BN-DICT IM03: Domestic Imaging Government Standards Evidence Base 2009: Policy Scenario

Version 1.1

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

1 Introduction

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

- As product policy is considered within the context of climate change policy, the UK government considers policies with a net UK costs of up to around £20 per tonne of CO2 saved (compared to the reference scenario). The ambition level, at a minimum, matches the Least Life Cycle Cost (LLCC) level to society of increased energy efficiency of products.

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

- This Government Standard Briefing Note (GSBN) covers domestic imaging equipment. The following definitions of imaging equipment types are adapted from the ErP Preparatory study on imaging equipment[1].

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

- **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

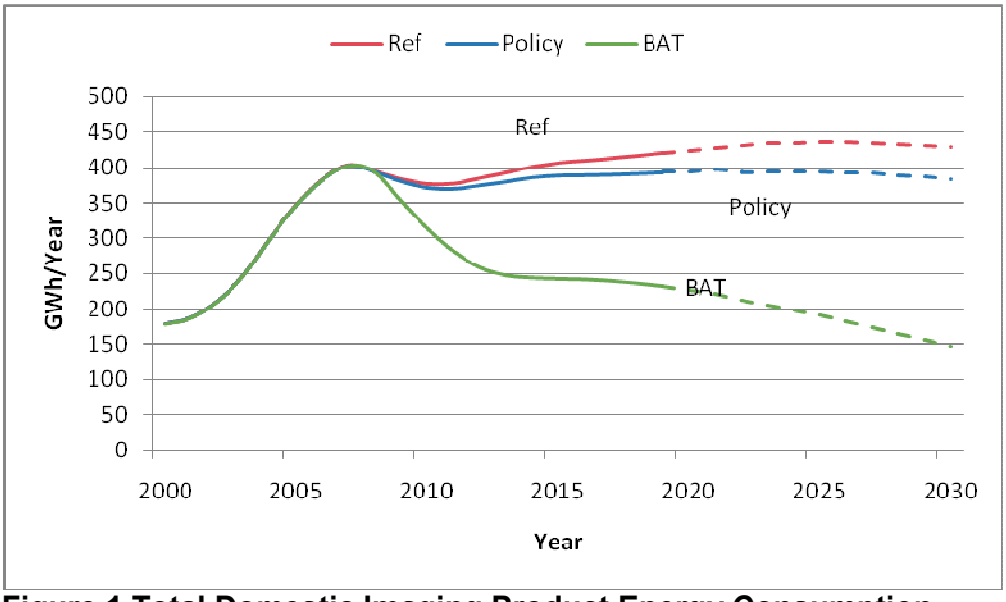

Figure 1 Total Domestic Imaging Product Energy Consumption

- Total energy consumption from domestic imaging products in the Policy scenario is expected to fall until 2010. After 2010 total energy consumption will increase each year until 2030. Much of the increase is due to increasing stock of products.

- Total energy consumption from non-thermal domestic imaging products in the Policy scenario is expected to fall until 2011 after which it will then start to increase until hitting a peak in 2025. Much of the increase is due to an increasing number of MFD inkjets in stock. After 2025 total energy consumption will begin to fall as sales of imaging products slow.

- Total domestic energy consumption from thermal imaging products in the Policy Scenario is expected to increase until 2014 and then start to reduce until 2022 when it will start to increase again. The increases and decreases are a result of varying power efficiency and changing stock levels.

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

Energy Consumption (GWh)	2009	2020	2030
Photo Printer	50	20	20
InkJet Multi-function Device (MFD)	160	260	260
Laser Multi-function Device (MFD)	50	60	60
InkJet Printer	70	20	20
Laser Printer	50	30	30
TOTAL	380	390	380
Energy Savings (GWh)			
Photo Printer	0	0	0
InkJet Multi-function Device (MFD)	0	20	30
Laser Multi-function Device (MFD)	0	10	10
InkJet Printer	0	0	0
Laser Printer	0	0	10
TOTAL	0	30	50
CO_2 Emissions ($MtCO_2$)			
Photo Printer	0.02	0.01	0.01
InkJet Multi-function Device (MFD)	0.06	0.10	0.10
Laser Multi-function Device (MFD)	0.02	0.02	0.02
InkJet Printer	0.03	0.01	0.01
Laser Printer	0.02	0.01	0.01
TOTAL	0.14	0.15	0.15
CO_2 Emissions Savings ($MtCO_2$)			
Photo Printer	0.00	0.00	0.00

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

InkJet Multi-function Device (MFD)	0.00	0.01	0.01
Laser Multi-function Device (MFD)	0.00	0.00	0.01
InkJet Printer	0.00	0.00	0.00
Laser Printer	0.00	0.00	0.00
TOTAL	0.00	0.01	0.02

Table 2 Summary costs and benefits[3]

	Average annual energy savings (£m)	Average annual product & policy cost increases (£m)	Net Benefit (£m)	Cost Effectiveness (traded) (£/tCO_2)
Domestic Imaging products	2	1	17	-39.4

Table 3 Government standards market average – domestic non thermal imaging products

Domestic non- thermal imaging products			
	Inkjet printer	Inkjet MFD	Photo printer
Year	Sleep Power (W)	Sleep Power (W)	Sleep Power (W)
2009	4.1	4.2	4.8

Table 4 Government standards market average – domestic (thermal) laser printers

Domestic 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	3.2	7.3	5.0	9.1

[3] Refer to BNXS26 Rationale for Policy Cost Estimates used in MTP Policy Briefs for details on factors used.

Table 5 Government standards market average – Domestic (thermal) laser MFD

Domestic MFD laser products				
TEC (kWh/week)				
Year	>10 ipm ≤ 26 Mono	>26 ipm ≤ 68 Mono	≤26 ipm Colour	>26 ipm ≤62 Colour
2009	3.0	11.6	9.3	12.7

3 Potential future policies & measures

- All policies and measures are discussed in detail within the Reference scenario GSBN for imaging products. This section of the document focuses on future measures included within each of the policies.

- Future, ENERGY STAR specifications have been modelled into the Policy scenario discussed in this GSBN.
    - These future ENERGY STAR specifications are expected every four years from 2013 onwards (2017, 2021, 2025, 2029).
    - Future ENERGY STAR specifications for the Typical Energy Consumption (TEC) requirements of thermal imaging products and the on-ready mode of non-thermal imaging products are expected to reduce every four years by an assumed percentage.
    - The ENERGY STAR sleep mode specifications for non-thermal imaging products are also expected to fall by an assumed percentage every four years.
    - The ENERGY STAR requirements for the off mode of all domestic imaging products are expected to match the ErP Standby Implementing Measures.

- Future imaging equipment specific ErP measures addressing the in use modes (TEC, on-ready and sleep modes) of imaging products are assumed to be implemented in 2012, 2016, 2020, 2024, 2028 with specifications levels assumed to based on the preceding ENERGY STAR specifications.

- Future ESR specifications are expected each year up to 2030. ESR on-ready mode specification levels into the future are based on a percentage reduction from preceding year's specification level. ESR sleep mode specifications are expected to remain constant into the future. ESR off-mode specifications are expected to match the ErP Standby Implementing Measures.

- The Policy Scenario assumes improvement to 97% power management enabling rate by 2022,through the introduction of additional ENERGY STAR and ErP requirements resulting in a significant reduction in total product energy consumption.

Table 6 Potential future policies & measures, Policy Scenario

Policy name	Period in force	Description	Impact	Cost	Justification
ENERGY STAR	2013, 2017, 2021, 2025, 2029 (estimated)	Provides energy efficiency specifications for all imaging products covered in this GSBN.	ENERGY STAR label is set at levels which 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.	No cost is assumed for ENERGY STAR compliance as it is a voluntary programme. ENERGY STAR compliance is heavily driven by the US market in particular its mandatory nature in US public procurement.	ENERGY STAR is the main energy efficiency policy impacting ICT products.
ErP Imaging Equipment Implementing Measures	2012-2030	Expected to be based on previous ENERGY STAR specifications.	Expected to remove remaining products from the market which have not reached the 4 year old ENERGY STAR specification.	The cost of changing products to meet the future ErP measures varies across the different types of imaging devices. costs. Costs are assumed to occur one year ahead of ErP implementation. Cost alterations are assumed for power supply units, motors and, where applicable, drum and fuser units.	ErP Implementing Measures for on-idle and sleep mode power consumption were highlighted in the ErP Imaging preparatory study. Within the preparatory study it was suggested that future ErP IM's could be based on past ENERGY STAR specifications.
Power Management	2014-2030	Increased power management enabling requirements within ErP and ENERGY	Potential significant impacts on total energy consumption from monitors.	No cost assumed as technology already exists on most imaging products.	Could have significant impacts on total energy consumption without

Policy name	Period in force	Description	Impact	Cost	Justification
		STAR specifications			the need to change any product components.
Energy Saving Recommended (ESR)	2009 to 2030	Applies maximum power levels for the on-ready, sleep and off modes of non-thermal imaging products. Specifications are expected to be refreshed each year.	ESR attempts to represent the top 20% of the market in terms of energy efficiency.	No costs assigned to the ESR label due to low coverage rates.	ESR is included in the MTP modelling as the UK's only national eco-label for ICT products.

Table 7: 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 daily imaging output.	The use profile included in the ENERGY STAR TEC test procedure is widely understood to over represent actual usage.
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) (non-thermal) imaging products (as defined under ENERGY STAR). This test standard does not address active imaging or ready mode.	
IEC 62301	2005	Provides a measurement method for	In the process of being revised.

Test Standard name	Date in force	Description	Comments
		standby/off-mode power (W)	
IEC 62301 Ed.2	TBD	Will provide a revised methodology for measuring standby/off-mode power (W)	

3.1 Policy timeline

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

Table 8 Future potential policies & measures, Policy Scenario

Policy name	Current specification in force	2009	2010	2011	2012	2013	2014	2015	2016-2020	2021-2025	2026-2030
ENERGY STAR (future measures)	2007 (2009)					2013 Estimate			2017 Estimate	2021 and 2025 Estimate	2029 Estimate
ErP Implementing Measures (TEC, Ready and Sleep modes)	n/a				2012 Estimate				2016 and 2020 Estimate	2024 Estimate	2028 Estimate
Power Management Enabling Increases	n/a									2022 Est 97% PM Rate)	
ESR	2007					2013 Estimate			2017 Estimate	2021 and 2025 Estimate	2029 Estimate

4 Efficiency

4.1 Summary

- This section provides details of the efficiency inputs assumed (for new sales i.e. not stock average).

- The tables below illustrate the expected ENERGY STAR coverage rate for a range of imaging products covered in this GSBN. Other imaging products follow a similar expected ENERGY STAR coverage rate pattern. The expected ENERGY STAR coverage rate increases each year until the new specification is implemented. It is assumed that ErP Implementing Measures will be based on the previous ENERGY STAR specification - therefore within 8 years 100% of products will be compliant to the previous ENERGY STAR specification.

- Efficiency metrics for **thermal products are given in average TEC (kWh/week) values** for each speed category 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 operational mode (OM) power (W) values** and are based on the sleep mode of the products. It is not possible to use the on-ready mode as ENERGY STAR does not currently address this power mode.

- Details for the current metrics behind the ENERGY STAR programme can be found in the Reference scenario GSBN.

Table 9 Expected Domestic Laser Printer (Mono ≤ 15 ipm) ENERGY STAR Coverage Rates

	Specification Years						
Year	2007 Spec (Agreed)	2009 Spec (Agreed)	2013 Spec (Forecast)	2017 Spec (Forecast)	2021 Spec (Forecast)	2025 Spec (Forecast)	2029 Spec (Forecast)
2010	42%	37%	10%	6%	3%	2%	1%
2015	0%	41%	35%	10%	7%	5%	4%
2020	0%	0%	41%	35%	10%	8%	6%

	Specification Years						
Year	2007 Spec (Agreed)	2009 Spec (Agreed)	2013 Spec (Forecast)	2017 Spec (Forecast)	2021 Spec (Forecast)	2025 Spec (Forecast)	2029 Spec (Forecast)
2025	0%	0%	0%	35%	31%	26%	7%
2030	0%	0%	0%	0%	37%	34%	29%

Table 10 Expected Domestic Laser MFD (Mono >26 ipm ≤ 68) ENERGY STAR Coverage Rates

	Specification Years						
Year	2007 Spec (Agreed)	2009 Spec (Agreed)	2013 Spec (Forecast)	2017 Spec (Forecast)	2021 Spec (Forecast)	2025 Spec (Forecast)	2029 Spec (Forecast)
2010	42%	33%	12%	7%	4%	2%	1%
2015	0%	45%	26%	11%	8%	5%	4%
2020	0%	0%	45%	28%	11%	9%	7%
2025	0%	0%	0%	44%	32%	15%	9%
2030	0%	0%	0%	0%	44%	36%	19%

Table 11 Expected Domestic Inkjet Printer ENERGY STAR Coverage Rates

	Specification Years						
Year	2007 Spec (Agreed)	2009 Spec (Agreed)	2013 Spec (Forecast)	2017 Spec (Forecast)	2021 Spec (Forecast)	2025 Spec (Forecast)	2029 Spec (Forecast)
2010	46%	22%	13%	7%	6%	4%	2%
2015	0%	45%	23%	12%	9%	7%	5%
2020	0%	0%	46%	26%	12%	9%	7%
2025	0%	0%	0%	47%	32%	12%	10%
2030	0%	0%	0%	0%	47%	37%	17%

- The tables below illustrate the MTP assumed Policy scenario efficiency metrics in terms of TEC (thermal imaging products) and power (non-thermal imaging products) values.

- The tables also list the estimated equivalent ENERGY STAR specifications in each year that they are expected to be refreshed. The ENERGY STAR specifications are slightly lower than the Policy scenario to account for the fact that not all products on the market will be expected to meet the current ENERGY STAR specifications.

Table 12 Domestic Laser Printer Energy Consumption – Policy Scenario

	Laser Printer			
	(Mono >15 ipm ≤ 40)		(Colour >32 ipm ≤ 58)	
	MTP Policy scenario	Estimated ENERGY STAR Specifications	MTP Policy scenario	Estimated ENERGY STAR Specifications
Year	TEC (kWh/week)	TEC (kWh/week)	TEC (kWh/week)	TEC (kWh/week)
2009	3.2		9.1	
2010	3.0		8.8	
2011	2.9		8.5	
2012	2.8		7.8	
2013	2.6	2.0	7.6	6.8
2014	2.5		7.4	
2015	2.3		7.2	
2016	2.1		7.0	
2017	2.0	1.9	6.9	6.4
2018	2.0		6.8	
2019	1.9		6.6	
2020	1.9		6.5	
2021	1.9	1.8	6.4	6.1
2022	1.9		6.4	
2023	1.8		6.3	
2024	1.8		6.2	
2025	1.8	1.7	6.1	5.8
2026	1.8		6.0	
2027	1.7		6.0	
2028	1.7		5.9	
2029	1.7	1.6	5.8	5.5
2030	1.7		5.7	

- The average TEC values of all thermal laser printer and laser MFDs are assumed to decrease under the policy scenario. This forecast decreases in TEC are heavily dependent on reductions in ENERGY STAR requirements which are expected to be refreshed every four years. ErP mandatory implementing measures are also expected to have a large influence by removing the least efficient products from the market place.

- TEC values for the highest speed brackets of laser printers, MFD lasers or for photocopiers are not listed as it is assumed that these products are exclusively for non-domestic use. Figures for laser MFD's in the under 10 ipm speed bracket are not listed due to a lack of data.

Table 13 Domestic Laser MFD Energy Consumption – Policy Scenario

	Laser MFD			
	(Mono >26 ipm ≤ 68)		(Colour >26 ipm ≤62)	
	MTP Policy scenario	Estimated ENERGY STAR Specifications	MTP Policy scenario	Estimated ENERGY STAR Specifications
Year	TEC (kWh/week)	TEC (kWh/week)	TEC (kWh/week)	TEC (kWh/week)
2009	11.6		12.7	
2010	10.5		11.7	
2011	9.7		10.6	
2012	8.6		10.0	
2013	7.9	5.5	9.2	6.3
2014	7.1		8.3	
2015	6.4		7.4	
2016	5.7		6.6	
2017	5.6	5.3	6.5	6.0
2018	5.5		6.3	
2019	5.4		6.2	
2020	5.3		6.1	
2021	5.3	5.0	6.0	5.7
2022	5.2		6.0	
2023	5.1		5.9	
2024	5.1		5.8	
2025	5.0	4.7	5.7	5.4
2026	4.9		5.7	
2027	4.9		5.6	
2028	4.8		5.5	
2029	4.7	4.5	5.5	5.2
2030	4.7		5.4	

Table 14 Domestic Inkjet Printer and Inkjet MFD Power Consumption – Policy Scenario

	Inkjet Printer		Inkjet MFD	
	MTP Policy scenario	Estimated ENERGY STAR Specifications	MTP Policy scenario	Estimated ENERGY STAR Specifications
Year	Sleep mode power (W)	Sleep mode power (W)	Sleep mode power (W)	Sleep mode power (W)
2009	4.11		4.24	
2010	3.51		3.73	
2011	2.91		3.25	
2012	1.85		2.40	
2013	1.76	1.4	2.17	1.3
2014	1.68		1.94	
2015	1.59		1.71	
2016	1.51		1.48	
2017	1.49	1.3	1.46	1.3
2018	1.48		1.45	
2019	1.47		1.43	
2020	1.45		1.41	
2021	1.44	1.3	1.40	1.2
2022	1.42		1.38	
2023	1.41		1.37	
2024	1.39		1.35	
2025	1.38	1.2	1.34	1.1
2026	1.36		1.32	
2027	1.34		1.31	
2028	1.33		1.29	
2029	1.32	1.1	1.28	1.1
2030	1.30	1.1	1.26	1.1

Table 15 Domestic Photo Printer Power Consumption – Policy Scenario

	Photo Printer	
	MTP Policy scenario	Estimated ENERGY STAR Specifications
Year	Sleep mode power (W)	Sleep mode power (W)
2009	4.8	
2010	4.9	
2011	4.9	
2012	4.9	
2013	4.9	8.1
2014	5.5	
2015	6.0	
2016	7.0	
2017	7.0	7.7
2018	7.0	
2019	7.0	
2020	7.0	
2021	7.0	7.3
2022	7.0	
2023	7.0	
2024	7.0	
2025	7.0	6.9
2026	6.9	
2027	6.9	
2028	6.8	
2029	6.7	6.6
2030	6.6	

- The average sleep-mode of inkjet printers and MFD inkjets has fallen in recent years. It is expected that the sleep-mode power consumption of these devices will continue to decrease under the policy scenario. ENERGY STAR will be the main driver of change in sleep mode power for these products, with ErP removing the least efficient products from the EU market place.

- The average sleep mode of photo printers is expected to increase in the near future as ENERGY STAR specifications are relaxed. Average sleep power is expected to start decreasing from 2025 onwards.

4.2 Data sources – efficiency & sales-weighting

Table 16 Efficiency data sources – all imaging products

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2009, 2013, 2017, 2021, 2025, 2029	Expert assumptions	2009	MTP Technical Expert	Expert assumptions required to collate power figures in Reference, Policy and BAT scenarios.	Medium

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

4.3 Methodology & key assumptions – efficiency & sales-weighting

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

- This section describes what has been done with the data listed in Table 16 along with a rationale for any key assumptions (in particular any expert judgements listed in Table 16) and detail of any background calculations behind the data points.

- Table 17 describes the process taken when developing the MTP Policy scenario.
  - Stage 1 identifies how the specification levels for each policy were calculated.
  - Stage 2 describes how the individual specifications were combined to develop the MTP Policy scenario.
  - Stage 3 details how the ENERGY STAR coverage rates were calculated.

4.3.1 Future data

Table 17 Extrapolation & background calculations – efficiency

Year	Methodology & assumptions
Stage 1: Policy Specification Value Calculations	
2009	ENERGY STAR specification value (TEC): This value is based on the average TEC value for products in the EU ENERGY STAR database which met the ENERGY STAR V1.1 specification. This value is calculated separately for each speed bracket and thermal imaging product type.
2013, 2017, 2021, 2025, 2029, 2033	ENERGY STAR specification value (TEC and power (all modes)): It is assumed that the ENERGY STAR specifications will be refreshed in these years. These values are based on an assumed increase in efficiency over the preceding ENERGY STAR specification value (which was developed four years in the past). The level of assumed efficiency gain ranges between 5% and 10%. The 10% value is used in the first refresh and the 5% values for each subsequent refresh period to reflect diminishing gains. The percentage decreases are based on expert assumption.
2010–2012, 2014–2016, 2018–2020, 2022-2024, 2026–2028, 2030-2032	ENERGY STAR specification value (TEC and power (all modes)): The values for each year are based on a straight line interpolation between the preceding year's and future year's ENERGY STAR specification value.
2009	ENERGY STAR specification value (off mode (W)): The ENERGY STAR Tier II specification value of 1W is used.
2009-2013	ENERGY STAR specification value (off mode (W)): The values for each year are based on a straight line interpolation between the preceding year's and future year's ENERGY STAR specification value.
2014 - 2030	ENERGY STAR specification value (off mode (W)): It is assumed that ENERGY STAR will use the 2013 ErP Implementing measure of 0.5W as a specification to ensure that ENERGY STAR qualified products are legally compliant in the EU.
2012, 2016, 2020, 2024, 2028, 2032	ErP specification value (TEC, on-ready and sleep mode): The ErP specification value in these years matches the previously implemented ENERGY STAR specification value.
2013–2015, 2017–2019, 2021–2023, 2025-2027, 2029–2031	ErP specification value (TEC, on-ready and sleep mode): The values for each year are based on a straight line interpolation between the preceding year's and future year's ErP specification value.
2010 and 2013	ErP specification value (off mode power (W)): The ErP standby Implementing Measures are applied (as a maximum consumption value) in these years (1W in 2010 and 0.5 W in 2013).
2014 to 2030	ErP specification value (off mode power (W)): The ErP 2013 standby implementing measure of 0.5 W is applied linearly in each subsequent year as no further improvement is considered possible without further policy intervention.
2010 - 2030	ESR specification values (TEC): Each year's value is based on an assumed reduction (1% in 2010 rising to 5% from 2016) of the ENERGY STAR specification value in the same year.
2009, 2013, 2017, 2021, 2025, 2029, 2033	ESR specification values (on-ready power): The 2009 value is the published ESR specification. All other years are based on an assumed increase in efficiency over the preceding ESR specification value. The level of assumed efficiency gain ranges between 5% and 10% for inkjet printers and 2% to 5% for inkjet MFDs. The 10% inkjet printer value is used in the first refresh and the 5% values for each subsequent refresh period to reflect diminishing gains. The inkjet MFD

Year	Methodology & assumptions
	specification is assumed to fall by 5% in the first refresh period and then 2% upon each further refresh. The percentage decreases are based on expert assumption.
2010-2012, 2014-2016, 2018-2020, 2022-2024, 2026-2028, 2030-2032	ESR specification values (on-ready power): The values for each year are based on a straight line interpolation between the preceding years' and future years' ESR specification value.
2010 to 2030	ESR specification values (sleep mode power): The 2009 value is the published ESR specification. All other years use the 2009 figure due to lack of further data.
2009, 2010, 2011, 2012	ESR Specification Values (off mode (W)): The ESR 2009 specification is used at 1W as no further performance improvements likely until the 2013 ErP measure.
2013-2030	ESR Specification Values (off mode (W)): It is assumed that ESR will use the 2013 ErP Implementing measure of 0.5W as a specification to ensure that ESR qualified products are legally compliant in the EU.
Stage 2: Policy scenario Calculation	
2009 - 2030	Overall Policy scenario: this overall Policy scenario brings together the results of all the individual Policy scenario calculations. The scenario is based on the minimum value that occurs in either the Reference scenario or in any of the individual Policy scenarios. If the minimum value occurs in the Reference scenario it shows that the package of policies is having no impact.
2010 - 2030	ESR coverage rates (all non-thermal products): the percentage of products on the market meeting the ESR specification values is assumed at 1% in 2010 to 2015 and increases to a maximum of 5% by 2016.
2010 - 2030	ErP coverage rates (all products): the percentage of products on the market meeting the ErP requirements is assumed to be 100% to ensure legal compliance.
2012, 2016, 2020, 2024, 2028, 2032	ENERGY STAR Policy scenario: Values (on-ready (W), sleep mode (W) and TEC (kWh)) are based on a weighted percentage of products which meet the ENERGY STAR specification with the remaining percentage of products meeting the average Reference line value.
2009-2011, 2013–2015, 2017–2019, 2021–2023, 2025-2027, 2029–2031	ENERGY STAR Policy scenario: Values for (on-ready (W), sleep mode (W) and TEC (kWh)): The values for each year are based on a straight line interpolation between the preceding year's and future year's calculated ENERGY STAR Policy scenario value.
2012, 2016, 2020, 2024, 2028, 2032	ESR Policy scenario: Values (on-ready (W), sleep mode (W) and TEC (kWh)) are based on a weighted percentage of products which are assumed to meet the ESR specification with the remaining percentage of products meeting the ENERGY STAR specifications values and the reference values.
2009-2011, 2013–2015, 2017–2019, 2021–2023, 2025-2027, 2029–2031	ESR Policy scenario: Values for (on-ready (W), sleep mode (W) and TEC (kWh)): The values for each year are based on a straight line interpolation between the preceding year's and future year's ESR Policy scenario value.
2009 - 2011	ErP Policy scenario (TEC and all power modes): includes an assumed improvement in product performance ahead of ErP implementation in 2012. This reflects the thinking that manufacturers would improve product energy efficiency ahead of the ErP implementation date. The figures for these years are calculated on an assumed % reduction from the Reference scenario figures. The percentage reductions are based on expert opinion and are tailored to ensure that the ErP Policy scenario in these years does not fall below the 2012 implementing

Year	Methodology & assumptions
	measure.
2012, 2016, 2020, 2024, 2028, 2032	ErP Policy scenario: Values (on-ready (W), sleep mode (W) and TEC (kWh)) are based on a weighted percentage of products which are assumed to meet the ErP specification with the remaining percentage of products meeting the ENERGY STAR and ESR specification values.
2013–2015, 2017–2019, 2021–2023, 2025-2027, 2029–2031	ErP Policy scenario: Values for (on-ready (W), sleep mode (W) and TEC (kWh)): The values for each year are based on a straight line interpolation between the preceding year's and future year's ErP Policy scenario value.
2010 and 2013	ErP Policy scenario (off-mode (W)): Includes the ErP Implementing Measures as maximum power consumption values in 2010 and 2013.
2012	ENERGY STAR Policy scenario (off-mode (W)): based on a weighted percentage of products which meet the ENERGY STAR specification with the remaining percentage of products meeting the average Reference scenario value.
2009 - 2011	ENERGY STAR Policy scenario (off-mode (W)): The values for each year are based on a straight line interpolation between the preceding year's and future year's ENERGY STAR values.
2012	ESR Policy scenario: Values (off-mode (W)): Values are based on a weighted percentage of products which are assumed to meet the ESR specification with the remaining percentage of products meeting the ENERGY STAR figures.
2009 - 2011	ESR Policy scenario: Values for (off-mode (W)): The values for each year are based on a straight line interpolation between the preceding year's and future year's ESR Policy scenario value.
2014 -2030	All Policy scenarios (off-mode (W)): All values based on the 2013 ErP Implementing Measure of 0.5W.
Stage 3: Efficiency Sales Weighting	
2009	Sales weighting for ENERGY STAR coverage graphs: Current coverage of products in EU ENERGY STAR database to the 2009 ENERGY STAR specification value. This calculation provides a percentage coverage rate for those products already in the EU ENERGY STAR database. Where necessary, a correction factor is then added (value assumed by the technical expert) to account for the fact that the products in the EU ENERGY STAR database do not account for the whole market. The correction factor therefore provides an estimate of how many products on the whole market are likely to be meeting the ENERGY STAR specification value.
2009	Sales weighting for ENERGY STAR coverage graphs: Coverage rates for 2009 against assumed 2013, 2017, 2021, 2025 and 2029 ENERGY STAR specification values are assumed. Assumption based on expert opinion and estimates of past ENERGY STAR coverage rates in light of no further information being available.
2012, 2016, 2020, 2024, 2028	Sales weighting for ENERGY STAR coverage graphs: It is assumed 1 year prior to the implementation of new ENERGY STAR specifications the specifications are developed to cover approximately 25% of the most energy efficient products on the market.
2012, 2016, 2020, 2024 and 2028	Sales weighting for ENERGY STAR coverage graphs: It is assumed that 100% of products meet revised ENERGY STAR specifications 7 years after implementation. This is based on the assumption that ErP will require that all products sold in the EU market meet the previous ENERGY STAR specifications.
2010–2015, 2013-2019, 2017-2023, 2021-2027, 2025-2030	Sales weighting for ENERGY STAR coverage graphs: The values for each year are based on a straight line interpolation between the preceding year's and future year's ENERGY STAR coverage rates.
2010, 2015,	Sales weighting for ENERGY STAR coverage graphs: Coverage rates for the

Year	Methodology & assumptions
2020, 2025 and 2030	2007, 2009, 2013, 2021, 2025 and 2029 ENERGY STAR specifications are normalised to 100% for graphing purposes.

4.4 Data issues – efficiency & sales-weighting

Table 18 Data issues – efficiency

Issue/risk	Approach taken/rationale
MTP have included a number of assumptions about the possible future efficiency of imaging products. Given the number of assumptions required, MTP cannot offer any guarantee about the future specification levels or market coverage of products against each policy.	MTP has made a number of informed assumptions about the possible future efficiency values of imaging products. These assumptions will be reviewed on an annual basis.
ENERGY STAR coverage rates are subject to a number of assumptions which are largely based on observations in the current market. Actual future ENERGY STAR coverage rates could vary significantly from these assumptions.	MTP has assumed that future coverage rates for products meeting ENERGY STAR specifications will be similar to coverage rates seen in the current market. These assumptions will be reviewed on an annual basis.

4.5 Confidence level – efficiency & sales-weighting

- A database of product information is used to estimate what could happen in future years to product energy efficiency. The fast moving nature of the ICT industry could result in these estimates needing to change considerably in future years.

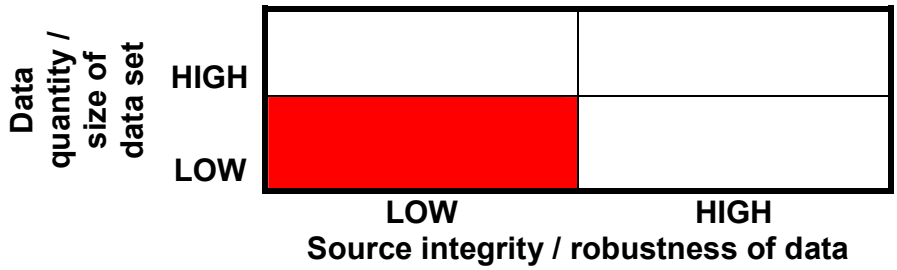

Figure 2 Confidence indicator for efficiency data

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) 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 has adjusted 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 GSBN 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 Policy Scenario enabling rate and the power managed and non power managed profiles discussed in the Key Inputs Briefing Note.

Table 19 Average Usage – Inkjet Printers

	Inkjet Printer				
	Policy scenario (Use Hours/Year)				Power Management Enabling Rates
Year	On-Ready	Sleep	Off	Off-Unplugged	%
2010	308	150	6742	1560	83
2020	293	165	6742	1560	92
2030	284	174	6742	1560	97

Table 20 Average Usage – MFD Inkjet

	MFD Inkjet				
	Policy scenario (Use Hours/Year)				Power Management Enabling Rates
Year	On-Ready	Sleep	Off	Off-Unplugged	%
2010	308	150	6855	1447	83
2020	293	165	6855	1447	92
2030	284	174	6855	1447	97

Table 21 Average Usage – Photo printer

	Photo Printer				
	Policy (Use Hours/Year)				Power Management Enabling Rates
Year	On-Ready	Sleep	Off	Off-Unplugged	%
2010	154	75	6971	1560	83
2020	146	83	6971	1560	92
2030	142	87	6971	1560	97

- The on-ready use hours of non-thermal imaging products are expected to fall in the future as more products are power managed as a result of the power management policy. An increase in power management enabling will also see the sleep mode time increase as on-ready time is reduced. There are not expected to be any changes in the off-mode or off-unplugged times.

- Power management enabling rates within the Policy Scenario are assumed to increase as a result of a new ENERGY STAR and ErP requirements increasing rates to 97% by 2022. In contrast power management rates in the reference scenario are only expected to remain at 80% into the future due to the lack of additional ENERGY STAR and ErP requirements focussing on power management.

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)
2009, 2022	Expert Assumptions	2009	MTP Technical Expert	Expert assumption required to develop use profiles in each year.	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 Future analysis

Table 23 Extrapolation & background calculations – usage data

Year	Methodology & assumptions
2010 - 2021	All non-thermal printers – power management enabling rates are based on an interpolation between the 2009 and 2021 values.
2022	Power management enabling rates for non-thermal products assumed to be 97% as new ENERGY STAR and ErP requirements are implemented. ENERGY STAR and ErP requirements could focus on identifying ways to ensure power management functionality does not impact product function and therefore can be enabled on every product.
2023 - 2030	All non-thermal printers - power management enabling rates equal to 2022 assumption

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 24 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.

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 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.

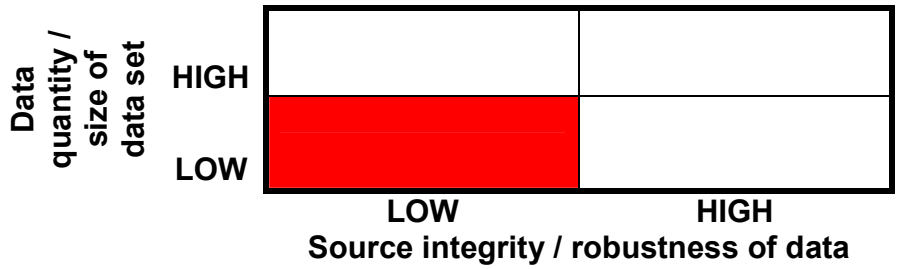

Figure 3 Confidence indicator for usage data

6 Cost

6.1 Summary

- The cost of adapting products to meet each set of future ErP specifications has been estimated below. No other policy costs are included as they are either voluntary in nature or adaptation would have fee or no costs attached.

- All of the measures suggested are either within the bounds of existing technology already in use within imaging products, or future refinements of those existing technologies.

- Cost data is commercially sensitive and not discussed openly within industry – for this reason, all cost data is based on expert opinion from within the MTP team.

- Costs have only been assumed for the future ErP TEC, on-ready and sleep mode requirements. Other policies have not been costed due to low coverage rates or their voluntary nature.

- All costs stated are marginal costs related to the introduction of a specific energy efficiency improvement in the Policy Scenario, and above the normal purchase cost implied in the Reference Scenario.

Table 25 Summary costs - undiscounted (real)

	Undiscounted costs £'s					
Year	Inkjet Printer	Laser Printer	MFD Inkjet	MFD Laser	Photo Printer	Total
2011	101,995	223,167	3,842,855	330,523	92,732	423,254
2015	41,503	176,281	4,213,584	211,604	20,055	231,659
2019	38,068	193,112	4,693,500	300,080	18,915	318,994
2023	34,842	209,911	4,849,860	326,174	17,774	343,948
2027	31,601	226,704	4,799,582	352,268	16,633	368,901

6.2 Data sources – cost

Table 26 Cost data sources

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2011, 2015, 2019, 2023, 2029	Expert assumption of cost per improvement option	2009	MTP Technical Expert	No cost data available	Low
2011, 2015, 2019, 2023, 2027	Expert assumption of percentage of products on the market requiring adaptation to meet ErP specification	2009	MTP Technical Expert	No data available	Low

6.3 Methodology & key assumptions – cost

- This section describes what has been done with the data listed in Table 26 along with a rationale for any key assumptions (in particular any expert judgements listed in Table 26) and detail of any background calculations behind the data points.

- This product group encompasses a vast range of devices. The policy scenario assumes that power supplies will need to be more energy efficient. Because of the variety of products and applications the costs of manufacturing compliance with efficiency requirements are assumed to vary from £0.50 for simple products like inkjet and photo printers up to £5 for complex multifunction devices and high speed lasers. Most power supplies are less efficient when operated at partial load than they are at full load [4]. To compensate for this, it has been assumed that where an imaging device has a single function, the change to the power supply will be relatively simple as it will affect the full load power consumption. However for multifunction devices, where the power supply has to be engineered to power multiple functions at once, the reality is that in normal operation, the user only uses one function at a time. This makes the design of the power supply more complex to achieve good efficiencies at partial load.

- It is assumed that MFD devices will incorporate an LED scanner lamp to eliminate the time taken for a conventional scanner lamp to warm-up. It is assumed that laser MFD's will require a heavier duty lamp than inkjet MFDs, and costs of compliance have been adjusted to recognise this - £5 for laser MFD and £2 for inkjet MFD.

- For all laser devices, it is assumed that drum heaters will be changed to designs which warm up from standby more quickly (e.g. internal or ceramic heaters). Cost of manufacturing compliance is estimated at £2.

- While estimates have been made of current and future costs, the confidence level reduces into the future as uncertainty around specification levels and cost of component changes increases. The cost in each policy implementation year is therefore assumed the same, but can be updated in any future studies.

- Estimated costs shown are to the consumer.

6.3.1 Future analysis

Table 27 Extrapolation & background calculations – cost

Year	Methodology & assumptions
2011, 2015, 2019, 2023, 2027	Multiple rounds of ErP specifications assigned to imaging equipment. Measures based on previous ENERGY STAR specification For all inkjet and laser printers: • More energy efficient power supply – assumed £0.50

[4] "Power Supplies: A Hidden Opportunity for Energy Savings" – NRDC, May22, 2002

Year	Methodology & assumptions
	• More energy efficient motors – assumed £0.50 For dot-matrix printers • More energy efficient power supply – assumed £2.00 • More energy efficient motors – assumed £1.00 For laser MFDs • More energy efficient power supply – assumed £5.00 • More energy efficient motors – assumed £0.50 • More efficient led scanner – assumed £5.00 For Inkjet MFDs • More energy efficient power supply – assumed £5.00 • More energy efficient motors – assumed £0.50 • More efficient led scanner – assumed £2.00 In addition for laser printers and laser MFDs • More efficient drum heater – assumed £2.00 • Lower temperature toner – assumed £3.00
2011, 2015, 2019, 2023, 2027	It is assumed that each ErP specification will be the same as the voluntary ENERGY STAR specification from 3 years previous. Therefore, it is assumed that in the ErP specification year, the majority of products placed on the market will be compliant, Expert assumptions have been made of the remaining percentage of products placed on the market which require adaptation in the ErP specification year as follows For inkjet printers 2011 12.5% 2015 5.5% 2019 5.5% 2023 5.5% 2027 5.5% For photo printers 2011 12.5% 2015 2.9% 2019 2.9% 2023 2.9% 2027 2.9% For MFD inkjet 2011 12.5% 2015 12.5% 2019 12.5% 2023 12.5% 2027 12.5% Laser printers and laser MFDs are subdivided by print speed and the detail is given in Table 28 and Table 29
2011, 2015, 2019, 2023, 2027	The costs are derived from multiplying the assumed cost of change by the number of products requiring adaptation in each specification year

Table 28 Percentage of laser printers requiring adaptation in ErP specification year

	Percentage Products Requiring Adaptation to Meet ErP					
Year	mono ≤ 15 ipm	mono 15 < ipm ≤ 40	mono 40 < ipm ≤ 82	mono > 82 ipm	colour ≤ 32 ipm	colour 32 < ipm ≤ 58
2011	5.0%	14.5%	13.0%	12.7%	10.4%	12.9%
2015	3.6%	10.4%	9.3%	9.1%	7.5%	9.2%
2019	3.6%	10.4%	9.3%	9.1%	7.5%	9.2%
2023	3.6%	10.4%	9.3%	9.1%	7.5%	9.2%
2027	3.6%	10.4%	9.3%	9.1%	7.5%	9.2%

Table 29 percentage of laser MFD requiring adaptation in ErP specification year

	Percentage Products Requiring Adaptation to Meet ErP					
Year	mono 10 < ipm ≤ 26	mono 26< ipm ≤ 68	mono > 68 ipm	colour ≤26	colour 26 < ipm ≤62	colour >62
2011	12.5%	12.5%	5.0%	12.5%	12.5%	12.5%
2015	7.9%	6.9%	3.6%	6.3%	8.3%	4.6%
2019	9.4%	9.4%	3.6%	9.4%	9.4%	9.4%
2023	9.4%	9.4%	3.6%	9.4%	9.4%	9.4%
2027	9.4%	9.4%	3.6%	9.4%	9.4%	9.4%

6.4 Data issues – cost

- 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 30 Data issues – cost

Issue/risk	Approach taken/rationale
Cost data is at the heart of commercial competition and not discussed openly within industry. Costs vary according to specification and with quantity of material purchased, While estimates have been made of current and future costs, the confidence level reduces into the future as uncertainty around specification levels and cost of component changes increases.	The approach has been to take indicative feedback provided by industry of current costs to prepare an expert opinion within the MTP. These assumptions have been extrapolated linearly into the future. MTP will review on an annual basis

6.5 Confidence level – cost

- Cost data for changing certain components of imaging products is difficult to source. Any assumptions are highly dependent on assumed future specification levels and potential energy savings from each component change.

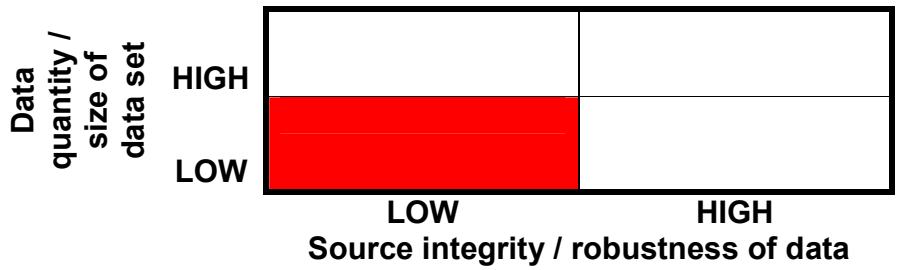

Figure 4 Confidence indicator for cost data

7 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 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 Version 1.0

- Cost and benefit figures updated.
- CEI calculation adjusted and figure updated.
- 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**