Chapter 11. Improving the energy performance of domestic heating and hot water systems

Evidence, analysis, targets and indicative standards

Overview

1.   This public consultation on domestic heating and hot water systems is being carried out by the UK Government.[1] It forms part of a wider annual review and policy development process, supporting delivery of the Government's objectives for energy and for sustainable consumption and production.

2.   In its Energy White Paper of 23 May 2007, the Government said it would publish a series of consultation papers setting out its analysis of how the performance of energy using products will need to improve over the next 10–20 years, including proposals for product standards and targets to phase out the least efficient products.[2] To achieve these will require a range of measures and approaches, which may include: international agreements; European and domestic legislation; and voluntary action through the supply chain to enhance markets for the most cost-effective energy efficient goods and services. In the Energy White Paper the Government announced a range of policies to support delivery.

3.   We believe that these standards provide retailers, manufacturers and service providers with a benchmark to improve the performance of products they provide. In addition, through this consultation, we are encouraging industry to deliver improvements in product standards.

4.   We are also inviting wider views on the proposed standards, on opportunities to move faster, and to identify any critical issues that might require a further policy response. Responses will inform the Government's view and decisions on policies such as the EU Framework Directive for Eco-design of Energy-using Products (EuP), labelling, Carbon Emissions Reduction Target (CERT) and successor schemes, and procurement policy, and on the need for further analysis.

5.   Domestic heating systems comprise a wide range of products, technologies and fuels. They are sold by different industries in competition with each other, and are designed and installed by separate groups of specialists. Their characteristics vary greatly and impose practical and economic limitations on their fields of application. In particular, options that are attractive for new buildings may not be feasible in existing buildings. A comprehensive review of all the options would require a large study and extensive research, which has not been attempted here. This consultation paper addresses in-use energy consumption and carbon emissions associated with **conventional domestic central heating systems**, defined as those with a gas or oil-fired boiler, sometimes augmented by a thermal solar collector. Such systems share a number of important characteristics:

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[1] AEA Energy & Environment is managing this consultation on domestic heating and hot water systems, as lead contractor on the Government's Market Transformation Programme (MTP) on behalf of the Department for Environment, Food and Rural Affairs.
[2] *See* Energy White Paper (23 May 2007), para. 2.102.

- They are hydronic (ie use water as the medium to transport heat to radiators or other emitters throughout the building).
- They are responsive, automatic in operation and share the same types of control.
- They have a long history, are widely known and understood by an experienced workforce, and together constitute the overwhelming majority of heating systems in British dwellings.

6.   Conventional systems are installed in 83% of the housing stock, and account for 52% of CO_2 emissions from the domestic sector. While there are alternative heating technologies that may ultimately displace them (discussed briefly in paragraph 111), the scope of this paper is limited to what can be done in the shorter term to improve conventional systems.

7.   Views are invited on whether it would be useful for the Government's Market Transformation Programme (MTP) to consider gathering evidence and consider policies on a wider range of other heat-generating products and systems (such as community heating, combined heat and power (CHP), micro-CHP, biomass, and heat pumps). This would enlarge the scope of the paper in subsequent years.

How do we expect domestic heating and hot water systems to contribute to future energy consumption?

8.   Heat generation measures for conventional heating systems previously focused mainly on boiler performance. Changes to the Building Regulations in the period 2005 to 2007 have set a minimum efficiency standard for both new and replacement boilers at a level that is close to the practical limit. However, several other areas have been opened for investigation by the Market Transformation Programme, including actions to:

- Ensure that heating controls are set and used correctly.
- Develop advanced control techniques that exploit the characteristics of condensing boilers.
- Make greater use of solar thermal collectors to augment water heating.
- Reduce electricity used by heating system components (e.g. pumps, fans, valves, controls).

9.   The following graph shows the Government's projections for energy use by conventional domestic heating and hot water systems.

Total energy consumption (TWh/year) of installed UK conventional domestic heating and hot water systems (see scope in paragraph 5)[3]
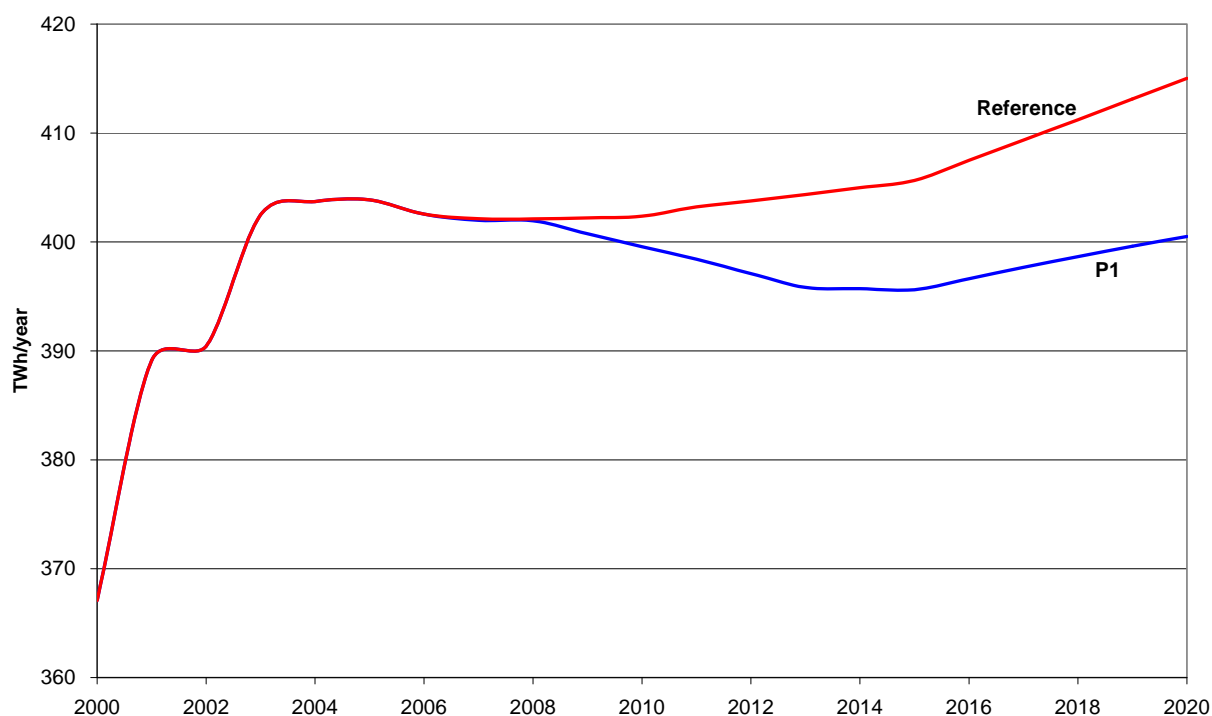
10.   The Reference[4] projection takes into account underlying trends in markets and technologies and the estimated or implicit impacts of historical and current policy measures. It includes the effect of recent influential changes, such as new Building Regulations in 2005 to 2007, which require all new boilers that are installed to be of the condensing type, except in defined limited circumstances. By 2016, 61% of installed gas boilers and 37% of installed oil boilers will be condensing and newly built homes will have zero net annual carbon emissions. The Reference projection does not, as yet, take account of the impact of policies announced in the Energy White Paper of 23 May 2007, which are still being developed and are not targeted at specific products (for example, CERT and successor schemes). The intention is to revise these projections once it becomes clearer how these new policy measures will affect domestic heating and hot water systems.

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[3] Historic values are affected by mainly by winters of varying severity, as heating demand is strongly influenced by weather conditions. Projected values take account of population and housing growth, but not external temperature rises forecast as a consequence of climate change.
[4] The Reference line or 'REF' is included as a baseline against which progress towards absolute consumption targets can be monitored. It also permits us to measure the impact of market changes in response to published targets and delivered policy measures and to assess the need for additional action. REF is updated to estimate the aggregate impact of existing policy measures, superimposed on underlying market trends, on the supply, sales and use of domestic heating and hot water products – and, therefore, on household energy consumption. The effectiveness of market transformation policy, taken as a whole, may be assessed as the extent to which it modifies REF.

11.   In other consultation papers on product standards an EBP[5] projection has also been included. No EBP projection is presented in this case as:

- The paper considers only conventional heating systems, whereas an EBP scenario should include alternative types as replacements for them.
- The P1 target is already ambitious, resting upon assumptions set out in notes 2 to 4 in the Appendix.

12.   The P1 projection sets a target level of ambition that the Government is proposing could be delivered at a reasonable cost, taking into account such things as current UK and global performance benchmarks, economies of scale and the capacity of the supply chain to take coherent action to deliver more energy efficient products.[6]

13.   The proposed P1 target would result in energy use from conventional domestic heating and hot water systems falling to 400.5 TWh[7] by 2020. This would represent an energy saving of 14.5 TWh (0.8 MtC, 2.9 Mt CO_2)[8] over the Reference projections for 2020.

14.   We estimate that the P1 target would be achieved if, on average, products supplied and brought into use each year were to meet the indicative performance standards set out in the Appendix. In this paper, the term 'indicative product standards' means the indicative average performance specifications and market penetration targets, including better use of existing controls. These P1 targets and product standards take into account:

- Benchmark product designs and technologies.
- Underlying market and technology trends.
- The scope for delivering policy benefits at a reasonable cost.

15.   We estimate this market shift could be delivered at a reasonable cost. If we are on track to deliver this target we would expect to see substantial shifts in the market, for example:

- 2013: 75% of homes with standard heating controls have them set and used correctly.
- 2020: 50% of homes with boilers have advanced heating controls.
- 2020: 2.5% of homes have solar water heating.

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[5] The Earliest Best Practice (EBP) projection shows what would happen if all new UK sales were based on the most resource efficient options, taking into account design and production cycles, but not taking account of price or other market barriers.

[6] These market based estimates for P1 are cross-compared with the performance improvements that could be envisaged through a set of ambitious but feasible policy options, over and above those included in the Reference line to check their feasibility. Section 3 of this consultation paper (policies, risks and measures) describes these along with the associated risks and proposed strengthening initiatives.

[7] 1 terawatt-hour (TWh) = 1,000,000,000 kilowatt-hours (kWh).

[8] Carbon emissions for electricity are calculated from Government predictions of the electricity generation mix. Oil and gas are converted using standard Government factors. See MTP Briefing Note BNXS01 at: www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=150

16. Our analysis indicates, in principle, that the P1 target is achievable through normal market mechanisms, supported by policies to be implemented as announced in the Energy White Paper.

17. For this reason, we are consulting with specifiers, installers, distributors and manufacturers on the indicative standards set out in the Appendix to build support across the supply chain to act coherently to deliver these.

18. This is in line with the approach taken in the EU's Eco-design of Energy-using Products Framework Directive (EuP) which encourages voluntary action where appropriate.

19. The Government is committed to working with specifiers, installers, distributors and manufacturers to overcome barriers that might impede progress, and to promote delivery of these indicative standards more widely in the market. We will, therefore, work with the full range of policies outlined in the Energy White Paper. Where international or domestic measures rely on performance standards, we propose that we should seek to align them with the indicative standards outlined in this consultation paper, subject to responses from the consultation. In particular we will:

- Press for EuP measures to adopt performance requirements for domestic heating and hot water systems in line with our published indicative standards, whilst acknowledging the Single Market legal base for EuP and recognising that final performance requirements should be fully harmonised across the whole of the European Union.
- Review the Building Regulations[9] Part L1 requirements for heating and hot water systems in relation to our indicative standards.
- Use the indicative standards to identify the most appropriate minimum and/or forward looking standards for use in Government procurement.

20. In this consultation, we set our P1 target and indicative standards based on our current understanding of what is necessary and deliverable. That analysis may change over time, for example, if new efficient technologies enter the market faster than expected; or if consumer trends change; or through international or EU action; or through policies on carbon emissions reduction more generally. We intend to maintain a continued active dialogue with businesses in the supply chain, for example through our Market Transformation Programme (MTP). The aim will be to review progress and to annually update this analysis, the P1 target and the indicative standards for domestic heating and hot water systems, among others, following consultation and review.

21. The purpose of this consultation paper is to provide a framework for engaging with policy, business and expert communities to build a common understanding of the scope and priorities for action in each product sector. With this aim, this document seeks your views on:

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[9] The Building Regulations are devolved to the 3 Administrations: England and Wales, Northern Ireland and Scotland. *See* Section 3.4.2 for more detail.

- The evidence and analysis.
- The P1 target, expected effect on the market, and indicative standards for the environmental performance of domestic heating and hot water systems.
- Acknowledged risks.
- Strengthening initiatives.

22.   Specific questions, posed throughout the document, are intended to stimulate discussion rather than restrict respondents' views. Further information, including how to respond, is available at www.mtprog.com/whitepaper.aspx.

23.   Any enquiries or responses to this consultation paper should be emailed to consult@mtprog.com, quoting Domestic heating and hot water consultation, January 2008.

24.   **The deadline for submission is 14 April 2008.**

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1   Status of document

25.   This paper is issued for consultation as part of an annual process, as announced in the Energy White Paper, to review and update the Government's published analysis, projections, P1 target and indicative standards for more sustainable products. The updated version will take into account the views received and, so far as possible, will identify and address any substantial issues raised.

2   Market overview

26.   As set out above, this paper addresses in-use energy consumption and carbon emissions associated with domestic conventional central heating systems in dwellings (defined as those with a gas or oil boiler, sometimes augmented by a thermal solar collector). The market for boilers in each European country has been analysed recently during the preparatory study for the EU Framework Directive for Eco-design of Energy-using Products (EuP)[10]. The preparatory study presents tables for stock and sales by system type, fuel, power class and technical design, and shows trends over a period. It shows that UK boiler sales are substantially greater than those in the other EU countries (in 2004, sales in the UK were 25% of those in the EU as a whole).

27.   Alternative heating systems that can replace gas and oil boilers (such as community heating, combined heat and power (CHP), micro-CHP, biomass boilers, heat pumps) are discussed briefly in section 4 of this paper, as they are expected to become increasingly important in future, although their impact on overall energy consumption before 2020 is likely to be small, and their contribution to energy savings has not been quantified in this paper.

28.   On a national scale the demand for heating and hot water in dwellings is about 25% of the UK's total energy consumption. In an average home with a boiler, heating and hot water far outweighs other energy usage and accounts for about 84% of the delivered energy, 68% of the carbon emissions, and 50% of the energy costs. Policy actions to achieve energy savings are divided into two groups: measures to reduce the demand for heat, and measures to improve the efficiency of heat generation and delivery. This paper considers only the second group.

29.   These activities involve the selection of new, more energy efficient products and important changes to householder behaviour. As the performance of boilers available on the market approaches the maximum attainable, the focus on improving the efficiency of conventional heating systems is shifting to:

- Better use of existing controls.
- Development of better control systems.
- Solar energy contribution.
- Improving the ability of the supply chain to deliver improved product designs, selection and operation advice, commissioning and maintenance.

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[10] Van Holsteijn en Kemna (VHK), Eco-design of Boilers & Combi-boilers, Task 2: Market Analysis http://www.ecoboiler.org/

30.   For heating systems to operate at high efficiency and with minimum fuel wastage, controls need to be installed and set correctly. In general, householders do not, and cannot be expected to, understand how controls work and how to set and adjust them whenever necessary; what householders can do is set the temperature required for their comfort at the times they need it. It is imperative they can do so easily and conveniently.

31.   Analysis of overall system performance in dwellings is complex, as consumption is determined primarily by the heat demand of the building, and has to be determined by an analytical tool. For regulatory and other purposes, the analytical tool is the Government's Standard Assessment Procedure[11] (SAP) and this may have to be adapted to take account of new heating control strategies.

32.   In addition, there are various alternative technologies, such as the examples given in paragraph 27, that could deliver a new wave of energy efficiency improvements, particularly in light of the Government's commitment to zero carbon homes. For these product areas to progress towards their potential, supply chain support and research is required.

2.1   Trends

33.   Heating systems comprise interacting components and their energy performance is strongly affected by the type of system, fuel, controls, building characteristics, occupancy patterns and climate. Compared with domestic appliances, they are expensive to install and relatively long-lived, so changes in the housing stock as a whole are slow to take effect. Individual products are components of larger systems, and their influence on overall performance has to be assessed by system models taking account of housing characteristics and occupancy patterns.

2.1.1   Boilers

34.   Changes made to the Building Regulations in the period 2005 to 2007 require new and replacement gas and oil boilers to be condensing, other than in exceptional circumstances. Since January 2005, the number of gas condensing boilers sold has risen from about 30% to over 95% of the market (see Figure 2.1).

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[11] The Government's Standard Assessment Procedure for Energy Rating of Dwellings, 2005 Edition. See http://projects.bre.co.uk/sap2005

Figure 2.1   Energy performance of domestic gas boilers (SEDBUK[12])
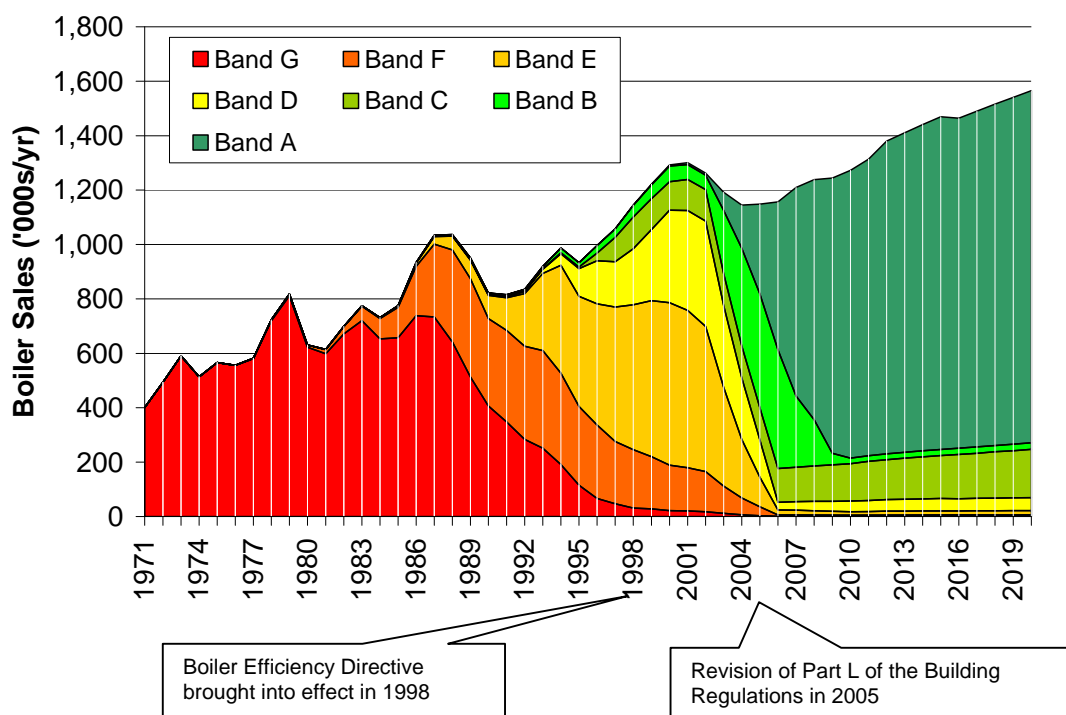
35.   Boiler installations are about 1.5 million per year. The Government's Domestic Heating Boiler Energy Model[13] estimates the number of domestic boilers in operation by reference to monthly sales figures (supplied by the gas and oil boiler manufacturer trade associations) and assumptions on boiler replacement rates, correlated with housing and population statistics. The model estimates current installations as follows:

Boilers currently installed in UK housing, 2006	
Non-condensing gas boilers	17,645,000
Condensing gas boilers	3,205,000
Non-condensing oil boilers	1,179,000[14]
Condensing oil boilers	27,000

36.   It is difficult to estimate what proportion of boiler sales is for the replacement of older types (typically with cast-iron heat exchangers, pilot flames, minimal electrical components and lifetimes of over 20 years) and what proportion is for the replacement of modern types (typically with lightweight heat exchangers, electronic ignition, fans and lifetimes of around 10 years). The trend towards shorter lifetime is a matter of concern as boiler replacement is liable to be troublesome, disruptive, and expensive for householders. A widespread perception of lower durability may encourage owners to retain older, less efficient, boilers for as long as it remains possible to repair them.

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[12] Seasonal Energy Efficiency of Domestic Boilers in the UK
[13] MTP Briefing Note BNDH11: The domestic heating boiler energy model: methods and assumptions
[14] Recent evidence is leading to a revision of these numbers. This will be incorporated in the next revision of the published evidence available at http://whatif.mtprog.com.

2.1.2   Standard heating controls

37.   The principal controls, as required by building regulations, are a programmer or time switch, thermostat(s) to provide boiler interlock, and zone control. Zone control is usually provided by thermostatic radiator valves (TRVs) in small to medium size properties (up to 150 m^2). In larger properties, additional zones require separate heating circuits with their own programmers and room thermostats, or programmable room thermostats.

38.   A Market Transformation Programme report[15] contains evidence that a substantial proportion of householders do not set and use their standard controls correctly, and the energy savings foregone have been estimated at about 14 TWh/year. A proportion of this could be recovered by raising consumer awareness and encouraging greater attention to controls. Sustained and effective action is required to persuade householders to utilise their controls more effectively, which, in most cases, they can do without having to purchase new products. Improved design of standard controls would assist householders who find difficulty in understanding the user interface.

2.1.3   Advanced heating controls

39.   The widespread installation of condensing boilers offers new opportunities for better control strategies. Advanced heating controls are designed to exploit the characteristics of condensing boilers and raise the average annual efficiency obtained from heating systems in which they are installed.

40.   Work is under way[16] to develop an authoritative evaluation model to determine savings from controls, which can be used to substantiate or refute designers' claims. Such a model is required so that energy savings from new control products can be recognised in the government's Standard Assessment Procedure. SAP results are used to establish compliance with the Building Regulations and to produce energy performance certificates for dwellings. Recognition is, therefore, the key to market development, without which there is little commercial incentive for investment.

2.1.4   Solar hot water

41.   Solar collector systems can be installed in suitable properties to reduce the fuel demand for water heating. Until recently the solar hot water industry was highly fragmented, with many small companies offering different designs with no common system standards. Annually, about 17,000 systems are installed, which compares poorly with 1.5 million boilers sold. There is scope for substantial growth, with maturing technology, installation techniques and market awareness.

2.2   Price

42.   Boilers and heating controls are not seen as aspirational products, and initial purchase price is the main factor determining market share. However, the initial capital cost of these products is related only loosely to whole-life cost, as installation

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[15] MTP Briefing Note BNDH15 : Use of Heating Controls
[16] See MTP Briefing Note BNDH19 : Evaluation of heating controls

costs, energy in use and product lifetime are also significant factors. In particular, boiler replacement is dominated by the cost of installation, and undiscounted quotations of over £3,000 are common.

2.3   Innovation

43.   Innovation is an important factor in market development and is covered in Section 4.1.

> **Question 1: Are there any other market or technological trends or factors that should be taken into account in this market overview?**

3   Policies, risks and measures

44.   In the Energy White Paper, the Government said it would:

- Take steps within the UK to improve the take up of energy efficient products and work internationally, and through the EU, to stimulate global innovation and competition to raise standards and to bring a greater choice and efficient products to UK consumers.
- Deliver on our Gleneagles G8 commitments to promote international co-operation on product labelling and standards and help develop practical standards to reduce standby power.
- Work with the UK supply chain to encourage delivery of more efficient goods and services.
- Publish a series of consultation papers, of which this is one, setting out our analysis of how the performance of energy-using products will need to improve between now and 2020, including proposals for indicative product standards and initiatives to phase out the least efficient products.

45.   As set out above, our analysis indicates, in principle, that the P1 target is achievable through normal market mechanisms, assisted by policies to be implemented as announced in the Energy White Paper.

46.   In this section we consider the potential for policy to assist in delivering P1. We identify:

- Policies we believe are already helping to deliver higher environmental performance standards.
- Supporting policies that could assist in delivering P1 in the event that the market fails to deliver it.
- The risks that these policies may not deliver efficiency improvements.
- Further actions that may be necessary to achieve the Government's targets.

47.   Figure 3.1 illustrates how policy instruments and initiatives could support delivery of more efficient boiler systems for domestic heating and hot water. The graph plots the data shown in Table A1 of the Appendix (i.e. the indicative

performance standards that correspond to the P1 projection). They comprise better use of standard heating controls, development of advanced heating controls and greater use of thermal solar water heating systems. The graph does not include minimum boiler efficiency, which is set at 86% by Building Regulations with no change planned over the period. Notes in the Appendix explain how the targets are derived.

Figure 3.1   Projected penetration of controls and solar water heating systems
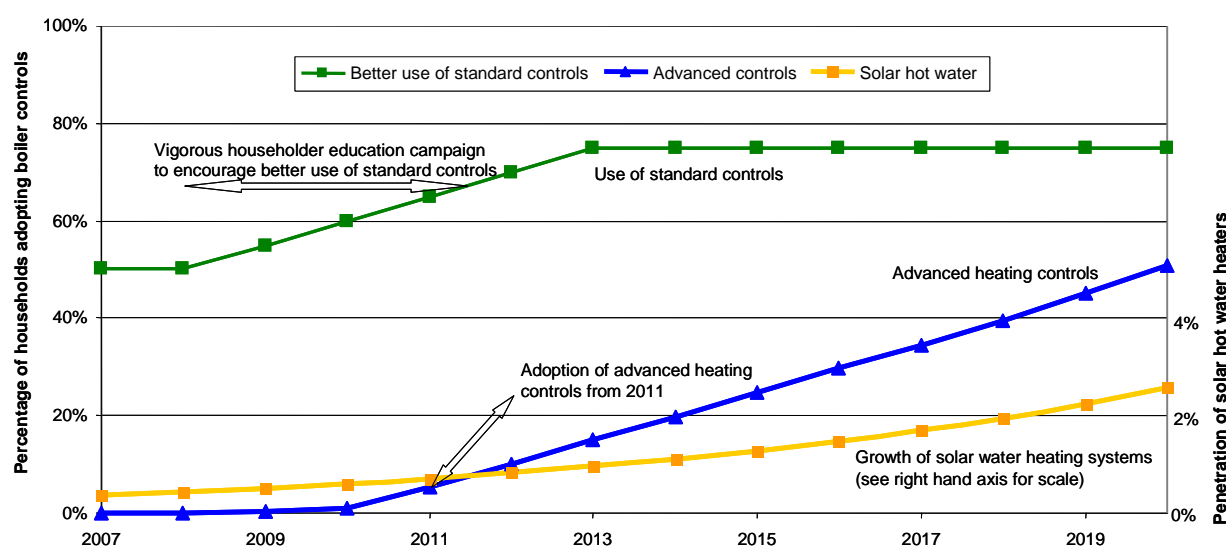
48.   Policies that affect heat generation in dwellings are:

- The Building Regulations (Part L) in England & Wales and equivalent legislation in Scotland and Northern Ireland (see Section 3.4.2). For new dwellings, and major refurbishment and extension projects in existing dwellings, the Building Regulations now set the maximum acceptable carbon emissions using the concept of flexible design (i.e. design to meet an overall carbon target for the building). However, some minimum standards for individual components are retained.

- The Energy Efficiency Commitment (EEC) scheme, to be known in its third phase (from 2008 to 2011) as the Carbon Emissions Reduction Target (CERT), puts an obligation on energy suppliers to meet a target for improvement in energy efficiency among household customers. Energy suppliers are not expected or required to deliver particular amounts of any measure or product to meet their obligations. As part of the development of the legal obligation the Government develops an Illustrative Mix of the type and number of measures that suppliers might use to meet the target proposed. CERT is expected to include both more efficient and lower carbon heating among the measures credited.

- Warm Front (England), HEES (Wales), Warm Deal (Scotland), and the Warm Homes Scheme (Northern Ireland). These programmes pay for energy efficiency improvements in privately owned existing dwellings. They influence heating system performance by the scheme standards they adopt.

> **Question 2: Does the above graph realistically illustrate how key existing policy instruments could support improvements to conventional heating systems?**

3.1   Market analysis, projections and targets

Current status

49.   This is our first annual consultation paper, as committed to in the Energy White Paper, addressing how the performance of domestic heating and hot water systems will need to improve between now and 2020, including proposals for product standards and initiatives to phase out the least efficient products. The intention is to update this analysis on a yearly basis.

50.   A table showing the targets and standards needed to realise the P1 target is provided in the Appendix. This table also provides metrics against which developments in the market can be measured.

> **Question 3: Are the performance and market penetration figures shown in Figures 2.1 and 3.1 and in the table in the Appendix set at the right levels?**

51.   The intention is to monitor progress against the current projection for technology and market development, to consult on the evidence and, annually, to review and update the published analysis and policy response, including indicative product performance standards for new products supplied to the UK market.

> **Policy:** Publish and update UK market and technology plans annually.
> **Start date:** 2006.
> **Reference:** Announcement in Energy White Paper 2007.
> **Next deliverables:**
> - 2007/08: Monitor market developments, refine models and consult on possible amendments to this paper.
> 2008: Publish an updated P1 target and indicative product standards.

Acknowledged risks

52.   There is a risk that products will develop in a direction that differs from that which was initially expected in the projections (i.e. P1 target will not be met). To offset this risk, the Government may consider, for example:

- Whether or not a more ambitious P1 target could be set as part of the review process.
- Pursuing measures designed to further accelerate the use of innovative technologies.

53.   Weaknesses in knowledge about market and technology trends, and the relationship between the performance of products measured under test conditions and what is achieved in real life, could lead to reduced effectiveness of the policy programme.

Strengthening initiatives

- Ongoing: Government will continue to monitor areas to identify where it may be beneficial to strengthen the evidence base on domestic heating and hot water systems.

> **Question 4: In the area of market analysis, projections and targets, should consideration be given to any additional:**
> - **Measures.**
> - **Risks.**
> - **Strengthening initiatives.**

3.2   Engaging the supply chain

3.2.1   Supply chain initiatives

Current status

54.   In line with announcements in the Energy White Paper, the Government will ask major UK companies in the supply chain to compete to supply heating and hot water generation products in line with the indicative standards set out in the Appendix. The term 'indicative product standards' in this paper means the indicative average performance specifications and market penetration targets, including better use of existing controls. The supply chain includes the retailers of systems, the engineering designers of new buildings, and the installation and maintenance contractors. Heating system installers play an influential role in the market for domestic boilers and heating systems, and householders rely upon their advice when deciding what to buy.

Acknowledged risks

- The supply chain initiative may not deliver the Government's P1 target or product standards.

Strengthening initiatives

- 2008: Government will continue to consider where further actions could be employed to encourage specifiers, distributors, installers and manufacturers to work to meet a more ambitious P1 target and product standards. This could help to sustain successful supply chain initiatives.

  Professional Development Training: The Government will continue to encourage training organisations and providers to ensure that best practice energy efficiency information is provided to new trainees and established installers regarding system choice, system design, correct sizing of plant, controls, installation practices and commissioning.

3.2.2 Metrics: market development

Current status

55.   The measure for whole-house performance is SAP, which, for the production of Energy Performance Certificates, delivers three indicators of energy performance of new and existing housing - an energy consumption per unit floor area indicator $kWh/m^2/year$ (kilowatt hours per unit of floor area per year), an energy cost indicator (£/year) that is mapped on to a scale of 1 to 100 (the SAP rating), and an Environmental Impact (CO_2) Rating measured by $kgCO_2/year$, which is also mapped on to a 1 to 100 scale. For Building Regulations compliance purposes, the SAP calculates the dwelling emission rate (DER), which is a measure of emissions in units of carbon dioxide emissions per unit of floor area per year ($kgCO_2/m^2/year$).

Acknowledged risks

56.   SAP has a regulatory and legal status that makes it impractical to amend frequently. That may discourage the adoption of higher standards by the supply chain, as the energy saving benefits of new products rely on recognition by SAP to provide the commercial incentive for investment and development. Nevertheless, between major revisions to SAP, it is possible to apply for recognition of new energy saving products by a procedure described in SAP Appendix Q[17].

57.   Unreliable product data, arising from insufficiently rigorous test methods and procedures, may undermine competition on the basis of energy performance. Limitations on standard boiler efficiency test methods are noted in paragraphs 53, 70 to 73 and 123.

58.   The perceived shorter lifetime of modern boilers may encourage consumers to retain older, less-efficient boilers for as long as possible (see paragraph 36).

Strengthening initiatives

59.   Ongoing: The Government will consider working closely with specifiers, distributors, installers and manufacturers to develop aids enabling them to adopt higher standards at low cost.

Question 5: In the area of engaging the supply chain, should consideration be given to any additional:
- **Measures.**
- **Risks.**
- **Strengthening initiatives.**

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[17] http://www.sap-appendixq.org.uk/

3.3 EU and international policy actions, programmes and initiatives

3.3.1 International collaboration

60.   No international trade collaboration agreements have been identified that are relevant to the promotion of more efficient conventional central heating systems. Although the manufacture of boilers and their component parts is undertaken internationally, boilers are designed for specific national markets. There are significant variations between heating systems in different countries, influenced by building and installation practices, usage patterns, and controls. The UK market differs notably from that of continental Europe.

3.3.2 Mandatory standards

Current status

61.   The Boiler Efficiency Directive, the Eco-design of Energy-using Products Directive (EuP; 2005/32/EC)[18] and the Energy Performance of Buildings Directive (EPBD) are the main legislative instruments at the European level influencing current developments. The Boiler Efficiency Directive is to be replaced by implementing measures for boilers under the EuP, and preliminary studies with industry experts have been undertaken to help develop the methodology to assess boilers and water heaters.

62.   New European standards affecting space-heating systems, hot-water systems, and boiler inspection have been created to support the Energy Performance of Buildings Directive. Mandatory standards for overall heating performance are applied in the form of national, rather than European, building codes. They require analytical methods to be defined and used to certify the energy performance of dwellings, and methods are currently left to national development. Measures have been introduced implementing Article 8, either to inspect boilers and heating systems with outputs over 20 kW or provide heating system advice with equivalent impact.

> **Policy:** EU Framework Directive for Eco-design of Energy-using Products (EuP).
> **Start date:** 2005 (Framework Directive adopted).
> **Reference:** http://ec.europa.eu/energy/demand/legislation/eco_design_en.htm
> **Next deliverables:**
> - 2008: EuP implementing measures for boilers and water heaters.

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[18] See MTP Briefing Note BNXS03;
www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=389

Policy: Energy Performance of Buildings Directive.
Start date: 2006.
Reference: http://eur-lex.europa.eu/LexUriServ/site/en/oj/2003/l_001/l_00120030104en00650071.pdf

Acknowledged risks

63.   Timing for delivery of standards via EuP is uncertain. Delivery of the UK's preferred standards via EuP is also uncertain, as EuP has a Single Market legal base so any final performance requirements should be fully harmonised across the whole of the European Union.

64.   There is also a significant risk that current regulatory processes will not be able to respond sufficiently nimbly to a rapidly changing market, leading to ineffective regulation and market drivers.

65.   Carbon emission factors used for regulatory compliance may not keep pace with changes in the electricity generation mix, as frequent alterations would make compliance more difficult for designers and builders. This may lead to a mismatch between real and perceived carbon emissions, and distortion of the market for competing products that are differentially affected by it.

66.   Advice given to boiler owners in accordance with Article 8 of the EPBD may not result in significant energy savings over and above existing advice mechanisms.

Strengthening initiatives

- Ongoing: The Government will continue to monitor the effectiveness of the regulatory processes in question and consider whether to press the European Commission to ensure domestic heating and hot water systems remain a priority for regulatory action under this Directive. However, the current timetable indicates that an implementing measure will not come into force before 2009. The Government will work with the supply chain in an effort to 'phase in' new standards in advance of this date (see Section 3.2.1).
- 2008: The Government may, in future, reconsider the value of boiler inspection, as an alternative to efficiency advice, for implementation of Article 8 of the EPBD.

3.3.3   Product information

Current status

67.   At present, there is no European mandatory energy labelling scheme for gas and oil boilers. The SEDBUK method of boiler efficiency measurement, while using results from European test standards, is limited to use in the UK. SEDBUK efficiencies, taken from the Boiler Efficiency Database, are used in SAP assessments and SEDBUK efficiency bands have been used on a voluntary basis to assist purchasers.

Acknowledged risks

68.   The SEDBUK method is limited to data obtained from standard European tests and is, therefore, unable to take into account additional aspects of performance, such as the electricity consumed by gas and oil heating systems. As boilers now approach the top of the SEDBUK scale, the absence of additional performance data hampers the selection of better products by discerning consumers.

Strengthening initiatives

69.   2008: The Government will consider pressing for the EC (via the Energy Labelling Framework Directive[19] and the EuP Directive (see Section 3.3.2)) and suppliers to provide harmonised product information covering the major environmental impacts of boilers and other heating equipment.

3.3.4   Metrics: test and measurement

Current status

70.   The Boiler Efficiency Directive relies on European test standards for thermal efficiency. However, these test standards do not produce consistent results in a market where there is strong competition for high efficiency. It is not yet known whether the same standards will be utilised by the EuP.

71.   The standards permit more than one method of testing, and do not define sufficiently rigorous conditions to achieve a satisfactory level of consistency and repeatability. Consequently, laboratories within the UK and across Europe are not able to accurately replicate test results.

Acknowledged risks

72.   Development of formal test standards may not keep pace with policy needs to differentiate the energy performance of products on the market, and such products may not be correctly and accurately represented. There is a concern that the contractual relationships that exist between laboratory and manufacturer may have an undue influence on the former's ability to act in a truly independent manner.

Strengthening initiatives

73.   The Government will consider identifying critical performance standards and working with formal bodies to agree more effective and reliable performance measurement methodologies. For example, current boiler efficiency test methods (see paragraph 70) can be improved by more rigorous definition of test conditions and by collecting additional measurement data during tests. New standards could be devised for the ergonomic design of heating controls. Solar heating systems could be more readily understood and evaluated if there were a limited set of standard specifications. The Government is also considering taking a more proactive role in product surveillance and monitoring the performance of Notified Bodies.

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[19] MTP Briefing Note BNXS37;
www.mtprog.com/ApprovedBriefingNotes/BriefingNoteTemplate.aspx?intBriefingNoteID=396

Question 6: In the area of EU and international policy actions, programmes and initiatives, should consideration be given to any additional:
- **Measures.**
- **Risks.**
- **Strengthening initiatives.**

3.4 UK policy actions, programmes and initiatives

3.4.1 Public procurement

Current status

74.   The Code for Sustainable Homes identifies a number of performance levels (1 through 6) as steps towards zero carbon dwellings. Currently, all new homes built with public sector funding must meet Code Level 3, equivalent to the next improvement in Part L of the Building regulations forecast for 2010. From 2013, Code level 4 will apply, requiring some type of renewable energy or solar hot water heating system installations. Zero-carbon requirements will come into force from 2016. To meet these increasingly strict energy performance requirements, conventional heating systems will have to be either (i) augmented by renewable energy sources (e.g. solar energy, geothermal energy, bio-fuels), or (ii) displaced by alternative systems or fuels (outside the definition of conventional central heating).

75.   The Government published its Sustainable Procurement Action Plan (SPAP) in March 2007, re-affirming its commitment to use Government procurement to drive the market for energy efficient products. Alongside the Action Plan it published updated and extended standards for an increased range of products that are mandatory for Central Government departments. Defra committed to review with stakeholders the range and level of the standards every two years and to publicly consult on mandatory standards for a wider range of products and services, now planned for Spring 2008. The information set out in these consultation papers will be used to inform the standards proposed for Government procurement.

76.   Guidance on energy efficiency and energy savings as possible assessment criteria in public sector tendering will be published in May 2008 as part of the Energy Services Directive. The Directive also sets out a number of options relating to public sector procurement of energy-using products, buildings and energy services, on which the Government is currently consulting (consultation close date of 6 March 2008).

77.   The NHS (England) published its Sustainable Procurement Action Plan in August 2007. Similar action plans for local authorities are expected from winter 2007/08.

78.   The Government is also committed to identifying stretching, forward-looking standards to provide longer term signals to business and to encourage innovation, for example through the use of the 'Forward Commitment Procurement Model'.[20]

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[20] See www.berr.gov.uk/files/file35312.pdf

Policy: UK Government Sustainable Procurement Action Plan
Start date: 2007
Reference:www.sustainable-development.gov.uk/publications/pdf/SustainableProcurementActionPlan.pdf
Next deliverables:
• Autumn 2008: Revised Government procurement standards announced.

Acknowledged risks

79.   Specifying fixed threshold values in procurement specifications may result in 'lock in' to incumbent technologies by excluding alternative products, and lead to innovation being stifled. Outcome-based specifications, along with challenging and progressive threshold values can help to minimise this.

80.   The relative environmental benefits of alternative products (e.g., heat pumps, micro-CHP) depend on carbon emission factors. The carbon emission factors used for regulatory emission thresholds may distort the markets for competing products if they do not broadly keep pace with changes in the electricity generation mix.

Strengthening initiatives

• The Government will consider including standards specifically for the procurement of domestic heating and hot water, where applicable, within its formal procurement guidelines that are at or above the performance targets in the Appendix.
• Strengthened leadership and scrutiny of performance on sustainable procurement throughout Government as set out in the SPAP.
• Transforming Government procurement agenda will build procurement capabilities and capacities within Departments and improve delivery of agreed policies.

3.4.2   Building Regulations Part L

Current status

81.   The revision of Part L of the Building Regulations in 2006 (in England and Wales, equivalent guidance elsewhere in the UK) implemented some parts of the Energy Performance of Buildings Directive and introduced new guidance using a method of compliance based on flexible design (i.e., targets for overall carbon emissions). Part L is reviewed at least every five years; the next amendment is scheduled for 2010.

82.   A second-tier document[21] provides guidance on complying with the Buildings Regulations for space heating and hot water systems in the domestic sector. For existing dwellings, this sets out reasonable provision for the installation or replacement of controlled services. It includes minimum standards for boilers (SEDBUK efficiency of 86%) and hot water storage vessels.

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[21] http://www.planningportal.gov.uk/england/professionals/en/1115314255842.html

83.   The Northern Ireland Building Regulations requirements (Part F) are the same as for E&W Part L. These requirements came into operation on 30 November 2006.[22]

84.   In Scotland, the Building (Scotland) Amendment Regulations 2007 came into force on 1 May 2007. These are to be revised at least every five years.

> **Policy:** Application of the Building Regulations.
> **Reference:** Approved Document L1A: Conservation of Fuel and Power in new dwellings (2006 edition).
> Approved Document L1B: Conservation of Fuel and Power in existing dwellings (2006 edition).
> **Start date:** April 2006 for Building Regulations.
> **Next deliverables**:
> - 2010: Revision of Building Regulations Part L to deliver a further 25% reduction in carbon emissions from new housing.

Acknowledged risks

85.   The energy-related parts of the Building Regulations (Part L) are updated typically every four years and the next revision is not scheduled until 2010.

86.   Delivery of P1 targets may fail because future revisions of Part L may not be sufficiently ambitious in lowering the maximum allowable carbon emissions. Enforcement of Building Regulations may not be sufficiently effective to realise the energy and carbon savings anticipated.

Strengthening initiatives

87.   The Government will continue to look at ways to ensure that performance levels are in line with the P1 target.

3.4.3   Product information

Current status

88.   The Boiler Efficiency Database[23] was created by the Government in 1999 as a source of boiler efficiency figures for use in SAP and for wider reference. Central Heating System Specifications[24] (CHeSS) identify the components of conventional heating systems that are critical to energy efficiency and help to align purchasing procedures to ensure quotations can be compared. The Energy Saving Recommended (ESR) scheme[25] is a voluntary labelling scheme run by the Energy Saving Trust (EST), which endorses products that comply with specified product performance criteria. It serves as a recognition of manufacturers' efforts towards efficiency best practice and as a straightforward consumer label. Only boilers whose efficiency lies in SEDBUK band A (90% or greater) qualify for the ESR scheme, and

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[22] See www.buildingregulationsni.gov.uk.
[23] www.sedbuk.com
[24] Energy Efficiency Best Practice in Housing publication CE51, www.energysavingtrust.org.uk/housingbuildings/publications
[25] www.energysavingtrust.org.uk/energy_saving_products/

for combi-boilers the test results for hot water performance must also be submitted. In addition, boilers will be accepted only when the standby power does not exceed 10 W.

Policy: Energy Saving Recommended (ESR) scheme
Start date: 2000
Reference: Energy Saving Recommended database[26]
Next deliverables:
- 2008: Energy Saving Trust (EST) and stakeholders to review endorsement criteria

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Acknowledged risks

89.   The lack of reliable or effective consumer information could prevent consumers making an informed choice and prevent effective competition on energy efficiency issues.

Strengthening initiatives

90.   2008: Government will continue to monitor the effectiveness of product information and, if necessary, consider whether to request the EST to increase the level of support it provides to merchants and installers to improve practices.

3.4.4   Energy Efficiency Commitment (EEC)/Carbon Emission Reduction Target (CERT)

Current status

91.   The Energy Efficiency Commitment (EEC) scheme[27] puts an obligation on energy suppliers to meet a target for improvement in energy efficiency among household customers. Energy suppliers are not expected or required to deliver particular amounts of any measure or product to meet their obligations. As part of the development of the legal obligation the Government develops an Illustrative Mix of the type and number of measures that suppliers might use to meet the target proposed.

92.   The draft order for the third phase of the Household Energy Supplier Obligation between 2008 and 2011, which will be called the Carbon Emission Reduction Target (CERT), was laid before Parliament on 5 December 2007 and needs to be approved by both houses.

Policy: Carbon Emission Reduction Target (CERT).
Start Date: 2007.
Reference: Consultation on CERT.[28]
Next deliverables:
- 2008: Full terms of CERT 2008–2011 to be set (Defra, Ofgem).

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[26] http://www.energysavingtrust.org.uk/proxy/view/full/407/recommendedproducts
[27] http://www.defra.gov.uk/environment/climatechange/uk/household/eec
[28] www.defra.gov.uk/corporate/consult/cert2008-11/index.htm

Acknowledged risks

93.   CERT is based on carbon savings, rather than specific products provided. Although EEC has made significant contributions to previous market transformations in the energy efficiency of household products, there is no guarantee that CERT will deliver any particular level of market transformation for any measure or product. It may be that, in practice, the programme delivers only a small number of more energy efficient boilers as the cost to suppliers is high in relation to the credit gained. It may not be possible to distinguish and accredit advanced heating controls.

Strengthening initiatives

94.   2010: The Government will monitor the effectiveness of CERT. The Government has said that a household Supplier Obligation in some form will continue to 2020, although the policy instrument has yet to be developed. A call for evidence on the post-2011 phase closed on 14 September 2007.[29]

Question 7: In the area of UK policy actions, programmes and initiatives, should consideration be given to any additional:
- **Measures.**
- **Risks.**
- **Strengthening initiatives.**

3.5   Other policies with potential to impact on domestic heating and hot water systems

3.5.1   General energy efficiency information

95.   The Government has initiated an 'Act on CO_2' campaign to help the general public make the link between their own individual actions and climate change. A carbon calculator at www.direct.gov.uk/actonco2 allows an individual or household to calculate the carbon footprint resulting from their home, appliances and personal travel. It then offers a tailored action plan with simple tips – such as turning your thermostat down by one degree – for reducing that footprint. The calculator takes the heating system into account in its 'home' section.

3.5.2   Promoting pro-environmental behaviour

96.   The Government is developing a stronger consumer-facing strategy to promote pro-environmental behaviour, covering the four major consumption impacts of homes, food, personal transport and tourism. This includes setting prioritised behaviour goals (which include better energy management and buying more energy efficient products), audience segmentation and consumer insight, re-organisation of structures and programmes and partnership working. As this work is still in its infancy, there are no domestic heating and hot water-specific initiatives yet in place, but the broader implications of the policy are potentially significant for all products.

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[29] www.defra.gov.uk/environment/climatechange/uk/household/supplier/pdf/evidence-call.pdf

97.   Work for *Future Water*, the Government's new water strategy for England, to be launched in early 2008, has shown that the use of hot water in our homes - washing, cooking and cleaning, but excluding that for space heating - contributes roughly 35 Mt CO_2 emissions. The overarching message of the new water strategy is the need for everyone to value water more and not waste it. Reducing the inadvertent wastage of water, particularly hot water, is a real win-win solution, saving water as well as energy and reducing greenhouse gas emissions.

3.5.3   Possible change of EU stance on rebating VAT on energy efficient products

98.   In July 2007, Gordon Brown and President Sarkozy of France announced that they have proposed to the European Commission that it is time to introduce new incentives for consumers purchasing environmentally friendly products - specifically a reduced rate of VAT for these products. This was followed up by a further letter from the Chancellor, Alistair Darling, and French Finance Minister, Christine Lagarde, in October 2007. EU tax proposals need unanimous support from the 27 Member States to become law.

3.5.4   Smart-metering

99.   The Energy White Paper set out a number of policies on energy billing and metering, designed to reduce energy consumption. The Department for Business, Enterprise and Regulatory Reform (BERR, formerly the DTI) recently consulted on the implementation of these policies (the consultation period closed on 31 October 2007). In summary, these are:

- To promote awareness of domestic energy use through a requirement on energy suppliers to present consumption data (preferably in graphical form) on consumers' bills to allow them to compare different periods of energy consumption.
- To provide real-time display units to certain customers so that they can see in real time, and in a way that is relevant to them, how much electricity they are consuming
- To require the installation of smart meters for business customers above a certain energy usage threshold, where it has been proven to be cost-effective.

100.   The Energy White Paper set out the Government's expectation that smart metering would be introduced in the remainder of the business sector and the domestic sector over the next decade. It also states that the Government will consider how to incentivise innovation in relation to household displays of gas consumption and cost. Such information has the potential to improve consumer awareness and increase the correct use of heating controls (for example by enabling consumers to see the impact of correctly setting boiler and heating controls such as thermostats and time switches).

> **Question 8: What is the potential for the introduction of smart systems (eg in-house management systems, remote management of boilers) as a means of delivering energy savings in the period up to 2020, and what additional measures would you suggest to promote this?**

> **Question 9: Are there any other policies likely to impact on domestic heating and hot water systems that should be taken into account?**

4 Other potential measures

101. This section looks towards other measures whose development may need to be encouraged to enable the desired improvements in energy performance to be achieved.

4.1 Other ways of improving conventional systems

102. Electrical components can be designed with lower power demand, and energisation periods minimised.

103. Lower temperature emission systems (such as underfloor heating, or oversized radiators) can be fitted to enable condensing boilers to operate for longer periods in condensing mode with higher efficiency. Correctly designed, whole-house underfloor heating systems are recognised in SAP as a way of achieving higher seasonal heating efficiency.

104. Weather compensation controls, in conjunction with condensing boilers, utilise lower water-circulation temperatures and, hence, obtain higher boiler efficiencies.

105. Passive flue-gas heat recovery units can be fitted to boilers to extract and make use of heat in the flue gases.

106. Heating controls can be linked to sensors, security systems, and other intelligent equipment installed within the building to sense whether occupants are absent or windows open, and turn down the heating accordingly.

107. Adherence to procedures to ensure the correct sizing of plant, better installation practices (eg careful insulation of pipework and setting of controls) and better commissioning will maximise the efficiency of newly installed systems.

108. The use of inefficient secondary heating appliances could be reduced by more responsive main heating systems.

109. Where mechanical ventilation is installed, heat recovery from the exhaust air may be used to warm incoming air and reduce boiler load.

110. It might be possible to improve the energy performance of older boilers by using 'upgrade kits' for installation in situ where the owner is reluctant to undergo the expense of a full boiler replacement.

4.2   Alternatives to conventional systems

111. Numerous alternatives are at various stages of development/deployment and some may start to displace gas and oil boilers on a large scale. They have diverse technical characteristics and a considerable range of potential savings in energy and carbon. However, they may also have limited fields of application, may be unsuitable for existing housing, and may not yet be cost effective. The table below lists some of those that have carbon saving benefits relative to gas boilers.

| Biomass community heating with CHP |
| Biomass community heating |
| Wood or pellet burning boiler |
| Ground source heat pump with underfloor heating |
| Gas community heating with CHP |
| Bio-kerosene (replacing oil) boiler |
| Micro-CHP |

112. Among those with the largest prospective savings are community heating with CHP, and boilers fired by low-carbon fuels such as biomass. Both are more economic in large schemes, necessitating a shift from single-dwelling heating systems to a different infrastructure requiring high initial investment, professional design, and continuous operation and management. Micro-CHP embraces a range of technologies including internal and external combustion engines, turbines, and fuel cells, and can be used to replace single-dwelling boilers.

113. Further research on the state of development of alternative systems, their advantages, limitations, and cost effectiveness is necessary to establish likely prospects of success and robust estimates of future market share.

> **Question 10: What additional measures would you suggest developing to drive forward sustainability in domestic heating and hot water systems?**

5   Potential impacts

114. This section provides a partial analysis of the more significant potential impacts of the proposals contained herein.

5.1   Consumer cost/benefit analysis

115. Consumer advice on the costs and benefits of conventional heating systems is available from independent sources, such as the Energy Saving Trust. The trend to shorter boiler lifetimes (see paragraph 36) leads to higher costs for consumers as boiler replacement is expensive (see paragraph 42). Heating controls have the potential to provide significant fuel cost savings at modest expense, and where adequate controls are already fitted, but not being used correctly, additional savings can be achieved at no cost at all. The costs and benefits of solar water heating vary

with system capacity and hot water demand, and need to be assessed in individual cases to provide a realistic estimate.

5.2   Business impacts

116. More effective use of standard heating controls calls for better information to consumers and design improvements for ease of use. Advanced controls, when their energy saving potential has been established, will require new design, development and promotion. A substantial increase in the demand for solar hot water systems will require greater activity by local suppliers and installers, and, for new housing, greater awareness by builders and developers of their contribution to the target emissions rating. Development of alternatives to conventional heating should continue to improve their cost-effectiveness and enlarge their field of application.

5.3   Waste impacts

117. The significant components of waste from conventional systems are metals (steel, cast iron, copper, aluminium, stainless steel) and electrical waste from circuit boards, controls and other small components. Some of the metal waste – notably radiators and pipework – is easily separable and likely to be recycled. With boilers, of which over 1 million are scrapped each year, recycling requires disassembly. The cost of disposal to landfill has been estimated at about £2 per boiler.

5.4   Health impacts

118. The health benefits of warm homes are well understood, and health risks from conventional heating systems are low provided they have been properly installed and maintained. Risks from carbon monoxide poisoning are reduced by the trend to room-sealed boilers. Other impacts are air pollution from NO_x and SO_x. Air pollution is reduced by careful control of combustion, and moves towards biomass may be restrained in areas subject to smoke control orders.

> **Question 11: Are there any other potential impacts resulting from these proposals that should be taken into account?**

6   Further information

119. The following MTP publications (available from www.mtprog.com/) are linked to this consultation paper and present the underlying evidence base of information such as further explanations, definitions, assumptions and important background information:

BNDH15	Use of heating controls
BNDH17	Water heaters: proposed energy labelling directives
BNDH19	Evaluation of heating controls
BNDH21	Solar water heating for housing
BNDH22	Micro-CHP performance measurement

Appendix – Indicative performance standards for domestic heating and hot water systems

120. Table A1 shows the indicative average performance specifications and market penetration targets for new products supplied to UK end-users (including better use of standard controls). These correspond with the Government's underlying published stock models and projected energy consumption in each sector (the P1 target presented in this consultation paper). The data can be seen graphically in Figure 3.1.

121. These specifications may be used directly in suitable policy instruments (e.g. the supply chain initiative) and provide a metric against which developments in the market can be measured.

122. The underlying stock modelling is subject to an ongoing consultation and review process. More detail on the modelling, current market analysis and data downloads is available via the MTP's What-If tool (http://whatif.mtprog.com).

Table A1   Targets for boiler performance, better use of existing heating controls, advanced heating controls, and solar water heating

Year	Minimum boiler efficiency (see Note 1)	Better use of standard controls (see Note 2)	Advanced controls (see Note 3)	Solar hot water (see Note 4)
2007	86%	50%	0%	0.37%
2008	86%	50%	0%	0.44%
2009	86%	55%	0%	0.52%
2010	86%	60%	1%	0.61%
2011	86%	65%	5%	0.71%
2012	86%	70%	10%	0.83%
2013	86%	75%	15%	0.96%
2014	86%	75%	20%	1.11%
2015	86%	75%	25%	1.29%
2016	86%	75%	30%	1.48%
2017	86%	75%	35%	1.70%
2018	86%	75%	40%	1.95%
2019	86%	75%	45%	2.24%
2020	86%	75%	51%	2.56%

Note 1: Minimum boiler efficiency

123. The minimum standard for gas and oil boiler efficiency on the SEDBUK scale has been determined by Building Regulations and no change is planned in the foreseeable future. SEDBUK is constrained by the present European standards for boiler testing, which are limited to thermal conversion efficiency. The prospects for further performance improvement rest upon development of more advanced, and more reliable, test methods (eg including mandatory measurement of hot water performance, and auxiliary power (electricity consumption)).

Note 2: Better use of standard heating controls

124. The target is the proportion of homes with standard controls whose occupiers set and use them correctly. Improved householder usage of standard controls assumes that (following a vigorous householder education programme) the number of householders using their controls correctly rises from 50% to 75% of those who have standard (rather than advanced) controls, over a 5-year period starting in 2009. The number of standard controls diminishes as advanced controls replace them, but meanwhile, improved design of standard controls would assist householders who find difficulty in understanding the user interface.

125. Standard heating controls comprise:

- For regular boiler systems:
  - Either a full programmer and room thermostat, or a programmable room thermostat.
  - A cylinder thermostat.
  - Thermostatic radiator valves (TRVs).

The above are installed so as to ensure that the boiler does not fire when there is no demand for heat or hot water.

- For combi boiler systems:
  - Either a time switch and room thermostat, or a programmable room thermostat.
  - Thermostatic radiator valves (TRVs).

These are installed so as to ensure that the boiler does not fire when there is no demand for heat.

Note 3: Advanced heating controls

126. The target is the proportion of homes with advanced controls. Advanced controls replace standard controls and are designed to exploit the characteristics of condensing boilers so as to raise the average annual efficiency obtained from heating systems in which they are installed. It is assumed that 5% energy saving by advanced controls is achievable and there is a short development period followed by adoption as standard practice from 2011, when Part L1 of the Building Regulations changes. Advanced controls will usually be installed when the boiler is replaced, with target market penetration of 50% reached by 2020.

Note 4: Thermal solar water heating systems

127. The target is the proportion of homes in which thermal solar water heating is installed. More rapidly increasing use of thermal solar systems for hot water is anticipated from 2008. It is assumed that each system installed saves 8.6% of the total energy used for space heating and hot water and that the annual growth rate in number of installations is 13.5% per year compounded, reaching 700,000 systems in use by 2020.