BNM C03: Circulators Government Standards Evidence Base 2009: Policy 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 Policy Scenario is a projection of what would happen if a defined set of new product-specific and related cross-cutting policies were implemented. The policies in the Policy Scenario have not yet been agreed or funded but represent those policies which are expected to be introduced as well as likely future revisions to existing policies and, in some cases, novel policy options. These policies aim to improve the average efficiency of products in the stock through a variety of mechanisms (e.g. minimum standards, product information and labelling, procurement, incentives) and thus reduce energy consumption and carbon emissions resulting from to these products.

- As product policy is considered within the context of climate change policy, the UK government considers policies with a net UK costs of up to around £20 per tonne of CO2 saved (compared to the Reference Scenario). The ambition level, at a

minimum, matches the Least Life Cycle Cost (LLCC) level to society of increased energy efficiency of products.

- The costs for each policy, where known, are also included, separated out for government, consumer and industry.

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 circulators).

- PM circulators are the most efficient available technology.

2 Scenario outputs

- The graphs below show the energy consumption for circulator stock under the three scenarios from 2009 to 2030.

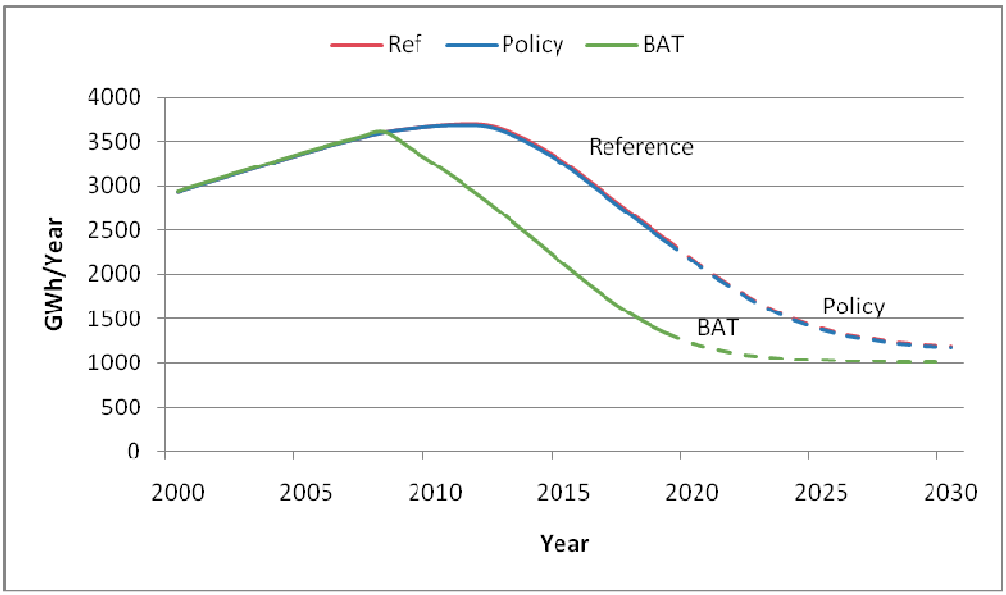

Figure 1 Comparison of scenarios for domestic circulators

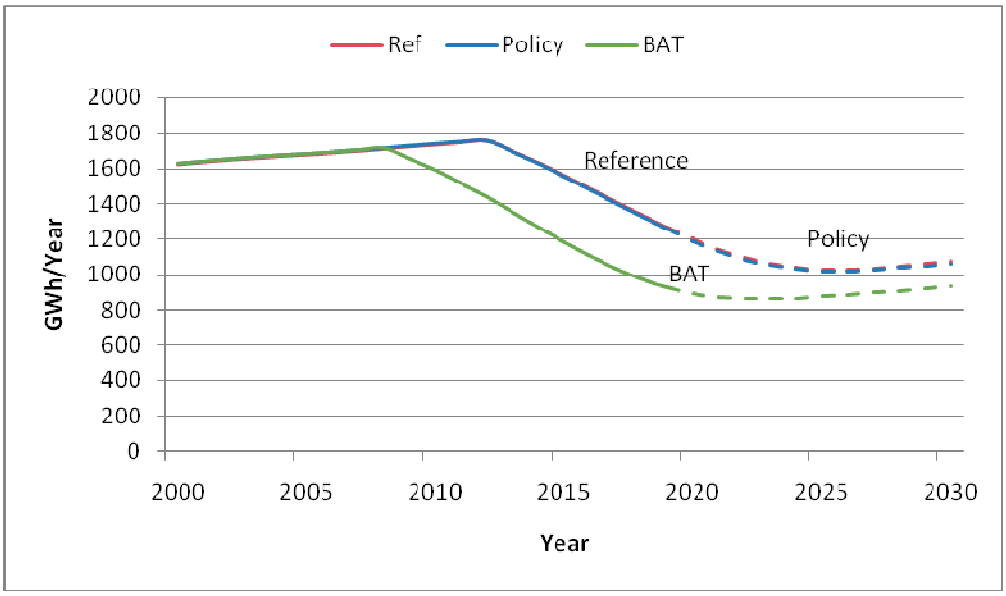

Figure 2 Comparison of scenarios for non-domestic circulators[1]

[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).

Table 1 Summary scenario outputs

Energy Consumption (GWh)	2009	2020	2030
BI	1720	1330	790
Small	1930	810	390
Large	1730	1190	1060
TOTAL	5380	3330	2240
Energy Savings (GWh)			
BI	0	10	10
Small	0	10	10
Large	0	10	10
TOTAL	0	30	30
CO_2 Emissions ($MtCO_2$)			
BI	0.74	0.57	0.34
Small	0.83	0.35	0.17
Large	0.74	0.51	0.46
TOTAL	2.31	1.43	0.96
CO_2 Emissions Savings ($MtCO_2$)			
BI	0	0.01	0.00
Small	0	0.00	0.00
Large	0	0.00	0.00
TOTAL	0	0.01	0.01

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 Product policy analysis and projections 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.

Table 2 Summary cost and benefits data

	Average annual energy savings (£m)	Average annual product & policy cost increases (£m)	Net Benefit 2009-2030 (£m)	Cost Effectiveness (traded) (£/tCO$_2$)
Domestic circulators (Small & BI)	1.6	4.0	-37.5	236.2[2]
Non-Domestic circulators (Large)	0.7	0.8	-1.3	-4.7

3 Future potential policy & measures

- The performance levels and timings for each of the policy measures in the policy mix are given below.

Table 3 Summary of future potential policies and measures

	SO subsidies[3]	EST endorsement label (ESR)[4]
2009		
2010		
2011	Imp PM (EEI=0.23)	Imp PM (EEI=0.23)
2012		
2013	Benchmark (EEI=0.20)	
2014		
2015		
2025		
2030		

[2]. This GSBN series uses a new set of cost-benefit factors, and a refinement of the approach taken to modeling the impact of ErP Ecodesign measure in the Circulators Reference Scenario, compared with the December 2009 Consultation Document. As a result of the improved modeling and change in factors, benefits are slightly reduced and costs are slightly increased, resulting in a difference in net benefit to that published in the consultation document. The emission savings are modest (and also lower than those presented in the consultation document). These effects combine to give large differences in the cost effectiveness indicator compared to that published in the 2010 Product policy analysis and projections document.

[3] Small standalone circulators only

[4] Small standalone circulators only

Table 4 Future potential policies & measures, Policy Scenario

Model	Policy name	Period in force	Description	Impact	Cost	Justification
Small, BI	Supplier Obligation (SO)	2011-2020	The SO replaces CERT in 2011 and it is assumed that levels of ambition will be increased to maintain a lead over the ErP measures. Applies to small standalone circulators only.	Assumed that 2% of sales of Imp PM (EEI=0.23) circulators sold in 2011 due to SO and 5% in 2012. From 2013 1% of Benchmark (EEI=0.20) circs sold increasing to 10% in 2020	Benchmark technology is approx 36% more expensive than Imp PM technology	Given that CERT already covers circulators, it is expected that they will also be included under the SO but at higher levels of ambition
Small,	ESR (Energy Saving Recommended)	2011-ongoing	At present no circulators are endorsed by ESR. It is assumed that small Imp PM (EEI=0.23) circs will be endorsed from 2011	1% increase in sales of Imp PM (EEI=0.23) per annum resulting from ESR from 2011-2015	Cost premium of purchasing a PM circulator varies between 10% and 50%.	It is expected that ESR will be aligned with the ErP and support the high efficiency circulators
Large	ECA (Enhanced Capital Allowance Scheme)	2011	ECAs are kept under review like all tax reliefs. Future revisions are a matter for HM Treasury and are made in light of developments in technologies on the market..	Assumptions and estimates for the future of the ECA scheme for circulators have been made by MTP experts based on their understanding of developments in technology,		Stimulates the top end of the market post introduction of ErP.

- ECAs, like all tax reliefs, are kept under review. There is potential for future revision of ECAs to reflect technology development and qualifying products which may impact on non-domestic circulators.
- The impact of Building Regulations (Part L in England and Wales and equivalent in Scotland and Northern Ireland) is not presently modelled. However, although these regulations are not expected to influence sales of high efficiency circulators it is anticipated that improved building insulation and standards will lead to reduced running hours of circulators, which will in turn reduce annual energy consumption (and therefore potential savings).
- Carbon Reduction Commitment will apply mandatory emissions trading to energy use emissions from large business and public sector organisations with at least one

meter settled on the half-hourly market. This policy may impact on non-domestic circulators, however, it has not been possible to conduct a full analysis of the CRC policy and data were not available to estimate costs and benefits on an annual basis.

3.1 Policy timeline

- The following policy timeline identifies when policies come into effect, including future revisions.

Model	Policy name	Current specification in force	2011	2012	2013	2014	2015	2016-2030
Small	Supplier Obligation	CERT 2008-2011	EEI=0.23		EEI=0.20			
Small	ESR	N/A	EEI = 0.23					

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 5.

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

Table 5 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 6 Small standalone circulator sales % split

	Sales weighted average power (W)	Std %	Imp %	Std PM %	Imp PM %	Benchmark %
2009	105.7	50	42	8	0	0
2010	104.2	47	44	9	0	0
2011	98.6	40	45	12	3	0
2012	87.6	28	44	20	8	0
2013	39.7	0.5	0.5	90	8	1
2014	38.5	0.5	0.5	62	35	2
2015	36.2	0	0	30	65	5
2016	34.8	0	0	0	94	6
2017	34.8	0	0	0	93	7
2018	34.7	0	0	0	92	8
2019	34.7	0	0	0	91	9
2020	34.6	0	0	0	90	10
2021	34.6	0	0	0	90	10
2022	34.6	0	0	0	90	10
2023	34.6	0	0	0	90	10
2024	34.6	0	0	0	90	10
2025	34.6	0	0	0	90	10
2026	34.6	0	0	0	90	10
2027	34.6	0	0	0	90	10
2028	34.6	0	0	0	90	10
2029	34.6	0	0	0	90	10
2030	34.6	0	0	0	90	10

Table 7 Boiler integrated circulator sales % split

	Sales weighted average power (W)	Std %	Imp %	Std PM %	Imp PM %	Benchmark %
2009	153.3	50	42	8	0	0
2010	151.1	47	44	9	0	0
2011	148.1	44	45	10	1	0
2012	144.3	39	48	11	2	0
2013	142.2	38	47	12	3	0
2014	106.1	25	25	12	38	0
2015	88.3	17	17	6	60	0
2016	61.9	5	5	0	90	0
2017	61.9	5	5	0	90	0
2018	61.9	5	5	0	90	0
2019	61.9	5	5	0	90	0
2020	50.8	0	0	0	98	2
2021	50.8	0	0	0	97	3
2022	50.7	0	0	0	96	4
2023	50.6	0	0	0	95	5
2024	50.5	0	0	0	94	6
2025	50.4	0	0	0	93	7
2026	50.4	0	0	0	92	8
2027	50.4	0	0	0	92	8
2028	50.3	0	0	0	91	9
2029	50.3	0	0	0	91	9
2030	50.2	0	0	0	90	10

Table 8 Non-domestic circulator sales % split

	Sales weighted average power (W)	Std %	Imp %	IM VS %	Std PM %	Imp PM %	Benchmark %
2009	345.5	48	31	15	6	0	0
2010	341.6	44	34	15	7	0	0
2011	335.5	39	37	15	8	1	0
2012	323.5	33	40	12	12	3	0
2013	191.2	0	0	0	90	10	0
2014	183.2	0	0	0	63	37	0
2015	173.3	0	0	0	31	67	2
2016	164.2	0	0	0	0	98	2
2017	164.0	0	0	0	0	97	3
2018	164.0	0	0	0	0	97	3
2019	163.8	0	0	0	0	96	4
2020	163.8	0	0	0	0	96	4
2021	163.5	0	0	0	0	95	5
2022	163.5	0	0	0	0	95	5
2023	163.3	0	0	0	0	94	6
2024	163.3	0	0	0	0	94	6
2025	163.1	0	0	0	0	93	7
2026	163.1	0	0	0	0	93	7
2027	162.9	0	0	0	0	92	8
2028	162.9	0	0	0	0	92	8
2029	162.7	0	0	0	0	91	9
2030	162.5	0	0	0	0	90	10

4.2 Data sources – efficiency & sales-weighting

Table 9 Efficiency & sales-weighting data sources

Model	Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
Small, Large	2008	"Results of Circulator Labelling	Dec 2008	University of Darmstadt	Amendments to EEI levels, explanation	High

Model	Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
		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

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

4.3.1 Future data

Table 10 Extrapolation & background calculations – efficiency

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	2009-2030	In 2009 the assumed split of sales, based on expert judgement, is 50% for Standard, 42% for Improved and 8% for Std PM. Sales due to S.O and ESR are assumed to be 2% and 5% in 2011 and 2012.
BI	2009-2030	BI circulators have a similar split of sales to small for 2009.

4.4 Data issues – efficiency

Table 11 Data issues – efficiency

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 than in reality.

5 Cost

5.1 Summary

Circulator Costs					
Type	**Technology**	**EEI (TRV)**	**Weighted Average Costs 2008**	**Cost Reduction to 2013**	**Assumed Future Costs 2013-2030[5]**
Small	Standard	1.16	£ 67.93	0%	£ 67.93
	Improved	0.87	£ 91.13	0%	£ 91.13
	Std PM	0.27	£ 146.66	20 %	£ 117.33
	Imp PM	0.23	£ 158.53	20 %	£ 126.83
	Benchmark	0.2	£ 172.95	0%	£ 172.95
BI	Standard	1.68	£ 81.76	0%	£ 81.76
	Improved	1.26	£ 101.24	0%	£ 101.24
	Std PM	0.27	£ 138.28	20 %	£ 110.62
	Imp PM	0.23	£ 158.53	20 %	£ 126.83
	Benchmark	0.2	£ 180.15	0%	£ 180.15
Large	Standard	0.54	£ 432.37	0%	£ 432.37
	Improved	0.45	£ 486.41	0%	£ 486.41
	IM VS	0.44	£ 540.46	0%	£ 540.46
	Std PM	0.27	£ 594.51	10 %	£ 535.06
	Imp PM	0.23	£ 648.55	10 %	£ 583.70
	Benchmark	0.20	£ 691.79	0%	£ 691.79

5.2 Data sources – cost

Table 12 Cost 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	High
Small, Large	2008	MTP UK manufacturer questionnaire	Nov 2008	Manufacturer responses	Information direct from UK manufacturers	Low
Small, BI,	2009	UK manufacturers	Feb 2009	Quotes from UK circulator	Source of latest UK market	Low

[5] 2015-2030 for BI circulators

Model	Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
Large		& retailers market research by MTP		agents	costs	

- The manufacturer questionnaire was sent to manufacturers and suppliers of circulators within the UK in November 2008, co-ordinated by MTP. A limited response was obtained, with varying levels of detail. The questionnaire looked for information on present and anticipated future costs, market size, market share, changes to manufacturing processes and capital costs associated with changing manufacturing processes.

5.3 Methodology & key assumptions – cost

5.3.1 Future analysis

Table 13 Extrapolation & background calculations – cost

Model	Year	Methodology & assumptions
Small, BI, Large	2009	The current costs of circulators are based on costs from MTP market research and those used in the ErP Preparatory Study. These were weighted to reflect a realistic average. Seven costs sources were obtained (ErP study, three manufacturers, three agents) and each cost source was given a weighting. As the ErP study was a peer reviewed document those costs were given a 50% weighting, with the remaining 50% split equally amongst the other six cost sources. In situations when UK costs were unavailable, the ErP study was given a 100% weighting.
Small, Large	2009-2012	The costs of all circulators are expected to remain at 2008 prices until 2012 (the year before the ErP implementing measure).
BI	2009-2014	The costs of all circulators are expected to remain at 2008 prices until 2014 (the year before the ErP implementing measure).
Small,	2013-2030	The costs of standard and improved circulators are assumed to remain constant into the future. The costs of PM circulators are expected to reduce by 20% from 2013, due to mass production resulting in economies of scale.
BI	2015-2030	The costs of standard and improved circulators are assumed to remain constant into the future. The costs of PM circulators are expected to reduce by 20% from 2013, due to mass production resulting in economies of scale.
Large	2013-2030	The costs of standard and improved circulators are assumed to remain constant into the future. The costs of PM circulators are expected to reduce by 10% in 2013, due to mass production resulting in economies of scale.

5.4 Data issues – cost

Table 14 Data issues – cost

Model	Issue/risk	Approach taken/rationale
Small, BI, Large	Discrepancy between UK costs provided by manufacturers and data in ErP Preparatory Study	As no large scale, peer reviewed market research of UK circulators was conducted there are some doubts about the accuracy of the costs used. These data were used in combination with the ErP Study data, with greater weight given to the ErP data since this is thought to be the more reliable source
Small, BI, Large	Cost reduction assumptions	No forecasts were available from manufacturers regarding cost reductions due to economies of scale of PM circulators. The assumptions used were based on cost reductions of 20% for small and BI circulators and 10% for large circulators based on expert opinion. Forecasts could be validated through better market data

5.5 Confidence level – cost

- As no large scale research of the UK circulator market has been carried out there are doubts over the validity of the data. Also, obtaining accurate costs for Boiler Integrated circulators is difficult which leads to assumptions being made. Thus, confidence in costing data and projections is low.

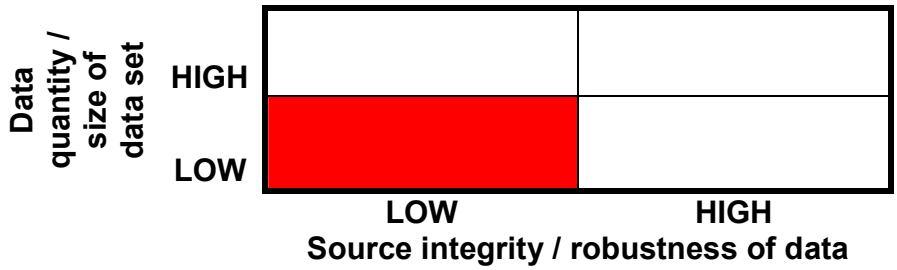

Figure 3 Confidence indicator for cost data

Related MTP information

- BNM C01: Circulators Government Standards Evidence Base 2009: Key Inputs
- BNM C02: Circulators Government Standards Evidence Base 2009: Reference Scenario

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