BNM C04: Circulators Government Standards Evidence Base 2009: Best Available Technology 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.

Document Abbreviations	
Small	Small Standalone Circulators
BI	Boiler Integrated Circulators
Large	Large Circulators
IM	Induction motor
VS	Variable Speed
PM	Permanent Magnet
FS	Fixed Speed
Std	Standard
Imp	Improved
TRV	Thermostatic Radiator Valve
EEI	Energy Efficiency Index

1 Introduction

- The Best Available Technology (BAT) Scenario is a hypothetical projection of what would happen if the best available technologies on the (current and future) market were bought and installed from now on.

- The best available technologies are defined as the most efficient, or lowest energy consuming technologies available on the market, or those which are close to market (where the development stage is completed, but it is not necessary available as a designed product).

1.1 Product definition

- Circulators are integrated pump and motor products which are typically used to re-circulate heating or cooling media within a closed circuit and are principally used for central heating systems. A small percentage (<4%) are used for other applications such as solar water heating, or chilling systems. They range in size from 1W – 2500W input power.

- Domestic circulators are those used in households and can be divided into two categories: small standalone and boiler integrated (BI). BI circulators are always integrated into the boiler and may also include other boiler control functions within the assembly. Standalone circulators are usually separate from the boiler, although can also be incorporated within the boiler. Unlike BI circulators and components, standalone circulators are available directly to the public, although in most cases it will be the tradesperson who purchases on the customer's behalf.

- Non-domestic circulators are used in central heating systems for industrial and commercial premises and are classed as large standalone circulators.

- Domestic and non-domestic circulators either use a standard induction motor (Standard or Improved circulators and, for non-domestic only, Improved Variable Speed) or a permanent magnet motor (Standard PM or Improved PM).

- PM circulators are the most efficient technology.

2 Scenario outputs

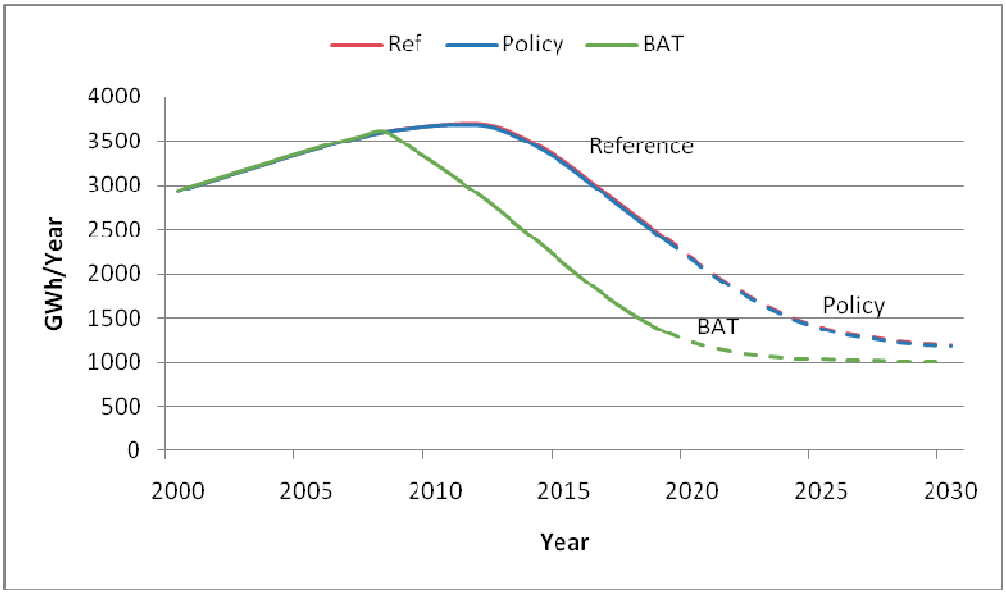

Figure 1 Comparison of scenarios for domestic circulators

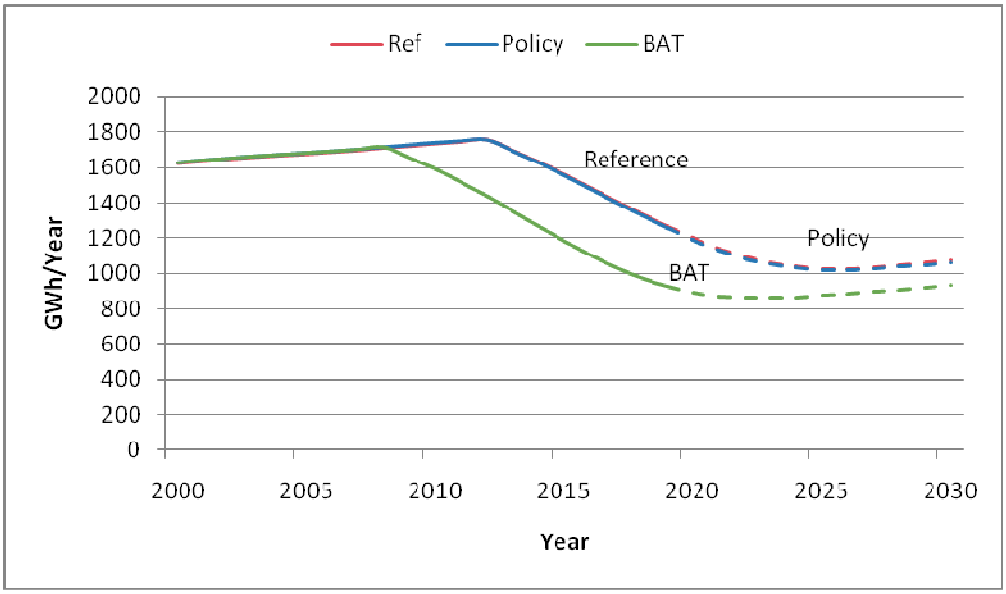

Figure 2 Comparison of scenarios for non-domestic circulators[1]

Table 1 Energy consumption of circulators under BAT Scenario

Energy Consumption (GWh)	2009	2020	2030
BI	1620	710	670
Small	1810	510	340
Large	1650	890	930
TOTAL	5080	2110	1940
Energy Savings (GWh)			
BI	0	640	130
Small	0	310	60
Large	0	310	140
TOTAL	0	1260	330

[1] Energy consumption figures for the non-domestic sector in the 2009/2010 Product policy analysis and projections document 'Saving energy through better products and appliances' were scaled down to match DECC projections for overall energy demand (www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx).

MTP data represents the best currently available information based on a bottom-up modelling approach. MTP's data is the basis for detailed energy calculations in the 2009/2010 Consultation Document. However, DECC projections indicate that overall energy demand in the non-domestic sector is lower than projected by MTP's detailed models. MTP has assumed that the differences between the DECC overall projections and its detailed bottom-up projections are due to incomplete data on the following inputs for some of its non-domestic products:

- existing product stock;
- existing product efficiency;
- product usage.

The energy consumption figures in these GSBNs have **not** been scaled down, in order to enable constructive stakeholder comment on the MTP input data, and therefore differ from the ones presented in the 2009/2010 Product policy analysis and projections document.

CO_2 Emissions ($MtCO_2$)			
BI	0.70	0.30	0.29
Small	0.78	0.22	0.14
Large	0.71	0.38	0.40
TOTAL	2.18	0.91	0.83
CO_2 Emissions Savings ($MtCO_2$)			
BI	0.05	0.27	0.06
Small	0.05	0.13	0.03
Large	0.03	0.13	0.06
TOTAL	0.13	0.54	0.14

3 BAT Timelines

- The following timeline table identifies when the BAT is available.

Table 2 BAT timelines to market

Model	Current BAT	2010	2011	2012	2013	2014	2015
Small	Std PM (EEI=0.27)		Imp PM (EEI=0.23)		Benchmark (EEI=0.2)		
BI	Std PM (EEI=0.27)				Imp PM (EEI=0.23)		Imp PM (EEI=0.23)
Large	Std PM (EEI=0.27)		Imp PM (EEI=0.23)		Benchmark (EEI=0.2)		

4 Efficiency

4.1 Summary

- Circulator efficiency is defined as the ratio of the hydraulic power (flow and pressure) delivered by the circulator to the electrical power consumed by the circulator; it is presented as an energy efficiency index (EEI), which is a rating system based on the total annual energy consumed by the circulator (kWh) when operating to a predetermined load pattern and number of running hours per annum.

- EEI varies with the heating mode (On/Off or thermostatic radiator valve, TRV) in which a circulator is used. Domestic circulators operate in On/Off or TRV mode, whereas non-domestic circulators only operate in TRV mode.

- The standard definition of EEI is based on the TRV mode of operation, which is highlighted in Table 3.

- The benchmark indicates the best available technology on the market using improved permanent magnet technology.

Table 3 Efficiency metric for circulators

		Benchmark	Imp PM	Std PM	IM VS	Imp	Std
Small	**EEI (TRV)**	0.2	0.23	0.27	N/A	0.87	1.16
	EEI (on/off)	0.36	0.43	0.47	N/A	0.93	1.21
BI	**EEI (TRV)**	0.2	0.23	0.27	N/A	1.26	1.68
	EEI (on/off)	0.52	0.63	0.68	N/A	1.34	1.75
Large	**EEI (TRV)**	0.2	0.23	0.27	0.44	0.45	0.54

Table 4 Small standalone circulator sales % split

	Sales weighted average power (W)	Std %	Imp %	Std PM %	Imp PM %	Benchmark %
2009	39.5	0	0	100	0	0
2010	39.5	0	0	100	0	0
2011	35.2	0	0	0	100	0
2012	35.2	0	0	0	100	0
2013	29.6	0	0	0	0	100
2014	29.6	0	0	0	0	100
2015	29.6	0	0	0	0	100
2016	29.6	0	0	0	0	100
2017	29.6	0	0	0	0	100
2018	29.6	0	0	0	0	100
2019	29.6	0	0	0	0	100
2020	29.6	0	0	0	0	100
2021	29.6	0	0	0	0	100
2022	29.6	0	0	0	0	100
2023	29.6	0	0	0	0	100
2024	29.6	0	0	0	0	100
2025	29.6	0	0	0	0	100
2026	29.6	0	0	0	0	100
2027	29.6	0	0	0	0	100
2028	29.6	0	0	0	0	100

	Sales weighted average power (W)	Std %	Imp %	Std PM %	Imp PM %	Benchmark %
2029	29.6	0	0	0	0	100
2030	29.6	0	0	0	0	100

Table 5 Boiler integrated circulator sales % split

	Sales weighted average power (W)	Std %	Imp %	Std PM %	Imp PM %	Benchmark %
2009	57.2	0	0	100	0	0
2010	57.2	0	0	100	0	0
2011	57.2	0	0	100	0	0
2012	57.2	0	0	100	0	0
2013	51.0	0	0	0	100	0
2014	51.0	0	0	0	100	0
2015	43.0	0	0	0	0	100
2016	43.0	0	0	0	0	100
2017	43.0	0	0	0	0	100
2018	43.0	0	0	0	0	100
2019	43.0	0	0	0	0	100
2020	43.0	0	0	0	0	100
2021	43.0	0	0	0	0	100
2022	43.0	0	0	0	0	100
2023	43.0	0	0	0	0	100
2024	43.0	0	0	0	0	100
2025	43.0	0	0	0	0	100
2026	43.0	0	0	0	0	100
2027	43.0	0	0	0	0	100
2028	43.0	0	0	0	0	100
2029	43.0	0	0	0	0	100
2030	43.0	0	0	0	0	100

Table 6 Non-domestic circulator sales % split

	Sales weighted average power (W)	Std %	Imp %	IM VS %	Std PM %	Imp PM %	Benchmark %
2009	194.1	0	0	0	100	0	0
2010	194.1	0	0	0	100	0	0
2011	164.6	0	0	0	0	100	0
2012	164.6	0	0	0	0	100	0
2013	143.4	0	0	0	0	0	100
2014	143.4	0	0	0	0	0	100
2015	143.4	0	0	0	0	0	100
2016	143.4	0	0	0	0	0	100
2017	143.4	0	0	0	0	0	100
2018	143.4	0	0	0	0	0	100
2019	143.4	0	0	0	0	0	100
2020	143.4	0	0	0	0	0	100
2021	143.4	0	0	0	0	0	100
2022	143.4	0	0	0	0	0	100
2023	143.4	0	0	0	0	0	100
2024	143.4	0	0	0	0	0	100
2025	143.4	0	0	0	0	0	100
2026	143.4	0	0	0	0	0	100
2027	143.4	0	0	0	0	0	100
2028	143.4	0	0	0	0	0	100
2029	143.4	0	0	0	0	0	100
2030	143.4	0	0	0	0	0	100

4.2 Data sources – efficiency & sales-weighting

Table 7 Efficiency & sales-weighting data sources

Model	Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
Small, BI, Large	2008	ErP Preparatory Study	April 2008	AEA Energy and Environment	Peer reviewed document, defines Blue Angel distribution	High
Small, Large	2008	“Results of Circulator Labelling	Dec 2008	University of Darmstadt	Amendments to EEI levels, explanation	High

		Revision"		(Dr. Gerhard Ludwig, Dr. Miriam Roth)	and new values provided	
Small, Large	2008	"Update of EEI levels"	17th Dec 2008	Europump	Explanation of changes to EEI levels, and new calculation methods	High

Note: Historic data sources are included in BNM C02 – Reference Scenario

4.3 Methodology & key assumptions – efficiency & sales-weighting

- Methodology & key assumptions for historic data are included in BNM C02 Reference Scenario.

4.3.1 Future analysis

Table 8 Extrapolation & background calculations – efficiency & sales-weighting

Model	Year	Methodology & assumptions
Small, BI, Large	2009-2030	The average efficiency (EEI) of new circulators for each circulator type is assumed to remain constant over time, although the percentage of sales assumed for each type will vary (see below), therefore the average efficiency of new sales will change over time.
Small, Large	2009-2030	BAT for 2009 is Std PM circulators. By 2011 this will move to Imp PM and in 2013 the BAT will be Benchmark technology (EEI=0.2), representing 100% of sales
BI	2009-2030	BAT for 2009 is Std PM circulators. By 2013 this will move to Imp PM and in 2015 the BAT will be Benchmark technology (EEI=0.2), representing 100% of sales

4.4 Data issues – efficiency & sales weighting

Table 9 Data issues – efficiency & sales weighting

Model	Issue/risk	Approach taken/rationale
Small, BI, Large	Distortion of EEI calculations which affects small circulators	Consultations with manufactures, experts and Europump have taken place to discuss the distortion. An adjustment factor has been agreed but may need to be revisited. Incorrect factors may lead to small circulators being classed as more efficient then in reality.

Related MTP information

- BNM C01: Circulators Government Standards Evidence Base 2009: Key Inputs
- BNM C02: Circulators Government Standards Evidence Base 2009: Reference Scenario
- BNM C03: Circulators Government Standards Evidence Base 2009: Policy Scenario
- BNM C05: Circulators Government Standards Evidence Base 2009: Key Outputs
- BNDH B01: Domestic Boilers Government Standards Evidence Base 2009: Key Inputs
- BNDH B02: Domestic Boilers Government Standards Evidence Base 2009: Reference Scenario
- BNDH B03: Domestic Boilers Government Standards Evidence Base 2009: Policy Scenario
- BNDH B04: Domestic Boilers Government Standards Evidence Base 2009: Best Available Technology Scenario
- BNDH B05: Domestic Boilers Government Standards Evidence Base 2009: Key Outputs

Changes from previous version

- Minor changes to the 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**