# BNDH B01: Domestic Central Heating Government Standards Evidence Base 2009: Key Inputs

**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 aim of this Briefing Note is to provide details and reference sources of the underlying data in the model, along with the key assumptions used in the model.

- There are three main sections to this Briefing Note, corresponding to the main variables of the MTP modelling approach:
  - Ownership & stock
  - Sales
  - Usage & lifespan

- Each section also includes an indication of the overall confidence in the dataset, to provide a sense of the robustness of the model.

### 1.1 Product Definitions

#### 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*

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

*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.*

- 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)

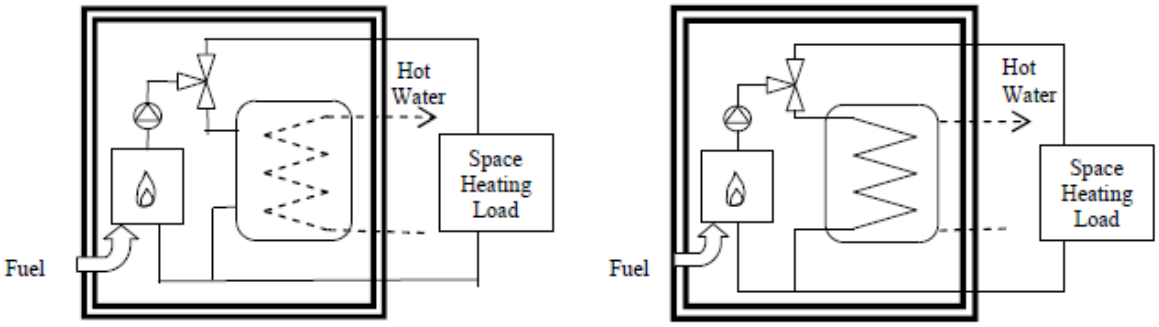



**Figure 1 - Primary storage CH-combi (left) and Secondary storage CH-combi (right)[4].**

- 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°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

[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

temperature causes some of the water vapour to condense and the remaining gases are expelled to the outside environment.

- 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 under floor 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 Ownership & stock

## *2.1 Summary*

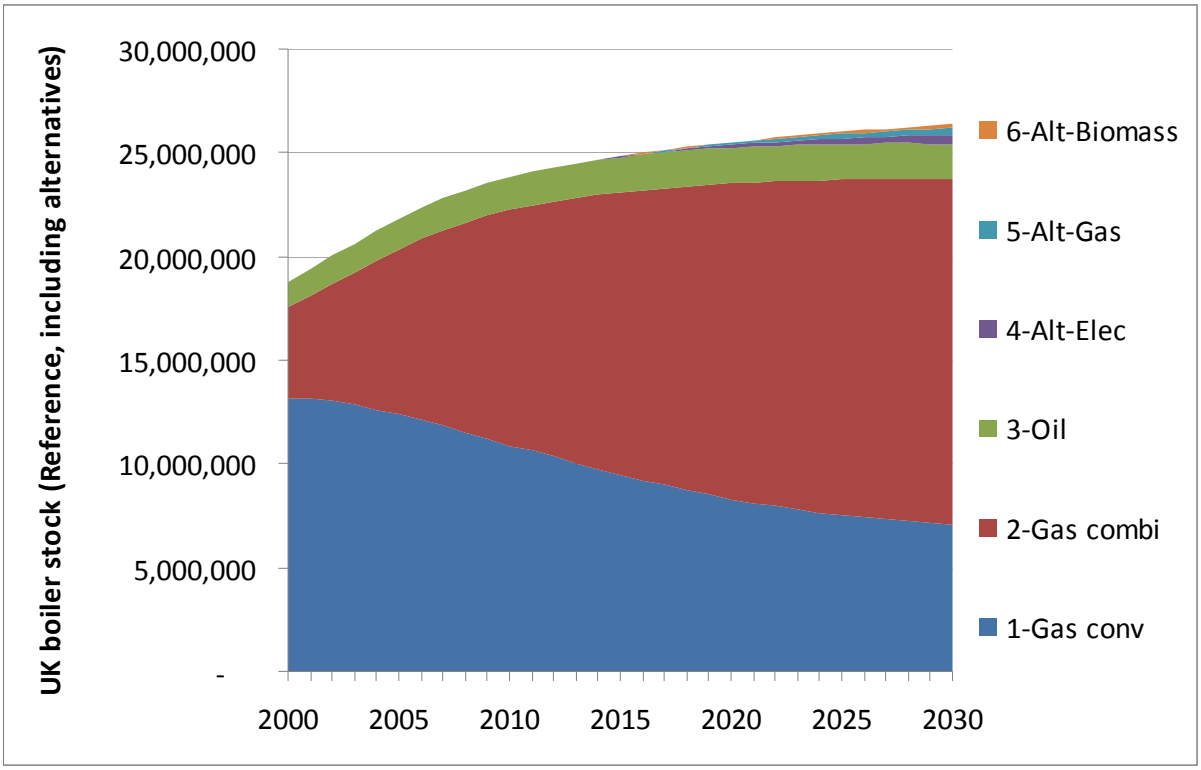



**Figure 2 - Domestic CH-Boilers Stock (Reference Scenario)**

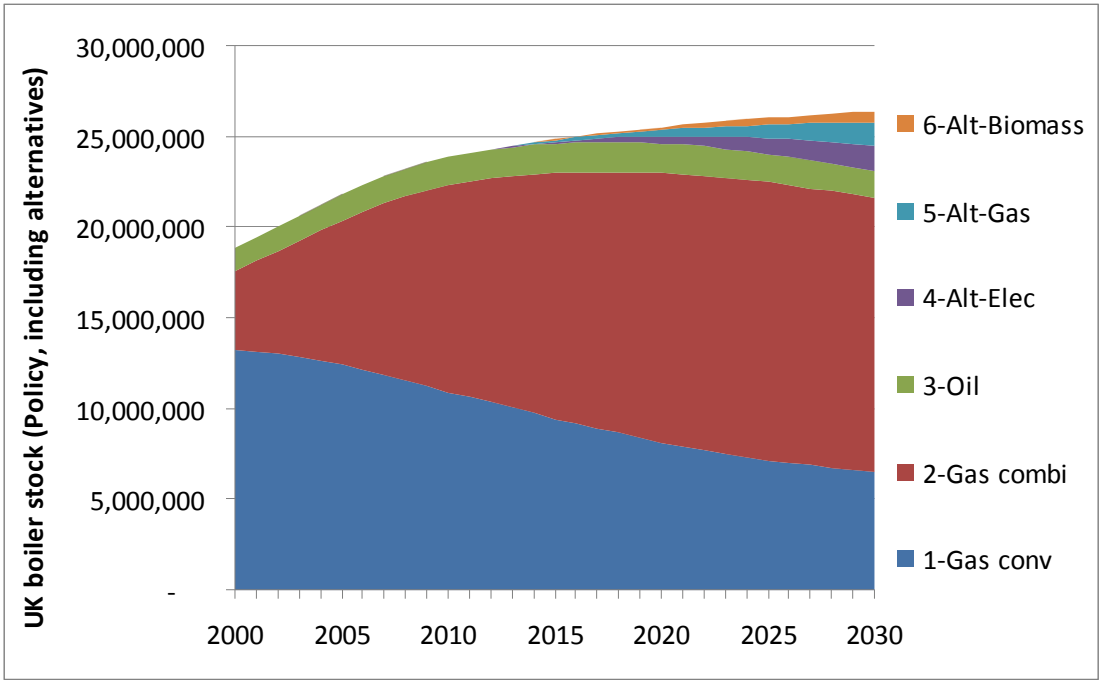



**Figure 3 - Domestic CH-Boilers Stock (Policy Scenario)**

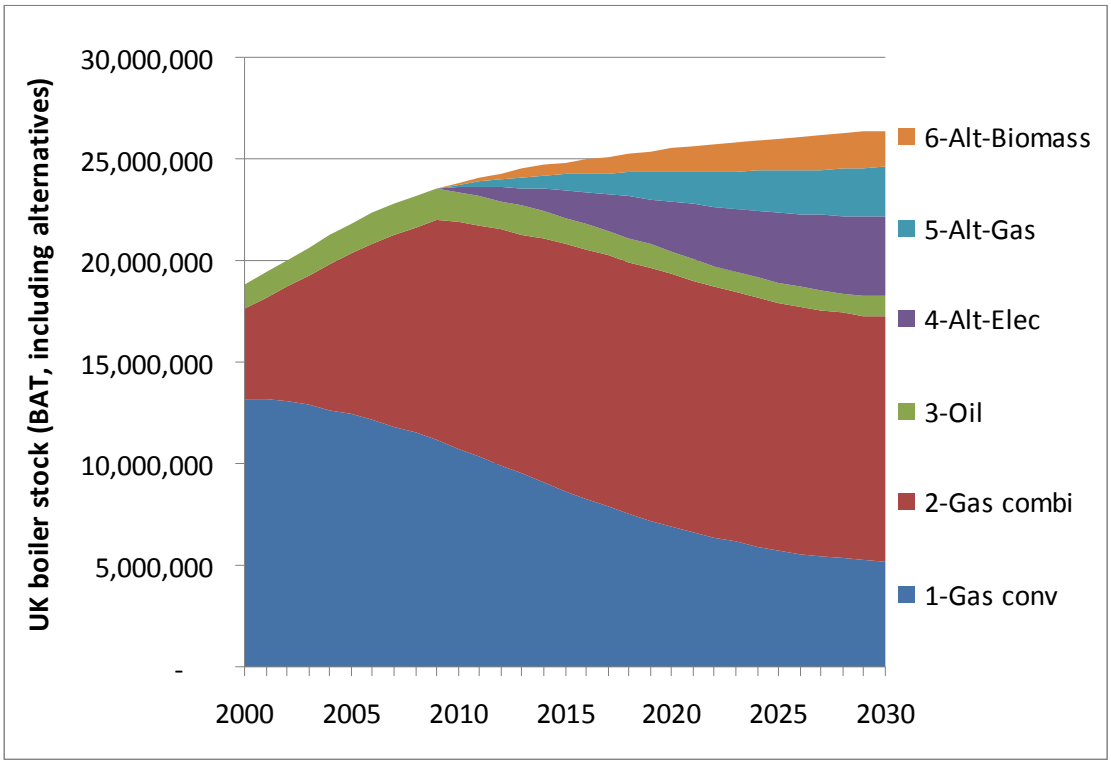



**Figure 4 - Domestic CH- Stock (Best Available Technology Scenario)**

## Table 1 – Summary Stock - Domestic CH-Boilers

### Reference Scenario Stock (000's)

| | Oil Boilers | Gas Regular | Gas Combi | Alt Electric | Alt Gas | Alt Biomass | Total[9] |
|---|---|---|---|---|---|---|---|
| 2010 | 1,580 | 10,900 | 11,400 | 0 | 0 | 0 | 24,000 |
| 2020 | 1,700 | 8,300 | 15,200 | 123 | 94 | 43 | 25,500 |
| 2030 | 1,720 | 7,100 | 16,600 | 455 | 350 | 159 | 26,400 |

### Policy Scenario Stock (000's)

| | Oil Boilers | Gas Regular | Gas Combi | Alt Electric | Alt Gas | Alt Biomass | Total |
|---|---|---|---|---|---|---|---|
| 2010 | 1,580 | 10,900 | 11,400 | 0 | 0 | 0 | 24,000 |
| 2020 | 1,640 | 8,120 | 14,900 | 395 | 339 | 165 | 25,500 |
| 2030 | 1,450 | 6,470 | 15,100 | 1,460 | 1,260 | 610 | 26,400 |

### BAT Scenario Stock (000's)

| | Oil Boilers | Gas Regular | Gas Combi | Alt Electric | Alt Gas | Alt Biomass | Total |
|---|---|---|---|---|---|---|---|
| 2010 | 1,500 | 10,800 | 11,100 | 0 | 0 | 0 | 23,400 |
| 2020 | 1,100 | 6,890 | 12,400 | 2,470 | 1,470 | 1,140 | 25,500 |
| 2030 | 993 | 5,140 | 12,100 | 3,970 | 2,380 | 1,780 | 26,400 |

[9] Totals may differ from sum due to rounding in all cases

## 2.2 Data sources – ownership & stock

### Table 2 – Stock data sources - Domestic CH Oil Boilers

| Year | Reference | Ref. date | Author | Justification | Confidence in sources (High/Low) |
|---|---|---|---|---|---|
| 1975 - 2030 | Reference Scenario associated with the Boiler Energy Model[10] | 2007 | MTP Expert | Best available representation of stock levels | High |
| 1970 – 2020 | Building Market Transformation (BMT) UK projected households | 2008 | Environmental Change Institute (ECI) | Cross-check for stock | High |
| 1970 - 2020 | MTP BNXS25 v3.0: UK Household and Population Figures 1970 – 2020 | January 2007 | MTP Expert | Cross-check for stock | High |

### Table 3 Domestic Gas Regular and Combi CH-Boiler – Stock data sources

| Year | Reference | Ref. date | Author | Justification | Confidence in sources (High/Low) |
|---|---|---|---|---|---|
| 1970 - 2030 | MTP Boiler Energy Model 2007 | 2007 | MTP Expert | Best data source available | High |
| 1970 - 2030 | Regular and combi stock split - Reference case associated with the Boiler Energy Model (see footnote below) | 2007 | MTP Expert | Best data source available | High |
| 1970 – 2020 | Building Market Transformation (BMT) UK projected household | 2008 | Environmental Change Institute (ECI) | Cross-check for stock | High |
| 1970 – 2020 | MTP BNXS25 v3.0: UK Household and Population Figures 1970 - 2020 | January 2007 | MTP | Cross-check for stock | High |

[10] 2007; The Boiler Energy Model underpins the scenarios in the MTP GSBNs with consolidated data obtained principally from the Government's Boiler Efficiency Database. The Boiler Energy Model makes assumptions about energy efficiency of boilers based on year of purchase, fuel and type.

- MTP has no reference sources for the future stock of alternative technologies. This is a relatively new market which is and will be subject to many influences. A series of assumptions have been made by the MTP team to represent future sales and hence stock of these technologies, described more fully below (3.1).

## 2.3 Methodology & key assumptions – ownership & stock

- The domestic heating models are stock-based, which calculate sales using the stock projection and product lifetime. Real sales data are used as a check against the output sales calculated from the model. This data series is usually incomplete. The sales shown in charts and tables are to illustrate the full, generated output (rather than input) sales data series.

### 2.3.1 Summary

- UK housing stock data are used to derive 40 'typical' UK house types, and the number of houses in each type.
- ErP EcoBoiler (v5b) calculates a heating demand profile for each house type.
- A boiler duty (kW output) is calculated for each heating demand profile
- Each duty (and therefore house type) is designated an (ErP) boiler size. (Each boiler size will be associated with more than one house type.)
- The profile of the boiler stock is broken down by boiler size. Each boiler size contains the sum of boilers from each corresponding house type.

### 2.3.2 Historic data

- The UK housing stock is represented by categorising typical thermal characteristics, physical dimensions and age profiles, shown below.

**Table 4- Dwelling types and age groups for modelling**

| Dwelling Type | Age Groups |
|---|---|
| Flats<br>End Terrace<br>Mid Terrace/Semi-detached<br>Detached<br>Bungalows | Pre-1918<br>1918-1938<br>1939-1959<br>1960-1975<br>1976-1992<br>1993-2002<br>2002-2005 |

- 40 typical dwellings (5 dwelling types x 8 age groups) are modelled, as of 2005. Age groups representing post 2005 were also created.

- The age groups reflect housing stock data and changes in Part L of the Building Regulations. The building fabric thermal performance is represented by U values and infiltration rates typical of each age group, allowing for estimated subsequent improvements (e.g. double glazing, loft insulation and draught-proofing).

- Table 5 summarises the methodology and assumptions used to interpolate Oil, Gas Regular and Gas Combi boilers stock.

**Table 5 Interpolation & background calculations – stock data**

| Year | Methodology & assumptions |
|---|---|
| | **Oil boilers** |
| 1970 – 2008 | Obtained from BRE Reference case associated with the MTP Boiler Energy Model. |
| | **Gas Regular and Combi Boilers** |
| 1970 – 2008 | Adopted MTP stock model developed by BRE from 2000 to 2008. |

### 2.3.3 Future analysis

- The tables below show the methodology and assumptions used to extrapolate Oil, Gas Regular and Gas Combi boiler stock.

- Aggregated stock projections have been checked against MTP (BNXS25, v3.0) and Environmental Change Institute (ECI) Building Market Transformation (BMT) UK projected household figures, based on a proportion of dwellings assumed to have each type of boiler.

- For each scenario (Reference, Policy and Best Available Technology (BAT)), assumptions have been made in relation to the likely displacement of boilers by alternative technologies, from 2010.

- To represent this displacement, a stock-based model was constructed to apportion central heating product sales accounted for by alternative technologies listed above.

**Table 6 Extrapolation & background calculations – ownership and stock**

**Oil Boilers**

| Year | Methodology & assumptions |
|---|---|
| | **Oil boilers** |
| 2009 | Obtained from BRE Reference case associated with Briefing Note BND11[1] - The Domestic Heating Boiler Energy Model: Methods and Assumptions |
| 2010 - 2030 | Stock model used to calculate reductions in oil boiler stock due to alternative technologies. (See table 7 below) |
| | **Gas Regular and Combi Boilers** |
| 2010-2030 | MTP calculation based on reductions in the numbers of gas boilers due to uptake of alternative technologies. (See table 7 below) |
| 2020 - 2030 | From 2020 it was assumed that stock would increase, but less rapidly (e.g. increase 2021 +90,000, 2022 +85,000 etc) |
| | **Alternative Technologies** |
| 2009 - 2030 | The Stock model has been used to derive stock of alternative technologies as replacements for conventional boiler stocks. (See table 8 below) |

- It s assumed that the presence of oil boilers in the stock implies that mains gas is not available, and therefore oil boilers are not projected to be displaced by alternative gas systems.

## *2.4 Data issues – ownership & stock*

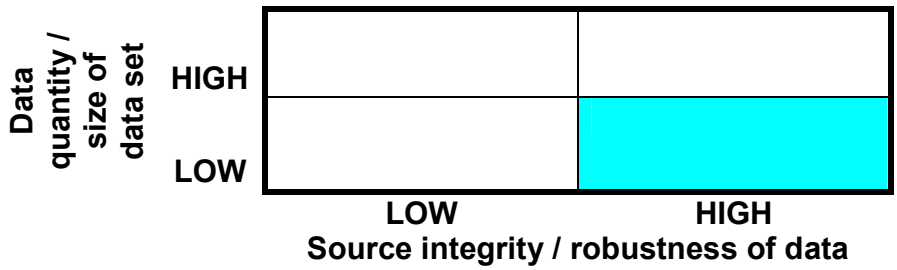
**Table 7 Data issues – ownership & stock**

| Issue/risk | Approach taken/rationale |
|---|---|
| Rate of future displacement of boilers by other technologies is uncertain | Projections cross checked with best available sources |

## *2.5 Confidence level – ownership & stock*

- There is a high level of confidence associated with stock data to 2007. The size of data set for boilers is significant, and data are derived from credible associated bodies, although assumptions have been necessary with regards to future growth of alternative technologies.

**Figure 5 Confidence indicators for ownership data**



# 3 Sales

## 3.1 Summary

- These models are stock-based, which calculate sales automatically using the stock projection and the product lifetime. Actual sales data are used as a check only, to help evaluate the output sales calculated from the models. This data series is incomplete.

- Actual and forecast sales data were sourced from *BRG Consult: UK Heating 2008* for 1991 – 2012[11].

- Assumptions have been made about the transfer of sales from Gas Conventional, Gas Combi, and Oil boilers to Alternative Gas, Alternative Electric, and Alternative Biomass technologies, between 2009 and 2030.Percentage sales of all Alternative technologies are assumed to be (near) zero in 2010, increasing progressively to the shares shown in Table 8, by 2030.

**Table 8 Summary transfer of sales to Alternative technologies to 2030**

| | Share of total sales by technology type | | | | | | |
|---|---|---|---|---|---|---|---|
| | Gas regular | Gas combi | Oil | Alt electric | Alt gas | Alt Biomass | Total |
| **2010** | | | | | | | |
| Reference | 22% | 70% | 8% | 0% | 0% | 0% | 100% |
| Policy | 22% | 70% | 8% | 0% | 0% | 0% | 100% |
| BAT | 13% | 54% | 4% | 14% | 8% | 7% | 100% |
| **2020** | | | | | | | |
| Reference | 16% | 75% | 6% | 1% | 1% | 0% | 100% |
| Policy | 15% | 71% | 5% | 4% | 3% | 2% | 100% |
| BAT | 12% | 59% | 4% | 13% | 8% | 6% | 100% |
| **2030** | | | | | | | |
| Reference | 17% | 72% | 6% | 2% | 2% | 1% | 100% |
| Policy | 15% | 64% | 4% | 7% | 6% | 3% | 100% |
| BAT | 14% | 56% | 4% | 13% | 8% | 6% | 100% |

[11] http://www.brgconsult.com/

### *3.1.1* Brief overview of market

Historical

- Due to changes in the UK Building Regulations in 2006 the use of condensing boilers was made mandatory in most cases, by setting high minimum efficiency criteria. By 2008 gas condensing boilers sales rose to 93.1% of all boilers sold, whilst gas non-condensing boiler sales reduced to 1.3%[12].

- In 2005 the *total* UK market for gas boilers decreased by over 5%, while in 2006 it rebounded by 6% to reach 2004 levels, and continued to grow in 2007.

- In addition to the trend towards condensing boilers, there are also trends in favour of gas boilers over oil boilers, for combi boilers over regular, and for wall-mounted boilers over floor standing.

Future trends

- It is assumed the total number of dwellings without a domestic boiler will increase in future years due to improvement of the building fabric and use of renewable energy sources for heating such as heat pumps, biomass boilers, or solar hot water panels for the provision of domestic hot water. The extent of increase will vary according to the Scenario modelled.
- The main drivers and barriers taken into consideration in modelling the take up of all alternative technologies modelled are:

    - Market/consumer related effects: (all scenarios)
        - Fuel prices: gas prices are projected in increase in real terms (from a relatively low base), leading to increased cost effectiveness, and therefore increased demand for highly efficient alternatives to conventional heating systems[13].
        - Up-front costs: generally higher for all alt. technologies, impeding take up.
        - Market share and consumer awareness: generally very low, impeding consumer confidence and opportunities for economies of scale in some cases (e.g. mCHP).
        - Space constraints: for some alternative technologies, more space is needed than for conventional technologies (e.g. ground source heat pumps, biomass storage), impeding take up.
        - Power supply: for some products (larger heat pumps), three phase power supply is required (usually not present in dwellings).
        - Cooling demand: low demand for summer cooling diminishes the attractiveness of reversible heat pumps; however demand for domestic cooling is expected to increase rapidly (from a low base)

[12] World Heating 2007 – United Kingdom – Domestic Boilers – BISRIA Report 50851/18 March 2008 http://www.bsria.co.uk/services/market-intelligence/

[13] Noting gas is also expected to take a larger share of the energy mix in electricity generation – especially in CHP plant

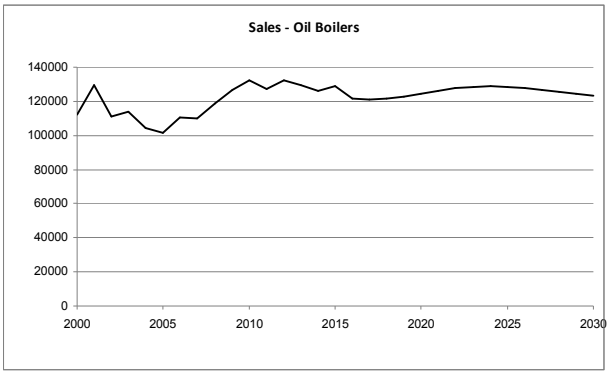
due to warmer climates, warmer (summer) new-build internal temperatures, and changing consumer preferences – improving the appeal of reversible heat pumps.

- Policy effects (extent of impact varies depending on scenario):
  - Reduced heating demand due to dwelling fabric improvements is likely to make alternative technologies – such as heat pumps - more suitable e.g.
    - Reference Scenario: Building Regulations (2006) minimum standards in new dwellings.
    - Policy Scenario: Building Regulations (2010-2016) minimum standards in new dwellings; Supplier Obligation (SO), Home Energy Savings Programme (HESP).
  - Direct impacts on alternative technologies (capital costs) e.g.
    - Reference Scenario: CERT; Low Carbon Buildings Programme to increase take up; particulate emissions/clean air regulations can limit take up of biomass.
    - Policy Scenario: Building Regulations (2016) zero carbon homes; EU Labelling Directive (central heating systems); SO; HESP.
  - Indirect impacts e.g.
    - Policy scenario: ErP Boilers NOx limits may lead to greater take up of alterative technologies such as electric heat pumps and biomass boilers
  - Note the Feed-in Tariff (FIT) and Renewable Heat Inventive (RHI) have not been factored into the modelling.

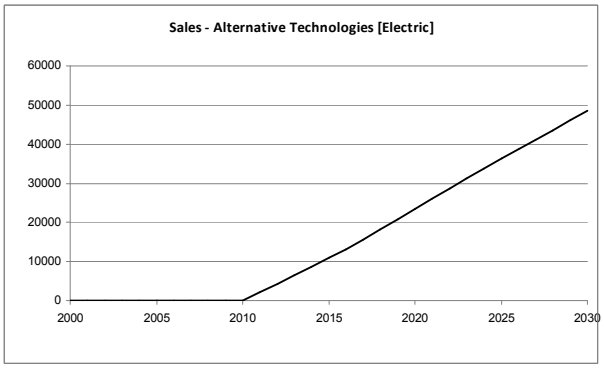
## 3.1.2 Graphs & Summary tables - Sales

- The figures and table below show annual UK domestic boiler sales from 2000 to 2030 (Reference Scenario):

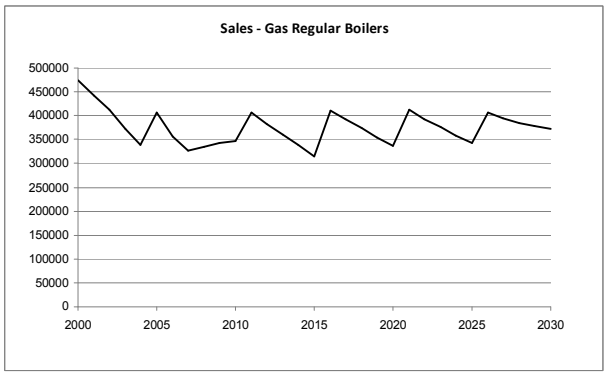
### Figure 6 – Sales – Domestic CH Boilers and Alternative Technologies



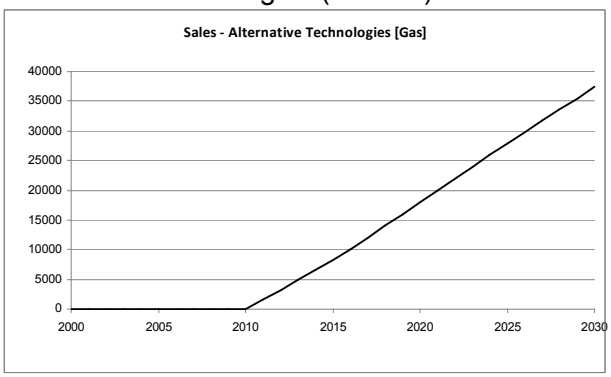

Oil Boilers



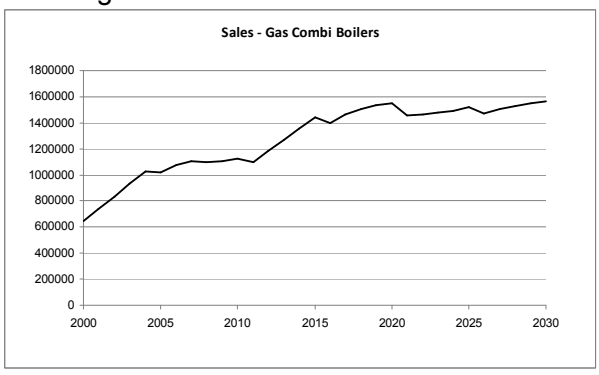

Alternative Technologies (Electric)



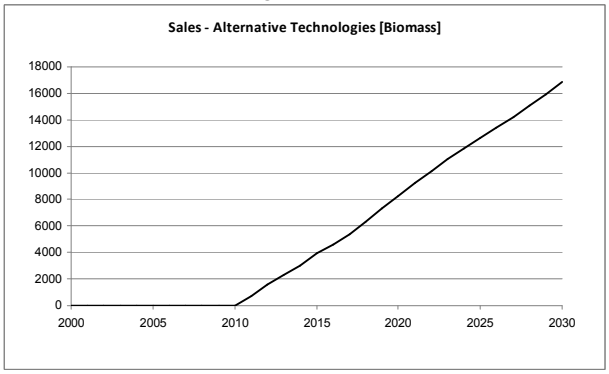

Gas Regular Boilers




Alternative Technologies (Gas)




Gas Combi Boilers




Alternative Technologies (Biomass)

**Table 9 - Sales - Domestic CH – Boilers and Alternative technologies**

**Reference Scenario Sales (000's)**

| | Oil Boilers | Gas Regular | Gas Combi | Alt Electric | Alt Gas | Alt Biomass | Total[14] |
|---|---|---|---|---|---|---|---|
| 2010 | 132 | 347 | 1,124 | 0 | 0 | 0 | 1,603 |
| 2020 | 125 | 337 | 1,550 | 24 | 18 | 8 | 2,062 |
| 2030 | 123 | 372 | 1,560 | 49 | 37 | 17 | 2,158 |

**Policy Scenario Sales (000's)**

| | Oil Boilers | Gas Regular | Gas Combi | Alt Electric | Alt Gas | Alt Biomass | Total |
|---|---|---|---|---|---|---|---|
| 2010 | 132 | 347 | 1,124 | 0 | 0 | 0 | 1,603 |
| 2020 | 111 | 309 | 1,468 | 75 | 64 | 32 | 2,059 |
| 2030 | 93 | 314 | 1,361 | 156 | 135 | 65 | 2,124 |

**BAT Scenario Sales (000's)**

| | Oil Boilers | Gas Regular | Gas Combi | Alt Electric | Alt Gas | Alt Biomass | Total |
|---|---|---|---|---|---|---|---|
| 2010 | 65 | 211 | 867 | 233 | 131 | 105 | 1,612 |
| 2020 | 72 | 234 | 1,167 | 250 | 150 | 112 | 1,985 |
| 2030 | 77 | 280 | 1,163 | 267 | 159 | 122 | 2,068 |

## *3.2 Data sources – sales*

- As the models developed for Domestic Heating are stock driven, the sources listed below were not modelled, but used for validation of model outputs only

**Table 10 Data sources - Domestic CH Oil Boiler sales**

| Year | Reference | Reference date | Author | Justification | Confidence in sources (High/Low) |
|---|---|---|---|---|---|
| 1991 - 2012 | BRG Consult UK Heating 2008[15] - Section 3-5; Fig.3.111-2.(Trends in sales of boilers by type 1991-2006 and forecasts to 2012) | 2008 | BRG Consult; International Market Strategy | Used for validation only (model is stock-based) | High |

[14] Totals may differ from sum due to rounding in all cases
[15] 2008; BRG Consult; UK Heating 2008; Section 3-5.

**Table 11 Data sources - Domestic Gas Regular and Combi Boiler**

| Year | Reference | Reference date | Author | Justification | Confidence in sources (High/Low) |
|---|---|---|---|---|---|
| 2008-2009 | Heating and Hotwater Industry Council (HHIC) gas and LPG Boiler sales by SEDBUK band | 2008 | Heating and Hotwater Industry Council (HHIC) | Used for validation only (model is stock-based) | High |
| 1991-2012 | BRG Consult; Heating Europe: UK Section 3 - Boilers and Burners. | 2008 | BRG Consult; International Market Strategy | Used for validation only (model is stock-based) | High |

## *3.3 Methodology & key assumptions – sales*

- Sales values are derived from the MPT 2007 stock data and by making assumptions about lifespan, using the MTP boiler models.

### 3.3.1 Historic data

**Table 12 Interpolation and background calculations – sales data**

| Year | Methodology & assumptions |
|---|---|
| 1960-2008 | Sales data for gas boilers have been calculated from stock data and lifespan information using the MTP models. |

### 3.3.2 Future analysis

**Table 13 Extrapolation and background calculations – sales data**

| Year | Methodology & assumptions |
|---|---|
| 2010-2030 | Sales data for gas boilers are calculated from stock data and lifespan information using the MTP model. |

## *3.4 Data issues – sales*

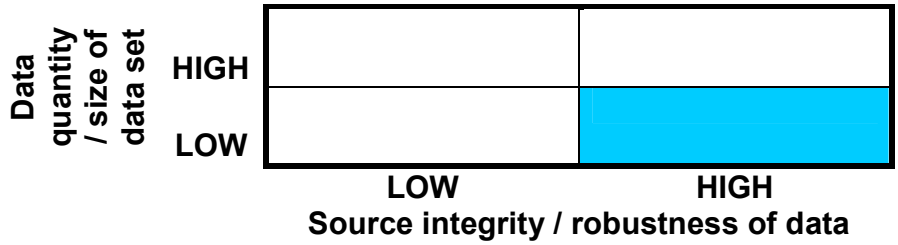
**Table 14 Data issues - sales**

| Issue/risk | Approach taken/rationale |
|---|---|
| Sales data has been derived from stock (1960 –2030) | Sales data obtained used to validate stock-based projections within limited time series (1991 – 2008) |

## *3.5 Confidence level*

- High level of confidence is due to source integrity of BRG Consult and HHIC data gathered (1991-2008 and projection to 2013). A level of uncertainty is noted for remaining years due to sales being estimated from stock and lifespan via MTP modelling.

**Figure 7 Confidence indicator for sales data**



# 4 Lifespan

## *4.1 Summary*

### 4.1.1 Lifespan

**Table 15– Lifespan in years for each type of boiler**

| | Oil Boilers | Gas Regular | Gas Combi | Alt Electric | Alt Gas | Alt Biomass |
|---|---|---|---|---|---|---|
| 2008 | 13.7 | 19.2 | 10.6 | 15.5 | 15.5 | 15.5 |
| 2010 | 13.7 | 18.9 | 10.6 | 15.5 | 15.5 | 15.5 |
| 2020 | 13.7 | 16.9 | 10.6 | 15.5 | 15.5 | 15.5 |
| 2030 | 13.7 | 14.9 | 10.6 | 15.5 | 15.5 | 15.5 |

## *4.2 Data sources – lifespan*

**Table 16– Domestic CH-Boiler - lifespan data sources**

| Year | Reference | Ref. date | Author | Justification | Confidence in sources (High/Low) |
|---|---|---|---|---|---|
| 1970-2008 | Oil boiler - MTP model data | 2007 | MTP Expert | Best source to date for oil boilers | High |
| 1970-2030 | MTP model data | 2007 | MTP Expert | Used only for validation for gas boiler types | High |
| 1970 - 2030 | EU Preparatory Study on Eco-Design of Boilers (FINAL) – Task 2 | Sept 2007 | Van Holsteijn en Kemna | Used only for validation for all boiler types | High |

- Information and published data for the lifespan of gas regular CH-boilers, CH-combi and alternative technologies are limited and often not available.

## 1.1 Methodology & key assumptions –Lifespan

- Linear decreases in lifespan were assumed for gas regular boilers between 1970 and 2030. Gas combination lifespan was assumed to decline between 1970 and 2010, thereafter remaining constant. Oil boiler lifespan remains relatively stable between 1980 and 2030

### 4.2.1 Historic data

**Table 17 - Interpolation & background calculations – lifespan (Domestic CH – Boiler)**

| Year | Methodology & assumptions |
|---|---|
| | **Oil boilers** |
| 1970 - 2008 | Data have been extracted from MTP model 2007 |
| | **Gas Regular Boiler** |
| 1970 - 2008 | Year on year reduction in lifespan of 0.2 years |
| | **Gas Combi Boiler** |
| 1970 - 2008 | Year on year reduction in lifespan of 0.15 years |

### 4.2.2 Future analysis

**Table 18 Extrapolation & background calculations - lifespan (Domestic CH – Boiler)**

| Year | Methodology & assumptions |
|---|---|
| | **Oil boilers** |
| 2009 - 2030 | Assumed constant at 13.14 years |
| | **Gas Regular Boiler** |
| 2009 - 2030 | Year on year reduction in lifespan of 0.2 years |
| | **Gas Combi Boiler** |
| 2009 | Reduction in lifespan of 0.15 years |
| 2010 - 2030 | Assumed constant at 10.6 years |
| | **Alternative Electric, Gas and Biomass** |
| 2009 - 2030 | Assumed constant at 15 years |

## 4.3 Data issues – lifespan

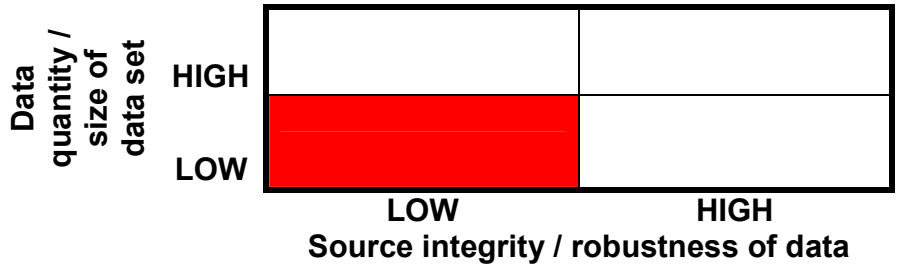
**Table 19 Data issues –lifespan**

| Issue/risk | Approach taken/rationale |
|---|---|
| Lack of measured data | Assumptions based on expert knowledge and estimates derived from stock and sales data |

## 4.4 Confidence level –lifespan

- Confidence level due to absence of actual or measured data.

**Figure 8 - Confidence indicator for lifespan data**



# 5 Usage

## 5.1 Summary

Unlike other end-use models, energy consumption by domestic heating products is dependent on factors other than equipment and the user service demand; most notably the fabric of the building. This has an impact on energy demand, or 'usage'.

- The usage in this model refers to the system (boiler, water cylinder, heating controls, etc) heat demand (kWh), otherwise defined as the dwelling heating energy consumption.

### 5.1.1 Usage

**Table 20– Usage for each type of boiler (kWh/year)**

| | Oil Boilers | Gas Regular | Gas Combi | Alt Electric | Alt Gas | Alt Biomass |
|---|---|---|---|---|---|---|
| 2010 | 9,330 | 7,231 | 7,231 | 8,281 | 8,281 | 8,281 |
| 2020 | 8,815 | 6,832 | 6,832 | 7,824 | 7,824 | 7,824 |
| 2030 | 8,575 | 6,646 | 6,646 | 7,610 | 7,610 | 7,610 |

## 5.2 Data sources –usage

**Table 21– Domestic CH-Boilers - usage data sources**

| Year | Reference | Reference date | Author | Justification | Confidence in sources (High/Low) |
|---|---|---|---|---|---|
| 2007 | www.ecoboiler.org (Ecoboiler v5b) | 2007 | Van Holsteijnen Kemna (VHK) | Need for UK to adapt to forthcoming ErP directive | High |
| 1970 - 2030 | MTP Boiler Model 2009[16] | 2008 | MTP expert | Need for UK to adapt to forthcoming ErP directive | High |

[16] This model is based on Ecoboiler v5b (www.ecoboiler.org.uk) a tool developed in the preparatory studies for the 2005/32/EC Directive Lots 1 and 2 by VHK.

| Year | Reference | Reference date | Author | Justification | Confidence in sources (High/Low) |
|---|---|---|---|---|---|
| 1970-2030 | Annual energy data from Digest UK Energy Survey 2005 | 2005 | unknown | Used for validation | High |

## *5.3 Methodology & key assumptions – Usage*

- The MTP Boiler Model 2009, an adaptation of the ErP Ecoboiler[17] model, calculates system heating demand. In this model existing dwellings have been modelled using housing stock data derived from National House Condition Surveys[18] and adjusted as necessary to agree with national annual energy data from DUKES[19]. The adjusted values are projected for future years using reference housing stock projections.

**Table 22 – Normalisation factors – heating demand**

| Technology | Original av. heating demand (kWh) | DUKES scaled heating demand (kWh) | Factor |
|---|---|---|---|
| Conventional Gas | 11,662 | 7,231 | 0.62 |
| Conventional Oil | 11,662 | 9,330 | 0.80 |
| Alternative (all) | 11,662 | 8,281 | 0.71 |

### 5.3.1 Historic data

**Table 23 - Interpolation & background calculations – usage**

| Year | Methodology & assumptions |
|---|---|
| 1970 - 2008 | Calculated using Eco-boiler model used to assess boiler products for ErP Preparatory Study on Eco-design of Boilers[20]<br><br>Average heating demand (kWh) is multiplied by a normalisation factor to reach agreement DUKES 2007 data |

### 5.3.2 Future analysis

**Table 24 Extrapolation & background calculations - usage**

| Year | Methodology & assumptions |
|---|---|
| 2009 - 2030 | Calculated using Eco-boiler model |

[17] Boiler Model Assumptions and Methodology - 2009
[18] The English Housing Condition Survey (EHCS), published by DCLG.
http://www.communities.gov.uk/housing/housingresearch/housingsurveys/englishhousecondition/
[19] Digest of UK Energy Statistics 2007, DECC
http://www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx
[20] For a full description of Ecoboiler, including usage, see related Briefing Note BNDH B02; Reference 0Scenario; Section 4.2

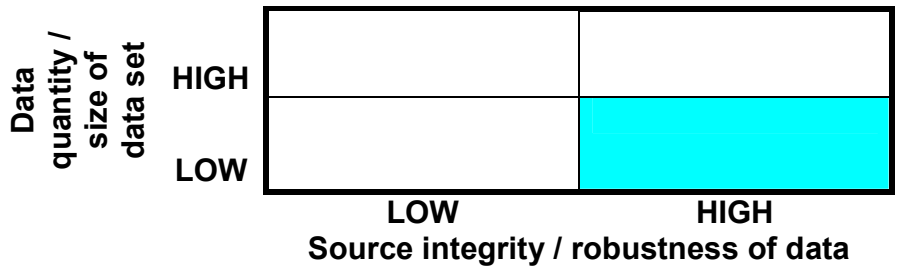
## 5.4 Data issues –usage

**Table 25 Data issues –usage**

| Issue/risk | Approach taken/rationale |
|---|---|
| Use of Ecoboiler v5b | This tool was adapted into the MTP boiler model (2009) because it is publicly available, allows input of detailed UK data and produces results which are consistent with those needed to evaluate developing ErP boiler policy |
| Assigning correct boiler size and type to each identified dwelling type. | The latest data available are used and flexibility in the MTP boiler model developed allows future adaptation. |

## 5.5 Confidence level – usage

**Figure 9 - Confidence indicator for usage data**



## Related MTP information

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

- Boiler Energy Model explained and reference to related Briefing Note (BNDH11) removed
- Added: rational behind take up of Alt. technologies (sales section)
- 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.

For further information on related issues visit **http://efficient-products.defra.gov.uk**