

BN-DICT IM02: Domestic Imaging Government Standards Evidence Base 2009: Reference Scenario

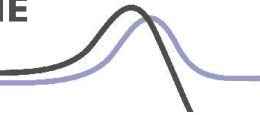
Version 1.0

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

1 Introduction

- The Reference Scenario is a projection of what is likely to happen to energy consumption of each product if no new policies are implemented. All agreed and formally signed-off policies are included in the Reference Scenario.
- [Note that in this round of Government Standards, any EuP measures which were passed at Regulatory Committee in March 2009 are included in the Reference Scenario, although at the time of writing not all of these measures had been published in the Official Journal of the European Union].
- For cross-cutting policies such as CERT and Building Regulations, which are agreed but where the likely impact for specific products is unknown, assumptions are made about the impact per product, and detailed in the following sections. Where possible, separate projections of the Reference line are made with and without such policies.
- This Government Standard Briefing Note (GSBN) covers domestic imaging equipment. The following definitions of imaging equipment types are adapted from the EuP 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

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



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.

- **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 GSBN fall under this category; Laser printers, inkjet printers and photo 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 GSBN 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 GSBN fall under this category; Laser printers and Laser MFDs.
- **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. The following products covered in this GSBN utilise inkjet marking technologies; inkjet printers, inkjet MFDs and some photo printers.
- **Dye Sublimation:** A marking technology where images are formed by depositing (subliming) dye onto the print media based upon the amount of energy delivered by

the heating elements. Photo printers are the only product covered in this GSBN which employ dye sublimation marking technologies.

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

Non-thermal			Thermal	
Photo Printer	Inkjet Printer	MFD Inkjet	Laser Printer	MFD Laser

2 Scenario outputs

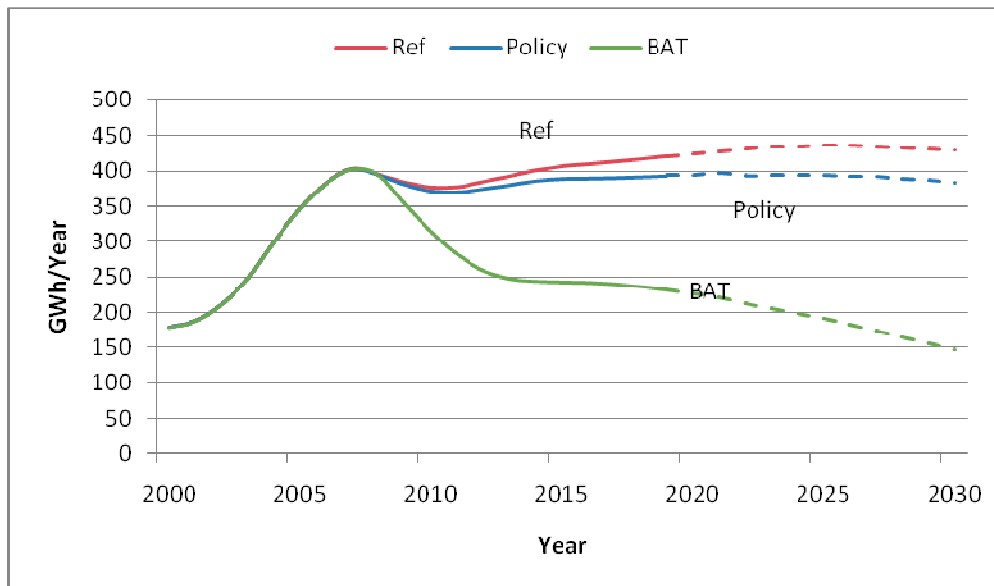


Figure 1 Total Domestic Imaging Product Energy Consumption

- Overall energy consumption from domestic imaging products in the Reference Scenario is expected to reduce until approximately 2012 when it will begin to increase again as the influence from currently approved policy measures wanes.
- Total energy consumption from domestic thermal imaging products in the Reference Scenario is expected to increase in the future until 2014 as a result of increasing stock. Energy consumption after 2014 is expected to decrease as a result of improved product efficiency.

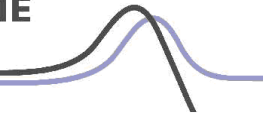
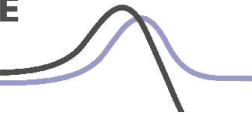


Table 1 Domestic Imaging Products Energy Consumption and CO₂ Emissions²

Energy Consumption (GWh)	2009	2020	2030
Photo	50	20	20
InkJ	160	280	290
Las	50	60	70
InkJ	70	20	20
Las	50	40	30
TOTAL	380	420	430
CO ₂ Emissions (MtCO ₂)			
Photo	0.02	0.01	0.01
InkJ	0.06	0.11	0.11
Las	0.02	0.02	0.03
InkJ	0.03	0.01	0.01
Las	0.02	0.02	0.01
TOTAL	0.14	0.16	0.16

- Total energy consumption from domestic inkjet printers is expected to decrease in the future. This decrease is largely as a result of domestic purchasers moving away from single function inkjet printers to MFD inkjets and MFD lasers.
- Total energy consumption from domestic photo printers is expected to decrease in the future as a result of domestic purchasers moving away from single function photo printers to MFD inkjets with photo print functionality.
- Total energy consumption from domestic laser printers is expected to decrease in the future as a result of falling stock. Stock levels are assumed to fall as domestic purchasers favour MFD laser products over single function laser printers.
- Total energy consumption from domestic MFD lasers is expected to first increase, then decrease and then increase again. The changeable patterns in energy consumption are attributable to increasing stock, increasing efficiency and market shift towards faster products which on average use more energy.

² Refer to BNXS01 Carbon Dioxide Emission Factors for UK Energy Use for details on factors used.



3 Current policy & measures

- ENERGY STAR is the dominant energy efficiency policy covering ICT products. The ENERGY STAR label is led by the US Environmental Protection Agency (EPA) but the European Commission has an agreement with the US Government to coordinate the energy labelling of office equipment through an EU ENERGY STAR programme. ENERGY STAR aims to qualify around the top performing 25 per cent of products at the time of specification (usually around nine months to one year prior to a specification coming into effect). Due to the complexity of the programme it is not possible to revise the criteria as frequently as perhaps needed for the fast moving ICT products. This means that compliance rates to ENERGY STAR can be high at the end of a specification cycle. The ENERGY STAR V1.0 imaging equipment specification (covering all imaging products included in this briefing note) was finalised in May 2006 and implemented in April 2007. Version 1.1 of the ENERGY STAR imaging equipment specification will be implemented in July 2009. Both specifications are included in the Reference Scenario.
- The Energy Using Products (EuP) Standby Implementing Measures are due to come into force January 2010 at 1W with a second tier of requirements due to be enforced January 2013 at 0.5W. The Standby Implementing measures are expected to apply to the off-mode of domestic imaging products.
- The Energy Saving Trust endorses a range of energy efficient ICT products under their Energy Saving Recommended (ESR) label. ESR is designed to cover the top 20% of energy efficient products on the market. This UK based eco-label currently covers non-thermal imaging products only. Current uptake of the label by ICT manufacturers remains low.

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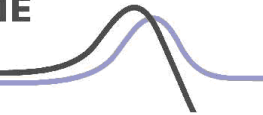


Table 2 Current policies & measures, Reference Scenario

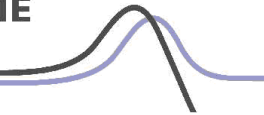
Policy name	Period in force	Description	Impact								
ENERGY STAR V1.0	2007	Provides energy efficiency specifications for all imaging products covered in this GSN.	ENERGY STAR label is set at levels that represent approximately the top 25% of products on the market (averaged across all categories). The large amount of influence associated with ENERGY STAR can, in part, be attributed to the fact that its specifications are mandatory criteria within public procurement contracts of some governments. Coverage levels of ENERGY STAR are highly dependent on the type and functionality of products.								
ENERGY STAR V1.1	July 2009 – 2013 (estimated)	Provides energy efficiency specifications for all imaging products covered in this GSN.	See above. Revised to ensure 25% coverage ambition is maintained.								
EuP Standby Implementing Measures	2010 (Stage 1) and 2013 (Stage 2)	Applies maximum off mode power consumption figures for domestic imaging equipment.	EuP levels of 1W off-mode by 2010 moving to 0.5W off-mode by 2013. Will remove worst performing products in off-mode from the EU market.								
Energy Saving Recommended (ESR)	2009-2013	Applies maximum power levels for the on-ready, sleep and off modes of non-thermal imaging products.	ESR attempts to qualify the top 20% of the market in terms of energy efficiency. Current specifications (averaged across all categories): <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>On-Ready (W)</th> <th>Sleep (W)</th> <th>Off (W)</th> </tr> </thead> <tbody> <tr> <td>Non-thermal Imaging</td> <td>22.0</td> <td>3.5</td> <td>1.0</td> </tr> </tbody> </table>		On-Ready (W)	Sleep (W)	Off (W)	Non-thermal Imaging	22.0	3.5	1.0
	On-Ready (W)	Sleep (W)	Off (W)								
Non-thermal Imaging	22.0	3.5	1.0								

Table 3a Test Standards

Test Standard name	Date in force	Description	Comments
ENERGY STAR Qualified Imaging Equipment Typical Electricity Consumption (TEC) Test Procedure (thermal products only)	2007-2013 (Estimated)	Provides a means for manufacturers to test the Typical Electricity Consumption (TEC) of their equipment, arriving at a kWh/week figure. The methodology includes power testing in each power mode during a standardised use profile which is based on imaging speed and expected	The use profile included in the ENERGY STAR TEC test procedure is widely understood to over represent actual usage.

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Test Standard name	Date in force	Description	Comments
		daily imaging output.	
ENERGY STAR [®] Qualified Imaging Equipment Operational Mode (OM) Test Procedure (non thermal products only)	2007-2013 (Estimated)	Provides a standardised method of measuring the sleep and off mode power consumption of Operational Mode (OM) imaging products (as defined under ENERGY STAR).	No usage assumptions are included in this test approach. This test standard does not address active imaging or ready mode.
IEC 62301	2005	Provides a measurement method for standby/off-mode power (W)	In the process of being revised.

3.1 Policy timeline

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

Policy name	Current spec in force	2009	2010	2011	2012	2013	2014	2015	2016-2020
ENERGY STAR	July 2007	Agreed July 2009							
EuP Standby Implementing Measures	2008 (Agreed)		Jan (1W)			Jan (0.5W)			
ESR	2007								



4 Efficiency

4.1 Summary

- The main energy efficiency metrics for imaging products are those found within the ENERGY STAR label.
- 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 has 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** for sleep and off mode as under ENERGY STAR. ENERGY STAR does not currently address the on-ready mode of non-thermal products.

Table 3 ENERGY STAR TEC Requirements for Standard Sized Laser Printers

Laser Printer Type	Tier I Requirements (ENERGY STAR v1.0)		Tier II Requirements (ENERGY STAR v1.1)	
	Speed (ipm)	Maximum TEC (kWh/week)	Speed (ipm)	Maximum TEC (kWh/week)
Mono	≤ 12	1.5 kWh	≤ 15	1.0 kWh
	12 < ipm ≤ 50	0.20 kWh/ipm)x – 1 kWh	15 < x ≤ 40	(0.10 kWh/ipm)x – 0.5 kWh
	> 50 ipm	(0.80 kWh/ipm)x – 31 kWh	40 < x ≤ 82	(0.35 kWh/ipm)x – 10.3 kWh
			> 82	(0.70 kWh/ipm)x – 39.0 kWh
Colour	≤ 50	(0.20 kWh/ipm)x + 2 kWh	≤ 32	(0.10 kWh/ipm)x + 2.8 kWh
	> 50	(0.80 kWh/ipm)x – 28 kWh	32 < x ≤ 58	(0.35 kWh/ipm)x – 5.2 kWh
			> 58	(0.70 kWh/ipm)x – 26.0 kWh

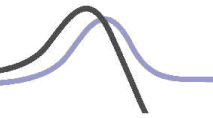


Table 4 ENERGY STAR TEC Requirements for Standard Sized MFD Laser

MFD Laser Type	Tier I Requirements (ENERGY STAR v1.0)		Tier II Requirements (ENERGY STAR v1.1)	
	Speed (ipm)	Maximum TEC (kWh/week)	Speed (ipm)	Maximum TEC (kWh/week)
Mono	≤20	(0.20 kWh/ipm)x + 2 kWh	≤10	1.5kWh
	20 < ipm ≤69	(0.44 kWh/ipm)x -2.8 kWh	10 < ipm ≤26	(0.10 kWh/ipm)x +0.5 kWh
	>69	(0.80 kWh/ipm)x -28 kWh	26< ipm ≤68	(0.35 kWh/ipm)x -6.0 kWh
			>68	(0.70 kWh/ipm)x -30 kWh
Colour	≤32	(0.20 kWh/ipm)x + 5 kWh	≤26	(0.10 kWh/ipm)x + 3.5 kWh
	32 < ipm ≤61	(0.44 kWh/ipm)x -2.8 kWh	26 < ipm ≤62	(0.35 kWh/ipm)x -3.0 kWh
	>61	(0.80 kWh/ipm)x -25 kWh	>62	(0.70 kWh/ipm)x -25 kWh

- The ENERGY STAR requirements for non-thermal (OM) products are communicated in power (W) values. The ENERGY STAR sleep mode requirements include additional power allowances for extra functionality such as increased memory or network connectivity options.

Table 5 ENERGY STAR Sleep Power Requirements for Standard and Small Sized Inkjet Printers and Inkjet MFDs

Product Type & Size Format	Tier I Requirements (ENERGY STAR v1.0)	Tier II Requirements (ENERGY STAR v1.1)
	Sleep (W)	Sleep (W)
Standard-size inkjet printers and inkjet MFDs	3	1.4
Small format Inkjet printers	3	9

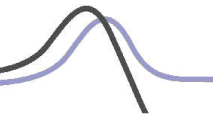


Table 6 ENERGY STAR Standby Power Requirements for Standard and Small Sized Inkjet Printers and Inkjet MFDs

	Tier I Requirements (ENERGY STAR v1.0)	Tier II Requirements (ENERGY STAR v1.1)
Product Type & Size Format	Standby (W)	Standby (W)
All small format and standard-size OM products without fax capability	1	1
All small format and standard-size OM products with fax capability	2	1
All large format OM products and mailing machines	N/A	1

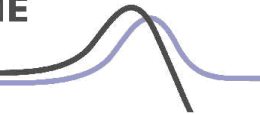
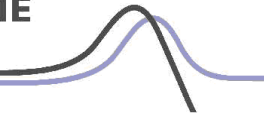


Table 7 Domestic Non-thermal Imaging Product Sleep Power Consumption

	Inkjet Printer	MFD Inkjet	Photo Printer
Year	Sleep (W)	Sleep (W)	Sleep (W)
2009	4.1	4.4	4.8
2010	3.5	4.0	4.9
2011	2.9	3.6	4.9
2012	2.3	3.2	4.9
2013	2.3	3.2	4.9
2014	2.3	3.2	5.5
2015	2.3	3.2	6.0
2016	2.3	3.2	7.0
2017	2.3	3.2	7.0
2018	2.3	3.2	7.0
2019	2.3	3.2	7.0
2020	2.3	3.2	7.0
2021	2.3	3.2	7.0
2022	2.3	3.2	7.0
2023	2.3	3.2	7.0
2024	2.3	3.2	7.0
2025	2.3	3.2	7.0
2026	2.3	3.2	7.0
2027	2.3	3.2	7.0
2028	2.3	3.2	7.0
2029	2.3	3.2	7.0
2030	2.3	3.2	7.0

- The average sleep-mode of inkjet printers and inkjet MFDs has fallen in recent years. It is expected that the sleep-mode power consumption of these devices will not decrease any further into the future past 2012 due to no policy having an influence.
- The average sleep mode power requirement of photo printers has increased since 2000. Consumption in this power mode is expected to increase as ENERGY STAR requirements have been relaxed from 3W to 9W.
- The average off-mode of inkjet printers has fallen in recent years. Off-mode power requirements will continue to fall in relation to the EuP Standby Implementing

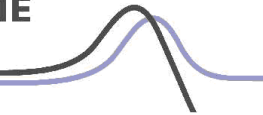


Measures in 2010 and 2013. Further decreases in off-mode power consumption are not expected post 2013.

Table 8 Domestic Laser Printer TEC Requirements

Year	Laser Printer				
	≤ 15ipm Mono	>15 ipm ≤ 40 Mono	>40 ipm ≤ 82 Mono	≤ 32ipm Colour	>32 ipm ≤ 58 Colour
	TEC (kWh/week)	TEC (kWh/week)	TEC (kWh/week)	TEC (kWh/week)	TEC (kWh/week)
2009	0.6	3.4	7.7	5.2	9.6
2010	0.6	3.2	7.3	4.9	9.2
2011	0.6	3.0	6.9	4.6	8.9
2012	0.6	2.9	6.5	4.3	8.6
2013	0.6	2.7	6.1	4.1	8.3
2014	0.6	2.5	5.8	4.0	8.0
2015	0.6	2.4	5.4	3.8	7.8
2016	0.6	2.2	5.1	3.6	7.5
2017	0.6	2.2	5.1	3.5	7.6
2018	0.6	2.2	5.1	3.5	7.6
2019	0.6	2.1	5.1	3.5	7.7
2020	0.6	2.1	5.1	3.4	7.8
2021	0.6	2.1	5.1	3.4	7.8
2022	0.6	2.1	5.1	3.3	7.9
2023	0.6	2.1	5.1	3.3	8.0
2024	0.6	2.0	5.1	3.2	8.0
2025	0.6	2.0	5.1	3.2	8.1
2026	0.6	2.0	5.1	3.1	8.1
2027	0.6	2.0	5.1	3.1	8.2
2028	0.6	2.0	5.1	3.0	8.3
2029	0.6	1.9	5.1	3.0	8.3
2030	0.6	1.9	5.1	2.9	8.4

- The average TEC values of mono laser printers (in the speed category of less than 15 ipm) are expected to increase slightly in the future. This increase is based on the average increase seen in the EU ENERGY STAR database over the period of 1 year (end of 2007 to end of 2008).
- The average TEC values of mono laser printers (speed categories of 15 to 40 ipm and 40 to 82 ipm) and of colour laser printers (speed categories of less than 32 ipm and 32 to 58ipm) are expected to decrease in the future. This decrease is based on

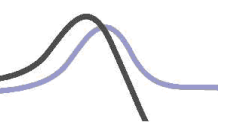


the average decrease seen in the EU ENERGY STAR database over the period of 1 year (end of 2007 to end of 2008).

Table 9 Domestic Laser MFD TEC Requirements

Year	Laser MFD			
	>10 ipm ≤ 26 Mono	>26 ipm ≤ 68 Mono	≤26 ipm Colour	>26 ipm ≤62 Colour
	TEC (kWh/week)	TEC (kWh/week)	TEC (kWh/week)	TEC (kWh/week)
2009	3.0	12.2	9.8	13.4
2010	2.8	11.0	8.6	12.3
2011	2.5	9.8	7.3	11.2
2012	2.3	8.7	6.1	10.1
2013	2.1	8.0	5.5	9.3
2014	1.9	7.4	4.9	8.6
2015	1.7	6.8	4.4	7.8
2016	1.6	6.2	3.8	7.1
2017	1.6	6.1	3.8	7.0
2018	1.6	6.1	3.7	6.9
2019	1.6	6.1	3.7	6.9
2020	1.6	6.1	3.7	6.8
2021	1.6	6.1	3.7	6.7
2022	1.6	6.1	3.6	6.7
2023	1.7	6.1	3.6	6.6
2024	1.7	6.1	3.6	6.5
2025	1.7	6.0	3.5	6.5
2026	1.7	6.0	3.5	6.4
2027	1.7	6.0	3.5	6.4
2028	1.7	6.0	3.5	6.3
2029	1.8	6.0	3.4	6.2
2030	1.8	6.0	3.4	6.2

- The average TEC values of mono MFD Lasers (all speed categories) are expected to decrease up until 2016 and then start to increase in the future. This decrease is based on the average increase seen in the EU ENERGY STAR database over the period of 1 year (end of 2007 to end of 2008).



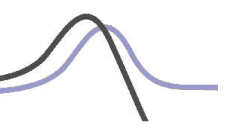
4.2 Data sources – efficiency

Table 10 Efficiency data sources – Inkjet Printer

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2008	Printer Manufacturer Data - Downloaded 01/07	2007	Various manufacturers	Best Data Available	Medium
2008	MFD Manufacturers Data - Downloaded 01/07	2007	Various manufacturers	Best Data Available	Medium
2008	Manufacturers' Data 07-02-08	2008	Various manufacturers	Best Data Available	Medium
2008	US OM Data Set Oct 08	2008	ENERGY STAR	Best Data Available	Medium
2008	Manufacturer Data Downloaded July 2008	2008	Various manufacturers	Best Data Available	Medium
2008	US Energy Star database FTP Download 20.07.06	2006	ENERGY STAR	Best Data Available	Medium
2008	EU Energy Star database website download 07/12/06	2006	ENERGY STAR	Best Data Available	Medium
2008	EPA Energy Star Current 27-10-06	2006	ENERGY STAR	Best Data Available	Medium
2008	EU ENERGY STAR DB download 29-10-08	2008	ENERGY STAR	Best Data Available	High
2008	STD FORMAT EU Energy Star Database 14-01-08	2008	ENERGY STAR	Best Data Available	High
2008	LARGE FORMAT EU Energy Star Database 14-01-08	2008	ENERGY STAR	Best Data Available	High
2008	EU ENERGY STAR DB download 29-10-08 (Standard Size)	2008	ENERGY STAR	Best Data Available	High
2008	EU ENERGY STAR DB download 29-10-08 (Large Format)	2008	ENERGY STAR	Best Data Available	High
2008	US OM Data Set Oct 08 (Standard	2008	ENERGY	Best Data	High

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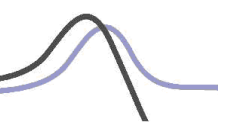
Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
	Size)		STAR	Available	
2008	US OM Data Set Oct 08 (Large Format)	2008	ENERGY STAR	Best Data Available	High
2008	US ENERGY STAR Download EU&UK Oct-08 (Standard Size)	2008	ENERGY STAR	Best Data Available	High
2008	US ENERGY STAR Download EU&UK Oct-08 (Large Format)	2008	ENERGY STAR	Best Data Available	High
2008	EU Energy Star Database 14-01-08	2008	ENERGY STAR	Best Data Available	High
1985, 1993, 1999, 2007, 2008, 2012, 2013, 2016, 2020	Expert assumptions	2009	MTP Technical Expert	Expert assumptions required to collate power figures in Reference, Policy and EBP lines.	Medium

Table 11 Efficiency data sources – MFD Inkjet

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2008	US OM Data Set Oct 08	2008	ENERGY STAR	Best Data Available	High
2006	Energy Star FTP Download 13-10-06	2006	ENERGY STAR	Best Data Available	High
2008	EU Energy Star Database Download 14-01-08	2008	ENERGY STAR	Best Data Available	High
2008	Manufacturers' Data March 2008	2008	ENERGY STAR	Best Data Available	Medium
2008	EU ENERGY STAR DB download 29-10-08	2008	ENERGY STAR	Best Data Available	High

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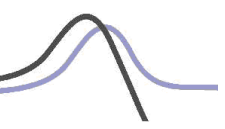
Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2008	US ESTAR Download EU&UK Oct-08	2008	ENERGY STAR	Best Data Available	High
2008	Manufacturer Data Downloaded July 2008	2008	Various manufacturers	Best Data Available	High
2008	Manufacturers' Downloaded Data March 2008	2008	Various manufacturers	Best Data Available	Medium
1999, 2000, 2007, 2008, 2012, 2016, 2020	Expert assumptions	2009	MTP Technical Expert	Expert assumptions required to collate power figures in Reference, Policy and BAT lines.	Medium

Table 12 Efficiency data sources – Photo Printer

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2008	Manufacturers Data - Downloaded 02/08	2008	Various manufacturers	Best Data Available	Medium
2008	Derived data from Inkjet evidence - 2008	2008	See Inkjet model	Best Data Available	High
2008	Manufacturers' Data 09-02-09	2009	Various manufacturers	Best Data Available	Medium
2008	US OM Data Set Oct 08	2008	ENERGY STAR	Best Data Available	High
2008	Energy Star OM Data Corresponding to the Final Version	2006	ENERGY STAR	Best Data Available	High

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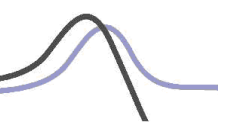


Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
	1.0 Specification - 2006				
2008	EU ENERGY STAR Database Download 14-01-08	2008	ENERGY STAR	Best Data Available	High
2008	Manufacturers Data - 02-08	2008	Various manufacturers	Best Data Available	Medium
2008	EU ENERGY STAR DB download 29-10-08	2008	ENERGY STAR	Best Data Available	High
2008	US ESTAR Download EU&UK Oct-08	2008	ENERGY STAR	Best Data Available	High
2008	EU Energy Star Database 14-01-08	2008	ENERGY STAR	Best Data Available	High
2008	Manufacturers' Data 08-02-08	2008	Various manufacturers	Best Data Available	Medium
2008	2006 Energy Star OM Data Corresponding to the Final Version 1.0 Specification - 2006	2006	ENERGY STAR	Best Data Available	High
2008	US OM Data Set Oct 08 (Small Size)	2008	ENERGY STAR	Best Data Available	High
1999, 2007, 2008, 2010, 2013, 2012, 2016	Expert assumptions	2009	MTP Technical Expert	Expert assumptions required to collate power figures in Reference, Policy and BAT lines.	Medium

Table 13 Efficiency data sources – Laser Printer

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Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2008	EU DL Mono Laser Jan-08	2008	ENERGY STAR	Best data	High
2008	US ES dl Mono Laser EU Oct-08	2008	ENERGY STAR	Best data	High
2008	US ES Mono dl Laser UK Oct-08	2008	ENERGY STAR	Best data	High
2008	EU NOV 08 Mono	2008	ENERGY STAR	Best data	High
2006	US TEC Laser Mono Dataset 2006	2006	ENERGY STAR	Best data	High
2008	US Mono Laser 230-Oct-08	2008	ENERGY STAR	Best data	High
2009	EU NOV 09 Mono	2009	ENERGY STAR	Best data	High
2008	US TEC Laser Col Dataset 2006	2006	ENERGY STAR	Best data	High
2008	EU DL Col Laser Jan-08	2008	ENERGY STAR	Best data	High
2008	US Col Laser 230-Oct-08	2008	ENERGY STAR	Best data	High
2008	US ES dl Col Laser EU Oct-08	2008	ENERGY STAR	Best data	High
2008	US ES Col dl Laser UK Oct-08	2008	ENERGY STAR	Best data	High
2008	EU NOV 09 Col	2009	ENERGY STAR	Best data	High
2007, 2008, 2012, 2016, 2020, 2024, 2028, 2032	Expert assumptions	2009	MTP Technical Expert	Expert assumptions required to collate power figures in Reference, Policy and BAT lines.	Medium

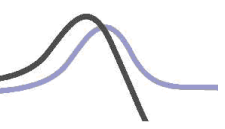
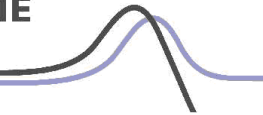


Table 14 Efficiency data sources – MFD Laser

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2008	EU ENERGY STAR DB download 29-10-08	2008	ENERGY STAR	Best Data Available	High
2008	US ENERGY STAR Dataset October 2008	2008	ENERGY STAR	Best Data Available	High
2008	US ESTAR Download EU Oct-08	2008	ENERGY STAR	Best Data Available	High
2008	US ESTAR Download UK Oct-08	2008	ENERGY STAR	Best Data Available	High
2006	ES TEC Dataset 2006	2006	ENERGY STAR	Best Data Available	High
2007, 2008, 2012, 2016, 2020, 2024, 2028, 2032	Expert assumptions	2009	MTP Technical Expert	Expert assumptions required to collate power figures in Reference, Policy and BAT lines.	Medium



4.3 Methodology & key assumptions – efficiency

- This section describes what has been done with the data listed in Table 10, Table 11, Table 12, Table 13 and Table 14 along with a rationale for any key assumptions (in particular any expert judgements listed in Table 10, Table 11, Table 12, Table 13 and Table 14) and detail of any background calculations behind the data points.

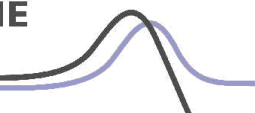
4.3.1 Historic data

Table 15 Interpolation & background calculations – efficiency

Year	Methodology & assumptions
2007	All non-thermal imaging products (all power modes): Reference line power figures for all imaging products are based on a weighted average of all datasets listed in section 4.2. Datasets are added to an Excel toolkit where they are assessed. Datasets are weighted to take account of confidence in data source (which organisation published the data), data year, size of dataset, country of origin and relevance to domestic or non-domestic sector. The individual model weighted average figures from each of the datasets are then combined to arrive at an overall domestic and non-domestic average figure. These 2007 figures are then used as a benchmark from which future product performance values are derived.
2008	All imaging products - Reference line power figures for all imaging products are based on a weighted average of all datasets listed in section 4.2. Datasets are added to an Excel toolkit where they are assessed. Datasets are weighted to take account of confidence in data source (which organisation published the data), data year, size of dataset, country of origin and relevance to domestic or non-domestic sector. The individual model weighted average figures from each of the datasets are then combined to arrive at an overall domestic and non-domestic average figure. These 2008 figures are then used as a benchmark from which future product performance values are derived.
2007	TEC products - Due to the lack of historic data on TEC values it has been necessary to interpolate the 2008 figures for each year prior.
1960-2007	TEC products – use the 2008 figures as described above
1993	Inkjet printer (on-ready mode) – power consumption assumed to be 10W. This is based on an expert assumption in light of not further information being available.
1960 – 1992	Inkjet printer (on-ready mode) – these years are deemed to be the same as the 1993 value. This is based on an expert assumption as no further data was available.
1994 - 2006	Inkjet printer (on-ready mode) – based on a straight line interpolation between the 1993 and 2007 values.
1985	Inkjet printer (sleep mode) – power level assumed to be 5W. This is based on an expert assumption due to lack of any other data.
1960 – 1984	Inkjet printer (sleep mode) – these years are deemed to be the same as the 1993 value. This is based on an expert assumption as no further data was available.
1986 - 2006	Inkjet printer (sleep mode) – based on a straight line interpolation between the 1993 and 2007 values.
1999	Inkjet printer (off mode) – assumed to be at 2W. This figure is based on an expert assumption in light of no further data being available.
1960 - 1998	Inkjet printer (off mode) – these years are deemed to be the same as the 1999 value. This is based on an expert assumption as no further data was available
2000 – 2006	Inkjet printer (off mode) - based on a straight line interpolation between the 1999 and 2007 values.
2000	MFD inkjet (on-ready mode) – assumed to be 25.5W. This value is based on an expert assumption as no further data was available.

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Year	Methodology & assumptions
1960 - 1999	MFD inkjet (on-ready mode) – these years are deemed to be the same as the 2000 value. This is based on an expert assumption as no further data was available.
2001 - 2006	MFD inkjet (on-ready mode) – based on a straight line interpolation between the 2000 and 2007 values.
1999	MFD inkjet (sleep mode) – assumed to be 22.5W. This value is an expert assumption which was made as no further information was available.
1960 - 1998	MFD inkjet (sleep mode) – these years are deemed to be the same as the 1999 value. This is based on an expert assumption as no further data was available.
2000 – 2006	MFD inkjet (sleep mode) based on a straight line interpolation between the 2000 and 2007 values.
2000	MFD inkjet (off mode) – This value (2.9W) is based on an expert assumption as no further data was available.
1960 - 1999	MFD inkjet (off mode) – these years are deemed to be the same as the 2000 value. This is based on an expert assumption as no further data was available.
2001-2006	MFD inkjet (off mode) – based on a straight line interpolation between the 2000 and 2007 values
1999	Photo printer (on-ready mode) – assumed to be 43.16W. This value is based on an expert assumption as no further data was available.
1960 - 1998	Photo printer (on-ready mode) – these years are deemed to be the same as the 1999 value. This is based on an expert assumption as no further data was available.
2001-2006	Photo printer (on-ready mode) – based on a straight line interpolation between the 2000 and 2007 values
1960 - 2006	Photo printer (sleep and off mode) – these years are deemed to be the same as the 2007 value. This is based on an expert assumption as no further data was available.

4.3.2 Future analysis

Table 16 Extrapolation & background calculations –efficiency

Year	Methodology & assumptions
2009-2011 2013 – 2015 2021 – 2023 2025 – 2027 2019 – 2031	All TEC products: These years are based on a straight line interpolation between the adjacent years' figures.
2012	All TEC products: The 2012 figures are based on an assumed distribution of products which meet the average 2008 figure and the current ENERGY STAR specification level (see Policy GSBN for details about how the ENERGY STAR levels are calculated). The distribution rates are based on an assumed percentage of products on the market which meet the ENERGY STAR specifications. The percentage of products that do not meet the ENERGY STAR specifications are assumed to perform at the 2008 average figure. The assumed ENERGY STAR coverage rates are shown in the Policy GSBN.
2016	All TEC products: The 2016 level is assumed to match the 2009 ENERGY STAR specification i.e. all products are assumed to be performing at their respective 2009 ENERGY STAR specification level.
2020 2024 2028 2032	All TEC products: The TEC values for each year are based on the value four years in the past plus the average increase or decrease seen in TEC values (for each speed category) over the course of 1 year in the EU ENERGY STAR database (2008 to 2009). This approach seeks to detail how the products change over time.

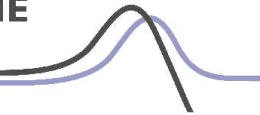
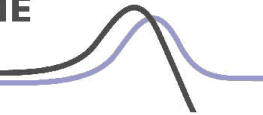


Table 17 Extrapolation & background calculations – non-thermal efficiency

Year	Methodology & assumptions
2009-2011	Inkjet printer and MFD inkjet (sleep modes) - these years are based on a straight line interpolation between the adjacent years' figures.
2009-2030	MFD inkjet and inkjet printer (on-ready mode) – all values match the 2008 level. This is an expert assumption as no further evidence was available. Based on the assumption that there are no future policies which will account for sleep mode power.
2012	MFD inkjet and inkjet printer (sleep mode) - the 2012 figures are based on an assumed distribution of products meeting the ENERGY STAR and reference line values
2013-2030	MFD inkjet (sleep mode) - values for these years assumed to match the 2012 value at 3.2 W as no further improvements assumed to be possible without further policy intervention.
2013-2030	Inkjet printer (sleep mode) - values for these years assumed to match the 2012 value at 2.3 W as no further improvements assumed to be possible without further policy intervention.
2013-2030	Inkjet printer (sleep mode) - Values for these years assumed to match the 2012 value at 2.3 W as no further improvements assumed to be possible without further policy intervention.
2009-2012	MFD inkjet and inkjet printer (off-mode) – These years are based on a straight line interpolation between the adjacent years' figures.
2013	MFD inkjet and inkjet printer (off-mode) - EuP Implementing Measure of 0.5W enforced.
2014 - 2030	MFD inkjet and inkjet printer (off-mode) - values for these years assumed to match the 2013 value at 0.5 W as no further improvements assumed to be possible without further policy intervention.
2009 - 2030	Photo printer (on-ready mode) – all figures same as in 2008.
2009 - 2011 2013-2015	Photo printer (sleep mode) – These years are based on a straight line interpolation between the adjacent years' figures.
2012	Photo printer (sleep mode) - The 2012 figures are based on an assumed distribution of products meeting the ENERGY STAR 2007 and 2009 specification levels (see Policy GSBN for details about how the ENERGY STAR levels are calculated). The remaining (25%) products are assumed to meet the 2008 reference line value. This is based on an expert assumption in light of no further evidence being available.
2016	Photo printer (sleep mode) – The 2016 figure is based on an assumed distribution of products meeting the 2012 value and the remaining meeting the ENERGY STAR 2009 specification. This is based on an expert assumption in light of no further evidence being available.
2017 - 2030	Photo printer (sleep mode) – all values match the 2016 level. This is an expert assumption as no further evidence was available. Based on the assumption that there are no future policies which will account for sleep mode power.
2009	Photo printer (off-mode) - based on a straight line interpolation between the adjacent years' figures.
2010 2013	Photo printer (off-mode) – EuP implementing measure included at 1W in 2010 and 0.5 W in 2013
2011 - 2012	Photo printer (off-mode) mode - based on a straight line interpolation between the adjacent years' figures.
2014 - 2030	Photo printer (off-mode) - Values for these years assumed to match the 2013 value at 0.5 W as no further improvements assumed likely without further policy intervention.



4.4 Data issues – efficiency

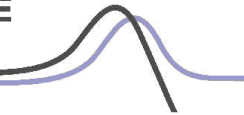
- This section flags any areas of uncertainty, both in general and for specific data points, along with a description of how this has been dealt with in the model.

Table 18 Data issues – efficiency

Issue/risk	Approach taken/rationale
Much of the power data sourced for TEC imaging products comes from products compliant to ENERGY STAR. There is a risk that the average figures could be too low in relation to the “true” market average.	MTP has used non-compliant values for products collected in the ENERGY STAR specification development process when determining the 2008 average efficiency figure.
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 (due in part to non-standardisation of test methodologies used).	MTP has attempted to source on-ready power consumption data from various manufacturers (from websites and supplier declarations). It is assumed that collecting data from a number of manufacturers has helped to reduce any potential errors.
EuP Implementing Measures for off-mode of thermal products has not been considered in the MTP modelling due to a lack of data. The lack of data is due to the fact that under ENERGY STAR off-mode power consumption is included within the TEC methodology and there are no requirements to communicate off-mode power consumption figures separately.	MTP has not modelled the off-mode of thermal products separately due to the lack of data. Off-mode power consumption is an integrated part of the TEC test methodology and so off-mode power is considered within the MTP figures. MTP might consider further investigations surrounding off-mode power consumption of the thermal imaging devices in the future.
The 2010 and 2013 EuP Implementing Measures for off-mode have been applied across all inkjet printers and inkjet MFDs at 1W and 0.5W respectively. There is a possibility (depending on interpretations) that some of these products will not need to comply with the off-mode requirements as listed under the EuP implementing Measures.	MTP have applied the EuP Implementing Measures for off-mode across all non-thermal products. MTP will reassess this assumption as the implementation of the EuP measures progresses and more information becomes available.

4.5 Confidence level – efficiency

- Confidence in the thermal imaging product data is generally low. There is a possibility that heavy reliance on ENERGY STAR data could result in the reference line assumptions being too low.



- Confidence levels in the on-ready mode for non-thermal (OM) 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. Confidence levels for other non-thermal (OM) power modes are higher but could also be subject to ENERGY STAR bias.

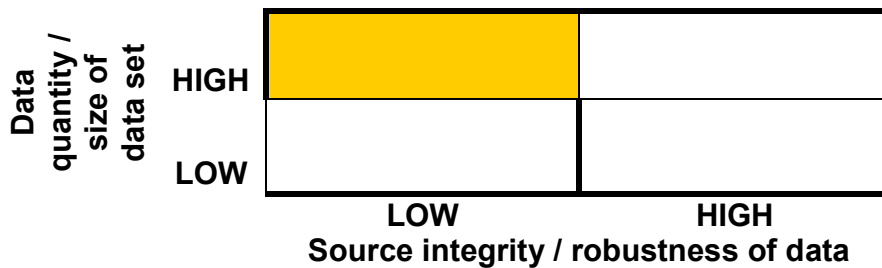
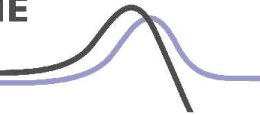


Figure 2 Confidence indicator for efficiency data

5 Usage

5.1 Summary

- This section of the GSBN 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) for a week's use. The TEC use profile under ENERGY STAR reflects an assumed usage pattern across all power modes in a non-domestic environment. MTP has adapted the TEC use profile to better reflect assumed usage of thermal imaging products in the domestic environment.
- Two sets of usage profiles are developed for non-thermal imaging products. The first usage profile is based on a situation where no power management is enabled and the second where power management is enabled (see Key Inputs GSBN for profiles). An "enabling rate" is used as a weighting factor between these two usage profiles to arrive at overall usage 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 GSN.
- The TEC approach under ENERGY STAR for thermal imaging products is based on an expected usage profile (based on speed and colour) for a week's use. The TEC usage profile under ENERGY STAR reflects an assumed usage in a non-domestic environment. MTP has "downgraded" the TEC usage profile to better reflect assumed usage of thermal imaging products in the domestic environment.

Table 19 Average Usage – Inkjet Printers

Year	Inkjet Printer				Power Management Enabling Rates
	Reference (Use Hours/Year)				
	On-Ready	Sleep	Off	Off-Unplugged	%
2008	314	144	6,742	1,560	80
2010	314	144	6,742	1,560	80
2020	314	144	6,742	1,560	80
2030	314	144	6,742	1,560	80

Table 20 Average Usage – MFD Inkjet


Year	MFD Inkjet				Power Management Enabling Rates
	Reference (Use Hours/Year)				
	On-Ready	Sleep	Off	Off-Unplugged	%
2008	314	144	6,855	1,447	80
2010	314	144	6,855	1,447	80
2020	314	144	6,855	1,447	80
2030	314	144	6,855	1,447	80

Table 21 Average Usage – Photo printer

Year	Photo Printer				Power Management Enabling Rates
	Reference (Use Hours/Year)				
	On-Ready	Sleep	Off	Off-Unplugged	%

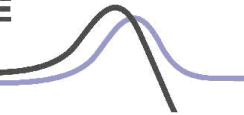
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2008	157	72	6,971	1,560	80
2010	157	72	6,971	1,560	80
2020	157	72	6,971	1,560	80
2030	157	72	6,971	1,560	80

- The usage hours of non-thermal imaging products are expected to remain constant into the future as power management rates stay unchanged and it is assumed that no increases in imaging (print/copy/scan) will occur. No further increases in power management enabling are considered to occur without policy intervention.



5.2 Data sources – usage

Table 22 Usage data sources (enabling rates) – Non-thermal Imaging Products

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
1988, 2008, 2021	Expert Assumptions	2009	MTP Technical Expert	Expert assumption required to develop power management rates.	Medium

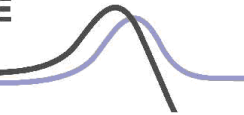
5.3 Methodology & key assumptions – usage

- This section describes what has been done with the data listed in Table 22 along with a rationale for any key assumptions (in particular any expert judgements listed in Table 22) and detail of any background calculations behind the data points.

5.3.1 Historic data

Table 23 Interpolation & background calculations – usage data

Year	Methodology & assumptions
1988	All non-thermal printers – power management enabling rates developed to be used as weighting factor between “power managed enabled” and “non-power management” enables use profiles. Enabling rate for non-thermal imaging products; 0% in 1988.
2001	All non-thermal printers – enabling rate for non-thermal imaging products; 80% in 2001. Based on expert assumptions in light of no further information being available. Enabling rate high as generally little impact on product use therefore users less inclined to disable.
1960 - 1987	All non-thermal printers - power management enabling rates equal to 1988 assumption.
1991 - 2000	All non-thermal printers - power management enabling rates based on interpolation between adjacent years' figures.
2002 - 2008	All non-thermal printers - power management enabling rates equal to 2001 assumption as no further improvements are assumed to occur in these years due to the high initial enabling rate.
2008	Thermal products - the usage profile including power management components for thermal imaging products is included in the TEC methodology. Details about the usage profiles can be found in the Key Inputs GSBN.



5.3.2 Future analysis

Table 24 Extrapolation & background calculations – usage data

Year	Methodology & assumptions
2009 - 2030	All non-thermal printers – power management enabling rates equal to 2008 values.

5.4 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 25 Data issues – usage

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

5.5 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 usage profiles are included in the Key Inputs GSBN's. Confidence levels in the power management enabling rates for non-thermal imaging products are relatively low, especially for future years, due to the potential for users to disable functionality.

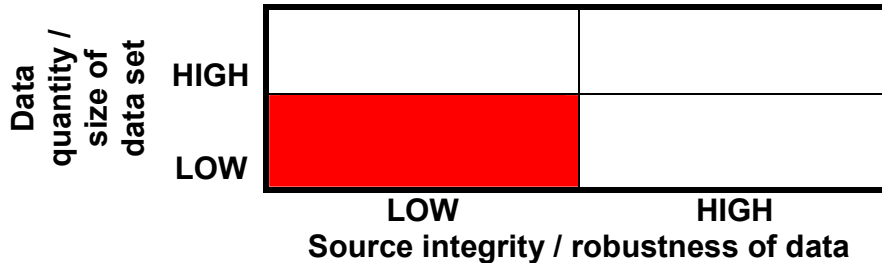


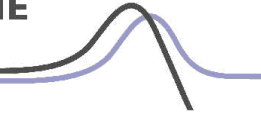
Figure 3 Confidence indicator for usage & lifespan data

6 Other issues

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

Related MTP information

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



Changes from previous version

- No changes. This is the first published version.

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 www.mtprog.com