



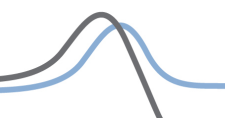
BN-DICT PC03: Domestic Computers Government Standards Evidence Base 2009: Policy Scenario

Version 1.1

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

1 Introduction

- The Policy Scenario is a projection of what would happen if a defined set of new product-specific and related cross-cutting policies were implemented. The policies in the Policy Scenario have not yet been agreed or funded but represent those policies which are expected to be introduced as well as likely future revisions to existing policies and, in some cases, novel policy options. These policies aim to improve the average efficiency of products in the stock through a variety of mechanisms (e.g. minimum standards, product information and labelling, procurement, incentives) and thus reduce energy consumption and carbon emissions resulting from these products.
- As product policy is considered within the context of climate change policy, the UK government considers policies with a net UK costs of up to around £20 per tonne of CO₂ saved (compared to the reference scenario). The ambition level, at a minimum, matches the Least Life Cycle Cost (LLCC) level to society of increased energy efficiency of products.
- The costs for each policy, where known, are also included, separated out for government, consumer and industry.



- This Government Standard Briefing Note (GSBN) covers domestic personal computers. The following definitions of PCs are adapted from the ErP 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 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 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.

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)

2 Scenario outputs

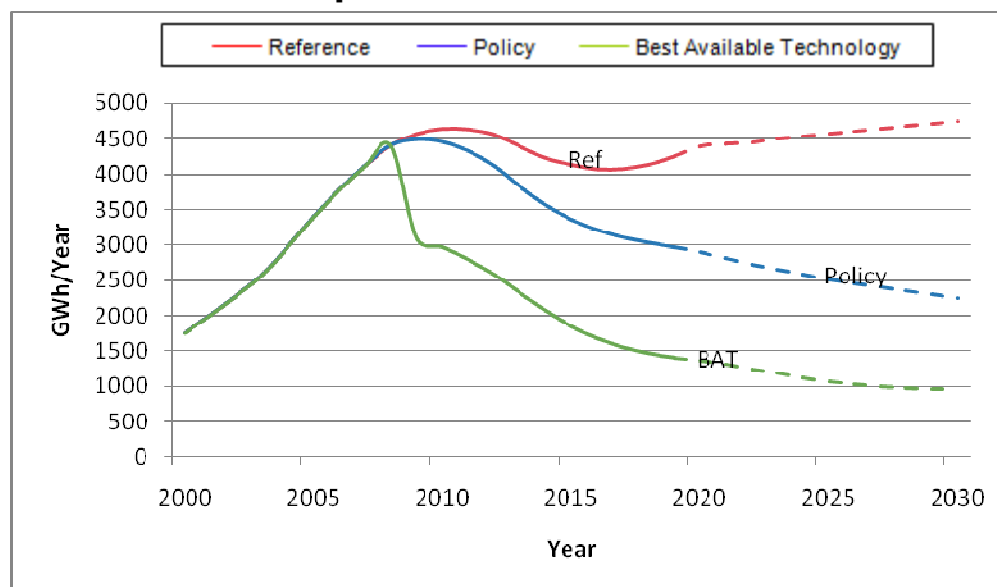


Figure 1 Total Domestic PC Energy Consumption

- Total domestic energy consumption from desktop and laptop PCs in the policy scenario is expected to fall from 2009. This decrease is primarily due to a shift towards laptop PCs from desktop PCs. Desktop and laptop PC efficiency is also expected to increase under the policy scenario until 2030 due to current and new policy initiatives extending until this time. These policies help to offset some of the extra energy consumption associated with the continued increase in laptop PC stock.
- Total energy consumption from domestic desktop PCs in the policy scenario is expected to fall from 2009 onwards due almost entirely due to falling stock levels.
- Total domestic energy consumption from laptop PCs in the policy scenario is expected to rise slowly toward 2030. Whilst the policy scenario energy consumption is considerably lower than the reference scenario, the increase in laptop PC stock will offset any efficiency gains expected in the products.

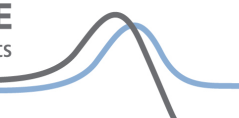
Table 1 Domestic PC Energy consumption and savings and CO2 emissions² and savings

Energy Consumption (GWh)	2009	2020	2030
Laptop	700	1530	1560
Desktop	3790	1370	690
TOTAL	4490	2900	2250

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

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Energy Savings (GWh)			
Laptop	0	740	1460
Desktop	0	770	1030
TOTAL	0	1500	2490
CO₂ Emissions (MtCO₂)			
Laptop	0.26	0.58	0.59
Desktop	1.41	0.52	0.26
TOTAL	1.67	1.09	0.85
CO₂ Emissions Savings (MtCO₂)			
Laptop	0.00	0.28	0.55
Desktop	0.03	0.29	0.39
TOTAL	0.03	0.57	0.94

Table 2 Summary costs and benefits³

	Average annual energy savings (£m)	Average annual product & policy cost increases (£m)	Net Benefit (£m)	Cost Effectiveness (traded) (£/tCO₂)
Desktop and laptop PCs	120	8	1,697	-107.9

Table 3 Government standards market average – domestic computer products

Domestic Computer Products		
	Desktop PC	Laptop PC
Year	on-idle power (W)	on-idle power (W)
2009	85.9	23.4

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



3 Future potential policy & measures

- All policies and measures are discussed in detail within the Reference scenario GSBN for computer products. This section of the document focuses on future measures included within each of the policies.
- Future ENERGY STAR revisions are expected every four years (occurring in 2013, 2017, 2021, 2025, 2029).
- Future ErP measures addressing the on-idle and sleep modes of desktop and laptop PCs are assumed to be implemented in 2012, 2016, 2020, 2024, 2028 with specifications levels assumed to be based on the preceding ENERGY STAR specifications. ENERGY STAR on-mode specifications levels into the future are based on a percentage reduction from preceding year's specification level (until 2013) and then an assumed percentage decrease for each preceding specification.
- The Energy Saving Trust endorses 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. A modest increase in ESR market coverage is expected in the future. Future ESR specifications are expected each year up to 2030. ESR on-mode specifications levels into the future are based on a percentage reduction from preceding year's specification level.
- 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.
- The Policy Scenario assumes improvement to 55% (desktop PCs) and 63% (laptop PCs) power management enabling rate by 2014, and a further improvement to 79% (desktop PCs) and 90% (laptop PCs) by 2020, resulting in a significant reduction in total product energy consumption.

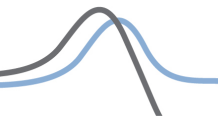
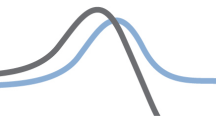


Table 4 Future potential policies & measures, Policy Scenario

Policy name	Period in force	Description	Impact	Cost	Justification
ENERGY STAR	2009 – 2030	Current ENERGY STAR specifications include maximum power (W) levels. The agreed 2009 specifications move to a TEC approach and declare maximum kWh/year levels for each category of desktop and laptop PC. MTP has translated the ENERGY STAR TEC values into power (W) figures using results in the 2008 ENERGY STAR specification development dataset. Future ENERGY STAR specifications are assumed for 2013, 2017, 2021, 2025 and 2029 each with increased efficiency requirements.	ENERGY STAR is assumed to have a large impact on the energy efficiency of desktop and laptop PCs in their on-idle and sleep modes. ENERGY STAR will have less of an influence on off-mode power as this will be heavily impacted by the ErP Standby Implementing Measures.	No cost is assumed for ENERGY STAR compliance as it is a voluntary programme. ENERGY STAR compliance is heavily driven by the US market in particular its mandatory nature in US public procurement	ENERGY STAR is the main energy efficiency policy impacting ICT products.
ErP desktop and laptop PC Implementing Measures	2012-2030	Expected to be based on previous ENERGY STAR specifications.	Expected to remove remaining products from the market which have not reached the 4 year old ENERGY STAR specification.	The cost of changing products to meet the future ErP measures varies across the different types of imaging devices. Please refer to section 5 in this GSBN for further information about costs.	ErP Implementing Measures for on-idle and sleep mode power consumption were highlighted in the ErP Computer preparatory study. Within the preparatory study it was suggested that future ErP Implementing Measures could be based on past ENERGY STAR specifications.
ESR	2009-2030	ESR label used by the EST to endorse products meeting the top 20% of the energy efficient products on the market.	ESR currently has a small impact in the market place with less than 1% of products on the UK market bearing the label. A small increase in uptake of the ESR label is assumed	No costs assigned to the ESR label due to low coverage rates and the programme's voluntary nature.	ESR is included in the MTP modelling as the UK's only national eco-label for ICT products.

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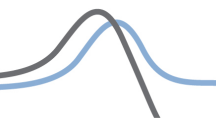
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Policy name	Period in force	Description	Impact	Cost	Justification
			by 2016.		
EU Eco-label	2011 - 2030	EU Eco-label is the European Commission eco-label. Covers wider lifecycle impacts as well as energy in use. Energy efficiency specifications expected to refer to ENERGY STAR.	Impact on market deemed to be minimal due to low coverage rates.	No costs assigned to the due to low coverage rates and the programme's voluntary nature.	EU Eco-label is the European Commission's own label. Whilst coverage rates are low they could increase if extra resources are put into the label programme.
Power Management	2014-2030	Increased power management enabling requirements within ErP and ENERGY STAR specifications	Potential significant impacts on total energy consumption from desktop and laptop PCs.	No cost assumed as technology already exists on most PCs.	Could have significant impacts on total energy consumption without the need to change any product components.

Table 5 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	2005	Provides a measurement method for standby/off-mode power (W)	In the process of being revised.
IEC 62301 Ed.2	TBD	Will provide a revised methodology for measuring standby/off-mode power (W). The revisions in the standard are likely to focus on nomenclature of power modes.)	



3.1 Policy timeline

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

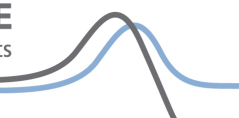
Table 6 Future policies & measures, Policy Scenario

Policy name	Current specification in force	2009	2010	2011	2012	2013	2014	2015	2016-2020	2021-2025	2026-2030
ENERGY STAR (future measures)	n/a					2013 Estimate			2017 Estimate	2021 and 2025 Estimate	2029 Estimate
ErP Implementing Measures (Desktop and laptop PC)	n/a				2012 Estimate				2016 and 2020 Estimate	2024 Estimate	2028 Estimate
ESR	2007	Estimated refresh each year →									
Power Management Programme	n/a						Est. (55% to 63% PM Rate)		2020 Est 79% to 90%PM Rate)		

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 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 desktop or laptop PCs. Further information about the ENERGY STAR metrics can be seen in the reference scenario GSBN for desktop and laptop PCs.



- The tables below illustrate the expected ENERGY STAR coverage rate for each product type covered in this GSBN. The expected ENERGY STAR coverage rate (the number of products which meet the ENERGY STAR specification) increases each year until the new specification is implemented. It is assumed that ErP Implementing Measures will be based on the previous ENERGY STAR specification (therefore within 8 years 100% of products will be compliant to the previous ENERGY STAR specification).

Table 7 Expected Domestic Desktop PC ENERGY STAR Coverage Rates

Year	Specification Years						
	2007 Spec (Agreed)	2009 Spec (Agreed)	2013 Spec (Forecast)	2017 Spec (Forecast)	2021 Spec (Forecast)	2025 Spec (Forecast)	2029 Spec (Forecast)
2010	41%	30%	13%	8%	4%	3%	2%
2015	32%	29%	20%	7%	5%	4%	3%
2020	0%	0%	43%	31%	11%	8%	7%
2025	0%	0%	0%	40%	31%	19%	9%
2030	0%	0%	0%	0%	42%	35%	23%

Table 8 Expected Domestic Laptop PC ENERGY STAR Coverage Rates

Year	Specification Years						
	2007 Spec (Agreed)	2009 Spec (Agreed)	2013 Spec (Forecast)	2017 Spec (Forecast)	2021 Spec (Forecast)	2025 Spec (Forecast)	2029 Spec (Forecast)
2010	39%	35%	12%	5%	4%	3%	2%
2015	31%	29%	22%	7%	5%	4%	3%
2020	0%	0%	42%	32%	11%	8%	7%
2025	0%	0%	0%	38%	31%	23%	8%
2030	0%	0%	0%	0%	39%	35%	26%

- The Reference Scenario GSBN provides a full description of the ENERGY STAR specification process and how MTP has interpreted the values.
- The on-idle mode power figures, developed from the ENERGY STAR specifications, is used as the main metric of desktop and laptop power consumption as it dominates the overall energy consumption of these products.

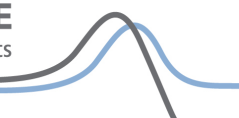
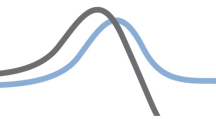


Table 9 Domestic Desktop and Laptop PC Power Consumption – Policy Scenario

Year	Desktop PC		Laptop PC	
	MTP Policy Scenario	Estimated ENERGY STAR Specifications	MTP Policy Scenario	Estimated ENERGY STAR Specifications
	On-Idle (W)	On-Idle (W)	On-Idle (W) ⁴	On-Idle (W) ²
2009	85.9	50.7	23.4	21.3
2010	74.7		22.8	
2011	64.3		22.3	
2012	52.7		21.8	
2013	51.2	45.6	21.0	18.9
2014	49.6		20.2	
2015	48.1		19.4	
2016	46.6		18.7	
2017	45.4	41.1	18.2	17.3
2018	44.3		17.6	
2019	43.2		17.1	
2020	42.1		16.6	
2021	41.4	39.0	16.2	15.5
2022	40.7		15.7	
2023	40.0		15.3	
2024	39.3		14.9	
2025	38.8	37.1	14.6	14.0
2026	38.4		14.3	
2027	37.9		14.0	
2028	37.4		13.8	
2029	36.9	35.2	13.6	13.1
2030	36.4		13.4	

- Table 9 shows the MTP power consumption requirements under the policy scenario for desktop and laptop PCs in on-idle mode. The table also lists the estimated ENERGY STAR specifications in each year that they are expected to be refreshed. The ENERGY STAR specifications are slightly lower than the policy scenario to account for the fact that not all products on the market will be expected to meet the current ENERGY STAR specifications.

⁴ Includes estimated power for screen (W)



4.2 Data sources – efficiency

Table 10 Desktop Efficiency data sources

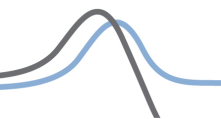
Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2009, 2010, 2012, 2013, 2015- 2017, 2020, 2021, 2024, 2025, 2028, 2029, 2032, 2033	Expert Assumptions	2009	MTP Technical Expert	Required expert assumptions to extrapolate sourced power data into the future and to calculate ENERGY STAR coverage rates	Medium

Table 11 Laptop Efficiency data sources

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2009, 2010, 2012, 2013, 2015- 2017, 2020, 2021, 2024,	Expert Assumptions	2009	MTP Technical Expert	Required expert assumptions to extrapolate sourced power data into the future	Medium

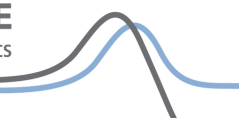
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Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2025, 2028, 2029, 2032, 2033					

Note: Historic data sources are included in BN-DICT PC02 – Reference Scenario



4.3 Methodology & key assumptions – efficiency

- This section describes what has been done with the data listed in the Reference Scenario GSBN along with a rationale for any key assumptions (in particular any expert judgements listed in Table 10 and Table 11) and detail of any background calculations behind the data points.
- Table 12 describes the process taken when developing the MTP policy scenario.
 - Stage 1 identifies how the specification levels for each policy were calculated.
 - Stage 2 describes how the individual specifications were combined to develop the MTP policy scenario.
 - Stage 3 details how the ENERGY STAR coverage rates were calculated.
- Methodology & key assumptions for historic data are included in BN-DICT PC02 – Reference Scenario

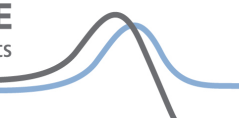
4.3.1 Future data

Table 12 Extrapolation & background calculations – Desktop and Laptop PC efficiency

Year	Methodology & assumptions
Stage 1: Policy Specification Value Calculations	
2009	Desktop and laptop PCs – ENERGY STAR specification (on-idle, sleep mode and off-mode power): Specification level is based on a model weighted distribution of ENERGY STAR specifications for each desktop and laptop PC category. Sales weighting is based on the distribution of products found in the EU ENERGY STAR database during 2008.
2013, 2017, 2021, 2025, 2029, 2033	Desktop and laptop PCs – ENERGY STAR specification value (on-idle and sleep mode power): It is assumed that the ENERGY STAR specifications will be refreshed in these years. These values are based on an assumed increase in efficiency over the preceding ENERGY STAR specification value (which was developed four years in the past). The level of assumed efficiency gain ranges between 5% and 10%. The 10% value is used in the first refresh and the 5% values for each subsequent refresh period to reflect diminishing gains. The percentage decreases are based on expert assumption. (note 2033 specification assumed for smooth modelling to 2030 overall).
2010–2012, 2014–2016, 2018–2020, 2022–2024, 2026–2028, 2030–2032	Desktop and laptop PCs – ENERGY STAR specification value (on-idle and sleep mode power): The values for each year are based on a straight line interpolation between the preceding year's and future year's ENERGY STAR specification value.
2013	Desktop and laptop PC – ENERGY STAR specification value (off-mode (W)) is assumed to be at 0.5W to match ErP.
2010–2012	Desktop and laptop PC – ENERGY STAR specification value (off-mode (W)): The values for each year are based on a straight line interpolation between the preceding year's and future year's ENERGY STAR specification value.
2014 - 2030	Desktop and laptop PC – ENERGY STAR specification value (off-mode (W)): It is assumed that ENERGY STAR will use the 2013 ErP Implementing measure of 0.5W as a specification to ensure that ENERGY STAR qualified products are legally compliant in the EU.
2009, 2010, 2011	Desktop and laptop PC - ESR Specification values (on-idle mode): The 2009, 2010 and 2011 values are the sales weighted averages of the published ESR

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Year	Methodology & assumptions
	specifications. The sales weighting is based on the distribution of products found in the EU ENERGY STAR database during 2008.
2012 - 2030	Desktop PC - ESR Specification values (on-idle mode): The specification value is assumed to be 5% lower than the ENERGY STAR specification in the same year.
2012 - 2030	Laptop PC - ESR Specification values (on-idle mode): The specification value is assumed to be 2% lower than the preceding years' ESR. The 2% is based on the reduction in power requirements between the 2011 and 2010 ESR specifications.
2009	Desktop and laptop PC – ESR Specification Values (off-mode (W)) are based on the published ESR specification.
2010 - 2012	Desktop PC – ESR Specification Values (off-mode (W)) are assumed to be 5% lower than the ENERGY STAR specifications of the same year. Assumption is based on expert opinion.
2010 - 2012	Laptop PC – ESR Specification Values (off-mode (W)): The ESR 2009 specification is used.
2013-2030	Desktop and laptop PC - ESR Specification Values (off-mode (W)): It is assumed that ESR will use the 2013 ErP Implementing measure of 0.5W as a specification to ensure that ESR qualified products are legally compliant in the EU.
2012, 2016, 2020, 2024, 2028, 2032	Desktop and laptop PC - ErP specification value (on-idle and sleep mode power): The ErP specification value in these years matches the previously implemented ENERGY STAR specification value.
2013–2015, 2017–2019, 2021–2023, 2025-2027, 2029–2031	Desktop and laptop PC - ErP specification value (on-idle and sleep mode power): The values for each year are based on a straight line interpolation between the preceding year's and future year's ErP specification value.
2014 to 2030	Desktop and laptop PC – ErP specification value (off-mode power (W)): The ErP 2013 standby implementing measure of 0.5 W is applied linearly in each subsequent year as no further improvement is considered possible.
2011 - 2030	Desktop and laptop PC – EU Eco-label values (on-idle and sleep mode) are assumed to equal the ENERGY STAR specifications in the same year.
Stage 2: Policy Scenario Calculation	
2009 - 2030	Overall policy scenario: this overall policy scenario brings together the results of all the individual policy scenario calculations. The scenario is based on the minimum value that occurs in either the reference scenario or in any of the individual policy scenarios. If the minimum value occurs in the reference scenario it shows that the package of policies is having no impact.
2012, 2016, 2020, 2024, 2028, 2032	Desktop and laptop PC - ENERGY STAR policy scenario: values (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 reference scenario value.
2009-2011, 2013–2015, 2017–2019, 2021–2023, 2025-2027, 2029–2031	Desktop and laptop PC - ENERGY STAR policy scenario: values for (on-idle and sleep mode): The values for each year are based on a straight line interpolation between the preceding year's and future year's calculated ENERGY STAR policy scenario value.
2012, 2016, 2020, 2024, 2028, 2032	Desktop and laptop PC - ESR policy scenario: values (on-idle and sleep mode) are based on a weighted percentage of products which are assumed to meet the ESR specification with the remaining percentage of products meeting the ENERGY STAR policy scenario figures.
2009-2011, 2013–2015, 2017–2019, 2021–2023,	Desktop and laptop PC - ESR policy scenario: values for (on-idle and sleep mode): The values for each year are based on a straight line interpolation between the preceding year's and future year's ESR policy scenario value.

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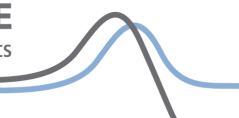
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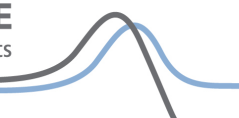
Year	Methodology & assumptions
2025-2027, 2029-2031	
2009 - 2011	Desktop and laptop PC - ErP policy scenario (on-idle and sleep mode): includes an assumed improvement in product performance ahead of ErP implementation in 2012. This reflects the thinking that manufacturers would improve product energy efficiency ahead of the ErP implementation date. The figures for these years are calculated on an assumed % reduction from the reference scenario figures. The percentage reductions are based on expert opinion and are tailored to ensure that the ErP policy scenario in these years does not fall below the 2012 implementing measure.
2012, 2016, 2020, 2024, 2028, 2032	Desktop and laptop PC - ErP policy scenario: values (on-idle and sleep mode) are based on a weighted percentage of products which are assumed to meet the ErP specification with the remaining percentage of products meeting the ESR policy scenario figures (ESR policy scenario includes the combined effects of the ENERGY STAR, EU Eco-label as well as the ESR specifications).
2013-2015, 2017-2019, 2021-2023, 2025-2027, 2029-2031	Desktop and laptop PC - ErP policy scenario: values for (all power modes): The values for each year are based on a straight line interpolation between the preceding year's and future year's ErP policy scenario value.
2009 - 2012	Desktop and laptop PC - ErP policy scenario (off mode): includes an assumed improvement in product performance ahead of ErP implementation in 2013. This reflects the thinking that manufacturers would improve product energy efficiency ahead of the ErP implementation date. The figures for these years are calculated on an assumed % reduction from the reference scenario figures. The percentage reductions are based on expert opinion. The off-mode and are tailored to ensure that the ErP policy scenario in these years does not fall below the 2013 implementing measure (as the 2013 implementing measure is assumed to be the lowest power requirement in the policy scenario).
2012	Desktop and laptop PC - ENERGY STAR policy scenario (off-mode (W)): based on a weighted percentage of products which meet the ENERGY STAR specification with the remaining percentage of products meeting the average reference scenario value.
2009 - 2011	Desktop and laptop PC - ENERGY STAR policy scenario (off-mode (W)): The values for each year are based on a straight line interpolation between the preceding year's and future year's ESR policy scenario value.
2012	Desktop and laptop PC - ESR policy scenario: values (off-mode (W)): values are based on a weighted percentage of products which are assumed to meet the ESR specification with the remaining percentage of products meeting the ENERGY STAR policy scenario figures. Market coverage of ESR is expected to be 1% until 2015 and then increase to 5%.
2009 - 2011	Desktop and laptop PC - ESR policy scenario: values for (off-mode (W)): The values for each year are based on a straight line interpolation between the preceding year's and future year's ESR policy scenario value.
2014 -2030	Desktop and laptop PC - All policy scenarios (off-mode (W)): All values based on the 2013 ErP Implementing Measure of 0.5W.
Stage 3: Efficiency Sales Weighting	
2009-2030	Desktop and laptop PC - sales weighting for ENERGY STAR coverage graphs: The ENERGY STAR coverage graphs illustrate an assumed mix of coverage levels in the market place against ENERGY STAR specifications set in 2007, 2009, 2013, 2107, 2021, 2025 and 2029.
2009	Desktop and laptop PC - sales weighting for ENERGY STAR coverage graphs: Current coverage of products in EU ENERGY STAR database to the 2009 ENERGY STAR specification value. This calculation provides a percentage

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First created: 22/04/2009

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Last reviewed: 26/06/2010



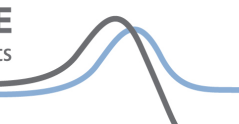
Year	Methodology & assumptions
	compliance rate for those products already in the EU ENERGY STAR database. Where necessary, a correction factor is then added (value assumed by the technical expert) to account for the fact that the products in the EU ENERGY STAR database do not account for the whole market. The correction factor therefore provides an estimate of how many products on the whole market are likely to be meeting the ENERGY STAR specification value.
2009	Desktop and laptop PC - sales weighting for ENERGY STAR coverage graphs: Coverage rates for 2009 against assumed 2013, 2017, 2021, 2025 and 2029 ENERGY STAR specification values are assumed.
2012, 2016, 2020, 2024, 2028	Desktop and laptop PC - sales weighting for ENERGY STAR coverage graphs: It is assumed 1 year prior to the implementation of new ENERGY STAR specifications the specifications are developed to cover approximately 25% of the most energy efficient products on the market.
2012, 2016, 2020, 2024 and 2028	Desktop and laptop PC - sales weighting for ENERGY STAR coverage graphs: It is assumed that 100% of products meet revised ENERGY STAR specifications 7 years after implementation. This is based on the assumption that ErP will require that all products sold in the EU market meet the previous ENERGY STAR specifications.
2010–2015, 2013-2019, 2017-2023, 2021-2027, 2025-2030	Desktop and laptop PC - sales weighting for ENERGY STAR coverage graphs: The values for each year are based on a straight line interpolation between the preceding year's and future year's ENERGY STAR coverage rates.
2010, 2015, 2020, 2025 and 2030	Desktop and laptop PC - sales weighting for ENERGY STAR coverage graphs: Coverage rates for the 2007, 2009, 2013, 2021, 2025 and 2029 ENERGY STAR specifications are normalised to 100% for graphing purposes.

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 13 Data issues – efficiency

Issue/risk	Approach taken/rationale
Much of the power data sourced for desktop and laptop PCs comes from products compliant to ENERGY STAR. There is a risk that the policy figures could be too low which results in future values also being too ambitious.	MTP have assumed future specification values for ENERGY STAR based on estimated efficiency savings. The expected efficiency gains in each four year period are kept to a relatively low level.
Product development in the ICT industry is rapid. The MTP future policy scenario assumptions could change with a sudden uptake of an extremely efficient or inefficient product.	MTP review the reference scenario figures on an annual basis. This annual review will ensure that MTP policy scenario 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 into the future. MTP will review this assumption on an annual basis.



4.5 Confidence level – efficiency

- MTP uses its current database of product information to estimate what could happen in future years to products’ energy efficiency. The fast moving nature of the ICT industry could result in these estimates needing to change considerably in future years.

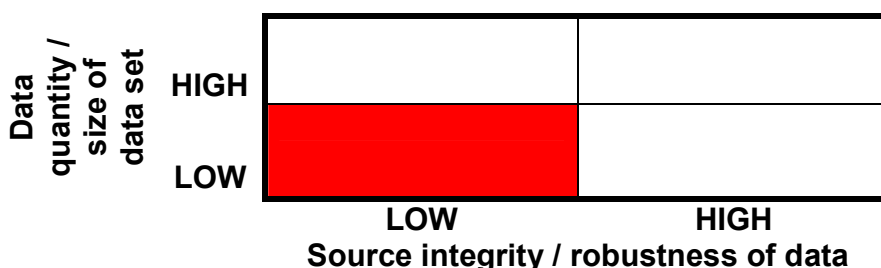


Figure 2 Confidence indicator for efficiency data

5 Usage

5.1 Summary

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

Table 14 – Average Usage Desktop PC

Year	Desktop PC				Power Management Enabling Rates
	(Use Hours/Year)				
	On-Idle	Sleep	Off	Off-Unplugged	%
2009	3050	342	5,170	199	26
2010	3118	441	5002	199	32
2020	3689	1699	3173	199	79
2030	3689	1699	3173	199	79

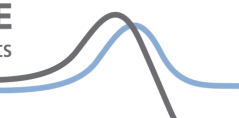
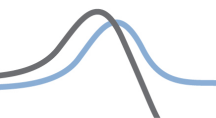


Table 15 – Average Usage Laptop PC

Year	Laptop PC (Use Hours/Year)				Power Management Enabling Rates
	On-Idle	Sleep	Off	Off-Unplugged	%
2009	2005	494	3131	3131	44
2010	2057	566	3068	3068	48
2020	2321	1661	2389	2389	90
2030	2321	1661	2389	2389	90

- Average desktop and laptop PC on-idle use under the policy scenario is expected to reduce slightly over time as more products are power managed.
- Power management enabling rates within the policy scenario are assumed to increase over time largely as a result of new ErP and ENERGY STAR requirements which increase enabling rates to 55% (desktop PCs) and 63% (laptop PCs) by 2014 (by comparison the reference scenario power management rate is only assumed to reach 40% for desktop PCs and 50% for laptop PCs by 2014).
- Power management enabling rates are assumed to increase to 79% (desktop PCs) and 90% (laptop PCs) by 2020 as technical issues become less of a barrier, and power management becomes more engrained in ENERGY STAR and ErP requirements. By comparison the power management rate in the reference scenario is assumed to remain at 40% for desktop PCs and 50% for laptop PCs in 2020 as no further change is expected without the extra policy influence.



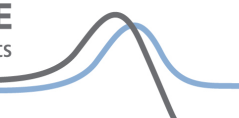
5.2 Data sources – usage

Table 16 Usage data sources (enabling rates) – Desktop and laptop PCs

Year	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
2009, 2014, 2020	Expert Assumptions	2009	MTP Technical Expert	Expert assumption required for power management enabling rates (desktop and laptop PCs).	Medium

5.3 Methodology & key assumptions – usage

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



5.3.1 Future analysis

Table 17 Extrapolation & background calculations – usage data

Year	Methodology & assumptions
2009 - 2030	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. See Key Inputs GSBN for details about use profiles.
2009	Desktop and laptop PC - enabling rate increases are based on expert opinion. Enabling rates for desktop PCs start at 26% in 2009 based on 30% increase from 2008 value. Enabling rates for laptop PCs start at 44% in 2009 (based on a straight line interpolation between the 2008 value and the policy target in 2014). Enabling rates based on expert opinion in light of no further evidence being available.
2010 - 2013	Desktop and laptop PC - enabling rates based on a straight line interpolation between the 2009 and 2014 values.
2014	Desktop and laptop PC - enabling rate increases to 55% (desktop PCs) and 63% (laptops PCs) as a result of a new ENERGY STAR and ErP specifications including enhanced power management requirements..
2015 - 2019	Desktop and laptop PC - enabling rates based on a straight line interpolation between the 2014 and 2020 values.
2020	Desktop and laptop PC - enabling rate increases to 79% (desktop PCs) and 90% (laptop PCs). Power management enabling rates are assumed to increase as ENERGY STAR and ErP requirements on power management become more stringent
2021 - 2030	Desktop and laptop PC - enabling rate same as the 2020 value

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 18 Data issues – usage

Issue/risk	Approach taken/rationale
The power management enabling rates can have a large impact on overall use profiles (especially for the sleep mode hours).	A number of assumptions have been made about future power management enabling rates. These enabling rates will be reviewed on an annual basis.

5.5 Confidence level – usage

- This section provides an indication of overall confidence in the data set (i.e. data points, interpolation and projections)
- Confidence levels about actual base use profiles are included in the key inputs GSBN’s. Confidence levels of the power management enabling rates are relatively low, especially for future years, due to the large potential for users to disable functionality.

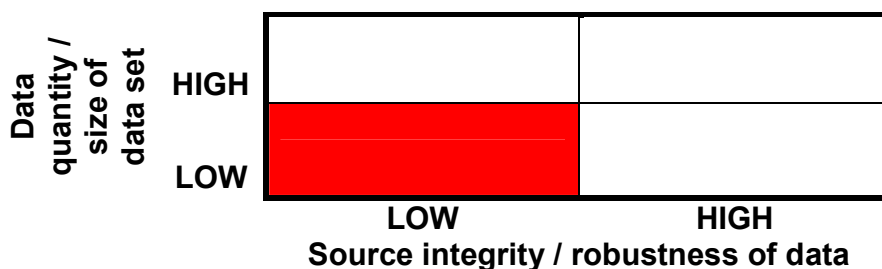


Figure 3 Confidence indicator for usage data

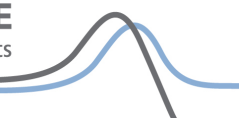
6 Cost

- The cost of adapting products to meet each set of future ErP specifications has been estimated below. No other policy costs are included as they are either voluntary in nature or adaptation would have no fee or costs attached.
- All of the measures suggested are either within the bounds of existing technology already in use on PC products, or future refinements of those existing technologies.
- Microprocessors are shown to have a cost of improvement, although it is feasible that some of this cost could be taken as a “business as usual” cost of on-going development by the chip manufacturer. For this reason, the cost of improvement of microprocessors is held low.
- Cost data is clearly at the heart of commercial competition and not discussed openly within industry – for this reason, all cost data is based on expert opinion from within the MTP team
- All costs stated are marginal costs related to the introduction of a specific energy efficiency improvement in the Policy Scenario, and above the normal purchase cost implied in the Reference Scenario.

6.1 Summary

Table 19 Summary of Costs in each specification year - Undiscounted (real)

Year	Undiscounted cost £000's		
	Desktop PC	Laptop PC	Total
2011	2,513	10,768	13,281
2015	1,382	5,503	6,885
2019	1,198	5,960	7,158
2023	978	6,542	7,521
2027	783	7,160	7,943



6.2 Data sources – cost

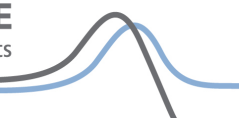
Table 20 Cost data sources

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

6.3 Methodology & key assumptions – cost

- This section describes what has been done with the data listed in Table 20 along with a rationale for any key assumptions (in particular any expert judgements listed in Table 20) and detail of any background calculations behind the data points.
- Power supply units (PSU) differ between desktop and laptop PCs. Desktop PCs use (physically) large higher power (up to 1000W) PSUs whereas laptop PCs use lower power (up to 100W) physically smaller external PSUs. The cost of improvement due to policy has been assumed to be the same for both types as desktop PCs may require larger more powerful components than laptop PCs, but laptop PCs have space constraints which require greater miniaturisation.
- Microprocessors are assumed to continue to follow Moore’s Law⁵ as each year more transistors are packed onto the same size silicon substrate. This does not necessarily mean that the newer generation devices will be more efficient than the previous generation as any benefit derived by closer packing of transistors could be offset by having a greater number of transistors. The policy scenario assumes that chip manufacturers will address these issues by “shutting down” cores (portions of the chip) when the processing load is light to effect efficiency improvement.
- The microprocessor’s clock speed directly influences its power consumption. The policy scenario assumes that chip manufacturers will incorporate “speed switching” in their microprocessors to reduce the clock speed (to improve energy efficiency) when the processing load is light.

⁵ Moore's law illustrates the number of transistors that can be placed inexpensively on an integrated circuit has increased exponentially since the invention of the integrated circuit in 1958, doubling approximately every two years.



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

6.3.1 Future analysis

Table 21 Extrapolation & background calculations – cost

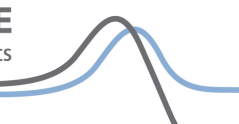
Year	Methodology & assumptions
2011, 2015, 2019, 2023, 2027	Multiple rounds of ErP specifications assigned to desktop and laptop PCs. Measures based on previous ENERGY STAR® specification More energy efficient power supply – assumed £2.00 More energy efficient microprocessor architecture/design – assumed £7.50 More energy efficient hard disk drive – assumed £1 Adaptive processor technology assumed no additional cost
2011, 2015, 2019, 2023, 2027	It is assumed that each ErP specification will be the same as the voluntary specification from 3 years previous. Therefore, it is assumed that in the ErP specification year, the majority of products placed on the market will be compliant, Expert assumptions have been made of the remaining percentage of products placed on the market which require adaptation in the ErP specification year as follows For desktop PCs 2011 12.5% 2015 7.4% 2019 7.4% 2023 7.4% 2027 7.4% For laptop PCs 2011 12.5% 2015 5.7% 2019 5.7% 2023 5.7% 2027 5.7%
2011, 2015, 2019, 2023, 2027	The costs are derived from multiplying the assumed cost of change by the number of products requiring adaptation in each specification year

6.4 Data issues – cost

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

Table 22 Data issues – cost

Issue/risk	Approach taken/rationale
Cost data is at the heart of commercial competition and not discussed openly within industry. Costs vary according to	The approach has been to take indicative feedback provided by industry of current costs to prepare an expert opinion within MTP. These assumptions have



Issue/risk	Approach taken/rationale
specification and with quantity of material purchased. While estimates have been made of current and future costs, the confidence level reduces into the future as uncertainty around specification levels and cost of component changes increases.	been extrapolated linearly into the future. MTP will review on an annual basis

6.5 Confidence level – cost

- This section provides an indication of overall confidence in the data set (i.e. data points, calculations, interpolation and projections)
- Cost data for changing certain components of PCs is difficult to source. Any assumptions are highly dependent on assumed future specification levels and potential energy savings from each component change.

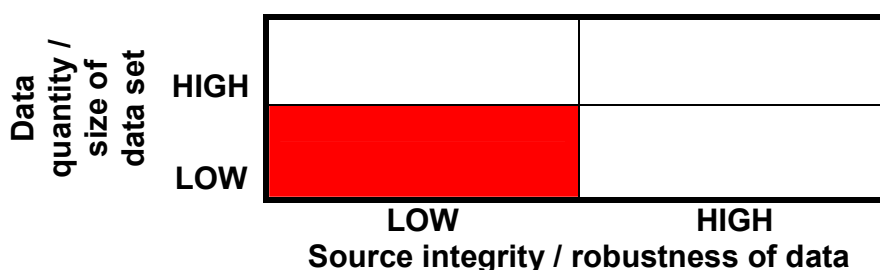


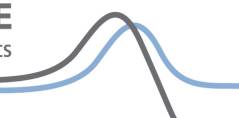
Figure 4 Confidence indicator for cost data

7 Other issues

- None addressed.

Related MTP information

- 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 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 Version 1.0

- Cost and benefit figures updated.
- CEI calculation adjusted and figure updated.
- Minor changes to the template.

Consultation and further information

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

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