

BN-NDICT PC02: Non-Domestic Computers 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 2008 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 non-domestic personal computers. The following definitions of PCs are adapted from the EuP Preparatory study on PCs¹.
- **Personal Computer:** A device which performs logical operations and processes data. Personal computers are composed of, at a minimum: (1) a central processing

¹ European Commission DG TREN Preparatory studies for Eco-design Requirements of EuPs (Contract TREN/D1/40-2005/LOT3/S07.56313) Lot 3 Personal Computers (desktops and laptops) and Computer Monitors Final Report (Task 1-8)

unit (CPU) to perform operations; and (2) user input devices such as a keyboard, mouse, digitizer or game controller. For the purposes of this study, personal computers include both stationary and portable units, including desktop computers, integrated computers, notebook computers and tablet PCs.

- **Desktop Personal Computer (PC):** A computer where the main unit is intended to be located in a permanent location, often on a desk or on the floor. Desktops are not designed for portability and utilize an external monitor, keyboard and mouse. Desktops are designed for a broad range of home and office applications including, email, web browsing, word processing, standard graphics applications, gaming, etc.
- **Laptop Personal Computer (PC):** A computer designed specifically for portability and to be operated for extended periods of time without a direct connection to an ac power source. Notebooks and tablets must utilize an integrated monitor and be capable of operation off and integrated battery or other portable power source. In addition, most notebooks and tablets use an external power supply and have an integrated keyboard and pointing device, though tablets use touch sensitive screens. Notebook and tablet computers are typically designed to provide similar functionality to desktops except within a portable device. Docking stations are considered accessories and therefore are not covered in this briefing note.
- This GSBN covers non-domestic desktop and laptop PCs. These products have been separated from domestic products as there can be functional differences between the

2 Scenario outputs

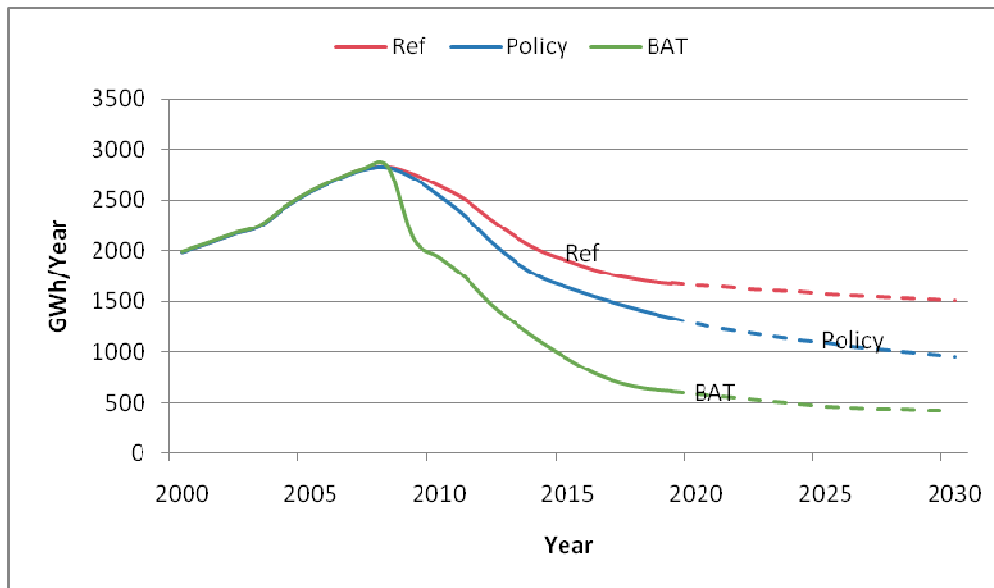


Figure 1 Total Non-domestic PC Energy Consumption

- With no additional policies, total non-domestic energy consumption from desktop and laptop PCs is expected to fall from 2009 until 2030. This reduction is primarily due to a switch from desktop to laptop PCs.
- Total energy consumption from non-domestic desktop PCs is expected to fall from 2010 onwards due to falling stock levels.
- Total non-domestic energy consumption from laptop PCs is expected to rise until 2030. This rise is due to an increase in laptop PC stock which offsets any efficiency gains expected in the products.

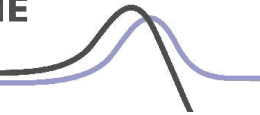


Table 1 PC Energy Consumption² and CO₂ emissions³

Energy Consumption (GWh)	2009	2020	2030
Lap	560	740	880
Desktop	2200	920	640
TOTAL	2760	1660	1520
CO ₂ Emissions (MtCO ₂)			
Lap	0.20	0.26	0.31
Desktop	0.77	0.33	0.23
TOTAL	0.97	0.59	0.54

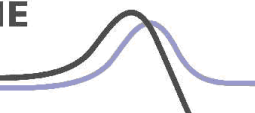
² Energy consumption figures for the non-domestic sector in the 2009/2010 Consultation Document 'Saving energy through better products and appliances' were scaled down to match DECC projections for overall energy demand (www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx).

MTP data represents the best currently available information based on a bottom-up modelling approach. MTP's data is the basis for detailed energy calculations in the 2009/2010 Consultation Document. However, DECC projections indicate that overall energy demand in the non-domestic sector is lower than projected by MTP's detailed models. MTP has assumed that the differences between the DECC overall projections and its detailed bottom-up projections are due to incomplete data on the following inputs for some of its non-domestic products:

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

The energy consumption figures in these GSBNs have **not** been scaled down, in order to enable constructive stakeholder comment on the MTP input data, and therefore differ from the ones presented in the 2009/2010 Consultation Document.

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



3 Current policy & measures

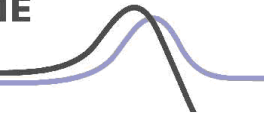
- ENERGY STAR is the dominant energy efficiency policy covering ICT products. The ENERGY STAR label is led by the US Environmental Protection Agency (EPA) but the European Commission has an agreement with the US Government to coordinate the energy labelling of office equipment through an EU ENERGY STAR 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 ICT product development moves. This means that compliance rates to ENERGY STAR can be high at the end of a specification cycle. The computer specification (covering desktop and laptop PCs in this briefing note) was finalised in September 2006 and implemented on the 20 July 2007. Version 5.0 of the ENERGY STAR Computer specification is implemented in July 2009.
- The European Commission has published a set of mandatory ecodesign implementing measures covering the standby and off-modes of electrical and electronic household and office equipment (although office equipment needs to be intended for use in the domestic premises). The Energy Using Products (EuP) Standby Implementing Measures are due to come into force in January 2010 with a second tier of requirements due to be enforced January 2013. The Standby Implementing measures are likely to apply to the off-mode of non-domestic desktop and laptop PCs as they could also be marketed as domestic products.
- The EU Eco-label voluntary scheme designed to encourage businesses to market products and services with reduced overall lifecycle environmental impacts. The EU Eco-label serves as a communication system to identify whether products are deemed to have reduced environmental impacts compared to average products on the market. Energy efficiency criteria included in the label are expected to refer to ENERGY STAR. Few ICT products currently hold the EU Eco-label. A modest increase in EU Eco-label coverage is expected into the future.
- Government procurement includes a mandate that all desktop and laptop PCs procured by central Government should meet ENERGY STAR specifications. This follows the 2007 revised ENERGY STAR agreement which requires central government procurement to ENERGY STAR efficiency levels or equivalent (without prejudice to Community and national law and economic criteria). Government procurement specifications are assumed to be implemented through the “Quick Wins” programme.

Table 2 Current policies & measures, Reference Scenario

Policy name	Period in force	Description	Impact
ENERGY STAR	2009 - 2013	Applies energy efficiency criteria across all power modes in a Typical	ENERGY STAR standard set to levels which represent approximately for top 25% of market (averaged across all ENERGY

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Policy name	Period in force	Description	Impact												
		Electricity Consumption (TEC) approach. MTP has broken TEC approach down into estimate power consumption (W) figures for each power mode.	STAR product categories): <table border="1" style="margin-left: 20px;"> <thead> <tr> <th></th> <th>On-Idle (W)</th> <th>Sleep (W)</th> <th>Off (W)</th> </tr> </thead> <tbody> <tr> <td>Desktop</td> <td>50.7</td> <td>2.87</td> <td>1.68</td> </tr> <tr> <td>Laptop</td> <td>14.2</td> <td>2.27</td> <td>0.98</td> </tr> </tbody> </table> Compliance is assumed to increase over time to 78% (desktops) and 77% (laptops) of market by 2013.		On-Idle (W)	Sleep (W)	Off (W)	Desktop	50.7	2.87	1.68	Laptop	14.2	2.27	0.98
	On-Idle (W)	Sleep (W)	Off (W)												
Desktop	50.7	2.87	1.68												
Laptop	14.2	2.27	0.98												
EuP Standby Implementing Measures	2010 and 2014	Applies maximum power consumption figures for off-mode of desktops and laptops	EuP levels of 1W off-mode by 2010 moving to 0.5W off-mode by 2014 (desktops and laptops). Will remove worst performing products in off-mode from the EU market.												
Government Procurement	2009	Applies ENERGY STAR criteria to all central Government procurement	Expected to have a relatively small impact due to use of ENERGY STAR specifications												

Table 3 Test Standards

Test Standard name	Date in force	Description	Comments
ENERGY STAR Program Requirements for Computers Version 5.0	2009	Provides methodology for measuring the on-idle, sleep mode and off-mode of desktop and laptop PCs.	
IEC 62301:1	2005-6	Household electrical appliances – Measurement of standby power	Used for measurement of standby and other low power modes (network and off-mode)

3.1 Policy timeline

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

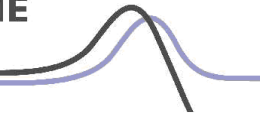


Table 4 Current policies & measures, Reference Scenario

Policy name	Current spec in force	2009	2010	2011	2012	2013	2014	2015	2016-2020
ENERGY STAR	July 2007	V5.0 in force July							
EuP Standby Implementing Measures	N/A		Jan (1W)				Jan (0.5W)		
Government Procurement	2009								

4 Efficiency

4.1 Summary

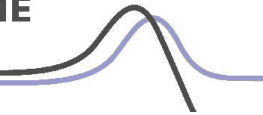
- This section provides details of the efficiency inputs assumed (for new sales i.e. not stock average).
- ENERGY STAR has adopted (for the revised 2009 specification) a Typical Electricity Consumption approach (TEC) which uses annual energy consumption thresholds (kWh/year) as requirements. TEC requirements have been developed for four categories of desktop PCs and three categories of laptop PCs. The categories are based on the functionality and computing power offered by these products. Products are allowed to consume more, the more functionality and computing power they provide:

Table 5 ENERGY STAR Desktop PC Categories

Desktop Category	ENERGY STAR Version 4.0 Requirements	ENERGY STAR Version 5.0 Requirements
A	All desktop computers that do not meet the definition of either Category B or C.	All desktop computers that do not meet the definition of Category B, Category C, or Category D.
B	Multi-core processor(s) or more than 1 discrete processor.	Equal to 2 physical cores
	Minimum of 1 GB system memory.	Greater than or equal to 2 gigabytes (GB) of system memory.
C	Multi-core processor(s) or more than 1 discrete processor.	Greater than 2 physical cores.
	GPU with more than 128 MB of dedicated, non-shared memory.	And a minimum of 1 of the following 2 characteristics:

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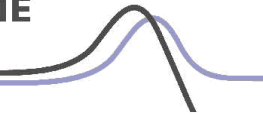


	2 of the following 3 characteristics: •Minimum of 2 GB system memory •Minimum of 2 hard disk drives. •TV-tuner and/or video capture capability with high definition support.	•Greater than or equal to 2 gigabytes (GB) of System Memory; and/or •A discrete GPU.
D	N/A	Greater than or equal to 4 Physical Cores.
		And a minimum of 1 of the following 2 characteristics: •Greater than or equal to 4 gigabytes (GB) of system memory; and/or •A discrete GPU with a frame buffer width greater than 128-bit.

Table 6 ENERGY STAR Laptop PC Categories

Laptop Category	ENERGY STAR Version 4.0 Requirements	ENERGY STAR Version 5.0 Requirements
A	All notebook computers that do not meet the definition of Category B below will be considered under Category A for ENERGY STAR qualification.	Category A: All notebook computers that do not meet the definition of Category B or Category C below will be considered under Category A for ENERGY STAR qualification.
B	A GPU with a minimum of 128 megabytes of dedicated, non-shared memory.	Discrete GPU.
		Greater than or equal to 2 gigabytes (GB) of system memory
C	n/a	Greater than or equal to 2 physical cores;
		Greater than or equal to 2 gigabytes (GB) of system memory; and A discrete GPU with a frame buffer width greater than 128-bit.

- ENERGY STAR has only recently moved towards the TEC based approach for specifications which has resulted in few TEC values being published for desktop and laptop PCs. Due to this lack of data, MTP has translated the future ENERGY STAR TEC requirements into estimated power (W) figures for each of the main power modes (on-idle, sleep and off mode). The TEC values within the US ENERGY STAR V5.0 Computer Dataset were used to estimate the average percentage of energy (kWh/week) attributable to the on-mode, sleep-mode and off-modes of the covered desktop and laptop PCs. These average percentage figures were then used to break down the ENERGY STAR TEC requirements (per PC category) into power requirements for each power mode. The calculated power modes for each PC category were then sales weighted based on the distribution of products found in the EU ENERGY STAR database. This sales weighting calculation provided an average power figure across all categories. Future ENERGY STAR requirements were then calculated by varying the assumed market split. MTP will reassess the approach in 2010.

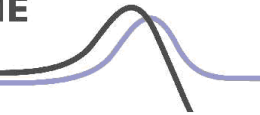


- The EuP Standby Implementing Measures include a power (W) rather than energy consumption (kWh) requirement.

Table 7 Domestic Desktop and Laptop PC Power Consumption

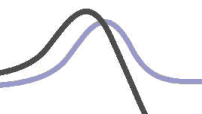
Year	Desktop PC			Laptop PC		
	ON-IDLE (W)	SLEEP (W)	OFF (W)	ON-IDLE (W)	SLEEP (W)	OFF (W)
2009	73.8	3.8	1.8	23.4	1.8	1.1
2010	69.5	3.7	1.0	22.9	1.9	1.0
2011	65.2	3.5	0.8	22.4	2.0	0.8
2012	60.9	3.3	0.7	21.9	2.1	0.7
2013	58.9	3.2	0.5	21.5	2.1	0.5
2014	56.9	3.1	0.5	21.2	2.2	0.5
2015	53.9	3.0	0.5	20.8	2.2	0.5
2016	50.9	2.9	0.5	20.4	2.3	0.5
2017	51.0	2.9	0.5	20.4	2.3	0.5
2018	51.1	2.9	0.5	20.3	2.3	0.5
2019	51.2	2.9	0.5	20.2	2.3	0.5
2020	51.2	2.9	0.5	20.0	2.3	0.5
2021	51.3	2.9	0.5	19.9	2.3	0.5
2022	51.4	2.9	0.5	19.8	2.3	0.5
2023	51.5	2.9	0.5	19.7	2.3	0.5
2024	51.6	2.9	0.5	19.6	2.3	0.5
2025	51.7	2.9	0.5	19.6	2.3	0.5
2026	51.8	2.9	0.5	19.6	2.3	0.5
2027	51.9	2.9	0.5	19.7	2.3	0.5
2028	52.0	2.9	0.5	19.8	2.3	0.5
2029	52.0	2.9	0.5	19.8	2.3	0.5
2030	52.1	2.9	0.5	19.9	2.3	0.5

- Table 7 shows the expected power consumption requirements for desktop and laptop PCs in on-idle, sleep and off-mode.
- On-idle power for desktop PCs is expected to fall until 2016. Much of this fall is attributable to currently agreed ENERGY STAR specifications still having an



influence in the market place. As the approved ENERGY STAR specification influence decreases (due to products entering the higher on-idle allowance brackets) the on-idle power consumption of desktop PCs starts to increase from 2019. The increase is based on a past percentage increase (2008 to 2009) in desktop PC on-idle power consumption seen in the MTP evidence base. This percentage increase is added each two years.

- Sleep-mode power consumption for desktop PCs is expected to fall until 2016 due to the continued influence of currently agreed ENERGY STAR specifications. After 2016 sleep mode power is assumed to remain the same until 2030 due to the lack of any further agreed policy measures.
- Desktop PC off-mode power is assumed to fall until 2010 when the first EuP Standby Implementing measure of 1W comes into force. Further desktop PC off-mode power requirement reductions are expected until the 2013 EuP Standby Implementing Measure is enforced at 0.5W. No further reductions are assumed after 2013.
- Laptop PC on-idle power is expected to follow a similar pattern to that of desktop PC on-idle power. As the currently approved ENERGY STAR specifications begin to take effect, the average power consumption of laptop PCs in the market place is assumed to fall. As the influence of the ENERGY STAR specifications begins to reduce, the average on-idle power consumption will slowly start to increase. The increase is based on the expected percentage increase in power associated with a move towards higher specification ENERGY STAR category C laptop PCs. This increase is slightly offset by increases in laptop PC screen efficiency.
- The currently agreed ENERGY STAR specifications do not account for screen power consumption. MTP have addressed this issue by adding an additional screen power requirement in each year. The screen power is assumed to be 50% of the on-idle power consumption in 2009. This 50% figure was obtained from MTP testing of laptops. The amount of screen power added each year diminishes as more efficient screen technologies such as LED backlit and later OLED screens become more common in the market.
- Laptop PC sleep mode power is assumed to increase from 2009 until 2015 as the ENERGY STAR V5.0 TEC approach is implemented. It is assumed that the focus on on-idle power consumption within the ENERGY STAR TEC approach will allow for greater power consumption in sleep mode. No further increases in laptop PC sleep-mode power consumption are assumed post 2016.
- Laptop PC off-mode power consumption is assumed to fall until 2010 when the first EuP Standby Implementing measure of 1W comes into force. Further desktop PC off-mode power requirement reductions are expected until the 2013 EuP Standby Implementing Measure is enforced at 0.5W. No further reductions are assumed after 2013.



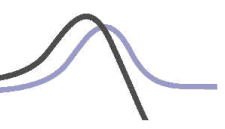
4.2 Data sources – efficiency

Table 8 Desktop Efficiency data sources

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2007, 2008	Energy Star Final Computer Dataset 22-09-06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	Energy Star Final Computer Dataset 20-10-06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	EPA Idle Data For Rationale 20-04-06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	Energy Star All Products download 13.10.06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	Energy Star All Products download 20.07.06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	EU Energy Star download 07.12.06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	MTP Tests 05/06	2006	MTP	Best Data Available	High
2007, 2008	MTP Tests 07/06	2006	MTP	Best Data Available	High
2007, 2008	MTP Tests 04/09/06 - 05/10/06	2006	MTP	Best Data Available	High
2007, 2008	Energy Star Database July 2006	2006	ENERGY STAR	Best Data Available	High
2007, 2008	MTP Intertek Tests June 2006	2006	MTP	Best Data Available	High
2007, 2008	Energy Star Analysis for New Specification 270406	2006	ENERGY STAR	Best Data Available	High
2007, 2008	Energy Star Analysis for New Specification Aug06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	Energy Star Computers List 27/10/06 (Amended)	2006	ENERGY STAR	Best Data Available	High
2007, 2008	Energy Star Computer Dataset 26/08/06	2006	ENERGY STAR	Best Data Available	High

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Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2007, 2008	Energy Star Computer Dataset 22/09/06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	Energy Star Computer Dataset 20/10/06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	Energy Star FTP Download 20.7.6	2006	ENERGY STAR	Best Data Available	High
2007, 2008	Energy Star Manufacturers' Data For Specifications Notebook Idle Data 2006	2006	ENERGY STAR	Best Data Available	High
2007, 2008	Energy Star Final Computer Dataset 22/09/06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	Energy Star Final Computer Dataset 22/10/06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	MTP ICT Model Data Test 10/06	2006	MTP	Best Data Available	High
2007, 2008	MTP Power Cons Measures 04/09/06 - 05/10/06	2006	MTP	Best Data Available	High
2007, 2008	MTP ICT Model Data Test 05/06	2006	MTP	Best Data Available	High
2007, 2008	MTP CDMTC3CE15 PC power cons meas	2007	MTP	Best Data Available	High
2007, 2008	MTP CDMTC3CE15 PC power cons meas 2006/07	2007	MTP	Best Data Available	High
2008	EU Energy Star Database 14-01-08	2008	MTP	Best Data Available	High
2008	MTP Tests June 2007 Budget Desktops	2008	MTP	Best Data Available	High
2008	MTP Tests November 2007 Ultimate Gaming	2008	MTP	Best Data Available	High
2008	MTP Tests January 2008 Luxury Desktops	2008	MTP	Best Data Available	High
2008	Danish Electricity Saving Trust DB - January 2008	2008	Danish EST	Best Data Available	High
2008	US ENERGY STAR FTP Oct 2008 (EU Prods) ftp://ftp.powweb.com/	2008	ENERGY STAR	Best Data Available	High
2008	US ENERGY STAR FTP Oct 2008 (UK Prods) ftp://ftp.powweb.com/	2008	ENERGY STAR	Best Data Available	High

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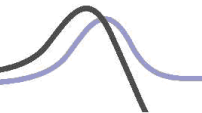
First created: 20/04/2009

Updated: 26/02/2010

Last reviewed: 26/02/2010

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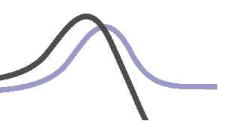
Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2008	EU ENERGY STAR DOWNLOAD OCT-2008	2008	ENERGY STAR	Best Data Available	High
2008	ENERGY STAR V5.0 Final Dataset	2008	ENERGY STAR	Best Data Available	High
2008	Danish EST 02-2009 - http://application.sparel.dk/ItWebUI/index.aspx	2009	Danish EST	Best Data Available	High
2008	ENERGY STAR V5.0 Final Dataset	2009	ENERGY STAR	Best Data Available	High
2008	MTP Test September 2008	2009	MTP	Best Data Available	High
1970, 2003, 2007, 2008, 2010, 2012, 2013, 2014, 2016, 2018, 2020, 2022, 2024, 2026, 2028, 2030	Expert Assumptions	2009	MTP Technical Expert	Required expert assumptions to collate power	Medium

Table 9 Laptop Efficiency data sources

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2007, 2008	EPA Notebook Idle Data 27-04-07	2007	ENERGY STAR	Best Data Available	High
2007,	Energy Star Final Computer Dataset 22-09-06	2006	ENERGY	Best Data	High

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Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2008			STAR	Available	
2007, 2008	Energy Star Final Computer Dataset 20-10-06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	Energy Star FTP download 13.10.06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	Energy Star FTP Download 20.7.06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	MTP ICT Model Data Test 05-06	2006	MTP	Best Data Available	High
2007, 2008	MTP ICT Model Data Test 07-06	2006	MTP	Best Data Available	High
2007, 2008	MTP ICT Model Data Test 09-06	2006	MTP	Best Data Available	High
2007, 2008	MTP ICT Model Data Test 11-06	2006	MTP	Best Data Available	High
2007, 2008	MTP Tests 04-09-06 - 05-10-06 power cons meas	2006	MTP	Best Data Available	High
2007, 2008	EU Energy Star Database 07-12-06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	Energy Star FTP download 20.07.06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	EPA Draft 2 - Low Power Data 27-04-06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	Energy Star Final Computer Dataset 09-22-06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	EPA Energy Star Complete List 27-10-06	2006	ENERGY STAR	Best Data Available	High
2007, 2008	MTP CDMTC3CE15 PC power cons meas	2007	MTP	Best Data Available	High
2007, 2008	MTP Testing September 2007 £499 Notebooks	2007	MTP	Best Data Available	High
2007, 2008	MTP Testing December 2007 Lite Notebooks	2007	MTP	Best Data Available	High
2008	EU Energy Star Database 14-01-08	2008	ENERGY STAR	Best Data Available	High
2008	ENERGY STAR V5.0 Final Dataset	2008	ENERGY	Best Data	High

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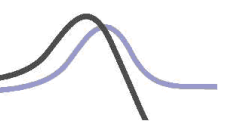
First created: 20/04/2009

Updated: 26/02/2010

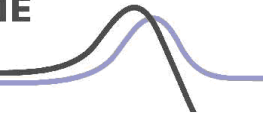
Last reviewed: 26/02/2010

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Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
			STAR	Available	
2008	US ENERGY STAR FTP Oct 2008 (EU Prods) ftp://ftp.powweb.com/	2008	ENERGY STAR	Best Data Available	High
2008	US ENERGY STAR FTP Oct 2008 (UK Prods) ftp://ftp.powweb.com/	2008	ENERGY STAR	Best Data Available	High
2008	EU ENERGY STAR DOWNLOAD OCT-2008	2008	ENERGY STAR	Best Data Available	High
2008	MTP Test September 2008	2008	MTP	Best Data Available	High
2008	Danish EST 02-2009 - http://application.sparel.dk/ItWebUI/index.aspx	2009	Danish Energy Saving Trust	Best Data Available	High
1990, 1999, 2007, 2008, 2010, 2012, 2013, 2014, 2016, 2018, 2020, 2022, 2024, 2026, 2028, 2030	Expert Assumptions	2009	MTP	Required expert assumptions to collate power	Medium



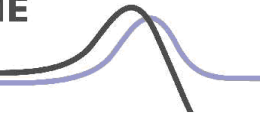
4.3 Methodology & key assumptions – efficiency

- This section describes what has been done with the data listed in Table 8 and Table 9 along with a rationale for any key assumptions (in particular any expert judgements listed in Table 8 and Table 9) and detail of any background calculations behind the data points.
- Note – for smooth modelling trends, some assumptions have been made beyond 2030, although the model itself does not project total figures beyond 2030.

4.3.1 Historic data

Table 10 Interpolation & background calculations – Desktop and Laptop PC efficiency

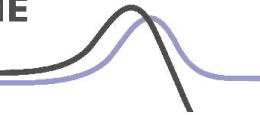
Year	Methodology & assumptions
1999	Laptop PC on-idle power of 30.15W assumed. Laptop PC sleep mode power of 2.7W is assumed. Laptop PC off mode power of 2.7 W is assumed. These values are expert assumptions due as no other data for this time period was available.
1960 - 1998	Laptop PC power (on-idle and sleep mode) is kept the same as the 1999 figure in previous years, in the absence of further information.
2000 - 2006	Laptop PC on-idle power is based on a straight line interpolation between the 1999 and 2007 figures.
1990	Laptop PC off mode assumed to be 2.7W. Based on an expert assumption as no further information available.
1991 - 2006	Laptop PC off mode power is based on a straight line interpolation between the 1990 and 2007 figures.
1960 - 1989	Laptop PC off mode power is assumed to be the same as the 1990 value in the absence of further information.
2003	Desktop PC on-idle power of 78.4W assumed. This value is an expert assumption as no other data for this time period was available.
1960 - 2003	Desktop PC on-idle power is kept the same as the 2003 figure in previous years, in the absence of further information.
2004 - 2006	Desktop PC on-idle power is based on a straight line interpolation between the 2003 and 2007 figures.
1970	Desktop PC sleep mode power of 15W is assumed. Desktop PC off mode power of 2.7 W is assumed. These values are expert assumptions as no other data for this time period was available.
1960 - 1969	Desktop PC sleep mode and off mode power is kept the same as the 1970 figure in previous years, in the absence of further information.
1971-2006	Desktop PC sleep mode and off mode power is based on a straight line interpolation between the 1970 and 2007 figures.
2007	Desktop and laptop PCs (all power modes): Weighted power figures across all data sources (prior to 2008) listed in Table 8 and Table 9 above. Weighting based on confidence in data source, data year, data source, size of dataset, country of origin and relevance to domestic or non-domestic sector.
2008	Desktop and laptop PCs – all power modes: Weighted power figures across all data sources listed in Table 8 and Table 9 above. Weighting based on confidence in data source, data year, data source, size of dataset, country of origin and relevance to domestic or non-domestic sector



4.3.2 Future analysis

Table 11 Extrapolation & background calculations – Desktop and Laptop PC efficiency

Year	Methodology & assumptions
2009 - 2011	Desktop and laptop PCs all power modes – based on a straight line interpolation between the 2008 and 2012 values.
2012	Desktop and laptop PCs reference Line: values (on-Idle (W) and sleep mode (W)) are based on a weighted percentage of products which meet the ENERGY STAR specification with the remaining percentage of products meeting the average 2009 Reference line value. The percentage of products assumed to comply with the 2009 ENERGY STAR specification is listed in the Key Inputs GSN for desktop and laptop PCs.
2014	Desktop PC: values (on-Idle (W)) are based on the assumption that all products meet previous ENERGY STAR specification (2007) values with an additional amount of power added to reflect changes which occurred between average power figures seen in the 2007 and 2008 MTP evidence base.
2016	Desktop PC: values (on-Idle (W)) are based on the assumption that all products meet previous ENERGY STAR specification (2009) values with an additional amount of power added to reflect changes which occurred between average power figures seen in the 2007 and 2008 MTP evidence base.
2018, 2020, 2022, 2024, 2026, 2028, 2030	Desktop PC: values (on-Idle (W)) are based on value two years in the past with an additional amount of power added to reflect changes which occurred between average power figures seen in the 2007 and 2008 MTP evidence base.
2017, 2019, 2021, 2023, 2025, 2027, 2029	Desktop PC on-Idle - straight line interpolation between adjacent years' figures.
2016	Laptop PC: values (on-Idle (W)) are based on the assumption that all products meet previous ENERGY STAR specification (2009).
2020, 2024, 2028, 2032	Laptop PC: values (on-Idle (W)) are based on value four years in the past with an additional amount of power added to reflect changes which occurred between average power figures seen in the 2007 and 2008 MTP evidence base.
2017-2019, 2021-2023, 2025-2027, 2029-2031	Laptop PC: values (on-Idle (W)) are based on a straight line interpolation between previous years' figures.
2016 - 2030	Desktop and laptop PCs: values (sleep mode (W)) are based on the assumption that all products meet previous ENERGY STAR specification (2009).
2013 - 2015	Desktop and laptop PCs: values (sleep mode (W)) are based on a straight line interpolation between the 2012 and 2016 figures.
2009	Desktop and laptop PCs: off-mode (W) - Straight line interpolation between 2008 - 2010
2010	Desktop and laptop PCs: off-mode (W) - EuP Standby Implementing Measures applied at 1.0W
2011 - 2012	Desktop and laptop PCs: off-mode (W) - Straight line interpolation between 2010 - 2013
2013	Desktop and laptop PCs: off-mode (W) - EuP Standby Implementing Measures applied at 0.5W
2014-2030	Desktop and laptop PCs: off-mode (W) - assumed that no further improvement potential on the 0.5W EuP implementing Measure is possible across all products.



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 12 Data issues – efficiency

Issue/risk	Approach taken/rationale
All MTP figures are product model weighted rather than sales weighted. This approach is taken as there are no reliable sources of information which list the sales of individual products alongside power requirements.	MTP have taken a model weighted approach to deriving average power requirements for desktop and laptop PCs.
Industry is moving towards a TEC based approach whereas MTP communicates power figures in watts for each mode.	Little TEC data available for products on market. Next MTP modelling phase to include TEC values if possible.
Much of the power data sourced for desktop and laptop PCs 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 have commissioned their own testing and power figures are included in the datasets. MTP could conduct more testing in future of non-ENERGY STAR compliant products.
Product development in the ICT industry is rapid. The MTP future reference line assumptions could change with a sudden uptake of an extremely efficient or inefficient product.	MTP review the reference line figures on an annual basis. This annual review will ensure that MTP reference line figures reflect current product performance as closely as possible.
Efficiency data for on-idle power heavily dependent on the functionality of PCs. Should functionality increase significantly as a response to an external factor (e.g. increase software sophistication) then future power consumption could increase significantly.	Power consumption assumed to decrease in On-idle until current policy influence reduces. Power consumption then assumed to increase.
There is little evidence to suggest whether or not future efficiency in sleep mode will increase or decrease. The situation is likely to become more complicated in the future as ENERGY STAR moves towards the TEC approach which could mask any changes in sleep mode power consumption.	Sleep mode power figures constant into future. MTP to re-evaluate during next modelling phase.

4.5 Confidence level – efficiency

- This section provides an indication of overall confidence in the data set (i.e. data points, calculations, interpolation and projections).
- Efficiency data for desktop and laptop PCs is available from a number of different sources including government programmes and industry declarations. There are some risks that the datasets may be too heavily dependent on data sourced from

ENERGY STAR as this programme offers the most comprehensive source of ICT product data. Placing too high a weighting on ENERGY STAR data could result in MTP reference line figures underestimating the average power requirement of ICT products on the market. MTP has taken some steps to minimise any excessive weighting assigned to ENERGY STAR specifications by including figures for non-ENERGY STAR compliant products in average power requirements calculations.

- ICT products can change rapidly. Therefore confidence in efficiency figures decreases with time.

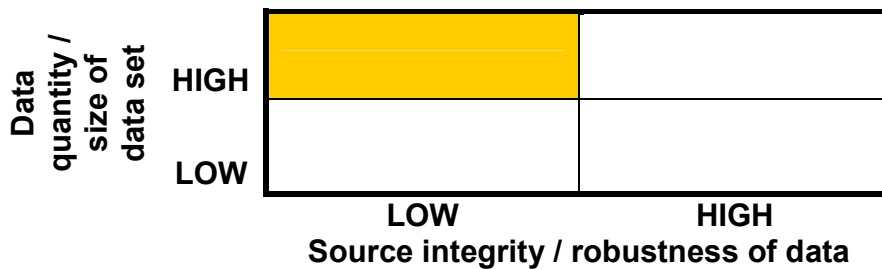


Figure 2 Confidence indicator for efficiency data

5 Usage

5.1 Summary

- Two sets of use profiles are developed for PCs. 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 for profiles). An “enabling rate” is used as a weighting factor between these two use profiles to arrive at an overall use profile for each product.
- The table below shows average usage profiles, derived from the reference scenario enabling rate and the power managed and non power managed profiles discussed in the Key Inputs briefing note.

Table 13 – Average Usage Desktop PC

Year	Desktop PC				Power Management Enabling Rates
	Reference (Use Hours/Year)				
	On-Active	Sleep	Off	Off-Unplugged	%
2009	1,960	80	6,431	289	10
2010	1,933	107	6,431	289	20
2020	1,827	213	6,431	289	40
2030	1,827	213	6,431	289	40

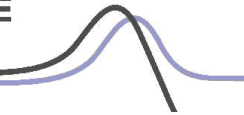
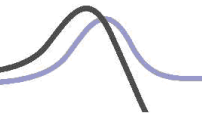


Table 14 – Average Usage Laptop PC

Laptop PC					
Reference (Use Hours/Year)					Power Management Enabling Rates
Year	On-Active	Sleep	Off	Off-Unplugged	%
2009	1,786	155	1,950	4,869	40
2010	1,755	186	1,950	4,869	43
2020	1,631	310	1,950	4,869	50
2030	1,631	310	1,950	4,869	50

- Desktop and laptop PC on-idle use is expected to reduce slightly over time as more products are power managed.
- Total use hours (on-idle and sleep mode) are limited by office hours and so, in total, do not increase into the future.
- Power management enabling rates are expected to increase as organisations become more aware of the energy savings achievable through the implementation of power management functionality.



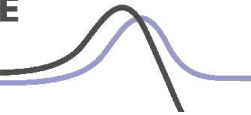
5.2 Data sources – usage

Table 15 Usage data sources (enabling rates) – Desktop PC

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2008	TIAX: US Residential IT Energy Consumption in 2005 and 2010	2006	TIAX	Includes estimated power management enabling rates	Medium
1988, 2014	Expert Assumptions	2009	MTP	Expert assumption required to develop power management enabling rates.	Medium

Table 16 Usage data sources (enabling rates) – Laptop PC

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2008	TIAX: US Residential IT Energy Consumption in 2005 and 2010	2006	TIAX	Includes estimated power management enabling rates	Medium
1988, 2014	Expert Assumptions	2009	MTP	Expert assumption required to develop power management enabling rates.	Medium



5.3 Methodology & key assumptions – usage

5.4 This section describes what has been done with the data listed in Table 15 and

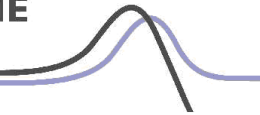
5.5 Table 16 along with a rationale for any key assumptions (in particular any expert judgements listed in Table 15 and

Table 16) and detail of any background calculations behind the data points.

5.5.1 Historic data

Table 17 Interpolation & background calculations – usage data

Year	Methodology & assumptions
1988	Desktop and laptop PC - power management enabling rate assumed to be 0% in 1988. Based on an expert assumption in light of no further evidence being available.
1960 -1987	Desktop and laptop PC - power management enabling rate assumed to be the same as in 1988. Based on an expert assumption in light of no further evidence being available.
1989 - 2005	Desktop and laptop PC - power management enabling rate based on a straight line interpolation between adjacent years' figures.
2006	Desktop and laptop PC - power management enabling rate assumed to be 10% in 2006 for desktop PCs and 20% for laptop PCs. Based on data included in TIAX report.
2007, 2008	Desktop and laptop PC - power management enabling rate assumed to be equal to the 2006 value.



5.5.2 Future analysis

Table 18 Extrapolation & background calculations – usage data

Year	Methodology & assumptions
2009 – 2014	Desktop and laptop PC - power management enabling rates based on a straight line interpolation between 2008 and 2014.
2014	Desktop and laptop PC - power management enabling rate assumed to be 40% in 2014 for desktop PCs and 50% for laptop PCs. Based on an expected increase from TIAX figures as it is assumed users will become more aware, accustomed and receptive to PC power management configuration. Increase based on an expert assumption in light of no further evidence being available
2015 - 2030	Desktop and laptop PC - power management enabling rates assumed to remain constant at the 2014 level.

5.6 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 19 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.

5.7 Confidence level – usage & lifespan

- 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.

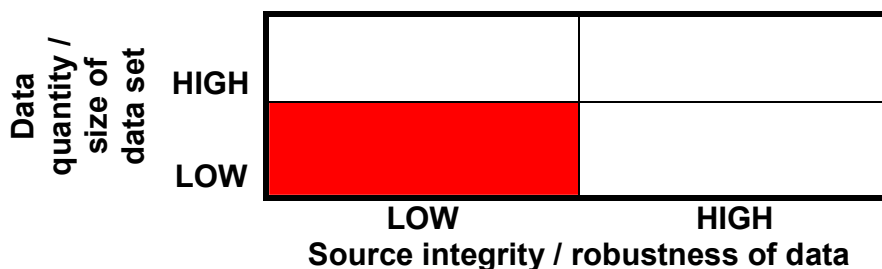
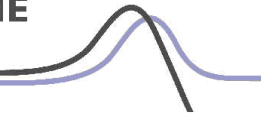


Figure 3 Confidence indicator for usage & lifespan data



6 Other issues

- None addressed.

Related MTP information

- BN-NDICT PC 01: Government Standards Evidence Base 2009 – Key Inputs, Non Domestic Computers
- BN-NDICT PC 03: Government Standards Evidence Base 2009 – Policy Scenario, Non Domestic Computers
- BN-NDICT PC 04: Government Standards Evidence Base 2009 – Best Available Technology (BAT) Scenario, Non Domestic Computers
- BN-DICT PC01: Government Standards Evidence Base 2009 – Key Inputs, Domestic Computers
- BN-DICT PC 02: Government Standards Evidence Base 2009 – Reference Scenario, Domestic Computers
- BN-DICT PC 03: Government Standards Evidence Base 2009 – Policy Scenario, Domestic Computers
- BN-DICT PC 04: Government Standards Evidence Base 2009 – Best Available Technology (BAT) Scenario, Domestic Computers
- BN-NDICT KO01: Government Standards Evidence Base 2009 – Key Outputs, Non Domestic ICT
- BN-DICT KO01: Government Standards Evidence Base 2009 – Key Outputs, Domestic ICT

Changes from 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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