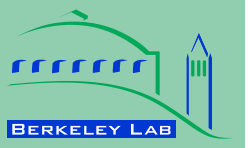

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International Comparison of Energy Efficiency Criteria and Test Procedures in Standards and Labeling Programs for Computer Monitors and Commercial Gas Stoves

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Executive Summary

This report presents a technical review and comparative analysis of existing and/or proposed international mandatory energy performance standards, and voluntary and mandatory energy efficiency labels and test procedures for two products – computer monitors and commercial gas stoves – being considered for revised and new minimum energy performance standards (MEPS) in China. An overview of the scope of international programs, energy efficiency and other energy-related requirements, description and detailed summary table of criteria and procedures in major test standards are presented. In addition, an estimation of potential energy savings if China were to adopt revised MEPS comparable to international levels is provided for computer monitors. A proposed methodology for estimating potential energy savings based on the European Union experience is provided for commercial gas stoves in the absence of available sales or energy consumption data.

Computer monitors labeling programs exist in the U.S. and Canada, Hong Kong and Korea and mandatory standards and categorical labeling programs have been proposed for Australia and the European Union (EU). The scope of standards and labeling (S&L) programs for monitors have been expanding over time, ranging from a narrow scope of only monitors in older voluntary labeling programs to a broader scope that includes other display products such as commercial signs and digital photo frames with similar features and performances in the newest proposed S&L programs. However, large digital displays, medical equipment displays and personal electronics and displays are excluded in all programs. In terms of efficiency metrics, all programs except Korea's e-standby label have power requirements for on-mode as well as standby- and off-modes. For on-mode power requirements, most programs calculate the maximum allowable power consumption in watts as a function of viewable screen area and resolution. The U.S. ENERGY STAR program uses different formulas for setting on-mode power requirements based on the display sizes and whether the monitor features automatic brightness control. Specifically, the recent ENERGY STAR v6.0 revision has expanded the size categories from two to five and introduced power allowances for enhanced performance and automatic brightness control. The EU Ecodesign proposal uses an energy efficiency index with a tiered approach of increasing stringency to account for expected rise in LED applications in backlit displays, and does not include additional allowances for new functionalities. Standby and off-mode power consumption limits are becoming more stringent over time as shown in proposed program requirements, decreasing from 2W standby and 1W off-mode to 0.5W for standby (and off-mode in the U.S.) and 0.3W for the most stringent off-mode requirement in the EU. Computer monitors' status as globally traded products has fostered international harmonization in the test procedures with most programs adopting the IEC test standard and/or

ENERGY STAR test standard for on-mode power measurements and all programs adopting IEC 62301 for standby power measurements.

Based on this international review, regular updates of S&L programs are needed to keep pace with computer monitor's rapid rate of technological development as evidenced by the major revisions undertaken for ENERGY STAR in just over four years and the introduction of allowances to address new performance features. There is also a growing trend of grouping computer monitors with other similar products including commercial signage displays, digital photo frames, and televisions in newer standards and labeling programs. For countries such as China, key lessons learned from recent international experiences include the need for more performance measurement data collection to improve comparability across test methods, the need to address newly emerging functionalities and enhanced performances of display products through either power allowances or tiered standards approach, and the importance of test procedure harmonization. A simple stock turnover analysis shows that if China were to adopt the most stringent standby and off-mode requirements that exist today, it could save up to 1330 GWh annually by 2030. Cumulatively from 2013 to 2030, a total of 20.3 TWh to 21 TWh could be saved depending on if a one-off or tiered standard is implemented for standby in 2013 (and in 2018 for tiered approach), with the vast majority of savings from standby power reduction.

Although S&L programs have been in place for residential gas cookstoves for nearly a decade, there is currently no existing voluntary or mandatory MEPS or labeling program in the world. The EU considered adopting S&L requirements for commercial gas stoves in a 2009 Ecodesign preparatory study for cooking products but ultimately excluded it from both Ecodesign standards and EU Energy Label due to lack of reliable data, lack of suitable efficiency measurements, low sales figures and fragmented market. In the absence of any existing efficiency program for commercial gas stoves and given the similarities between household and commercial gas stoves, a review of the EU Ecodesign proposal for residential gas stoves and the recently revised U.S. MEPS for residential cooking products found very different efficiency metrics between the two programs. The U.S. only mandates that all gas cooking products not have a constant burning pilot light. The EU proposes a tiered approach with minimum gas burner efficiency being raised from 52% one year after the legislation enter into force to 65% five years after the legislation enters into force, along with standby power requirements and power management functionalities. In the absence of any harmonized international or leading test method, the U.S. and EU both use its own method for measuring gas cooktop energy consumption.

As illustrated by the few countries that considered adopting MEPS and/or labels for commercial gas stoves, data availability and the appropriate test method will be two of the major barriers facing China's standard-setting and label development process. Data collection different from that of common household or commercial energy-using products will be needed to support commercial gas stove S&L development, and the EU approach of linking commercial gas stoves to for-profit and institutional food services outlets can be considered as a starting point. In developing test procedures, the common approach of measuring efficiency by measuring the energy used to heat water in comparison to a theoretical minimum can be referenced but specific user behavior need to be considered to improve the test procedure's representativeness of real life efficiency. In the absence of any China-specific data on stock or usage of commercial gas stoves to conduct a potential savings estimate, the EU Ecodesign study is reviewed in terms of key assumptions (e.g., 12 year lifetime, existing efficiency levels of 23%-55%) and best available technologies for improvements (pot presence sensors, electronic ignition as replacement for pilot lights, gas burner design changes).

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1. COMPUTER MONITORS

1.1. Overview of Scope of International Standards and Labeling Programs

As an increasingly common item of home and office electronic equipment, computer monitors are being covered by a growing number of international energy efficiency labeling programs, and more minimum energy performance standards (MEPS) have recently been proposed. The major standards and labeling programs for computer monitors include the voluntary U.S. and Canada ENERGY STAR endorsement labeling program, voluntary Hong Kong endorsement labeling program, mandatory Korea e-standby labeling program and two new proposals for MEPS and categorical energy labeling programs in Australia and the European Union (EU). Australia and EU's proposed labeling programs are similar in that both labels would differentiate between ten efficiency grades or classes using an energy efficiency index, with the least efficient class set at the MEPS level and the top four classes or grades intended for super-efficient products. Section 1.5 contains a summary table for all of these programs and test procedures.

The scope of these programs differs and reflects changing technological trends for computer monitors. On one end of the spectrum, older standards and labeling programs including the existing U.S. and Canadian ENERGY STAR version 5.1 and Hong Kong endorsement label cover only computer monitors. On the other end of the spectrum, more recently revised ENERGY STAR version 6.0 specifications and proposed EU Ecodesign standard and EU Energy Label encompass a broader scope that covers other display devices such as digital photo frames and commercial advertising signage displays. The proposed EU Ecodesign standard also covers televisions because recent technology trends in the development of televisions and computer monitors share similar features and performance and computer monitors are expected to be more efficient than televisions since they do not include a tuner. In fact, Korea's e-standby program requirements already apply to both computer monitors and televisions. Australia's proposed programs reflect a hybrid between old and new regulations; its proposed MEPS covers only computer monitors as it directly follows the older ENERGY STAR version 5.1 specifications but its energy labeling program is linked to the recently revised 10-star categorical energy label for televisions.

Some similarities can be seen in the specific products excluded in international MEPS and labeling programs for computer monitors. The U.S. and Canadian ENERGY STAR and Australian proposed MEPS and labeling programs all exclude large displays with diagonal screen sizes of greater than 60 inches and medical equipment. All of the reviewed programs, including the recently finalized ENERGY STAR version 6.0 revision and proposed EU Ecodesign and labeling program all specifically exclude mobile computing and communication devices such as smartphones, tablets and electronic readers. This represents a general international consensus that the energy efficiency of newly emerging technologies in personal display devices will need to be regulated in separate standards and/or labeling programs in the future.

1.2. Energy Values in Existing Programs

The energy-related criteria set by international MEPS and labeling programs for computer monitors and related displays all cover on-mode, sleep or standby mode and off-mode power consumption, with the exception of Korea's e-standby program which only sets standby power consumption limits.

1.2.1. On-Mode Power Consumption Limits

For on-mode power consumption limits, the proposed Australia MEPS and the existing ENERGY STAR version 5.1 specifications on which it is based differentiate between monitors with and without automatic brightness control (ABC). The on-mode power consumption limit for displays with ABC are set assuming the display is in low ambient lighting conditions 20% of the time. For displays without ABC that are below a diagonal screen size of 30 inches, the formula for determining on-mode power consumption limits are differentiated between units with high and low resolution (with the threshold set at 1.1 megapixel). The specific power consumption limit for a given display with ABC is then set based on resolution and screen area. For displays over 30 inches without ABC, the on-mode power consumption limit is impacted only by the screen size. In contrast, the Hong Kong voluntary label sets the on-mode power consumption limit for computer monitors based only on resolution and does not consider screen size or viewable screen area. For both displays with and without ABC, the formula for calculating power consumption limits are essentially the same for ENERGY STAR version 5.1 and Australia's proposed MEPS level, with the exception that a lower screen area coefficient of 0.00775 rather than ENERGY STAR's coefficient of 0.05 is used for displays less than 30 inches in Australia.

The revised ENERGY STAR specifications effective in June 2013 and EU Ecodesign proposal for computer monitors and other displays show significant differences in how on-mode power consumption is set for the label and MEPS, respectively. A major change in the ENERGY STAR version 6.0 specifications for displays is further differentiation in allowable power consumption by display sizes based on both resolution and screen area. Rather than the two size categories of above and below 30 inch screen size, the new ENERGY STAR specifications sets power consumption limits for five size categories as well as a separate category for large signage displays between 30 and 60 inches. The introduction of more differentiated size categories is intended to allow higher qualification rates in key sizes that are becoming increasingly popular with consumers, including 19-, 20-, 22-, 23- and 25-inch monitors. For the signage display category, the new ENERGY STAR specifications adopt the power consumption limits currently set for large displays between 30 to 60 inches. Another important change in ENERGY STAR version 6.0 is the introduction of pixel density, rather than megapixels, as the unit for calculating resolution when determining the power consumption limit of displays with high resolution image quality. Lastly, ENERGY STAR version 6.0 also introduces for the first time additional power allowances for features such as ABC and enhanced performance. To incentivize the production of more displays with effective ABC, 10% additional power allowance is given for displays with ABC that are able to achieve at least 20% on-mode power reduction. To account for greater energy consumption of enhanced performance displays that meet all three performance criteria in terms of greater contrast,

resolution and color gamut, a 30% additional power allowance for enhanced-performance displays is also given.

As another newly formulated proposal for setting computer monitor and other display MEPS and labeling thresholds, the proposed EU Ecodesign and energy label regulation currently undergoing review presents another approach to regulating the energy efficiency of electronic displays. Under the EU Ecodesign proposal, the MEPS for displays are not set as absolute values calculated using a formula, but rather as an energy efficiency index. The energy efficiency index compares a unit's actual power consumption with a baseline power consumption set based on screen area. Two size categories – displays with screen areas of greater than or less than 16.5 dm^2 – are used for determining the baseline power consumption. The MEPS are also set in a three-tiered approach in order to account for recent and expected future technological development of displays. The tier 1 MEPS level help address the additional energy associated with the recent rise in displays with additional functions and higher resolutions without introducing adjustment adders and correction factors, while the tier 2 and 3 MEPS account for expected performance gains with increasing applications of LEDs in backlit displays. The proposal also reduces the on-mode power consumption for calculating EEI by 10% for displays with automatically activated ABC if ambient light intensity is automatically reduced. The Ecodesign proposal specifically avoided introducing additional allowances for new functionalities because the European Commission believes these functionalities should be user controlled or power managed.

1.2.2. Standby- and Off-Mode Power Consumption

A comparison of the standby- and off-mode power consumption limits in existing and proposed MEPS and labeling programs highlights advancements in reducing computer monitors and displays' inactive energy consumption in recent years. While older program requirements including ENERGY STAR version 5.1 and the related Australian proposal and the Hong Kong label set the limits for standby mode power consumption at 2W and off-mode at 1W, the newer U.S. ENERGY STAR revision and EU proposal reduces standby power limit to 0.5 W. The EU Ecodesign proposal is also more ambitious in lowering the off mode power limit to only 0.3 W, while the U.S. sets off-mode power limit at 0.5 W. Moreover, U.S. ENERGY STAR version 6.0 gives additional allowances for displays with different data or networking capabilities, while the EU Ecodesign proposal provides a higher standby power allowance of 1W for displays that constantly provide information or status display. Beginning in 2015, the EU also sets two-tiered networked standby allowable power consumption for displays with and without high network availability functionality.

1.2.3. Additional Energy Related Requirements

Besides setting the maximum power consumption limits for on-, standby- and off-modes, ENERGY STAR and the EU Ecodesign programs also include other energy-related power management requirements. Both the existing ENERGY STAR version 5.1 and forthcoming ENERGY STAR version 6.0 specifications require qualifying products to have external power supplies that meet international efficiency marking

level V performance and default power management features. The ENERGY STAR version 6.0 specifications further requires computer monitors and displays to automatically switch into standby- or off-mode within 15 minutes after being disconnected. Similarly, the EU Ecodesign proposal also requires monitors and displays to automatically switch into standby- or off-mode within four hours of inactivity after a warning alert has been shown; and requires networked electronic displays to automatically switch into power management function within 20 minutes by 2015.

1.3. Comparison of Test Procedures

Although standards and labeling programs for computer monitors and displays were introduced only within the last ten years, their status as globally traded products has fostered international harmonization in the test procedures for measuring their energy performance. In measuring the active power consumption of computer monitors and displays, there is general harmonization with IEC 62087 for televisions. The ENERGY STAR program uses the IEC test standard content in conjunction with its own test methods, while the EU directly follows the IEC test standard for televisions. Besides IEC 62087, the other major test standard adopted for computer monitors and displays is the ENERGY STAR Test Method for Displays, which is also adopted by Australia for its proposed MEPS and labeling programs. For non-active power measurements, there is complete harmonization in the test standard for measuring standby power consumption as all programs adopt IEC 62301 for standby power measurements.

Two new developments in test procedures for computer monitors and displays have been observed in recent years. First, the new ENERGY STAR test method revised in June 2012 provides much more detailed requirements for light measurements, such as specified ambient light measurement tolerance levels and a standardized light source. It also specifies the methods for measuring power in monitors and displays with network connections. Second, newer proposals including ENERGY STAR version 6.0 and EU Ecodesign are both harmonized with the updated IEC standards IEC 62087 Ed. 3.0 and IEC 62301 Ed. 2.0 for measuring on-mode and standby-mode consumption, respectively. These two trends illustrate that updates to test procedures are necessary to account for the rapid advancements in display technologies as well as revisions in harmonized international test standards.

1.4. Barriers to Program Development and Lessons Learned from International Experiences

The evolution of MEPS and labeling programs and their accompanying test procedures for computer monitors and displays demonstrates the product's rapid rate of technological development and the need for standards and labeling programs to keep pace. For example, major revisions have been initiated for the ENERGY STAR specifications and test procedures for computer monitors and displays just over the last four years. The EU proposal also reflects the first time that MEPS are set for networked standby power consumption, an increasingly common feature of office displays. The convergence of performance and features amongst different technologies with display functions has resulted in a

growing trend of grouping computer monitors with other similar products including commercial signage displays, digital photo frames, and televisions in newer standards and labeling programs.

As other countries including China begin initiating new or revised MEPS and labeling programs for computer monitors and possibly other display products, there are several key lessons that can be learned from the challenges that the U.S. and EU have faced in their recent standards and labeling development experiences. First, because performance measurement data on computer monitors and other displays tend to be sparse, there is a need to collect more data from manufacturers and industry before and during the standards and labeling development process. This is particularly important in ensuring comparability if a country intends to use the same measurement method as televisions for display products. Second, in light of recent technological changes, extra functionalities and high performance of display products need to be addressed in both standard-setting levels and test procedures. This includes possibly providing additional power allowances for specific functions or if a set of high performance criteria is met as specified in U.S. ENERGY STAR version 6.0, or by following a tiered approach as proposed for the EU. The tiered approach can help accommodate extra functionalities by giving manufacturers more time to adapt and improve the efficiency of functionalities over the short-term, while still accounting for expected efficiency gains from newer technologies such as backlit LEDs for televisions. Third, in terms of test procedures, cross-country experiences have demonstrated the importance of test standard harmonization as virtually all existing programs have adopted test procedures based on the IEC standards and/or ENERGY STAR test standard.

1.5. Summary of International S&L programs and Test Methods for Computer Monitors and Display Products

	U.S. ENERGYSTAR v5.1 Voluntary	**U.S. ENERGYSTAR v6.0** Voluntary	**Canada ENERGYSTAR v5.1** Voluntary
Classification/Scope	Displays information from computer, workstation or server; USB flash drive; memory card; or wireless internet connection Excludes displays with diagonal screen size greater than 60 inches; TVs; medical equipment displays	Computer monitor* (i.e., diagonal screen size > 12 inches), digital picture frame (diagonal screen size < 12 inches), signage display (d > 12 inches, pixel density < 5000 pixels/in2) *Computer monitor with enhanced-performance display if it has: contrast ratio of at least 60:1, resolution ≥2.3 MP, color gamut of at least sRGB as defined by IEC Excludes displays with diagonal screen size greater than 60 inches; TVs and dual-function TVs/computer monitors; mobile computing and communication devices (e.g., tablets, smart phones); medical equipment displays	Displays information from computer, workstation or server; USB flash drive; memory card; or wireless internet connection Excludes displays with diagonal screen size greater than 60 inches; TVs (i.e., products with an integrated TV tuner)
Effective Dates	Diagonal screen size < 30 inches: 10/30/2009 Diagonal screen size 30-60 inches: 1/30/10	6/1/2013	Tier 1: Diagonal screen size < 30 inches: 10/30/2009 Diagonal screen size 30-60 inches: 1/30/10 Tier 2: All screen sizes: 10/30/2011

	U.S. ENERGYSTAR v5.1 Voluntary	**U.S. ENERGYSTAR v6.0** Voluntary	**Canada ENERGYSTAR v5.1** Voluntary
Energy Values	Maximum On Mode Power Consumption, in Watts On-Mode, with Automatic Brightness Control (ABC): Power ≤ (0.8 x Ph) + (0.2 x Pl) where Ph = measured power in high ambient lighting (300 lux) Pl = measured power in low ambient lighting (0 lux) On-Mode, without ABC: size < 30 inches and resolution (r) ≤ 1.1 megapixels: Power = (6.0 x r) + (0.05 x A) + 3.0, where A = viewable screen area size < 30 inches and resolution (r) > 1.1 megapixels: Power = (9.0 x r) + (0.05 x A) + 3.0, where A = viewable screen area size between 30 to 60 inches for any resolution: Power = (0.27 x A) + 8.0	Maximum On Mode Power Consumption, in Watts Pixel density = (r x 10^6)/A where, r = screen resolution in Megapixels and A=screen area in square inches If pixel density exceeds 14,000 pixels/inch, use screen resolution = (14,000 x A)/10^6 to calculate max power consumption size < 12 inches: Power = (6.0 x r) + (0.05 x A) + 3.0, where A = viewable screen area, r=resolution 12 ≤ size < 17: Power = (6.0 x r) + (0.01 x A) + 5.5 17 ≤ size < 23: Power = (6.0 x r) + (0.025 x A) + 3.7 23 ≤ size < 25: Power = (6.0 x r) + (0.06 x A) - 4.0 25 ≤ size ≤ 61: Power = (6.0 x r) + (0.1 x A) - 14.5 For signage displays: 30 ≤ size ≤ 61: Power = (0.27 x A) + 8.0 Additional Power Allowances: 30% for enhanced-performance displays	Maximum On Mode Power Consumption, in Watts On-Mode, with Automatic Brightness Control (ABC): Power ≤ (0.8 x Ph) + (0.2 x Pl) where Ph = measured power in high ambient lighting (300 lux) Pl = measured power in low ambient lighting (0 lux) On-Mode, without ABC: size < 30 inches and resolution (r) ≤ 1.1 megapixels: Power = (6.0 x r) + (0.05 x A) + 3.0, where A = viewable screen area size < 30 inches and resolution (r) > 1.1 megapixels: Power = (9.0 x r) + (0.05 x A) + 3.0, where A = viewable screen area size between 30 to 60 inches for any resolution: Power = (0.27 x A) + 8.0

	U.S. ENERGYSTAR v5.1 Voluntary	**U.S. ENERGYSTAR v6.0** Voluntary	**Canada ENERGYSTAR v5.1** Voluntary
		10% allowance for default automatic brightness control if power reduction ≥20%	
	Sleep Mode: Maximum Power Requirement < 2 W Off Mode: Maximum Power Requirement < 1 W	Sleep Mode: Maximum Power Requirement < 0.5 W Additional power allowances in sleep mode for data/network capabilities: Wired USB 1.x: 0.1 W Wired USB 2.x: 0.5 W Wired USB 3.x: 0.7 W Fast ethernet: 0.2 W Gigabit ethernet: 1.0 W Wireless Wi-Fi: 2.0 W Occupancy sensor: 0.5 W Flash memory-card/smart-card readers, camera interfaces: 0.2 W Off Mode: Maximum Power Requirement < 0.5 W	Sleep Mode: Tier 1: Maximum Power Requirement < 2 W Tier 2: Maximum Power Requirement < 1 W Off Mode: Tier 1 & 2 Maximum Power Requirement < 1 W
Additional Requirements	International Energy Efficiency Marking for EPS level V performance, power management feature by default	International Energy Efficiency Marking for EPS level V performance, power management feature by default Computer monitors auto enter Sleep or Off Mode within 15 minutes of being disconnected	International Energy Efficiency Marking for EPS level V performance, power management feature by default

	U.S. ENERGYSTAR v5.1 Voluntary	**U.S. ENERGYSTAR v6.0** Voluntary	**Canada ENERGYSTAR v5.1** Voluntary
Test Method/Specs	ENERGY STAR Test Method for Displays rev Aug 2010; IEC 62087, Ed 2.0; IEC 62301 Ed. 1.0 for Standby	ENERGY STAR Test Method for Displays rev June 2012;; IEC 62087, Ed 3.0 for test content; IEC 62301 Ed. 2.0 for Standby	Same as US: ENERGY STAR Test Method for Displays rev Aug 2010; IEC 62087, Ed 2.0; IEC 62301 Ed. 1.0 for Standby
	Measurement accuracy: ±2% at 95% confidence level	Power measurement accuracy: ±2% at 95% confidence level; Light measuring device accuracy of ±2% with repeatibility within 0.4% of displayed value	Measurement accuracy: ±2% at 95% confidence level
	Refresh rate: 60 Hz for fixed pixel displays, 75 Hz for CRT displays	Refresh rate: 60 Hz for fixed pixel displays, 75 Hz for CRT displays	Refresh rate: 60 Hz for fixed pixel displays, 75 Hz for CRT displays
	Standby power measurements: measured after stable to within 1% over 3 minute period	Ambient light values measured at Automatic Brightness Control sensor; ambient light measured measured with tolerances of: ±1 lux at 10 lux; ±5 lux at 100 lux; ±9 lux at 300 and 500 lux	Power measurements: measured after stable to within 1% over 3 minute period
	Light measurement: measured with device at center of, and perpendicular to screen	Light source standardized as standard spectrum halogen flood reflector lamp with rated brightness of 980 ± 5% lumens (see diagram for test set up of light source and measurement)	Light measurement: measured with device at center of, and perpendicular to screen
	On Mode Fixed Pixel Displays: luminance setting of 175 Cd/m2 for resolution ≤1.1 MP; 200 Cd/m2 for resolution > 1.1 MP	Power measurements for network connections: activate network capabilities if available; unit connect to a single active data source or network in following order of preference: WiFi, Ethernet, Thunderbolt, USB, Firewire, other	On Mode Fixed Pixel Displays: luminance setting of 175 Cd/m2 for resolution ≤1.1 MP; 200 Cd/m2 for resolution > 1.1 MP
		Remove batteries when testing back-up battery operated products; fully charge batteries before testing solely battery operated products	

	Hong Kong Voluntary	**Korea e-Standby**	**EU Ecodesign Proposal** Mandatory	**EU Energy Label Proposal** Mandatory
Classification /Scope	Standard LCD monitors designed for use with computers only	Computer monitors with power supply output ≤ 1000W; dual function computer monitors and TVs	TVs, TV monitors, computer monitors, digital photo frames, advertising displays and public displays Excludes: projectors, high performance electronic displays, medical displays	TVs, TV monitors, computer monitors, digital photo frames, advertising displays and public displays Excludes: projectors, high performance electronic displays, medical displays
Effective Dates	Phase I: 12/22/2003 - 9/30/2007 Phase II: 10/1/2007	7/1/2009	Tier 1: 7/1/2014 Tier 2: 1/1/2016 Tier 3: 7/1/2017	
Energy Values	Maximum Power Requirements, in Watts **On-Mode:**	**Standby Power Requirement**	Maximum On Mode Power Consumption, in Watts **Energy Efficiency Index (EEI):**	Maximum On Mode Power Consumption, in Watts **Energy Efficiency Index (EEI):**
	Phase I: Power = 30 + 2 x Megapixels (MP) Phase II: If X < 1 MP, Power = 23 If X > 1 MP; Power = 28* MP	Maximum power requirement < 1 W	Screen Areas ≤ 16.5 dm2: EEI = on-mode power consumption / [(0.88 x A + 2.70) x 2.1] Screen Areas > 16.5 dm2: EEI = on-mode power consumption / [(60.645 x ln(A) - 152.64) x 2.1]	Screen Areas ≤ 16.5 dm2: EEI = on-mode power consumption / [(0.88 x A + 2.70) x 2.1] Screen Areas > 16.5 dm2: EEI = on-mode power consumption / [(60.645 x ln(A) - 152.64) x 2.1]

	Hong Kong	Korea e-Standby	EU Ecodesign Proposal	EU Energy Label Proposal
	Voluntary Sleep Mode: Phase I: ≤ 4 W (with ≤ 15 min default time) Phase II: ≤ 2 W (with ≤ 30 min default time) Off Mode: Phase I: ≤ 2 W Phase II: ≤ 1 W (with ≤ 30 min default time)		Mandatory Tier 2: 0.4 Tier 3: 0.2 Displays with automatic brightness control: reduce standard power consumption by 10% if luminance is reduced by 0-20 lux ambient light intensity Sleep Mode: When providing reactivation function only: ≤0.5 W When providing information or status display: ≤ 1W Off Mode: Maximum Power Requirement: ≤ 0.3W Displays with easily visible switch that can put display into mode with power consumption ≤ 0.01W, any other off-mode condition can be ≤ 0.5W	Mandatory A+: 0.16 ≤ EEI < 0.23 A: 0.23 ≤ EEI ≤ 0.30 B: 0.30 ≤ EEI ≤ 0.42 C: 0.42 ≤ EEI < 0.60 D: 0.60 ≤ EEI < 0.80 E: 0.80 ≤ EEI < 0.90 F: 0.90 ≤ EEI < 1.00 G: 1.00 ≤ EEI

	Hong Kong	Korea e-Standby	EU Ecodesign Proposal	EU Energy Label Proposal
Additional Requirements	Luminance: minimum of 100 Cd/m2 Contrast ratio: minimum of 200:1		**Networked Standby:** Power consumption requirements by 1/1/2015: Displays with high network availability (HiNA) functionality: ≤ 12 W Displays without high network availability (HiNA) functionality: ≤ 6 W Power consumption requirements by 1/1/2017: Displays with high network availability (HiNA) functionality: ≤ 8 W Displays without high network availability (HiNA) functionality: ≤ 3 W Default switch to standby or off-mode within 4 hours of last activity; display alert message before switching to standby or off-mode Electronic displays intended for signage may contain function for user to disable auto power-down functionality By 1/1/2015: auto shift into power management function within 20 minutes for networked electronic displays; wireless networked electronic display displays should offer possibility for deactivating wireless network connections TVs and Displays: peak luminance of on-mode as delivered ≥ 65% of brightest on-mode condition provided	

	Hong Kong	Korea e-Standby	EU Ecodesign Proposal	EU Energy Label Proposal
Test Method/Specs	Unspecified Refresh rate: 50 Hz Power measurements: 20 minute warm up period; measured after stable to within 1% over 3 minute period Light measurement: measured with device at center of, and perpendicular to screen	N/A	European standard (EN 62087) mirroring IEC 62087: 2011 for TVs, with modifications as needed for other display products provided in annex	European standard (EN 62087) mirroring IEC 62087: 2011 for TVs, with modifications as needed for other display products provided in annex

	Australia Proposed MEPS Mandatory	**Australia Proposed Label** Mandatory
Classification/Scope	Computer monitors Excludes: digital signage displays and photo frames, high performance displays, specialized displays (medical equipment), multifunctional displays including networking functions, tablets, smart phones, readers; public displays larger than 32 inch screen size; large displays greater than 60 inch screen size, TVs	Computer monitors Excludes: digital signage displays and photo frames, high performance displays, specialized displays (medical equipment), multifunctional displays including networking functions, tablets, smart phones, readers; public displays larger than 32 inch screen size; large displays greater than 60 inch screen size, TVs
Effective Dates	4/1/2013	4/1/2013
Energy Values	Maximum On Mode Power Consumption, in Watts **On-Mode, with Automatic Brightness Control (ABC): Power ≤ (0.8 x Ph) + (0.2 x Pl)** where Ph = measured power in high ambient lighting (300 lux) Pl = measured power in low ambient lighting (0 lux) **On-Mode, without ABC:** size < 30 inches and resolution (r) ≤ 1.1 megapixels: Power = (6.0 x r) + (0.00775 x A) + 3.0, where A = viewable screen area size < 30 inches and resolution (r) > 1.1 megapixels: Power = (9.0 x r) + (0.00775 x A) + 3.0, where A = viewable screen area	Maximum On Mode Power Consumption, in Watts **Star Rating Index (SRI) = 1 + [log(labeled unit energy consumption/baseload energy consumption)/log(1-0.2)]** 1-Star: 1.0 ≤ SRI < 1.5 1.5-Star: 1.5 ≤ SRI < 2.0 2-Star: 2.0 ≤ SRI < 2.5 2.5-Star: 2.5 ≤ SRI < 3.0 3-Star: 3.0 ≤ SRI < 3.5 3.5-Star: 3.5 ≤ SRI < 4.0 4-Star: 4.0 ≤ SRI < 4.5 4.5-Star: 4.5 ≤ SRI < 5.0 5-Star: 5.0 ≤ SRI < 5.5 5.5-Star: 5.5 ≤ SRI < 6.0 6-Star: 6.0 ≤ SRI < 7.0 7-Star: 7.0 ≤ SRI < 8.0 8-Star: 8.0 ≤ SRI < 9.0

	Australia Proposed MEPS Mandatory	**Australia Proposed Label** Mandatory
	Sleep Mode: Maximum Power Requirement < 2 W **Off Mode:** Maximum Power Requirement < 1 W	9-Star: 9.0 ≤ SRI < 10.0 10-Star: 10.0 ≤ SRI Note: under revised label, previous 4-star unit becomes 1-star
Additional Requirements	None	None
Test Method/Specs	AS/NZS 62087; based on ENERGY STAR Test Method for Displays V5.0 and IEC 62087 Ed. 3.0 for test content Measurement accuracy: ±2% at 95% confidence level Power measurements: measure after monitor has been in off mode for at least 1 hour immediately followed by at least 1 hour in on mode and completed before maximum of 3 hours in on mode On Mode Fixed Pixel Displays: luminance setting of 175 Cd/m2 for resolution ≤1.1 MP; 200 Cd/m2 for resolution > 1.1 MP	AS/NZS 62087; based on ENERGY STAR Test Method for Displays V5.0 and IEC 62087 Ed. 3.0 for test content

1.6. Estimating the Energy Savings Potential of Possible Revised Computer Monitor MEPS for China

In light of the international review of existing and upcoming MEPS and labeling requirements for computer monitors and China's upcoming revision to its existing MEPS and labeling requirements, a cross-regional comparison can help illustrate the energy savings potential for more stringent Chinese efficiency requirements. China's 2008 MEPS and energy label for computer monitors sets the minimum efficiency for on-mode power consumption and off-mode power consumption by monitor technology type. For on-mode power consumption, China sets efficiency using candelas per watt, which is different from the common on-mode power requirement of watts used in ENERGY STAR and Hong Kong, and the energy efficiency index based on on-mode power consumption used in the proposed EU Ecodesign proposal and labeling program. Due to this difference in efficiency criteria and the use of different testing methods between China and other key countries and regions, it is not possible to directly compare Chinese monitors' regulated on-mode power consumption levels with that of international programs to estimate potential efficiency gains. To accurately assess the energy savings potential of potential revised on-mode power limits for monitors in China, a more in-depth and careful evaluation that is beyond the scope of this project is needed to account for these divergences.

However, China's 2008 MEPS and energy label for computer monitors do include off-mode power requirement which is directly comparable to international levels given the international harmonization of test standards for standby and off-mode power consumption to IEC standards. Thus, a simplified analysis can be conducted to estimate the off-mode energy savings potential for China if it adopts a more stringent off-mode MEPS on par with advanced international levels in its upcoming standards revision. In addition, because China's existing MEPS and energy labeling requirements do not cover standby power consumption, the introduction of stringent standby power limits based on international levels can result in additional savings from lowered standby energy consumption.

The following sections present a simple quantitative analysis of potential standby and off-mode energy savings for China if more stringent MEPS and energy labeling requirements are put into place in the upcoming standard revision. This analysis is conducted using a simple Excel-based stock turnover analysis based on best available Chinese data, taken mainly from previous CNIS analyses and the annual White Paper for the Energy Efficiency Status of Chinese Energy-Use Products published by CNIS. International data from existing and proposed international standards and labeling programs are also taken as proxies for what China can achieve in terms of efficiency gains and in terms of usage patterns where China-specific data is not available.

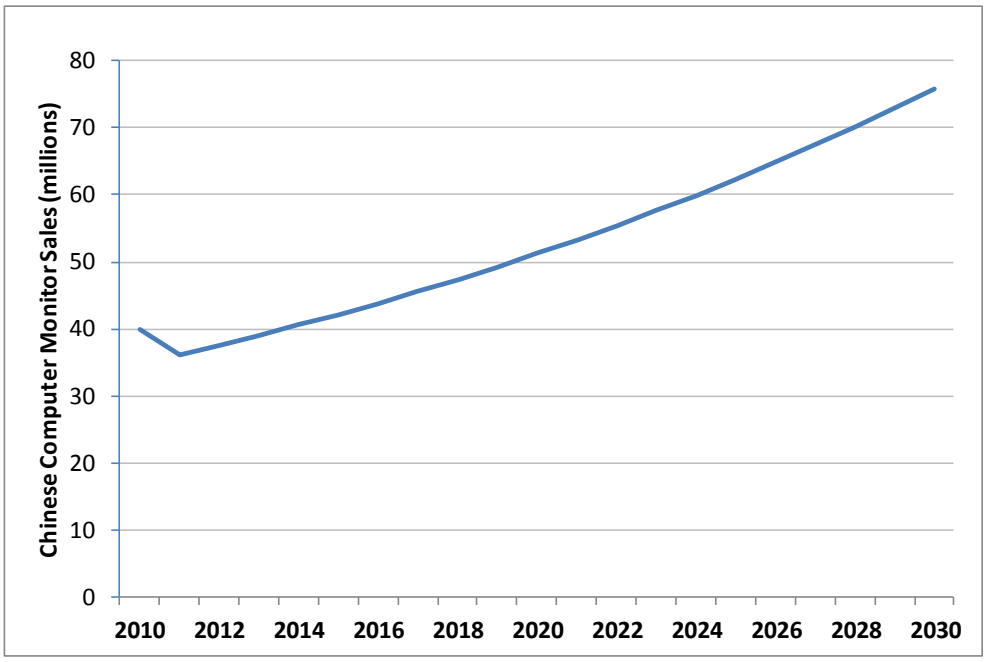
1.6.1. Key Assumptions for Analysis

To characterize China's potential energy savings from adopting standby and more stringent off-mode power consumption requirements for computer monitors in 2013, projections about future sales and stock of efficient equipment are made using assumptions about annual growth in sales and lifetime.

Projected Sales

Historical sales data were taken from the annual White Papers, and an average annual growth rate in the future sales of computer monitors was calculated by looking at the sales trend from 2007 to 2010.[1] The average annual growth rate is calculated to be about 4% based on 2007 total sales of 35.5 million and 2010 total sales of 39.8 million units. This steady annual growth rate takes into account the sustained growth in demand expected for computer monitors in the near future with growing computer ownership from rural households, growing demand from more urban and wealthier households and from office use. This rate is consistent with the higher assumed value of 6% annual average growth that CNIS had used in previous analyses. Computer monitor sales in China is expected to increase to 51 million by 2020 and 76 million by 2030, if the 4% annual growth rate is applied to the latest reported sales of 36 million for 2011 (Figure 1).

Figure 1. Computer Monitor Sales Forecast for China

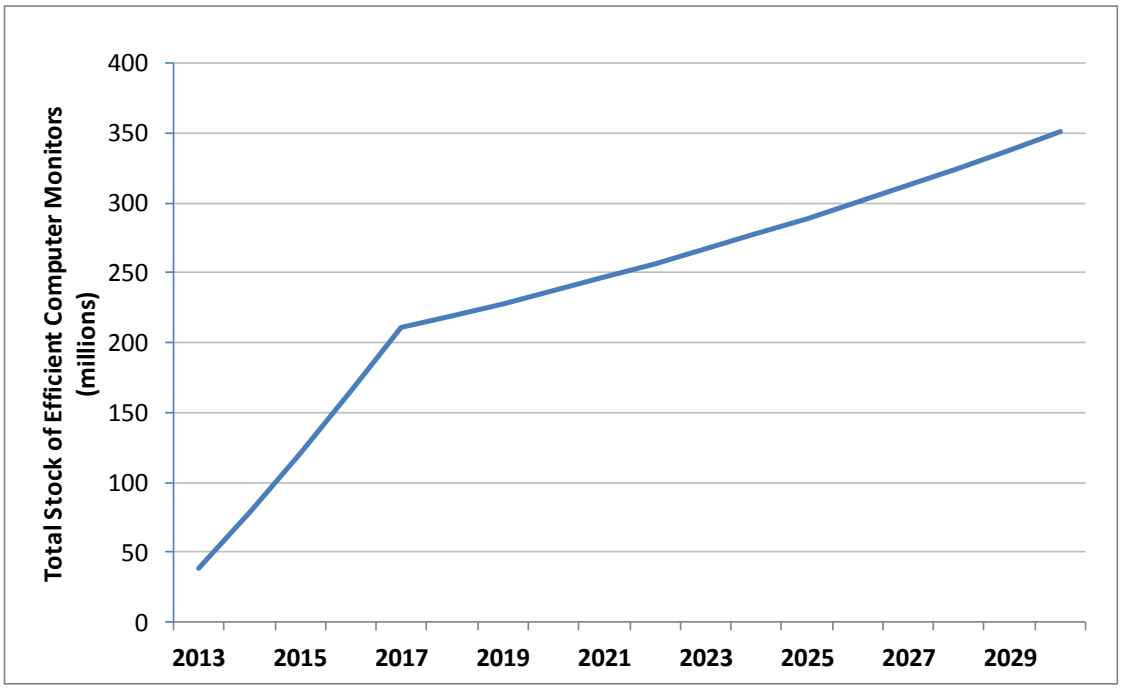


Stock of Efficient Computer Monitors

[1] Although the latest reported data on total sales is available for 2011, this was not used in calculating the average annual growth rate over the last few years because the dip in sales is not representative of previous trends and may be an one-time occurrence due to other market factors.

With a projected sales forecast, the stock of efficient computer monitors (i.e., monitors that meet the more stringent standby and off-mode power consumption limits by 2013 as described below) can be estimated by assuming a lifetime and retirement function. In this simple analysis, a lifetime of 5 years is assumed based on CNIS's previous use of this value and its comparability to the more recent use of a lifetime of 6 years in the EU Ecodesign study for Displays. Because this is a simple spreadsheet turnover analysis, a simple step function retirement function where all products retire at the end of its lifetime rather than a more realistic linear or curve distribution retirement function is used. In other words, computer monitors sold in 2013 are assumed to retire after its 5th year of life in 2018. The calculated stock of efficient monitors is shown in Figure 2 below, growing from less than 40 million in 2013 to 240 million in 2020 and 350 million in 2030.

Figure 2. Estimated Stock of Efficient Computer Monitors in China



Standby and Off-Mode Power Assumptions

Two scenarios are used to evaluate the potential standby and off-mode energy savings of computer monitors. The base case assumes that computer monitors will remain at its existing average level of efficiency from 2013 through 2030 in the absence of new standards while the one-time efficient standards case assumes that more stringent standby and off-mode standards are adopted and go into effect in 2013 for all new products sold. An additional tiered standby efficiency standards case assumes a more iterative approach to implementing efficiency standards for standby power, with an incremental Tier 1 standby efficiency standard of 1W going into effect in 2013 for all new products sold, followed by a Tier 2 standby efficiency standard of 0.5W going into effect in 2018 for all new products sold. A tiered approach is not adopted for off-mode efficiency standard because there is very small incremental gain between the current base case level of 0.62W and the international best practice level of 0.3W.

To evaluate the potential energy savings from efficiency gains in computer monitors' standby and off-mode power consumption, key assumptions as shown in Table 1 below were developed for both scenarios based on available data about the Chinese computer monitors market and international best practices.

Table 1. Key Assumptions about Standby and Off-Mode Energy Use for Monitors

	Power Consumption (W)	**Unit Energy Consumption (kWh/year)**
Standby Mode		
Base Case	2.0 W	5.04 kWh/year
One-time Efficient Standards Case (2013)	0.5W	1.26 kWh/year
One-time Efficiency Savings (2013)	1.5W	3.78 kWh/year
Tier 1 Efficient Standards Case (2013)	1W	2.52 kWh/year
Tier 1 Efficiency Savings (2013)	1W	2.52 kWh/year
Tier 2 Efficient Standards Case (2018)	0.5 W	1.26 kWh/year
Tier 2 Efficiency Savings, relative to Base Case (2018)	1.5 W	3.78 kWh/year
Off-Mode		
Base Case	0.62 W	2.26 kWh/year
Efficient Standards Case	0.30 W	1.10 kWh/year
Efficiency Savings	0.32 W	1.16 kWh/year

Standby Base Case Power Consumption of 2 W: based on the existing national average as reported by CNIS in previous analyses.

One-time and Tier 2 Standby Efficient Standards Case Power Consumption of 0.5 W: based on requirements set in the newest international programs of ENERGY STAR version 6.0 and proposed Ecodesign requirements.

Tier 1 Standby Efficiency Standards Case Power Consumption of 1W: incremental value between current base case and most stringent international value of 0.5W.

For both the base case and standards cases, the standby power consumption per unit is converted into annual unit energy consumption in kWh per year by assuming that monitors operate in standby mode for 10 hours a day for 252 working days in a year. These usage assumptions are specific to China and were taken from previous CNIS analyses.

Off-Mode Base Case Power Consumption of 0.62 W: based on the 2011 sales-weighted average as reported in the 2012 annual White Paper.

Off-Mode Efficient Standards Case Power Consumption of 0.3W: based on the most stringent requirement adopted by EU for its Ecodesign proposal.

In the absence of China-specific usage data on monitors in off-mode, EU Ecodesign data was referenced to estimate computer monitors' average total hours of use in off-mode in a year. As reported in the Ecodesign preparatory study, computer monitors operate in off-mode for 6.5 hours in office use and 13.2 hours in home use at 365 days a year. Assuming a roughly even split between home and office monitors, an average of 10 hours is used in this analysis for a computer monitor in off-mode. With this assumed hours of usage, the annual base case and efficient standards case UEC for monitors in off-mode can be calculated.

1.6.2. Energy Results

For each scenario, the total energy consumption for computer monitors for a given year is calculated as:

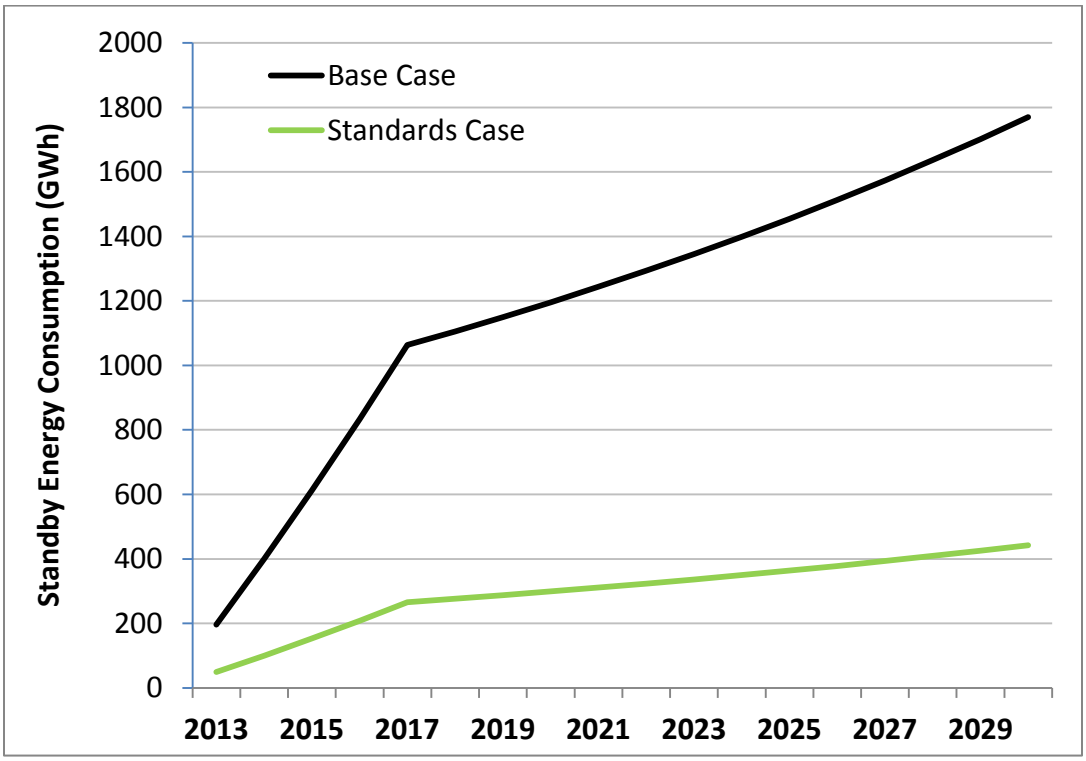
$$Total\ Energy\ Consumption = Efficient\ Product\ Stock\ \times UEC$$

and total energy savings for a given year is calculated as:

$$Total\ Energy\ Savings = Base\ Case\ Total\ Energy\ Consumption - Standards\ Case\ Total\ Energy\ Consumption$$

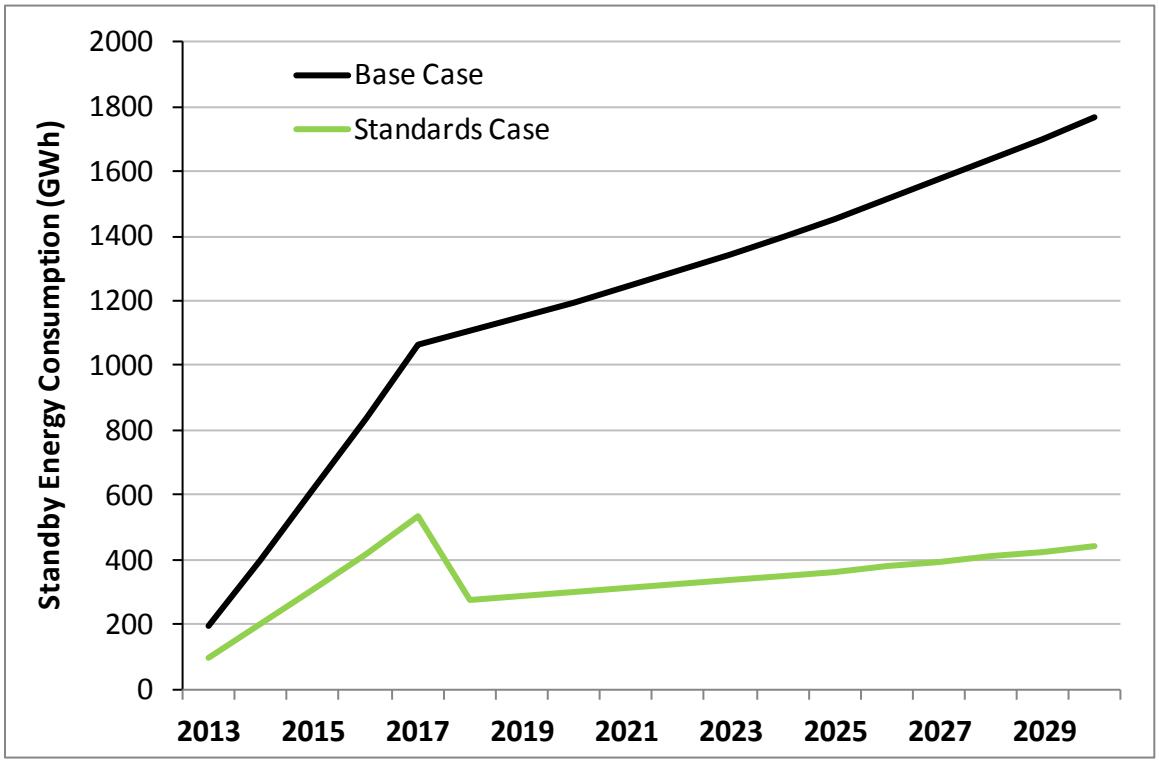
The energy results for standby and off-mode energy results for Chinese computer monitors are shown in Figure 3 - 5.

Figure 3. Computer Monitor Standby Energy Consumption for Base and Standards Case, One-time Improvement



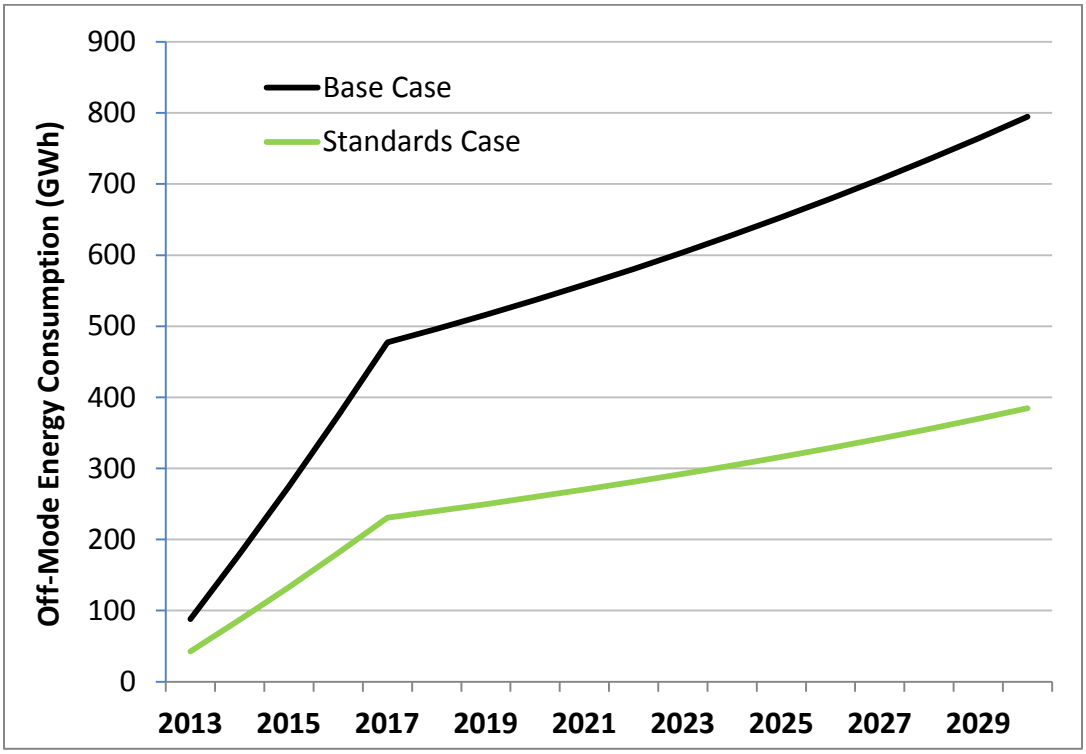
With a one-time efficiency improvement in 2013, total standby energy consumption for computer monitors is expected to increase rapidly from 200 GWh in 2013 to nearly 1800 GWh in 2030 under the base case, but only reaches 440 GWh in 2030 if more stringent standards are adopted in 2013. This suggests that annual energy savings of 1330 GWh by 2030 and cumulative potential savings of over 16.1 TWh from 2013 to 2030 are possible if standby MEPS are adopted in 2013.

Figure 4. Computer Monitors Off-mode Energy Consumption for Base and Standards Case, Tiered Aproach



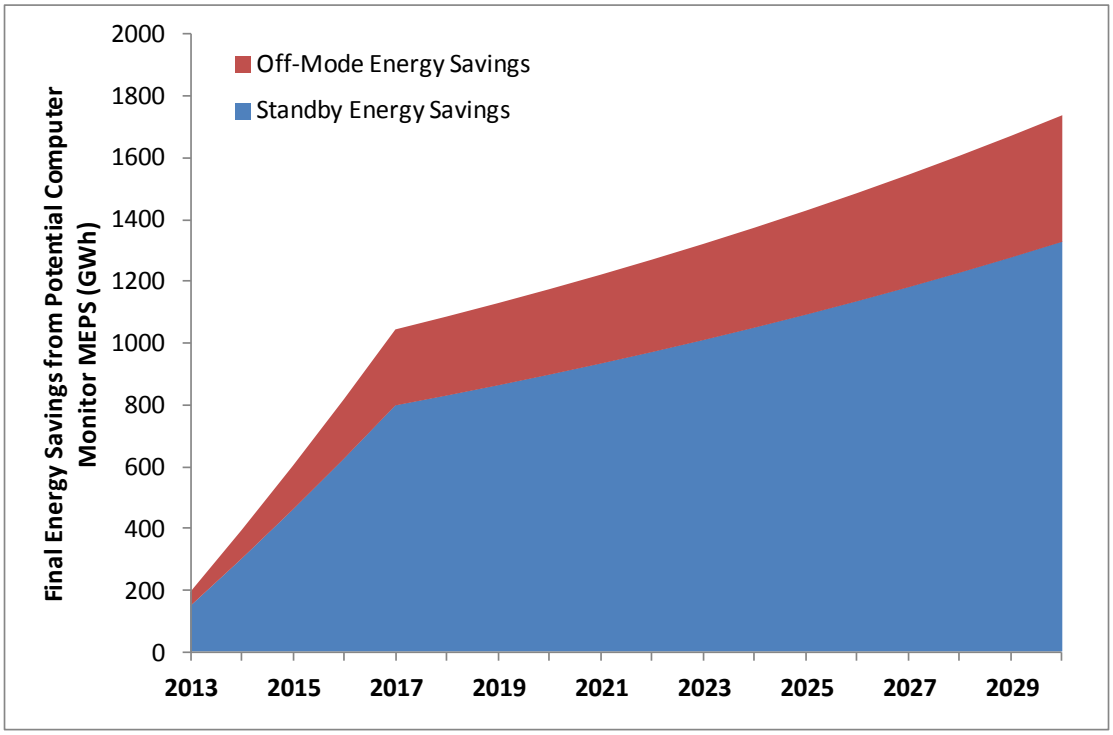
With a tiered approach to improving standby efficiency through two standard revisions adopted in 2013 and 2018, total standby energy consumption will drop significantly from 531 GWh in 2017 to 276 GWh in 2018 once the Tier 2 standard is adopted. Cumulatively, potential energy savings will reach nearly 15.4 TWh by 2030, slightly lower than the cumulative savings potential of 16.1 TWh with the one-time improvement.

Figure 5. Computer Monitors Off-mode Energy Consumption for Base and Standards Case



Total annual off-mode energy consumption for computer monitors is more than halved by 2030 if more stringent requirements are adopted; with 790 TWh in the base case compared to only 380 TWh in the efficient standards case (Figure 5). This leads to cumulative potential energy savings of nearly 5 TWh from 2013 through 2030 for off-mode efficiency improvement.

Figure 6. Computer Monitors' Potential Off-mode and Standby Energy Savings under Standards Case, One-time Improvement



Altogether, adopting a one-time new standby efficiency standard and more stringent off-mode efficient standards for computer monitors in China in 2013 can save 1.7 TWh annually by 2030 and 21 TWh cumulatively from 2013 to 2030 (Figure 6). If two-tiered standby efficiency standards were adopted in 2013 and 2018 instead, cumulative energy savings would be slightly lower at 20.3 TWh. The bulk of these savings will be from standby efficiency gains, which suggests that including MEPS and labeling requirements for standby power consumption could be an important consideration for the upcoming standard revision as it can lead to significant energy savings in both the short and long-term.

2. COMMERCIAL GAS STOVES

2.1. Overview of Scope of International Standards and Labeling Programs

Standards and labeling programs have existed for household gas stoves for nearly a decade, including Brazil's categorical energy label for household gas stoves based on burners' mean efficiency and Japan's Top Runner standards for gas burners and ranges. Most recently in April 2012, the U.S. adopted revised MEPS for household cooking products that included conventional household gas stoves and ranges, but found that it was not cost-effective to set a specific energy efficiency level for gas stoves. For commercial gas stoves, there is currently no existing voluntary or mandatory MEPS or labeling program in the world.

The EU was the first region to directly consider commercial gas stoves[2] by evaluating the feasibility of MEPS and labeling in its comprehensive Ecodesign Preparatory Study for cooking products in 2009. The EU Ecodesign and EU energy label proposals for cooking products is currently undergoing review, with two consultation forums held in April and July of 2012 to discuss the proposals. The initial Ecodesign proposal discussed at the April 2012 consultation forum included MEPS for commercial electric and gas ranges at levels on par with household electric and gas ranges. However, stakeholders decided at the consultation forum to exclude commercial cooking products from the Ecodesign proposal due to lack of reliable data and suitable efficiency measurements for commercial products. Thus, the scope of the current Ecodesign proposal discussed at the July 2012 consultation forum only includes household electric ovens, household electric and gas cooking ranges and range hoods with electric motors. As part of the Ecodesign standard setting and EU energy label development process, it was also decided that an energy label for commercial ranges is not feasible due to low sales figures and fragmented markets at the EU level. Instead, it was recommended that more efficient commercial gas stoves qualify for green public procurement programs for institutional cooking facilities such as schools and public facilities. The effective date for the Ecodesign standard and EU energy label is also dependent on when the regulation is finalized and adopted into law.

In the absence of any existing efficiency program for commercial gas stoves, this report will focus primarily on the EU Ecodesign proposal and the recently revised U.S. MEPS for cooking products given the similarities between household and commercial gas stoves. Older standards and labeling programs such as Brazil's energy label and Japan's Top Runner standard will not be reviewed due to its dated information and coverage in previous reports.

[2] The EU definition of "hobs," defined as "a set of electric heating elements or gas burners used for heating food fitted into a work surface (built-in), on top of a range cooker with an over or as a portable appliance," has a very similar meaning to commonly used term of "cooking ranges." For consistency in terminology, EU hobs will be generally referred to as ranges for the remainder of this report.

2.2. Energy Values in Existing Programs

As briefly mentioned above, the recent U.S. MEPS rulemaking found that proposed energy efficiency standard levels for household gas stoves cannot be economically justified and that only prescriptive requirements are technologically feasible and economically justified. For gas ranges, the prescriptive requirement is that there cannot be constant burning pilot light. Because pilot lights burn a small amount of gas constantly for 24 hours a day at 365 days a year, it can waste as much as 40% to 50% of the energy used by a gas range (Goorskey Wang and Smith 2004). The results of the recent rulemaking for household gas ranges suggest that U.S. MEPS for commercial gas ranges in the near future is also highly unlikely. In terms of labeling, the U.S. ENERGY STAR program covers commercial cooking equipment such as commercial fryers, griddles, and steam cookers but does not cover any commercial gas or electric stove or ranges.

The EU Ecodesign proposal stands as one of the newest programs for setting mandatory efficiency standard and categorical labeling thresholds for household gas stoves. The proposed energy efficiency criterion for both EU Ecodesign requirement and labeling requirement is based directly on the proposed method for measuring gas burner efficiency. Specifically, the proposal calls for measuring efficiency by comparing the energy content of consumed gas for heating water with the theoretical minimum required energy for heating water given the mass of the pan and water, the specific heat of pan and water and temperature change. The Ecodesign standards for household gas ranges will then be introduced through a tiered approach with the minimum gas burner efficiency being raised over time. The original proposal called for a two-tier MEPS over a two year period, while the latest revised proposal calls for a three-tiered approach over a four-year period, with the minimum gas burner efficiency rising from 52% one year after the legislation enter into force to 65% five years after the legislation enters into force. In addition to setting minimum gas burner efficiency, the EU Ecodesign would also set standby power consumption values consistent with the broader Ecodesign requirements for standby power that go into effect in 2013. Lastly, the proposed Ecodesign for cooking products requires household gas stoves to have power management functionality and technical documentation of product models.

2.3. Test Procedures

As gas stoves are covered by very few international standards and labeling programs, there has not been any harmonization of test procedures for gas stoves with the exception of the EU adopting the IEC test standard for measuring standby power consumption. The U.S., for instance, uses its own Department of Energy uniform test method for Measuring Energy Consumption of Cooking Products as specified in the Federal Register on October 3, 1997 (62 FR 51976) while the EU has its own test standards for safety and for measuring the performance of commercial gas stoves (EN 203-2-1:2005) and domestic gas stoves (EN 30-2-1: 1998/A2: 2005). During the Ecodesign development process, EU stakeholders recognized that these existing test standards for gas stoves fail to accurately represent actual energy usage by not taking into consideration the heat needed to maintain pan at high temperature. Consequently, the EU has proposed a revised measurement method based on heating a specified amount of water from 293

Kelvin to 363 Kelvin in a specified size of aluminum pot, depending on which of the three bins a given gas cooking range's maximum power falls into.

2.4. Barriers to Program Development and Lessons Learned from International Experiences

Although no standards and labeling programs exist internationally for commercial gas stoves and not many exist for household gas stoves, the experiences of the few existing programs have important implications for China's development of MEPS and labeling for commercial gas stoves. As illustrated by the few countries that have or are considering adopting MEPS and/or labels for commercial gas stoves, data availability and the appropriate test method will be two of the major barriers facing China's standard-setting and label development process. This suggests that data collection approaches different from that of common household or commercial energy-using products will be needed to accurately and effectively assess potential MEPS levels and labeling thresholds. International approaches to collecting data on commercial gas stoves – particularly that of the EU Ecodesign Preparatory Study – can be consulted to evaluate if a similar approach is feasible for China. As such, a review of the European approach is presented in further detail in a following section of the report. Depending on product similarities and differences, China may be able to reference its MEPS and/or testing procedures for household gas stoves in developing its commercial gas stove standards and labeling programs.

In terms of developing test procedures for commercial gas stoves, there is currently no harmonized international test standard that can be referenced, although most existing test procedures for measuring the efficiency of household gas stoves are based on measuring the energy used to heat water and comparing it to a theoretical minimum. Another important factor to consider in developing commercial gas stove test procedure is the impact of user behavior on the real life efficiency of cooking products and the degree to which it can be reflected in the test procedure. The real life efficiency for cooking products can be heavily dependent on user behavior such as choice of cooking utensils, temperature settings, and duration of cooking process. For example, previous studies conducted in the U.S. have shown that some people may use 50% more energy than others to cook the same meal (Goorskey Wang and Smith 2004). The EU has attempted to improve the representativeness of its proposed test procedure to real life efficiency by incorporating the heat needed to maintain the pan's high temperature.

A consideration in China is the use of non-standard gas sources such as coke oven gas and town gas in some cities. These gases have a different composition and lower heat content than natural gas, and these differences will need to be accounted for if the market for commercial ranges in cities with non-standard supply is large enough to warrant distinction.

2.5. Summary of International S&L programs and Test Methods for Commercial Gas Stoves

	U.S. MEPS Mandatory Requirement	EU Ecodesign Proposal
Classification/ Scope	Gas, electric and microwave energy cooking products including: conventional ranges, conventional cook tops, conventional ovens, microwave ovens, microwave/conventional ranges and other cooking products	Domestic (i.e. household) ovens, hobs (incorporates one or more cooking zones, heated by gas burners) and range hoods Exclusions: commercial ovens, hobs and hoods; grills; standalone microwave ovens; non-gas or non-electricity appliances; small ovens; portable ovens; range hoods without motors
Effective Dates	4/9/2012	Power management and standby requirements effective 2013; MEPS to be determined
Energy Values	Not applicable; Rulemaking finds that proposed energy efficiency standard levels cannot be economically justified and that only prescriptive requirements are technologically feasible and economically justified. For gas ranges, the prescriptive requirement is that there cannot be constant pilot burning light.	**On-Mode Energy Consumption, as measured by efficiency of gas burners in hob (EEh)** = (Theoretical Minimum Required Energy in MJ/Energy Content of Consumed Gas for Heating Water in MJ) x 100 Theoretical Energy = (mass of water in pan x specific heat of water in kJ/kg.K x mass of aluminum pan with lid x specific heat of aluminum kJ/kg.K) x (maximum temperature of water - initial temperature of water) 1 year after Ecodesign entry into force: EE > 52% 3 years after Ecodesign entry into force: EE > 60% 5 years after Ecodesign entry into force: EE > 65% **Standby Power Consumption:** When providing only reactivation function: ≤ 0.5W When providing information or status display: ≤ 1.0 W

2.6. Estimating the Energy Savings Potential of a Possible Commercial Gas Stove MEPS for China

After an exhaustive literature and internet research, it was determined that public data regarding the sales, usage, lifetime, and market average efficiency levels of commercial gas stoves in China are not available. In the absence of China-specific data, a quantitative analysis of the potential energy savings of implementing MEPS for commercial gas stoves is not feasible.

In light of the significant data challenges facing the Chinese standard-setting process for commercial gas stoves, the EU's approach to collecting data and evaluating the potential energy savings of its proposed Ecodesign requirements for gas stoves is reviewed to help inform the Chinese standard development process. Key steps in the standard-setting process along with key parameters and assumptions used in the European methodology are presented below as a possible analytical model and international proxies for China.

2.6.1. Market Data Collection

Because the EU faces data limitations like China on estimating the total stock of commercial cooking appliances, the Ecodesign preparatory study uses an approach in which the stock of commercial gas stoves is assumed to be directly linked to the for-profit (e.g., private restaurants) and institutional (e.g., schools, hospitals) food service sectors. The stock and market distribution of commercial gas stoves is then estimated by gathering data on the number of foodservice outlets in the EU region along with conducting market surveys at the manufacturer level. The key findings from the market research and stock estimation approach include (EU Ecodesign Final Report):

Current Market Share: 60% market share for gas ranges in the commercial foodservice sector

Sales Forecast Trends: stable market expected for commercial gas ranges with decreasing sales of electric ranges. Total units sold falls below the threshold for setting Ecodesign requirements, but high energy use intensity may warrant the setting of Ecodesign requirements

Product usage: gas range usage in the commercial sector differs significantly from household use and varies by institution type. Commercial ranges in restaurants tend to be left on full power and used to cook food at high heat for relatively shorter periods of time, when compared to greater household use of simmering at low heat for longer periods of time. In contrast, institutional use of commercial gas ranges is more similar to household use with more predictable cooking times.

2.6.2. Development of a Base Case

Once market research has been conducted to better understand the current and expected market distribution of commercial gas stoves, sales trends and usage patterns, technological review of existing and soon to be commercialized technologies can aid in the development of a base case technology for evaluating potential efficiency gains in the standard-setting process. The EU Ecodesign preparatory study review of existing technologies highlighted a range of primary energy efficiencies of using commercial gas stoves to heat water. The efficiency levels of products reviewed range from a 2010 Netherland study that found a low of 23% if heat losses and the heat used to heat more water than necessary are included to a high of 55% advertised by commercial hob supplier. Market surveys at the manufacturer level also identified representative products and product characteristics as a free-standing gas range with four burners and maximum power of 28 kW. Market data on usage patterns served as the basis for the assumption that commercial gas stoves are used for 1248 hours over a year at the maximum equivalent of 28 kW per hour. In terms of product lifetime, the EU literature review also revealed a wide range in the assumed lifetime for gas stoves internationally. The U.S., for instance, assumed a lifetime of 19 years while Australia assumed 15 years for all gas stoves, including household and commercial stoves. Taking into consideration that lower lifetimes are expected for commercial equipment due to heavier usage, the EU assumed a lifetime of 12 years for commercial electric and gas stoves versus 19 years for household stoves. These lifetime values are consistent with German data and were verified in discussions with manufacturers.

2.6.3. Best Available Technology Analysis and Evaluation of Improvement Potential

Once a representative product has been developed for the base case, technologies and design options are evaluated to assess the potential energy savings gain of different options. For commercial gas stoves, the major energy saving options include:

Pot Presence Sensors: these sensors automatically switch off gas flame when a pot is removed and automatically switch the gas flame back on when a pot is replaced. This can significantly reduce the time that a gas burner is left on when it is not being used, especially since gas ranges tend to be left on continuously in commercial kitchens. Although energy savings will vary depending on the reduction in time that an unused burner is left on, energy savings estimates of up to 30% have been made.

Electronic Ignition as Replacement for Pilot Lights: unlike household gas stoves, pilot lights are still very common in commercial gas stoves due to a perception of greater reliability. However, because pilot lights are constantly on, the use of electronic ignition as a replacement can result in savings of up to 6 kWh per day.

Gas Burner Design Changes: design changes to improve gas and air mixing and optimize the gas to air ratio can achieve in a high efficiency of 60% for open gas burners, compared to existing average

efficiencies of 50%. Thus, energy consumption savings of up to 10% can be achieved through burner design changes.

Based on these three technology options and the possibility of adopting multiple options concurrently, six improvement options were proposed and evaluated in the Ecodesign preparatory study. Each improvement option was then evaluated in terms of its energy savings, increased cost and payback period when compared to the base case. The results are shown Table 2 below.

Table 2. EU Ecodesign Preparatory Study Energy Efficiency Options for Commercial Gas Stoves

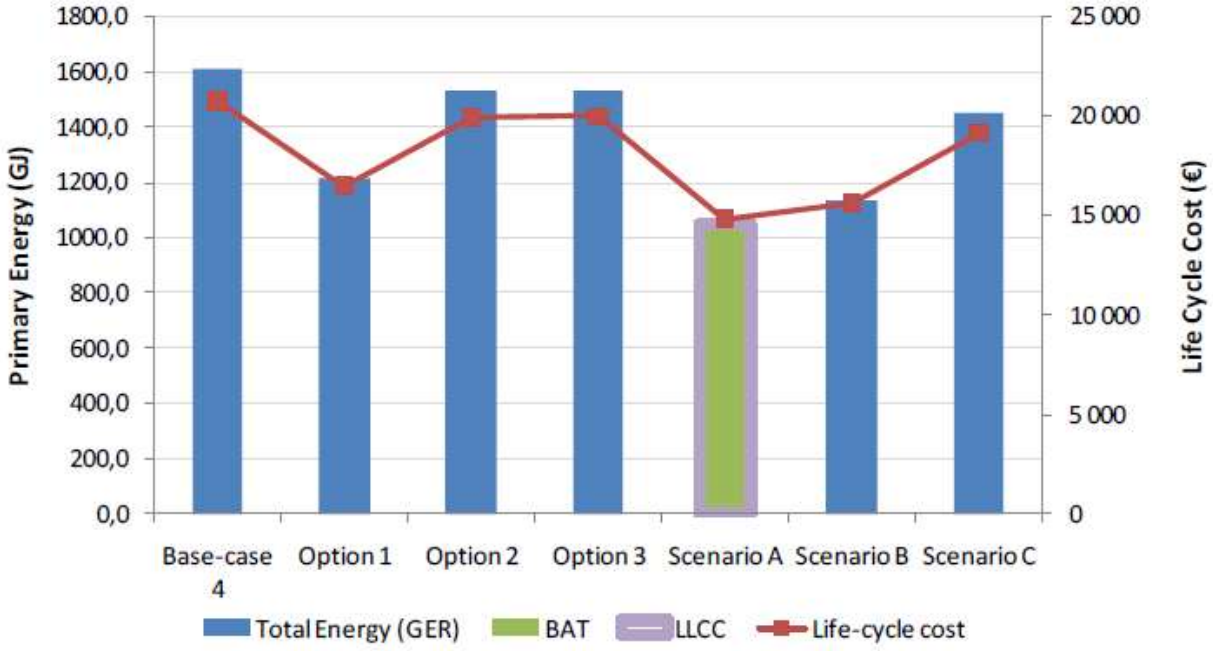
	Improvement Options	Annual energy consumption (kWh)	Comparison to Base-case		
			Energy savings (%)	Increase of product price (€)	Payback time (years)
Base-case		35,000			
Option 1*	Pot sensors	26,250	25%	60€	0.1
Option 2	Electronic ignition (instead of pilot lights)	33,250	5%	30€	0.3
Option 3	Wider output range via independently controlled multi-ring burners and/or improved gas/air mixing	33,250	5%	80€	0.9
Scenario A*	1+2+3	22,750	35%	160€	0.2
Scenario B*	1+2	24,500	30%	80€	0.1
Scenario C	2+3	31,500	10%	110€	0.6

(*) relates to options/scenarios which are user-dependent, therefore the related energy savings cannot be directly considered within test standards and MEPS.

Source: European Commission. 2011. *Preparatory Studies for Ecodesign Requirements of EuPs (III) Lot 23: Domestic and Commercial Hobs and Grills. Task 7: Improvement Potential.* Table 7-4: Identified energy saving options for commercial gas hobs.

The best available technology option and least life-cycle cost option are then ascertained by comparing the total primary energy use and total lifecycle cost of each improvement option. As Figure 7 shows, scenario A in which all three improvement options are adopted is determined to be both the best available technology and the least life-cycle cost option. This result will then serve as the basis for the Ecodesign proposal and standard-setting discussion.

Figure 7. EU Ecodesign Preparatory Study Comparison of Primary Energy Use and Lifecycle Cost for Commercial Gas Stoves



Source: European Commission. 2011. *Preparatory Studies for Ecodesign Requirements of EuPs (III) Lot 23: Domestic and Commercial Hobs and Grills. Task 7: Improvement Potential.* Figure 7-20: Identification of BAT and LLCC for commercial gas hobs.

The EU approach to evaluating the potential MEPS efficiency levels and corresponding energy savings for commercial gas stoves can therefore serve as a helpful example to China and other countries considering adopting MEPS for commercial gas stoves in the near future, both in terms of possible analytical approaches and in terms of data to use as a first-order international proxy.

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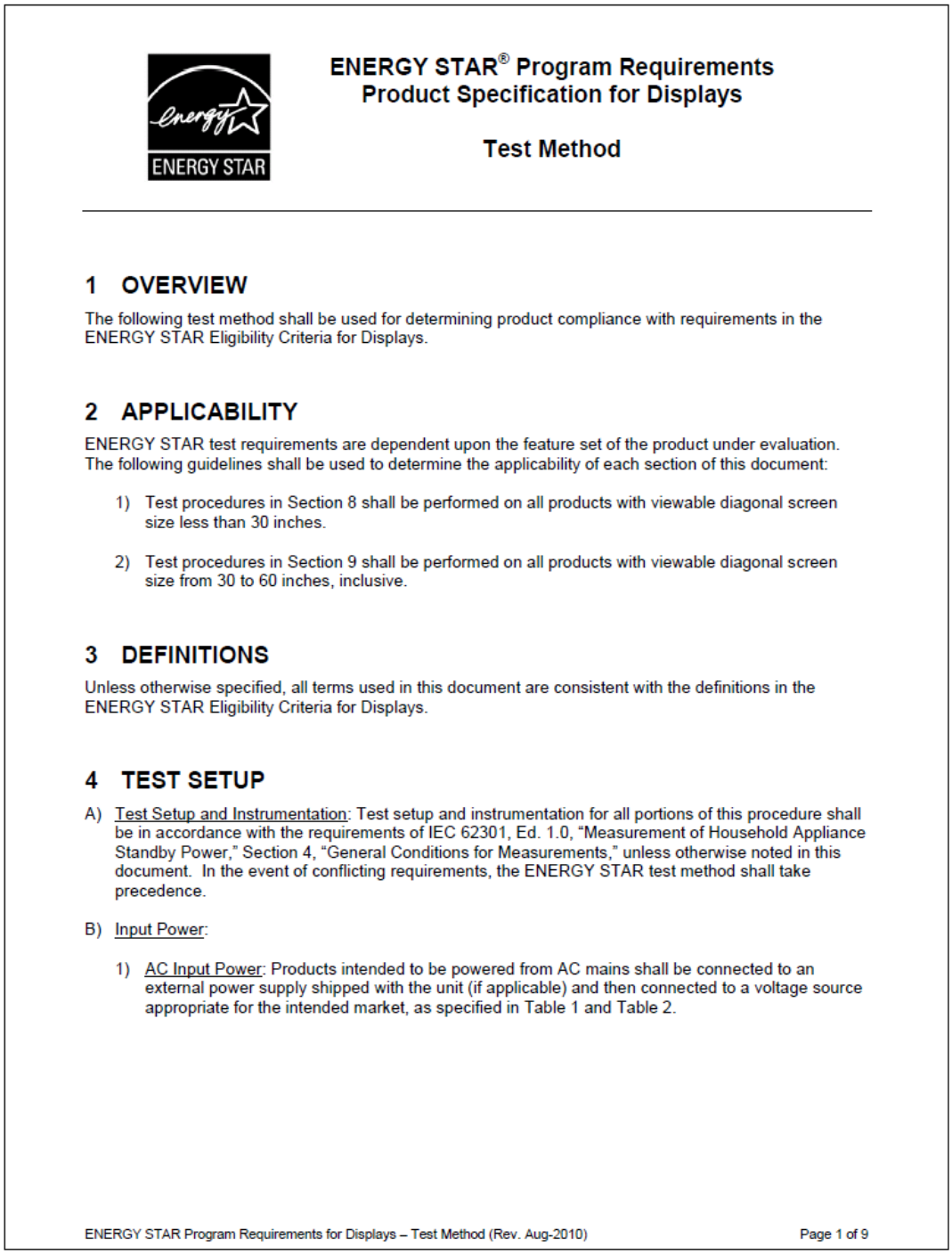
Appendix 1.1 U.S. ENERGY STAR Program Requirements Product Specification for Displays Version 5.1 Test Method

Source: U.S. Environmental Protection Agency. 2009. "ENERGY STAR Program Requirements for Displays Version 5.1."
http://www.energystar.gov/ia/partners/product_specs/program_reqs/Displays_Program_Requirements.pdf?4a12-d4e7



ENERGY STAR® Program Requirements
Product Specification for Displays

Test Method

1 OVERVIEW

The following test method shall be used for determining product compliance with requirements in the ENERGY STAR Eligibility Criteria for Displays.

2 APPLICABILITY

ENERGY STAR test requirements are dependent upon the feature set of the product under evaluation. The following guidelines shall be used to determine the applicability of each section of this document:

1) Test procedures in Section 8 shall be performed on all products with viewable diagonal screen size less than 30 inches.

2) Test procedures in Section 9 shall be performed on all products with viewable diagonal screen size from 30 to 60 inches, inclusive.

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Eligibility Criteria for Displays.

4 TEST SETUP

A) Test Setup and Instrumentation: Test setup and instrumentation for all portions of this procedure shall be in accordance with the requirements of IEC 62301, Ed. 1.0, "Measurement of Household Appliance Standby Power," Section 4, "General Conditions for Measurements," unless otherwise noted in this document. In the event of conflicting requirements, the ENERGY STAR test method shall take precedence.

B) Input Power:

1) AC Input Power: Products intended to be powered from AC mains shall be connected to an external power supply shipped with the unit (if applicable) and then connected to a voltage source appropriate for the intended market, as specified in Table 1 and Table 2.

ENERGY STAR Program Requirements for Displays – Test Method (Rev. Aug-2010) Page 1 of 9

Table 1: Input Power Requirements for Products with Nameplate Rated Power Less Than or Equal to 1500 W

Market	Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion	Frequency	Frequency Tolerance
North America, Taiwan	115 Vac	+/- 1.0 %	2.0 %	60 Hz	+/- 1.0 %
Europe, Australia, New Zealand	230 Vac	+/- 1.0 %	2.0 %	50 Hz	+/- 1.0 %
Japan	100 Vac	+/- 1.0 %	2.0 %	50 Hz/60 Hz	+/- 1.0 %

Table 2: Input Power Requirements for Products with Nameplate Rated Power Greater Than 1500 W

Market	Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion	Frequency	Frequency Tolerance
North America, Taiwan	115 Vac	+/- 4.0 %	5.0 %	60 Hz	+/- 1.0 %
Europe, Australia, New Zealand	230 Vac	+/- 4.0 %	5.0 %	50 Hz	+/- 1.0 %
Japan	100 Vac	+/- 4.0 %	5.0 %	50 Hz/ 60 Hz	+/- 1.0 %

C) Low-voltage DC Input Power:

1) Products may only be powered with a low-voltage DC source (e.g., via network or data connection) if the DC source is the only available source of power for the product (e.g., no AC plug or EPS is available).

2) Products powered by low-voltage DC shall be configured with an AC source of the DC power for testing (e.g., an AC-powered USB hub).

3) Reported UUT power shall be equal to the AC power consumption of the low-voltage DC source with the UUT as the load, minus the AC power consumption of the low-voltage DC source with no load (P_S), as measured per Section 6 of this procedure.

D) Ambient Temperature: Ambient temperature shall be from 18 °C to 28 °C.

E) Relative Humidity: Relative humidity shall be from 10% to 80%.

F) Power Meter: Power meters shall possess the following attributes[1]:

1) Crest Factor:

i) An available current crest factor of 3 or more at its rated range value; and

ii) Lower bound on the current range of 10mA or less.

2) Minimum Frequency Response: 3.0 kHz

3) Minimum Resolution:

i) 0.01 W for measurement values less than 10 W;

ii) 0.1 W for measurement values from 10 W to 100 W; and

iii) 1.0 W for measurement values greater than 100 W.

G) Measurement Accuracy:

1) Power measurements with a value greater than or equal to 0.5 W shall be made with an uncertainty of less than or equal to 2% at the 95% confidence level.

2) Power measurements with a value less than 0.5 W shall be made with an uncertainty of less than or equal to 0.01 W at the 95% confidence level.

5 TEST CONDUCT

A) Power Measurements:

1) Power measurements shall be taken from a point between the power source and the unit under test (UUT).

2) Power measurements shall be recorded in watts and rounded to the nearest tenth of a watt.

3) Power measurements shall be recorded after instrument readings are stable to within 1% over a three-minute period.

B) Dark Room Conditions:

1) Unless otherwise specified, the display screen illuminance measured with the UUT in Off Mode shall be less than or equal to 1.0 lux.

C) Light Measurements:[2]

1) Light measurements shall be performed with the Light Measurement Device (LMD) located at the center of, and perpendicular to, the display screen.[3]

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[1] Characteristics of approved meters taken from IEC 62301 Ed 1.0: Household Electrical Appliances – Measurement of Standby Power.
[2] VESA FPDM Standard 2.0, Section 301-2H
[3] VESA FPDM Standard 2.0, Appendix A115

2) The LMD shall measure a rectangular area that is the greater of (1) an area each side of which is 10% as long as the corresponding side of the viewable screen area, or (2) 500 pixels.

3) The LMD measurement area shall be no larger than the illuminated screen area.

D) UUT Configuration and Control:

1) As-shipped Condition: The UUT shall be tested in its "as-shipped" configuration. For products that offer a choice of user-configurable options, all options, including color controls, shall be set to their default conditions.

2) Peripherals:

i) External devices shall not be connected to Universal Serial Bus (USB) ports.

ii) Built-in speakers, TV tuners, and other product features and functions not specifically addressed by the ENERGY STAR eligibility criteria or test method may be configured in a minimum power configuration, as adjustable by the user.

3) Signal Interface: Displays that offer both an analog and a digital interface shall be tested with the analog interface.

E) Resolution and Refresh Rate:

1) Fixed-pixel Displays:

i) Pixel format shall be set to the native level.

ii) Refresh rate shall be set to 60 Hz, unless a different default refresh rate is specified in the product manual, in which case the specified default refresh rate shall be used.

2) CRT Displays:

i) Pixel format shall be set to the highest resolution that is designed to be driven at a 75 Hz refresh rate, as specified in the product manual. VESA Discrete Monitor Timing (DMT) or other industry standard pixel format timing shall be used for testing.

ii) Refresh rate shall be set to 75 Hz.

F) Battery Operated Products: For products designed to operate using batteries when not connected to the mains, the battery shall be fully charged before the start of testing and shall be left in place for the test.

6 LOW-VOLTAGE DC SOURCE MEASUREMENT

1) Connect the DC source to the power meter and relevant AC supply as specified in Table 1.

2) Verify that the DC source is unloaded.

3) Allow the DC source to warm up for a minimum of 30 minutes.

4) Measure and record the unloaded DC source power (P_S) according to IEC 62301 Ed. 1.0.

7 PRE-TEST UUT INITIALIZATION FOR ALL PRODUCTS

A) Prior to the start of testing, the UUT shall be initialized as follows:

1) Set up the UUT per the instructions in the supplied operating manual.

2) Connect the power meter to the power source and connect the UUT to the power outlet on the power meter.

3) Set the ambient light level such that the measured display screen illuminance is less than 1 lux.

4) Power on the UUT and perform initial system configuration, as applicable.

5) Ensure that UUT settings are in their as-shipped configuration.

6) Warm up the UUT for at least 20 minutes and until the unit has completed initialization and is ready for use.[4]

7) Measure and record the ac input voltage and frequency.

8) Measure and record the test room ambient temperature.

8 TEST PROCEDURES FOR PRODUCTS WITH VIEWABLE DIAGONAL SCREEN SIZE LESS THAN 30 INCHES

8.1 On Mode Test for CRT Displays

1) Ensure that the UUT has been initialized per Section 7.

2) Display the VESA FPDM Standard 2.0, A112-2F, AT01P test pattern.

3) Set the UUT image size to the manufacturer's recommended image size (typically slightly smaller than maximum viewable screen size).

4) Display the VESA FPDM2, A112-2F, SET01K test pattern (8 shades of gray from full black (0 volts) to full white (0.7 volts)).[5]

5) Verify that input signal levels conform to VESA Video Signal Standard (VSIS), Version 1.0, Rev. 2.0, December 2002.

6) If possible, adjust display brightness control until the lowest black-bar luminance level is just slightly visible, per VESA FPDM Section 301-3K.

7) Display the VESA FPDM A112-2H, L80 test pattern (full white (0.7 volts) box that occupies 80% of the image).

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[4] VESA FPDM Standard 2.0, Section 301-2D or 305-3 for warm-up test.

[5] For digital-interface displays, image brightness shall correspond to voltage as follows:

- 0.0 V (black) = a setting of 0
- 0.1 V (darkest shade of gray analog) = 36 digital gray
- 0.7 V (full white analog) = 255 digital gray

8) Ensure that the LMD measurement area falls entirely within the illuminated portion of the test pattern.

9) Adjust the contrast control until the measured luminance of the white area of the screen is 100 cd/m^2 or nearest achievable value.

10) Measure and record display luminance. Note: Following this point in the test procedure, dark room conditions are no longer required.

11) Measure and record On Mode power (P_{ON}) and total pixel format (horizontal x vertical).

8.2 On Mode Test for Fixed-pixel Displays

1) If the UUT does not have ABC Enabled by Default:

   i) Ensure that the UUT has been initialized per Section 7.

   ii) Display the VESA FPDM2, A112-2F, SET01K test pattern (8 shades of gray from full black (0 volts) to full white (0.7 volts)).

   iii) Verify that input signal levels conform to VESA Video Signal Standard (VSIS), Version 1.0, Rev. 2.0, December 2002.

   iv) With the brightness and contrast controls at maximum, verify that the white and near-white-grey levels can be distinguished. If necessary, adjust contrast controls until the white and near-white-grey levels can be distinguished

   v) Display the VESA FPDM2, A112-2H, L80 test pattern (full white (0.7 volts) box that occupies 80% of the image).

   vi) Ensure that the LMD measurement area falls entirely within the white portion of the test pattern.

   vii) Adjust the brightness control until the luminance of the white area of the screen is as specified in Table 3. If the UUT cannot achieve the specified luminance, set display luminance to the nearest achievable value.

Table 3: Luminance Settings for On Mode Testing of Fixed-Pixel Displays

Screen Resolution	Luminance (Cd/m^2)
Less than or equal to 1.1 MP resolution	175
Greater than 1.1 MP resolution	200

   viii) Measure and record display luminance. Note: Following this point in the test procedure, dark room conditions are no longer required.

   ix) Measure and record On Mode power (P_{ON}) and total pixel format (horizontal x vertical).

2) If the UUT has ABC Enabled by Default:

   i) Ensure that the UUT has been initialized per Section 7.

ii) Set the ambient light level to 300 lux, as measured at the face of the product's ambient light sensor.

iii) Measure and record On Mode power in high ambient lighting conditions (P_H) and total pixel format (horizontal x vertical).

iv) Set the ambient light level to 0 lux, as measured at the face of the product's ambient light sensor.

v) Measure and record On Mode power in low ambient lighting conditions (P_L).

8.3 Sleep Mode

1) At the conclusion of the On Mode test, initiate Sleep Mode.

2) Document the method of adjustment and sequence of events required to reach Sleep Mode.

3) If the product has a variety of Sleep Modes that can be manually selected, measurements shall be performed in the most energy consumptive Sleep Mode. If the product automatically cycles through its various Sleep Modes, measurement time shall be long enough to obtain a true average of all Sleep Modes.

4) Measure and record Sleep Mode power (P_{SLEEP}).

8.4 Off Mode

1) At the conclusion of the Sleep Mode test, initiate Off Mode via the most easily accessible power switch.

2) Document the method of adjustment and sequence of events required to reach Off Mode.

3) Any input sync signal check cycle may be ignored when measuring Off Mode power.

4) Measure and record Off Mode power (P_{OFF}).

9 TEST PROCEDURES FOR PRODUCTS WITH VIEWABLE DIAGONAL SCREEN SIZE FROM 30 TO 60 INCHES, INCLUSIVE

Table 4: Test Procedures

Requirement	Test Protocol
On Mode Power	IEC 62087, Ed 2.0: Methods of Measurement for the Power Consumption of Audio, Video and Related Equipment, Section 11, "Measuring conditions of television sets for On (average) mode."

9.1 On Mode

A) Products shall be tested in On Mode according to the method specified in Table 4, subject to the following guidance:

1) Accuracy of Input Signal Levels: Video inputs shall be within ±2% of reference white and black levels.

2) Signal Input: HDMI inputs should be used for testing wherever possible.

3) True Power Factor: Due to increased awareness of the importance of power quality on the part of EPA and electric utilities, Partners shall indicate the true power factor of their displays during On Mode measurement.

4) Test Materials: "Dynamic Broadcast Content" shall be used for testing, as specified in IEC-62087 Ed. 2.0, Section 11.6.1, "On mode (average) testing with dynamic broadcast-content video signal."

5) As-shipped Conditions: The UUT shall be tested in its as-shipped factory-default condition. All picture adjustments required for On Mode testing shall be performed per IEC-62087, Ed. 2.0, 11.4.8, "Picture level adjustments."

6) Forced Menu: If the product includes a "forced menu" upon initial start-up for user selection of a picture mode, "standard" or "home" picture mode shall be selected.

B) If the UUT has ABC Enabled by Default:

1) Ensure that the UUT has been initialized per Section 7.

2) Set the ambient light level to 300 lux as measured at the face of an ambient light sensor.

3) Measure the high ambient lighting On Mode power consumption, P_h, as described in section 11.6.1, "On mode (average) testing with dynamic broadcast-content video signal."

4) Set the ambient light level to 0 lux as measured at the face of an ambient light sensor.

5) Measure the low ambient lighting On Mode power consumption, P_l, as described in section 11.6.1, "On mode (average) testing with dynamic broadcast-content video signal."

6) Calculate average On Mode power consumption using the equation in section 3.A.3., Displays with Automatic Brightness Control.

9.2 Luminance

7) At the conclusion of the On Mode test, display a three bar (L_t) static video signal per section 11.5 of IEC 62087.

8) Measure and record the center point, axial luminance of the display (per VESA FPDM Version 2.0, section 301-2H).

9.3 Sleep Mode

1) At the conclusion of the Luminance test, initiate Sleep Mode.

2) Document the method of adjustment and sequence of events required to reach Sleep Mode.

3) If the product has a variety of Sleep Modes that can be manually selected, measurements shall be performed in the most energy consumptive Sleep Mode. If the product automatically cycles through its various Sleep Modes, measurement time shall be long enough to obtain a true average of all Sleep Modes.

4) Measure and record Sleep Mode power (P_{SLEEP}).

9.4 Off Mode

1) At the conclusion of the Sleep Mode test, initiate Off Mode via the most easily accessible power switch.

2) Document the method of adjustment and sequence of events required to reach Off Mode.

3) Any input sync signal check cycle may be ignored when measuring Off Mode power.

4) Measure and record Off Mode power (P_{OFF}).

Appendix 1.2 U.S. ENERGY STAR Program Requirements Product Specification for Displays Version 6.0

Source: U.S. EPA. 2012. "ENERGY STAR Program Requirements for Displays Version 6.0." http://energystar.gov/products/specs/sites/products/files/Final_Version_6.0_Displays_Program_Requirements.pdf?3ebb-414c

ENERGY STAR® Program Requirements
Product Specification for Displays

Eligibility Criteria
Version 6.0

Following is the ENERGY STAR product specification ("specification") for Displays. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

1 DEFINITIONS

A) Product Types:

1) Electronic Display (Display): A commercially-available product with a display screen and associated electronics, often encased in a single housing, that as its primary function displays visual information from (1) a computer, workstation or server via one or more inputs (e.g., VGA, DVI, HDMI, DisplayPort, IEEE 1394, USB), (2) external storage (e.g., USB flash drive, memory card), or (3) a network connection.

a) Computer Monitor: An electronic device, typically with a diagonal screen size greater than 12 inches and a pixel density greater than 5,000 pixels per square inch (pixels/in^2), that displays a computer's user interface and open programs, allowing the user to interact with the computer, typically using a keyboard and mouse.

(1) Enhanced-Performance Display: A computer monitor that has all of the following features and functionalities:
(a) A contrast ratio of at least 60:1 measured at a horizontal viewing angle of at least 85°, with or without a screen cover glass;
(b) A native resolution greater than or equal to 2.3 megapixels (MP); and,
(c) A color gamut size of at least sRGB as defined by IEC 61966 2-1. Shifts in color space are allowable as long as 99% or more of defined sRGB colors are supported.

b) Digital Picture Frame: An electronic device, typically with a diagonal screen size less than 12 inches, whose primary function is to display digital images. It may also feature a programmable timer, occupancy sensor, audio, video, or bluetooth or wireless connectivity.

c) Signage Display: An electronic device typically with a diagonal screen size greater than 12 inches and a pixel density less than or equal to 5,000 pixels/in^2. It is typically marketed as commercial signage for use in areas where it is intended to be viewed by multiple people in non-desk based environments, such as retail or department stores, restaurants, museums, hotels, outdoor venues, airports, conference rooms or classrooms.

B) External Power Supply (EPS): Also referred to as an external power adapter. A component contained in a separate physical enclosure external to a display, designed to convert line voltage ac input from the mains to lesser dc voltage(s) in order to provide power to the display. An EPS connects to the display via a removable or hard-wired male/female electrical connection, cable, cord or other wiring.

C) Operational Modes:

1) On Mode: The power mode in which the product has been activated, and is providing one or more of its principal functions. The common terms, "active," "in-use," and "normal operation" also describe this mode. The power in this mode is typically greater than the power in Sleep Mode and Off Mode.

2) Sleep Mode: The power mode the product enters after receiving a signal from a connected device or an internal stimulus. The product may also enter this mode by virtue of a signal produced by user input. The product must wake on receiving a signal from a connected device, a network, a remote control, and/or an internal stimulus. While the product is in this mode, it is not producing a visible picture, with the possible exception of user-oriented or protective functions such as product information or status displays, or sensor-based functions.

Note: Examples of internal stimuli are a timer or occupancy sensor.

Note: A power control is not an example of user input.

3) Off Mode: The power mode in which the product is connected to a power source, and is not providing any On Mode or Sleep Mode functions. This mode may persist for an indefinite time. The product may only exit this mode by direct user actuation of a power switch or control. Some products may not have this mode.

D) Luminance: The photometric measure of the luminous intensity per unit area of light travelling in a given direction, expressed in candelas per square meter (cd/m^2). Luminance refers to the brightness settings of a display.

1) Maximum Reported Luminance: The maximum luminance the display may attain at an On Mode preset setting, and as specified by the manufacturer, for example, in the user manual.

2) Maximum Measured Luminance: The maximum luminance the display may attain by manually configuring its controls, such as brightness and contrast.

3) As-shipped Luminance: The luminance of the display at the factory default preset setting the manufacturer selects for normal home or applicable market use. The As-shipped Luminance of displays with Automatic Brightness Control (ABC) enabled by default may vary based on the Ambient Light Conditions of the location in which the display is installed.

E) Screen Area: The viewable screen width multiplied by the viewable screen height, expressed in square inches (in^2).

F) Automatic Brightness Control (ABC): The self-acting mechanism that controls the brightness of a display as a function of ambient light.

G) Ambient Light Conditions: The combination of light illuminances in the environment surrounding a display, such as a living room or an office.

H) Bridge Connection: A physical connection between two hub controllers, typically, but not limited to, USB or FireWire, which allows for expansion of ports typically for the purpose of relocating the ports to a more convenient location or increasing the number of available ports.

I) Network Capability: An ability to obtain an IP address when connected to the network.

J) Occupancy Sensor: A device used to detect human presence in front of or in the area surrounding a display. An occupancy sensor is typically used to switch a display between On Mode and Sleep or Off Mode.

K) Product Family: A group of displays, made under the same brand, sharing a screen of the same size and resolution, and encased in a single housing that may contain variations in hardware configurations.

Example: Two computer monitors from the same model line with a diagonal screen size of 21 inches and a resolution of 2.074 megapixels (MP), but with variations in features such as built-in speakers or camera, could be qualified as a product family.

L) Representative Model: The product configuration that is tested for ENERGY STAR qualification and is intended to be marketed and labeled as ENERGY STAR.

2 SCOPE

2.1 Included Products

2.1.1 Products that meet the definition of a display as specified herein and are powered directly from ac mains, via an external power supply, or via a bridging or network connection, are eligible for ENERGY STAR qualification, with the exception of products listed in Section 2.2. Typical products that would be eligible for qualification under this specification include:

i. Computer Monitors;

ii. Digital Picture Frames;

iii. Signage Displays; and,

iv. Additional products including monitors with keyboard, video and mouse (KVM) switch functionality, and other industry-specific displays that meet the definitions and qualification criteria in this specification.

2.2 Excluded Products

2.2.1 Products that are covered under other ENERGY STAR product specifications are not eligible for qualification under this specification. The list of specifications currently in effect can be found at www.energystar.gov/products.

2.2.2 The following products are not eligible for qualification under this specification:

i. Products with a viewable diagonal screen size greater than 61 inches;

ii. Products with an integrated television tuner;

iii. Products that are marketed and sold as televisions, including products with a computer input port (e.g., VGA) that are marketed and sold primarily as televisions;

iv. Products that are component televisions. A component television is a product that is composed of two or more separate components (e.g., display device and tuner) that are marketed and sold as a television under a single model or system designation. A component television may have more than one power cord;

v. Dual-function televisions / computer monitors that are marketed and sold as such;

vi. Mobile computing and communication devices (e.g., tablet computers, slates, electronic readers, smartphones);

vii. Products that must meet FDA specifications for medical devices that prohibit power management capabilities and/or do not have a power state meeting the definition of Sleep Mode; and,

viii. Thin clients, ultra-thin clients, or zero clients.

3 QUALIFICATION CRITERIA

3.1 Significant Digits and Rounding

3.1.1 All calculations shall be carried out with directly measured (unrounded) values.

3.1.2 Unless otherwise specified, compliance with specification requirements shall be evaluated using directly measured or calculated values without any benefit from rounding.

3.1.3 Directly measured or calculated values that are submitted for reporting on the ENERGY STAR website shall be rounded to the nearest significant digit as expressed in the corresponding specification requirements.

3.2 General Requirements

3.2.1 External Power Supply: If the product is shipped with an EPS, the EPS shall meet the level V performance requirements under the International Efficiency Marking Protocol, and include the level V marking. Additional information on the Marking Protocol is available at www.energystar.gov/powersupplies.

- External Power Supplies shall meet level V requirements when tested using the *Test Method for Calculating the Energy Efficiency of Single-Voltage External Ac-Dc and Ac-Ac Power Supplies, Aug. 11, 2004.*

3.2.2 Power Management:

i. Products shall offer at least one power management feature that is enabled by default, and that can be used to automatically transition from On Mode to Sleep Mode either by a connected host device or internally (e.g., support for VESA Display Power Management Signaling (DPMS), enabled by default).

ii. Products that generate content for display from one or more internal sources shall have a sensor or timer enabled by default to automatically engage Sleep or Off Mode.

iii. For products that have an internal default delay time after which the product transitions from On Mode to Sleep Mode or Off Mode, the delay time shall be reported.

iv. Computer monitors shall automatically enter Sleep Mode or Off Mode within 15 minutes of being disconnected from a host computer.

3.3 On Mode Requirements

3.3.1 On Mode power (P_{ON}), as measured per the ENERGY STAR test method (referenced in Table 6), shall be less than or equal to the Maximum On Mode Power Requirement (P_{ON_MAX}), as calculated and rounded per Table 1, below.

i. If the product's pixel density (D_P), as calculated per Equation 1, is greater than 20,000 pixels/in^2, then the screen resolution used to calculate P_{ON_MAX} shall be determined per Equation 2.

Equation 1: Calculation of Pixel Density

$$D_p = \frac{r \times 10^6}{A}$$

Where:

- *D_P is the pixel density of the product rounded to the nearest integer, in pixels/in^2,*
- *r is the screen resolution, in megapixels, and*
- *A is the viewable screen area, in in^2.*

Equation 2: Calculation of Resolution if D_p > 20,000 pixels/in^2

$$r_1 = \frac{20{,}000 \times A}{10^6} \qquad r_2 = \frac{(D_p - 20{,}000) \times A}{10^6}$$

Where:

- *r_1 and r_2 are the screen resolutions, in megapixels, to be used when calculating P_{ON_MAX},*
- *D_P is the pixel density of the product rounded to the nearest integer, in pixels/in^2, and*

- *A is the viewable screen area, in in^2.*

Table 1: Calculation of Maximum On Mode Power Requirements (P_{ON_MAX})

Product Type and Diagonal Screen Size, *d* (in inches)	$P_{ON\ MAX}$ where $D_P \leq 20{,}000$ pixels/in^2 (in watts) *Where:* • *r = Screen resolution in megapixels* • *A = Viewable screen area in in^2* • *The result shall be rounded to the nearest tenth of a watt*	$P_{ON\ MAX}$ where $D_P > 20{,}000$ pixels/in^2 (in watts) *Where:* • *r = Screen resolution in megapixels* • *A = Viewable screen area in in^2* • *The result shall be rounded to the nearest tenth of a watt*
$d < 12.0$	$(6.0 \times r) + (0.05 \times A) + 3.0$	$\left((6.0 \times r_1) + (3.0 \times r_2) + (0.05 \times A) + 3.0\right)$
$12.0 \leq d < 17.0$	$(6.0 \times r) + (0.01 \times A) + 5.5$	$\left((6.0 \times r_1) + (3.0 \times r_2) + (0.01 \times A) + 5.5\right)$
$17.0 \leq d < 23.0$	$(6.0 \times r) + (0.025 \times A) + 3.7$	$\left((6.0 \times r_1) + (3.0 \times r_2) + (0.025 \times A) + 3.7\right)$
$23.0 \leq d < 25.0$	$(6.0 \times r) + (0.06 \times A) - 4.0$	$\left((6.0 \times r_1) + (3.0 \times r_2) + (0.06 \times A) - 4.0\right)$
$25.0 \leq d \leq 61.0$	$(6.0 \times r) + (0.1 \times A) - 14.5$	$\left((6.0 \times r_1) + (3.0 \times r_2) + (0.1 \times A) - 14.5\right)$
$30.0 \leq d \leq 61.0$ *(for products meeting the definition of a Signage Display only)*	$(0.27 \times A) + 8.0$	$(0.27 \times A) + 8.0$

3.3.2 For products meeting the definition of an Enhanced-Performance Display, a power allowance (P_{EP}), as calculated per Equation 3, shall be added to P_{ON_MAX}, as calculated per Table 1. In this case, P_{ON}, as measured per the ENERGY STAR test method (referenced in Table 6), shall be less than or equal to the sum of P_{ON_MAX} and P_{EP}.

Equation 3: Calculation of On Mode Power Allowance for Enhanced-Performance Displays

$$P_{EP<27"} = 0.30 \times P_{ON\_MAX}$$

$$P_{EP\geq 27"} = 0.75 \times P_{ON\_MAX}$$

Where:

- *$P_{EP<27"}$ is the On Mode power allowance, in watts, for an Enhanced-Performance Display with a diagonal screen size less than 27 inches,*
- *$P_{EP\geq 27"}$ is the On Mode power allowance, in watts, for an Enhanced-Performance Display with a diagonal screen size greater than or equal to 27 inches, and*
- *P_{ON_MAX} is the maximum On Mode power requirement, in watts.*

3.3.3 For products with Automatic Brightness Control (ABC) enabled by default, a power allowance (P_{ABC}), as calculated per **Equation 5**, shall be added to P_{ON_MAX}, as calculated per Table 1, if the On Mode power reduction (R_{ABC}), as calculated per **Equation 4**, is greater than or equal to 20%.

i. If R_{ABC} is less than 20%, P_{ABC} shall not be added to P_{ON_MAX}.

ii. P_{ON}, as measured with ABC disabled per the ENERGY STAR test method, referenced in Table 6 below, shall be less than or equal to P_{ON_MAX}.

Equation 4: Calculation of On Mode Power Reduction for Products with ABC Enabled by Default

$$R_{ABC} = 100 \times \left(\frac{P_{300} - P_{10}}{P_{300}}\right)$$

Where:

- *R_{ABC} is the On Mode percent power reduction due to ABC,*
- *P_{300} is the measured On Mode power, in watts, when tested with an ambient light level of 300 lux, and*
- *P_{10} is the measured On Mode power, in watts, when tested with an ambient light level of 10 lux.*

Equation 5: Calculation of On Mode Power Allowance for Products with ABC Enabled by Default

$$P_{ABC} = 0.10 \times P_{ON\_MAX}$$

Where:

- *P_{ABC} is the On Mode power allowance, in watts, and*
- *P_{ON_MAX} is the maximum On Mode power requirement, in watts.*

3.3.4 For products powered with a low-voltage dc source, P_{ON}, as calculated per Equation 6, shall be less than or equal to P_{ON_MAX}, as calculated per Table 1.

Equation 6: Calculation of On Mode Power for Products Powered by a Low-voltage Dc Source

$$P_{ON} = P_L - P_S$$

Where:

- *P_{ON} is the calculated On Mode power, in watts,*
- *P_L is the ac power consumption, in watts, of the low-voltage dc source with the unit under test (UUT) as the load, and*
- *P_S is the marginal loss of the ac power supply of the source, in watts.*

3.4 Sleep Mode Requirements

3.4.1 Measured Sleep Mode power (P_{SLEEP}) for products with none of the bridging or network capabilities included in Table 3 or 4 shall be less than or equal to the Maximum Sleep Mode Power Requirement (P_{SLEEP_MAX}), as specified in Table 2.

Table 2: Maximum Sleep Mode Power Requirement (P_{SLEEP_MAX})

P_{SLEEP_MAX} (watts)
0.5

3.4.2 Measured Sleep Mode power (P_{SLEEP}) for products with one or more of the bridging, network, or additional capabilities included in Table 3 or 4 shall be less than or equal to the Maximum Bridging/Network Sleep Mode Power Requirement (P_{SLEEP_AP}), as calculated per Equation 7.

Equation 7: Calculation of Maximum Bridging/Network Sleep Mode

$$P_{SLEEP\_AP} = P_{SLEEP\_MAX} + P_{DN} + P_{ADD}$$

Where:

- *P_{SLEEP_AP} is the Maximum Sleep Mode Power Requirement, in watts, for products that were tested with additional power-consuming capabilities,*
- *P_{SLEEP_MAX} is the Maximum Sleep Mode Power Requirement, in watts, as specified in Table 2,*
- *P_{DN} is the sum of power allowances, in watts, as specified in Table 3, for the bridging and/or network capabilities that are connected and enabled during Sleep Mode testing, and*
- *P_{ADD} is the sum of power allowances, in watts, as specified in Table 4, for the additional capabilities that are enabled during Sleep Mode testing.*

Table 3: Power Allowances in Sleep Mode for Bridging or Network Capabilities

Capability	Included Types	P_{DN} (watts)
Bridging	USB 1.x	0.1
	USB 2.x	0.5
	USB 3.x, DisplayPort (non-video connection), Thunderbolt	0.7
Network	Wi-Fi	2.0
	Fast Ethernet	0.2
	Gigabit Ethernet	1.0

Table 4: Power Allowances in Sleep Mode for Additional Capabilities

Capability	Included Types	P_{ADD} (watts)
Sensor	Occupancy Sensor	0.5
Memory	Flash memory-card/smart-card readers, camera interfaces, PictBridge	0.2

Example 1: A digital picture frame with only one bridging or network capability connected and enabled during Sleep Mode testing, **Wi-Fi**, and no additional capabilities enabled during Sleep Mode testing, would qualify for the 2.0 W Wi-Fi adder. Recalling that $P_{SLEEP\_AP} = P_{SLEEP\_MAX} + P_{DN} + P_{ADD}$, P_{SLEEP_AP} = 0.5 W + 2.0 W + 0 W = **2.5 W**.

Example 2: : A computer monitor with **USB 3.x** and **DisplayPort (non-video connection)** bridging capability shall be tested with only the USB 3.x connected and enabled. Assuming no additional capabilities are enabled during Sleep Mode testing, this display would qualify for the 0.7 W USB 3.x adder. Recalling that $P_{SLEEP\_AP} = P_{SLEEP\_MAX} + P_{DN} + P_{ADD}$, P_{SLEEP_AP} = 0.5 W + 0.7 W + 0 W = **1.2 W**.

Example 3: A computer monitor with one bridging and one network capability, **USB 3.x** and **Wi-Fi**, shall be tested with both capabilities connected and enabled during Sleep Mode testing. Assuming no additional capabilities are enabled during Sleep Mode testing, this display would qualify for the 0.7 W USB 3.x adder and the 2.0 W Wi-Fi adder. Recalling that $P_{SLEEP\_AP} = P_{SLEEP\_MAX} + P_{DN} + P_{ADD}$, P_{SLEEP_AP} = 0.5 W + (0.7 W + 2.0 W) + 0 W = **3.2 W**.

3.4.3 For products that offer more than one Sleep Mode (e.g., "Sleep" and "Deep Sleep"), measured Sleep Mode power (P_{SLEEP}) in any Sleep Mode shall not exceed P_{SLEEP_MAX} in the case of products without bridging or network connection capabilities, or P_{SLEEP_AP} in the case of products tested with additional power-consuming capabilities, such as bridging connections or network connections.

3.5 Off Mode Requirements

3.5.1 A product need not have an Off Mode to be eligible for qualification. For products that do offer Off Mode, measured Off Mode power (P_{OFF}) shall be less than or equal to the Maximum Off Mode Power Requirement (P_{OFF_MAX}) specified in Table 5.

Table 5: Maximum Off Mode Power Requirement (P_{OFF_MAX})

P_{OFF_MAX} (watts)
0.5

3.6 Luminance Reporting Requirements

3.6.1 Maximum reported and maximum measured luminance shall be reported for all products; as-shipped luminance shall be reported for all products except those with ABC enabled by default.

Note: Products intended for sale in the US market are subject to minimum toxicity and recyclability requirements. Please see ENERGY STAR® Program Requirements for Displays: Partner Commitments for details.

4 TEST REQUIREMENTS

4.1 Test Methods

4.1.1 Test methods identified in Table 6 shall be used to determine qualification for ENERGY STAR.

Table 6: Test Methods for ENERGY STAR Qualification

Product Type	Test Method
All Product Types and Screen Sizes	ENERGY STAR Test Method for Determining Displays Energy Use Version 6.0 – Final, Sep-2012

4.2 Number of Units Required for Testing

4.2.1 One unit of a Representative Model, as defined in Section 1, shall be selected for testing.

4.2.2 For qualification of a product family, the product configuration that represents the worst-case power consumption for each product category within the family shall be considered the Representative Model.

4.3 International Market Qualification

4.3.1 Products shall be tested for qualification at the relevant input voltage/frequency combination for each market in which they will be sold and promoted as ENERGY STAR.

5 USER INTERFACE

5.1.1 Manufacturers are encouraged to design products in accordance with the user interface standard, *IEEE P1621: Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments*. For details, see http://eetd.LBL.gov/Controls. Note, adoption of *IEEE P1621* is not a requirement for ENERGY STAR qualification, but in the event that the manufacturer does not adopt *IEEE P1621*, EPA requests that the manufacturer provide EPA with its reason for not doing so.

6 EFFECTIVE DATE

6.1.1 Effective Date: The Version 6.0 ENERGY STAR Display Products specification shall take effect on **June 1, 2013**. To qualify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on its date of manufacture. The date of manufacture is specific to each unit and is the date (e.g., month and year) on which a unit is considered to be completely assembled.

6.1.2 Future Specification Revisions: EPA reserves the right to change this specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the specification are arrived at through stakeholder discussions. In the event of a specification revision, please note ENERGY STAR qualification is not automatically granted for the life of a model

7 CONSIDERATIONS FOR FUTURE REVISIONS

7.1 Displays Larger Than 61" in Diagonal Screen Size

7.1.1 EPA understands that interactive displays greater than 60" in diagonal screen size are currently available in the market and are namely used for commercial and educational purposes. EPA is interested in better understanding the power consumption associated with these products when tested according to the Displays Test Method and will work with stakeholders prior to, and during, the next specification revision development process to access the information. DOE may also explore testing of these products. EPA is interested in exploring expanding the scope of products to those greater than 61" in diagonal screen size in the next specification revision.

7.2 Touch Screen Functionality

7.2.1 EPA is committed to continuing to develop performance levels for displays that account for new features and functionality, and anticipates that displays with touch screen functionality, which are included in the scope of this specification, will become more prevalent in the market, especially among signage displays. Going forward, EPA and DOE will explore with stakeholders whether touch screen functionality impacts On Mode power consumption to determine to what extent the next specification development process should address touch screen functionality.

Appendix 1.3 U.S. ENERGY STAR Program Requirements Product Specification for Displays Version 6.0 Test Method

Source: U.S. EPA. 2012. "ENERGY STAR Program Requirements for Displays Version 6.0." http://energystar.gov/products/specs/sites/products/files/Final_Version_6.0_Displays_Program_Requirements.pdf?3ebb-414c

ENERGY STAR® Program Requirements
Product Specification for
Displays

Test Method for Determining
Displays Energy Use
Version 6.0 – Final
Sep-2012

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1 OVERVIEW

The following test method shall be used for determining product compliance with requirements in the ENERGY STAR Eligibility Criteria for Displays.

2 APPLICABILITY

The following test method is applicable to all products eligible for qualification under the ENERGY STAR Product Specification for Displays.

Note: DOE has published the Test Procedure for Television Sets Notice of Proposed Rulemaking (77 FR 2830). Any product that is included in DOE's scope of coverage for TVs shall ultimately be tested according to the Test Procedure for Television Sets Final Rulemaking published by DOE.

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Eligibility Criteria for Displays.

4 TEST SETUP

A) Test Setup and Instrumentation: Test setup and instrumentation for all portions of this method shall be in accordance with the requirements of IEC 62301, Ed. 2.0, "Measurement of Household Appliance Standby Power," Section 4, "General Conditions for Measurements," unless otherwise noted in this document. In the event of conflicting requirements, the ENERGY STAR Test Method shall take precedence.

B) Ac Input Power: Products capable of being powered from ac mains shall be connected to an external power supply, if one is shipped with the unit, and then connected to a voltage source appropriate for the intended market, as specified in Table 1.

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Table 1: Input Power Requirements for Products

Market	Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion	Frequency	Frequency Tolerance
North America, Taiwan	115 V ac	+/- 1.0 %	5.0 %	60 Hz	+/- 1.0 %
Europe, Australia, New Zealand	230 V ac	+/- 1.0 %	5.0 %	50 Hz	+/- 1.0 %
Japan	100 V ac	+/- 1.0 %	5.0 %	50 Hz or 60 Hz	+/- 1.0 %

C) Low-voltage Dc Input Power:

1) Products may be powered with a low-voltage dc source (e.g., via network or data connection) only if the dc source is the only available source of power for the product (i.e., no ac plug or External Power Supply (EPS) is available).

2) Products powered by low-voltage dc shall be configured with an ac source of the dc power for testing (e.g., an ac-powered Universal Serial Bus (USB) hub).

3) The USB hub power adapter must have the following attributes:

a) Voltage Rating: 5 V

b) Current Range: 2 A to 3 A

4) Power for the unit under test (UUT) shall include the following, as measured per Section 5.3 of this method:

a) Ac power consumption of the low-voltage dc source with the UUT as the load (P_L).

b) Ac power consumption of the low-voltage dc source with no load (P_S).

D) Ambient Temperature: Ambient temperature shall be 23° C ± 5° C.

E) Relative Humidity: Relative humidity shall be from 10% to 80%.

F) UUT Alignment:

1) All four corners of the face of the Unit Under Test (UUT) shall be equidistant from a vertical reference plane (e.g., wall)

2) The bottom two corners of the face of the UUT shall be equidistant from a horizontal reference plane (e.g., floor).

G) Light Source:

1) Lamp Type:

a) Standard spectrum halogen flood reflector lamp. The lamp shall not meet the definition of "Modified spectrum" as defined in 10 CFR 430.2 - Definitions[1].

b) Rated Brightness: 980 ± 5% lumens.

2) Light Source Alignment For Testing Products With ABC Enabled By Default:

a) There shall be no obstructions between the lamp and the UUT's Automatic Brightness Control (ABC) sensor (e.g., diffusing media, frosted lamp covers, etc.).

b) The center of the lamp shall be placed at a distance of 5 feet from the center of the ABC sensor.

[1] http://www.gpo.gov/fdsys/pkg/CFR-2011-title10-vol3/pdf/CFR-2011-title10-vol3-sec430-2.pdf

c) The center of the lamp shall be aligned at a horizontal angle of 0° with respect to the center of the UUT's ABC sensor.

d) The center of the lamp shall be aligned at a height equal to the center of the UUT's ABC sensor with respect to the floor (i.e. the light source shall be placed at a vertical angle of 0° with respect to the center of the UUT's ABC sensor).

e) No test room surface (i.e., floor, ceiling, and wall) shall be within 2 feet of the center of the UUT's ABC Sensor.

f) Illuminance values shall be obtained by varying the input voltage of the lamp.

g) Figure 1 and Figure 2 and provide more information on UUT and light source alignment.

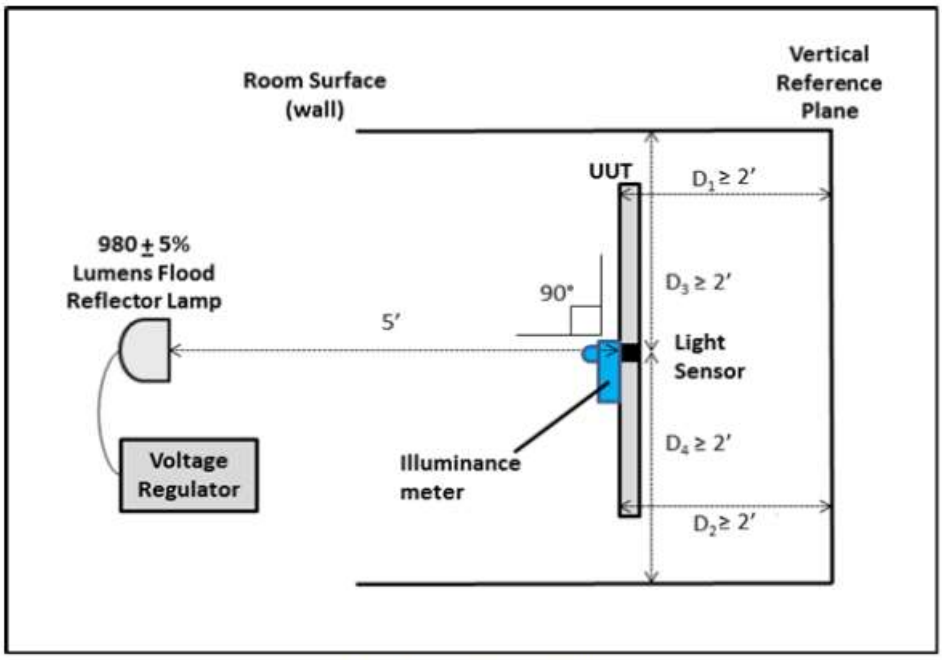

Figure 1: Test Setup - Top View

Notes:

- $D_1 = D_2$ with respect to vertical reference plane
- D_1 and D_2 indicate that the corners of the face of the UUT shall be at least 2 feet from the vertical reference plane
- D_3 and D_4 indicate that the center of the light sensor shall be at least 2 feet from the room walls

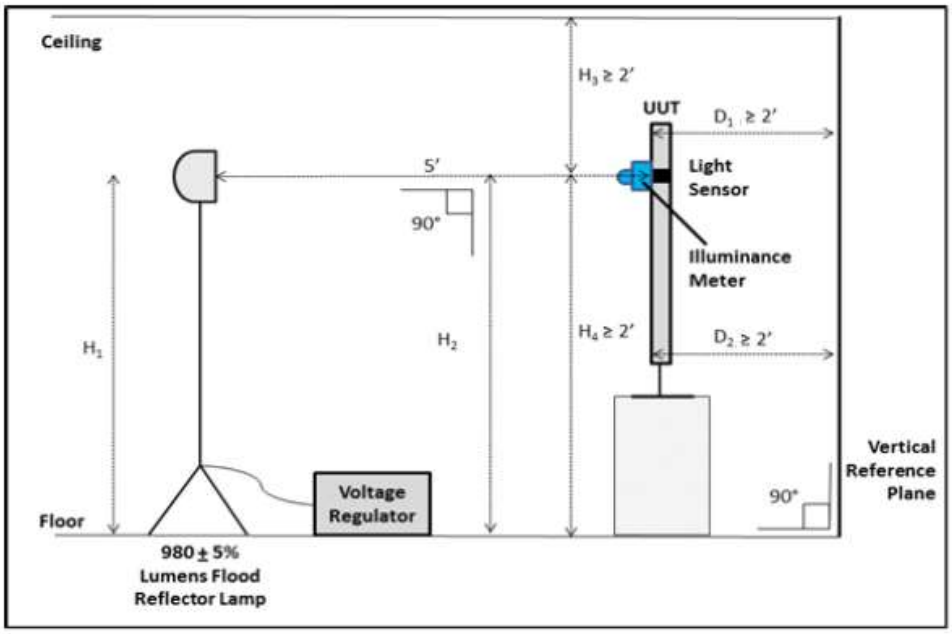

Figure 2: Test Setup - Side View

Notes:

- $D_1 = D_2$ with respect to vertical reference plane
- D_1 and D_2 indicate that the corners of the face of the UUT shall be at least 2 feet from the vertical reference plane
- Illuminance meter shall be removed for power measurements, after target illuminance achieved
- $H_1 = H_2$ with respect to horizontal reference plane (e.g. floor)
- H_3 and H_4 indicate that the center of the light sensor must be at least 2 feet from the floor and 2 feet from the ceiling
- Illuminance meter removed for power measurements, after target illuminance achieved

H) Power Meter: Power meters shall possess the following attributes

1) Crest Factor:

   a) An available current crest factor of 3 or more at its rated range value; and

   b) Lower bound on the current range of 10 mA or less

2) Minimum Frequency Response: 3.0 kHz

3) Minimum Resolution:

   a) 0.01 W for measurement values less than or equal to 10 W;

b) 0.1 W for measurement values from greater than 10 W to 100 W; and

c) 1.0 W for measurement values greater than 100 W.

I) Light Measuring Device (LMD):

1) Luminance measurement shall be performed using either

a) A contact meter; or

b) A distance meter

2) All LMDs shall meet the following specifications:

a) Accuracy: ± 2% (± 2 digits) of the digitally displayed value

b) Acceptance Angle: 3 degrees or less

The overall accuracy of LMDs is found by taking (±) the absolute sum of 2% of the targeted illuminance and a 2 digit tolerance of the displayed value least significant digit. For example, if the LMD displays "200.0" when measuring a screen brightness of 200 nits, 2% of 200 nits is 4.0 nits. The least significant digit is 0.1 nits. "Two digits" implies 0.2 nits. Thus, the displayed value would be 200 ± 4.2 nits (4 nits + 0.2 nits).The accuracy is specific to the LMD and shall not be considered as tolerance during actual light measurements. Light measurement accuracy shall be within the tolerance specified in 4.J)4).

J) Measurement Accuracy:

1) Power measurements with a value greater than or equal to 0.5 W shall be made with an uncertainty of less than or equal to 2% at the 95% confidence level.

2) Power measurements with a value less than 0.5 W shall be made with an uncertainty of less than or equal to 0.01 W at the 95% confidence level.

3) All ambient light values (measured lux) shall be measured at the location of the ABC sensor on the UUT with light entering directly into the sensor and with the IEC 62087 Ed. 3.0 test signal main menu displayed on the product. For products not compatible with the IEC 62087 test signal format, ambient light values shall be measured with the VESA FPDM2 FK test signal being displayed on the product.

4) Ambient light values shall be measured within the following tolerances:

a) At 10 lux, ambient lighting shall be within ± 1.0 lux; and

b) At 300 lux, ambient lighting shall be within ± 9.0 lux.

5 TEST CONDUCT

5.1 Guidance for Implementation of IEC 62087 Ed. 3.0

A) Testing at Factory Default Settings: Power measurements shall be performed with the product in its as-shipped condition for the duration of Sleep Mode and On Mode testing, with all user-configurable options set to factory defaults, except as otherwise specified by this test method.

1) Picture level adjustments shall be performed per the instructions in this test method.

2) Products that include a "forced menu" upon initial start-up shall be tested in "standard" or "home" picture setting. In the case that no "standard" setting or equivalent exists, the default setting recommended by the manufacturer shall be used for testing and recorded in the test report. Products that do not include a "forced menu" shall be tested in the default picture setting.

B) Point of Deployment (POD) Modules: Optional POD modules shall not be installed.

C) Multiple Sleep Modes: If the product offers multiple Sleep Modes, the power during all Sleep Modes shall be measured and recorded. All Sleep Mode Testing shall be carried out as per Section 6.5.

5.2 Conditions for Power Measurements

A) Power measurements:

1) Power measurements shall be taken from a point between the power source and the UUT. No Uninterruptible Power Supply (UPS) units may be connected between the power meter and the UUT. The power meter shall remain in place until all On Mode, Sleep Mode and Off Mode power data are fully recorded.

2) Power measurements shall be recorded in watts as directly measured (unrounded) values at a rate of greater than or equal to 1 reading per second.

3) Power measurements shall be recorded after voltage measurements are stable to within 1%.

B) Dark Room Conditions:

1) Unless otherwise specified, the illuminance measured at the UUT screen with the UUT in Off Mode shall be less than or equal to 1.0 lux. If the UUT does not have an Off Mode, the illuminance shall be measured at the UUT screen with the UUT's power cord disconnected.

C) UUT Configuration and Control:

1) Peripherals and Network Connections:

a) External peripheral devices (e.g. mouse, keyboard, external hard disk drive (HDD) etc.) shall not be connected to USB ports or other data ports on the UUT.

b) Bridging: If the UUT supports bridging per the definition in section 1 of the ENERGY STAR Eligibility Criteria Version 6.0, a bridge connection shall be made between the UUT and the host machine. The connection shall be made in the following order of preference. Only one connection shall be made and the connection shall be maintained for the duration of the test.

i. Thunderbolt

ii. USB

iii. Firewire (IEEE 1394)

iv. Other

Note: Examples of bridging for displays may include:

1. *A case where the display converts data between two different port types (e.g. Thunderbolt and Ethernet). This can allow a device to use Thunderbolt as an Ethernet connection or vice versa.*
2. *Allowing a USB keyboard/mouse to be connected to another system (e.g. host system) through the display by a USB hub controller.*

c) Networking: If the UUT has networking capability (i.e., it has the ability to obtain an IP address when configured and connected to a network) the networking capability shall be activated, and the UUT shall be connected to a live physical network (e.g., WiFi, Ethernet, etc.). The physical network shall support the highest and lowest data speeds of the UUT's network function. An active connection is defined as a live physical connection over the physical layer of the networking protocol. In the case of Ethernet, the connection shall be via a standard Cat 5e or better Ethernet cable to an Ethernet switch or router. In the case of WiFi the device shall be connected and tested in proximity to a wireless access point (AP). The tester shall configure the address layer of the protocol, taking note of the following:

   i. Internet Protocol (IP) v4 and IPv6 have neighbor discovery and will generally configure a limited, non-routable connection automatically.

   ii. IP can be configured manually or by using Dynamic Host Configuration Protocol (DHCP) with an address in the 192.168.1.x Network Address Translation (NAT) address space if the UUT does not behave normally when autoIP is used. The network shall be configured to support the NAT address space and/or autoIP.

d) The UUT shall maintain this live connection to the network for the duration of testing, disregarding any brief lapses, (e.g., when transitioning between link speeds). If the UUT is equipped with multiple network capabilities, only one connection shall be made in the following order of preference:

   i. WiFi (Institution of Electrical and Electronics Engineers - IEEE 802.11- 2007[2])

   ii. Ethernet (IEEE 802.3). If the UUT supports Energy Efficient Ethernet (IEEE 802.3az-2010[3]), then it shall be connected to a device that also supports IEEE 802.3az

   iii. Thunderbolt

   iv. USB

   v. Firewire (IEEE 1394)

   vi. Other

e) In the case of a UUT that has a single connection capable of performing both bridging and networking functionality, a single connector can be used to meet these functionalities provided it is the highest preferred connection the UUT supports for each functionality.

f) In the case of a UUT that has no data/network capabilities, the UUT shall be tested as-shipped.

g) Built-in speakers and other product features and functions not specifically addressed by the ENERGY STAR eligibility criteria or test method must be configured in the as-shipped power configuration.

h) Availability of other capabilities such as occupancy sensors, flash memory-card/smart-card readers, camera interfaces, PictBridge shall be recorded.

2) Signal Interface:

   a) If the UUT has multiple digital interfaces, the UUT shall be tested with the first available interface from the list below:

      i. Thunderbolt

      ii. DisplayPort

[2] IEEE 802 – Telecommunications and information exchange between systems—Local and metropolitan area networks – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications

[3] Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications - Amendment 5: Media Access Control Parameters, Physical Layers, and Management Parameters for Energy-Efficient Ethernet

iii. HDMI

iv. DVI

v. Other Digital Interface

vi. Analog Component

vii. Analog Composite

viii. Other Analog Interfaces

3) Occupancy Sensor: If the UUT has an occupancy sensor, the UUT shall be tested with the occupancy sensor settings in the as-shipped condition. For UUT's with an occupancy sensor enabled as-shipped:

a) A person shall be within close proximity of the occupancy sensor for the entire warm up, stabilization, luminance testing and On Mode to prevent the UUT from entering a lower power state (e.g. Sleep Mode or Off Mode). The UUT shall remain in On Mode for the duration of the warm up period, stabilization period, luminance test and On Mode test.

b) No person shall be within close proximity of the occupancy sensor for the duration of the Sleep Mode and Off Mode tests to prevent the UUT from entering a higher power state (e.g. On Mode). The UUT shall remain in Sleep Mode or Off Mode for the duration of the Sleep Mode or Off Mode tests, respectively.

D) Resolution and Refresh Rate:

1) Fixed-pixel Displays:

a) Pixel format shall be set to the native level as specified in the product manual.

b) For non-Cathode Ray Tube (CRT) Displays, refresh rate shall be set to 60 Hz, unless a different default refresh rate is specified in the product manual, in which case the specified default refresh rate shall be used.

c) For CRT Displays, pixel format shall be set to the highest resolution that is designed to be driven at a 75 Hz refresh rate, as specified in the product manual. Typical industry standards for pixel format timing shall be used for testing. Refresh rate shall be set to 75 Hz.

E) Battery Operated Products:

1) For products designed to operate using batteries when not connected to the mains, the battery shall be removed for all tests. For UUTs where operation without a battery pack is not a supported configuration, the batteries shall be fully charged before the start of testing and shall be left in place for the test. To ensure the battery is fully charged, perform the following steps:

a) For products that have an indicator to show that the battery is fully charged, continue charging for an additional 5 hours after the charged indicator is present.

b) If there is no charge indicator, but the manufacturer's instructions provide a time estimate for when charging this battery or this capacity of battery should be complete, continue charging for an additional 5 hours after the manufacturer's estimate.

c) If there is no indicator and no time estimate in the instructions, but the charging current is stated on the UUT or in the instructions, terminate charging 1 hour after the calculated test duration or, if none of the above applies, the duration shall be 24 hours.

F) Accuracy of Input Signal Levels: When using analog interfaces, video inputs shall be within ± 2% of referenced white and black levels. When using digital interfaces, the source video signal shall not be adjusted for color, or modified by the tester for any purpose other than to compress/inflate and encode/decode for transmission, as required.

G) True Power Factor: Partners shall report the true power factor (PF) of the UUT during On Mode measurement. The power factor values shall be recorded at the same rate at which the power values are recorded. The reported power factor shall be averaged over the entire duration of the On Mode

testing.

H) Test Materials:

1) "IEC 62087-2011 Dynamic Broadcast-Content Signal" shall be used for testing, as specified in IEC 62087, Ed. 3.0, Section 11.6, "On (average) mode testing using dynamic broadcast-content video signal."

2) "Video Electronics Standard Association (VESA) Flat Panel Display Measurements (FPDM) Standard version 2.0 test patterns" (shall be used only for products that cannot be tested using the IEC 62087-2011 Dynamic Broadcast-Content Signal).

5.3 Low-Voltage Dc Source Measurement

A) Connect the dc source to the power meter and relevant ac supply as specified in Table 1

1) Verify that the dc source is unloaded.

2) Allow the dc source to warm up for a minimum of 30 minutes.

3) Measure and record the unloaded dc source power (P_S) according to IEC 62301 Ed. 2.0

4) Record the brand name, model number, voltage and current rating of the dc source.

6 TEST PROCEDURES FOR ALL PRODUCTS

6.1 Pre-Test UUT Initialization

A) Prior to the start of testing, the UUT shall be initialized as follows:

1) Set up the UUT per the instructions in the supplied product manual.

2) Connect an acceptable watt meter to the power source and connect the UUT to the power outlet on the watt meter.

3) With the UUT off, set the ambient light level such that the measured screen illuminance is less than 1.0 lux (see Section 5.2B)).

4) Power on the UUT and perform initial system configuration, as applicable.

5) Ensure UUT settings are in their as-shipped configuration, unless otherwise specified in this Test Method.

6) Warm up the UUT for 20 minutes, or the time it takes the UUT to complete initialization and become ready for use, whichever is longer. The IEC 62087 test signal format, as specified in section 5.2 H) 1), shall be displayed for the entire warm up period. Displays that are not compatible with the IEC 62087 test signal format shall have the VESA FPDM2 L80 test signal, as specified in section 5.2H)2), displayed on the screen.

7) Report the ac input voltage and frequency.

8) Report the test room ambient temperature and relative humidity.

6.2 Luminance Testing

A) Luminance testing shall be performed immediately following the warm up period and in dark room conditions. Product screen illuminance, as measured with the UUT in Off Mode, shall be less than or equal to 1.0 lux.

B) Luminance shall be measured perpendicular to the center of the product screen using a Light Measuring Device (LMD). Following the LMD manufacturer's instructions, it is recommended that the LMD either be used as close to the screen as possible or measure an area of at least 500 pixels.

C) The position of the LMD relative to the product screen shall remain fixed throughout the duration of testing.

D) For products with ABC, luminance measurements shall be performed with ABC disabled. If ABC cannot be disabled, luminance measurements shall be measured perpendicular to the center of the product screen with light entering directly into the UUT's ambient light sensor at greater than or equal to 300 lux.

E) Luminance measurements shall be performed as follows:

1) Verify that the UUT is in the default as-shipped luminance value or "Home" picture setting.

2) Display the test video signal for the specific product class, as described below:

a) All products: IEC 62087-2011 Three-bar video signal specified in IEC 62087, Ed. 3.0, Section 11.5.5 (three bars of white (100%) over a black (0%) background).

b) Products that cannot be tested with signals from IEC 62087: VESA FPDM2 L80 test signal for the maximum resolution supported by the product.

3) Display the test video signal for no less than 10 minutes to allow the UUT luminance to stabilize. This 10 minute stabilization period may be reduced if luminance measurements are stable to within 2% over a period of not less than 60 seconds.

4) Measure and record the luminance in default as-shipped setting $L_{As\text{-}shipped}$.

5) Set the brightness and contrast levels of the UUT to their maximum values.

6) Measure and record the luminance as $L_{Max\_Measured}$.

7) Record the manufacturer-reported maximum luminance $L_{Max\_Reported}$.

6.3 On Mode Testing for Products without ABC Enabled by Default

A) Prior to On Mode power measurement, the luminance of the UUT shall be set according to the following:

1) For products with viewable diagonal screen size **less than 30 inches and any Computer Monitors 30 inches or more**, adjust appropriate controls until the luminance of the screen is **200 candelas per square meter (cd/m^2)**. If the UUT cannot achieve this luminance, set the product luminance to the nearest achievable value. Luminance values shall be measured as per section 6.2. This luminance value L_{On} shall be reported.

2) For products with viewable diagonal screen size of **30 inches or more that are Signage Displays**, the product shall be tested with luminance set at a value greater than or equal to 65% of the manufacturer-reported maximum luminance ($L_{Max\_Reported}$). Luminance values shall be measured as per section 6.2. This luminance value L_{On} shall be recorded.

B) For a UUT capable of displaying the IEC signals, On Mode power (P_{ON}) shall be measured according to IEC 62087 Ed 3.0 Section 11: Measuring Conditions for Television Sets in On (average) Mode; with the additional guidance in Section 5.

1) Section 11.6 "On (average) Mode testing using dynamic broadcast-content video signal" for products capable of playing video.

C) For a UUT not capable of displaying the IEC signals, On Mode power (P_{ON}) shall be measured as follows:

1) Ensure that the UUT has been initialized per Section 6.1.
2) Display the VESA FPDM2, A112-2F, SET01K test pattern (8 shades of gray from full black (0 volts) to full white (0.7 volts)).
3) Verify that input signal levels conform to VESA Video Signal Standard (VSIS), Version 1.0, Rev. 2.0, December 2002.
4) With the brightness and contrast controls at maximum, verify that the white and near-white grey levels can be distinguished. If necessary, adjust contrast controls until the white and near-white grey levels can be distinguished.
5) Display the VESA FPDM2, A112-2H, L80 test pattern (full white (0.7 volts) box that occupies 80% of the image).
6) Ensure that the LMD measurement area falls entirely within the white portion of the test pattern.
7) Adjust appropriate controls until the luminance of the white area of the screen is **200 Cd/m^2**. If the UUT cannot achieve the specified luminance, set product luminance to the nearest achievable value.
8) Record the screen luminance (L_{On}).
9) Record On Mode power (P_{ON}) and total pixel format (horizontal x vertical).

6.4 On Mode Testing for Products with ABC Enabled by Default

The average On Mode power consumption of the product shall be tested with the dynamic broadcast-content as defined in IEC 62087 Ed. 3.0.

A) Stabilize the UUT for 30 minutes. This shall be done with three repetitions of the 10 minute IEC dynamic broadcast-content video signal.

B) Set the light output of the lamp used for testing to 10 lux as measured at the face of the ambient light sensor.

C) Display the 10 minute dynamic broadcast-content video signal. Measure and record the power consumption, P_{10}, during the 10 minute dynamic broadcast-content video signal.

D) Repeat steps 6.4B) and 6.4C) for an ambient light level of 300 lux, to measure P_{300}.

E) Disable ABC and measure On Mode power (P_{ON}) per Section 6.3. If ABC cannot be disabled, power measurements shall be conducted as follows:
   1) If the brightness can be set to a fixed value as specified in Section 6.3, then On Mode power for these products shall be measured as per Section 6.3 with light entering directly into the UUT's ambient light sensor at greater than or equal to 300 lux.
   2) If the brightness cannot be set to a fixed value, then On Mode power for these products shall be measured as per Section 6.3 with light entering directly into the UUT's ambient light sensor at greater than or equal to 300 lux and without modifying the screen brightness.

6.5 Sleep Mode Testing

A) Sleep Mode power (P_{SLEEP}) shall be measured according to IEC 62301-2011: Household Electrical Appliances – Measurement of Standby Power, with the additional guidance in Section 5.

B) The Sleep Mode test shall be conducted with the UUT connected to the host machine. Sleep Mode shall also be initiated in the host machine to which the UUT is connected.

C) If the product has a variety of Sleep Modes that can be manually selected, measurements shall be performed and recorded in all Sleep Modes. If the product automatically cycles through its various Sleep Modes, the measurement time shall be long enough to obtain a true average of all Sleep Modes, which will be the Sleep Mode power used for qualification.

6.7 Off Mode Testing

A) For products having Off Mode capability, at the conclusion of the Sleep Mode test, initiate Off Mode via the most easily accessible power switch.

B) Measure Off Mode power (P_{OFF}) according to Section 5.3.1 of the IEC 62301 off mode test. Document the method of adjustment and sequence of events required to reach Off Mode.

C) Any input synchronizing signal check cycle may be ignored when measuring Off Mode power.

D) Off Mode power for products without a physical power switch shall be measured with the UUT connected to the host machine, with the host machine in the power Off Mode.

6.8 Additional Testing

A) For products with data/networking capabilities, in addition to tests performed with data/networking capabilities activated and a bridge connection established (see Section 5.2C)1)), Sleep Mode Testing shall be performed with data/networking features deactivated and without any bridge connection established, per Section 5.2C) b), c) and d).

Appendix 1.4 Hong Kong Voluntary Energy Label Test Standard for Computer Displays

Source: Hong Kong Electrical and Mechanical Services Department (HKEMSD). 2010. "The Hong Kong Voluntary Energy Efficiency Labeling Scheme for LCD Monitors."
http://www.emsd.gov.hk/emsd/e_download/pee/veels_lcd_monitor.pdf

6. Test Methodology & Standards

General

6.1 All test standards and specifications specified in this document are only related to checking compliance with the energy efficiency and general performance requirements. It is not the intention of this document to detail out the test standards and requirements for checking compliance with the Electrical Products (Safety) Regulation of the HKSAR. The participant should conduct appropriate tests, where necessary, in addition to those specified in this document in order to obtain Certificates of Safety Compliance for his appliances.

Compliance with Safety Requirements

6.2 The testing standards for checking compliance with the safety requirements are based on IEC 60950, "Information Technology Equipment – Safety". For detailed requirements and procedural descriptions one should refer to the respective standard.

6.3 To the extent that definitions in the IEC standards do not conflict with the definitions of this document, the definitions in the aforesaid standards shall be included.

Test Conditions

6.4 For all LCD monitors, the test conditions shall be as follows:

Supply Voltage	220 (± 1%) Volts AC, 50 Hz (± 0.5Hz)
Total Harmonic Distortion (Voltage)	< 2% THD
Ambient Temperature:	20 °C ± 5°C
Relative Humidity	30% - 80%
Line Impedence	< 0.25 ohm

6.5 Dark Room Conditions: When performing light measurements, the monitor shall be located in a dark room condition. The monitor screen illuminance measurement (E), when screen is switched off, 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 power to the monitor off.

6.6 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 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.

6.7 Power Measurement Test Conditions: For LCDs and other fixed pixel technologies, pixel format shall be set to the native level. LCD refresh rate shall be set to 50 Hz, unless a different refresh rate is specifically recommended by the manufacturer, in which case that rate shall be used.

6.8 Power Measurement Protocols: Monitor power consumption shall be measured in watts with an imposed test pattern – a full white screen. Warm-up time shall be a minimum of a 20-minute period. A true RMS power meter with a crest factor of at least five shall be used to measure the power use of each of five or more randomly chosen units from the production line at 220 Volts AC at 50 Hz. Measurements shall be taken after wattage values are stable over a 3-minute period. Measurements are considered stable if the wattage reading does not vary more than 1% over the 3-minute period. Calibrated measuring equipment shall be used with an accurate measurement to one tenth of a watt or better.

Testing Methodology

6.9 Following are the test procedures for measuring the true power requirements of the test unit in On Mode/Active Power, Sleep Mode/Low Power, and Off Mode/Standby Power. As regards monitor tests, the analogy interface is required to use, 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). [1] For digital interface monitors, please see Footnote 1 for voltage information and then follow the test method below using a digital signal generator.

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[1] *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) = 36 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

6.10 The measurement procedures for the "On Mode/Active Power" operation are as follows:

(a) Connect the test sample to the outlet or power source and test equipment. For monitors shipped with an external power supply, the external power supply (as opposed to a reference power supply) must be used in the test.

(b) Power on all test equipment and properly adjust power source voltage and frequency.

(c) Check for normal operation of the test unit and leave all customer adjustments set to factory default settings.

(d) 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).

(e) Set the proper display mode. Refer to Section 6.7, Power Measurement Test Conditions.

(f) Provide dark room conditions. See Sections 6.5, Dark Room Conditions.

(h) Either verify that the wall outlet power is within specifications or adjust the AC power source output as described in Section 6.4 (ex. 220Vrms ± 1%, 50Hz ± 0.5Hz).

(i) Set the power meter current range. The full-scale value selected multiplied by the crest factor rating (Ipeak/Irms) of the meter must be greater than the peak current reading from the oscilloscope.

(j) 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 3-minute period. See Section 6.8, Power Measurement Protocols.

(k) Power consumption shall be recorded as well as total pixel format (horizontal x vertical pixels displayed) to calculate pixels/watt.

(l) Record the test conditions and test data.

6.11 The measurement procedures for the "Sleep Mode/Low Power (Power Switch On, No Video Signal)" operation are as follows:

(a) At the conclusion of the On Mode/Active Power test, initiate the monitor 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.

(b) Allow the 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 3-minute period.

(c) Record the test conditions and test data. The measurement time shall be sufficiently long to measure the correct average value. 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.

6.12 The measurement procedures for the "Off Mode/Standby Power (Power Switch Off)" operation are as follows:

(a) At the conclusion of the Sleep Mode/Low Power test, initiate the monitor Off Mode/Standby Power. 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.

(b) Allow the 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 3-minute period.

(c) Record the test conditions and test data. The measurement time shall be sufficiently long to measure the correct average

Appendix 2.1 EU Ecodesign Proposed Measurement Method for Gas Ranges

Source: European Commission. 2012. "Commission Explanatory Working Document on possible Ecodesign and Energy Labelling Requirements for domestic ovens, hobs and range hoods." July 2012. http://efficient-products.defra.gov.uk/cms/assets/Explanatory-WD-on-kitchen-appliances-final4.pdf

Domestic gas hobs

The measuring of the efficiency of domestic gas hobs shall be done with an aluminium pot with lid. The sizes of the pots and the amount of water shall be fit to the size of the gas hobs according to the sizes in the Table 5. The water is heated from 293K to 363K.

Table 5: Sizes and water amount for measuring efficiency of domestic gas hobs

Maximum power of the cooking zone (kW)	Internal diameter pot (mm)	Quantity of water (kg)
<1.16 < 1.64	220	3.7
<1.64 < 1.98	240	4.8
<1.99 < 4.20*	260	6.1

* burners > 2.36 kW maximum power are set at 2.36 W power.

The efficiency of gas burners in a hob is calculated using the formulas:

$$EE_{hob} = (E_{theoretic} / E_{gas}) \times 100$$

and

$$E_{theoretic} = (m_1 \times c_1 + m_3 \times c_3) \times (t_2 - t_1)$$

Where:

EE_{hob} = energy efficiency of the hob in % and rounded to the first decimal place

$E_{theoretic}$ = theoretic minimum required energy for heating the water in MJ and rounded to the first decimal place

E_{gas} = energy content of the consumed gas for heating the prescribed amount of water in MJ and rounded to the first decimal place

m_1 = mass of water in the pan in kg and rounded to the first decimal place

m_3 = mass of the aluminium pan including its lid in kg and rounded to the first decimal place

c_1 = specific heat of water in kJ/kg.K and rounded to the first decimal place

c_3 = specific heat of aluminium in kJ/kg.K and rounded to the first decimal place

t_1 = initial temperature of the water in K

t_2 = the maximum temperature of the water in K