



BN-NDICT IM04: Non-Domestic Imaging Government Standards Evidence Base 2009: Best Available Technology Scenario

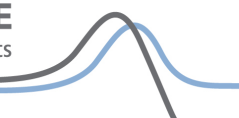
Version 1.1

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.

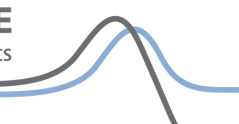
1 Introduction

- 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 or 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).
- This Government Standard Briefing Note (GSBN) covers non-domestic imaging equipment. The following definitions of imaging equipment types are adapted from the ErP Preparatory study on imaging equipment¹.
- **Office Imaging Equipment** is a commercially available product which was designed for the main purpose of producing a printed image (paper document or photo) from a digital image (provided by a network/card interface) through a marking process. Office Imaging Equipment is also a commercially available product which was designed for the main purpose of producing a digital image from a hard copy through a scanning/copying process. The definition covers products which are marketed as printers, photocopiers and multifunction devices (MFDs). For the purposes of this GSBN, "Office Imaging Equipment" is also used to cover imaging products used in a domestic environment.

¹ European Commission DG TREN ErP Preparatory Studies "Imaging Equipment" (LOT 4) Draft Final Report on Task 1



- **Printer** is a commercially available imaging product that serves as a hard copy output device, and is capable of receiving information from single-user or networked computers, or other input devices (e.g. digital cameras). The unit must be capable of being powered from a wall outlet or from a data or network connection. The following products covered in this GSN fall under this category; Laser printers, inkjet printers and dot-matrix printers.
- **Multifunction Devices (MFD)** is a commercially available imaging product which is a physically integrated device or a combination of functionally-integrated components combining two or more of the core functions of copying, printing, scanning, or faxing. The copy functionality as addressed in this definition is considered to be distinct from single sheet convenience copying offered by fax machines. The unit must be capable of being powered from a wall outlet or from a data or network connection. The following products covered in this GSN fall under this category; Laser MFDs and Inkjet MFDs.
- Each type of imaging product detailed above can employ one or more of the following marketing technologies:
- **Electro Photographic (EP):** EP is a marking technology characterized by illumination of a charged organic photoconductor drum in a pattern representing the desired hard copy image via a light source (typically a Laser or LED). The image is created with particles of (dry) toner using the latent image on the photoconductor to define the presence or absence of toner at a given location. The toner is transferred to the final hard copy medium (typically paper or foil) and cured in a thermal fusing process while applying pressure to cause the desired hard copy to become durable. The process allows a very fast throughput and creation of hardcopy images. EP marking technology is normally applied in medium to high speed printers and copiers. Products using EP marking technologies are defined as “thermal” imaging products due to the use of heat in the process. The following products covered in this GSN fall under this category; Laser printer, laser MFDs and photocopiers.
- **Ink Jet (IJ):** Inkjet (IJ) is a marking technology where images are formed by depositing (jet) colorant (liquid ink) in small drops directly to the print media in a matrix manner. The print head of the inkjet printer scans the page in horizontal strips, using a motor to move it back and forth, as another motor rolls the paper in vertical steps. Products using inkjet marking technologies are normally defined as “non-thermal” imaging products as no heating is required to set the ink on the paper. The following products covered in this GSN utilise inkjet marking technologies; inkjet printers and MFD inkjets.
- **Impact:** A marking technology characterized by the formation of the desired hard copy image by transferring colorant from a “ribbon” to the media via an impact process. Two types of impact technology are Dot Formed Impact and Fully-formed



Impact. Products using impact marking technologies are normally defined as “non-thermal” imaging products as no heating is required to set the ink on the paper. The following products covered in this GSN utilise impact marking technologies; dot-matrix printers.

- Products using EP marking technologies are defined as “thermal” imaging products due to the use of heat in the process. Conversely, products using inkjet or impact marking technologies are normally defined as “non-thermal” imaging products as no heating is required.

Non-thermal			Thermal		
Dot-matrix Printer	Inkjet Printer	MFD Inkjet	Laser Printer	MFD Laser	Photo-copier

2 Scenario outputs

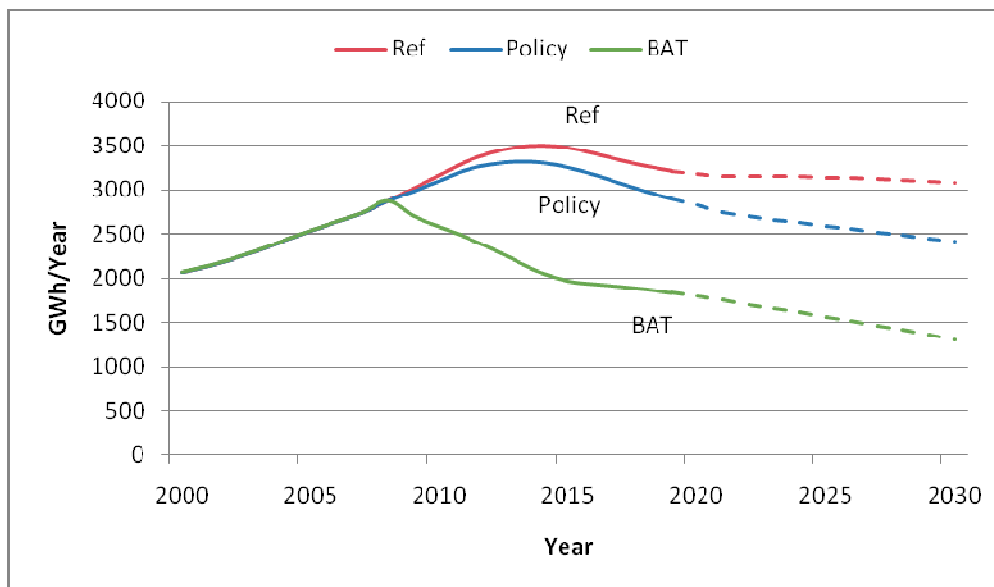


Figure 1 Non-Domestic Imaging Product Energy Consumption

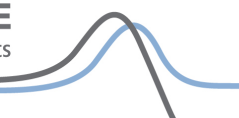


Table 1 Non-Domestic Imaging Products Energy Consumption² and Savings and CO₂ Emissions³ and Savings

Energy Consumption (GWh)	2009	2020	2030
Photocopiers	160	0	0
InkJet MFD	120	80	50
Laser MFD	640	840	710
Dot Matrix	10	0	0
InkJet printer	140	20	10
Laser printer	1620	840	530
TOTAL	2700	1790	1300
Energy Savings (GWh)			
Photocopiers	0	0	0
InkJet MFD	0	240	280
Laser MFD	0	470	790
Dot Matrix	0	0	0
InkJet printer	0	70	30
Laser printer	0	610	670
TOTAL	0	1380	1780
CO₂ Emissions (MtCO₂)			
Photocopiers	0.06	0.00	0.00
InkJet MFD	0.04	0.03	0.02
Laser MFD	0.23	0.30	0.26
Dot Matrix	0.00	0.00	0.00
InkJet printer	0.05	0.01	0.00
Laser printer	0.57	0.30	0.19
TOTAL	0.95	0.64	0.47
CO₂ Emissions Savings (MtCO₂)			

² 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 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:

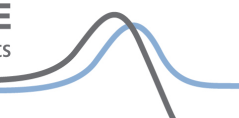
- existing product stock;
- existing product efficiency;
- product usage.

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.

³ Refer to BNXS01 Carbon Dioxide Emission Factors for UK Energy Use for details on factors used.

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Photocopiers	0.00	0.00	0.00
InkJet MFD	0.02	0.09	0.10
Laser MFD	0.04	0.17	0.28
Dot Matrix	0.00	0.01	0.00
InkJet printer	0.02	0.02	0.01
Laser printer	0.04	0.22	0.24
TOTAL	0.11	0.49	0.64

3 Efficiency

3.1 Summary

- Efficiency metrics for **thermal products are given in average TEC (kWh/week) values** for each speed category (based on images per minute (ipm) rather than as a formula (as provided by ENERGY STAR). MTP have taken this approach as it allows easier comparisons of total energy consumption between the different speed categories.
- Power consumption for **non-thermal products are communicated in operational mode (OM) power (W) values** as under ENERGY STAR. ENERGY STAR does not currently address the on-ready mode of non thermal products.

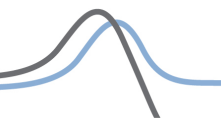


Table 2 Non-Domestic Non-thermal Imaging products power consumption

Year	Inkjet Printer			MFD Inkjet			Dot-matrix Printer		
	On-Ready (W)	SLEEP (W)	OFF (W)	On-Ready (W)	Sleep (W)	Off (W)	On-Ready (W)	Sleep (W)	Off (W)
2009	10.0	3.0	0.2	15.5	2.2	0.4	72.5	9.0	0.0
2010	9.7	2.9	0.2	15.0	1.9	0.4	71.3	8.7	0.0
2020	6.2	1.8	0.1	10.1	0.5	0.3	6.2	1.8	0.1
2030	2.7	0.6	0.0	5.1	0.5	0.2	2.7	0.6	0.0

- Power consumption for all non-thermal products is expected to fall in the future under the BAT scenario. The lowest power consumption for each product and each power mode is based on the most efficient product currently on the market.

Table 3 Non-Domestic Laser Printer TEC Requirements

Year	Laser Printer					
	TEC (kWh/week)					
	≤ 15ipm Mono	>15 ipm ≤ 40 Mono	>40 ipm ≤ 82 Mono	> 82ipm Mono	≤ 32ipm Colour	>32 ipm ≤ 58 Colour
2009	0.6	1.9	4.5	30.8	3.2	7.0
2010	0.6	1.8	4.4	30.6	3.1	6.9
2020	0.6	1.3	4.0	29.3	2.0	5.7
2030	0.6	0.7	3.6	27.9	1.0	4.6

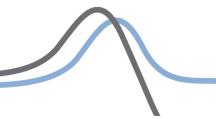


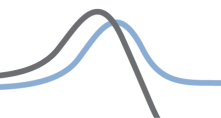
Table 4 Non-Domestic Laser MFD TEC Requirements

	MFD Laser					
Year	TEC (kWh/week)					
	>10 ipm ≤ 26 Mono	>26 ipm ≤ 68 Mono	> 68 ipm Mono	≤26 ipm Colour	>26 ipm ≤62 Colour	>62ipm Colour
2009	1.3	5.4	14.9	3.6	6.7	14.1
2010	1.2	5.2	14.5	3.5	6.6	13.6
2020	1.0	3.4	11.2	2.5	5.5	8.8
2030	0.7	1.6	7.8	1.6	4.5	8.8

Table 5 Non-Domestic Photocopier TEC Requirements

	Photocopier						
Year	TEC (kWh/week)						
	≤ 15ipm Mono	>15 ipm ≤ 40 Mono	>40 ipm ≤ 82 Mono	> 82ipm Mono	≤ 32ipm Colour	>32 ipm ≤ 58 Colour	> 58ipm Colour
2009	1.0	1.2	7.8	21.8	4.2	11.3	19.4
2010	0.9	1.2	7.4	21.6	4.2	10.2	19.1
2020	0.9	0.9	2.8	18.6	4.1	4.6	17.6
2030	0.9	0.6	2.8	15.7	4.0	4.6	17.6

- The TEC values for all thermal products are expected to fall in the future under the BAT scenario. The lowest TEC values for each product and each speed category is based on the most efficient product currently on the market (i.e. “class leader”).



3.2 Data sources – efficiency

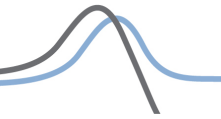
- *Note: Historic data sources are included in BN-NDICT IM02 – Reference Scenario*

Table 6 Efficiency data sources - All imaging products

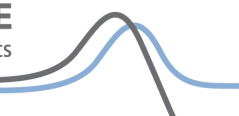
Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2009, 2017, 2030	Expert assumptions	2009	MTP Technical Expert	Expert assumptions required to develop best practice levels and year that all products could meet class leader level (inkjet printers).	Medium
2009, 2015, 2030	Expert assumptions	2009	MTP Technical Expert	Expert assumptions required to develop best practice levels and year that all products could meet class leader level (MFD Inkjets).	Medium
2009, 2030	Expert assumptions	2009	MTP Technical Expert	Expert assumptions required to develop best practice levels and year that all products could meet class leader level	Medium

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				(dot-matrix printers).	
2009, 2017, 2030	Expert assumptions	2009	MTP Technical Expert	Expert assumptions required to develop best practice levels and year that all products could meet class leader level (laser printers).	Medium
2009, 2019, 2030	Expert assumptions	2009	MTP Technical Expert	Expert assumptions required to develop best practice levels and year that all products could meet class leader level (MFD laser).	Medium
2009, 2012, 2015, 2016, 2020, 2030	Expert assumptions	2009	MTP Technical Expert	Expert assumptions required to develop best practice levels and year that all products could meet class leader level (photocopiers).	Medium



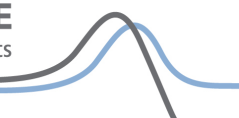
3.3 Methodology & key assumptions – efficiency

- This section describes what has been done with the data listed in Table 6 along with a rationale for any key assumptions (in particular any expert judgements listed in Table 6) and detail of any background calculations behind the data points.
- Methodology & key assumptions for historic data are included in BN-NDICT IM02 – Reference Scenario.

3.3.1 Future analysis

Table 7 Extrapolation & background calculations – efficiency

Year	Methodology & assumptions
	All imaging products
2009	All imaging products – best practice power figures for all imaging products are based on a top performing percentage of products found in all referenced datasets. The level at which this percentage figure is set varies depending on the range of products performances found in each dataset. It is typically set at between 10-20%. Class leading products are defined as the single most efficient product over all datasets (per product group).
2009	All imaging products (all power modes) - uses best practice value.
	Non thermal products
2010-2029	MFD inkjet (on-ready and off mode) - straight line interpolation between 2009 and 2030 value
2030	MFD inkjet (on-ready and off mode) - class leader value.
2010-2014	MFD inkjet (sleep mode) - straight line interpolation between 2009 and 2030 value
2015-2030	MFD inkjet (sleep mode) - class leader value.
2010-2029	Inkjet printer (on-ready, sleep and off mode) - straight line interpolation between 2009 and 2030 value
2030	Inkjet printer (on-ready, sleep and off mode) - class leader value.
2010-2029	Dot-matrix printer (on-ready and sleep mode) - straight line interpolation between 2009 and 2030 value
2030	Dot-matrix printer (on-ready and sleep mode) - class leader value.
2010-2030	Dot-matrix printer (off mode) - uses the 2009 value
	Thermal products
2009	Laser printer ($\leq 15\text{ipm}$) - uses best practice value.
2010-2017	Laser printer ($\leq 15\text{ipm}$) - straight line interpolation between 2009 and 2030 value
2017 - 2030	Laser printer ($\leq 15\text{ipm}$) - class leader value.
2010-2029	Laser printer (all other speeds) - straight line interpolation between 2009 and 2030 value
2030	Laser printer and MFD laser (all other speeds) - class leader value.
2010-2018	MFD laser (colour $>62\text{ipm}$) - straight line interpolation between 2009 and 2030 value
2019	MFD laser (colour $>62\text{ipm}$) - class leader value.
2020-2030	MFD laser (colour $>62\text{ipm}$) - class leader value.
2010-2029	MFD laser (all other speeds) - straight line interpolation between 2009 and 2030 value
2010 - 2011	Photocopier (mono $<15\text{ipm}$) - straight line interpolation between 2009 and 2012 value
2012	Photocopier (mono $<15\text{ipm}$) - class leader value.
2013 - 2030	Photocopier (mono $<15\text{ipm}$) - class leader value.



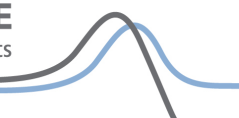
Year	Methodology & assumptions
2010 - 2019	Photocopier (mono >40 ipm ≤ 82) - straight line interpolation between 2009 and 2020 value
2020	Photocopier (mono >40 ipm ≤ 82) - class leader value.
2021 - 2030	Photocopier (mono >40 ipm ≤ 82) - class leader value.
2010 - 2019	Photocopier (mono >40 ipm ≤ 82) - straight line interpolation between 2009 and 2020 value
2020	Photocopier (mono >40 ipm ≤ 82) - class leader value.
2021 - 2030	Photocopier (mono >40 ipm ≤ 82) - class leader value.
2010 - 2014	Photocopier (colour >32 ipm ≤ 58) - straight line interpolation between 2009 and 2015 value
2015	Photocopier (colour >32 ipm ≤ 58) - class leader value.
2016- 2030	Photocopier (colour >32 ipm ≤ 58) - class leader value.
2010 - 2015	Photocopier (colour > 58ipm) - straight line interpolation between 2009 and 2016 value
2016	Photocopier (colour > 58ipm) - class leader value.
2017- 2030	Photocopier (colour > 58ipm) - class leader value.
2010 - 2015	Photocopier (all other speeds) - straight line interpolation between 2009 and 2016 value
2016	Photocopier (all other speeds) - class leader value.
2017- 2030	Photocopier (all other speeds) - class leader value.

3.4 Data issues – efficiency

- This section flags any areas of uncertainty, both in general and for specific data points, along with a description of how this has been dealt with in the model

Table 8 Data issues – efficiency

Issue/risk	Approach taken/rationale
Much of the power data sourced for thermal imaging products comes from products compliant to ENERGY STAR. There is a risk that the best practice figures could be too low in relation to the “true” market best practice level which results in future values also being too ambitious.	MTP has commissioned its own testing and power figures are included in the datasets. Inclusion of these figures helps to develop realistic best practice figures. MTP will review on an annual basis.
On-ready mode power consumption of non-thermal imaging products is not covered under the ENERGY STAR programme. Data for this power mode of non-thermal products is therefore primarily sourced from manufacturers’ declarations. Data included in these manufacturer declarations could be less reliable than data found in government programme databases.	MTP has attempted to source on-ready power consumption data from various manufacturers. It is assumed that collecting data from various manufacturers has helped to reduce any potential errors.
Some of the “class leader” values could be associated with products with reduced functionality which allows them to use significantly less power.	MTP has separated ICT products into distinct product types based on similar functionality e.g. laser printers. It is accepted that the products within these groups could offer a large range of functionalities.



3.5 Confidence level – efficiency

- Confidence in best practice levels for thermal imaging product data is generally high though there is a possibility that heavy reliance on ENERGY STAR data could result in the BAT Scenario assumptions being too low.
- There is also a risk that “class leading” products offer limited functionality and therefore are not representative of true efficiency potential in each product group.
- Confidence levels in the on-ready mode for non thermal products is generally low due to the reliance on manufacturer declared data that has not been independently verified or that might not have been measured according to a standard methodology.

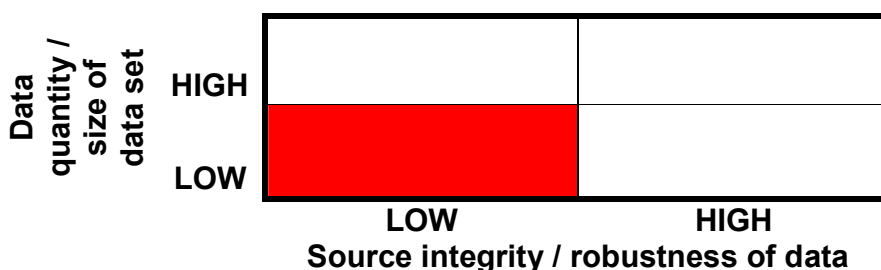
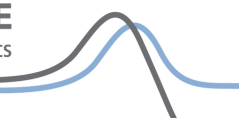


Figure 2 Confidence indicator for efficiency data

4 Usage

4.1 Summary

- This section of the GSN details the usage assumptions included for the **non-thermal imaging products**.
- Thermal products are included under the TEC approach and therefore their usage is integral to the efficiency metrics section and cannot be drawn out in detail separately. The TEC approach under ENERGY STAR for thermal imaging products is based on an expected use profile (based on speed and colour) across all power modes for a week’s use. MTP has “downgraded” the TEC use profile to 50 weeks per year to better reflect assumed usage of thermal imaging products.



- Two sets of use profiles are developed for non-thermal imaging products. The first use profile is based on a situation where no power management is enabled and the second where power management is enabled (see Key Inputs GSN for profiles). An “enabling rate” is used as a weighting factor between these two use profiles to arrive at overall use profile for each product.
- The table below shows average usage profiles, derived from the reference scenario enabling rate and the power managed and non power managed profiles discussed in the Key Inputs Briefing Note.

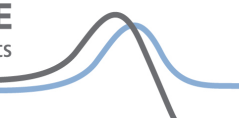
Table 9 Average Usage – Inkjet Printers and MFD Inkjet

Inkjet Printer and MFD Inkjets					
BAT (Use Hours/Year)					Power Management Enabling Rates
Year	On-Ready	Sleep	Off	Off-Unplugged	%
2009	623	1,417	6,720	-	100
2010	623	1,417	6,720	-	100
2020	623	1,417	6,720	-	100
2030	623	1,417	6,720	-	100

Table 10 Average Usage – Dot-matrix printer

Dot-matrix Printer					
Reference (Use Hours/Year)					Power Management Enabling Rates
Year	On-Ready	Sleep	Off	Off-Unplugged	%
2009	289	1,751	6,303	418	100
2010	289	1,751	6,303	418	100
2020	289	1,751	6,303	418	100
2030	289	1,751	6,303	418	100

- The use hours of non-thermal imaging products are expected to remain constant into the future as power management rates stay unchanged at 100%.
- A 100% power management enabling rate is assumed in the BAT Scenario by 2009 (by comparison a 100% power management rate in the policy scenario is only



assumed by 2021) as industry communicates ways of ensuring that any power management functionality does not interfere with the normal operation of products, so that power management can be enabled as compulsory across all products.

4.2 Data sources – usage

Table 11 Usage data sources (enabling rates) – Non-thermal Imaging Products

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2009	Expert Assumptions	2009	MTP Technical Expert	Expert assumption required to develop use profiles in each year.	Medium

4.3 Methodology & key assumptions – usage

- This section describes what has been done with the data listed in Table 11 along with a rationale for any key assumptions (in particular any expert judgements listed in Table 11) and detail of any background calculations behind the data points.

4.3.1 Future analysis

Table 12 Extrapolation & background calculations – usage data

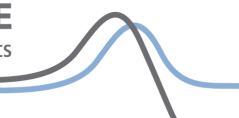
Year	Methodology & assumptions
2009 - 2030	All non-thermal printers –use hours for all power modes based on 2008 figures. See Key Inputs GSN for details.
2009	All non-thermal printers –power management enabling rates assumed to be 100% as power management enabled as compulsory.
2010-2030	All non-thermal printers –power management enabling rates same as 2009
2009 - 2030	Thermal products – usage deemed to be the same as the 2008 values.
2009 - 2030	All lifespan data based on the 2008 values. See Key Inputs GSN for details.

4.4 Data issues – usage

- This section flags any areas of uncertainty, both in general and for specific data points, along with a description of how this has been dealt with in the model

Table 13 Data issues – usage

Issue/risk	Approach taken/rationale
Power management enabling rates can have a large impact of overall use profiles. Over or under estimation of power management enabling rates could have a consequentially large impact on overall use hours.	MTP has included a number of expert assumptions which estimate power management enabling rates. MTP will continue to evaluate new use profile data.



4.5 Confidence level – usage

- This section provides an indication of overall confidence in the data set (i.e. data points, interpolation and projections).
- Confidence levels about actual base use profiles are included in the Key Inputs GSBN. Confidence levels in the power management enabling rates are relatively low, especially for future years, due to the large potential for users to disable functionality.

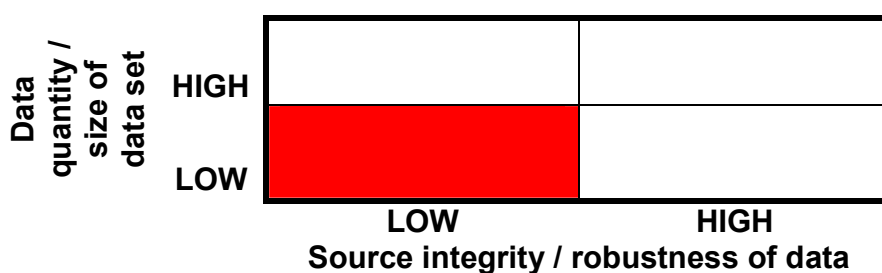


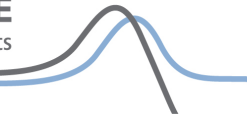
Figure 3 Confidence indicator for usage & lifespan data

5 Other issues

- There are also environmental impacts associated with the use of consumables for imaging products.

Related MTP information

- BN-NDICT IM01: Government Standards Evidence Base 2009 – Key Inputs, Non Domestic Imaging Products
- BN-NDICT IM02: Government Standards Evidence Base 2009 – Reference Scenario, Non Domestic Imaging Products
- BN-NDICT IM03: Government Standards Evidence Base 2009 – Policy Scenario, Non Domestic Imaging Products
- BN-DICT IM01: Government Standards Evidence Base 2009 – Key Inputs, Domestic Imaging Products
- BN-DICT IM02: Government Standards Evidence Base 2009 – Reference Scenario, Domestic Imaging Products
- BN-DICT IM03: Government Standards Evidence Base 2009 – Policy Scenario, Domestic Imaging Products
- BN-DICT IM04: Government Standards Evidence Base 2009 – Best Available Technology (BAT) Scenario, Domestic Imaging Products
- BN-NDICT KO01: Government Standards Evidence Base 2009 – Key Outputs, Non Domestic ICT
- BN-DICT KO01: Government Standards Evidence Base 2009 – Key



Outputs, Domestic ICT

Changes from Version 1.0

- 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>