



Environment and Spatial Planning  
*Ministry of Housing, Spatial Planning and  
the Environment*

# Criteria for the Sustainable Public Procurement of **Hardware**

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These criteria for Sustainable Public Procurement were developed by NL Agency at the request of the Ministry of Housing, Spatial Planning and the Environment (VROM). The programme for sustainable operational management for public authorities (DBO) is a joint initiative of the Dutch Government, the Association of Netherlands Municipalities (VNG), the Association of Provincial Authorities (IPO) and the Association of Water Boards (UvW).

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# 1 Introduction

The Dutch government wants to take concrete steps towards a sustainable society, and to set a good example. Each year, government organisations spend more than EUR 50 billion on the purchase of Supplies, Services and Public works. By purchasing sustainably, the government can significantly boost the market for sustainable products. Governmental authorities have set clear objectives to achieve this: the central government is aiming for 100% Sustainable Public Procurement in 2010, while the municipalities aspire towards 75% in 2010 and 100% in 2015. Provincial governments and water boards have set themselves the target of at least 50% in 2010. 100% Sustainable Public Procurement is understood to mean that all purchases meet the minimum requirements that have been set for the relevant product groups at the time of purchase. More information on this topic is available from the website Sustainable Procurement ([www.agentschapnl.nl/sustainableprocurement](http://www.agentschapnl.nl/sustainableprocurement)).

NL Agency supports government authorities in various ways to help reach these objectives. These include developing criteria for Supplies, Services and Public works procured by these authorities. This document focuses on the criteria for the Hardware product group, the elaboration of the criteria in specification texts and a more detailed assessment of the criteria, as well as a number of points for attention in the pre- and post-procurement stages. Additional background information and considerations regarding the content of the criteria can be found in the criteria document on the website Sustainable Procurement [www.agentschapnl.nl/duurzaaminkopen/criteria](http://www.agentschapnl.nl/duurzaaminkopen/criteria),

## 1.1 Definition of the product group

The Hardware product group comprises desktops, laptops and monitors. The product group excludes: software, reproduction equipment, networks and infrastructure, and servers/data centres. Any services in the area of hardware also fall outside the scope.

For the benefit of the contracting authority, a number of CPV codes that might be of relevance to this product group have been included in this document. This selection is by no means exhaustive or complete. The contracting authority retains responsibility for compiling the correct set of CPV codes that matches the relevant tender.

The following CPV codes apply to this product group:

30200000-1 Computer equipment and supplies.

30210000-4 Data processing machines (hardware).

30237000-9 Computer parts, accessories and supplies.

## 2 Sustainability in the procurement process

The criteria in this document have been classified in the various steps of the procurement process. More information about these steps and how to combine them with sustainability can be found in the Sustainable Public Procurement Manual. This manual can be downloaded from the website [www.agentschapnl.nl/sustainableprocurement](http://www.agentschapnl.nl/sustainableprocurement)

### 2.1 Preparatory stage (points for consideration)

Every purchase or call for tender starts with drawing up the inventory of the needs of the internal or external customer. Sustainability can be incorporated into this stage by considering whether the purchase is truly necessary and whether a more sustainable alternative might be available. Specific points for consideration regarding procurement for the Hardware product group are:

- When procuring computers, anticipate trends or the restructuring of the organisation, such as ICT trends, the increase in telecommuting and changes in the office environment, such as the creation of flexible workplaces. Rapid changes within the organisation require flexible workplaces and work systems.
- When procuring new computers assess the possibilities of expanding the hardware and/or software in the future. Specific trends or restructuring within the organisation can lead to changing software applications and hardware use. Procure systems with sufficient capacity for expandability or systems that are easy to adapt. Note: it is more difficult to expand laptops or to add additional hardware to laptops.
- Procure laptops instead of desktops and monitors when hardware expansion is less essential. The average laptop (notebook), depending on the specifications, uses 50% to 80% less energy than the average desktop plus monitor. Furthermore, the raw materials used to produce the overall product are less.
- Where feasible procure flat panel monitors instead of CRT monitors. The average flat panel monitor (LCD or TFT) uses approximately 50% of the energy used by the average conventional (CRT) monitor. Furthermore, an LCD monitor requires fewer raw materials to produce.
- Do not procure any larger monitors than necessary. The cost of acquiring 15" flat panels is 30% lower than the cost of 17" flat panels. Furthermore, the average energy consumption of 15" monitors is approximately 25%-30% lower than the energy consumed by the average 17" monitor.

### 2.2 Specification stage (criteria)

During the specification stage, the internal or external customer's needs are translated into a tender document. This stage entails the formulation of:

- Criteria for supplier qualification. These could include grounds for exclusion and suitability requirements, i.e. requirements with regard to suppliers, and, in the case of restricted procedures, optional selection criteria, i.e. wishes with regard to suppliers.
- A description of the minimum requirements pertaining to Supply, Service or Public works (the Schedule of Requirements).

- Award criteria, i.e. wishes regarding Supplies, Services and Public works. These are only applicable when the tendering process is based on the principle of the economically most advantageous offer.
- The contract stipulating the contract provisions.

More information on the various types of criteria and the various tender options can be found in the Sustainable Public Procurement Manual. Innovation is also included in the award criteria, where relevant. Innovation is oriented towards the development and introduction of new ideas and products.

The criteria in this document have been formulated to support the purchaser in the Sustainable Public Procurement of Hardware. The criteria have been subjected to legal review. However, every procurement and tender process is unique. For that reason, the drafting of a tender document remains the responsibility of the purchaser.

## 2.2.1 Supplier qualifications

No specific criteria have been formulated for this specific product group with regard to supplier qualification. More information on the possibilities of incorporating sustainability at this stage of the process can be found in the Sustainable Public Procurement Manual.

## 2.2.2 Schedule of requirements

### Minimum requirements

<b>Minimum requirement No.1</b>	<p>The desktops and laptops to be supplied must meet the Energy Star criteria for computers, version 4.0, dated 20-07-2007, Chapters 3 and 4, as contained in Appendix 1.</p> <p>If the desktops and laptops come with the Energy Star label, version 4.0, dated 20 April 2007, they are considered to meet this minimum requirement.</p> <p><u>Means of proof:</u></p> <ol style="list-style-type: none"> <li>1. Self declaration to be included in this tender by the tenderer to confirm compliance with this minimum requirement;</li> <li>2. A specification of the hardware to be supplied;</li> <li>3. A certificate or another document for the computers to be supplied, to be included in the tender as evidence that the tenderer complies with this minimum requirement. If the hardware comes with the Energy Star label, version 4.0, dated 20 April 2007, it is considered to meet this minimum requirement.</li> </ol>
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Notes for purchaser	<p>Energy Star is an international programme for the voluntary labelling of energy-efficient appliances established by the US Environmental Protection Agency (EPA) in 1992. The European Union participates in the Energy Start Programme in terms of office equipment on the basis of an Agreement negotiated with the American Government. The Energy Star criteria for computers were fine tuned in 2006 and were incorporated into the document 'ENERGY STAR® Program Requirements for Computers' document. The criteria became effective on 20 July 2007.</p> <p><u>Verification of means of proof:</u></p> <ol style="list-style-type: none"> <li>1. Product certificates that confirm the equipment's compliance with the specified criteria. If a certificate is lacking the equipment must be subjected to measurements in accordance with the test method described in Section 4 of the Appendix.</li> <li>2. Equipment with an Energy Star label is included in the Energy Star database (<a href="http://www.eu-energystar.org">www.eu-energystar.org</a>). This database can be used to verify that the equipment has an Energy Star label and that it therefore meets the specified criteria.</li> <li>3. No further verification.</li> </ol>
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Minimum requirement No.2	<p>The monitors to be supplied must meet the Energy Star criteria for monitors, version 4.0, dated 1 January 2006, Chapters 3 and 4, as contained in Appendix 2.</p> <p>If the monitors come with the Energy Star label, version 4.0, dated 1 January 2006, they are considered to meet this minimum requirement.</p> <p><u>Means of proof:</u></p> <ol style="list-style-type: none"> <li>1. Self declaration to be included in this tender by the tenderer to confirm compliance with this minimum requirement;</li> <li>2. A specification of the monitors to be supplied;</li> <li>3. A certificate or another document for the monitors to be supplied, to be included in the tender as evidence that the tenderer complies with this minimum requirement. If the monitors come with the Energy Star label, version 4.0, dated 1 January 2006, they are considered to meet this minimum requirement.</li> </ol>
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Notes for purchaser	<p>Energy Star is an international programme for the voluntary labelling of energy-efficient appliances established by the US Environmental Protection Agency (EPA) in 1992. The European Union participates in the Energy Start Programme in terms of office equipment on the basis of an Agreement negotiated with the American Government. The Energy Star criteria for monitors are established in the document 'ENERGY STAR® Program Requirements for Computer Monitors' and went into effect on 1 January 2006 (for products manufactured on or after that date).</p> <p><u>Verification of means of proof:</u></p> <ol style="list-style-type: none"> <li>1. Product certificates that confirm the equipment's compliance with the specified criteria. If a certificate is lacking the equipment must</li> </ol>
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	<p>be subjected to measurements in accordance with the test method described in Section 4 of the Appendix.</p> <ol style="list-style-type: none"> <li>2. Equipment with an Energy Star label is included in the Energy Star database (<a href="http://www.eu-energystar.org">www.eu-energystar.org</a>). This database can be used to verify that the equipment has an Energy Star label and that it therefore meets the specified criteria.</li> <li>3. No further verification.</li> </ol>
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### 2.2.3 Award criteria

No award criteria have been formulated for this product group.

### 2.2.4 Contract

No contract provisions have been formulated for this product group.

## 2.3 Utilisation stage (points for consideration)

Once the procurement stage has been concluded and a product or service has been purchased, there are opportunities for using the product in a sustainable manner. Specific points for consideration for this product group are:

#### Extended lifespan

The average lifespan of a PC in the European Community is approximately 6 years. Due to the fact that new processors consume more energy than older ones (e.g., a PC with a 486 processor uses approx 60 Watts in the on mode while a PC with a Pentium 4 processor uses approx double that, i.e. 120 Watts), it is more beneficial – from an environmental perspective – to extend the lifespan of PCs to the maximum possible, provided they are not used as servers.

#### Energy efficient use

Encourage employees to make energy efficient use of their computers by limiting the standby time of their computers when they are not in use. Regularly turning off computers, for example during lunch, meetings and after working hours, saves energy. Communicate this to users.

#### Encourage reuse

Encourage reuse throughout the entire organisation when computers are discarded or when there is a surplus of computers in a certain department. In case of reorganisations and staff changes a surplus of computers may arise in certain departments. Encourage employees/team leaders to identify such surpluses as soon as possible so that others can make use of these computers.

#### Energy management

By setting the proper energy management options, the energy saving potential of the purchased products is used. The EU Energy Star® website also contains tips for managing the energy consumption of computers and monitors ([www.eu-energystar.org](http://www.eu-energystar.org)).

**No screen savers**

Screen savers were originally designed to prevent the burn-in of monitors. However, with present-day monitors the chances of this are nil. The moving images of a screen saver, particularly 3D animations, consume a lot of energy, more than, for example, a text processor.

**Responsible disposal**

The producer/supplier is legally obliged to guarantee the free-of-charge removal of computer equipment. In addition, there are various companies that upgrade old computers for schools and less well-off national or international organisations. Only computers that are operational may be exported. Otherwise this is considered waste transport and in that case other rules apply.

# Appendix 1 Energy Star Program Requirements for Computers

## Energy Star Program Requirements for Computers (version 4.0), Eligibility Criteria, section 3 and 4

3) **Energy Efficiency and Power Management Criteria:** Computers must meet the requirements below to qualify as ENERGY STAR. Effective dates for Tier 1 and Tier 2 are covered in Section 5 of this specification.

**A) Tier 1 Requirements - Effective July 20, 2007**

**(1) Power Supply Efficiency Requirements**

**Computers Using an Internal Power Supply:** 80% minimum efficiency at 20%, 50%, and 100% of rated output and Power Factor  $\geq 0.9$  at 100% of rated output.

**Computers Using an External Power Supply:** Must be ENERGY STAR qualified or meet the no-load and active mode efficiency levels provided in the ENERGY STAR Program Requirements for Single Voltage Ac-Ac and Ac-Dc External Power Supplies. The ENERGY STAR specification and qualified product list can be found at [www.energystar.gov/powersupplies](http://www.energystar.gov/powersupplies). Note: This performance requirement also applies to multiple voltage output external power supplies as tested in accordance to the Internal Power Supply test method referenced in Section 4, below.

**(2) Operational Mode Efficiency Requirements**

**Desktop Categories for Idle Criteria:** For the purposes of determining Idle state levels, desktops (including integrated computers, desktop-derived servers and game consoles) must qualify under Categories A, B, or C as defined below:

ENERGY STAR Program Requirements for Computers: Version 4.0

**Category A:** All desktop computers that do not meet the definition of either Category B or Category C below will be considered under Category A for ENERGY STAR qualification.

**Category B:** To qualify under Category B desktops must have:

- Multi-core processor(s) or greater than 1 discrete processor; and
- Minimum of 1 gigabyte of system memory.

**Category C:** To qualify under Category C desktops must have:

- Multi-core processor(s) or greater than 1 discrete processor; and
- A GPU with greater than 128 megabytes of dedicated, non-shared memory.

In addition to the requirements above, models qualifying under Category C must be configured with a minimum of 2 of the following 3 characteristics:

- Minimum of 2 gigabytes of system memory;
- TV tuner and/or video capture capability with high definition support; and/or
- Minimum of 2 hard disk drives.

**Notebook Categories for Idle Criteria:** For the purposes of determining Idle state levels, notebooks and tablets must qualify under Categories A or B as defined below:

**Category A:** All notebook computers that do not meet the definition of Category B below will be considered under Category A for ENERGY STAR qualification.

**Category B:** To qualify under Category B notebooks must have:

- A GPU with a minimum of 128 megabytes of dedicated, non-shared memory.

**Workstation Levels:** Workstation levels will be determined using a simplified Typical Electricity Consumption (TEC) approach to allow manufacturers energy trade offs between different operating modes, based on a given weighting factor for each mode. The final level will be based on the TEC power level ( $P_{TEC}$ ) which will be determined by the following formula:

$$P_{TEC} = 0.1 * P_{standby} + 0.2 * P_{sleep} + 0.7 * P_{idle}$$

where,  $P_{standby}$  is the power measured in Standby,  $P_{sleep}$  is the power measured in Sleep, and  $P_{idle}$  is the power measured in Idle. This  $P_{TEC}$  value will then be compared to the TEC budget which is determined by a fixed percentage of the maximum power of the system, including an adder for installed hard drives as indicated in the equation in Table 1. The test procedure for determining the maximum power of workstations can be found in Section 4 of Appendix A.

**Power Level Requirements:** The following tables indicate the required power allowances for the Tier 1 specification. Table 1 gives the baseline requirements, while Table 2 gives additional power allowances for WOL. For those products that meet the WOL enabling requirement for either Sleep or Standby, a model must meet the energy level provided in Table 1 summed with the appropriate allowances from Table 2. **Note: Products whose Sleep levels meet the Standby power requirements do not need to have a distinct Standby (Off mode), and may qualify for this specification using only Sleep mode.**

**Table 1: Tier 1 Energy Efficiency Requirements**

Product Type	Tier 1 Requirements
Desktops, Integrated Computers, Desktop-Derived Servers and Gaming Consoles	<p>Standby (Off Mode): <math>\leq 2.0</math> W</p> <p>Sleep Mode: <math>\leq 4.0</math> W</p> <p>Idle State:                      Category A: <math>\leq 50.0</math> W                      Category B: <math>\leq 65.0</math> W                      Category C: <math>\leq 95.0</math> W</p> <p><i>Note: Desktop-derived servers (as defined in section 1. F) are exempt from the Sleep level above.</i></p>
Notebooks and Tablets	<p>Standby (Off Mode): <math>\leq 1.0</math> W</p> <p>Sleep Mode: <math>\leq 1.7</math> W</p> <p>Idle State:                      Category A: <math>\leq 14.0</math> W                      Category B: <math>\leq 22.0</math> W</p>
Workstations	<p>TEC Power (<math>P_{TEC}</math>):  <math>\leq 0.35 * [P_{Max} + (\# HDDs * 5)]</math> W</p> <p><i>Note: Where <math>P_{max}</math> is the maximum power drawn by the system as tested per the test procedure in Section 4 of Appendix A, and #HDD is the number of installed hard drives in the system.</i></p>

**Table 2: Tier 1 Capability Adder for Sleep and Standby**

Capability	Additional Power Allowance
Wake On LAN (WOL)	+ 0.7 W for Sleep + 0.7 W for Standby

**Qualifying Computers with Power Management Capabilities:** The following requirements should be followed when determining whether models should be qualified with or without WOL:

**Standby:** Computers should be tested and reported as shipped for Standby. Models that will be shipped with WOL enabled for Standby should be tested with WOL enabled and will qualify using the extra allowance for Standby found in Table 2 above. Likewise, products shipped with WOL disabled for Standby must be tested with WOL disabled and must meet the baseline requirement for Standby found in Table 1.

**Sleep:** Computers should be tested and reported as shipped for Sleep. Models sold through enterprise channels, as defined in the Tier 1 Power Management Requirements (Section 3.A.3), shall be tested, qualified, and shipped WOL enabled. Products going directly to consumers through normal retail channels are not required to be shipped with WOL enabled from Sleep, and may be tested, qualified, and shipped with WOL either enabled or disabled. Those models sold

both through enterprise channels and directly to consumers must test and meet both the levels with and without WOL.

Systems where any additional management services are, at the customer's request, pre-provisioned by the manufacturer, do not need to test the systems with these functions in an active state providing the function is not actually activated until there is specific action by the end user (i.e., manufacturer should test in pre-provisioned state and does not have to consider the power use after full provisioning occurs on site).

### (3) Power Management Requirements

**Shipment Requirement:** Products must be shipped with the display's Sleep mode set to activate within 15 minutes of user inactivity. All products, except for desktop-derived servers which are exempt from this requirement, must be shipped with a Sleep mode which is set to activate within 30 minutes of user inactivity. Products may have more than one low power mode but these proposed criteria address Sleep mode as defined in this specification. Computers shall reduce the speed of any active 1 Gb/s Ethernet network links when transitioning to Sleep or Standby.

All computers, regardless of distribution channel, shall have the ability to enable and disable WOL for Sleep mode. Systems shipped through enterprise channels must have Wake On LAN (WOL) enabled from the Sleep mode when operating on ac power (i.e. notebooks may automatically disable WOL when operating on their portable power sources). For the purpose of this specification, "enterprise channels" are defined as sales channels normally used by large and medium-sized business, government organizations, and educational institutions, with the intent of identifying machines that will be used in managed client/server environments. For all computers with WOL enabled any directed packet filters shall be enabled and set to an industry standard default configuration. Until one (or more) standards are agreed upon, partners are asked to provide their direct packet filter configurations to EPA for publication on the Website to stimulate discussion and development of standard configurations. Systems in which the Sleep mode maintains full network connectivity, providing the same fully connected network state found in Idle, can be considered to meet the WOL enabling requirement and may qualify using the corresponding WOL capability adder.

All machines shipped to enterprise customers shall be capable of both remote and scheduled wake events from Sleep mode. Manufacturers shall ensure, where the manufacturer has control (i.e., configured through hardware settings rather than software settings), that these settings can be managed centrally, as the client wishes, with tools provided by the manufacturer.

**User Information Requirement:** In order to ensure that purchasers/users are properly informed on the benefits of power management, the manufacturer will include with each computer, one of the following:

- Information on ENERGY STAR and the benefits of power management in either a hard copy or electronic copy of the user manual. This information should be near the front of the user guide; or
- A package or box insert on ENERGY STAR and the benefits of power management.

Either option must at least include the following information:

- Notice that the computer has been shipped enabled for power management and what the time settings are; and
- How to properly wake the computer from Sleep mode;

#### **(B) Tier 2 Requirements - Effective January 1, 2009**

**(1a) Tier 2 Energy Efficiency Performance Metric.** All computers will be required to meet the

qualification. If the initial unit tested meets the maximum power level for Idle but falls within 10% of that level, one additional unit of the same model with an identical configuration must also be tested. Manufacturers shall report Idle values for both units. To qualify as ENERGY STAR, both units must meet the maximum Idle level for that product category. **Note:** This additional testing is only required for Idle qualification – only one unit is required to be tested for Sleep and Standby. The following example further illustrates this approach:

Category A desktops must meet an Idle level of 50 watts or less, making 45 Watts the 10% threshold for additional testing. The following scenarios could then occur when testing a model for qualification:

- If the first unit is measured at 44 watts, no more testing is needed and the model qualifies (44 watts is 12% more efficient than the specification and is therefore "outside" the 10% threshold).
- If the first unit is measured at 45 watts, no more testing is needed and the model qualifies (45 watts is exactly 10% more efficient than the specification).
- If the first unit is measured at 47 watts, then an additional unit must be tested to determine qualification (47 Watts is only 6% more efficient than the specification and is "within" the 10% threshold).
- If the two units are then tested at 47 and 51 watts, the model does not qualify as ENERGY STAR—even though the average is 49 watts—because one of the values (51) exceeds the ENERGY STAR specification.
- If the two units are then tested at 47 and 49 watts, the model does qualify as ENERGY STAR because both values meet the ENERGY STAR specification of 50 watts.

**B. Models Capable of Operating at Multiple Voltage/Frequency Combinations:** Manufacturers shall test their products based on the market(s) in which the models will be sold and promoted as ENERGY STAR qualified. EPA and its ENERGY STAR Country Partners have agreed upon a table with three voltage/frequency combinations for testing purposes. Please refer to the Test Conditions in the Test Procedure (Appendix A) for details regarding international voltage/frequency combinations for each market.

For products that are sold as ENERGY STAR in multiple international markets and, therefore, rated at multiple input voltages, the manufacturer must test at and report the required power consumption or efficiency values at all relevant voltage/frequency combinations. For example, a manufacturer that is shipping the same model to the United States and Europe must measure, meet the specification, and report test values at both 115 Volts/60 Hz and 230 Volts/50 Hz in order to qualify the model as ENERGY STAR in both markets. If a model qualifies as ENERGY STAR at only one voltage/frequency combination (e.g., 115 Volts/60 Hz), then it may only be qualified and promoted as ENERGY STAR in those regions that support the tested voltage/frequency combination (e.g., North America and Taiwan).

Table 3: Test Procedures for Measuring Operational Modes

Specification Requirement	Test Protocol	Source
Standby (Off Mode), Sleep Mode, Idle State and Maximum Power	ENERGY STAR Computer Test Method (Version 4.0)	Appendix A

Power Supply Efficiency	IPS: Internal Power Supply Efficiency Protocol  EPS: ENERGY STAR Test Method for External Power Supplies	IPS: <a href="http://www.efficientpowersupplies.org">www.efficientpowersupplies.org</a>  EPS: <a href="http://www.energystar.gov/powersupplies">www.energystar.gov/powersupplies</a>
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C. Qualifying Families of Products: Models that are unchanged or that differ only in finish from those sold in a previous year may remain qualified without the submission of new test data assuming the specification remains unchanged. If a product model is offered in the market in multiple configurations or styles, as a product "family" or series, the partner may report and qualify the product under a single model number, as long as all of the models within that family or series meet either of the following requirements:

- Computers that are built on the same platform and are identical in every respect except for housing and color may be qualified through submission of test data for a single, representative model.
- If a product model is offered in the market in multiple configurations, the partner may report and qualify the product under a single model number that represents the highest power configuration available in the family, rather than reporting each and every individual model in the family. In this case, the highest configuration would consist of: the highest power processor, the maximum memory configuration, the highest power GPU, etc. For desktop systems which meet the definition for multiple desktop categories (as defined in section 3.A.2) depending on the specific configuration, manufacturers will have to submit the highest power configuration for each category under which they would like the system to qualify. For example, a system that could be configured either as a Category A or a Category B desktop would require a submittal of the highest power configuration for both categories in order to qualify as ENERGY STAR. If a product could be configured to meet all three categories, it would then have to submit data for the highest power configuration in all categories. Manufacturers will be held accountable for any efficiency claims made about all other models in the family, including those not tested or for which data was not reported.

## Appendix 2 Energy Star Program Requirements for Computer Monitors

### Energy Star Program Requirements for Computer Monitors (version 4.0), Eligibility Criteria, sections 3 ('Energy-Efficiency Specifications for Qualifying Products') and 4 ('Test Methodology')

- 3) **Energy-Efficiency Specifications for Qualifying Products:** Only those products listed in Section 2 that meet the following criteria may qualify as ENERGY STAR. Effective dates for Tiers 1 and 2 are provided in Section 6 of this specification.

**Widescreen Models:** Widescreen (e.g., 16:9, 15:9, etc.) models are eligible to earn the ENERGY STAR, provided that they meet EPA's energy-efficiency requirements. There are no separate specifications for widescreen models and as such, they must comply with Sections 3.A and 3.B, below. For Tier 2, future revisions or clarifications for widescreen models will be evaluated and considered, when adequate energy consumption data is readily available to EPA.

#### A. On Mode/Active Power

- Tier 1:** To qualify as ENERGY STAR, computer monitor models must not exceed the following maximum active power consumption equation:  $Y = 38X + 30$ . Y is expressed in watts and rounded up to the nearest whole number and X is the number of megapixels in decimal form (e.g., 1,920,000 pixels = 1.92 megapixels). For example, the maximum power consumption for a computer monitor with 1800 x 1440 resolution, or 2,592,000 pixels, would be:  $38(2.592) + 30 = 128.49$  or 129 watts when rounded up. Under this metric, maximum allowed power consumption for computer monitors with various standard resolutions is provided below in Table 1.
- Tier 2:** To qualify as ENERGY STAR, computer monitor models must not exceed the following maximum active power consumption equation: If  $X < 1$  megapixel, then  $Y = 23$ ; if  $X \geq 1$  megapixel, then  $Y = 28X$ . Y is expressed in watts and rounded up to the nearest whole number and X is the number of megapixels in decimal form (e.g., 1,920,000 pixels = 1.92 megapixels). For example, the maximum power consumption for a computer monitor with 1024 x 768 resolution (or .78 megapixels) would be  $Y = 23$  watts and for a computer monitor with 1600 x 1200 resolution would be  $28(1.92) = 53.76$  or 54 watts when rounded up.

**Table 1: Sample Tier 1 On Mode Maximum Power Levels**

Resolution	Total Pixels	Maximum Power Use for Tier 1
640 x 480	307,200	42 watts
800 x 600	480,000	49 watts
1024 x 768	786,432	60 watts
1280 x 768	983,040	68 watts
1280 x 1024	1,310,720	80 watts
1600 x 1024	1,638,400	93 watts
1600 x 1200	1,920,000	103 watts
1920 x 1200	2,304,000	118 watts
1800 x 1440	2,592,000	129 watts
2048 x 1440	2,949,120	143 watts
2048 x 1536	3,145,728	150 watts

To qualify a computer monitor as ENERGY STAR, it must be tested according to the protocol outlined in Section 4, Test Methodology.

#### B. Sleep and Off Modes

- Tiers 1 and 2:** Maximum power consumption levels for Sleep and Off Modes are provided in Table 2 below. Computer monitors capable of multiple Sleep Modes (i.e., Sleep and Deep Sleep) shall meet the Sleep Mode requirement below in all such modes. For example, under Tier 1, a computer monitor tested at 7 watts in Sleep and 3 watts in Deep Sleep would not qualify because one of the Sleep Modes exceeds 4 watts.

2. **Sleep Mode Exception:** Computer monitors that have the capability to proceed automatically from On Mode/Active Power to an Off Mode/Standby Power of 2 watts or less in Tier 1 and 1 watt or less in Tier 2 comply with these energy consumption requirements. The computer monitor's Off Mode/Standby Power must be activated within 30 minutes of user inactivity or as otherwise defined in future versions of the Computer Agreement (issued after current Version 3.0). Upon resumption of user activity (e.g., user moves the mouse or presses a key on the keyboard), the computer monitor must return to full operational capability. In other words, a Sleep Mode is not necessary if the computer monitor can proceed from On Mode/Active Power to Off Mode/Standby Power and meet the ENERGY STAR requirements in the Off Mode/Standby Power.

**Table 2: Energy-Efficiency Criteria for Sleep and Off Modes (Tiers 1 and 2)**

	Tier 1	Tier 2
<b>Sleep Mode</b>	≤ 4 watts	≤ 2 watts
<b>Off Mode</b>	≤ 2 watts	≤ 1 watt

3. **Sleep Mode Enabling:** Energy savings from the computer monitor's Sleep Mode can only be achieved if this power-saving mode is enabled. EPA recognizes that enabling and default times are driven by the computer, and as such, has outlined these requirements in the Computer Agreement. However, where feasible (e.g., where monitor manufacturer has a business relationship with specific computer manufacturers or where monitor manufacturer also sells its own computers or bundled products), monitor manufacturer should ensure that ENERGY STAR qualified computer monitors have their Sleep Modes enabled when shipped to the customer. Further, the computer shall activate the computer monitor's Sleep Mode within 30 minutes of user inactivity or as otherwise defined in future versions of the Computer Agreement (issued after current Version 3.0). **If a computer monitor has the capability to proceed automatically from On Mode/Active Power to Off Mode/Standby Power, then, consistent with the Sleep Mode requirements, the computer monitor's Off Mode/Standby Power must be activated within 30 minutes of user inactivity or as otherwise defined in future versions of the Computer Agreement (issued after current Version 3.0).**

#### 4) **Test Methodology**

**Product Testing Set-up, Methodology, and Documentation:** EPA utilizes, where possible, existing, widely-accepted industry practices for measuring product performance and power use under normal or typical operating conditions. The testing and measurement methods below reference published specifications from the Video Electronics Standards Association (VESA) Display Metrology Committee and the International Electrotechnical Commission (IEC), and supplement those guidelines where necessary with methods developed in cooperation with the computer monitor industry.

Manufacturers are required to perform tests and self-certify those product models that meet the ENERGY STAR guidelines. Families of computer monitor models that are built on the same chassis and are identical in every respect but housing and color may be qualified through submission of test data for a single, representative model. Likewise, models that are unchanged or that differ only in finish from those sold in a previous year may remain qualified without the submission of new test data, assuming the specification remains unchanged.

The power requirement shall be measured from the outlet or power source to the product under test. The average true power consumption of the computer monitor shall be measured during the On Mode/Active Power, the Sleep Mode/Low Power, and the Off Mode/Standby Power. When performing measurements to self-certify a product model, the product being tested must initially be in the same condition (e.g., configuration and settings) as when shipped to the customer, unless adjustments need to be made pursuant to instructions below.

To ensure a consistent means for measuring the power consumption of electronics products, the following protocol must be followed, which has three main components:

*Product Testing Set-up and Conditions:* Outlined below in Sections A through H are the ambient test conditions and measurement protocols that must be respected when performing power measurements.

*Product Testing Methodology:* The actual test steps for measuring power in On Mode/Active Power, Sleep Mode/Low Power, and Off Mode/Standby Power are provided in Section I, below.

*Product Testing Documentation:* Documentation requirements for submittal of qualified product data to EPA are detailed in Section J, below.

This protocol ensures that outside factors do not adversely affect the test results and that the test results can be consistently reproduced. Manufacturers may elect to use an in-house or independent laboratory to provide the test results. A sample of test facilities and recommended test equipment will be provided in the near future on the ENERGY STAR Web site at [www.energystar.gov](http://www.energystar.gov).

**Product Testing Set-up and Conditions**

A. Test Conditions:

**General Criteria**

<b>Supply Voltage*:</b>	North America: Europe: Australia/New Zealand: Japan:	115 (± 1%) Volts AC, 60 Hz (± 1%) 230 (± 1%) Volts AC, 50 Hz (± 1%) 230 (± 1%) Volts AC, 50 Hz (± 1%) 100 (± 1%) Volts AC, 50 Hz (± 1%)/60 Hz (± 1%)
<b>Total Harmonic Distortion (Voltage):</b>	< 2% THD	
<b>Ambient Temperature:</b>	20°C ± 5°C	
<b>Relative Humidity:</b>	30 – 80 %	
<b>Line Impedance:</b>	< 0.25 ohm	

(Reference IEC 62301: Household Electrical Appliances – Measurement of Standby Power, Sections 3.2, 3.3 and VESA Flat Panel Display Measurements (FPDM) Standard 2.0, Section 301-2)

\***Supply Voltage:** Manufacturers shall test their computer monitors based on the market in which the models will be sold. Manufacturers must ensure that qualifying products marketed and sold in any region as ENERGY STAR do not exceed the power levels declared on the Qualifying Product Information (QPI) form (and stored in the ENERGY STAR database) at the standard mains voltage and frequency conditions of that region. For equipment that is sold in multiple international markets and therefore rated at multiple input voltages, the manufacturer must test at and report all relevant voltages and power consumption levels if it intends to register the product as ENERGY STAR in the respective markets. For example, a manufacturer that is shipping the same computer monitor model to the United States and Europe must measure and report the On, Sleep, and Off power consumption at both 115 Volts/60 Hz and 230 Volts/50 Hz.

B. Dark Room Conditions: When performing light measurements, the computer monitor shall be located in a dark room condition. The computer monitor screen illuminance measurement (E), when in Off Mode/Standby Power, must be 1.0 Lux or less. Measurements should be made at a point perpendicular to the center of the screen using a Light Measuring Device (LMD) with the computer monitor in Off Mode/Standby Power (Reference VESA FPDM Standard 2.0, Section 301-2F).

- C. **Color Controls and Peripherals:** All color controls (hue, saturation, gamma, etc.) shall be placed at their factory default settings. No external devices shall be connected to any included Universal Serial Bus (USB) hubs or ports. Any built-in speakers, TV tuners, etc. may be placed in their minimum power configuration, as adjustable by the user, to minimize power use not associated with the display itself. Circuit removal or other actions not under user control may not be taken to minimize power use.
- D. **Power Measurement Test Conditions:** CRT pixel format shall be set at the preferred pixel format with the highest resolution that is intended to be driven at a 75 Hz refresh rate. A VESA Discrete Monitor Timing (DMT) or newer industry standard pixel format timing must be used for the test. The CRT monitor must be capable of meeting all its manufacturer-stated quality specifications in the tested format. For LCDs and other fixed pixel technologies, pixel format shall be set to the native level. LCD refresh rate shall be set to 60 Hz, unless a different refresh rate is specifically recommended by the manufacturer, in which case that rate shall be used.
- E. **Power Measurement Protocols:** Computer monitor power consumption shall be measured in watts with an imposed test pattern. Warm-up time shall be a minimum of a 20-minute period (Reference VESA FPD Standard 2.0, Section 301-2D or 305-3 for warm-up test). A true RMS power meter with a crest factor of at least five shall be used to measure the power use of each randomly chosen unit at one or more, as appropriate, of the voltage/frequency combinations provided in Section 4.A (Reference VESA Standard: Display Specifications and Measurement Procedures, Version 1.0, Revision 1.0, Section 8.1.3). Measurements shall be taken after wattage values are stable over a three-minute period. Measurements are considered stable if the wattage reading does not vary more than 1% over the three-minute period (Reference IEC 4.3.1). (Manufacturers shall ignore the input sync signal check cycle when metering the model in Sleep Mode/Low Power and Off Mode/Standby Power.) Manufacturers shall use calibrated measuring equipment capable of measurements accurate to one-tenth of a watt or better.

Borrowing from European Norm 50301 (Reference BSI 03-2001, BS EN 50301:2001, Methods of Measurement for the Power Consumption of Audio, Video, and Related Equipment, Annex A), EPA has established a test procedure where the number of units required for test depends on the test results for the first unit. For the purposes of ENERGY STAR, if a tested computer monitor uses at least 15% less power (i.e., greater than or equal to 15%) than the ENERGY STAR specification in all three operating modes (On Mode/Active Power, Sleep Mode/Low Power, and Off Mode/Standby Power), then it only has to be tested once. However, if a tested computer monitor is within 15% (i.e., less than 15%) of the ENERGY STAR specification in any of the three operating modes, then two more units have to be tested. None of the test values may exceed the ENERGY STAR specification for the model to qualify as ENERGY STAR. All of the test results as well as the average values (based on the three or more data points) must be reported on an ENERGY STAR QPI form.

The following example further illustrates this approach:

**EXAMPLE:** For simplicity, assume the specification is 100 watts or less and only applies to one operational mode. 85 watts would represent the 15% threshold...

- If the first unit is measured at 80 watts, no more testing is needed and the model qualifies (80 watts is at least 15% more efficient than the specification and is "outside" the 15% threshold).
- If the first unit is measured at 85 watts, no more testing is needed and the model qualifies (85 watts is exactly 15% more efficient than the specification).
- If the first unit is measured at 90 watts, then two more units must be tested to determine qualification (90 watts is only 10% more efficient than the specification and is "within" the 15% threshold).
- If three units are tested at 90, 98, and 105 watts, the model does not qualify as ENERGY STAR—even though the average is 98 watts—because one of the values (105) exceeds the ENERGY STAR specification.

- F. **Luminance Test Patterns and Procedures:** For CRT monitors, the technician shall initiate the AT01P (Alignment Target 01 Positive Mode) pattern (VESA FPDM Standard 2.0, A112-2F, AT01P) for screen size and use it to set the computer monitor to the manufacturer's recommended image size, which is typically slightly smaller than maximum viewable screen size. Then, test pattern (VESA FPDM Standard 2.0, A112-2F, SET01K) shall be displayed that provides eight shades of gray from full black (0 volts) to full white (0.7 volts).<sup>2</sup> Input signal levels shall conform to VESA Video Signal Standard (VSIS), Version 1.0, Rev. 2.0, December 2002. The technician shall adjust (where feasible) the computer monitor brightness control downward from its maximum until the lowest black bar luminance level is just slightly visible (VESA FPDM Standard 2.0, Section 301-3K). The technician shall then display a test pattern (VESA FPDM Standard 2.0, A112-2H, L80) that provides a full white (0.7 volts) box that occupies 80% of the image. The technician shall then adjust the contrast control until the white area of the screen provides at least 100 candelas per square meter of luminance, measured according to VESA FPDM Standard 2.0, Section 302-1.

For all Fixed Pixel displays (e.g., LCDs and others), test pattern (VESA FPDM Standard 2.0, A112-2F, SET01K) shall be displayed that provides eight shades of gray from full black (0 volts) to full white (0.7 volts).<sup>2</sup> Input signal levels shall conform to VESA Video Signal Standard (VSIS), Version 1.0, Rev. 2.0, December 2002. With the brightness and contrast controls at maximum, the technician shall check that, at a minimum, the white and near white gray levels can be distinguished. If white and near white gray levels cannot be distinguished, then contrast shall be adjusted until they can be distinguished. The technician shall next display a test pattern (VESA FPDM Standard 2.0, A112-2H, L80) that provides a full white (0.7 volts) box that occupies 80% of the image. The technician shall then adjust the brightness control until the white area of the screen provides at least 175 candelas per square meter of luminance, measured according to VESA FPDM Standard 2.0, Section 302-1. [If computer monitor's maximum luminance is less than 175 candelas per square meter (e.g., 150), then technician shall use the maximum luminance (e.g., 150) and report the value to EPA with other required testing documentation. Similarly, if the computer monitor's minimum luminance is greater than 175 candelas per square meter (e.g., 200), then technician shall use the minimum luminance (e.g., 200) and report the value to EPA.]

- G. **Light Measurement Protocols:** When light measurements, such as illuminance and luminance, need to be made, a LMD shall be used with the computer monitor located in dark room conditions. The LMD shall be used to make measurements at the center of, and perpendicular to the computer monitor screen (Reference VESA FPDM Standard 2.0, Appendix A115). The screen surface area to be measured shall cover at least 500 pixels, unless this exceeds the equivalent of a rectangular area with sides of lengths equal to 10% of the visible screen height and width (in which case this latter limit applies). However, in no case may the illuminated area be smaller than the area the LMD is measuring (Reference VESA FPDM Standard 2.0, Section 301-2H).
- H. **Display Set-up and Characterization:** The computer monitor test sample characteristics shall be recorded prior to the test. The following information shall be recorded at a minimum:

<sup>2</sup> Corresponding voltage values for digital only interface monitors that correspond to the brightness of the image (0 to 0.7 volts) are:

0 volts (black) = a setting of 0  
0.1 volts (darkest shade of gray analog) = 38 digital gray  
0.7 volts (full white analog) = 255 digital gray

Please note that future digital interface specifications may widen this range, but in all cases, 0 volts shall correspond to black and the maximum value shall correspond to white, with 0.1 volts corresponding to one-seventh of the maximum value.

Product Description/Category (e.g., 17-inch computer monitor with white housing)
Display Technology (e.g., CRT, LCD, Plasma)
Brand Name/Manufacturer
Model Number
Serial Number
Rated Voltage (VAC) and Frequency (Hz)
Viewable Diagonal Size (inches)
Aspect Ratio (e.g., 4:3)
Recommended Image Size (actual size tested) Width X Height
Viewing Angle (horizontal and vertical degrees)
Screen Refresh Rate (during test) (Hz)
Number of Pixels as Tested (horizontal)
Number of Pixels as Tested (vertical)
Maximum Claimed Resolution (horizontal)
Maximum Claimed Resolution (vertical)
Analog, Digital, or Both Interfaces
Instrumentation Information (e.g., type of signal generator)

**Product Testing Methodology**

I. **Test Method:** Following are the test steps for measuring the true power requirements of the test unit in On Mode/Active Power, Sleep Mode/Low Power, and Off Mode/Standby Power. Manufacturers are required to test their computer monitors using the analog interface, except in those cases where one is not provided (i.e., digital interface monitors, which are defined as only having a digital interface for purposes of this test method). For digital interface monitors, please see Footnote 2 on page 9 for voltage information and then follow the test method below using a digital signal generator.

**On Mode/Active Power**

1. Connect the test sample to the outlet or power source and test equipment. For computer monitors shipped with an external power supply, the external power supply (as opposed to a reference power supply) must be used in the test.
2. Power on all test equipment and properly adjust power source voltage and frequency.
3. Check for normal operation of the test unit and leave all customer adjustments set to factory default settings.
4. Bring the test unit into On Mode/Active Power either by using the remote control device or by using the ON/OFF switch on the test unit cabinet. Allow the unit under test to reach operating temperature (approximately 20 minutes).
5. Set the proper display mode. Refer to Section D, Power Measurement Test Conditions.
6. Provide dark room conditions. See Sections G, Light Measurement Protocols, and B, Dark Room Conditions.
7. Set size and luminance. Refer to Section F, Luminance Test Patterns and Procedures for CRT or Fixed Pixel displays. Once luminance is set, dark room conditions are no longer needed.
8. Either verify that the wall outlet power is within specifications or adjust the AC power source output as described in Section A (e.g., 115V ± 1%, 60Hz ± 1%).
9. Set the power meter current range. The full-scale value selected multiplied by the crest factor rating (I<sub>peak</sub>/I<sub>rms</sub>) of the meter must be greater than the peak current reading from the oscilloscope.
10. Allow the readings on the power meter to stabilize and then take the true power reading in watts from the power meter. Measurements are considered stable if the wattage reading does not vary more than 1% over the three-minute period. See Section E, Power Measurement Protocols.
11. Power consumption shall be recorded, as well as total pixel format (horizontal x vertical pixels displayed), to calculate pixels/watt.
12. Record the test conditions and test data.

**Sleep Mode/Low Power (Power Switch On, No Video Signal)**

1. At the conclusion of the On Mode/Active Power test, initiate the computer monitor's Sleep Mode/Low Power. The method of adjustment shall be documented along with the sequence of events required to reach the Sleep Mode/Low Power. Power on all test equipment and properly adjust operation range.
2. Allow the computer monitor to remain in Sleep Mode/Low Power until stable power readings are measured. Measurements are considered stable if the wattage reading does not vary more than 1% over the three-minute period. Manufacturers shall ignore the input sync signal check cycle when metering the model in Sleep Mode/Low Power.
3. Record the test conditions and test data. The measurement time shall be sufficiently long to measure the correct average value (i.e., not peak or instantaneous power). If the device has different Sleep Modes that can be manually selected, the measurement should be taken with the device in the most energy consumptive of those modes. If the modes are cycled through automatically, the measurement time should be long enough to obtain a true average that includes all modes.

**Off Mode/Standby Power (Power Switch Off)**

1. At the conclusion of the Sleep Mode/Low Power test, initiate the computer monitor's Off Mode/Standby Power. If only one power switch is provided (i.e., a soft off or a hard off), press that switch; if two power switches are provided (i.e., a soft off AND a hard off), press the soft off switch. The method of adjustment shall be documented along with the sequence of events required to reach the Off Mode/Standby Power. Power on all test equipment and properly adjust operation range.
2. Allow the computer monitor to remain in Off Mode/Standby Power until stable power readings are measured. Measurements are considered stable if the wattage reading does not vary more than 1% over the three-minute period. Manufacturers shall ignore the input sync signal check cycle when metering the model in Off Mode/Standby Power.
3. Record the test conditions and test data. The measurement time shall be sufficiently long to measure the correct average value (i.e., not peak or instantaneous power).

***Product Testing Documentation***

- J. Submittal of Qualified Product Data to EPA: Partners are required to self-certify those product models that meet the ENERGY STAR guidelines and report information to EPA on a QPI form. ENERGY STAR qualifying product lists, including information about new as well as discontinued models, must be provided on an annual basis, or more frequently if desired by the manufacturer.