Draft 3 Version 6.0 ENERGY STAR® Displays Specification Webinar

February 22, 2012

U.S. Environmental Protection Agency (EPA)

U.S. Department of Energy (DOE)

ENERGY STAR Program

Webinar Agenda

	Topic
1	Introductions & Overview
2	Test Method Discussion
3	Definitions & Scope
4	Power Management
5	On Mode Power
6	Enhanced-Performance Displays
7	Automatic Brightness Control (ABC)
8	Sleep Mode Adders
9	Non-Energy-Use Requirements
10	Closing Comments

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Version 6.0 Displays Specification Revision History

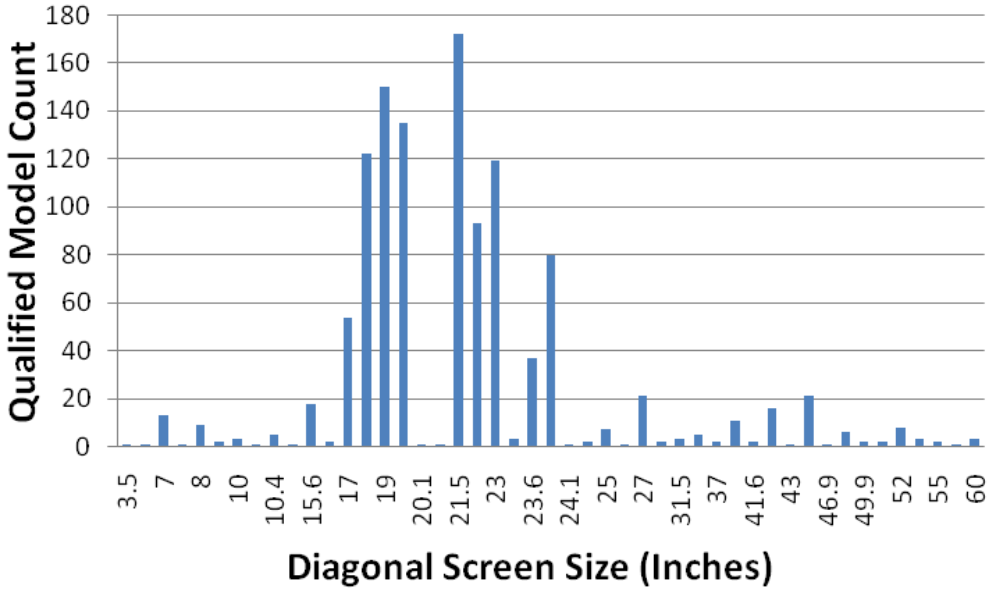
- Revision launch December 2010
- Framework Document: Resolution, Luminance discussion
- Draft 1 released June 3, 2011
  - Webinar for clarifications to test method June 23, 2011
- Draft 2 released September 20, 2011
  - On Mode power levels proposed
  - Stakeholder meeting for Draft 2 September 27, 2011

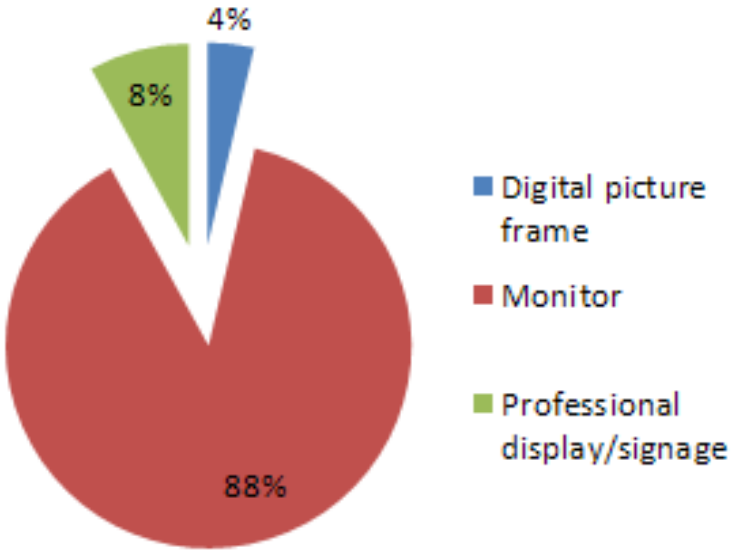
Version 6.0 Anticipated Timeline

- Draft 3 comments due March 9, 2012.
- Draft Final to be released late March / early April 2012.
- Specification to be finalized in April 2012.
- Specification effective date in early 2013.

** Dates are subject to change.

Overview of Displays in the ENERGY STAR Dataset





- 55 partners qualified over 2,000 models

Displays Market Overview

- Digital picture frames (size usually <12”): small market share
  - ENERGY STAR qualified models do not represent majority of models on market. Digital picture frames (DPFs) added in Version 5.0.

- LCD Monitors <30” (majority of qualified products list): high market share
  - ENERGY STAR qualified models represent majority of models on the market. Participating Partners represent approximately all current displays manufacturers selling products in the U.S.

- Signage Displays (size usually 30” and greater): very small market share
  - ENERGY STAR qualified represent a small share of models on market, but also relatively new product introduced to end users. Signage over 30” added in Version 5.0.

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DOE Notice of Proposed Rulemaking (NOPR) for Televisions

- Published January 19, 2012
- Products shall follow the DOE NOPR for TVs if they fall under DOE's proposed definition:
  - A product that:
    - Is powered by mains power;
    - Has a diagonal screen size of ≥ 15 inches:
    - Is manufactured with a TV tuner;
    - Is capable of displaying dynamic visual information from various sources.
- Link: http://www.gpo.gov/fdsys/pkg/FR-2012-01-19/pdf/2012-687.pdf

Topics for Discussion

1. Products Tested
2. Test Setup and Measurements
3. Issues and Recommendations
4. Summary of Proposed Changes

Products Tested

- DOE tested 7 products

Product	Size (in)	Specification
USB Powered Display	14	Powered and operated by a Universal Serial Bus (USB)
Computer Monitor 1	14	LCD backlit
Computer Monitor 2	27	LCD backlit Network connectivity
Digital Picture Frame 1	8	Supports network connectivity
Digital Picture Frame 2	15	Supports network connectivity
Professional Display 1	42	Plasma Display
Professional Display 2	52	LCD Display

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Test Setup and Measurement

- Testing conducted at Rhein Tech Laboratories
- Test Signals
  - IEC 62087* Three bar static signal
  - IEC 62087 Dynamic broadcast content (DBC) video signal
  - IEC 62087 Internet video content (IVC) signal
- Dark room for luminance testing
- On Mode power for ABC products measured at ambient lighting levels of 10, 100, 150 and 300 lux.

*IEC – International Electrotechnincal Commission Standard 62087 Ed: 2.0

Test Setup and Measurements

Test name	Test signal	Setup	Recorded value
Luminance	IEC 62087-2010 • Three bar static	Dark room	• As shipped • Maximum Value
On Mode (Products without ABC)	IEC 62087-2010 • DBC • IVC	Luminance set as shipped	Power
On Mode (Products with ABC)	IEC 62087-2010 • DBC • IVC	Room illuminance of 10, 100, 150 and 300 lux	Power
Sleep Mode	-	-	Power
Off Mode	-	-	Power

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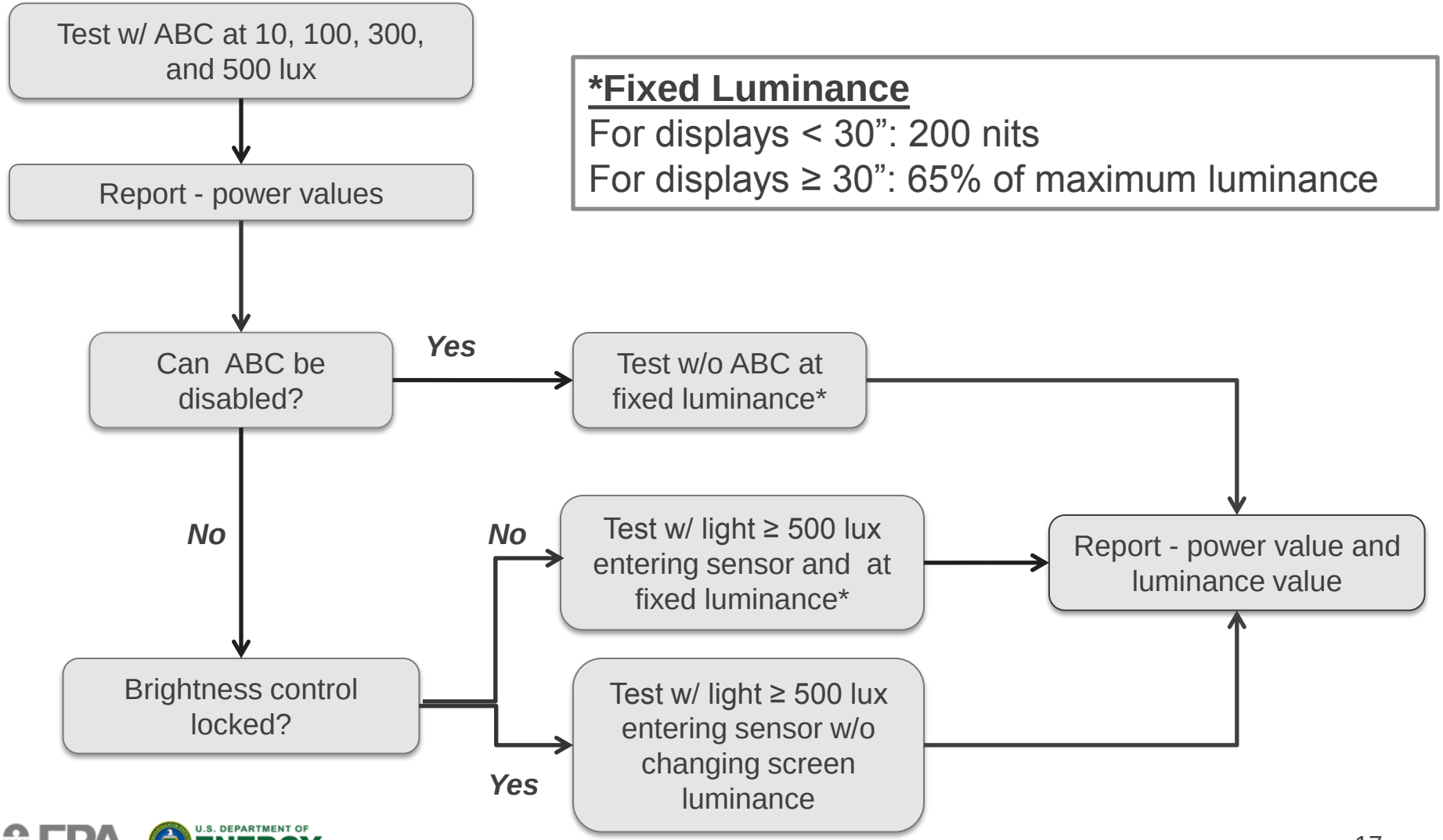
Issue 1: On Mode power for ABC enabled products

- Issue:
  - Draft 2 test method did not specify how to determine On Mode power consumption of ABC enabled displays.
- Proposed Approach:
  - Test 1: Test On Mode power for ABC enabled products at room lighting levels of 10,100, 300 and 500 lux
  - Test 2: Test On Mode power with ABC disabled

Recommendation 1: On Mode power for ABC enabled products



Issue 2: Test Signal for Digital Picture Frames

- Digital Picture frames not compatible with IEC 62087 test signal format
  - IEC test signal is in the DVD/Blu-ray format
  - All test signals are embedded in a single file
  - Converting the IEC 62087 into a format readable by the digital picture frame violates IEC copyright

Recommendation 2: Test with VESA Test Signal

- Three Bar Signal was generated by laboratory - similar to IEC 62087 static signal

Product	Image Source	Luminance Value – As Shipped (cd/m2)	Luminance Value – Max (cd/m2)	On Mode Power (W)
Digital Picture Frame 1	Three Bar	113.6	239.6	5.1
	VESA* – L80	113.6	240.5	5.1
Digital Picture Frame 2	Three Bar	300.1	310.1	22.8
	VESA – L80	300.1	308.1	22.6

*VESA – Video Electronics Standards Association, Display Metrology Committee

- Observed ~1% difference in On Mode power

Recommendation 2: Test with VESA Test Signal

- Proposed Change:
  - Use VESA *FPDM2** static L80 signal to test products that are not compatible with the IEC 62087 test signal format
- Advantages:
  - VESA static test signals are in .png format
  - Easy to load on a USB or memory device readable by the Digital Picture Frame
- Disadvantage:
  - Different test signal when compared to other products

*FPDM 2 – VESA Flat Panel Display Measurements Version 2.0

Issue 3: USB hub power consumption

- AC power consumed by USB hub depends on
  - number of USB ports supported
  - adapter current rating
- Observed variation in idle power consumed by hubs from two different manufacturers

Hub	Adapter Rating (Output)	Idle Power (watts)	Active Power DBC (watts)
Hub 1	5V, 2.6 A	0.35	7.3
Hub 2	5V, 2.1 A	0.19	7.3

Recommendation 3: Specify USB hub power ratings

- Proposed Change:
  - For testing USB powered displays, use AC powered USB hub with adapter output rating 5V/2A-3A
- Advantages:
  - Commonly used low powered hubs satisfy the rating mentioned
  - Maintains testing uniformity
  - Improves repeatability
- Limitation:
  - May not support USB 3.0-only compatible products

Issue 4: Light measuring device specifications

- Issue:
  - Draft 2 Test Method does not specify accuracy/attributes for the light measuring device
- Proposed Change
  - Light measuring device must be accurate within 2 percent (2 digits) of the digitally displayed value
  - Repeatability of 0.4 percent (2 digits) of the displayed value

Recommendation 4: Example

- Measuring screen luminance of 200 nits
  - If LMD displays “200.0” then 2% will be:

$$\pm\frac{2}{100} * 200 = \pm 4\ nits$$

  - The least significant digit is 0.1 nits, therefore

$$\pm 2\ digits = \pm 0.2\ nits$$

  - Total accuracy must be within

$$\pm 4\ nits \pm 0.2\ nits = \pm 4.2\ nits$$

Issue 4: Light measuring device specifications

- Advantages:
  - Consistent with DOE Test Procedure NOPR for TVs
  - Similar to the existing industry (VESA FPDM2) specifications
  - Uniformity in testing
  - Improves test repeatability

Issue 5: Ambient Light Tolerance levels

- Issue:
  - Draft 2 proposed 10% tolerance level for room illuminance
  - This is a very large tolerance window at higher illuminance levels
- Proposed Changes:
  - At 10 lux, ambient lighting shall be within 1.0 lux
  - At 100 lux, ambient lighting shall be within 5.0 lux
  - At 300 lux and 500 lux, ambient lighting shall be within 9.0 lux
- Advantages:
  - Consistent with DOE Test Procedure NOPR for TVs
  - Improve test procedure repeatability

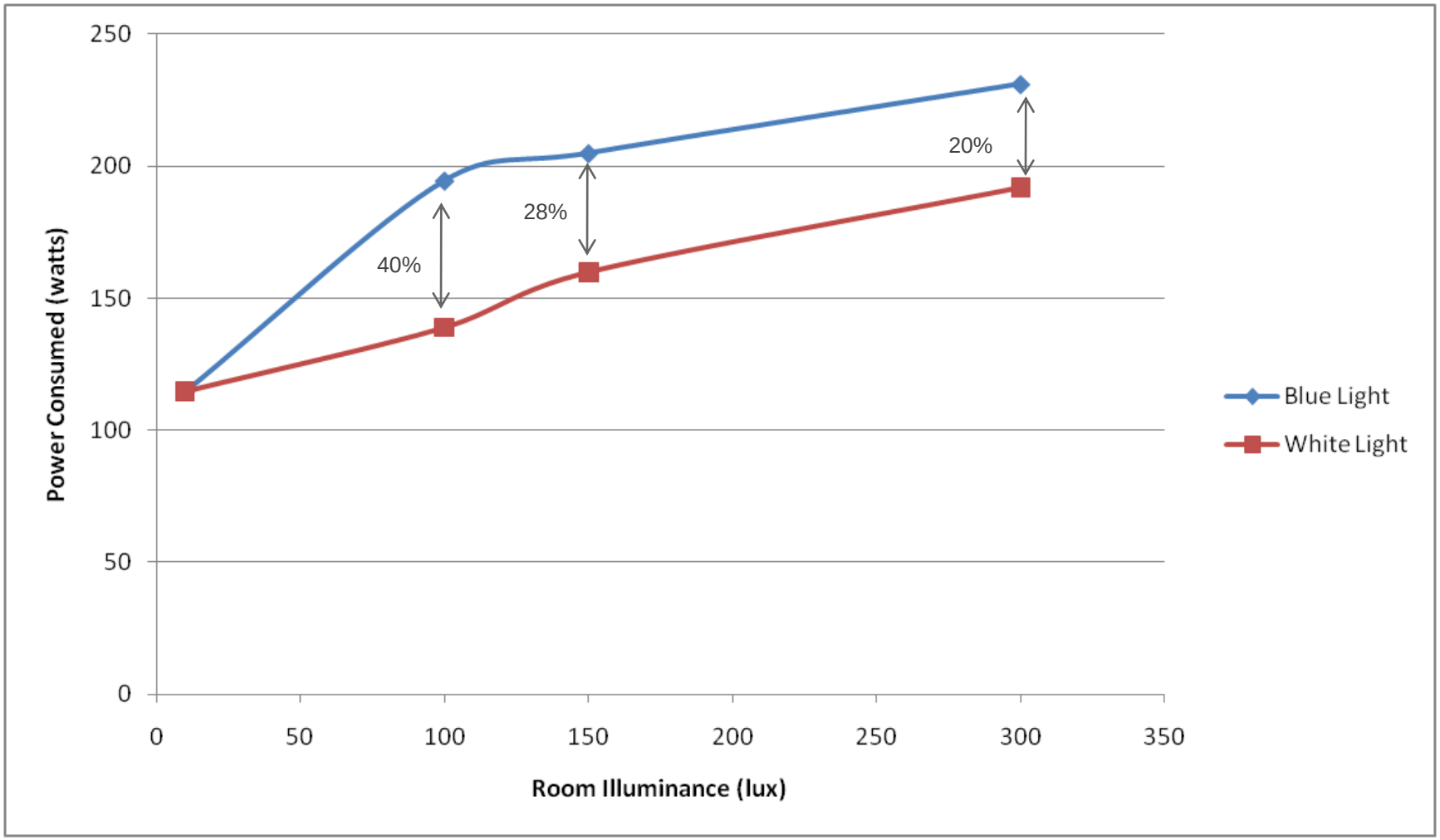
Issue 6: ABC product energy use is a function of light source

- Light source impacts energy consumed by products enabled with ABC

Light Color	Test Signal	Power (watts)			
		10 lux	100 lux	150 lux	300 lux
White Light	IEC 62087 – DBC	115	139	160	192
Blue Light	IEC 62087 – DBC	115	195	205	231

  - Testing with bluer light source resulted in an increase in power consumption for certain lux values

Issue 6: ABC product energy use is a function of light source



Recommendation 6: Specify light source

- Proposed Change:
  - Test with 100 watt halogen incandescent light source
- Advantages:
  - Consistent with DOE Test Procedure NOPR for TVs
  - Better representation of visible spectrum in comparison to other incandescent light sources
  - Provides testing uniformity across labs
  - Improves test repeatability
- Feedback and Comments
  - Specify color temperature?
  - Warm up time?

Additional Changes

- Recommendation 7:
  - Battery operated products shall be tested with the battery removed or fully charged if the battery cannot be removed.

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Summary of Proposed Changes

Topic	Test Method – Draft 2	Test Method – Draft 3
Test Signal for products not compatible with IEC format	IEC 62087 Test Signals	VESA FPDM2 L80
USB hub power rating	None	Power adapter of the USB hub shall have a power rating of 5V /2A-3A
Light Measuring Device (LMD) specification	None	Accuracy: 2% (2 digits) of the digitally displayed value Repeatability: 0.4% (2 digits) of the digitally displayed value
Ambient light tolerance levels	10% tolerance for all lux values measured	At 10 lux: 1 lux of nominal value At 100 lux: 5 lux of nominal value At 300 and 500 lux: 9 lux of nominal value

Summary of Proposed Changes (cont'd)

Topic	Test Method – Draft 2	Test Method – Draft 3
Light source	None	100 watt halogen incandescent
On Mode power for ABC enabled products	TBD	Test at 10, 100, 300 and 500 lux Test with ABC disabled and with fixed luminance values
Battery operated devices	None	Test with battery removed. If battery cannot be removed, test with battery fully charged.

Topics for Feedback

- Luminance value for On Mode power testing
  - 65% of manufacturer specified maximum value
  - Luminance value depends on:
    - Test signal used
    - Ambient test conditions
  - May vary from manufacturer to manufacturer

- Would 65% of measured maximum value be more consistent for comparing products in the market?

Topics for Feedback (cont'd)

- USB 3.0 compatible products
- Ambient room lighting levels for On Mode power
- Tolerance levels for ambient light values
- How to generate lighting conditions for ABC enabled product testing?
- On Mode power for products in which ABC cannot be disabled

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Display Type Definitions

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

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.

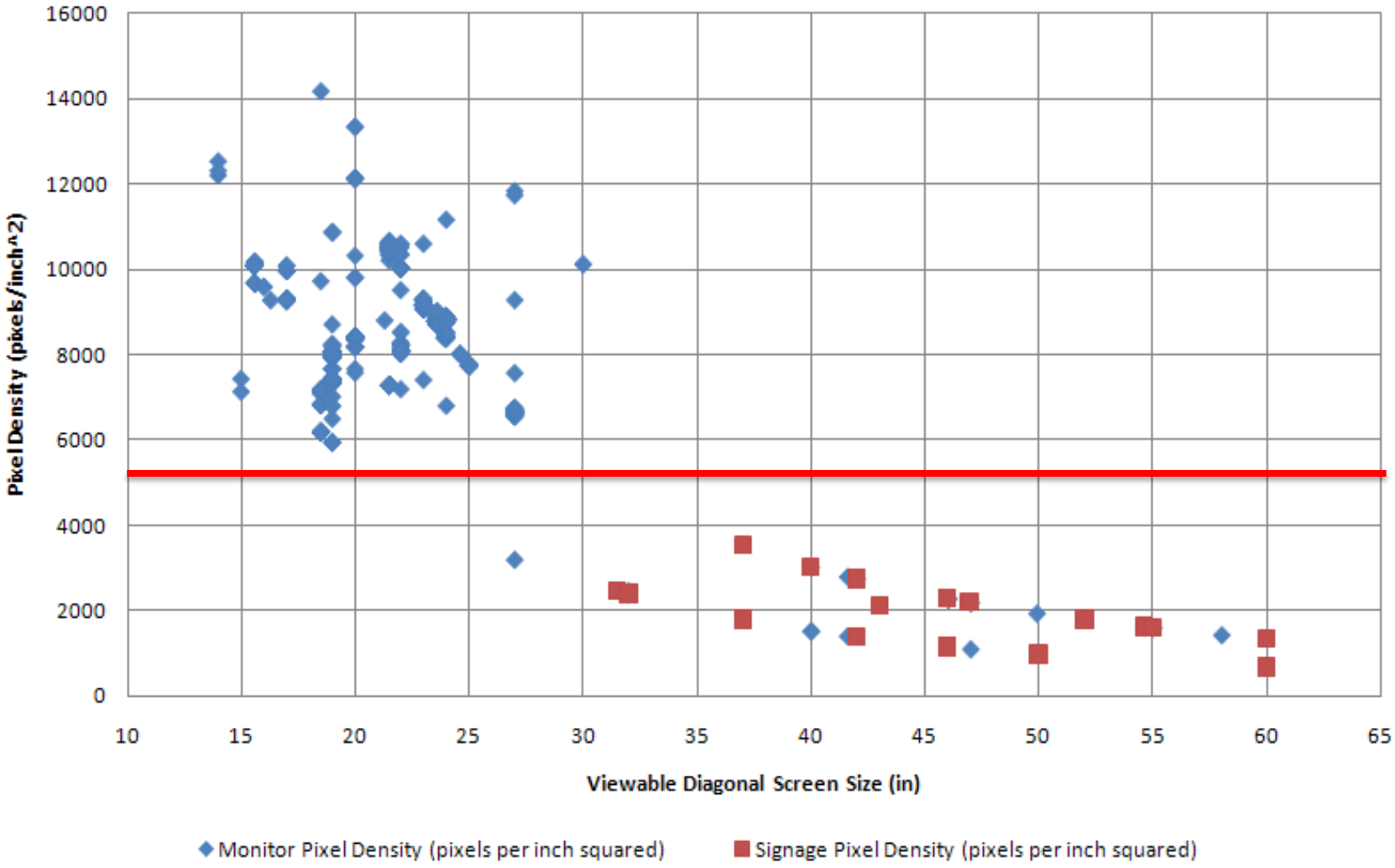
Signage Display: An electronic device typically with a diagonal screen size greater than 12 inches and a pixel density less than 5,000 pixels per square inch (pixels/in^2). It is typically marketed as commercial signage for use in areas where it is intended to be viewed by multiple people in non-desk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

Type	Diagonal Screen Size	Pixel Density
Computer Monitor	≥ 12”	> 5,000 pixels/in^2
Digital Picture Frame	< 12”	N/A
Signage Display	> 12”	< 5,000 pixels/in^2

Factor Analysis

- The largest size ENERGY STAR qualified digital picture frame reported was 10.4”
- The smallest size monitor reported was 12”
- Some signage displays were reported to EPA as monitors, even though they are marketed as signage displays

Pixel Density Analysis



Enhanced-performance displays definition

Enhanced-Performance Display: A Computer Monitor that has all of the following features and functionalities:
(a) A contrast ratio of at least 60:1 at horizontal viewing angles of at least 85°,
(b) A native resolution greater than or equal to 2.3 megapixels (MP), and
(c) A color gamut of at least sRGB (IEC 61699 2-1).

- Stakeholder feedback and data analysis: such products consume more energy; they are intended for specific uses/audiences; they are growing market.
- Extensive outreach to stakeholders for input.
- Harmonized with the draft EU & CSA definition.
- Combination of features in proposed definition makes these products technically distinct from conventional models.
- Very small subset of full dataset (10 models out of ~2000, and only in larger computer monitors).

Sleep Mode Definition

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.

- Sleep mode definition revised to indicate:
  - How the product enters and exits the mode
  - A sample description of product capabilities

- EPA/DOE also seek comment on whether proposed definition for Standby mode from DOE TV TP NOPR would be appropriate for the definition of Sleep Mode for Displays.

Luminance and Illuminance Definitions

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 On Mode preset setting in which the display is brightest, as specified by the manufacturer, for example, in the user manual.
2) Maximum Measured Luminance: The On Mode setting in which the display controls, such as brightness and contrast level, are set to a maximum level.
3) As-shipped Luminance: The factory default preset setting which is selected by the manufacturer for normal home or applicable market use.

Illuminance: The areal density of the luminous flux incident at a point on a surface. Illuminance refers to the ambient light conditions in the environment in which the display is located.

- Proposed definition for max measured luminance based on max settings
- Proposed definition for illuminance included for clarity and harmonizes in part with the draft definition from the CSA

Product Family

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 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.

- To ensure accurate product family composition, the definition includes criteria that must be shared by members of a family, such as:
  - Brand Name
  - Screen Size
  - Resolution

Excluded Products: Displays with Diagonal Size Larger Than 61”

- Not enough data to propose power consumption levels for products larger than 60” – EPA only received data from one manufacturer.

- Based on received data for displays with a screen size of 60.49”, EPA proposes to raise the scope up to 61” to allow qualification of these products

- EPA plans to consider expanding this limit in a future revision once more information becomes available.

Excluded Products:
Zero (Ultra-Thin) Clients and Virtual Clients

- Intended to be covered under the ENERGY STAR Computers specification due to similarities with Thin Clients:
  - Similar to many Thin Clients, these products attribute more power consumption to their integrated display rather than their computational operations
  - Power consumption of additional capabilities, such as compression / decompression, is characteristic of Thin Clients
  - The Computers test method is more applicable

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Power Management

Default Time to Sleep

- In an effort to decrease energy consumption while displays, especially computer monitors, are left on, EPA is interested in establishing a default delay time to sleep requirement.
- Based on stakeholder feedback noting that prescribing a default delay time to sleep may not be applicable to some products, like signage displays.
- EPA proposes to require that manufacturers report the default delay time to sleep for the product. EPA believes this information will be helpful to consumers.

Other energy savings opportunities

Although some stakeholders submitted comments on occupancy sensors and timers, EPA did not receive enough information on power savings associated with occupancy sensors, timers or other emerging power management technologies. EPA will continue to research their use to gauge potential energy savings for possible future integration with the specification.

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Dataset and Proposed On Mode Power for computer monitors 12”-30”

- Dataset includes Version 5.1 ENERGY STAR qualified Display models and non-ENERGY STAR qualified models from Partners available in August 2011 (~ 2000 models) to provide full market representation for computer monitors.

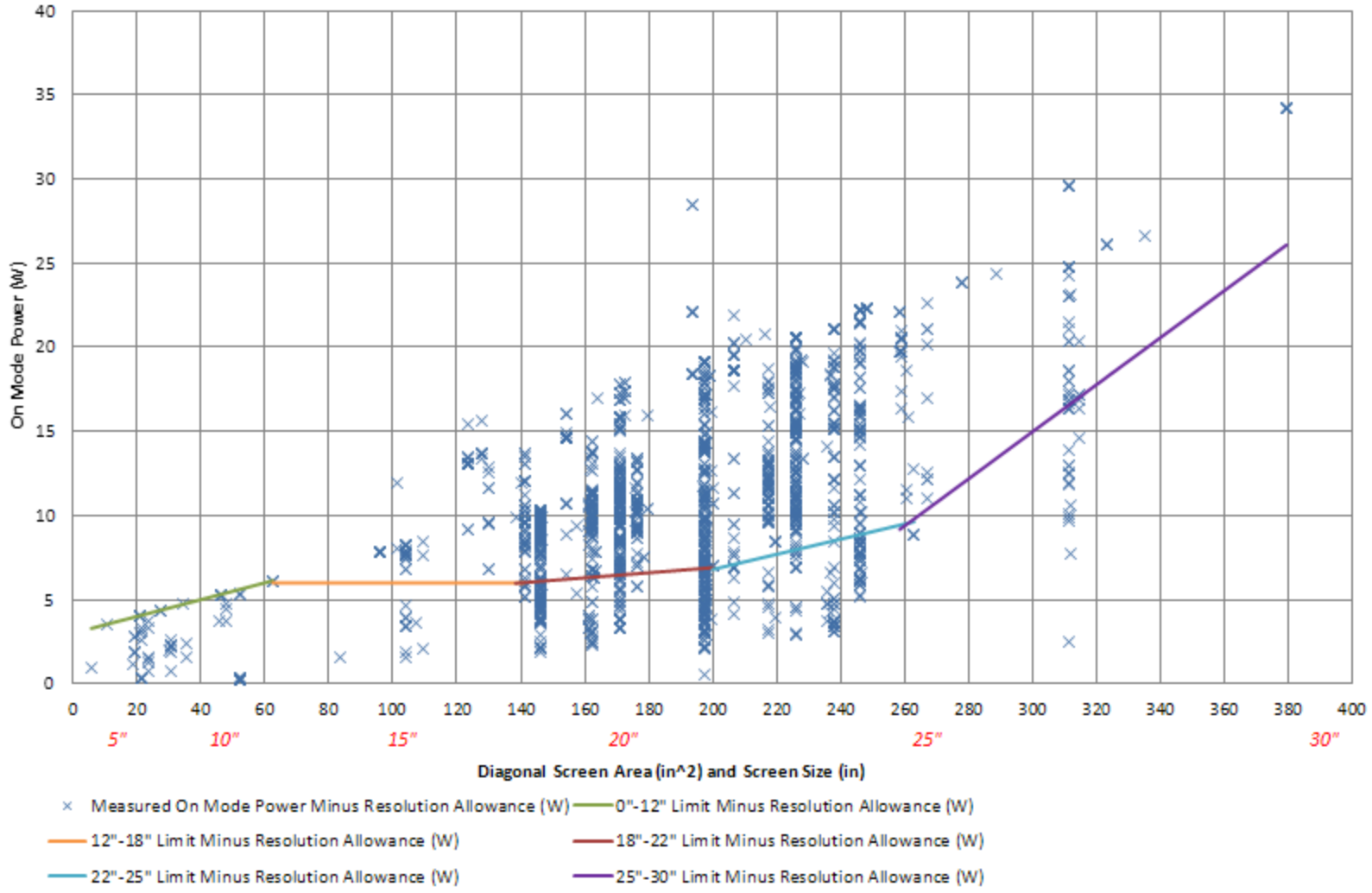
- The most popular sizes today are in the 18”-25” size bin. Most opportunity for energy savings.
  - Data indicates higher investments made in energy efficiency at 18-<25” (i.e. some 18” and 21” models are more efficient than smaller 15” and 17” models).

- Stakeholder feedback and re-evaluation of qualified products shows that further binning products in the 12”-25” size range would more effectively capture top performing products, especially among popular sizes.

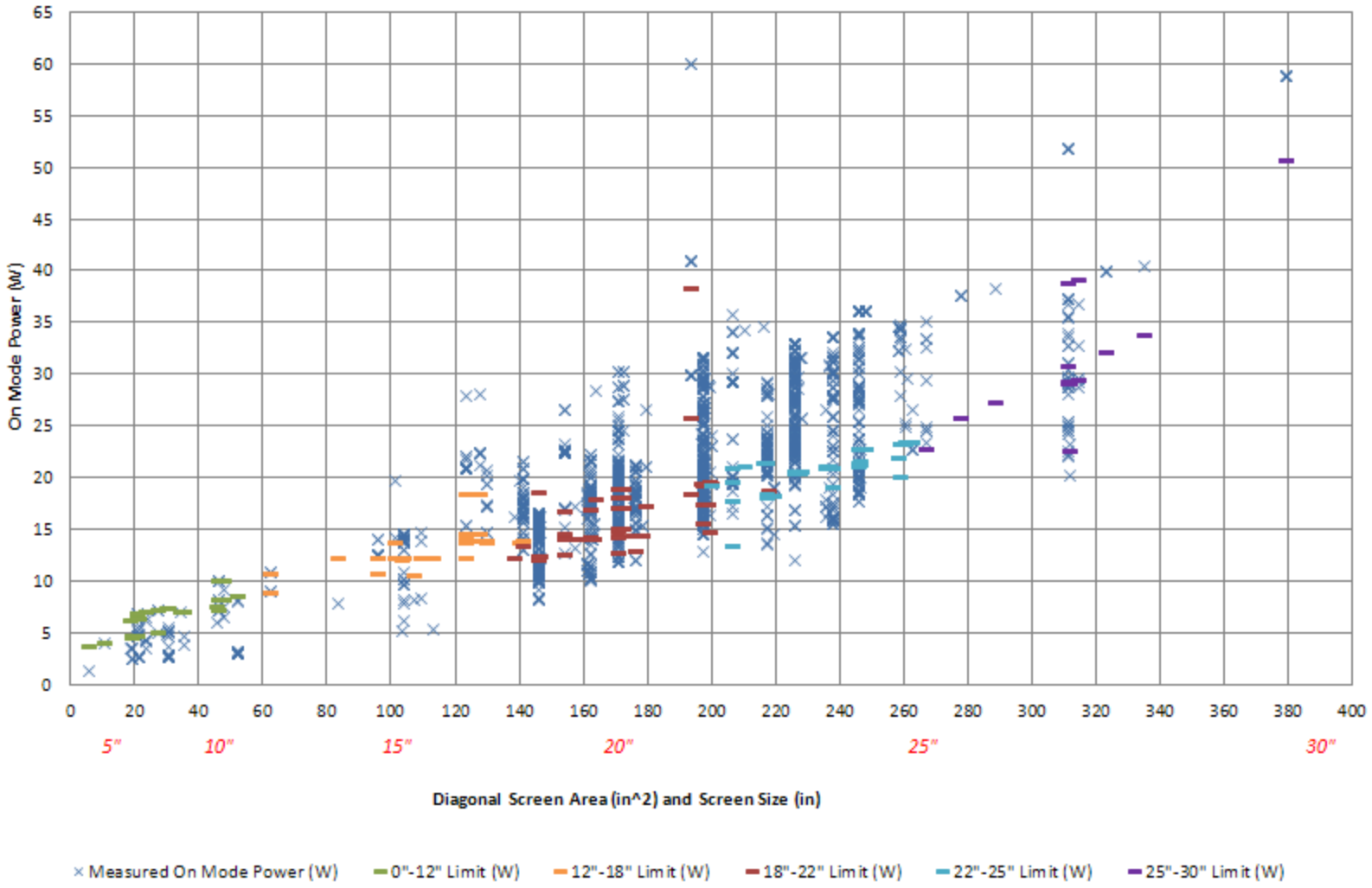
- The proposed levels capture a good selection of products across all major sizes at a cost-effective price from most major Displays Partners.

** Equations remain the same from Draft 2 (same as Version 5.1 levels) for digital picture frames and signage displays, where ENERGY STAR has low market penetration.

On Mode Power for 0”-30” with Resolution Subtracted



Actual Spread of On Mode Power for 0”-30”



On Mode Equations

Product Type and Diagonal Screen Size, *d* (inches)	$P_{ON\ MAX}$ (watts) *Where:* ▪ *r = Screen resolution in megapixels* ▪ *A = Viewable screen area* ▪ *The result shall be rounded to the nearest tenth of a watt*
$d < 12.0$	$(6.0 \times r) + (0.05 \times A) + 3.0$
$12.0 \leq d < 18.0$	$(6.0 \times r) + 6.0$
$18.0 \leq d < 22.0$	$(6.0 \times r) + (0.015 \times A) + 3.9$
$22.0 \leq d < 25.0$	$(6.0 \times r) + (0.045 \times A) - 2.2$
$25.0 \leq d$	$(6.0 \times r) + (0.14 \times A) - 27.0$
$30.0 \leq d \leq 61.0$ *(for products meeting the definition of a signage display only)*	$(0.27 \times A) + 8.0$

- A total of 6 size bins.

Proposed On Mode Power for Computer Monitors vs. Signage Displays

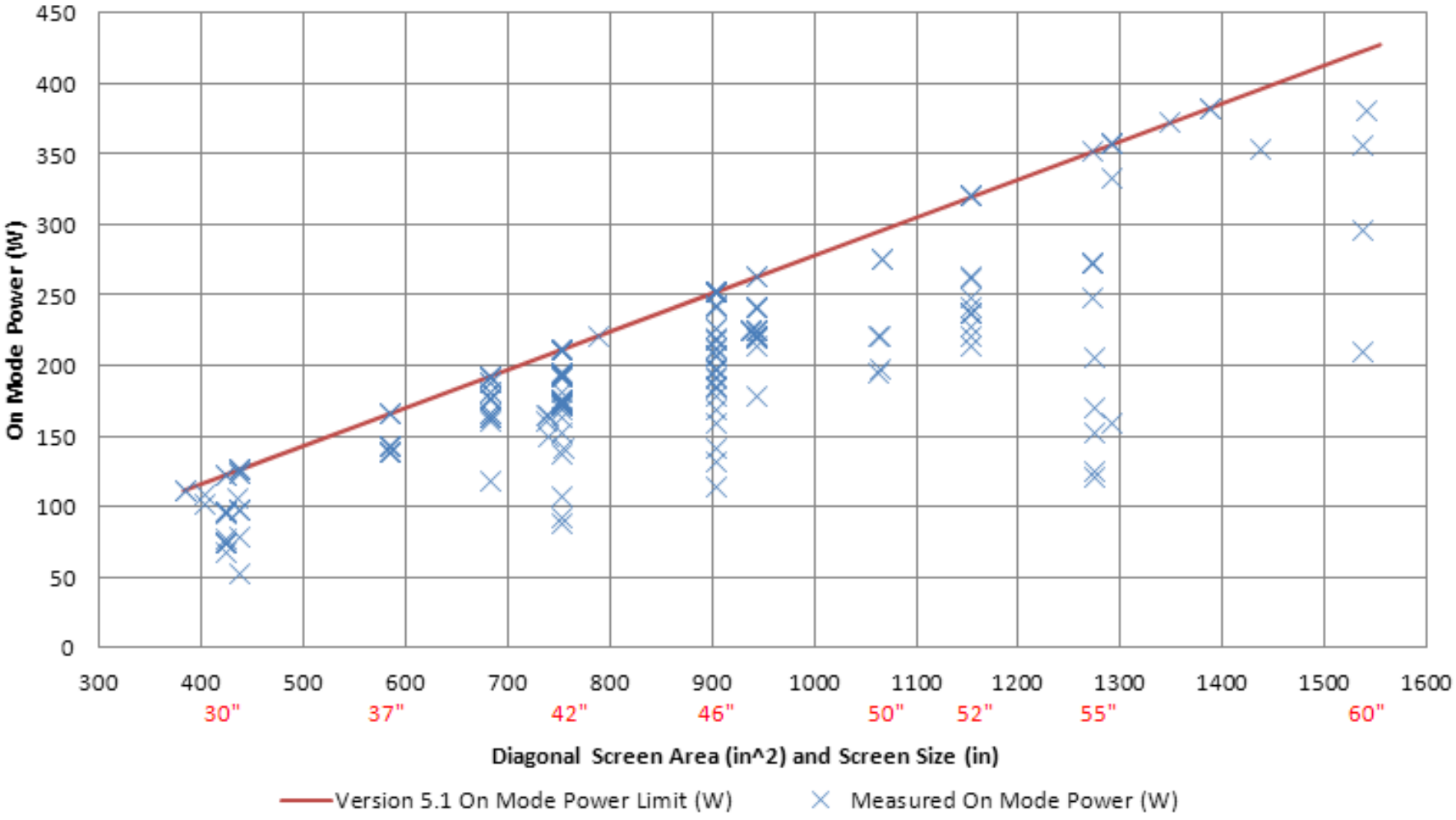
- EPA is proposing a slight modification to the binning of monitors and signage to guard against computer monitors just over 30” being granted a threefold increase in power allowance.

- 26 products in the ENERGY STAR dataset are between 30”-32”, most of which are signage. Though computer monitors over 30 inches appear to currently represent a small share of the market, it is possible that they may become more popular in the near future.

- EPA is proposing that the On Mode power equation be extended to cover computer monitors over 25 inches in diagonal screen size.

- As noted previously, EPA does not intend to modify the On Mode power allowance for displays with diagonal sizes 30 inches to 61 inches. EPA proposes that those limits pertain only to products that meet the proposed signage display definition, and not to computer monitors.

On Mode Power for 30”-61”



Screen Resolution

If the product screen resolution (r) is more than 4.096 MP, then the screen resolution (r) used for the Maximum On Mode Power Requirement (P_{ON_MAX}) calculation shall be 4.096 MP.

- The highest reported product resolution in EPA's dataset was 4.096 MP
- EPA thus only has sufficient data to set a resolution coefficient (watts/megapixel) of 6 W/MP up to 4.096 MP
- The resolution adder of the equation for products with resolution above 4.096 MP will be: $\left(\frac{\quad}{\quad}\right)$

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Requirements for Eligibility

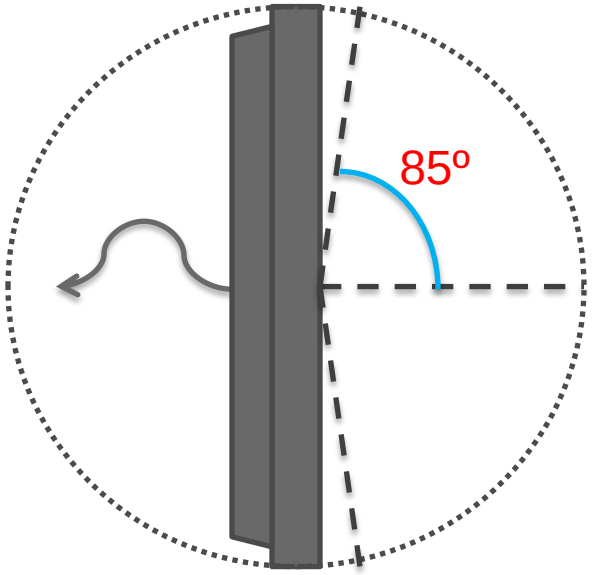
Contrast ratio of at least 60:1 at horizontal viewing angles of at least 85

+

Native resolution greater than or equal to 2.3 megapixels (MP)

+

Color gamut of at least sRGB (IEC61699 2-1)



- EPA used draft definitions from other international standards as a foundation
- Most stakeholders agreed that the contrast ratio measurement at 85º is appropriate given bezel interference and measuring device accessibility
- Data submitted by stakeholders shows that a 60:1 contrast ratio at 85º distinguishes enhanced-performance displays from the rest

Data Analysis

- The dataset was compiled based on recently submitted data as well as qualified product data
- The few models that lacked data for contrast ratio at 85º were assumed to meet the contrast ratio requirement
- 10 models in the dataset met the proposed requirements
- 6 manufacturers were represented
- All 10 models had screen sizes 24” or 27”
- The power consumption of similar models varied significantly

Adder & Request for Feedback

- EPA proposes an adder to the calculated On Mode power limit in order to account for additional power consumption due to enhanced capabilities

- This adder P_{EP} would be calculated as 20% of the On Mode power limit for the display. Adder is based on data analysis of products that meet the proposed definition of enhanced-performance displays.

- EPA seeks stakeholder feedback on the additional power consumption required for the enhanced capabilities, particularly for models from 2010, 2011, and current and future models

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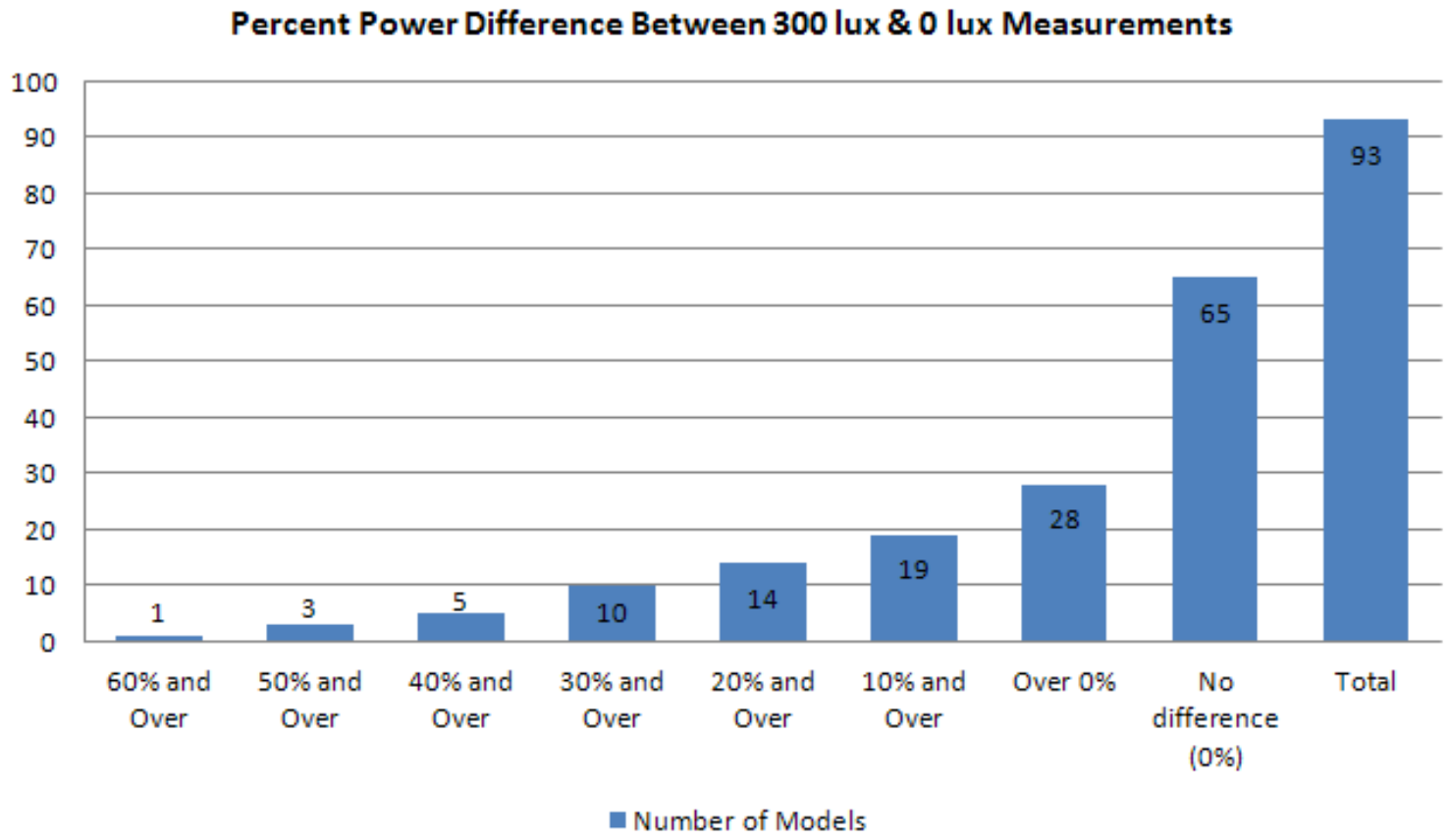
Proposed ABC Approach

- Only 4% of current ENERGY STAR qualified displays are shipped with ABC enabled.
- To improve the current ABC qualification method, EPA proposes modified ambient light levels for testing and an adder for shipping with ABC enabled.

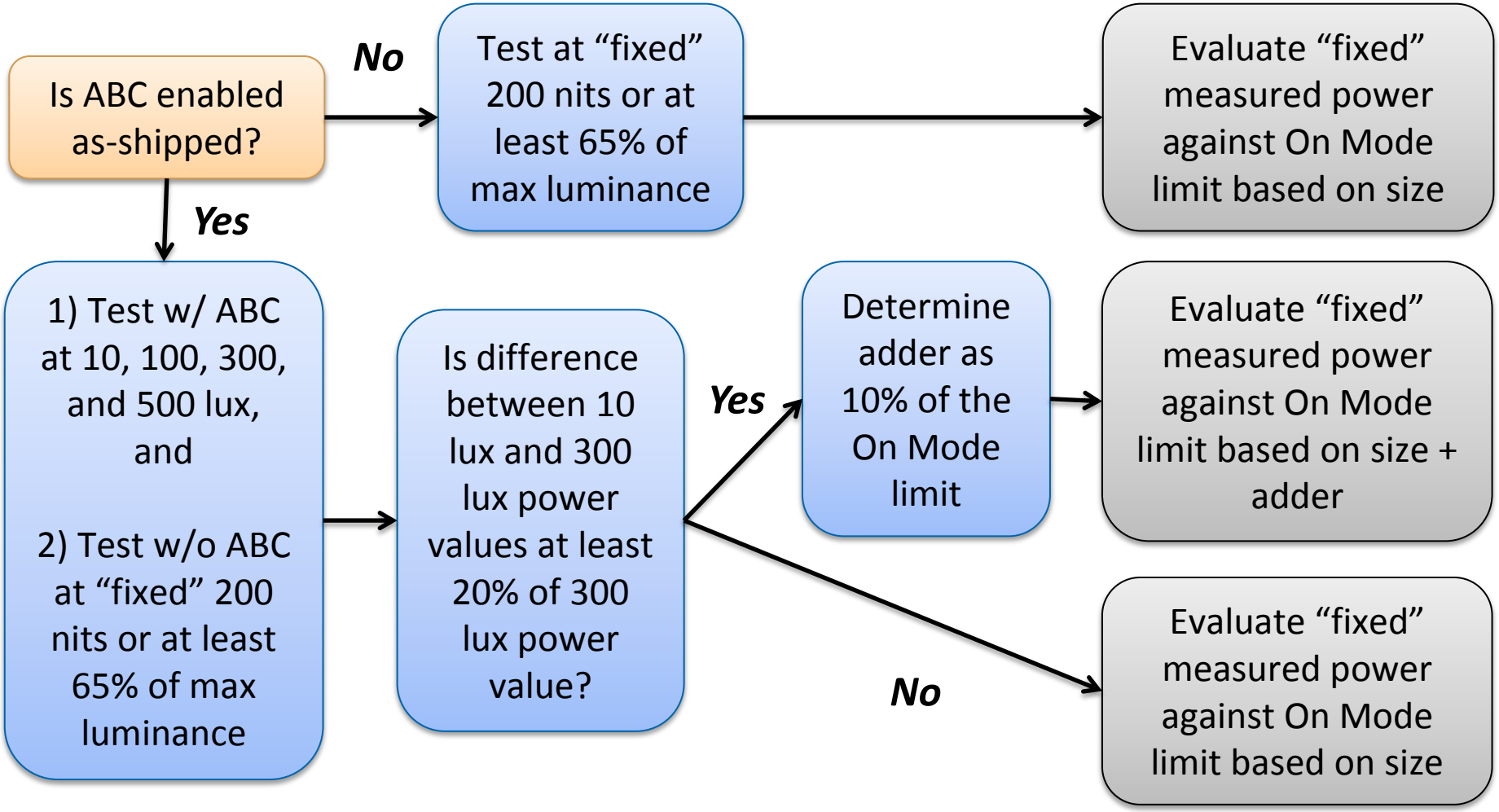
- EPA's goals:
  - Incentivize the use of ABC in displays for energy savings potential.
  - Test displays at ambient light levels that better reflect real-world use.
  - Keep ABC approach flexible to allow for more understanding of how ABC is implemented until more data is available.

Current Version 5.1 ABC Data



- Most products that qualified with ABC enabled as-shipped do not reduce power consumption from 300 lux to 0 lux

Proposed ABC Approach



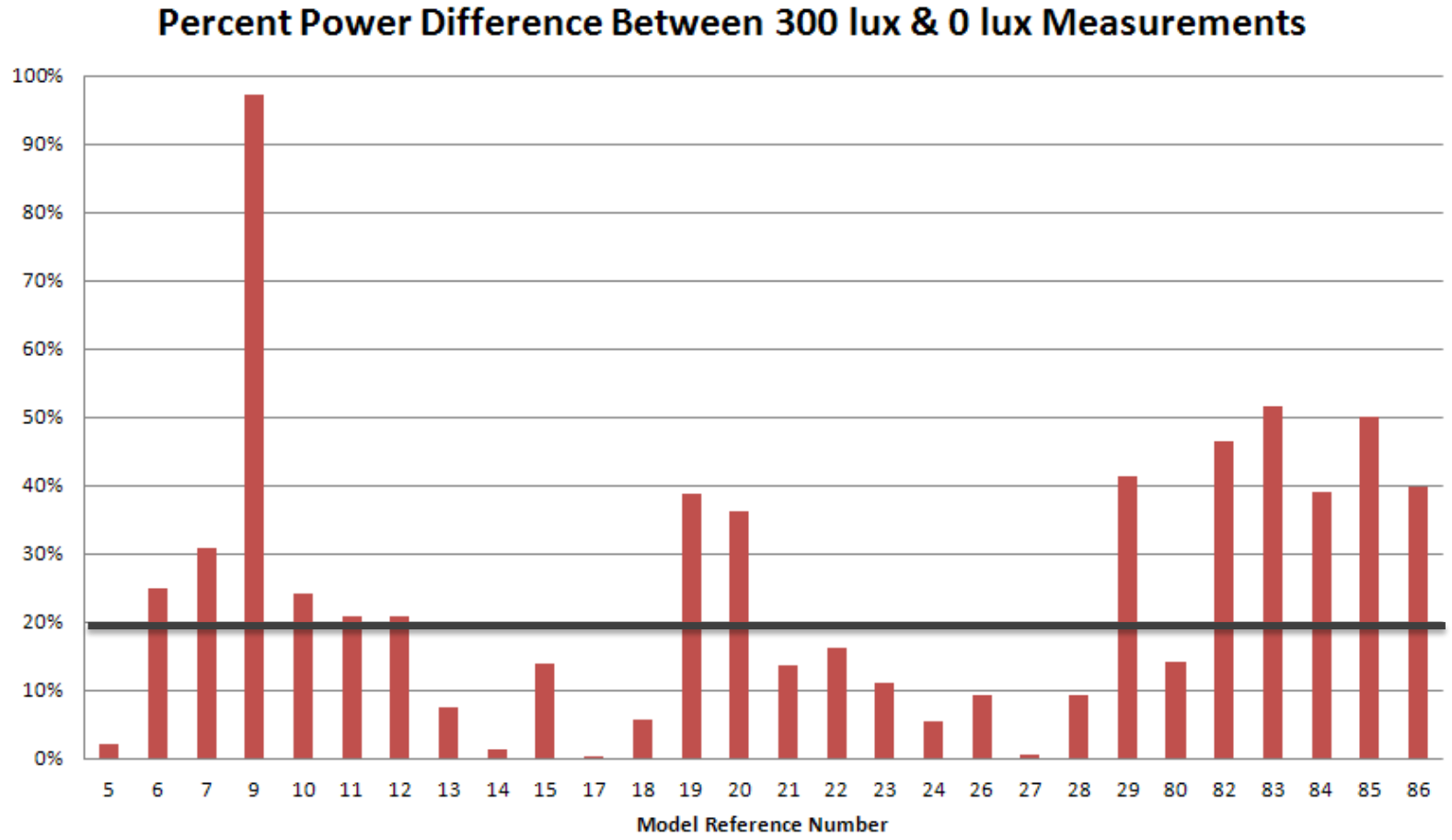
Proposed ABC Approach

- Analysis of qualified data and additionally submitted data indicates scaling of power reduction according to the screen size, i.e., the watt reduction is larger for larger screen sizes.

- Therefore, both the ABC power reduction requirement (20%) and the ABC adder (10%) are percentages to account for this scaling.

- EPA believes 20% is a viable power reduction requirement, from 300 lux to 10 lux, that ensures meaningful energy savings.

20% Reduction



- After filtering out models that did not reduce power consumption, 14 out of 28 models showed power reduction by 20% or more

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9	Non-Energy-Use Requirements
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Sleep Mode Adders

- For products with capabilities that require additional power in Sleep Mode, such as data or networking connections, EPA proposes to provide an adder according to the capability. Adder values were determined based on data submitted by stakeholders. Only one of the following adders may be applied for data or networking capabilities:

Capability	Included Types	P_{DN} (watts)
Wired	Fast Ethernet, USB 1.x	0.1
	Gigabit Ethernet, USB 2.x	0.5
	DisplayPort, Thunderbolt, USB 3.x	0.7
Wireless	Wi-Fi	2.0

- The following adders may be applied only if the capability remains active in Sleep Mode, and thereby continues to consume power::

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

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Non-Energy requirements

- ENERGY STAR: differentiating products based on energy efficiency only.
- Many ENERGY STAR product specifications (e.g. lighting) incorporate non-energy requirements. This reflects longstanding practice of ensuring that ENERGY STAR products deliver on consumer expectation for quality.
- In developing these requirements, EPA seeks to avoid associating the ENERGY STAR label with poor-quality or otherwise undesirable products.
- For Version 6.0 Displays drafts, EPA drew from existing standards for toxicity and design for recyclability.

Non-Energy requirements

Response to Stakeholder Feedback in Draft 3

- Clarified that non-energy requirements are exempt from third-party certification process.
- Clarified that non-energy requirements are not intended for international adoption and that when products are sold in countries other than US, they are not subject to proposed non-energy requirements.
- Added exemptions for toxicity harmonized with RoHS Directive where applicable to Displays. EPA seeks feedback on whether additional exemptions apply to displays.
- F-GHGs: EPA is exploring alternative, near term approaches to address F-GHG emissions reductions outside the scope of the specification process.
- Packaging: Due to lack of measureable criteria and information on how definitions for sustainable packaging could apply specifically to displays, EPA has removed the requirement.

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Next Steps

- Submit comments by **March 9, 2012** via email to:
  - displays@energystar.gov

Contact Information

Verena Radulovic, EPA
Radulovic.Verena@epa.gov

Christopher Kent, EPA
Kent.Christopher@epa.gov

Bizhan Zhumagali, ICF International
BZhumagali@icfi.com

Ashley Armstrong, DOE
Ashley.Armstrong@ee.doe.gov

Bryan Berringer, DOE
Bryan.Berringer@ee.doe.gov

Akshay Odugoudar, Navigant
Akshay.Odugoudar@navigant.com

Thank You