



BN-NDICT PC01: Non-Domestic Computers Government Standards Evidence Base 2009: Key Inputs

Version 1.1

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

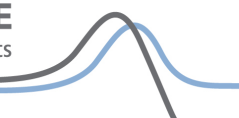
1 Introduction

- The aim of this Briefing Note is to provide details and reference sources of the underlying data in the model, along with the key assumptions used in the model.
- There are three main sections to this Briefing Note, corresponding to the main variables of the MTP modelling approach:
 - Ownership & stock
 - Sales
 - Usage & lifespan
- Each section also includes an indication of the overall confidence in the dataset, to provide a sense of the robustness of the model.
- This Government Standard Briefing Note (GSBN) covers non-domestic personal computers. The following definitions of PCs are adapted from the ErP Preparatory study on PCs¹.

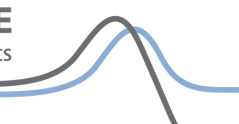
¹ European Commission DG TREN Preparatory studies for Eco-design Requirements of ErPs (Contract TREN/D1/40-2005/LOT3/S07.56313) Lot 3 Personal Computers (desktops and laptops) and Computer Monitors Final Report (Task 1-8)

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- **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, 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.



2 Ownership & stock

2.1 Summary

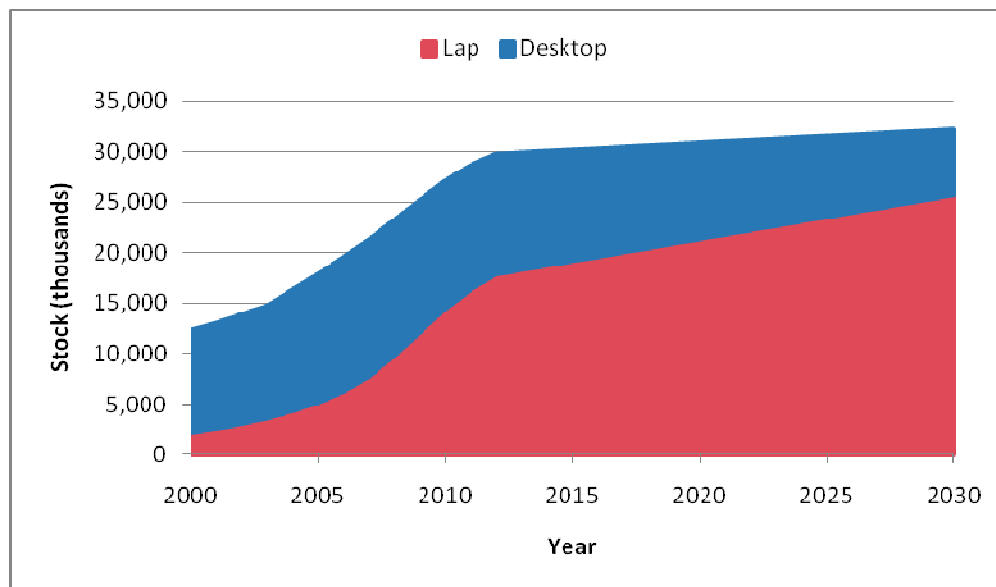
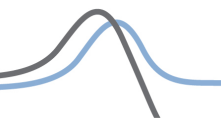


Figure 1 – Total Non-Domestic PC Stock

Table 1 Non-Domestic Desktop and Laptop PC Stock

	Desktop PC	Laptop PC	Total PC
Year	Stock('000s)	Stock('000s)	Stock('000s)
2009	13,054	12,173	25,227
2010	12,669	14,457	27,126
2020	9,484	21,426	30,910
2030	6,450	25,799	32,249

- Desktop PC stock is assumed to fall from 2009 onwards. Laptop stock is expected to increase significantly leading to an overall increase in total PC stock. The graph above shows that laptop PC sales increase steeply until around 2012 after which time sales slow due to market saturation.



Data sources – ownership & stock

Table 2 Ownership & stock data sources – Non-Domestic Desktop PC

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
1960 - 2030	Household Numbers ²	2008	MTP Supplied	Best Data Available	High
1960 - 2020	NATIONAL STATISTICS : UK labour population	2009	National Statistics	Best Data Available	High
2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012	Gartner Forecast: PC Installed Base, Worldwide, 2004-2012, September 2008 Update	2008	Gartner	Best Data Available	High
1978, 1979, 1989, 2003, 2021, 2030	Expert Assumption	2009	MTP Technical Expert	Required assumption to estimate past non-domestic desktop PC stock	High

² Refer to BNXS25 UK Household and Population Figures 1970-2030 for details on household population figures.

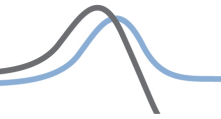
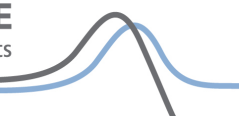


Table 3 Ownership & stock data sources – Non-Domestic Laptop PC

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
1960 - 2030	Household Numbers	2008	MTP Supplied	Best Data Available	High
1960 - 2020	NATIONAL STATISTICS : UK labour population http://www.statistics.gov.uk/STATBASE/Product.asp?vlnk=1944	2009	National Statistics	Best Data Available	High
2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012	Gartner Forecast: PC Installed Base, Worldwide, 2004-2012, September 2008 Update	2008	Gartner	Best Data Available	High
1979, 1990, 1990, 2003, 2021, 2030	Expert Assumption	2009	MTP Technical Expert	Required assumption to estimate past non-domestic laptop PC stock	Medium



2.2 Methodology & key assumptions – ownership & stock

- This section describes what has been done with the data listed in Table 2 and
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- Table 3 along with a rationale for any key assumptions (in particular any expert judgements listed in Table 2 and
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- Table 3) and detail of any background calculations behind the data points.

2.2.1 Historic data

Table 4 Interpolation & background calculations – ownership & stock

Year	Methodology & assumptions
2003 - 2008	Desktop and laptop PC stock – Gartner data used (which shows considerable shift from desktops to laptops).
1989	Desktop and laptop PC stock – assumed that in 1989 100% of non-domestic PCs are desktop PCs. Based on an expert assumption as no further data available.
2003	Desktop and laptop PC stock – ratio of desktop PCs to laptop PCs calculated by dividing Gartner stock data for desktop PCs over laptop PCs.
2004 - 2008	Desktop and laptop PC stock - ratio of desktop PCs to laptop PCs calculated using the same approach as in 2003.
1989 - 2008	Desktop and laptop PC stock - ratio of desktop PCs to laptop PCs smoothed using two sided exponential window, two pass (kalman filter and lagrange multiplier) (smoothing continued into the future as described in table below).
1971 - 2008	Number of workers in the UK based on figures from National Statistics data.
1973	Number of desk based workers in the UK calculated by assuming that one third of all UK workers are desk based.
1974 - 2008	Number of desk based workers in the UK based on same ratio as in 1973.
1983	Total number of PC's per desk based worker assumed to be 0.
2003	Total number of PC's per desk based worker calculated by dividing Gartner stock data over number of desk based workers.
1984 - 2002	Total number of PC's per desk based worker based on a straight line interpolation between the 1983 value and the 2003 value.
1984	Total PC stock – calculated by multiplying ratio of PCs per worker by total number of desk based workers.
1985 - 2002	Total PC stock – calculated using the same method as for 1984.
1984	Desktop and laptop PC stock – stock calculated by multiplying total number of PCs by ratio of desktop and laptop PCs.
1985 - 2002	Desktop and laptop PC stock – stock calculated by multiplying total number of PCs by ratio of desktop and laptop PCs.

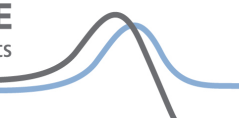
2.2.2 Future analysis

Table 5 Extrapolation & background calculations – ownership & stock

Year	Methodology & assumptions
2009- 2012	Desktop and laptop PC stock – Gartner forecasts figures used
2021	Desktop and laptop PC stock – assumed that 80% of PCs are laptop PCs. Based on an expert assumption in light of further data being unavailable.
2009 - 2030	Desktop and laptop PC stock - ratio of desktop PCs to laptop PCs smoothed

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Year	Methodology & assumptions
	using two sided exponential window, two pass (kalman filter and lagrange multiplier) (smoothing continued from past figures future as described in table above).
2009 - 2020	Number of workers in the UK based on figures from National Statistics data.
2021 - 2030	Number of workers in the UK: Applied growth rate derived from National Statistics values.
2009 - 2030	Number of desk based workers in the UK calculated using same approach as in 2008.
2013	Total number of PC's per desk based worker calculated by dividing the 2012 Gartner stock data over number of desk based workers.
2030	Total number of PC's per desk based worker uses the same value as in 2013.
2030	Total PC stock – calculated by multiplying ratio of PCs per worker by total number of desk based workers.
2009 - 2012	Desktop and laptop PC stock – Gartner data used.
2013 - 2029	Desktop and laptop PC stock – based on a straight line interpolation between the 2012 and 2030 values.
2030	Desktop and laptop PC stock – calculated by multiplying the ratio of desktop and laptop PCs in 2030 by the total stock of PCs in 2030.

2.3 Data issues – ownership & stock

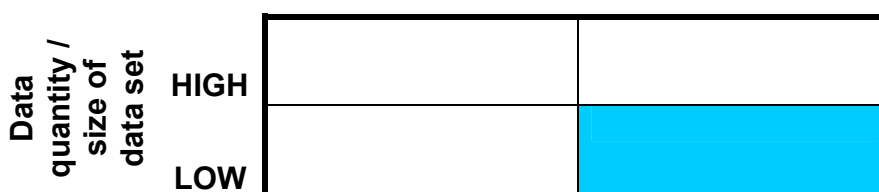
- This section flags any areas of uncertainty, both in general and for specific data points, along with a description of how this has been dealt with in the model

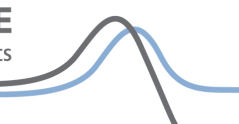
Table 6 Data issues – ownership & stock

Issue/risk	Approach taken/rationale
The ICT market changes rapidly. A sudden change in the ICT market can have large impacts on sales and hence stock of particular products. For example, the distribution PC type has shifted dramatically in the last two years towards Laptop PCs due to decreased costs.	MTP take account of probable changes in future stock. These assumptions are reviewed on an annual basis.

2.4 Confidence level – ownership & stock

- This section provides an indication of overall confidence in the data set (i.e. data points, calculations, interpolation and projections)
- MTP has a large amount of confidence in the sourced stock data inputted into the desktop and laptop models. Confidence in stock levels reduces further into the future, where changes in the ICT industry could cause larger divergences in stock levels compared to MTP assumptions.





LOW
HIGH
 Source integrity / robustness of data

Figure 2 Confidence indicator for ownership data

3 Sales

3.1 Summary

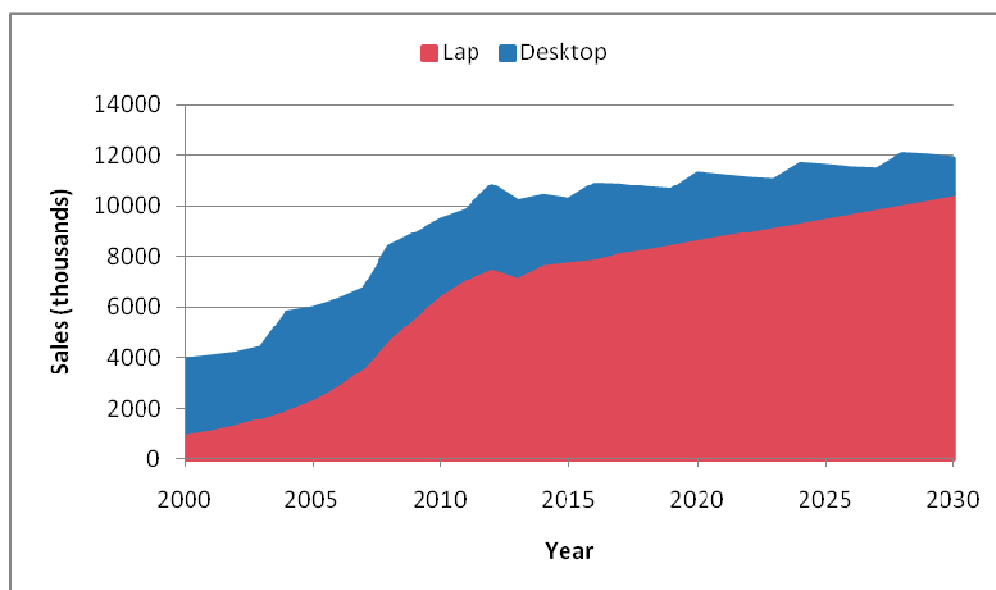
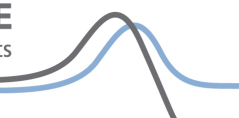


Figure 3 – Total Non-Domestic Monitor Sales

Table 7 Desktop and Laptop PC Sales

	Desktop PC	Laptop PC	Total PCs
Year	Sales ('000)	Sales ('000)	Sales ('000)
2009	3,183	12,173	15,356
2010	2,907	14,457	17,363
2020	2,543	21,426	23,969
2030	1,393	25,799	27,192

- Desktop PC sales are assumed to continue decreasing as sales of laptop PCs continue to increase into the future. The irregular lines in the sales graph above are



caused by interactions between the dying desktop PC sales and the growing laptop PC sales.

3.2 Data sources - sales

- This model is a stock-based model, which calculates sales automatically using the stock projection and the product lifetime. Real sales data is put in as a check only, to help evaluate the output sales calculated from the model. This data series is usually incomplete. The sales shown in the previous charts and tables were to illustrate the full generated (rather than input) sales data series.

Table 8 Sales data sources

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2006-2012	Gartner Forecast: PCs, EMEA, September 2008 Update	2008	Gartner	Sales data from a leading market research company.	High

3.3 Methodology & key assumptions - sales

- This section describes what has been done with the data listed in Table 8 along with a rationale for any key assumptions (in particular any expert judgements listed in Table 8) and detail of any background calculations behind the data points.

3.3.1 Historic data

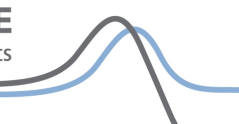
Table 9 Interpolation & background calculations – sales data

Year	Methodology & assumptions
1960 - 2030	The MTP model is a stock-based model, which calculates sales using a stock projection, the product lifetime and a stock churn calculation to account for products purchased in previous years gradually leaving stock. Real sales data is put in as a check only, to help evaluate the output sales from the model. This data series is usually incomplete.
2006 – 2008	Desktop and laptop PC sales - used sales figures in Gartner Forecast: PCs, EMEA, September 2008

3.3.2 Future analysis

Table 10 Extrapolation & background calculations – sales data

Year	Methodology & assumptions
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2009-2012	Desktop and laptop PC sales - used sales forecast figures in Gartner Forecast: PCs, EMEA, September 2008
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3.4 Data issues - sales

- 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 11 Data issues - sales

Issue/risk	Approach taken/rationale
The ICT market changes rapidly. A sudden change in the ICT market can have large impacts on sales. For example, the PCs have shifted dramatically in the last two years from desktop PCs toward laptop PCs due to decreased costs.	MTP takes account of probable changes in future stock. These assumptions are reviewed on an annual basis.

3.5 Confidence level

- This section provides an indication of overall confidence in the data set (i.e. data points, interpolation and projections).
- MTP has a large amount of confidence in the sourced sales data inputted into the desktop and laptop models.

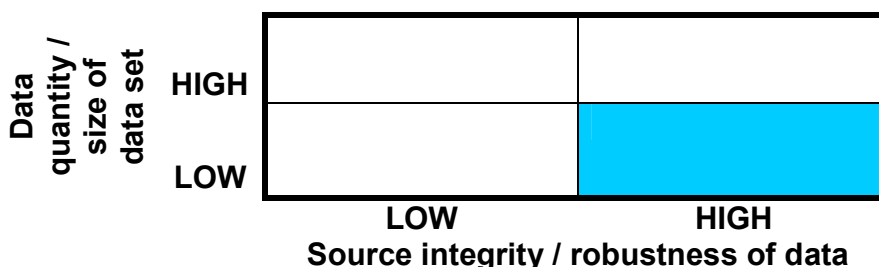
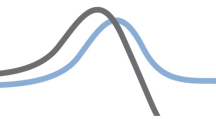


Figure 4 Confidence indicator for sales data



4 Usage & lifespan

4.1 Summary

- Two sets of use profiles are developed for desktop and laptop PCs. The first use profile is based on a situation where no power management is enabled and the second where power management is enabled. The non-enabled power managed use profile is the same as the enabled use profile but with the sleep time added to the on-idle time. An “enabling rate” is used as a weighting factor between these two use profiles to arrive at overall use profile for each product. Details of enabling rates can be found in each scenario GSN.
- The table below shows the **fully enabled use profile** (i.e. what 100% enabling would look like). The non-power managed use profile is calculated by adding the sleep mode time to the on-ready time.

Table 12 Usage PCs - all scenarios

	Desktop				Laptop			
	(Use Hours/Year)				(Use Hours/Year)			
Year	On-Active	Sleep	Off	Off-Unplugged	On-Active	Sleep	Off	Off-Unplugged
2008	1,507	533	6,431	289	1,321	620	1,950	4,869
2010	1,507	533	6,431	289	1,321	620	1,950	4,869
2020	1,507	533	6,431	289	1,321	620	1,950	4,869
2030	1,507	533	6,431	289	1,321	620	1,950	4,869

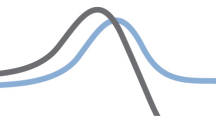


Table 13 Lifespan of PCs and laptops

	Desktop PCs	Laptop PCs
	Lifespan	Lifespan
	All Scenarios	All Scenarios
Year	Years	Years
2008	4.0	2.5
2010	4.0	2.5
2020	4.0	2.5
2030	4.0	2.5

- Total use hours for desktop and laptop PCs (on-idle and sleep mode) are limited by office hours and so in total do not increase into the future.
- Lifespan is expected to remain constant into the future as advances in desktop and laptop PC technology continue to necessitate regular upgrading.

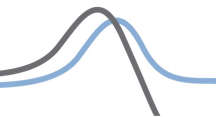
4.2 Data sources – usage & lifespan

Table 14 Usage & lifespan data sources – Desktop PC

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2008	Fraunhofer	2006	Fraunhofer	Used to compare against expert	Medium

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Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
				assumed figures.	
2008	ENERGY STAR Use profiles	2005 and 2006	ENERGY STAR	Used to compare against expert assumed figures.	Medium
2008	LBNL use profiles	2005	LBNL	Used to compare against expert assumed figures.	Medium
2008	TIAX	Jun-05	TIAX	Used to compare against expert assumed figures.	Medium
1988, 2000, 2008 -	Expert Assumptions	2009	MTP Technical Expert	Expert assumption required to develop use profiles in each year.	Medium
2008	Expert Assumptions	2009	MTP Technical Expert	Expert assumption required for lifespan in each year.	Medium

Table 15 Usage & lifespan data sources – Laptop PC

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2008	Fraunhofer	2006	Fraunhofer	Used to	Medium

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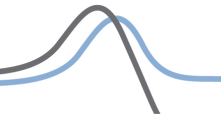
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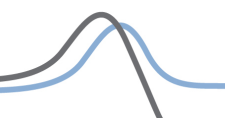
Last reviewed: 24/06/2010

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Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
				compare against expert assumed figures.	
2008	ENERGY STAR Use profiles	2005 and 2006	ENERGY STAR	Used to compare against expert assumed figures.	Medium
2008	LBNL use profiles	2005	LBNL	Used to compare against expert assumed figures.	Medium
2008	TIAX	Jun-05	TIAX	Used to compare against expert assumed figures.	Medium
2008,	Expert Assumptions	2009	MTP Technical Expert	Expert assumption required to develop use profiles in each year.	Medium
2008	Expert Assumptions	2009	MTP Technical Expert	Expert assumption required for lifespan in each year.	Medium



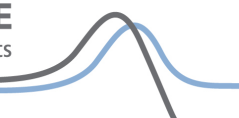
4.3 Methodology & key assumptions – usage & lifespan

- This section describes what has been done with the data listed in Table 14 and Table 15 along with a rationale for any key assumptions (in particular any expert judgements listed in Table 14 and Table 15) and detail of any background calculations behind the data points.

4.3.1 Historic data

Table 16 Interpolation & background calculations – usage & lifespan data

Year	Methodology & assumptions
	General PC usage
1960 - 2007	Desktop and laptop PC – two sets of use profiles are developed for each product type one based on a situation where no power management is enabled and the second where power management is enabled. An “enabling rate” is used as a weighting factor between these two use profiles to arrive at overall use profile for each product. Desktop and laptop PC non-enabled use profile based on same approach used for 2008. Daily use profiles converted to annual use profiles using same approach as in 2008
2008	Desktop and laptop PC non-enabled use profile are the same as the enabled use profile but with the sleep time added to the on-idle time. This is to account for the fact that non-power managed enabled products will not spend any time in sleep mode. Assumptions based on expert opinion as no further information available. Daily use profiles as detailed above are multiplied by 240 days for on-idle and sleep mode and 365 days for off mode and off unplugged to develop annual use profiles.
	Desktop PC (all power modes)
1960 - 1999	Desktop PC (all power modes) assumed to be the same as in 2000. This assumption is based on an expert opinion as no further data was available.
2000	Desktop PC (all power modes) use profiles based on an expert assumption as there no other data available. Assumed that on-idle time is 5.7 hours a day. Off unplugged time is 0.8 hours a day. Sleep mode time is assumed to be the remainder of an 8.5 hour work day after on-idle time is subtracted. Off mode time is assumed to account for the rest of each 24 hour period.
	Desktop PC (on idle)
2001 - 2008	Desktop PC – on-idle use is assumed to increase slightly over time. MTP has added an assumed percentage increase in time spent in on-idle modes for each year. These percentage increases are based on expert opinion assumptions of increased use into the future. Annual percentage increases at 1% in 2001-2008.
	Desktop PC (sleep/off)
2001- 2008	Desktop PC – sleep and off mode use is calculated in the same way as in 2000.
2001 - 2008	Desktop PC – off unplugged time assumed to be equal to the value of 0.8 hours a day in 2000. This is based on an expert assumption as no further information was available.
	Laptop PC (on idle)
1960 – 2007	Laptop PC – on-idle time is based on the same assumption made in 2008.
2008	Laptop PC – on-idle time assumed to be that of desktop PC on-idle time minus the extra time spent in sleep mode and minus a further 7% to account for on-idle whilst on battery power. This calculation is based on expert assumption.
	Laptop PC (sleep/off)
1960 – 2007	Laptop PC – sleep mode time is based on the same assumption made in 2008.
1960 – 2007	Laptop PC – off mode and off unplugged time is based on the same assumption

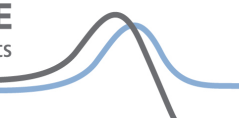


Year	Methodology & assumptions
	made in 2008.
2008	Laptop PC – sleep mode time assumed to be 25% higher than that of desktop PC sleep mode time but 7% (3 hours per week) assumed to be spent on battery power. Estimates are based on expert assumptions.
2008	Laptop PC – off-mode use time is assumed to account for the rest of each 24 hour period once on-idle, sleep and off-unplugged time are accounted for.
2008	Laptop PC – off unplugged time - based on the assumption that 80% of the time laptop PCs are not in on-idle or sleep mode are spent off unplugged (as opposed to the energy consuming off (plugged in) mode). Accounts for 80% people unplugging after work. Also added 25% of on-idle and sleep time to account for use on battery power.
	Lifespan
2008	Lifespan assumed to be constant at 4.0 years for desktop PCs and 2.5 years for laptop PCs. Lifespans are based on expert opinion. These lifetimes do not reflect any possible second lifetime of products.
1960 - 2007	Lifespan assumed to be the same as in 2008.

4.3.2 Future analysis

Table 17 Extrapolation & background calculations – usage & lifespan data

Year	Methodology & assumptions
	General PC usage
2009 - 2020	Desktop and laptop PC non-enabled use profile based on same approach used for 2008. Daily use profiles converted to annual use profiles using same approach as in 2000.
2021 - 2030	Desktop and laptop PC – (all power modes) use is assumed to be the same as in 2020.
	Desktop PC (on-idle)
2009-2020	Desktop PC – on-idle use is assumed to remain the same as in 2008 due to an assumed maximum 8.5 hour work day.
	Desktop PC (sleep/off)
2009-2020	Desktop PC – sleep and off mode use is calculated in the same way as in 2000.
2009 -2020	Desktop PC – off unplugged time assumed to be equal to the value of 0.8 hours a day in 2000. This is based on an expert assumption as no further information was available.
	Laptop PC (on-idle)
2009 - 2020	Laptop PC – on-idle time calculated using the same method as in 2008.
	Laptop PC (sleep/off)
2009 - 2020	Laptop PC – sleep mode time is based on the same assumption made in 2008.
2009 - 2020	Laptop PC – off mode and off unplugged time is based on the same assumption made in 2008.
	Lifespan
2009 - 2030	Lifespan assumed to be constant at 4.0 years for desktop PCs and 2.5 years for laptop PCs. Lifespans are based on expert opinion. These lifetimes do not reflect any possible second lifetime of products.



4.4 Data issues – usage & lifespan

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

Table 18 Data issues – usage & lifespan

Issue/risk	Approach taken/rationale
Estimates of the time ICT products spend in each power mode varies considerably from source to source. The amount of time products spend in “on-modes” has a large impact on total energy consumption calculations. Large divergences in estimates suggest that knowledge in this area needs to be improved.	MTP have collated the most widely known use profiles and applied expert assumptions to derive expected use profiles for ICT products in the UK. MTP will continue to evaluate new use profile data.
The ICT industry can change rapidly. Rapid changes such as uptake of new technologies can have large impacts on the use of products as organisations take up new or altered practices.	MTP attempt to model the most likely set of use profiles to reflect current product usage and take possible future uses into consideration.
Lifetime data may vary considerably. Likelihood that some desktop and laptop PCs have a second lifetime after first 4.0 or 2.5 years.	It is recognised that some additional energy consumption may be derived from PCs during second lifetimes. MTP assumes that use from these products will be minimal in the UK as most organisations would purchase a new PC.

4.5 Confidence level – usage & lifespan

- This section provides an indication of overall confidence in the data set (i.e. data points, interpolation and projections)
- Use profile figures vary considerably between published sources. Calculating simple averages of the published figures resulted in unrealistic use profiles. For this reason, MTP needed to make some assumptions surrounding expected use profiles.

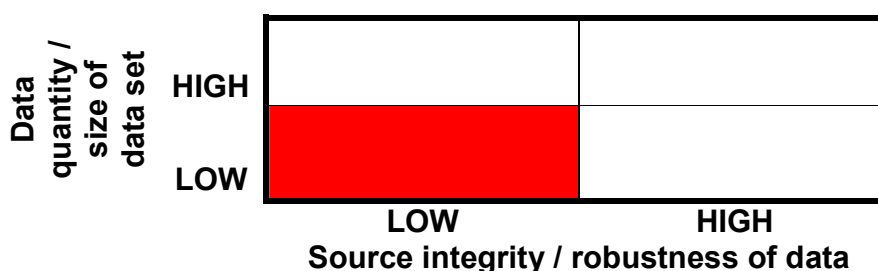
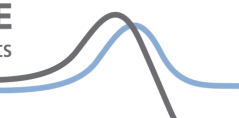


Figure 5 Confidence indicator for usage & lifespan data



Related MTP information

- 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 Imaging Products
- 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 Version 1.0

- Minor changes to the template.

Consultation and further information

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

For further information on related issues visit <http://efficient-products.defra.gov.uk>