

# Product Definition: Laptops

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## 1. Summary Definition and Categorisation

This work covers laptop personal computers (PCs), which are also called notebook PCs, and tablet PCs. Following consultation with an appointed independent expert and Annex participants, the definition and categorisation shown in Table 1 is proposed for laptop computers. Sections 2 and 3

Table 1: Simplified Product Categorisation Matrix

Definition & scope	<p><i>‘A portable computer that performs logical operations and processes data designed to be operated for extended periods of time without a direct connection to an ac power source and typically designed to have similar functionality and software to that of desktop computers. Laptop computers are composed of, at a minimum: (1) a central processing unit (CPU) to perform operations; (2) user input devices such as a keyboard, mouse or digitizer; and (3) an integrated computer display screen to output information.’<sup>1</sup></i></p> <p>Limited to screen sizes above 9 inches.</p>		
ENERGY STAR category	ENERGY STAR V5 Category A	ENERGY STAR V5 Category B	ENERGY STAR V5 Category C
Other physical variables to be noted (but not separately plotted or analysed in detail)	<p>Size of screen</p> <p>Design input voltage for external power supply</p>		

Note:

- Energy requirements of the external power supply are included.
- Energy for any docking station is excluded from this analysis.
- Tablet PCs with touch sensitive screens are included in the scope.

<sup>1</sup> Adapted for this project purposes from ENERGY STAR® Program Requirements for Computers Eligibility Criteria (Version 5.0), US EPA.

## 2. Product Sub-Category Rationalisation

This section explains the rationale behind the summary definition presented in Section 1, and how this was developed. Table 2 shows the first proposed way to break down the product category, and each aspect is discussed sections 1.1 to 1.3.

**Table 2: Initial matrix definition of possible laptop sub-categorisation.**

		Aspect	Possible Permutations		
A	Technology	Screen size	Various sub-divisions are possible, between 9 inches and 17.3 inches (diagonal)		
B	Technology	Other technology	Many possibilities including screen technology, laptop weight, processor speed, storage disk / solid state, storage size, operating system, power supply voltage etc.		
C	Functionality	Laptop processing power characterisation	ENERGY STAR V5 Category A (defined below)	ENERGY STAR V5 Category B (defined below)	ENERGY STAR V5 Category C (defined below)
D	Other	Intended use	Home		Work

### 1.1 Technology

#### **Matrix Row A): Screen size**

The size of screen will influence consumption, often to a comparable extent to the processing power. But screen size is not the sole determining factor of energy consumption. As a guideline to exclude handhelds and smart phones, only screen sizes above 9 inches diagonal will be included.

- *Proposal: It is therefore proposed to seek data for products with screen size equal to or above 9 inches, but not to initially subdivide products by screen size. Data will be invited on this for possible analysis later, particularly if other means to fairly categorise products are not possible. It will also be noted as a means to understand products that may have particularly large or small consumption.*

#### **Matrix Row B): Other technology characteristics**

Laptop PCs could be subdivided by many technology related characteristics such as screen technology, laptop weight, processor speed, storage disk type / solid state, storage size, memory type, graphics processing capabilities, operating system etc). Whilst this complexity may be necessary to manage for product certification schemes, it is proposed that broad benchmarks of performance can be derived without further product subdivision for this project.

However, we recognise that the mains voltage will affect the power supply efficiency, and so overall system efficiency as measurements will generally be taken in this mode. We therefore propose to invite applicable mains voltage as a data item, and checks can be made on any impact of this on market performance.

- *Proposal: It is therefore proposed not to subdivide products by other technology characteristics, but to invite mains voltage rating as a characteristic for analysis.*

### 1.2 Functionality

#### **Matrix Row C): Laptop categories**

In order to fairly compare products with similar characteristics, a method is required to sub-divide the market into similar product types. A categorisation has been developed for laptop PCs under the ENERGY STAR programme, which has been adopted in the US and Europe, and the Energy

Conservation Centre of Japan (ECCJ) also refer to ENERGY STAR for laptop PC energy efficiency purposes.

It is noted, however, that only products registered on the ENERGY STAR scheme are likely to be categorised in this way. It would be very challenging within the resources of this project to determine the appropriate class for databases of products based on published specifications. But conversely, a TEC value could be calculated for any laptop PC for which the idle, sleep and off mode consumptions are known and so all laptop PCs could be compared in one data set using the TEC metric.

- *Proposal: To invite data that allows sub-division into the ENERGY STAR categories defined as below, but recognising that in order to compare ENERGY STAR qualifying and non-qualifying products together, they would have to be analysed as one data set.*

ENERGY STAR categories:

Category A:

- All notebook computers that do not meet the definition of Category B or Category C below are considered under Category A.

Category B notebooks must have:

- A discrete Graphics Processing Unit (GPU).

Category C notebooks must have:

- 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.

### **1.3 Other**

#### ***Matrix Row D): Intended use (home or work)***

This does materially affect the type of product and specification in many cases. However, it is increasingly difficult to distinguish the two in terms of individual products and in terms of market data. (A similar challenge is faced with household air-conditioners).

- *Proposal: not to subdivide the market by intended use.*

Separation of products into home and work usage would be very difficult to achieve in practice from sales and performance data.

## **2. Participating Country Requirements**

*Interest levels were not collated for this product.*

## **3. Metrics**

ENERGY STAR version 5 has defined a **Typical Energy Consumption (TEC)** as:

*A method of testing and comparing the energy performance of computers, which focuses on the typical electricity consumed by a product while in normal operation during a representative period of time. For Desktops and Notebooks, the key criterion of the TEC approach is a value for typical annual electricity use, measured in kilowatt-hours (kWh),*

*using measurements of average operational mode power levels scaled by an assumed typical usage model (duty cycle).*

Note that the assumed TEC duty cycle has two possible patterns for notebooks/laptop network connectivity: 'Conventional' and 'proxying'. For this analysis the **conventional duty cycle** will be adopted which consists of 60% of the time in off mode 10% in sleep mode and 30% in idle mode.

Since late 2008 this has been adopted in many parts of the world. It is proposed to use this metric as a primary measure of energy performance for current data, but data prior to 2008 will be using other metrics and so products will have to be analysed using other metrics below. A TEC value could be calculated for any data set that includes sleep mode, idle mode and off mode consumption figures.

Other energy metrics in common use include:

**Efficiency of the (external) power supply**, expressed as a percentage, as a decimal between zero and one or as a Roman numeral between I and VI (according to the International Efficiency Marking Protocol)<sup>2</sup>.

**Energy consumption in operational modes**, in Watts, as defined in the ENERGY STAR Programme<sup>3</sup>:

- **Off Mode:** The power consumption level in the lowest power mode which cannot be switched off (influenced) by the user and that may persist for an indefinite time when the appliance is connected to the main electricity supply and used in accordance with the manufacturer's instructions. For systems where ACPI standards are applicable, the Off Mode correlates to ACPI System Level S5 state.
- **Sleep Mode:** A low power state that the computer is capable of entering automatically after a period of inactivity or by manual selection. A computer with sleep capability can quickly 'awake' in response to network connections or user interface devices with a latency of  $\leq 5$  seconds from initiation of wake event to the system becoming fully usable, including rendering of display. For systems where ACPI standards are applicable, the Sleep mode most commonly correlates to ACPI System Level S3 (suspend to RAM) state.
- **Idle State**<sup>4</sup>: The state in which the operating system and other software have completed loading, a user profile has been created, the machine is not asleep, and activity is limited to those basic applications that the system starts by default.
- **Active State:** The state in which the computer is carrying out useful work in response to (a) prior or concurrent user input or (b) prior or concurrent instruction over the network. This state includes active processing, seeking data from storage, memory, or cache, including idle state time while awaiting further user input and before entering low power modes. This mode does not feature in the TEC calculation and will therefore not be requested.

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<sup>2</sup> See [http://www.energystar.gov/ia/partners/product\\_specs/program\\_reqs/eps\\_prog\\_req.pdf](http://www.energystar.gov/ia/partners/product_specs/program_reqs/eps_prog_req.pdf).

<sup>3</sup> See

[http://www.energystar.gov/ia/partners/prod\\_development/revisions/downloads/computer/Version5.0\\_Computer\\_Spec.pdf](http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/computer/Version5.0_Computer_Spec.pdf).

<sup>4</sup> We note that Standard ECMA-383 'Measuring the Energy Consumption of Personal Computing Products' (defines "short idle" and "long idle" active modes, although these are not yet incorporated into the ENERGY STAR programme and will not be analysed for this project. See <http://www.ecma-international.org/publications/standards/Ecma-383.htm>.

**Default time to computer sleep mode and default time for display to sleep mode (as shipped).** This affect the actual consumption in the home (assuming it is not altered by the user), and is the subject of ENERGY STAR and other policy requirements. This could also be noted in the analysis.

The key metrics to be used in mapping graphs are therefore:

*Typical energy consumption (TEC): kWh per year (for 2008 / 2009 / 2010 data)*

*Idle mode consumption: W*

*Sleep mode consumption: W*

*Off mode consumption: W*

Of secondary interest:

*Default time to sleep (computer) Minutes*

*Default time to sleep (screen) Minutes*

## 4. Data requirements

To enable the most effective analysis of data and comparison between countries, we would like to collect the data listed below:

- **Black text** indicates the main data requirements for this process.
- **Blue text** indicates data that is not necessary to undertake the mapping and benchmarking for this product but that will bring other benefits to the process and/or allow more detailed analysis at a later date.
- Where the data is not available in the format requested, **italic text** indicates alternative formats in which the data may be provided.

It is recognised that ENERGY STAR is likely to be the most significant global source of performance data, and that US and EU databases contain largely similar products. One result could be a limited ability to distinguish different performance levels between countries / markets, and a skew of many datasets towards the better products (since performance data of non ENERGY STAR qualified products is difficult to get hold of in comparable quantities).

### **Information on new products on sale**

For all years available between 1996 and 2008 and for all categories as defined in Table 3, ideally this will be in the form of **individual model information** including (in approximate order of priority):

- A. Screen size (diagonal measurement, in inches/cm)
- B. Idle mode consumption (W); off mode consumption (W); sleep mode consumption (W). We recognise that this may not be available with consistent metrics prior to 2007.
- C. Which ENERGY STAR computer category the product is grouped under (category A, B or C as defined in Section 1.2 above)
- D. *Where this is not possible, other information that allows the identification of best, worst and sales weighted average consumption of products available on the local market.*
- E. **Typical Energy Consumption (TEC, according to ENERGY STAR requirements for computers, Version 5). We recognise that this will only be available for 2009 and 2010.**
- F. **The design input voltage of the external power supply for that model.**

Note: These information requests are formulated in line with the timing of widespread adoption of these metrics, as exemplified by development of the ENERGY STAR programme.

### **Information on stock and sales**

For all years available between 1996 and 2008:

- G. The country / regional stock of laptops in use at that time:
  - a. Overall number of products used in homes (or average number per household).
  - b. Indicative sales weighted average on / idle mode consumption
  - c. Indicative sales weighted average off mode consumption
  - d. Indicative sales weighted average sleep mode consumption
  - e. Average product lifetime
- H. Where this is not possible, other available information on stock, eg overall average energy consumption etc.
- I. Total annual sales volume.

**Additional Information Required for Data Processing**

- J. Test methodology(ies) used to derive the data, and any relationship to known international standards (e.g. consistent with Standard ECMA-383 ‘Measuring the Energy Consumption of Personal Computing Products’; clone of test method XYZ [with these amendments: A, B and C], etc.)
- K. Dates at which any changes to test methods occurred
- L. List of local regulations that define and affect product efficiency
- M. Efficiency of the (external) power supply (expressed as a percentage, as a decimal between zero and one or as a Roman numeral between I and VI)
- N. Factory preset default time to sleep for the computer (minutes), and factory present default time to sleep for the screen (minutes).

**Additional Information Required for Other Planned Analysis**

- O. Summary of all major policy actions affecting laptops over the period data is available including whether voluntary or mandatory, the year when policy was first considered, the year of formal announcement of the policy plans, and the year when the policy came into force.
- P. Summary of any major cultural or other issues that are thought to affect this product at the local level.

## 5. Budget Estimate

Based on this product definition and assuming data is available in a manageable format from all participating countries, it is *estimated* that mapping and benchmarking of the product group will require the following resources:

**For the 10 Participating Countries<sup>5</sup>- total 27 man-days**

	<b>Mapping and Benchmarking process:</b>	<b>Total Resource Requirements (for 10 countries)</b>
1	Product definition	2 days
2	Design of overall analysis process; set up of analysis spreadsheet template; data collection & cleaning	4 days
3	Processing of data sets from each country into usable formats for the analysis template; policy and timeline analysis, and policy summaries for benchmarking.	6 days
4	Basic category analysis products (mapping 10 countries, plus benchmarking 10 countries)	15 days

<sup>5</sup> Australia, Austria, Canada, Denmark, France, Korea, The Netherlands, Switzerland, UK, USA.

**For the 5 Additional Target Countries/Regions<sup>6</sup>- total 10 man-days**

	<b>Mapping and Benchmarking of:</b>	<b>Total Resource Requirements (for 5 additional countries)</b>
5	<i>Finding and cleaning data; processing of data sets from each country into usable formats for the analysis template; policy and their timelines analysis, and policy summaries for benchmarking.</i>	5 days
6	<i>Basic laptop category analysis (mapping 5 additional countries, plus benchmarking 5 additional countries <b>at the same time</b> as the 10 participating countries)</i>	5 days

## 6. Request for Country Data Availability and Interest Levels

The final decision on which product sub-sectors that will be mapped and benchmarked will depend on the actual data available within participating countries, and the interest participating countries have in the mapping and benchmarking of individual sub-categories.

***Therefore, could you please complete the following table to indicate what data will be available from your country, and the level of interest your country has in the mapping and benchmarking of this product:***

<b><i>Our country has the following level of interest in mapping and benchmarking laptop computers:</i></b> <i>Score between 0 and 10, where 0=no interest and 10=very high interest.</i>	(0-10)
<b><i>Our country will probably be able to provide the following model specific data on new products, representing a good proportion of the national market:</i></b> <i>Sleep, Idle and Off mode consumption (W)</i>	[Y/N]
<b><i>Our country will probably be able to provide the following market average / sales weighted data on new products, representing a good proportion of the national market:</i></b> <i>Sleep, Idle and Off mode consumption (W)</i>	[Y/N]
<b><i>The data we will probably provide is derived from ENERGY STAR data, and/or is derived from the same test methods as used for ENERGY STAR (most recent applicable versions of criteria).</i></b>	[Y/N/Unknown]

<sup>6</sup> EU, China, India, Japan and Russia.