

# BN-DICT PC02: 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.

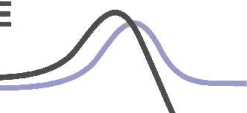
## 1 Introduction

- 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 March 2009 are included in the Reference scenario, although at the time of writing not all of these measures had been published in the Official Journal of the European Union].
- For cross-cutting policies such as CERT and Building Regulations, which are agreed but where the likely impact for specific products is unknown, assumptions are made about the impact per product, and detailed in the following sections. Where possible, separate projections of the reference line are made with and without such policies.
- This Government Standard Briefing Note (GSBN) covers domestic personal computers. The following definitions of PCs are adapted from the EuP Preparatory study on PCs<sup>1</sup>.
- **Personal Computer:** A device which performs logical operations and processes data. Personal computers are composed of, at a minimum: (1) a central processing unit (CPU) to perform operations; and (2) user input devices such as a keyboard,

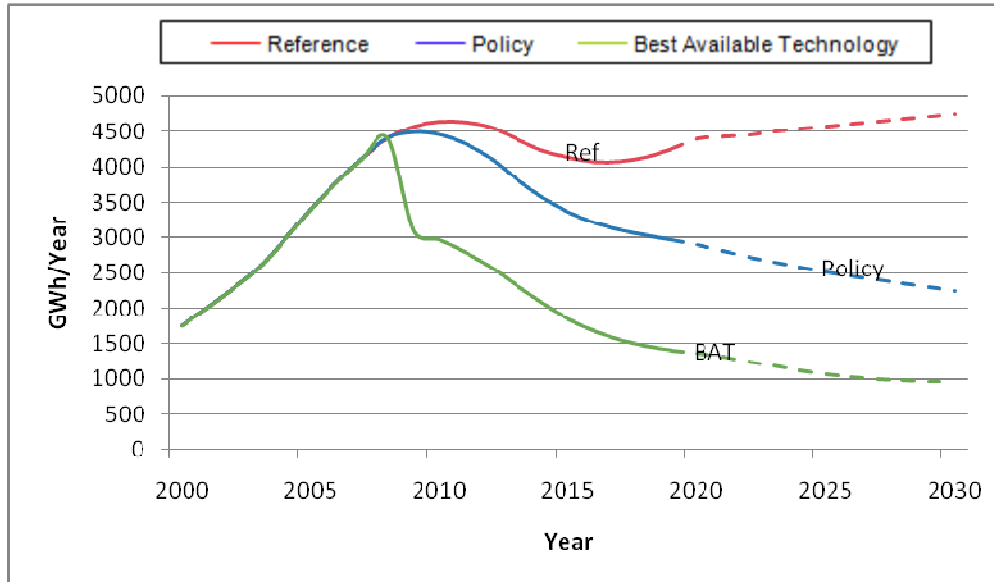
<sup>1</sup> European Commission DG TREN Preparatory studies for Eco-design Requirements of EuPs (Contract TREN/D1/40-2005/LOT3/S07.56313) Lot 3 Personal Computers (desktops and laptops) and Computer Monitors Final Report (Task 1-8)

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 an 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.



## 2 Scenario outputs



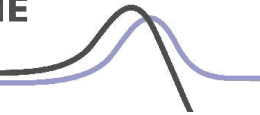
**Figure 1 Total Domestic PC Energy Consumption**

- Total domestic reference scenario energy consumption from desktop and laptop PCs is expected to rise until 2010. This rise is primarily due to an increase in laptop PC stock. From 2010 until 2016 total energy consumption is expected to fall. This fall is due to increasing product efficiency and falling desktop PC stock. From 2016 total energy consumption is likely to increase as the stock of laptop PCs grows further.
- Total energy consumption in the reference scenario from domestic desktop PCs is expected to fall from 2010 onwards due to falling stock levels.
- Total domestic energy consumption in the reference scenario 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 Consumption and CO2 emissions<sup>2</sup>**

Energy Consumption (GWh)	2009	2020	2030
Lap	710	2270	3020
Desktop	3860	2140	1720
<b>TOTAL</b>	<b>4570</b>	<b>4400</b>	<b>4750</b>

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



CO <sub>2</sub> Emissions (MtCO <sub>2</sub> )			
Lap	0.26	0.85	1.14
Desktop	1.44	0.81	0.65
<b>TOTAL</b>	<b>1.70</b>	<b>1.66</b>	<b>1.79</b>

### 3 Current policy & measures

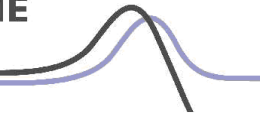
- ENERGY STAR is the dominant energy efficiency policy covering ICT products. The ENERGY STAR label is led by the US Environmental Protection Agency (EPA) but the European Commission has an agreement with the US Government to coordinate the energy labelling of office equipment through an EU ENERGY STAR 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 4.0). 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 environment”). The Energy Using Products (EuP) Standby Implementing Measures are due to come into force 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 both desktop and laptop PCs.
- The Energy Saving Trust endorse a range of energy efficient ICT products under their Energy Saving Recommended (ESR) label. ESR is designed to cover the top 20% of energy efficient products on the market. Current uptake of the label by ICT manufacturers remains low.

**Table 2 Current policies & measures, Reference Scenario**

Policy name	Period in force	Description	Impact						
ENERGY STAR	2009 - 2013	Voluntary label. Applies energy efficiency criteria across all power modes in a Typical Electricity Consumption (TEC in kWh/week) approach. MTP breaks TEC approach down into	ENERGY STAR standard set to levels which represent approximately for top 25% of market (averaged across all categories): <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>On-Idle</th> <th>Sleep</th> <th>Off</th> </tr> </thead> <tbody> <tr> <td>(W)</td> <td>(W)</td> <td>(W)</td> </tr> </tbody> </table>	On-Idle	Sleep	Off	(W)	(W)	(W)
On-Idle	Sleep	Off							
(W)	(W)	(W)							

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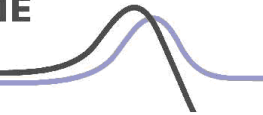
Policy name	Period in force	Description	Impact																
		estimate power consumption (W) figures for each power mode for modelling purposes.	<table border="1"> <tr> <td><b>Desktop</b></td> <td>50.7</td> <td>2.9</td> <td>1.7</td> </tr> <tr> <td><b>Laptop</b></td> <td>14.2</td> <td>2.3</td> <td>1.0</td> </tr> </table> <p>Compliance is assumed to increase over time to 78% (desktops) and 77% (laptops) of market by 2013.</p>	<b>Desktop</b>	50.7	2.9	1.7	<b>Laptop</b>	14.2	2.3	1.0								
<b>Desktop</b>	50.7	2.9	1.7																
<b>Laptop</b>	14.2	2.3	1.0																
EuP Standby Implementing Measures	2010 and 2013	Mandatory requirement. Specifies 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 2013 (desktops and laptops). Will remove worst performing products in off-mode from the EU market.																
Energy Saving Recommended (ESR)	2009-2010	Voluntary label. Applies maximum power levels for the on-idle, sleep and off modes of desktop and laptop PCs.	<p>ESR attempts to represent the top 20% of the market in terms of energy efficiency. Current specifications (averaged across all categories):</p> <table border="1"> <thead> <tr> <th></th> <th>On-Idle</th> <th>Sleep</th> <th>Off</th> </tr> <tr> <th></th> <th>(W)</th> <th>(W)</th> <th>(W)</th> </tr> </thead> <tbody> <tr> <td><b>Desktop</b></td> <td>56.91</td> <td>3.50</td> <td>1.50</td> </tr> <tr> <td><b>Laptop</b></td> <td>15.12</td> <td>1.60</td> <td>1.00</td> </tr> </tbody> </table>		On-Idle	Sleep	Off		(W)	(W)	(W)	<b>Desktop</b>	56.91	3.50	1.50	<b>Laptop</b>	15.12	1.60	1.00
	On-Idle	Sleep	Off																
	(W)	(W)	(W)																
<b>Desktop</b>	56.91	3.50	1.50																
<b>Laptop</b>	15.12	1.60	1.00																

**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 2009							
ESR	Not included due to low take up by suppliers		ESR 2010 defined in 2007						
EuP Standby Implementing Measures (off mode)	N/A		Jan 2010 (1W)			Jan 2013 (0.5W)			

## 4 Efficiency

### 4.1 Summary

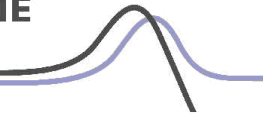
- ENERGY STAR has adopted (for the revised 2009 specification) a Typical Electricity Approach (TEC) which uses annual energy consumption thresholds (kWh/year) as requirements. TEC requirements have been developed for four categories of desktop PCs and three categories of laptop PCs. The categories are based on the functionality and computing power offered by these products:

**Table 5 ENERGY STAR Desktop PC Categories**

Desktop Category	ENERGY STAR Version 4.0 Requirements	ENERGY STAR Version 5.0 Requirements
<b>A</b>	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>B</b>	Multi-core processor(s) or more than 1 discrete processor.	Equal to 2 physical cores; and
	Minimum of 1 GB system memory.	Greater than or equal to 2 gigabytes (GB) of system memory
<b>C</b>	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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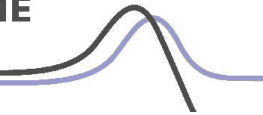


Desktop Category	ENERGY STAR Version 4.0 Requirements	ENERGY STAR Version 5.0 Requirements
	2 of the following 3 characteristics: •Minimum of 2 GB system memory •Minimum of 2 hard disk drives. •TV-tuner and/or video capture capability with high definition support.	•Greater than or equal to 2 gigabytes (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). See Table 8 for estimated power consumption figures in the Reference Scenario.
- 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



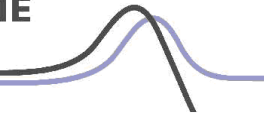
ENERGY STAR requirements were then calculated by varying the assumed market split. MTP will reassess the approach in 2010.

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

**Table 7 Domestic Desktop and Laptop PC Power Consumption**

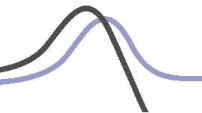
Year	Desktop PC			Laptop PC		
	ON-IDLE (W)	SLEEP (W)	OFF (W)	ON-IDLE (W)	SLEEP (W)	OFF (W)
2009	90.4	4.4	1.8	23.4	1.7	1.1
2010	83.0	4.1	1.0	22.9	1.8	1.0
2011	75.6	3.8	0.8	22.4	1.8	0.8
2012	68.2	3.5	0.7	21.9	1.8	0.7
2013	64.3	3.4	0.5	21.5	1.9	0.5
2014	60.4	3.2	0.5	21.2	2.1	0.5
2015	57.2	3.0	0.5	20.8	2.2	0.5
2016	54.1	2.9	0.5	20.4	2.3	0.5
2017	55.8	2.9	0.5	20.5	2.3	0.5
2018	57.6	2.9	0.5	20.6	2.3	0.5
2019	59.5	2.9	0.5	20.7	2.3	0.5
2020	61.4	2.9	0.5	20.8	2.3	0.5
2021	63.5	2.9	0.5	20.8	2.3	0.5
2022	65.5	2.9	0.5	20.8	2.3	0.5
2023	67.7	2.9	0.5	20.9	2.3	0.5
2024	69.8	2.9	0.5	21.0	2.3	0.5
2025	72.1	2.9	0.5	21.1	2.3	0.5
2026	74.5	2.9	0.5	21.2	2.3	0.5
2027	76.9	2.9	0.5	21.5	2.3	0.5
2028	79.4	2.9	0.5	21.7	2.3	0.5
2029	82.0	2.9	0.5	21.9	2.3	0.5
2030	84.6	2.9	0.5	22.0	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. The increase in power consumption is likely to be heavily influenced by increases in the specification levels of products.

- 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 and laptop 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 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.
- The currently agreed ENERGY STAR specifications do not account for laptop 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 2016 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.



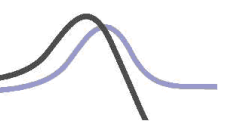
## 4.2 Data sources – efficiency

**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 measure	2007	MTP	Best Data Available	High
2007, 2008	MTP CDMTC3CE15 PC power cons measure 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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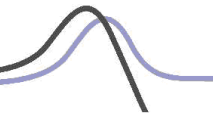
First created: 20/04/2009

Updated: 25/02/2010

Last reviewed: 25/02/2010

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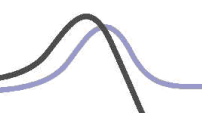
Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2008	EU ENERGY STAR DOWNLOAD OCT-2008	2008	ENERGY STAR	Best Data Available	High
2008	ENERGY STAR V5.0 Final Dataset	2008	ENERGY STAR	Best Data Available	High
2008	Danish EST 02-2009 -	2009	Danish EST	Best Data Available	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
1993, 1999, 2007, 2008, 2010, 2012, 2013, 2014, 2016, 2018, 2020, 2022, 2024, 2026, 2028, 2030, 2032	Expert Assumptions	2009	MTP	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

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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	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 measure	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 measure	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

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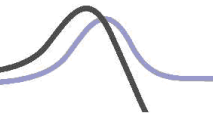
First created: 20/04/2009

Updated: 25/02/2010

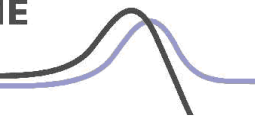
Last reviewed: 25/02/2010

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Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2008	ENERGY STAR V5.0 Final Dataset (	2008	ENERGY STAR	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)	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 -	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, 2032	Expert Assumptions	2009	MTP Technical Expert	Required expert assumptions to collate power	Medium



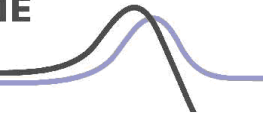
## 4.3 Methodology & key assumptions – efficiency

- 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**

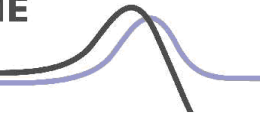
Year	Methodology & assumptions
1999	Laptop PC on-idle power of 30.15W assumed. Laptop PC sleep mode power of 2.7W is assumed. Laptop PC off mode power of 2.7 W is assumed. These values are expert assumptions due as no other data for this time period was available.
1960 - 1998	Laptop PC power (on-idle, 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.
1960-1989	Laptop PC off mode power is kept the same as the 1990 figure in previous years, in the absence of further information.
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.
1993	Desktop PC on-idle power of 60.0W assumed. This value is an expert assumption due as no other data for this time period was available.
1960 - 1992	Desktop PC on-idle power is kept the same as the 1993 figure in previous years, in the absence of further information.
1994- 2006	Desktop PC on-idle power is based on a straight line interpolation between the 1993 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: values for on-Idle and sleep mode 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 scenario 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 for on-Idle 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 for on-Idle 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 for on-Idle 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 for on-Idle are based on the assumption that all products meet previous ENERGY STAR specification (2009).
2020, 2024, 2028, 2032	Laptop PC : values for on-Idle 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 for on-Idle are based on a straight line interpolation between previous years' figures.
2016 - 2030	Desktop and laptop PCs : values for sleep mode are based on the assumption that all products meet previous ENERGY STAR specification (2009).
2013 - 2015	Desktop and laptop PCs : values for sleep mode 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



Year	Methodology & assumptions
	potential on the 0.5W EuP implementing Measure will occur without further intervention.

## 4.4 Data issues – efficiency

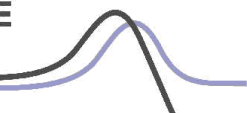
- This section flags any areas of uncertainty, both in general and for specific data points, along with a description of how this has been dealt with in the model

**Table 12 Data issues – efficiency**

Issue/risk	Approach taken/rationale
No reliable sources of information which list the sales of individual products alongside power requirements. All figures sourced are per model.	MTP has taken a model weighted approach to deriving average power requirements for desktop and laptop PCs.
Industry is moving toward 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 may include TEC values if possible.
Much of the power data sourced for desktop and laptop PCs comes from products compliant with ENERGY STAR. There is a risk that the average figures could be too low in relation to the “true” market average.	MTP has commissioned testing to obtain non-ENERGY STAR power figures which are included in the datasets. More testing in future of non-ENERGY STAR compliant products could be considered.
Product development in the ICT industry is rapid. The MTP future reference scenario assumptions could change with a sudden uptake of an extremely efficient or inefficient product.	MTP reviews the reference scenario figures on an annual basis. This annual review ensures that MTP reference line figures reflect current product performance as closely as possible.
Efficiency data for on-idle power is heavily dependent on the functionality of PCs. Should functionality increase significantly as a response to an external factor (e.g. increased 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 to account for additional product capabilities in future and lack of approved policies to influence.
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 assumed 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 scenario figures underestimating the average power requirement of ICT products on the market. MTP have 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.

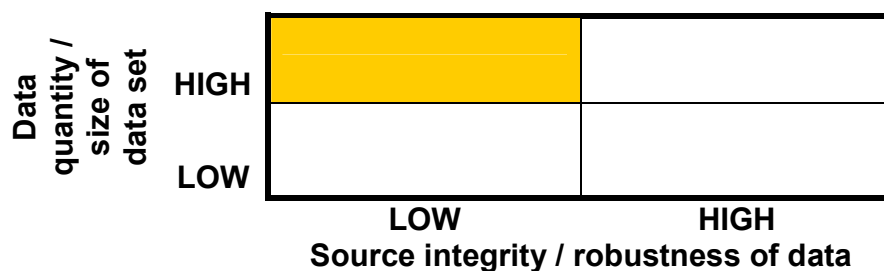


Figure 2 Confidence indicator for efficiency data

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

Table 13 – Average Usage Desktop PC

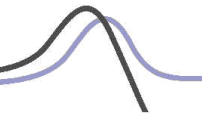
Year	Desktop PC				Power Management Enabling Rates
	Reference Scenario (Use Hours/Year)				
	On-Idle	Sleep	Off	Off-Unplugged	%
2009	3,085	307	5,170	199	23
2010	3,190	369	5,002	199	27
2020	4,528	860	3,173	199	40
2030	4,528	860	3,173	199	40



**Table 14 – Average Usage Laptop PC**

Year	Laptop PC				Power Management Enabling Rates
	Reference (Use Hours/Year)				%
	On-Idle	Sleep	Off	Off-Unplugged	
2009	2,029	470	3,131	3,131	42
2010	2,109	515	3,068	3,068	43
2020	3,059	923	2,389	2,389	50
2030	3,059	923	2,389	2,389	50

- Power management enabling rates are assumed to increase over time as awareness of this functionality increases. The increasing amount of time spent in sleep mode is a result of the combination of desktop and laptop PCs being used more but with increased power management. Without the increase in power management rates the extra time seen in sleep mode would occur during in on-idle mode.



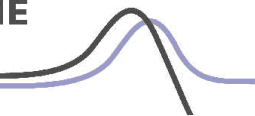
## 5.2 Data sources – usage & lifespan

**Table 15 Usage data sources – Desktop PC**

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2006	TIAX: US Residential IT Energy Consumption in 2005 and 2010	2006	TIAX	Includes estimated power management enabling rates	Medium
1988, 2007, 2008, 2014	Expert Assumptions	2009	MTP	Expert assumption required to develop power management enabling rates.	Medium

**Table 16 Usage data sources – Laptop PC**

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2006	TIAX: US Residential IT Energy Consumption in 2005 and 2010	2006	TIAX	Includes estimated power management enabling rates	Medium
1988, 2007, 2008, 2014	Expert Assumptions	2009	MTP	Expert assumption required to develop power management enabling rates.	Medium



## 5.3 Methodology & key assumptions – usage

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

### 5.3.1 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 20% in 2006 for desktop PCs and 40% 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.

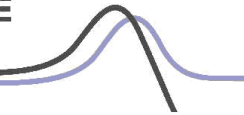
### 5.3.2 Future analysis

**Table 18 Extrapolation & background calculations – usage data**

Year	Methodology & assumptions
2009 – 2013	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.

## 5.4 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.

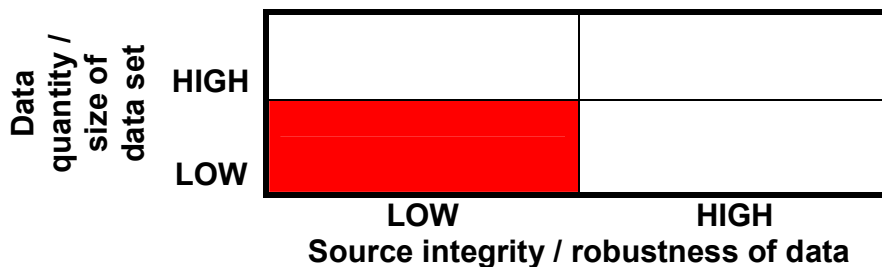


**Table 19 Data issues – usage**

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 can 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 GSNB'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-DICT PC01: Government Standards Evidence Base 2009 – Key Inputs, 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 PC 01: Government Standards Evidence Base 2009 – Key Inputs, Non Domestic Computers
- BN-NDICT PC 02: Government Standards Evidence Base 2009 – Reference Scenario, 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 KO01: Government Standards Evidence Base 2009 – Key Outputs, Domestic ICT
- BN-NDICT KO01: Government Standards Evidence Base 2009 – Key Outputs, Non Domestic ICT

## Changes from previous version

- No changes. This is the first published version.

## Consultation and further information

Stakeholders are encouraged to review this document and provide suggestions that may improve the quality of information provided, email [info@mtprog.com](mailto:info@mtprog.com) quoting the document reference, or call the MTP enquiry line on +44 (0) 845 600 8951.

For further information on related issues visit [www.mtprog.com](http://www.mtprog.com)