# BNDH B02: Domestic Central Heating Government Standards Evidence Base 2009: Reference Scenario

**Version 1.1**

This Briefing Note and referenced information is a public consultation document and will be used to inform Government decisions. The information and analysis forms part of the Evidence Base created by Defra's Market Transformation Programme.

## 1 Introduction

- The Reference Scenario is a projection of what is likely to happen to energy consumption of each product if no new policies are implemented. All agreed and formally signed-off policies are included in the reference scenario.

- For existing crosscutting policies such as CERT and Building Regulations, which are agreed but where the likely impact for specific products is unknown, assumptions are made about the impact per product, and detailed in the following sections.

### *1.1 Product definition*

**Conventional Central Heating (CH) Boiler**

- This briefing note and related model include the energy consumed by domestic boilers both to heat domestic hot water and provide space heating. Dedicated water heaters are dealt in a separate set of briefing notes[1].

- The definition of a CH Boiler has been adopted from the ErP Working Document (published 29 Feb 2008) that*: A CH-boiler is a product that is equipped to generate heat and to transfer this heat to a heat transfer fluid (CH-water) circulating in a distribution system (CH distribution network) to which at least one heat exchanging means is connected (CH-emitter) that is equipped to transfer the heating energy of the CH-water into space heating of (a part of) buildings.*

[1] BNDH GWH01: Domestic Gas Water Heaters Government Standards Evidence Base 2009 and BNDH EWH01: Domestic Electric Water Heaters Government Standards Evidence Base 2009.

- Domestic Boilers can be regular boilers (CH-boiler) or combi boilers (CH-combi)[2] type: A *CH-boiler* provides heating directly and can provide domestic hot water through a separate CH-water tank (i.e. insulated storage tank or cylinder*). A CH-combi is a product with the functionality of both a CH-boiler and a Water Heater.* A *CH-combi* has the capability to provide domestic hot water directly. Some CH-combis, defined also as 'primary storage' combis, can include a small hot water store of up to 15 litres. Secondary storage CH-combis include a built in hot water store of 15 litres or more[3] (Figure 1)

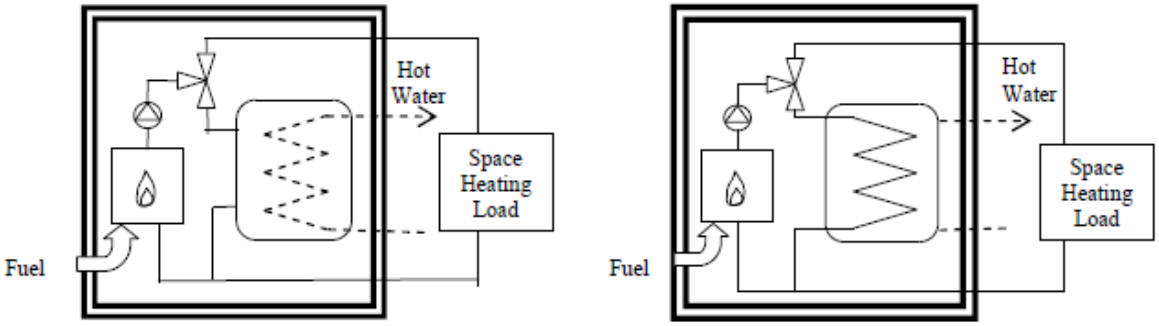


**Figure 1 - Primary storage CH-combi (left) and Secondary storage CH-combi (right)[4].**

- Condensing boilers can achieve seasonal efficiencies (SEDBUK)[5] between 83% and 92%.This is higher than for non-condensing boilers due to the extraction of latent heat by condensing water from the flue gases.

- Most boilers comprise a single combustion chamber enclosed by the waterways of the heat exchanger .Combustion gases are expelled through the flue having given up most of their heat to the water. The temperature at which these gases are expelled to atmosphere is a major determinant of the efficiency of the boiler.

- Non-condensing boilers expel these gases at around 180$^{o}$C.

- Condensing boilers are designed to allow a reduction of the flue gas temperature to a much lower temperature, 55°C when other conditions permit. This reduction of temperature causes some of the water vapour to condense and the remaining gases are expelled to the outside environment.

[2] Working document on possible Ecodesign Energy labelling and Installation requirements for Boilers and Water Heaters – February 2008 - p5
[3] Combination Boilers and Low Flow Fittings - Elemental Solutions 2007.www.environment-agency.gov.uk/savewater
[4] The Government's Standard Assessment Procedure for Energy Rating of Dwellings 2005 (SAP 2005) edition revision 2.
[5] Seasonal Efficiency Domestic Boiler UK – this is an industry standard for measuring and publishing the thermal efficiency of a boiler. http://www.sedbuk.com/cgi-local/dynamicv.cgi?page=boiler8

- According to The UK Government's Standard Assessment Procedure for Energy Rating of Dwellings 2005 [SAP 2005] a Condensing boiler is *'a boiler designed to make use of the latent heat released by the condensation of water vapour in the combustion flue products. The boiler must allow the condensate to leave the heat exchanger in liquid form by way of a condensate drain'.*

- SAP 2005 therefore defines Non-Condensing Boilers *as boilers […] without the means to remove the condensate in liquid form.*

- The current domestic boiler stock in the UK is evenly split between regular and combi boilers. However, sales figures show that the latter are becoming increasingly popular in the UK, although these almost exclusively use gas.

- The Domestic CH-Boilers covered by this brief have been subdivided into three main categories:

  1. *Gas Fired – Regular Boilers (Condensing and Non-Condensing);*
  2. *Gas Fired – Combi Boilers (Condensing and Non-Condensing);*
  3. *Oil Fired – all boilers*

**Alternative Heating Technologies**

- Additionally, three groups of alternative technologies have been considered as likely replacements for boilers:

  4. *Alt- Elect - (*alternative, electrically-driven systems: *ground source heat pumps, air source heat pumps …)*
  5. *Alt-Gas - (*alternative, gas-driven systems: *gas heat pumps, micro CHP...)*
  6. *Alt- Biomass - (alternative, biomass-fired systems: solid fuel boiler)*

- Heat pumps are identical in operation to refrigerators, incorporating an electrically driven compressor to create a pressure difference between two volumes of refrigerant. In the refrigerator the aim is to extract heat from the food compartment (i.e. cool it down) and reject this heat to atmosphere as waste heat. In the heat pump, the "waste heat" is transferred to a heating medium. Heat is extracted from a convenient source such as the atmosphere or the ground. In effect heat is "pumped" from a low temperature to a higher temperature.

- The main advantage of a heat pump is that it produces more useful heat than is used to drive the compressor. As such, the efficiency is greater than 100%.

- Ground source heat pumps use buried pipes to extract heat from the ground, which is usually used to warm water for space heating systems. It can also pre-heat water before transferring it to a more conventional boiler.[6]

- Air source heat pumps absorb heat from the outside air. This heat can then warm water for radiators or underfloor heating systems, or warm the air directly.

- As both ground source and air source systems heat water to a lower temperature than a standard boiler system would, they are more suitable for under floor than radiator distribution systems. An air-to-air system produces warm air which is circulated through a dwelling by fans.

- Micro CHP systems simultaneously generate usable heat and electricity in a single process. They are suited to single dwellings, and range in size from around 4kW heat output (suited to small, well-insulated dwellings) up to 36kW (these units will incorporate a supplementary boiler for additional heat output in larger or hard to heat dwellings). Electrical power output is typically 1kW to 3kW and can be grid-connected. [7]

- Biomass heating comprises a modified solid fuel boiler designed to operate on unprocessed wood chips or logs, or wood pellets (a processed form of waste wood and sawdust). Such boilers are available for individual dwellings or as community heating boilers.

- Biomass boilers reduce $CO_2$ emissions compared to conventional fossil-fuelled boilers by virtue of the comparatively low effective carbon content of the biomass. The residual effective carbon content is from the energy expended in harvesting, processing and transport.

- All of these alternative technologies utilise renewable energy sources that do not directly contribute to greenhouse gas emissions. They do however require conventional power sources to control and drive the equipment (mainly compressors, pumps and fans).[8]

[6] http://www.energysavingtrust.org.uk/Generate-your-own-energy/Ground-source-heat-pumps
[7] http://www.energysavingtrust.org.uk/business/Business/Building-Professionals/Helpful-Tools/Hard-to-treat-homes/Matrix/Micro-CHP
[8] UK Heating 2008 -BRG Consult; Section 3.124 - http://www.brgconsult.com/

# 2 Scenario outputs

- The graph below provides a comparison of scenarios for Domestic Central Heating.

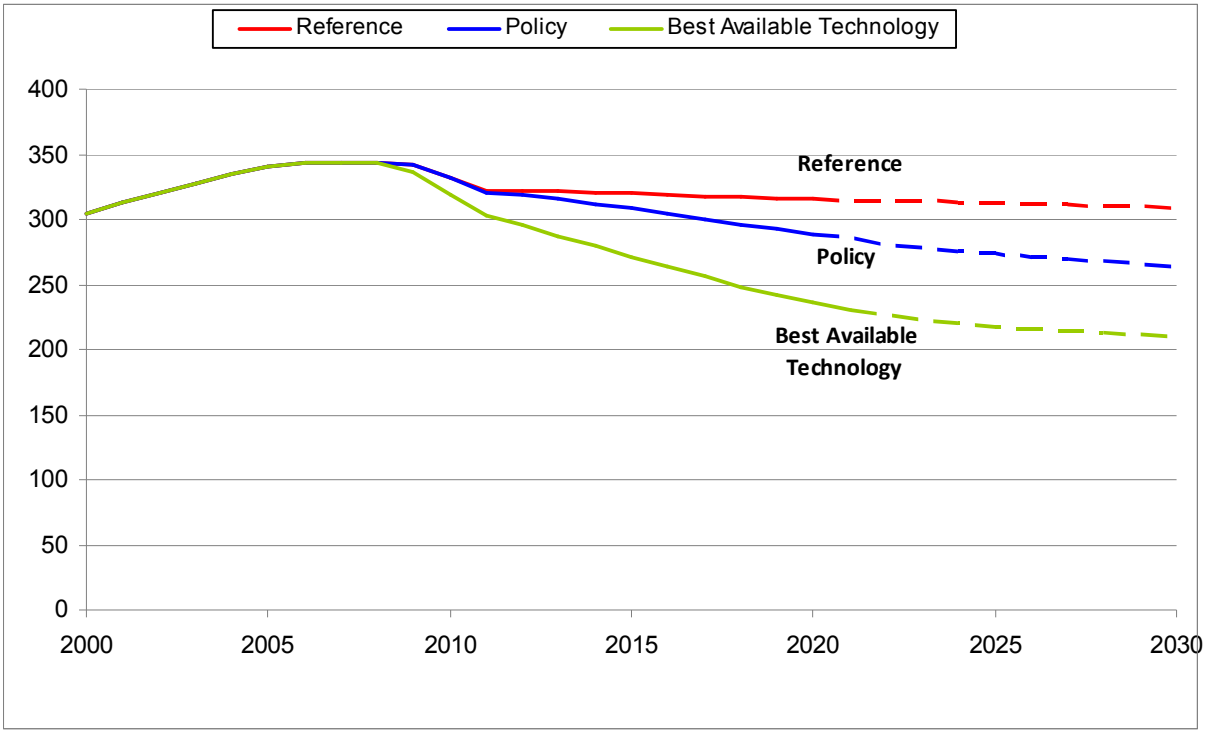


**Figure 2 - Summary Graph Energy Consumption – Domestic Central Heating (TWh/year)**

- The MTP Boiler Model (2009) calculates energy consumption based on Ecoboiler,[9] a tool developed in the preparatory studies for the 2005/32/EC Directive Lots 1 and 2 by VHK.

**Table 1 – Summary energy consumption - Domestic CH Boilers and Alternative Technologies (GWh/year)**

| Product | 2010 | 2020 | 2030 |
|---|---|---|---|
| **Gas Regular Boilers** | 155,600 | 105,600 | 85,000 |
| **Gas Combi Boilers** | 147,300 | 181,000 | 192,100 |
| **Oil Boilers** | 29,300 | 27,500 | 26,100 |
| **Alt - Electric** | - | 600 | 2,170 |
| **Alt – Gas systems** | - | 670 | 2,420 |
| **Alt - Biomass** | - | 480 | 1,720 |

[9] www.ecoboiler.org – Ecoboiler v5b –Van Holsteijn en Kemna (VHK)

- NB stock and sales figures are provided because there is technology switching: i.e. unlike in other product areas, the distribution of stock and sales vary between scenarios (not just the efficiency of the stock).

**Table 2 – Summary Stock – Domestic CH-Boilers and Alternative Technologies: Reference Scenario (000's)**

| | Oil Boilers | Gas Regular | Gas Combi | Alt Electric | Alt Gas | Alt Biomass | Total |
|---|---|---|---|---|---|---|---|
| 2010 | 1,580 | 10,896 | 11,369 | 0 | 0 | 0 | 23,845 |
| 2020 | 1,708 | 8,293 | 15,249 | 123 | 94 | 43 | 25,510 |
| 2030 | 1,716 | 7,064 | 16,642 | 455 | 350 | 159 | 26,386 |

**Table 3 – Summary Sales - Domestic CH-Boilers and Alternative Technologies: Reference Scenario (000's)**

| | Oil Boilers | Gas Regular | Gas Combi | Alt Electric | Alt Gas | Alt Biomass | Total |
|---|---|---|---|---|---|---|---|
| 2010 | 132 | 347 | 1,124 | 0 | 0 | 0 | 1,602 |
| 2020 | 125 | 337 | 1,550 | 24 | 18 | 8 | 2,062 |
| 2030 | 123 | 372 | 1,560 | 49 | 37 | 17 | 2,157 |

# 3 Current policy & measures

- The Reference Scenario includes all policies approved and formally signed off by 2009 (although policies may not have been implemented).

- The major policies and measures taken into account in the Reference Scenario are:
  - Building Regulations Part L (Conservation of Fuel and Power) (1975 to 2006)
  - Energy Efficiency Commitment (EEC 2002-05 and 2005-08) and Carbon Emissions Reduction Target (CERT, 2008-2011)
  - Home Energy Efficiency Scheme/Warm Front
  - Code for Sustainable Homes

## *3.1 Building Regulations*

- There are separate Building Regulations[10] in England and Wales, Scotland, and Northern Ireland. Part L (Conservation of fuel and power) (England and Wales and the equivalent in Scotland and Northern Ireland) places minimum standards for the thermal insulation and air tightness (permeability) of new buildings and replacement elements (such as windows) in existing buildings undergoing refurbishment, and for the efficiency and control standards of heating systems for installation in both new and existing dwellings.

[10]http://www.energysavingtrust.org.uk/business/google/search?SearchText=building+regulations&SearchButton=Search

- England, Wales and Northern Ireland provides detailed guidance on the minimum requirements for heating and hot water systems in the Domestic Heating Compliance Guide[11]. In Scotland, detailed guidance is incorporated in Technical Standards handbooks[12].

- The current Domestic Heating Compliance Guide (E&W) states that all gas boilers fitted in new homes must be condensing boilers with either an 'A' or 'B' SEDBUK[13] efficiency rating (A= greater than 90%, (gross) B= 86%-90% (gross)). For existing installations, a condensing boiler must be fitted on boiler replacement unless the exemption criteria are satisfied.

## *3.2 Carbon Emissions Reduction Commitment (CERT)*

- CERT[14] is the one of the principal policy mechanisms driving increases in the efficiency of existing homes. Under CERT, electricity and gas suppliers are required to achieve targets for the promotion of energy efficiency improvements in the domestic sector.

- Suppliers may fulfil their CERT obligations by supplying and fitting high efficiency boilers.

- From 10 February 2009 the early replacement of operational G-rated boilers is an eligible measure, and the programme does accredit carbon reductions for the replacement of D-rated (Building Regulations 2000) exceptions – if they are replaced with an A or B-rated boiler. 170,000 A or B rated boilers are expected to be installed through CERT 2008-2011

- Published data on predicted savings in $CO_2$ emissions arising from CERT were also used to estimate likely impact on boiler energy demand over these years, as an annual percentage reduction.

## *3.3 Code for Sustainable Homes*

- The Code for Sustainable Homes (CfSH)[15] is a standard for key elements of design and construction which affect the sustainability of a new home. It will become the single national standard for sustainable homes, used by home designers and

[11] Domestic Heating Compliance Guide, (Compliance with Approved Documents L1A: New Dwellings and L1B: Existing Dwellings), First Edition, Communities and Local Government, 2006 http://www.communities.gov.uk/planningandbuilding/buildingregulations
[12] Section 6: Energy, Domestic Technical Handbook, Guidance on achieving the standards set in the Building (Scotland) Regulations 2004, Scottish Building Standards Agency, 2007. http://www.sbsa.gov.uk/tech_handbooks/tbooks2007.htm
[13] SEDBUK was developed under the UK Government's Energy Efficiency Best Practice Programme for measuring seasonal (gross) efficiency for individual boilers, for use in the UK Building Regulations Part L. www.sedbuk.com/pages/bands.htm
[14] http://www.decc.gov.uk/en/content/cms/what_we_do/consumers/saving_energy/cert/cert.aspx
[15] http://www.communities.gov.uk/planningandbuilding/buildingregulations/legislation/codesustainable/

builders as a guide to development, and by homebuyers to assist in their choice of home.

- To comply with this guideline, new, publicly funded housing in England and Wales is required to achieve 25% (CfSH Level 3) carbon dioxide reduction (over Part L 2006) through improvements to building fabric and heating efficiency.

## *3.4 Other policy effects:*

- In the medium term new-build apartment buildings and new 'eco-towns' are likely to be served by community systems such as those fired by gas Combined Heat and Power [CHP] or biomass boilers.

- There are also a number of Government initiatives to improve energy efficiency in homes, funding wall or loft insulation, better boilers or innovative technologies. Examples include the Home Energy Efficiency Scheme and Warm Front in England and Wales (similar but different schemes apply in Scotland and Northern Ireland) and the Low Carbon Buildings Programme.

**Table 4 Current policies & measures, Reference Scenario**

| Policy name | Period in force | Description | Impact |
|---|---|---|---|
| Building Regulations, Part L1A and 1B (Conservation of Fuel and Power) | **2002 - 2006** | From April 2002 heating to be a 'controlled service', and the provisions apply to 'material alterations' carried out to existing heating systems. | The Regulations improve energy saving in new and existing dwellings when renewing heating systems. |
| Boiler Regulations (Efficiency) (Amendment) ('the 2006 Regulations'). | **2006 - 2010** | These Regulations implement Article 16 of the EC Directive on the promotion of cogeneration. They have the effect of exempting micro-cogeneration from the requirements of the Boiler (Efficiency) Regulations 1993) | Requirement for new and replacement boilers to be condensing, with a minimum SEDBUK efficiency of 86%. |
| Building Regulation 2006 | **2006-2010** | Part L: 2006 introduces specific energy-efficiency criteria for components of heating systems. These regulations affect both new and existing buildings. | There is no additional impact for boilers over and above the implementation of SEDBUK B requirements for domestic boilers in UK. |

| Policy name | Period in force | Description | Impact |
|---|---|---|---|
| Code for Sustainable Homes | **2008 - 2010** | All new social housing in England and Wales to achieve 25% carbon dioxide reduction (Code level 3) through building fabric and heating efficiency by 2010. | Reduction of energy demand for heating and consequent reduction of boiler sales. For some types of social housing, this reduction is difficult to meet by conventional means and some designers are looking at other technologies (including CHP and district heating) to meet this reduction |
| CERT | **2008-2011** | From 10 February 2009 the early replacement of operational G-rated boilers is an eligible measure, and the programme does accredit carbon reductions for the replacement of D-rated (Building Regulations 2000) exceptions – if they are replaced with an A or B-rated boiler. | 170,000 A or B rated boilers are expected to be installed through CERT 2008-2011 |

## *3.5 Policy timeline*

- The policy timeline below identifies when major policies come into effect, including future revisions that are formally signed off:

**Table 5 Policy Timeline**

| Policy name | Current specification in force | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016-2020 |
|---|---|---|---|---|---|---|---|---|---|
| Boiler (Efficiency) Regulations | 1993 | | | | | | | | |
| Building Regulations, Part L1A | 2006 | | future revision | | | | | | |
| Code for Sustainable Homes | 2008 | | 25% target | | | | | | |
| CERT | 2008 | | | Future revision | | | | | |

# 4 Efficiency

## *4.1 Summary*

- Average system efficiency in the reference scenario is expected to improve moderately, primarily driven by new and replacement boiler requirements under Part

L of the Building Regulations (2006). Secondary policies and market innovation offer some support for the limited take up of alternative technologies.

**Table 6 Summary - Average system efficiency sold – all scenarios**

| | Average heating system efficiency | | |
|---|---|---|---|
| **Scenario** | **Reference** | **Policy** | **BAT** |
| 2010 | 0.57 | 0.59 | 0.93 |
| 2020 | 0.59 | 0.70 | 0.92 |
| 2030 | 0.60 | 0.75 | 0.92 |

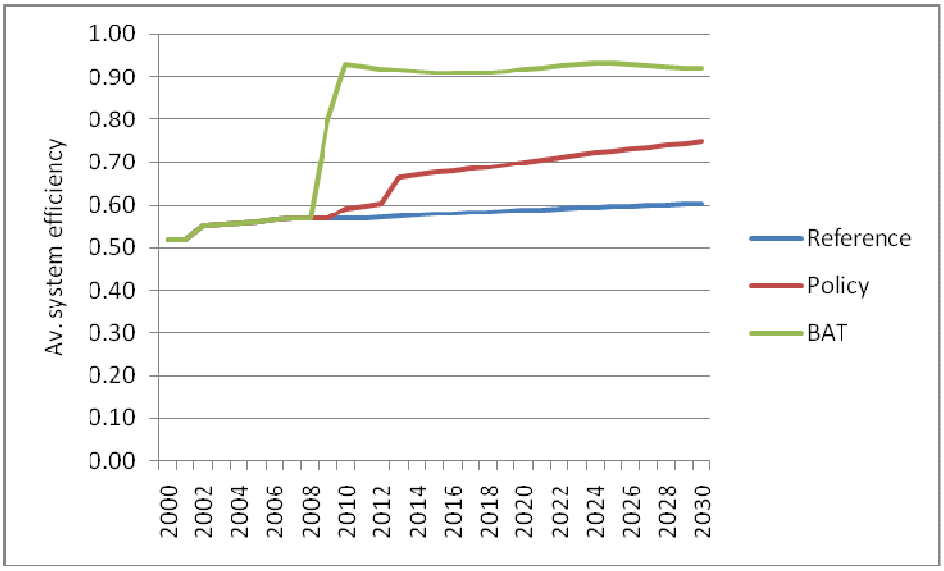


**Figure 3 - Summary - Average system efficiency sold – all scenarios**

**Table 7 Summary Reference system efficiency – by technology type (%)**

| Product | 2010 | 2020 | 2030 |
|---|---|---|---|
| **Oil Boilers** | 54 | 56 | 56 |
| **Gas Regular Boilers** | 55 | 55 | 55 |
| **Gas Combi Boilers** | 58 | 58 | 58 |
| **Alt - Electric** | 160 | 160 | 160 |
| **Alt – Gas systems** | 110 | 110 | 110 |
| **Alt - Biomass** | 70 | 70 | 70 |

## 4.2 Data sources – efficiency

- Efficiency, like energy consumption, is calculated using the MTP Boiler Model (2009) based on Ecoboiler as described in 4.3 below.

**Table 8 Efficiency data sources**

| Year | Reference | Reference date | Author | Justification | Confidence in sources (High/Low) |
|---|---|---|---|---|---|
| 2007 | EcoBoiler: www.ecoboiler.org | 2007 | Van Holsteijn en Kemna (VHK) | Need for UK to adapt to forthcoming ErP directive | High |
| 2006 - 2030 | Part L Domestic Heating Compliance Guide | 2006 | ODPM | Minimum boiler efficiency requirements | High |
| 2008 - 2009 | Heating and Hot Water Industry Council (HHIC) | 2008 | HHIC | Boiler sales breakdown by efficiency class | High |
| 1996-2030 | The UK Housing Stock 2005 to 2050: Assumptions used in Scenarios and Sensitivity Analysis in UKDCM2 | March 2007 | Environmental Change Institute – Oxford University | Cross-check for energy efficiency calculation | High |
| 2007 | Annual energy data from Digest UK Energy Survey 2007 | 2007 | DTI | Used for validation | High |
| 1970-2020 | SEDBUK | 2008 | Boiler manufacturers | Used for efficiency calculation | High |

## 4.3 Methodology & key assumptions – efficiency

- In order to estimate the effect of efficiency requirements or technology switching on domestic energy use due to future policies, a model must be used.
- The first part of this section describes the model that has been used and the data fed into the model in order to obtain the efficiency values.

- The model used to calculate system efficiency is an adaptation of the Ecoboiler[16] model prepared by Van Holsteijn en Kemna (VHK) for the European Commission, DG Transport and Energy (DG TREN).
- Ecoboiler is a steady state, system-based model. It takes into account system losses such as temperature fluctuation, stratification, ventilation and distribution losses, and timer-related energy losses. Useful solar and internal heat gains and transfers are taken into account, and system temperatures are calculated in 5 states (on, off, re-heat, cool-down, and steady state), to generate a typical heat demand profile.
  - Rather than using Degree-Days (as SAP and BREDEM do), Ecoboiler utilises average (UK) outdoor air temperature during several time-periods each day, for each month of the year. At each interval, return water temperature is determined and Ecoboiler selects the most appropriate boiler efficiency. This yields a more realistic schedule of dwelling heating demand. To make use of this improvement, boiler efficiencies are required at both full-load and part-load operation, rather than via a single seasonal average. The heating energy requirement is then summated for the whole year.
- Note that system efficiencies are significantly lower than SEDBUK[17] *boiler* efficiencies. E.g. the efficiency for a typical UK heating system calculated with Ecoboiler is around 60%, whereas new gas-fired boilers have SEDBUK boiler seasonal efficiencies of between 85% and 91%.
  - UK boilers are currently tested and rated using SEDBUK against a BS EN standard. The boiler is tested at both full and part-load under steady state conditions. For testing condensing boilers the return water is held constant at 30$^{o}$C for both full and part load. This return temperature will ensure condensation.
  - Part L Building Regulations 2006 (E&W and equivalent in Scotland and NI) require (almost without exception) that gas or oil boilers installed in new or existing dwellings be of the condensing type. However, in order to condense, return water temperatures to the boiler need to be significantly lower than those for which radiators were conventionally sized. As a result, during cold weather most replacement condensing boilers (and therefore most boilers sold) may not

[16] Version 5b: See http://www.ecoboiler.org/ for more detail
[17] Seasonal Efficiency of Domestic Boilers UK, The Boiler Efficiency database holds information on both current boilers, which by law have to comply with minimum energy efficiency values, and obsolete boilers, which do not.

condense. The single seasonal average boiler efficiency produced by SEDBUK will not reflect this.

- However Ecoboiler requires full and part-load boiler efficiencies to be provided under both condensing and non-condensing conditions (return water temperatures of 30 and 60°C respectively), producing four test points and a more accurate result - although tests are still carried out at steady state.

- The figure below shows the boundaries of the 'system'.

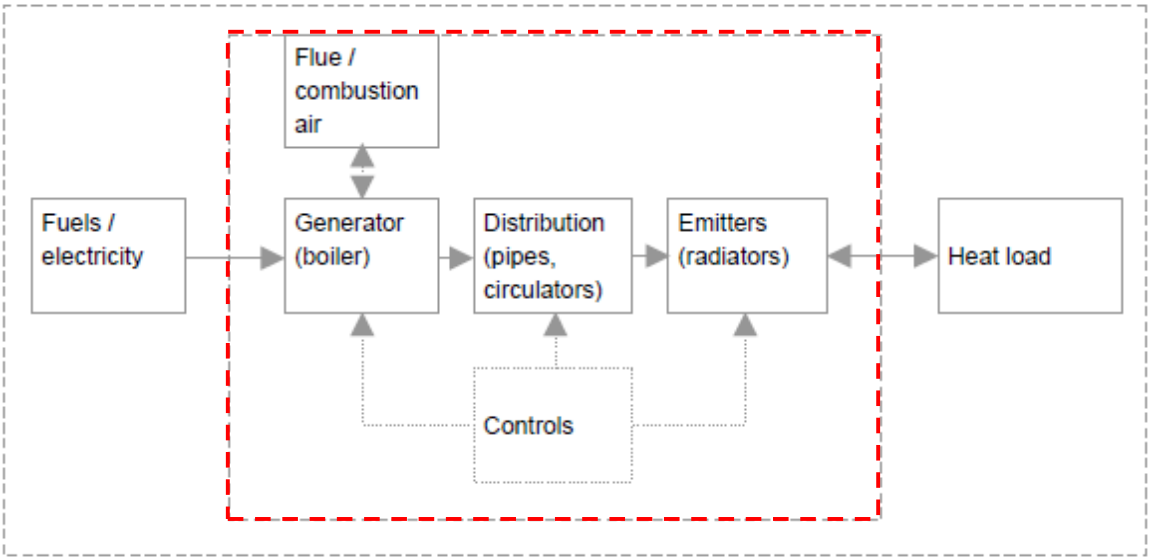


**Figure 4 - Component of CH-system (red box)**[18]

- **Hot water demand** profiles for each of the dwelling sizes (i.e. number of likely occupants) are also calculated in Ecoboiler. To derive domestic hot water demand, EcoBoiler uses a number of discrete "tapping" schedules that mimic actual hot water draw-off at various times of the day. These schedules range from "extra small" to "large". The schedules are attributed to the house type/sizes modelled (see below). Ecoboiler makes allowances for heat losses from pipe work and cylinders (as does SAP).
- In comparison SAP bases annual hot water demand on the floor area of the dwelling on the basis that the larger the dwelling the greater the number of occupants. This is a simple kWh/m$^2$ year approach based on measured data, but differentiates between combi and hot water cylinders.

- **Space heating demand**: unlike domestic hot water, mean annual energy demand for space heating depends upon a large number of factors. These are:

    - Building external surface area

[18] Eco-design Boilers, task 3, Final | 30 September 2007; VHK for European Commission – www.ecoboiler.org/FinalDocuments.

  - Building fabric thermal properties (U values)
  - Building air tightness (infiltration)
  - Building location (regional weather)
  - Building exposure (local climate)
  - Window area, type, orientation and shading (solar gains)
  - Internal temperature selected by occupant
  - Internal heat gains
  - Hours of operation/occupancy
  - Boiler efficiency
  - Heating system and controls effectiveness

- Very limited data are available to enable these factors to be taken into account in a detailed manner, in a model of current and projected UK space heating. For example, English House Conditions Surveys (EHCS) provide SAP ratings for a range of house types but, crucially, limited information on heat loss factors and boiler/heating system efficiency.
- Thus separating out the effect of building fabric and heating system losses from the impact of future changes in boiler/heating system efficiency in the existing housing stock is difficult to estimate.

- The **MTP Boiler Model** (2009) is adapted from Ecoboiler, described above. It uses dwelling data sets for typical UK housing stock represented by type (i.e. flat, mid-terrace, semi-detached and end-of-terrace, detached, and bungalow) and age of construction (8 age bands). House type projections use data from 1996 to present and projected to 2030, from the Environmental Change Institute's UK Domestic Carbon Model (UKDCM2)[19] and other sources.
- For future dwelling *fabric* conditions, two reference building fabric designs, and related Fabric Reference Scenarios were developed:
  - Fabric Reference Scenario One: this factors in the impact of *future* building fabric, or heating demand-related policies. These include the building *fabric* impacts of CERT (or Supplier Obligation), of future Building Regulations, and of future CfSH requirements.
  - Fabric Reference Scenario Two: this only factors in the impact of *current* building fabric, or energy demand related policies, including the anticipated impacts of CERT up to 2011 and Building Regulations up to 2010. Policy measures affecting the building fabric are not assumed to change beyond 2011 in this scenario.
  - Energy use in all scenarios (Reference, Policy and BAT) is estimated using Fabric Reference Scenario One to reflect savings (difference between Reference and Policy or Reference and BAT) due to impacts of product policies only, rather than policies that affect building fabric. Results from Reference Scenario 2 are not presented.

[19] For more information see related Briefing Note BNDH B01 Domestic Central Heating Government Standards Evidence Base 2009: Key Inputs; Section 2 Stock and Ownership

- The MTP Boiler Model calculates the heating demand (kWh) of each house type, and an appropriately sized boiler is selected based on the associated boiler duty. Actual energy consumption for the specified boiler size (kW) and the efficiency of the heating system (boiler, water cylinder, controls, etc.) are calculated using this model, for both space heating and domestic hot water.

- Data are adjusted to agree with national annual energy data from DUKES[20].

### 4.3.1 Historic data

**Table 9 Interpolation & background calculations – efficiency**

| Year | Methodology & assumptions |
|---|---|
| 1970-2008 | Calculation from MTP Boiler Model 2009 an adaptation of Ecoboiler v5b |
| 1970-2008 | Ecoboiler used to determine the "system efficiency" of boilers corresponding to a representative sample of UK housing. The data derived was manipulated to provide for the MTP model a representative efficiency for the different boiler sizes and types. |

### 4.3.2 Future analysis

**Table 10 Extrapolation & background calculations – efficiency**

| Year | Methodology & assumptions |
|---|---|
| 2009-2030 | Calculation from MTP Boiler Model 2009 an adaptation of Ecoboiler v5b |
| 2009-2030 | Ecoboiler used to determine the "system efficiency" of boilers corresponding to a representative sample of UK housing. The data derived was manipulated to provide for the MTP model a representative efficiency for the different boiler sizes and types. |

[20] Digest of UK Energy Statistics, 2007 www.decc.gov.uk › Statistics › Statistics publications

## *4.4 Data issues – efficiency*

- The information used in this model differs from previous years as the efficiency calculated is system related. Water heating efficiency is new and has been accounted for as part of the system efficiency.

- Efficiency calculation depends on housing stock projection and heating system ownership (by type), therefore inaccuracy here may cause imprecise estimation of the average stock efficiency.

**Table 11 Data issues – efficiency**

| Issue/risk | Approach taken/rationale |
|---|---|
| Ecoboiler v5b is a draft tool | This tool is used as a basis for the MTP Boiler Model 2009 because it is a publicly available calculation tool that allows input of appropriate data for the UK, and allows projections of consumption that is consistent with the methodology behind proposed ErP policy |
| Difficulties assigning ownership of specific heating systems to each identified dwelling type. | The latest data available were used and flexibility in the MTP boiler model will allow future iterations. |
| Ecoboiler requires four steady-state boiler efficiencies – at full and part load under both condensing and non-condensing operation. UK boilers are rated under SEDBUK using a single value of efficiency (approximately equal to the mean part load and full load efficiency). | In keeping with default boiler efficiency values in Ecoboiler, boiler efficiency at full and part load is assumed the same. For condensing boilers, the boiler efficiency under non-condensing operation is assumed as 6 percentage points lower than in condensing mode based on a comparison of SEDBUK efficiencies for condensing and non-condensing boilers. |

## 1.1 Confidence level – efficiency

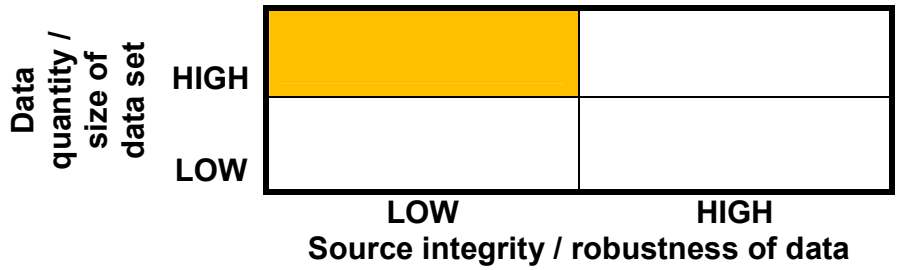


**Figure 5 Confidence indicator for efficiency data**

## Related MTP information

- BNDH B01: Domestic Central Heating Government Standards Evidence Base 2009: Key Inputs
- BNDH B03: Domestic Central Heating Government Standards Evidence Base 2009: Policy Scenario
- BNDH B04: Domestic Central Heating Government Standards Evidence Base 2009: BAT Scenario
- BNDH KO01: Domestic Central Heating Government Standards Evidence Base 2009: Key outputs

## Changes from version 1.0

- Removed reference to obsolete Briefing note
- Minor changes to template

## Consultation and further information

Stakeholders are encouraged to review this document and provide suggestions that may improve the quality of information provided, email **info@mtprog.com** quoting the document reference, or call the MTP enquiry line on +44 (0) 845 600 8951.

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