BN-DICT IM04: Domestic Imaging Government Standards Evidence Base 2009: Best Available Technology 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 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 domestic imaging equipment. The following definitions of imaging equipment types are adapted from the EuP Preparatory study on imaging equipment[1].

- **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 EuP 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 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 copies. 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

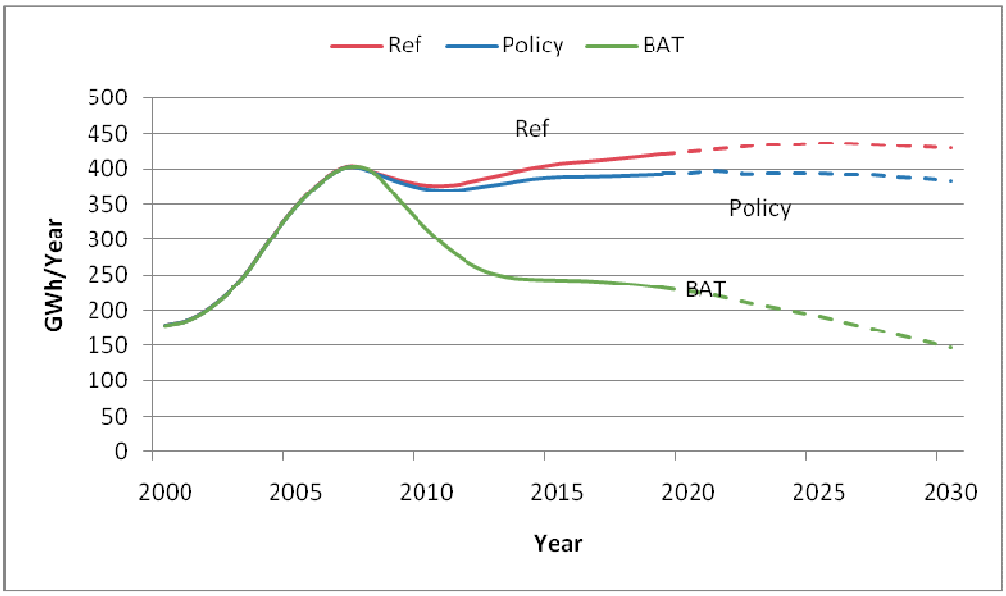

Figure 1 Total Domestic Imaging Product Energy Consumption

- The graph above shows that the adoption of Best Available Technology (BAT) in imaging products could result in significant savings from 2009 to 2030.

Table 1 Domestic Imaging Products Energy Consumption and Savings and CO_2 Emissions[2] and Savings

Energy Consumption (GWh)	2009	2020	2030
Photo	50	10	10
InkJ	140	140	80
Las	40	40	40
InkJ	70	10	0
Las	50	30	20
TOTAL	350	230	150
Energy Savings (GWh)			
Photo	0	10	10
InkJ	0	140	210
Las	0	20	40
InkJ	0	10	10
Las	0	10	20
TOTAL	0	200	280
CO_2 Emissions ($MtCO_2$)			
Photo	0.02	0.00	0.00
InkJ	0.05	0.05	0.03
Las	0.02	0.02	0.01
InkJ	0.03	0.00	0.00
Las	0.02	0.01	0.01
TOTAL	0.13	0.09	0.06
CO_2 Emissions Savings ($MtCO_2$)			
Photo	0.00	0.00	0.00
InkJ	0.01	0.05	0.08
Las	0.00	0.01	0.01
InkJ	0.00	0.01	0.01
Las	0.00	0.00	0.01
TOTAL	0.01	0.07	0.11

3 Efficiency

3.1 Summary

- The main energy efficiency metrics for imaging products are those found within the ENERGY STAR label.

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

- 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 (OM) products are communicated in power (W) values as under ENERGY STAR. ENERGY STAR does not currently address the on-ready mode of OM products.

Table 2 Domestic Non-thermal Imaging Products Power Consumption

	Inkjet Printer			MFD Inkjet			Photo Printer		
Year	On-Ready (W)	SLEEP (W)	OFF (W)	On-Ready (W)	Sleep (W)	Off (W)	On-Ready (W)	Sleep (W)	Off (W)
2009	10.0	2.5	0.2	15.5	2.2	0.4	10.4	3.4	0.8
2010	9.7	2.3	0.2	15.0	1.9	0.4	10.1	3.3	0.7
2020	6.2	0.6	0.1	10.1	0.5	0.3	7.0	2.3	0.3
2030	2.7	0.6	0.0	5.1	0.5	0.2	3.9	1.3	0.3

- 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 Domestic Laser MFD TEC Requirements

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

Table 4 Domestic Laser MFD TEC Requirements

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

- 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-DICT IM02 – Reference Scenario*

Table 5 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 collate power figures in Reference, Policy and BAT scenarios (Inkjet printer)	Medium
2009, 2015, 2030	Expert assumptions	2009	MTP Technical Expert	Expert assumptions required to collate power figures in Reference, Policy and BAT scenarios (MFD inkjet)	Medium
2009, 2030	Expert assumptions	2009	MTP Technical Expert	Expert assumptions required to collate power figures in Reference, Policy and BAT scenarios (Photo printer)	Medium
2009, 2017, 2030	Expert assumptions	2009	MTP Technical Expert	Expert assumptions required to collate power figures in Reference, Policy and BAT scenarios (Laser Printer)	Medium
2009, 2030	Expert assumptions (X:\MTP\Modelling08_09\ModelsInProgress\CE_ICT\Domestic\ICT\e-Evidence\4-Printers&MFDs\4-Laser\Laser-MFD)	2009	MTP Technical Expert	Expert assumptions required to collate power figures in Reference, Policy and BAT scenarios (MFD laser)	Medium

3.3 Methodology & key assumptions – efficiency

- Methodology & key assumptions for historic data are included in BN-DICT IM02 – Reference Scenario

3.3.1 Future analysis

Table 6 Extrapolation & background calculations – efficiency

Year	Methodology & assumptions
2009	All imaging products – best practise 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.
2010-2029	MFD inkjet (on-ready and off mode) - straight line interpolation between 2009 and 2030 value
2030	MFD inkjet and inkjet printer (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 and off mode) - straight line interpolation between 2009 and 2030 value
2010-2016	Inkjet printer (sleep mode) - straight line interpolation between 2009 and 2030 value
2017 - 2030	Inkjet printer (sleep mode) - class leader value.
2010-2017	Laser printer (≤ 15ipm) - straight line interpolation between 2009 and 2030 value
2017 - 2030	Laser printer (≤ 15ipm) - class leader value.
2010-2029	Laser printer (all other speeds) - straight line interpolation between 2009 and 2030 value
2030	Laser printer (all other speeds) - class leader value.
2010-2029	MFD laser (all speeds) - straight line interpolation between 2009 and 2030 value
2030	MFD laser (all speeds) - class leader value.
2010 - 2029	Photo printer (on-ready and sleep mode) - class leader value.
2030	Photo printer (on-ready and sleep mode) - uses best practice value.
2010 - 2029	Photo printer (off mode) - class leader value.
2030	Photo printer (off mode) - uses best practise 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 7 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 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 for non ENERGY STAR power figures, which are included in the datasets. Inclusion of these figures helps to develop realistic best practice figures. MTP will review on an annual basis.

Issue/risk	Approach taken/rationale
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 recognised 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 and 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.

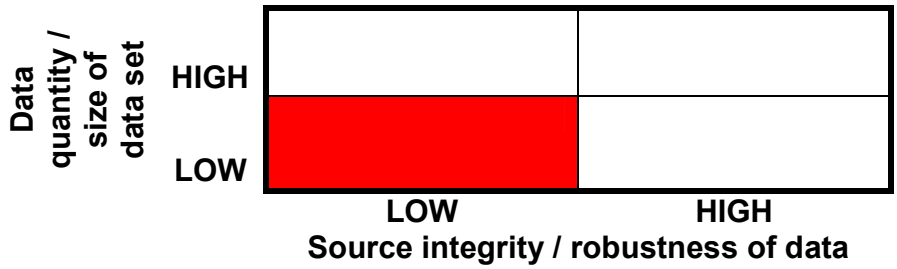

Figure 2 Confidence indicator for efficiency data

4 Usage

4.1 Summary

- This section of the 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) across all power modes for a week's use. The TEC use profile under ENERGY STAR reflects an assumed usage in a non-domestic environment. MTP have "downgraded" the TEC use profile to better reflect assumed usage of thermal imaging products in the domestic environment (assumed to be approximately 1/5th of the non-domestic time).

- 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 BN 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 BAT Scenario enabling rate and the power managed and non power managed profiles discussed in the Key Inputs briefing note.

Table 8 Average Usage– Inkjet Printers and MFD inkjets

	Inkjet Printer and MFD Inkjets				
	BAT (Use Hours/Year				Power Management Enabling Rates
Year	On-Ready	Sleep	Off	Off-Unplugged	%
2009	310	148	6,742	1,560	82
2010	308	150	6,742	1,560	83
2020	287	171	6,742	1,560	95
2030	278	180	6,742	1,560	100

Table 9 Average Usage– Photo printer

	Photo Printer				
	BAT (Use Hours/Year				Power Management Enabling Rates
Year	On-Ready	Sleep	Off	Off-Unplugged	%
2009	155	74	6,971	1,560	82
2010	154	75	6,971	1,560	83
2020	144	85	6,971	1,560	95
2030	139	90	6,971	1,560	100

- Average on-ready use is expected to fall over time in the BAT Scenario as power management enabling rates improve within the BAT Scenario are assumed to increase over time reaching 100% by 2021. The increasing amount of time spent in sleep mode is a result of the combination of imaging products being used more but with increased power management. Without the increase in power management rates the extra time seen in sleep mode would occur during on-ready mode.

- A 100% power management enabling rate is assumed in the BAT Scenario by 2021 as industry identifies ways of ensuring that any power management functionality does not interfere with the normal operation of products. With this potential barrier removed it is assumed that all products will be power management enabled as compulsory. The power management enabling rates for the BAT Scenario match those found in the Policy Scenario.

4.2 Data sources – usage

Table 10 Usage data sources (enabling rates) – Non-thermal Imaging Products

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2021	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 10 along with a rationale for any key assumptions (in particular any expert judgements listed in Table 10) and detail of any background calculations behind the data points.

4.3.1 Future analysis

Table 11 Extrapolation & background calculations – usage data

Year	Methodology & assumptions
2009 - 2030	All non-thermal printers – (BAT scenario) use hours for all power modes based on 2008 figures. See Key Inputs GSBN for details.
2021	All non-thermal printers – (BAT scenario) power management enabling rates assumed to be 100% as industry identifies ways of ensuring that any power management functionality does not interfere with the normal operation of products. With this potential barrier removed it is assumed that all products will be power managed as compulsory.
2009 - 2020	All non-thermal printers – (BAT scenario) power management enabling rates based on a straight line interpolation between the 2008 and 2021 values.
2022 - 2030	All non-thermal printers – (BAT scenario) power management enabling rates assumed to be the same as the 2021 value.
2009 - 2030	Thermal products – usage deemed to be the same as the 2008 values.

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 12 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's. 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.

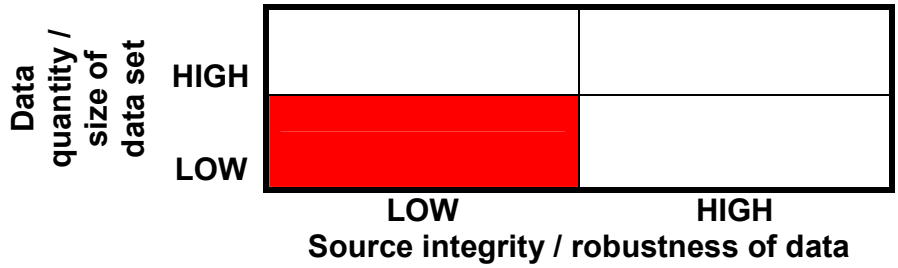

Figure 3 Confidence indicator for usage data

5 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 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-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.

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