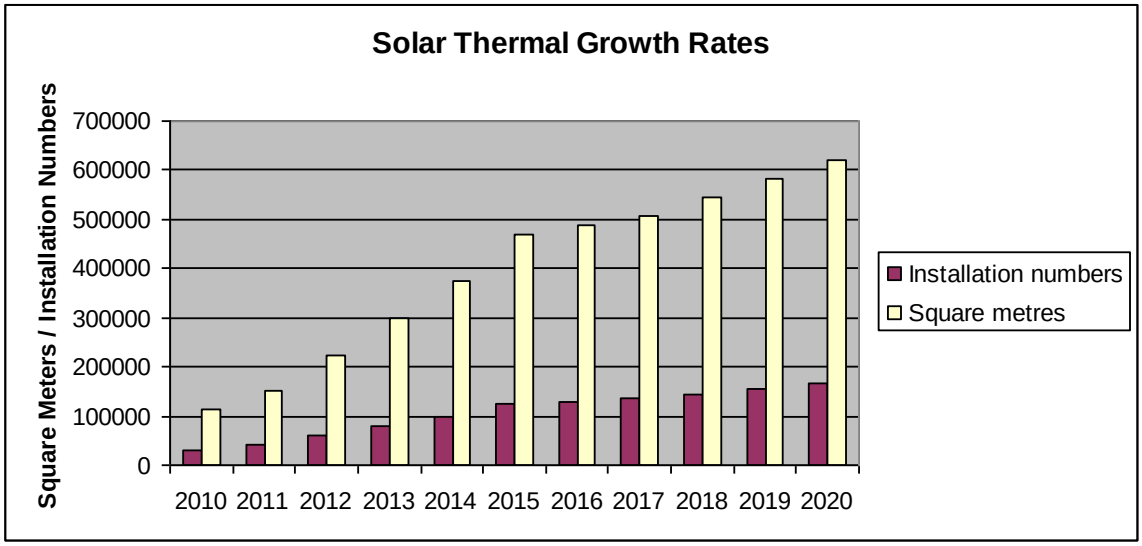
Of all of the micro-renewable technologies solar thermal is one of the easiest to retrofit onto an existing home. Any home with a south, east or west facing roof is a potential candidate for the technology. Ideally homes looking to have solar thermal installed will have a hot water storage system already in place, but those with combination boilers can be retrofitted to accept solar thermal systems.

It is likely that in excess of 70% of UK homes will be appropriate for solar thermal technologies, having space for mounting the collectors on the roof, and also water storage or space for water storage to be added. Flats can also often be fitted with communal solar thermal systems. The Solarge project (http://www.solarge.org/) has more information on these market opportunities. This therefore means that there is the potential for 16.8M or more solar thermal installations in the UK. If all of these systems were average water heating systems this could equate to 63M m^2 of collector.

This potential only covers traditional water heating solar thermal scenarios, and does not make any suggestion as to the size of the potential market for solar space heating solutions, which are becoming very common in solar leading countries such as Germany. To put these figures in context, Germany at the end of 2008 had 8,994,000 m^2 of installed solar thermal capacity, Austria had 2,892,627m^2 (Source ESTIF Solar Thermal Markets in Europe 2007).

8.4. Practical potential

Looking at installation rates for solar thermal in other European countries we can see that in 2008 in Germany they installed in excess of 1M m2 of collector, with France, Italy, Spain and Austria all installing in excess of 250,000 m^2 in the same year (Source ESTIF Solar Thermal Markets in Europe 2007). Our current level of British ambition for solar thermal indicates that in 2020, the UK will install fewer solar thermal systems than Germany installed in 2010.



The current main practical restrictions on achieving very significant growth in solar thermal are twofold.

- The first is achieving the correct financial incentives to reduce the installation costs; and the second is training and accreditation of enough installers to meet the growing demand, whilst maintaining the quality. Hopefully the Renewable Heat Incentive will remove the first barrier in April 2011.

- The second main barrier of installer training is being addressed. Installer training is available and environmental training is beginning to be included in heating, plumbing & electrical apprenticeships. Solar thermal design training is coming to the UK market. However, as well as the above, microgeneration training needs to be prepared for architects, specifiers, housing associations, local authorities, planning permission officers, building control officers, builders merchants, the construction industry, building surveyors, home advisors and any other interested parties.

The MCS and CPS schemes still cause concern because a much higher standard is required to install microgeneration as compared to a fossil fuel system such as OFT code of ethical practice, Quality Management System and accredited products. Whilst the microgeneration industry is fully behind the quality benefits of these accreditation systems it also recognises that a playing field that sets lower standards for the fossil fuel industry will discourage the uptake of microgeneration.

8.5. Current Drivers

The key driver for the uptake of solar thermal technology has been the simple and effective technology itself. In the UK there are in excess of 100,000 households who already have this technology, who have generally begun using it for a mixture of reasons; both environmental concern as well as financial benefit.

Financial support has been available through a number of routes:

- The DECC funded Low Carbon Buildings Programme, which offers grants for the installation of renewable and low carbon technologies, and previously the Clear skies program. In Scotland the Energy Saving Scotland home renewables grant scheme (previously known as SCHRI) provides grants for properties in Scotland. The LCBP Phase 1 programme funded the installation of 5400 solar thermal systems up to September 2009, with a total area of 20,000m^2

- The installation of solar thermal is also an eligible measure under the Carbon Emissions Reduction Target (CERT). However in the first six quarters of CERT only 216m2 of solar thermal installations was installed (*Source: Office of Gas and Electricity Markets / OFGEM Quarterly CERT reports*). That is equivalent to around 60 homes.

Installation of renewable technologies in *new homes* is a very feasible option (disruption to the household is no longer relevant), although issues around cost are still pertinent. According to STA estimates, the installed cost on new build is about 60% of an existing home as the cost of the scaffolding and cylinder is allocated to the new building rather than to the solar thermal installation.

CLG has proposed that from 2016, all *new* homes built in England should be zero carbon (i.e. will not account for any net emissions). To achieve that target renewable technologies will need to be used and in a balanced market the most promising role for renewable technologies may be the new build sector.

Indeed building regulations provide a framework that, coupled with targets for higher standards, will promote the installation of some type of renewable energy or solar heating system. It is worth noting that all homes require a hot water system and that insulation levels do little to alleviate hot water energy requirements. Solar thermal is the main renewable technology for meeting household hot water needs and the technology easily integrates with every other microgeneration and system boiler technology.

For existing homes, however, renewable technologies are expensive and disruptive and the rate of adoption by UK householders is low. In the UK microgeneration technologies are at an ‘early adopter’ stage in their lives (although it is worth noting that the market for many microgeneration products is more mature in other countries). This situation is unlikely change unless the issues discussed below are addressed.

8.6. Barriers and proposed solutions

There are a number of barriers to achieving the practical target, which are summarised below with our proposed solutions.

Incentives

Barriers	Solutions
○ The expense of purchase and installation – sales of solar thermal (and of microgeneration technologies in general) are currently low and so there are few economies of scale that would be associated with mass-market products; ○ The long payback period on capital expenditure; ○ The low number of installations carried out to date has meant that equipment suppliers and installers have had little incentive to invest in the sector.	○ The RHI needs to come in as proposed and give consumers and companies the comfort to make the investment. It should be aiming to provide a similar return to the FIT mechanism of around 10% ROI ○ The period before the introduction of the RHI needs extra incentives on the LCBP1 grant to increase the uptake and start the industry growing in advance of the launch of the tariffs. ○ Currently solar grant is £400 and this needs to be £1000 to £1500 or more to remove cost barrier. ○ Pre-capitalisation of the tariff will be important to achieve take up, some serious thought needs to be given to the provision of low-interest loans.

Installer Capacity

Barriers	Solutions
○ The existing building services and construction industry needs to be upskilled to include on-site renewable technologies as part of their skills portfolio. ○ As well as existing installer training, a portfolio of training measures needs to be established for apprentices, design engineers and all relevant stakeholders ○ Good accreditation schemes are a key part of the high quality delivery. However, the current plethora of accreditation schemes such as MCS and CPS acts a block rather than a market benefit	○ An alliance with the relevant Sector Skills Councils such as Summitskills and Construction Skills, role out high quality QCF unit based apprentice, installer, designer, relevant stakeholder training. The solar industry has taken the lead in this sector and so this is an extension of current work rather than new initiatives. ○ Rationalise the accreditation schemes in the building services industry. This might be a scheme such as a licence to practice or something similar. It has to set a level playing field for all technologies.

Planning and New Build

Barriers	Solutions
○ Planning laws have, before the introduction of permitted development, tended to restrict developments; ○ Permitted development right need to be extended to schools and public buildings (including social housing). ○ Low carbon technologies are often favoured over zero carbon technologies. ○ In the longer term, it will be necessary under carbon targets to obtain as much zero carbon energy as possible and top up with low carbon technologies	○ Continue the revision of planning laws to allow solar thermal developments to be a permitted development in a wider range of applications ○ Introduce a technology full sighted decision process that recognises the importance of zero carbon technologies before low carbon technologies.

Public Education

Problems	Solutions
○ Lack of promotion and therefore low public awareness of the benefits of microgeneration technologies generally. ○ Misleading and confusing information appears in relation to solar thermal technologies both from public sources (such as EST) and others such as individual companies. We need to make sure that industry and Government deliver the same message rather than one section overselling and vice versa, the other section underselling these technologies.	○ Industry and government need to collaborate on an information portal for all the renewable technologies that give consistent information as to their benefits and limitations. ○ A general public awareness campaign needs to be undertaken to show that government endorses these technologies. ○ A very public campaign of installing these technologies on Government buildings would give the general public confidence in their efficacy.

8.7. Sources of information on solar thermal

Sources
DECC / NERA / AEA: 'The UK Supply Curve for Renewable Heat 2009'
Energy Efficiency Partnership for Homes / Element Energy: 'An assessment of the size of the UK household energy efficiency market 2008'
Energy Saving Trust: 'Generating the Future: An Analysis of Policy Interventions to achieve widespread Microgeneration Penetration'
Element Energy 'Growth potential for microgeneration 2008'
HHIC (www.centralheating.co.uk)
Solar Trade Association (www.solar-trade.org.uk)
BEAMA (www.beama.org.uk)
Office of Gas and Electricity Markets / OFGEM Quarterly CERT reports (www.ofgem.gov.uk)

9. Heat pumps

9.1. Definition

Heat pumps are a key microgeneration technology. Electrical energy is used to pump renewable heat energy from the environment, mostly to meet space heating requirements but also to heat water.

Heat pump systems are available in a variety of types and combinations. For heating purposes, they can be divided into basic types, determined by the source and the destination of the heat and the medium that the heat pump uses to either absorb or reject the heat in each of these locations.

At either of the heat exchangers the heat transfer media can be either liquid (water, or often a glycol mixture) or air. Sometimes it is a combination of the two. In describing the type of heat pump, generally the heat source is provided first, followed by the destination or heat sink.

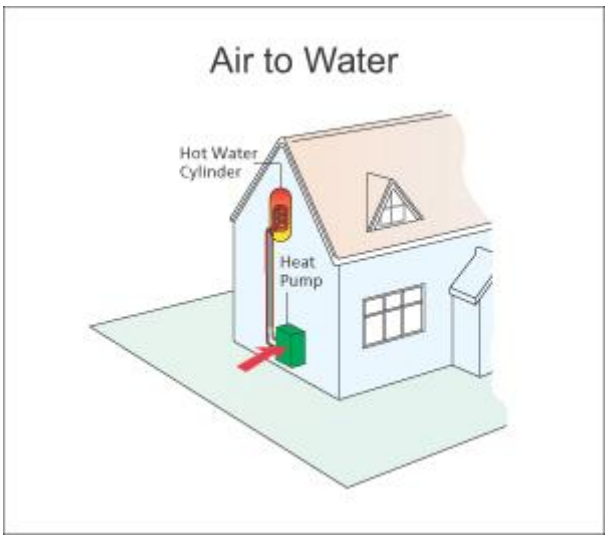
The main variations in common use are:

- Air to Air
- Water to Water
- Water to Air
- Air to Water
- Ground to Water
- Ground to Air

The two main alternatives for domestic heating and hot water are air source heat pumps (air to water) and ground source heat pumps.

Air-source heat pumps

'Air to Water' systems use the heat energy contained in the outside air and its vapour as a source of free heat. Heat is absorbed from the outside air and delivered to a water based indoor system of radiators or fan coils.

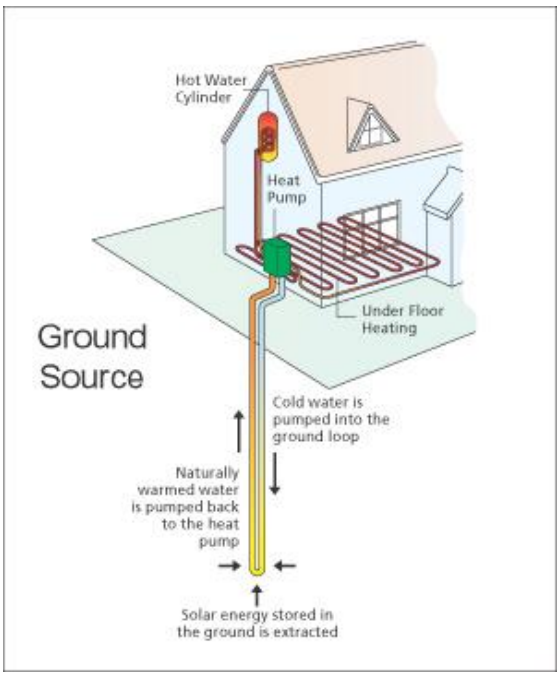


Source: Heat Pump Association

Ground-source heat pumps

With ground source heat pumps, heat energy is extracted from the ground using closed pipe loops buried horizontally in trenches or in vertical boreholes that are connected back to the heat pump. The fluid circulating in the closed loop will normally be a water/propylene glycol or acceptable equivalent antifreeze mixture, however, some direct acting ground-source heat pumps will use refrigerant in the closed loops.

Heat is introduced to the dwelling and distributed either to a water heating system (ground to water heat pumps) or to an air distribution system (ground to air heat pumps).



Source: Heat Pump Association

9.2. Current number of installations

Heat pumps are a key microgeneration technology. The two main alternatives for domestic heating and hot water are air source heat pumps (air to water) and ground source heat pumps.

There is considerable uncertainty over the number of heat pumps currently installed and likely future installation rates.

BEAMA has estimated that the installed base of heat pumps, as of early 2009, is approximately 15,000, most of which are ground source heat pumps (we have assumed around 90%).

Air-source heat pumps are believed to be more suited to the UK environment and BEAMA therefore estimates that they will account for almost half of heat pump sales by end of 2010 quarter 1. Based on BSRIA statistics and using a notional uplift for BEAMA and HHIC members not contributing to the BSRIA analysis, BEAMA estimates that sales of heat pumps in the year 2009/10 will be around 12,000-14,000, of which only around 10% will be ground-source heat pumps and 90% air-source heat pumps.

Projected installed base of heat pumps 2010

	Installed base as of early 2009	Projected sales for 2009/10	Total predicted installed base early 2010
Ground source heat pumps	13,500	1,300	14,800
Air source heat pumps	1,500	11,700	13,200
All heat pumps	**15,000**	**13,000**	**28,000**

Source: BEAMA estimates (based on BSRIA data) 2009

9.3. Technical potential

A domestic heat pump (air and ground to water predominantly) has the technical capability to provide heat and hot water for every home in the UK.

The technology potential to date has been constrained by the ethos of requiring low temperature heat emitters to distribute the heat around the home. Modern heat pump technology is capable of reaching higher temperatures but this is still a developing situation so the technical potential remains pinned to the minimum differential between source and sink temperatures.

9.4. Practical potential

It is not *practically* feasible to replace every heating appliance in the UK with a heat pump due to a number of technical and market constraints:

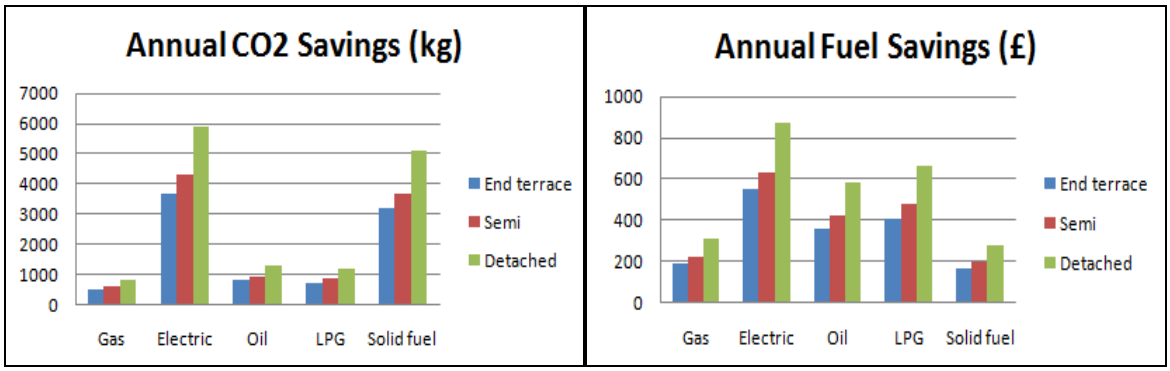
- Space to accommodate the heat pump (or loop for ground source)
- Ability to retrofit low temperature distribution systems (underfloor/skirt heating or oversized radiators)
- The CO2 intensity of grid electricity must be 0.48kg CO2/kWh or lower to ensure a heat pump with a CoP of 2.5 performs better than a gas boiler[2]
- The current cost of a heat pump is difficult to justify versus a gas boiler against current savings (without a high level of return through the Renewable Heat Incentive)
- There is not enough installation capacity in the sector to enable a large scale switch from gas to heat pump heating
- Absence of any field data to demonstrate the noise implications of large scale installation in terraced/high density areas

Due to supply chain training constraints (currently only low hundreds of installers) and the profile of the UK housing stock (c. 48% flats and maisonettes), it is unrealistic to estimate the technical potential of a complete switch to heat pumps – although it should be noted that multi-residential applications may be served by community scale heat pumps.

[2] The Committee for Climate Change estimates UK reaching a little over 0.3kg CO2/kWh by 2020 but is around 0.5-0.54kg CO2/kWh in 2010

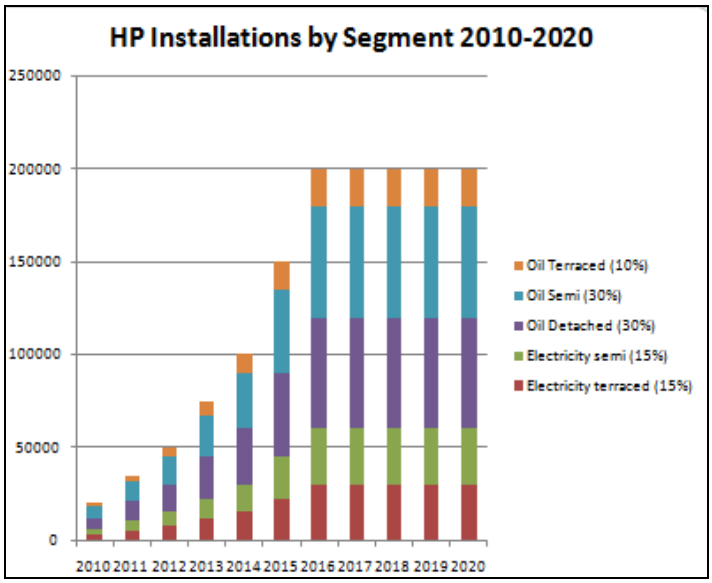
It must also be recognised that 1.3m boilers are sold each year with a mature low cost offering that has resulted in over 20m homes with gas heating penetration and an installer base of over 61,000 installation companies in the 'comfort zone' of a tried and tested product with repeat business potential.

The primary target for heat pumps up to 2020 are the 'off gas' dwellings. The CO2 and fuel bill savings potential is most compelling based on current knowledge:



Source: EST advice fact sheets 2009 (based on air source heat pump at CoP 2.5)

BEAMA estimates that the off gas replacement potential is significant. Around 16% of heat and hot water fuel consumption is from gas alternatives (2007), largely oil and electricity. For this reason, BEAMA has focused its market potential to 2020 on oil and electricity replacement and assessed CO2 savings against a replacement potential from the graph below.



Based on the above graph and reaching 200,000 installations of heat pumps per annum by 2016, the CO2 savings potential is 9.8MtCO_2. Thus the total installed base in 2020 would be approximately 1.2m. However, to achieve the 200,000 per annum figure, market conditions would need to increase the oil replacement market from the current 100,000 units per annum to provide a realistic share for heat pumps and there would need to be a programme of replacing electric heating that is sufficient to subsidise the cost of adding heat and hot water distribution systems where these do not exist currently.

It is worth noting that this does not include new build potential. Many new build installations are on the gas network and policy appears to be shifting towards central plant and community systems. Predicting new build potential is difficult as there would need to be a change in planning practice and many planning authorities do not yet perceive heat pumps to be renewable which holds back individual and community scale schemes. Also, there has been significant down turn in the new housing sector and whilst public sector housing has held up versus private, the forecast 2009 completion rate of 105,000 is a reduction of around 38% overall. If we assume a rise back to 150,000 by 2015 then we may see additional annual volumes of around 50,000 assuming the 2006 detached and semi detached figures and a steer towards renewable heat in larger dwellings with lower heat demand than currently but above the 'electric heating' solution for flats and terraced dwellings.

9.5. Barriers and proposed solutions

There are a number of barriers to achieving the practical target, which are summarised below with our proposed solutions.

Installer Capacity

Barriers	Solutions
○ Currently in the low hundreds, the installer base would need to increase to 8,000 individuals with 4,000 teams of 2 to achieve 200,000 heat pump systems per annum ○ Heating installers have an existing heat market to work from and additional costs of market entry with schemes such as MCS need to be removed or reduced to encourage training and capacity building Heating installers tend to be small businesses and training and accreditation means lost business which needs subsidising ○ Heating installers are confused with regards to training and accreditation requirements for installing heat pumps and need support to identify a training path ○ It is not clear that the level of RHI or its planned implementation in 2011 is driving a significant volume of installers towards MCS (still with only low hundreds of installers)	○ Industry finalise Qualifications and Credit Framework (QCF) for heat pumps and prepare draft qualification units with Summit Skills in 2010 ○ Fundamental review of MCS backed by installer research with a view to MCS aligning with training and qualifications and switch emphasis to training, competency rather than business process. This must be completed before the RHI launch in 2011 to ensure scheme success. ○ Government work with industry to develop a standard 'How and why to get into Renewable heat' course to be rolled out by heat appliance manufacturers in the main – similar to the previous energy efficiency course process ○ Create a web portal funded by Government to signpost training pathways for heat pumps (and other emerging technologies) ○ Provide incentives for training course attendance to encourage capacity building ○ Industry to report regularly to Government on capacity building progress and share market statistics to correlate installer growth with increased sales (this could also apply to other emerging technologies)

Planning and New Build

Barriers	Solutions
○ Planning authorities do not consistently view heat pumps as renewable and cannot calculate the renewable content of heat pumps ○ A new building lasts for 60 years in policy terms yet is assessed for regulations using current fuel carbon emissions which has a negative impact on heat pump emission ratings and is not a long term sustainable option fitting with the smart grids outlook	○ Develop and issue a heat pump specific guide for planners incorporating the Renewable Energy Sources Directive (RESD) formula ○ Incorporate the guide into broader planning guidance in support of the RESD. ○ Adapt SAP to enable calculation of the renewable content of heat pumps for the planning and specifying process ○ Review the grid emission figures in SAP 2009 and ensure these are 'future proofed' suitably to encourage heat pump growth

Incentives

There is also some financial support available. The installation of heat pumps is an eligible measure under the Carbon Emissions Reduction Target (CERT). Of all the microgeneration measures carried out in the first six quarters of CERT (estimated at just under 900), the majority (803) were installations of ground source heat pumps.

Number of heat pump installations in first six quarters of CERT

	Installations of ground source heat pumps
Year 1 2008/09	545
First six months of second year 2009/10	258
Total	**803**

Source: Office of Gas and Electricity Markets / OFGEM Quarterly CERT reports

However this remains only a small number of installations compared to other measures under CERT, such as cavity wall and loft insulation (almost two million measures combined).

As for solar thermal, financial support is also available through the Low Carbon Buildings Programme and the Energy Saving Scotland home renewables grant scheme in Scotland.

Barriers	Solutions
○ The current incentive arrangement under CERT does not provide enough impetus for suppliers to promote heat pumps or customers to take them up when funded. ○ The default CERT figures must be linked to SAP Appendix Q savings linked to MCS to maximise claimed savings	○ Have a long term approach to linking incentives to SAP Appendix Q and MCS such that all the technology benefit is funded and not an assumed low level default ○ Although the Renewable Heat Incentive is still unknown, industry has advised Government that the typical payback required by the customer for the additional renewable heat investment is no more than 5 years

9.6. Longer term issues to 2050 as we progressively switch to heat pumps

The following are issues that need to be considered in the policy context for 2020 – 2050:

- How must heat pump growth track the investment in a stronger electricity network to avoid load issues?
- What new tariff arrangements are required to support heat pumps and their potential for load shifting within a smart grid structure?
- What mechanism is required to migrate the gas installer network to install heat pumps?
- When will heat pumps reach price parity with the gas equivalent to provide natural incentive for purchase?
- Do models such as SAP need to change the way they calculate heating performance to assume heat pumps with bivalent support from electric heating or other form of heat production

9.7. Sources of information on heat pumps

Sources
'Domestic Energy Fact File 2008' – BRE / Energy Saving Trust / DECC (this report in turn sources data from GfK Home Audit, Digest of UK Energy Statistics and BREHOMES / English House Condition Survey
DECC / NERA / AEA: 'The UK Supply Curve for Renewable Heat 2009'
Energy Efficiency Partnership for Homes / Element Energy: 'An assessment of the size of the UK household energy efficiency market 2008'
Energy Saving Trust: 'Generating the Future: An Analysis of Policy Interventions to achieve widespread Microgeneration Penetration'
Element Energy 'Growth potential for microgeneration 2008'
Heat Pump Association (www.heatpumps.org.uk)
BEAMA (www.beama.org.uk)
Office of Gas and Electricity Markets / OFGEM Quarterly CERT reports (www.ofgem.gov.uk)

10. Micro CHP

10.1. Installed base

CHP is an effective carbon/energy saving technology in which heat and electric power are produced simultaneously. MicroCHP is defined (by Government) as CHP with an electric output of less than 50kW. However for domestic use we are really only considering products with an electric output of up to about 5kW and the real mass market is for products with an output of about 1kW, suitable for use in individual homes. In reality these are boilers which also produce electricity for use either directly within the home or which can be exported to the grid.

There are in fact a number of microCHP products suitable for the domestic market. These relate the power generation technology within the product.

- Internal combustion engine driven generator – some available now but limited potential in UK homes because power outputs are generally above 1kW and physical size.

- Stirling engine driven generator – one floor standing product available now, wall hung products being introduced to the market from Spring 2010. Potential for mass market take up particularly in existing homes.

- Organic Rankine Cycle generators – first wall hung product expected to become available later in 2010. This will largely compete in the same market as the Stirling engine products

- Fuel Cells – First products expected to become available in 2011 and these will be wall hung units. The main advantage of a fuel cell is that is ratio of power to heat is significantly higher than the other technologies. This the extends the potential market to low and very low heat loss homes i.e. new build. Fuel cells are also well suited to the existing home market.

Consultancy *Element Energy* estimates that, as of 2008, the total cumulative installed units of micro-CHP units in the UK number less than 1,000, although the wide range of estimates given are illustrative of the lack of robust data on microgeneration technology installations.

Annual sales are low, and Element Energy estimates the number of units installed in 2007 to be less than ten.

Micro-CHP units installed

Grid-connected micro-CHP units installed	Estimated units installed
Units installed up to 2007	200-1,000
Units installed in 2007	<10

Source: EEPH 'An assessment of the size of the UK household energy efficiency market 2008'

10.2. Technical potential

Benefits

Although generally considered a heating technology, microCHP delivers energy and carbon savings through the local generation of electricity at very high efficiencies. The power generated can either be used directly in the home or exported. The accepted CO2 savings from a microCHP product over a Band A boiler is 700-800kg/annum. (For comparison the saving in CO2 from replacing a Band G with a Band A boiler as in the scrappage scheme is 1260 kg/annum).

The typical electrical power output of a microCHP unit in a home is 1 kW and so every million homes equipped with microCHP would effectively provide 1GW of low-carbon generation capacity. In addition, microCHP systems generate power when there is a demand for heat and hot water. This is precisely when grid-supplied electricity demand is at its highest and when grid carbon intensity is at its maximum. This will therefore help both reduce the pressure on the grid at peak times and the need for less efficient power stations.

MicroCHP is essentially a boiler replacement product and the consumer would see the product as a boiler. With 98% of UK boiler sales being wall hung products, the importance of the availability of wall hung microCHP products is self evident.

Since it is a boiler replacement the route to market is already well established. With over 1.5 million gas boilers installed in UK homes each year (most of which are replacements) the potential market is huge. Also as a direct boiler replacement there is likely to be less installer and consumer resistance compared with other low carbon technologies.

MicroCHP has been said to have the greatest mass market potential of any emerging low carbon domestic microgeneration solution. Studies have shown that microCHP could displace as much as 90% of existing boiler sales.

By 2020 the technical potential is sales of 900,000 units per annum with as many as 4.0 million actually installed in UK homes.

Barriers to technical potential

- The most significant barrier is the cost of the products. This will be a particular challenge during the first few years of introducing the product to the market and until volume production and mass market sales are achieved. MicroCHP manufacturers are forecasting that the premium for some microCHP products compared with a condensing boiler may be as little as £500 but only with volume production. At this cost then no financial incentives will be required. The challenge is therefore to stimulate the market to enable volume production and this will require financial support. Manufacturers will continue to invest market development but the level of investment that they will be able to provide will inevitably mean a very slow penetration. The Feed in Tariff mechanism is the most appropriate means of supporting mCHP because it generates electricity and the industry is currently campaigning for its inclusion with an appropriate reward to help kick start the market.

- At present there are limited numbers of products available on the market. If microCHP products are to take a major share of the boiler market there will need to be a good number and range of products available. There are plenty of products under development but manufacturers need to see the emergence of a market before committing major investment accelerating product development and quickly bringing products to market. A commitment by Government to encourage the development of a market for microCHP (including the provision of incentives such as through the FIT) would encourage this investment.

- Installer resistance: Whilst this is likely to be less than for other technologies it will still be a significant factor affecting the uptake of microCHP. (The attitudes and behaviours of installers was a major barrier to the use of condensing boilers prior to changes to Building Regulations in 2005 and the associated training of installers funded by Government and delivered largely by industry). For a skilled installer of boilers the additional skills and knowledge needed to install microCHP are small. The crucial need will be to educate installers to understand how microCHP works and its benefits and to overcome fears and instil confidence about the new technology.

- Some consumer resistance will also be inevitable but much of this can be overcome with an educated installer work force.

- SAP and nationally accepted performance measures are all built around traditional technologies and ways of doing things. They often do not easily accommodate new products and technologies and often do not fully credit and reward the performance and savings delivered. This is certainly true or microCHP. The attitudes of the organisations that are responsible for these systems can also be a barrier and in particular the pace they are prepared to work to make changes. MicroCHP needs performance assessment systems which fully take into account and reward performance and more flexibility and pace of change by the organisations responsible

- The Microgeneration Certification Scheme could become a major barrier to the take up of microCHP. Over 1.5 million boilers are safely and effectively installed in UK homes each year using existing and well established routes for product and installer certification. With microCHP a boiler replacement product, MCS will only add bureaucracy and cost with little or no benefit.

10.3. Practical potential

The *practical* potential is very dependent on policy intervention and in particular the availability of financial support to kick start market take up. With limited policy support sales are only likely be in the range 50-100,000 units per annum by 2020. With strong policy support the 900,000 units per annum is achievable, giving a total installed base of 4m units.

10.4. Key interventions required

- Feed in Tariff mechanism needs to include microCHP from its introduction in April 2010 with an appropriate level of support. The industry has requested a generation tariff of 15p/kWh and plus the export tariff. The industry understands Government concerns about possible run away costs if the market takes off very quickly during the first period of the Feed in Tariff and has proposed review and capping measures for inclusion within the policy.

- Promotion of microCHP as a cost effective carbon and energy saving measure within other Government policy measures affecting the heating industry, HEMs. PAYS etc.

- Building Regulations: Use opportunities to raise minimum efficiency standards in Building Regulations in future revisions of Part L to require the installation of higher efficiency products such as microCHP, passive flue gas recovery. Clearly such a move would not be possible until there are sufficient ranges of products available at the right price and performance and that there is sufficient experience with them. It is this type of regulatory intervention that will deliver the high potentials. (Note the impact to raise the proportion of condensing boilers from 10% to over 90% in three years).

10.5. Sources of information on micro-CHP

Sources
DECC / NERA / AEA: 'The UK Supply Curve for Renewable Heat 2009'
Energy Efficiency Partnership for Homes / Element Energy: 'An assessment of the size of the UK household energy efficiency market 2008'
Energy Saving Trust: 'Generating the Future: An Analysis of Policy Interventions to achieve widespread Microgeneration Penetration'
Element Energy 'Growth potential for microgeneration 2008'
HHIC (www.centralheating.co.uk)
Office of Gas and Electricity Markets / OFGEM Quarterly CERT reports (www.ofgem.gov.uk)

11. Solid fuel technologies

11.1. Available technologies and the installed base

Solid fuel heating systems generate heat by burning wood pellets, chips or logs. Heat is produced either from a stand-alone stove or from a boiler burning pellets and connected to a central heating and hot water system.

Biomass heating usually involves the use of commercial energy crops in the form of organic materials such as plants or fast-growing trees such as willow or popular or waste wood products such as sawdust, pallets or untreated recycled wood for pellets.

There is considerable uncertainty over the number of homes with solid fuel heating technologies installed, but it is believed by industry groups such as HETAS and the Stove Industry Alliance (SIA) to be small.

HETAS estimates that there are approximately 1,500 biomass boilers installed in domestic properties as of 2009, although there is again considerable uncertainty over that figure.

The Stove Industry Alliance, whilst predominantly focused on stoves, does cover manufacturers of stoves with boilers and some freestanding boilers. Data is not collected from all manufacturers with an interest in the UK but based on the data collected it is estimated that around 150,000 units were installed in 2009, mainly stand alone stoves.

The number of installations is expected to fall or stabilise in 2010 due to the recession.

The 2009 whole year figures for jobs notified to HETAS by installers, and one month Jan 2010 are as follows (percentage of types of appliance notified by HETAS Registered installers):

Installations notified to HETAS 2009 and January 2010

	2009	Jan 2010 only
Dry Open Fire	5.0%	4.2%
Open Fire with Boiler	0.2%	0.1%
Dry Room-heater / Stove	89.7%	90.0%
Room-heater / Stove with Boiler	2.3%	2.5%
Dry Cooker	0.4%	0.2%
Cooker with Boiler	0.6%	0.3%
Independent Boiler	1.3%	2.1%
Other	0.7%	0.6%
Total	**100%**	**100%**

These figures indicate a small number of freestanding boilers. Most room-heating stoves use wood logs.

Anecdotal evidence from research with distributors selling wood stoves and stoves with boilers alongside wood/biomass boilers suggests that up to the end of summer 2009 there were many inquiries about biomass fired heating appliances but very few actual sales. There are signs of a change where independent boilers and stoves with boilers are increasing in sales.

A number of stove manufacturers are introducing new ranges of appliances with boilers and HETAS is spearheading "link-up" systems to enable such stoves with boilers to be included in heating systems fired by gas and oil and also combined with solar heating systems thus reducing the CO_2 emissions.

An increasing number of biomass boiler manufacturers are entering the market with units designed to burn wood logs, pellets and chips. This is evidenced by inquiries to HETAS for product approval with increasing numbers being for biomass boilers.

Again it is worth making a distinction between existing strong sales of wood log fired stoves and the other "biomass" appliances.

Wood stoves

Clearly from the figures given above we can see a very strong market for wood stoves that has grown over the last three years by some 40% per annum.

The log stove market is strong (a recent rough estimate indicates about one million tonnes a year of logs are currently burned) and needs no help from subsidy or regulation. Unfortunately it is difficult to count carbon savings from this sector. Anecdotal evidence suggests that large numbers of consumers displace some high carbon fuel use by burning logs in dry appliances in homes with gas and oil fired central heating. This also gives them some fuel independence. Some of these consumers use the wood appliance to shorten their gas/oil heating season and to displace some gas/oil use over the winter. Others light their wood stoves an special occasions. It would appear sensible to research this and at least count an average carbon saving figure rather than, as now, ignoring what may be a significant figure in reality. This also raises issues in SAP.

Stoves that are either wood burning or multi-fuel represent an estimated 85% of the market.

Pellet stoves.

These could be considered "best alternative technology" in respect of replacing old stoves and fires. They are more controllable and in some respects "higher tech" (and considerably more expensive).

We must consider that they will need an electrical supply which may at present be high carbon. There is real debate over their value as a "best alternative" over a modern clean burn high efficiency log stove. The additional cost means that it may be necessary to incentivise sales and they are included in the MCS scheme.

Other disadvantages are:

- The flame picture is not as aesthetically pleasing as from wood log flames.
- Logs are often "free" or low cost and there is a limited infrastructure for pellet fuels at the moment
- We don't yet count carbon savings from dry stoves
- Current SAP only allows for 10% of domestic heat load from a secondary appliance when in reality it may and can provide much more at very low net CO_2 emission levels

Stoves with Boilers

Again most of these are log burning appliances and may be inset or freestanding. A number of the most significant manufacturers are promoting this technology strongly. Whilst there are carbon saving advantages with the fuel, there is also a need to consider lifestyle if this type of appliance is the only form of heating the home.

There are real advantages in linking log or pellet stoves/boilers with existing systems to displace fossil fuel use.

There are also technical and safety considerations. Many manufacturers and trade bodies are looking hard at giving advice to consumers, specifiers, architects and installers on the "link-up" systems referred to earlier. For instance there is great potential for integrating biomass with solar thermal where one fuel is favoured in summer and one in winter.

Issues are:

- Fuel storage
- The need for a chimney or chimney system (one must exist or be fitted and must be swept regularly)
- Integration design and skills required to install
- Fuel quality need to be maintained for clean and efficient operation
- There is a need to store hot water
- The more sophisticated automatic boilers need expert annual servicing

Independent boilers

This is the technology that most people would think of as providing biomass central heating. It is most likely to be automatic and be wood log, pellet or chip fired.

Just over 2% of solid fuel installations are currently freestanding boilers and some of those will be fuelled by anthracite; others by biomass.

Anecdotal evidence suggests that there is the beginning of a pattern of growth in this segment. Certainly a gathering of pace evidenced by consultation with manufacturers on levels of sales and inquiries. EST grant figures support the fact that this is a young market with huge potential; but one that needs financial incentive alongside efforts to encourage customer to buy in.

Considerations and advantages are similar to those for stoves with boilers, but additionally:

- The appliances are often large and not designed to be "kitchen appliances" although this may change (limited by some technological issues); so space for a boiler may be needed.
- Further, many appliances of this type (particularly gasification log boilers) need to discharge heat in to an accumulator and there still may be a need for another hot water store in some cases. So again space may be a concern in some cases.
- Fuel must be stored and if wood logs are used they will need to be seasoned.
- There may be a need for automatic fuel delivery from store to boiler where pellets and chips are used.
- The fuel delivery lorry must have access to the storage area.

Design and installation takes a relatively high degree of thought and skill. Many heating installers have not yet understood the differences between gas/oil heating (as discussed below) and biomass heating. Integrated circuits will be very advantageous e.g. with solar thermal or other hot water producers and the issue of integrating biomass boilers with another fuel (including existing fossil for displacement) makes biomass a very worthwhile choice where circumstances allow.

Good quality boilers are very clean and efficient with long periods between de-ashing.

11.2. Potential by 2020

The key advantage of biomass and wood burning technologies is the replacing of fossil fuels by low and zero carbon fuel and energy.

This is a market that would benefit from incentives to buy or to integrate with existing fossil fuel heating systems in existing homes. SAP favours the use of biomass but should deal effectively with the integration of fuels, energy sources and systems.

The practical potential for biomass boilers is considerable and in the right environment it is estimated that, by 2020, biomass boilers could represent 10% of annual boiler installations.

Potential growth of biomass boilers

Year	Percentage of boiler installations using biomass fuel	Estimated number of biomass boilers installed
2010	0.25%	3,750
2011	1.5%	22,500
2012	2%	30,000
2013	3%	45,000
2014	4%	60,000
2015	5%	75,000
2016	6%	90,000
2017	7%	105,000
2018	8%	120,000
2019	9%	135,000
2020	10%	150,000

Thus in the period 2010 to 2020 potentially 850,000 biomass boilers could be installed, so that the total installed base could be as many as 1m units.

These estimates are, however, heavily dependent on incentives such as RHI being available, as currently a number of barriers preventing greater use of biomass and wood burning technologies for heating, as follows.

Cost

Typical costs for a standalone stove are around £3,000 including installation, and a typical automatically fed boiler for an average home costs around £9,000 including installation of the boiler and a suitable flue (both estimates from the Energy Saving Trust).

Although savings are considerable in terms of energy, energy bills and emissions when a wood boiler replaces a solid (coal) fired system or electricity-based system, if a gas heating system is replaced that is not the case (the Energy Saving Trust estimates that in the latter case fuel bills may be *higher* with wood burning systems). Biomass boilers systems may therefore only be suitable for homes off the gas grid.

Low number of qualified installers

There are around 60 installers listed on the MCS web site as being approved to install biomass boilers. A significant number are not HETAS registered and from research there appear to be few or no other biomass installers with other schemes. This means that not all of the installers listed as MCS Biomass installers could self-certificate under Building Regulations. The installers not registered as competent installers must inform their customers that they must seek a Building Notice from their Local Authority. This can be costly and time consuming.

The installers of log burning dry stoves are mostly registered with HETAS and are self certificating work under Building Regulations through the HETAS Scheme. A significant number of HETAS heating installers are complying with Building Regulations but are not engaging with the MCS scheme. There is a clear need to encourage existing Registered Installers to qualify for listing as MCS installers.

Whereas at the moment the main focus of HETAS is on incentives to purchasers, consideration should be given to incentives to installer companies who may need financial support to train operatives, designers and survey staff.

Lack of installer competence

There are also issues with the competency of installers. The skills required to install biomass boilers and systems (and fuel stores/feeds) are in some respects similar to those needed to install gas or oil or ordinary solid fuel, but are different in many very significant areas, notably in design and safety related areas.

HETAS has around 2500 engineers registered through businesses but around half only fit dry appliances. Some of those with wet system skills would not be trained in biomass. For this reason HETAS has developed a Biomass Installer Training Course. There are installers (HETAS and non-registered) who have undertaken manufacturer's courses. However, manufacturers' training often only covers product familiarity. Industry bodies suggest that many installers who consider themselves competent and able in biomass installation are actually not.

This is a serious concern, resulting in a significant percentage of biomass installations that may be poorly designed or fitted and will not be making best use of the fuel in terms of efficiency or general utility.

Industry is working to develop a Biomass Installer course. It relies on pre-requisites of (a) a heating background, (b) a water regulations understanding and (c) knowledge of and a certificate for un-vented hot water installation practice. There is a need to up-skill and train the UK's central heating and hot water workforce to cope with the market demands that will come with enactment of Government Policy and a push to more environmentally appropriate use of fuels and energy.

There appears to be no installer courses aimed at teaching the integration of fuel sources and energy systems. We believe that the future of heating in homes is the appropriate integration of energies and fuels in the most carbon and energy efficient way. This is true for both new and existing homes. This area of work must be attended to.

Industry has encouraged the formation of a Renewable Energy Systems Integration Group – several meetings have been held with industry (oil, hot water, heating associations, hot water storage manufacturers) and the groups have agreed that a web site is to be developed giving advice to consumers, installers, specifiers and architects. HETAS and others are funding this initiative although it would be more effective and quicker if more investment were available.

In summary, industry's concerns are:

- Competence of installers in installing central heating and hot water systems fired by biomass. We have made a proposal to our Council that we employ a Technical Training Manager to ensure that training is updated, relevant and accessible. This requires significant investment and managerial effort.
- The number of good central heating business (CORGI/GasSafe, OFTEC etc) that may be doing biomass work (some very well but from evidence we receive – many not so well) but with insufficient understanding of the differences between the designs of the installations required for the various fuel types.

Inconvenience

As indicated above, wood and biomass burning stoves and boilers have to be filled by hand although some pellet and chip burners use automatic fuel feeders, which refill them at regular intervals from fuel storage units (called hoppers).

Requirement for storage space

Although the biomass boiler option is a low carbon option, it does require space for the boiler and to store the fuel (near the boiler)

Planning permission

Solid fuel heating systems may not be permissible in smoke free zones. In addition they may need planning permission.

11.3. Further issues for consideration

There are significant issues that must be considered to ensure that the reputation of biomass as a sustainable low carbon fuel remains high and that the market grows.

Clean air

We consider that attending properly and pragmatically to the matter of clean air is essential for the reputation of biomass and the industry. There is a potential for misunderstanding; and if not dealt with through appliance design and utilisation there could be a potential to damage the reputation of the industry. In reality most modern, approved and tested appliances that have been CE marked under the Construction Products Directive will be relatively clean in the way they combust fuel. This relies on good fuel of course. Further, some appliances have been tested and are exempt under the clean air act for use in smoke control areas. These are very clean burning appliances.

It could be argued that any appliances installed under a grant or incentive should be of the exempted class. Many log burning appliances achieve the standards and pellet appliances are known to be relatively clean burning. The good appliances can pass the tests necessary for exemption for use in smokeless areas.

The RHI policy is likely to give limits for particulates and it is hoped that these will be no different than the already stringent requirements operated in the UK for exemption. There is some concern about over-regulation and argue that there is no need for exempted appliances in rural areas. However, splitting the support of grant aided biomass appliances in this way may not be practical nor desirable – this without preventing the use of a simple log burning open fire in none urban areas.

Fuel quality

Burning the right fuel, of the right quality is essential for high appliance efficiency and low emissions. The appliance and the fuel must be a matched pair, and with any incentivised appliances or installation there should be a requirement to use a quality fuel; this is already a requirement in a smoke control area. HETAS has believed this to be an issue for some time and has now received a grant from DECC to introduce a UK Solid Biomass Assurance scheme. This scheme could be promoted and utilised to ensure that consumers can access the right fuels and those of the right quality.

Skills

There is a significant skills gap and HETAS has signed an agreement with SummitSkills the sector skills council to develop National Occupational Standards (NOS) covering solid fuel installations and heating systems.

This will lead to the development of an apprenticeship and “new entrants” route. SUMMIT is working on NOS for all areas covered by the MCS scheme. Government can be certain that there is a significant need for training in this area of work. There is a need for strong policy and incentives here.

Integration of fuel/energy and systems

The future of heating and hot water systems is in the integration of technologies, energies and fuels as appropriate for the home or family. No one fuel or technology will meet all needs and there may be seasonal issues that mean at least two forms of energy if not three might be most appropriate.

Significant effort is needed to make sure that SAP and Building regulations attend to this properly. There will be a significant task relating to training and awareness to be done.

Chimneys & chimney sweeping

Unlike some other European countries, such as Germany, the UK does not have robust legislation on chimney safety. This means that chimney safety and standards have to allow for failure to sweep chimneys and maintain appliances. Without such a regime any relaxation of building regulations/standards in respect of chimney heights and termination positions should not be contemplated. HETAS operates a Sweeps Solid Fuel Awareness course and a Sweeps Approval Scheme together with three sweeps associations, encouraging the raising of standards in this area.

As indicated earlier there are efforts in Europe to put together a room sealed chimney standard for domestic solid fuel appliances. Such a development is important as new dwellings are becoming ever more tightly sealed and the Approved Document F deals with ventilation in new ways. There is

an important link between chimney operation and ventilation that will be eliminated when room sealed wood burning appliances and chimneys are ever more readily available.

Building regulations

A review of Approved Document (AD) J is almost complete so we feel that it will be up to date and relevant. Similarly for AD L and G. However second tier supporting documents are necessary (in the same way that the Domestic Heating Compliance Guide was a good supporting document after the last review). It is understood that there will be a number of reviews of Approved Documents and industry hope that these keep pace with a developing market.

Construction Products Directive

This is under review and it is hoped that all European member states will require CE marking of Biomass Appliances soon (2011 or 2012). Failure to get this in place will lead to risk in terms of product quality.

Incentives

Financial incentives, through supplier obligation schemes such as CERT, may be required to stimulate market growth.

In terms of incentives, there should be an attempt to draw together the various offers and create a common entry point or perhaps a single incentive scheme. The Microgeneration Certification Scheme provides such an opportunity. If one scheme proves unworkable, there is a HETAS Appliance Approval scheme where key safety and performance factors are assessed and CE marking is a requirement. There must always be a standard to judge against before giving an incentive.

Log burning stoves

At this time some feel there is no need to give incentives for the sale or installation of wood log burning dry stoves. It may be that the manufacturing industry sees this differently.

Whilst the market is buoyant, the use of wood as a low carbon fuel is a good thing generally and incentives for all types of wood burning will be seen as a positive thing. The debate would be around the use of incentives to encourage the purchase of the low carbon, higher efficiency, cleaner burn (clean air exempted) appliances. As referred to above a change to the 10% limit for secondary heating enabling the increased carbon saving to be incorporated in the SAP calculation would be a positive encouragement.

Stoves with boilers

This includes log and pellet appliances and these are going through technological development. Modern high efficiency, clean burn appliances will be utilised in new build and existing homes. There is good potential for linking or integration with other energy sources and it is important that the carbon saving can be counted.

There may be a need to upgrade or change hot water cylinders to take best advantage from linked systems.

It is interesting to note that manufacturers are now bringing into the UK, stove/boilers that can operate on sealed heating systems safely. This shows evidence of a change in this segment. It may bring greater controllability with it as well as opening up this type of appliance to installation in

situations that may previously have been difficult. Water storage in homes is required for many biomass units and indeed for solar thermal and other linked energy sources

These appliances should be incentivised. Manufacturers need to attend to the design elements e.g. room sealed appliances/chimneys, some smaller output appliances for use in highly insulated new homes; larger appliances for existing homes.

Independent boilers

These are the most efficient and flexible providers of heating in many appropriate properties. They are available across the range of wood log, pellet and chip firing systems and are usually automatically controlled and very clean and efficient to operate with low particle emission rates and efficiencies approaching 90%.

It is difficult to compare efficiencies with gas/oil boilers in a meaningful way and it should not be assumed that, for instance, a gas condensing boiler with a high carbon fuel is better than a highly efficient biomass boiler!.

This type of appliance can be fitted on sealed or open vented systems. They can be linked or integrated with most other types of hot water sources. In terms of location they can be fitted to a range of chimneys or chimney systems.

Independent boilers mostly rely on an element of stored water or accumulators, thermal stores etc so there is a need for stored hot water and space.

These appliances are safe, clean and efficient and should be incentivised.

11.4. Sources of information on solid fuel heating

Sources
DECC / NERA / AEA: 'The UK Supply Curve for Renewable Heat 2009'
Energy Efficiency Partnership for Homes / Element Energy: 'An assessment of the size of the UK household energy efficiency market 2008'
Energy Saving Trust: 'Generating the Future: An Analysis of Policy Interventions to achieve widespread Microgeneration Penetration'
Element Energy 'Growth potential for microgeneration 2008'
HHIC (www.centralheating.co.uk)
Office of Gas and Electricity Markets / OFGEM Quarterly CERT reports (www.ofgem.gov.uk)

12. Summary of issues arising and barriers to the market potential

There are a number of cross-technology issues and barriers that are likely to inhibit achieving the potential market of the different heating technologies.

The main barriers are as follows.

12.1. Installer capacity

A key issue for all heating technologies, with the exception of traditional boiler-based heating systems, is installer capacity. There are currently few engineers installing microgeneration technologies, mainly because consumer demand is low. As demand increases for microgeneration products there will need to be an increase in the number of trained installers.

Ensuring that there are sufficient trained installers to cope with increased demand for newer heating technologies requires a number of actions.

- Providing the information and training required to either facilitate the transfer of plumbers and heating engineers from traditional heating systems to other technologies or to train new entrants (for example by providing a skills web portal to specify the requirements and procedures to transfer skills);
- Educating installers in order to change the conservative mind-set and encourage the development of new skills and promote the installation of newer technologies as a viable career path;
- Providing incentives or compensation for time and work lost when installers choose to retrain.

These initiatives are a joint Government / industry responsibility.

The Taskforce believes that the Microgeneration Certification Scheme has an important role in this area, but that it requires reform, as it is currently thought to be onerous and expensive for installers. The MCS scheme requires a much higher standard to install microgeneration than equivalent requirements for the installation of a fossil fuel system such as the OFT code of ethical practice, Quality Management System and accredited products.

Whilst the microgeneration industry is fully supportive of the quality benefits of accreditation systems like MCS, it also recognises that the standards for fossil fuel and microgeneration systems should represent a level playing field. Current standards for fossil fuel systems, while lower than those of MCS, are well established and have been proven to be effective in the mass market. These could therefore provide the basis for the microgeneration standards.

Installers also need to be mobilised to advise on control solutions and to support greater uptake by their customers. They could be supported through more independent validation of the benefits and even through a fee paid to accredited installers to provide an advice survey. This could be tied in with the CLG advice package for heating systems and funded out of existing advice budgets.

In summary, the heating industry believes that there needs to be a focus on capacity building initiatives to develop a critical mass of installers of micro renewable heat technologies backed by awareness raising and training. Additionally, non financial barriers to market development such as installer certification schemes need to be reviewed in light of research and industry feedback.

The Heating Taskforce recommends a number of 'quick wins' relating to installer capacity and proposes a number of relevant questions that might be posed in the Microgeneration Strategy Consultation. Both recommended 'quick wins' and suggested questions are outlined in the following table.

12.2. Manufacturing capacity

It is important that different domestic heating technologies are available to meet the needs of different properties, to provide consumer choice and to encourage competition. It is a strength of the industry that it delivers such a range of products.

The Taskforce believes that the manufacturers in the heating and hot water sector can ramp up production to meet increasing demand for most technologies.

For technologies at an earlier stage of development, such as micro-CHP, passive flue gas heat recovery and advanced controls, manufacturers will require greater certainty on future market scenarios to plan product development appropriately.

This is again an issue for both Government and industry.

12.3. Legislation and regulations

Legislation and regulation has been successfully employed in the past to drive the use of energy efficient heating technologies. The introduction of the condensing boiler into the market is a good example.

The Taskforce believes that regulations can be used at appropriate times to raise minimum efficiency and performance standards and thereby encourage the uptake of low and zero carbon technologies. Our view is that incentives and schemes will not be sufficient to drive the level of uptake to achieve the targets and that some form of legislation will be required.

It is however unlikely that the stipulation of use of a single product, in the way that condensing boilers were made mandatory, will be appropriate in future, due to the range of products required for different occasions (as indicated above). An alternative approach may be to specify a performance level based on carbon emissions.

12.4. Consumer buy-in

The Taskforce believes that there is a need to stimulate consumer demand for newer heating measures (and indeed the adoption of more energy efficient traditional heating systems and heating controls). We believe that the Boiler Scrappage Scheme, although an important stimulus to action, has been just as important as a means of delivering the *message* of the importance of upgrading G rated boilers.

It is also important that there is consistency of messages delivered to consumers, for example on the use of controls.

12.5. Financing installation

It is broadly recognised within the heating industry that consumers are resistant to expenditure on heating measures that will require a payback period of more than five years.

It is therefore vital that financial incentives are offered for the installation of heating measures.

- The Taskforce welcomes the Boiler Scrappage Scheme, launched in January 2010. Members of the Taskforce have been actively involved in discussions with Government during the inception and development of the scheme and believe that is will help stimulate the replacement of old inefficient boilers. However the scheme will only replace 125,000 boilers, some of which would have been replaced anyway by 2020. That is less than 1% of all the inefficient non-condensing boilers estimated to be installed in UK homes and less than 3% of the very poorest performing installed base of G-rated boilers;
- Feed in Tariffs and the Renewable Heat Incentive will clearly have an important role in stimulating interest in newer heating technologies.

There is an urgent requirement to review the whole issue of funding expensive heating measures through approaches such as grants, incentives and green finance.

12.6. Performance measures and calculation method

SAP and nationally accepted performance measures are generally designed for traditional technologies. They often do not easily accommodate new products and technologies and often do not fully credit and reward the performance and savings delivered. This is true of micro-CHP. It is not possible to calculate the energy benefits of the use of more sophisticated controls (for example the control of heating by zones or times of the day) using the current SAP calculation methodology. Given that most policy approaches use SAP to determine suitability of technologies then this is a significant barrier to adoption of advanced controls.

The current calculation methodology needs to be reviewed to more effectively calculate the benefits of controls. In the shorter term, ‘bonus’ scores for controls could be introduced in CERT and CESP to encourage the provision of incentives. The Taskforce believes that Government should review the calculation methods to accommodate these technologies.

12.7. Communications and controls

Many of the energy efficiencies offered by heating technologies are heavily dependent on the installation and correct use of heating controls. By reducing the energy required, using it most appropriately and ensuring interoperability of different technologies they are a significant enabling technology to fully utilise low and zero carbon technologies.

There is significant potential for reducing the amount of energy required to heat homes and provide hot water, through:

- Policies to ensure that all homes have a minimum level of controls consistent with the current building regulations (a cost effective measure that about 70% of homes don’t have);
- Strengthened building regulations from 2013 to ensure that best available technology in controls is installed with all new boilers;

- Market availability of controls technology to ensure that combinations of technologies (e.g. fossil fuelled and renewable) can be easily integrated on site to optimise towards the most carbon efficient operation;
- Market availability of communications and customer interface technologies to ensure that the potential opportunities offered by the rollout of smart meters, and the development of a smart grid and smart homes technologies, are fully utilised.

The development and application of more sophisticated communications technologies and the simultaneous integration of controls offer significant potential. In particular it will be possible to link householders' demands for internal temperatures, hot water, light and air quality, and then deliver them through the best combination of passive measures, appliances, on-site/local renewable generation and grid supply varying by carbon content or tariff.

To realise this potential it will be important for a wide range of industry sectors to work together to bring cohesive solutions to market, and for Government to establish a supportive policy framework, bearing in mind that many of the technologies required cannot be seen as a 'measure' that delivers a defined energy saving, but will be 'facilitative' towards the overall system that will deliver the benefits.

12.8. Hot water and system integration

In addition to effective heating controls, one of the essential 'enabling technologies' to help fully utilise low and zero carbon technologies is hot water storage. In future one of the main reasons for using hot water storage with low and zero carbon technologies is its ability to 'harvest' and store the energy from heat sources such as solar, biomass and heat pumps. However the increasing popularity of combination ('combi') boilers have meant that new boiler installations have often not included a hot water cylinder and new building design often does not factor in space for hot water storage.

There are therefore issues around building design and the installation of heating systems (including combi boilers) that do not allow for and are not compatible with the possible future installation of low or zero carbon technologies such as solar thermal or heat pumps.

The issue of system integration also relates to the integration of other technologies. It is entirely feasible that multiple technologies will be used in tandem within a property. This has implications for system design and building regulations.

These are issues that are relevant to all heating technologies and require further consultation between Government and industry.

12.9. Generation mix

It is also important to understand the interaction of heating technologies with the network in order to aid longer term planning on investment.

The domestic heating industry will need a clear view of the likely energy supply mix to homes from 2020. Such a view will help the industry to make investment decisions on which products to develop and bring to market.

A key issues here is, for example, the extent to which the electricity grid will grow in importance and possibly drive a switch from heating by fossil fuels to heating with electricity. Similarly the injection of biomethane into the gas grid would help gas to remain an attractive option, and liquid biofuels will continue to make oil as an attractive option.

All of these scenarios are technically feasible and the likely landscape post-2020 will impact greatly on the kinds of domestic heating technologies that are required.

A key related issue is how much the UK Government and the heating industry wish to anticipate and drive any fuel switching, and if so what measures to put in place.

12.10. Costs

Cost is a key issue, with the installation of new heating technologies essentially a distress purchase.

The expense and disruption may encourage householders to retain their older, less efficient boilers for as long as it is possible to repair them. It is indeed the oldest, poorest performing boilers that tend to survive longest with continual repairing.

There are a number of options for addressing this issue, such as incentives, raising consumer awareness and possible legislation, as discussed above.

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Many of these issues are co-dependent. For example, investment in increased manufacturing of technology requires consumer demand to be stimulated through promotion of heating measures and financial assistance; also, if consumer demand is stimulated, that must go hand in hand with an expansion of installer numbers and skills to meet that demand.

13. Actions required to achieve 2020 vision

In order to overcome the barriers which restrict the growth of energy efficient technologies, the Taskforce recommends a number of solutions and actions that need to be undertaken in order for the market potential to be realised.

Some of the key action areas are summarised in the table below.

Issue	Actions required to address issue
Building installer capacity	Providing guidance for installers to allow existing, skilled engineers to up-skill into new technology areas e.g. developing a course on how to up-skill, developing a web portal explaining how to up-skill (and search a live training database to find current courses) Incentivising the attendance of skills courses and/or encouragement to joint suitable industry scheme to improve the competency of installers or switch them from current heat practice (i.e. gas/oil boiler or electric heating installation) Reviewing the MCS to make it less onerous and expensive for small installer firms and ensure it is consistent with schemes for other (traditional) technologies *Co-ordination of industry and Government-funded bodies to prioritise and align skills development plans*
Consumer buy-in	Raising awareness of the range of heating technologies available and promoting the benefits of installing more energy efficient heating technologies, including payback on investment Informing consumers on financial assistance available for the installation of energy efficient heating technologies Improving consumer behaviour and usage of heating technology, particularly heating controls, to maximise the energy efficiency of that technology *Ongoing industry co-ordination on Government-funded consumer advertising and funding initiatives (e.g. Act on CO2 campaign)*
Financing installation	Financial incentive schemes; Providing additional funding for the successful Boiler Scrappage Scheme and promoting heating measures under Government schemes such as CERT and future energy supplier obligation programmes If a payback period for the installation of a heating technology exceeds five years, then a financial mechanism such as PAYS should be promoted (i.e. one that links investment to the home rather than the individual) The reduction of VAT for the supply of energy efficient heating technologies by qualified and registered installers

Performance measures and calculation method	The basis of SAP calculations should be reviewed to ensure that energy efficiency measures recognise, for example, the use of controls and the use of solid fuel technologies when integrated with gas or oil heating technologies or when used as secondary heating Making performance measures and calculation methods more flexible in order to bring new products to market more quickly, and support funding for manufacturers to get new products into Appendix Q of SAP Greater promotion of tools such as SAP and EPCs to the general public in order to raise awareness and setting a target date for when all homes will have an EPC and when all homes will have to have specified improvements made to enable people to sell or let their properties *Co-ordinate industry and Government work to align performance measurement (SAP) requirements and develop programmes for the existing housing stock (in particular for heating)*
Communications and controls	Government to commit to upgrading controls by 2020 in the Home Energy Management strategy alongside insulation, as it is a comparatively cost effective measure The basis of incentives for energy suppliers obligations post 2013 needs to be reviewed Industry develops cohesive marketing and works with the supply chain to deliver practical solutions to consumers *Industry to develop a strategic group to identify appropriate solutions to fit the contextual policy timeline and ensure that these are market ready as required and Government to commit to this group to guide development of SAP, building regulations etc.*
Other product development	Industry to continue developing energy efficient technologies e.g. passive flue gas recoverables, micro-CHP Field trials to provide evidence on applicability to dwellings and performance of technologies
Hot water and system integration	It is vital that the heating products installed now and in the near future are 'future proof' so that renewable technologies can be easily integrated at a later date (e.g. fitting hot water cylinders that are 'solar ready' and ensuring that when combi boilers are installed they are solar compatible) - this is perhaps not an 'easy win' but rather is sound preparation for the future Formal guideline on Legionella for dwellings and objective evidence of risk of Legionella Technology development to reduce standing heat loss without cost or space implications Industry has encouraged the formation of a Renewable Energy Systems Integration Group, which has developed a website advising consumers, installers and specifiers on the integration of

	low and zero carbon fuels and energies, and on the displacement of higher carbon fuel use by integrating low and zero carbon systems with existing higher carbon systems. Industry bodies are currently resourcing and funding this initiative although it would be more effective and quicker if more investment were available to support the group's activities, including the development and promotion of the website
Renewable Heat Incentive (RHI)	The potential market for renewable heating technologies is greatly dependent on the introduction of the RHI and so it is essential that commitment to this initiative remains firm
Electricity network	*A network risk review is required to ensure that the network can accommodate the number of heat pumps estimated in our vision*

Appendix A: Glossary - Government policy, regulations and other initiatives

There are a number of relevant EU directives that influence Government policy and thereby have an impact on the heating sector. Directives include:

- Energy Using Product Directive (EuP)
- Energy Performance of Buildings Directive (EPBD)
- Energy Services Directive
- Renewable Heating Directive

Building regulations are a key driver of energy efficiency in the housing stock. Building Regulations relate to the conservation of fuel and power and aim to achieve improvement in the energy efficiency of new buildings. The regulations include improved energy efficiency requirements for refurbishments and extensions of existing buildings. Under Building Regulations it is mandatory for almost all new or replacement boilers to be condensing ones.

Government initiatives represent another key driver of change. These initiatives include the following:

Initiative	Description
Code for Sustainable Homes (CSH)	The Code for Sustainable Homes will form the basis for future developments of the Building Regulations in relation to carbon emissions from, and energy use in, homes and therefore offering greater regulatory certainty to developers. The code is currently a voluntary code for housing developers in England and Wales stipulating energy and water efficiency requirements and ranking of dwellings. The aim is that from 2016 new homes will be 'carbon neutral.'
Carbon Emissions Reduction Target (CERT) 2008-2011	The Carbon Emissions Reduction Target (CERT) is one of the principal policy mechanisms by which energy efficiency improvement measures has been delivered into existing homes in Great Britain. Under CERT, energy suppliers are required to achieve targets for the promotion of energy efficiency improvements in the household sector. Subject to approval by Ofgem, suppliers are given flexibility to choose from a range of measures, typically insulation, low energy lighting or high efficiency appliances and heating systems, in order to meet their targets. Suppliers may promote measures directly to consumers or work with project partners like social housing providers, retailers or manufacturers. Measures may be delivered in different ways, for example through a third party contractor, retail outlets or mail order. The Government has proposed an extension to CERT up to December 2012.
Supplier Obligation	To ensure the momentum built up under CERT is maintained into the next decade, the government announced in the 2006 Energy Review that some form of supplier obligation would be in place until at least 2020, with an ambition level at least equal to CERT.

Renewable Energy Strategy (RES)	Increasingly the uptake of microgeneration technologies is a high priority in the Government's efforts to increase the sustainability of the housing stock and meet renewable targets. For example the Low Carbon Buildings Programme offers grants to help with the cost of installing microgeneration technologies. The key driver of growth in the microgeneration sector is therefore Government policy. A key part of the UK Renewable Energy Strategy is that UK households and communities (in addition to public services and businesses) will be able to generate their own renewable energy through the introduction of a new Renewable Heat Incentive and 'Feed-In Tariffs.' These tariffs, which are currently under consideration, apply to electricity-generating microgeneration technologies and guarantee payments for energy produced. FITs would therefore greatly improve the economics of installing microgeneration technologies.
Community Energy Saving Programme (CESP)	Part of the Government's Heat and Energy Saving Strategy (HESS), currently under consultation. Funding is to be available for Community Groups, Housing Associations and local authorities to improve GB household energy efficiency and reduce fuel bills. Low income households are to be targeted. CESP promotes a 'whole house' approach and aims to treat as many properties as possible in defined areas. It represents a statutory obligation on the largest gas and electricity suppliers (along the lines of CERT).
Energy Performance Certificates (EPCs)	Introduced in 2007 and are required on the sale or rental of buildings. They give potential buyers or tenants information on the current energy performance of a dwelling. From 2009 all buildings in the UK that are constructed, sold or rented out have to have an Energy Performance Certificate, in accordance with the European Energy Performance of Buildings Directive.
Decent Homes	The government aims to make all council and housing association dwellings decent by 2010 i.e. warm, weatherproof and with reasonably modern facilities. The Decent Homes initiative is not designed specifically to improve energy efficiency but includes a thermal comfort criterion and so impacts on energy performance.
Warm Front	Warm Front provides a package of insulation and heating improvements for English homes. It is a government funded scheme available to householders who are in receipt of certain income related and disability benefits and who own their own home or rent it from a private landlord. Equivalent schemes in the devolved administrations are the Home Energy Efficiency Scheme (HEES) in Wales and Warm Deal in Scotland.
Smart meters	Part of the UK Low Carbon Transition Plan is to roll out smart meters to all homes by 2020.
Energy Performance of Buildings Directive (EPBD)	The Energy Performance of Buildings Directive (EPBD) requires all EU countries to enhance their building regulations and to introduce energy certification schemes for buildings. All countries are also required to have inspections of boilers and air-conditioners.
Microgeneration Certification Scheme	The Microgeneration Certification Scheme (MCS) is an independent scheme that certifies microgeneration products and installers in

(MCS)	accordance with consistent standards. It is designed to evaluate microgeneration products and installers against robust criteria providing greater protection for consumers.
Renewable Heat Incentive (RHI)	A key part of the UK Renewable Energy Strategy is that UK households and communities (in addition to public services and businesses) will be able to generate their own renewable energy through the introduction of a new Renewable Heat Incentive and 'Feed-In Tariffs.' These tariffs, which are currently under consideration, apply to electricity-generating microgeneration technologies and guarantee payments for energy produced. FITs would therefore greatly improve the economics of installing microgeneration technologies.
Standard Assessment Procedure (SAP)	The Standard Assessment Procedure (SAP) is the Government's recommended method of assessing the energy efficiency of residential dwellings. The calculation is based on the energy balance taking into account a range of factors that contribute to energy efficiency: • materials used for construction of the dwelling • thermal insulation of the building fabric • ventilation characteristics of the dwelling and ventilation equipment • efficiency and control of the heating system(s) • solar gains through openings of the dwelling • the fuel used to provide space and water heating, ventilation and lighting • use of renewable energy technologies.

The UK Low Carbon Transition Plan spells out a number of other planned steps, including:

- Clarifying that Ofgem should tackle climate change and ensure security of energy supply;
- Making homes greener by channelling around £3.2billion to help households become more energy efficient;
- Piloting 'pay as you save' ways to help people make their whole house greener;
- Introducing clear energy cash-back schemes;
- Opening a competition for cities and villages to pioneer green innovation;
- Creating mandated social price support;
- Piloting a community-based approach to delivering green homes in low income areas;
- Increasing the level of Warm Front grants;
- Supporting the development of green technologies;
- Producing a longer term roadmap for the transition to a low carbon UK up to 2050.

Appendix B: Questions for the Microgeneration Strategy Consultation

In the Technology Review, submitted to DECC under separate cover, the Heating and Hot Water Taskforce made a number of recommendations on questions that the Microgeneration Strategy consultation might pose.

In summary those questions are as follows.

Installer capacity:	• Do you agree that the best route to market for microgeneration products is through the existing supply chain? If not what alternatives would you suggest? • How can we ensure that there will be sufficient numbers of trained and motivated installers of microgeneration products? • What methods could be used to incentivise installers to become formally qualified and competent to install renewable heat technologies? • Do you agree that Microgeneration Certification Scheme provides the most effective means of assessing and demonstrating competence and customer assurance to install microgeneration products? • If so, what needs to happen to encourage more installers to register with MCS? • What are the practical non financial barriers of the current MCS installer scheme and what are the most effective solutions to deliver quality installation without presenting a barrier to market entry? • What are the merits of developing a national database of training courses for renewable heat accessible through a central web portal that simply explains the qualifications required to be a 'competent' installer? • What is the merit of having an awareness course as outlined above? • How should installer education and training programmes be best organised and funded?
Legislation and regulations:	• To what extent can targets for the installation of energy efficient technologies be met through incentives, fiscal stimuli and advice alone? At what stage should we introduce regulations to drive the uptake of microgeneration products (as was successfully employed for condensing boilers)? • Is regulation required to stimulate the market for microgeneration technologies (as it was for condensing boilers) and where would regulation be most effectively targeted? • As there is not one microgeneration technology to promote but rather a range of technologies for different situations, what kind of regulation options might be appropriate to stimulate the use of a range of microgeneration technologies?

Consumer buy-in:	• What can be done to stimulate consumer demand for microgeneration technologies? • Who should be responsible for stimulating consumer demand – what role should different parties play? • How can advice and information on microgeneration provided both by Government and from industry be best organised to provide consistent messages to householders?
Financing installation:	• What financial incentives should be offered to stimulate consumer demand for microgeneration technologies? • What are the most effective financial incentives?
Performance measures and calculation method:	• Are current performance measures and calculation methods fit for purpose? • Where are current measures and calculation methods working well and which areas need development? • How could they be improved to be more effective?
Communications and controls:	• What level of contribution can controls and communications make to ensure that new technologies can be integrated within existing domestic building services, and to utilise the advantages offered by smart meters and a smart grid? • Are there any technology gaps that need to be filled? • How can the benefits of such technology be assessed to support market development? • What are the implications for householder acceptance and behaviour in relation to microgeneration technologies in both the private and public sector? • What potential solutions through controls or communications could address any potential problems?
Hot water and system integration:	• How can current building design and heating system design be made compatible with the possible future installation of low or zero carbon technologies? • What are the opportunities in system integration or multiple technologies involving renewable technologies and how should the industry be preparing for those opportunities?