ENERGY STAR®
Version 8.0 Draft 1 Displays Stakeholder Webinar

May 7, 2018

James Kwon, U.S. Environmental Protection Agency

Jeremy Dommu, U.S. Department of Energy

ENERGY STAR Products Labeling Program

EPA   U.S. DEPARTMENT OF ENERGY

Webinar Details

- Webinar slides and related materials will be available on the Displays Web page:

  – www.energystar.gov/revisedspecs

  – *Follow link to "Version 8.0 is in Development" under "Displays"*

- Audio provided via teleconference:

  Call in: +1 (877) 423-6338 (U.S.)

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  Code: **198-920** #

  – Phone lines will remain open during discussion

  – Please mute line unless speaking

  – Press *6 to mute and *6 to un-mute your line

Webinar Agenda

Time	Topic
12:00 – 12:15	Introductions
12:15 – 12:30	Draft 1 Version 8.0 Development
12:30 – 1:00	Monitor Requirements
1:00 – 1:30	Signage Displays
1:30 – 1:45	Draft 1 Test Method
1:45 – 2:00	Open Discussion, Next Steps

Introductions

James Kwon
U.S. Environmental Protection Agency

Jeremy Dommu
U.S. Department of Energy

Amit Khare
ICF

Rachel Unger
ICF

Matt Malinowski
ICF

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The ENERGY STAR Brand

- ENERGY STAR is an influential brand recognized by over 90% of Americans.

- Approximately half (45%) of U.S. households knowingly purchased an ENERGY STAR labeled product in the past year:
  - Of these purchasers, About three-fourths (74%) report the label as influential in their purchasing decision.
  - Eighty percent of households report they are likely to recommend products that have earned the ENERGY STAR to friends and approximately one-fourth (27%) of these households reported they were "extremely" likely to recommend ENERGY STAR labeled products.

Source: EPA Office of Air and Radiation, Climate Protection Partnerships Division. National Awareness of ENERGY STAR® for 2016: Analysis of 2016 CEE Household Survey. U.S. EPA, 2017.

Version 8.0 Draft 1 Dataset

Over 900 Version 7.0 certified models

- 776 unique monitor models representing a variety of sizes and features
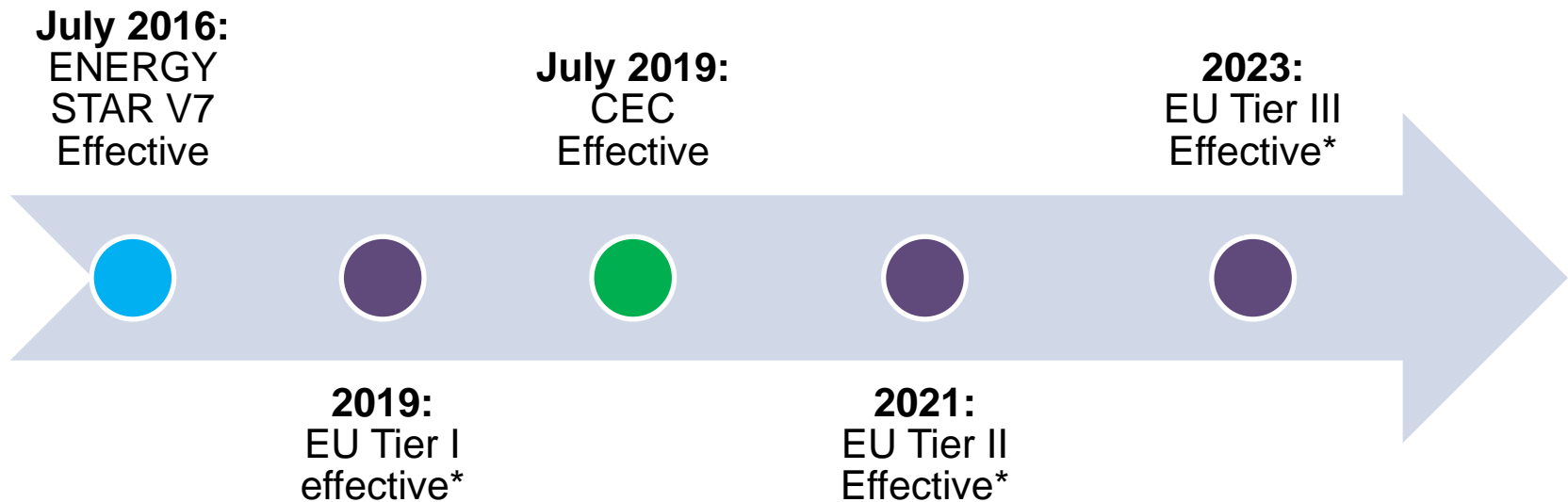- 138 unique signage display models mostly under 60" diagonal screen size

Version 8.0 Goals

- Revise Monitor energy efficiency criteria to continue to recognize top energy efficient Monitors.
  - Market share for ENERGY STAR monitors could be as high as 90% based on 2017 Unit Shipment Data provided by Partners

- Understand if existing criteria is capturing a wide variety of energy-efficient Signage Display models

- Work with U.S. Department of Energy to make clarifications to the existing test method.
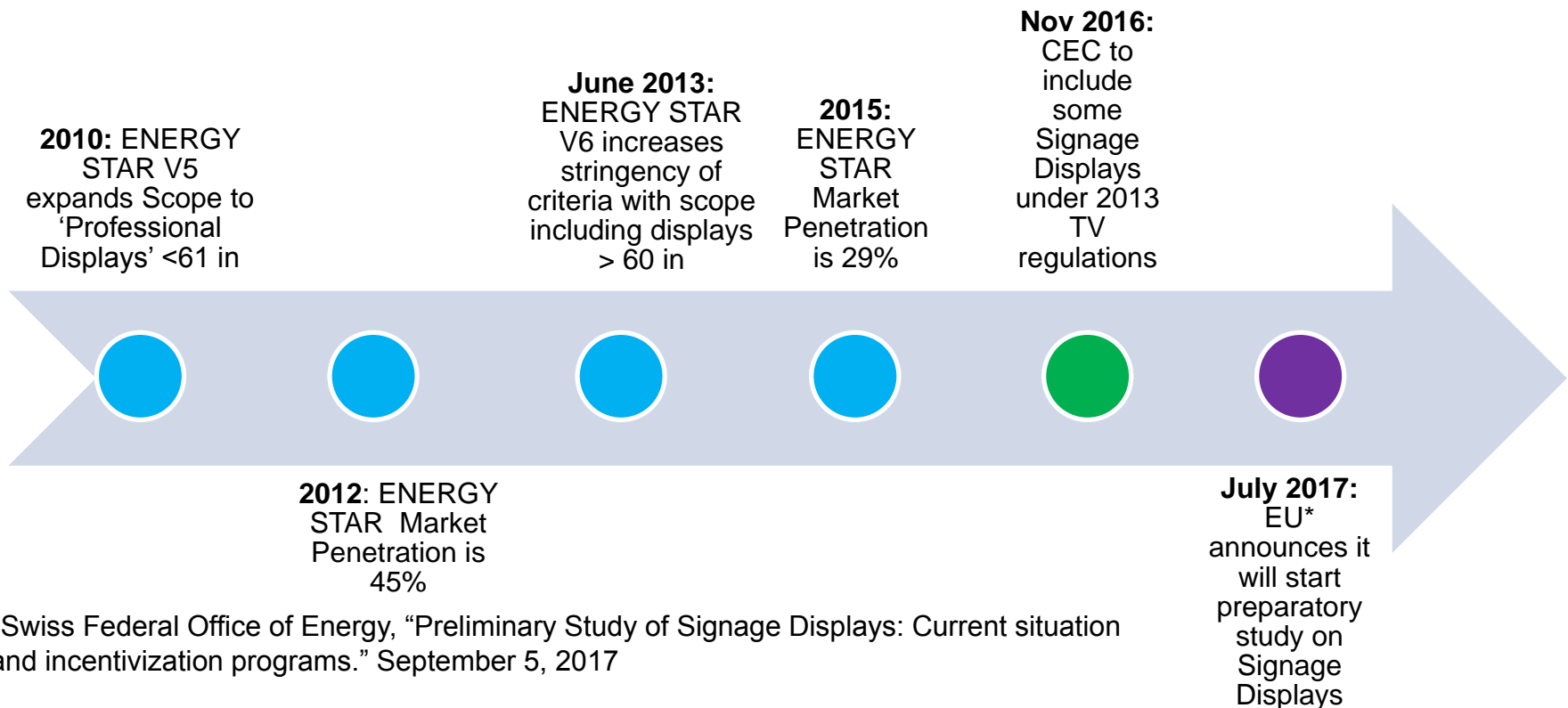
Overview of Monitor Landscape

July 2016:
ENERGY
STAR V7
Effective

July 2019:
CEC
Effective

2023:
EU Tier III
Effective*

2019:
EU Tier I
effective*

2021:
EU Tier II
Effective*

*Draft published in December 2016 with Tier 1, 2, and 3 effective dates of 12, 36, and 60 months after publication of Final (not yet published).

Overview of Signage Displays Landscape

2010: ENERGY STAR V5 expands Scope to 'Professional Displays' <61 in

June 2013: ENERGY STAR V6 increases stringency of criteria with scope including displays > 60 in

2015: ENERGY STAR Market Penetration is 29%

Nov 2016: CEC to include some Signage Displays under 2013 TV regulations

2012: ENERGY STAR Market Penetration is 45%

July 2017: EU* announces it will start preparatory study on Signage Displays
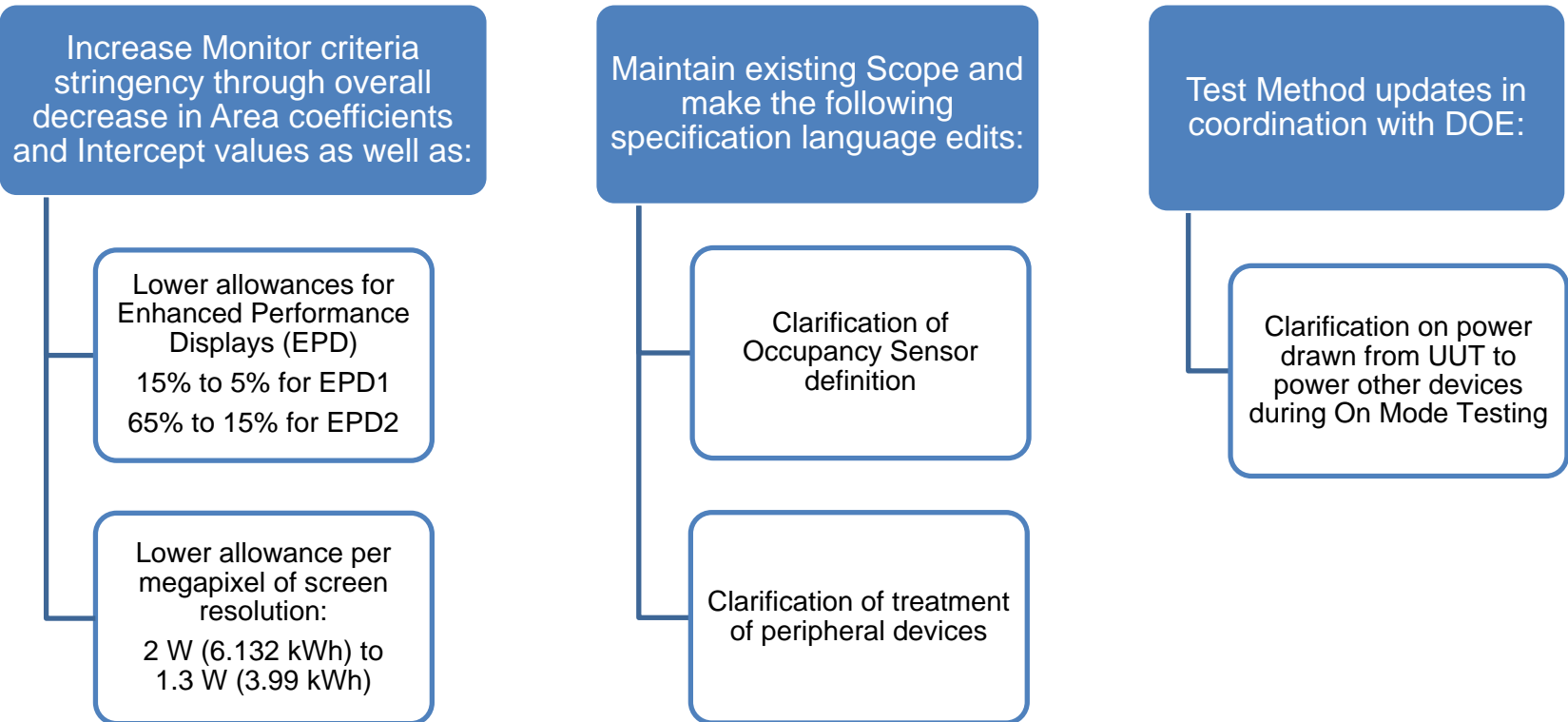
*Swiss Federal Office of Energy, "Preliminary Study of Signage Displays: Current situation and incentivization programs." September 5, 2017

Signage Displays are not currently subject to any energy efficiency requirements in the EU.

Overview of V8 Draft 1 Changes

Increase Monitor criteria stringency through overall decrease in Area coefficients and Intercept values as well as:

Lower allowances for Enhanced Performance Displays (EPD)
15% to 5% for EPD1
65% to 15% for EPD2

Lower allowance per megapixel of screen resolution:
2 W (6.132 kWh) to 1.3 W (3.99 kWh)

Maintain existing Scope and make the following specification language edits:

Clarification of Occupancy Sensor definition

Clarification of treatment of peripheral devices

Test Method updates in coordination with DOE:

Clarification on power drawn from UUT to power other devices during On Mode Testing

Webinar Agenda

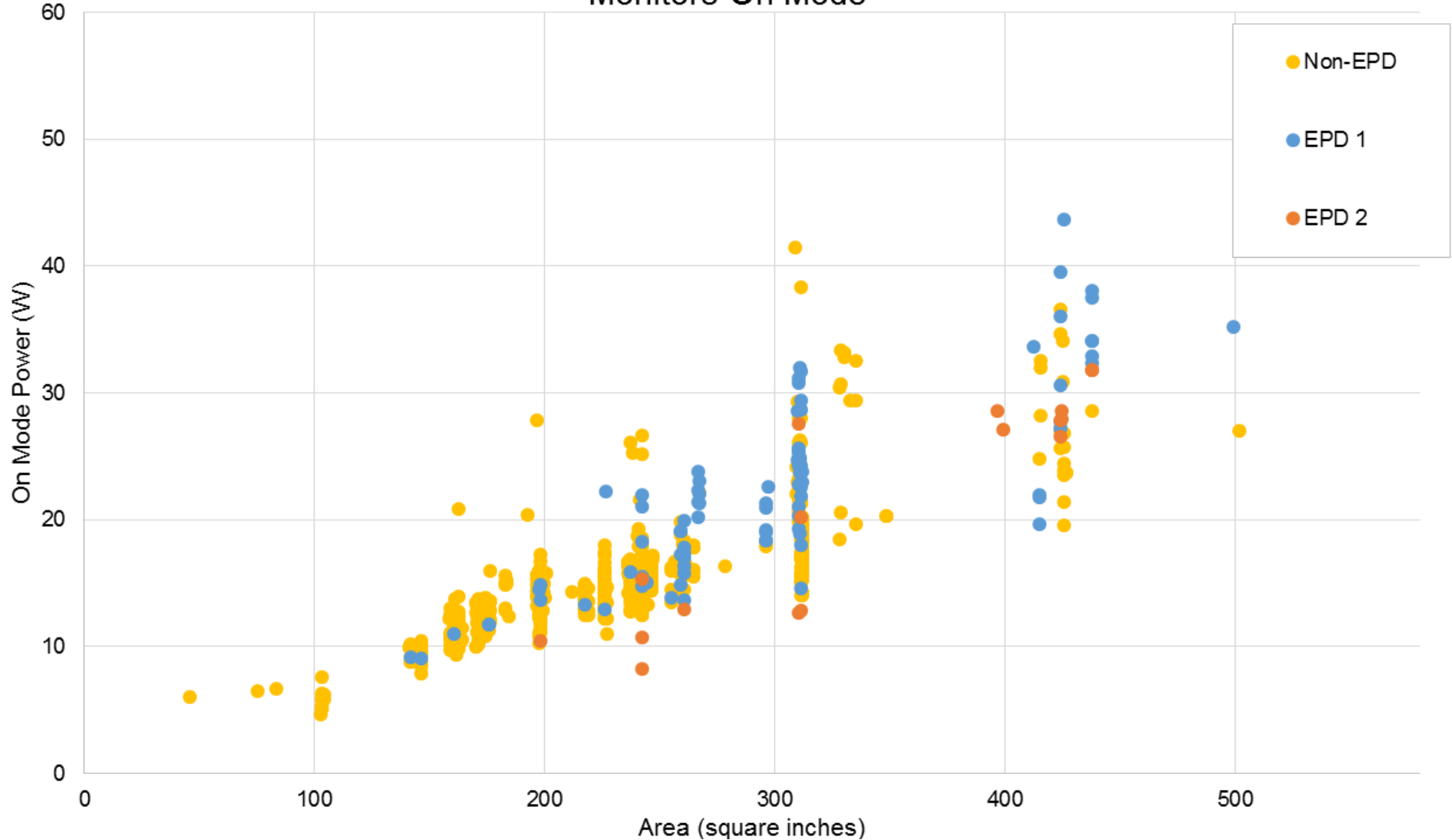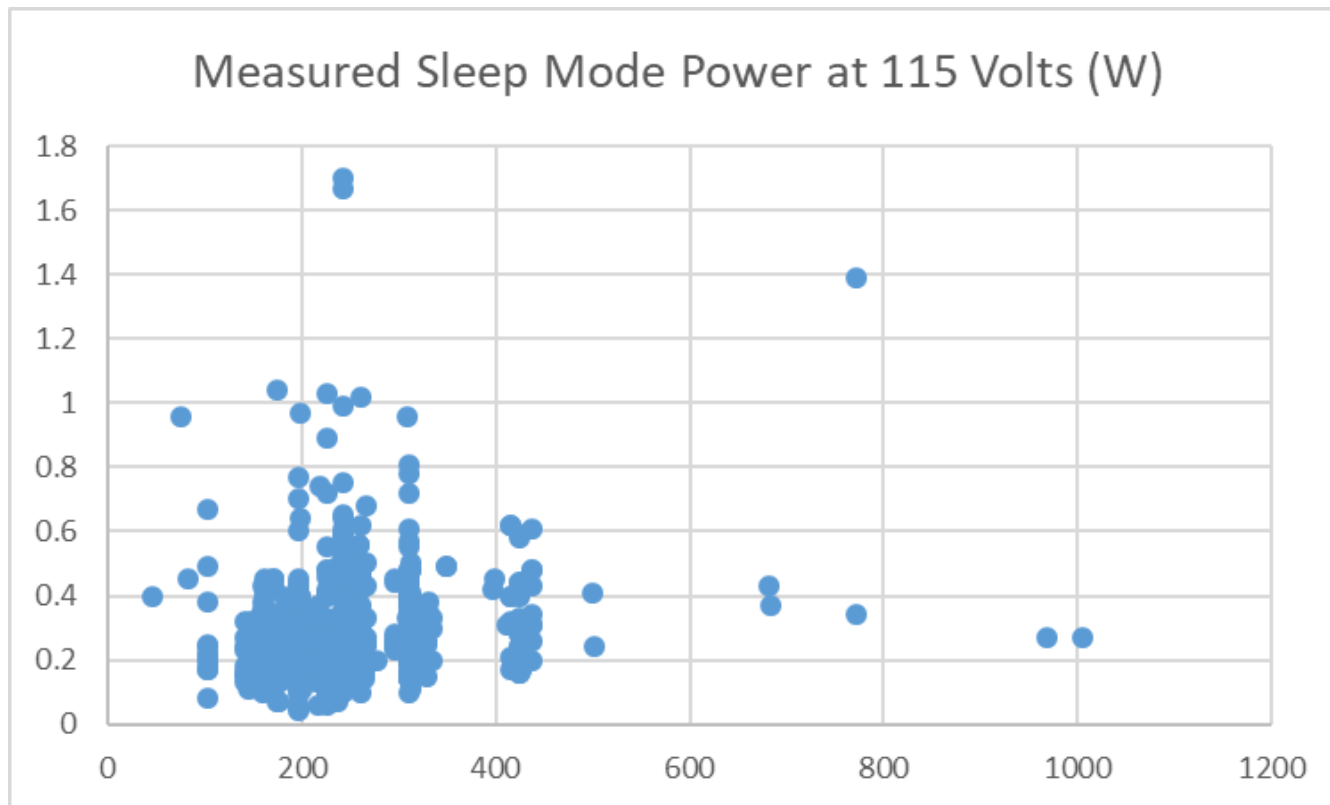| Time	Topic
12:00 – 12:15	Introductions
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1:00 – 1:30	Signage Displays
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MONITORS
Proposed Draft 1 Criteria and Analysis

On Mode Power Overview

Sleep Mode Power Overview

Average Sleep Mode power is 0.28 W with few models exceeding 1 W

Measured Sleep Mode Power at 115 Volts (W)

V8 Draft 1 Total Energy Consumption Base Limit

Resolution allowance (held constant among sizes)

+

Area allowance (held constant among sizes)

+

Intercept (varies by size to achieve balanced pass rate and includes constant equivalent to **0.25 W in Sleep**)

=

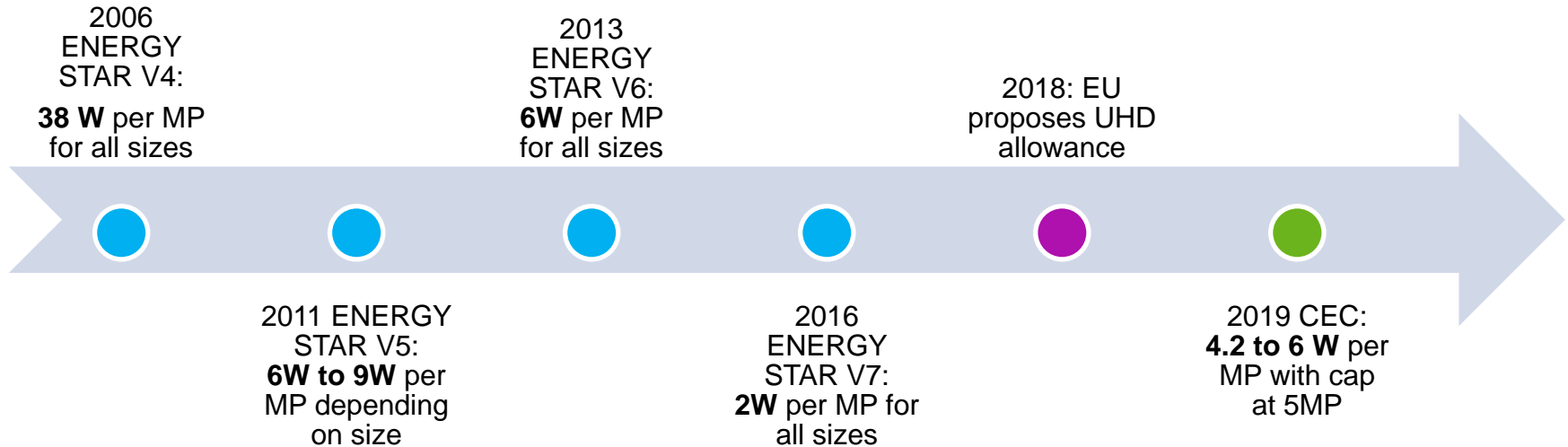**Total Energy Consumption** (35% of time in On Mode & 65% of time in Sleep)
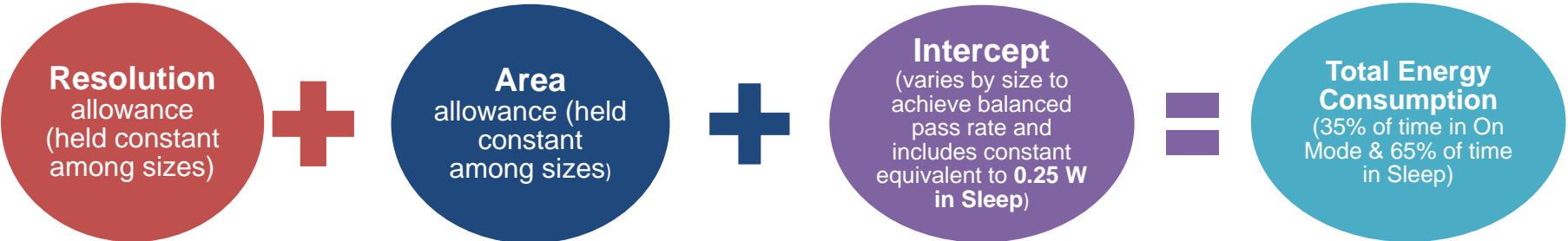
Table 1: Calculation of Maximum TEC (E_{TEC_MAX}) for Monitors in kWh

Diagonal Screen Size Equivalent (in)	Area (in^2)	E_{TEC_MAX} (kWh) Where: A = Viewable screen area in in^2 r = Screen resolution in megapixels The result shall be rounded to the nearest tenth of a kWh for reporting
D < 20	A < 171	$(3.99 \times r) + (0.123 \times A) + 8.78$
20 ≤ D < 23	171 ≤ A < 226	$(3.99 \times r) + (0.123 \times A) + 10.0$
23 ≤ D < 30	226 ≤ A < 385	$(3.99 \times r) + (0.123 \times A) + 8.48$
D > 30	A ≥ 385	$(3.99 \times r) + (0.123 \times A) + 15.5$

TEC Base Limit: Resolution Allowance Summary

2006 ENERGY STAR V4:
38 W per MP for all sizes

2013 ENERGY STAR V6:
6W per MP for all sizes

2018: EU proposes UHD allowance

2011 ENERGY STAR V5:
6W to 9W per MP depending on size

2016 ENERGY STAR V7:
2W per MP for all sizes

2019 CEC:
4.2 to 6 W per MP with cap at 5MP

- Basic multi-regression analysis of Monitors indicates 1.3 W On Mode power demand per MP on average

- V8 Draft 1 proposes **1.3 W** (3.99 kWh) per MP, which achieves even pass rate across low and high resolution models

- No separate allowance required at higher resolutions (no resolution cap)

Total Energy Consumption Limit with Allowances and Adjustment for dc

Equation 2: Total Energy Consumption Requirement for Monitors

$$E_{TEC} \leq (E_{TEC\_MAX} + E_{EP} + E_{ABC} + E_N + E_{OS} + E_T) \times eff_{AC\_DC}$$
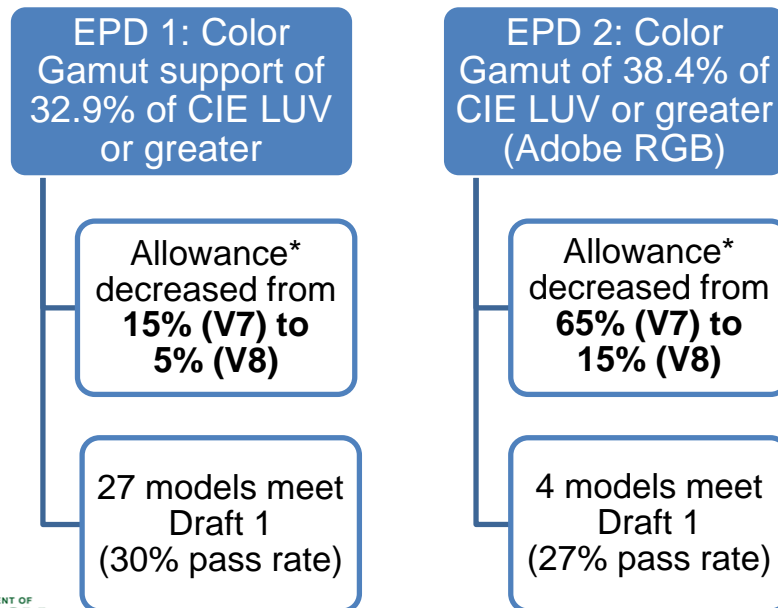
Where:

- E_{TEC} is TEC in kWh calculated per Equation 1;
- E_{TEC_MAX} is the Maximum TEC requirement in kWh calculated per Table 1;
- E_{EP} is the enhanced performance display allowance in kWh per Section 3.3.4;
- E_{ABC} is the Automatic Brightness Control allowance in kWh per Equation 4;
- E_N is the Full Network Connectivity allowance in kWh per Table 3;
- E_{OS} is the Occupancy Sensor allowance in kWh per Table 4;
- E_T is the Touch Technology allowance in kWh per Equation 5; and
- eff_{AC_DC} is the standard adjustment for ac-dc power conversion losses that occur at the device powering the Display, and is 1.0 for Ac-powered Displays and 0.85 for Displays with Standard dc.

Enhanced Performance Display (EPD) Allowances

Version 8 proposes to maintain V7 EPD criteria:

- Contrast ratio of at least 60:1 measured at a horizontal viewing angle of at least 85° from the perpendicular on a flat screen and at least 83° from the perpendicular on a curved screen and

- Screen resolution of MP > 2.3

- EPD 1 and EPD 2 for different tiers of Color Gamut support:

EPD 1: Color Gamut support of 32.9% of CIE LUV or greater

EPD 2: Color Gamut of 38.4% of CIE LUV or greater (Adobe RGB)

Allowance* decreased from **15% (V7) to 5% (V8)**

Allowance* decreased from **65% (V7) to 15% (V8)**

27 models meet Draft 1 (30% pass rate)

4 models meet Draft 1 (27% pass rate)

* For greater simplicity, draft 1 proposes to apply the allowance to the entirety of E_{TEC_MAX}.

Allowances for Monitors Continued

Automatic Brightness Control (ABC)

- For monitors with ABC enabled by default, V8 Draft 1 proposes to maintain the V7 energy allowance (E_{ABC}) of 5%

- EPA reduced the ABC allowance from 10% in V6 to 5% in V7.

- The analysis shows that of products currently qualified with ABC enabled by default, 76% would continue to qualify with 5% ABC allowance.

Energy Allowance for Touch Technology (E_T)

- For products tested with Touch Technology active in On Mode, an allowance of 20% of E_{TEC_Max} is proposed in Version 8. The Touch Technology allowance is 15% in Version 7.

Allowances for Monitors Continued

**Occupancy Sensor Energy Allowance (E_{OS})**

- Version 8 Draft 1 proposes to maintain the V7 allowance constant of 1.7 kWh for Monitors with Occupancy Sensors enabled by default.

- To date, no Monitors report Occupancy Sensor functionality (8 Signage Displays report this feature)

Full Network Connectivity Energy Allowance (E_N)

- For monitors that meet the Full Network Connectivity definition in Sleep Mode, V8 Draft 1 proposes to maintain the V7 allowance (E_N) of 2.9 kWh.

- To date, no Monitors report Full Network Connectivity functionality (59 Signage Displays report this feature)

Draft 1 Monitor TEC Graphical Representation
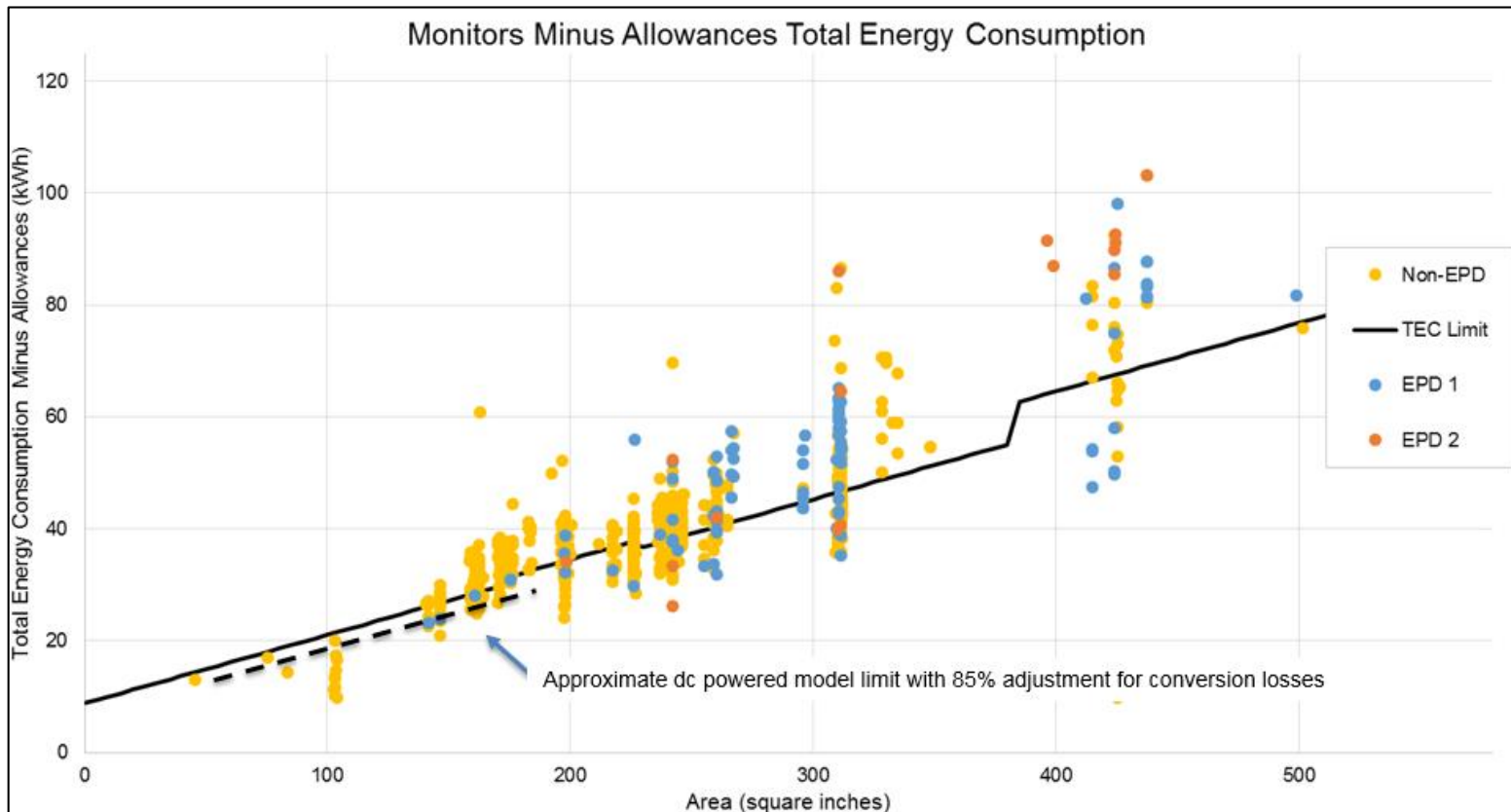
Draft 1 Monitors Pass Rates for Entire Dataset

V8 Draft 1 Criteria Area Bin	Diagonal Screen Size (in)	Total Models in Dataset	# Meeting V8 Draft 1	% Meeting V8 Draft 1
A < 171	d<20	90	32	36%
171 ≤ A < 226	20<=d<23	191	52	27%
226 ≤ A < 385	23<=d<25	279	89	32%
	25<=d<30	166	55	33%
A ≥ 385	30<=d	50	6	12%
	ALL	**776**	**234**	**30%**

Draft 1 Monitors Pass Rates for TOUCH and ABC

- Touch and ABC allowances allows models in the popular mid-size bins to meet the V8 Draft 1 criteria

		TOUCH			ABC	
	Total	# Meeting V8 Draft 1	% Meeting V8 Draft 1	Total	# Meeting V8 Draft 1	% Meeting V8 Draft 1
d<20	4	4	100%	0	0	
20<=d<23	4	1	25%	3	3	100%
23<=d<25	5	2	40%	10	9	90%
25<=d<30	1	0	0%	3	1	33%
30<=d	0	0		1	0	0%
ALL	14	7	50%	17	13	76%

Draft 1 Monitors Pass Rates for EPD 1 and EPD 2

		Total Models in Dataset	# Meeting V8 Draft 1	% Meeting V8 Draft 1
EPD 1	d<20	3	3	100%
	20<=d<23	5	3	60%
	23<=d<25	21	9	43%
	25<=d<30	43	9	21%
	30<=d	17	3	18%
	ALL	89	27	30%
EPD 2	d<20	0	0	
	20<=d<23	0	0	
	23<=d<25	4	2	50%
	25<=d<30	4	2	50%
	30<=d	7	0	0%
	ALL	15	4	27%

Revised EPD allowances for V8 Draft 1 allow for pass rate consistent with total dataset (~30%)

Color Gamut & Other Features

- The Draft 1 Version 8 specification has two separate Enhanced Performance Display allowances based on color gamut:
  - Enhanced Performance Display 1: 32.9% CIE (99% sRGB)
  - Enhanced Performance Display 2: 38.4% CIE (99% AdobeRGB)
  - One stakeholder has suggested EPA use a calculated power allowance function to eliminate abnormal display behavior and account for a continuous range of color gamut performance. EPA welcomes feedback on this proposal and will consider it further in Draft 2

- EPA is also interested in feedback concerning the energy impact of emerging performance features, such as, High Dynamic Range
  - EPA welcomes data and feedback on HDR in the default as-tested display settings.
  - At this time, no updates to the test method that incorporate HDR content are anticipated.

Gaming Monitors

- The proposed California Energy Commission (CEC) regulations effective July 2019 include the allowances for Gaming Monitors.
- EPA currently does not have data regarding this feature and requests feedback on:
  - What are the features that distinguish a gaming monitor from a non-gaming monitor including information on their features, power consumption, and usage patterns?
  - Does the 'gaming monitor' require incremental hardware-based assistance?
  - Is the 'gaming monitor' capable of adjusting refresh rate with the frame rate of video content?

Draft 1 Monitors Pass Rates for LOW and HIGH Resolution

- CEC proposed separate criteria for models below and above 5 MP with resolution cap at 5 MP

- Under the V8 Draft 1 proposal, there is relatively equal pass rate for models below and above 5 MP without a resolution cap at 5 MP

		Total Models in Dataset	# Meeting V8 Draft 1	% Meeting V8 Draft 1
<=5 MP non-EPD	d<20	87	29	33%
	20<=d<23	185	49	26%
	23<=d<25	248	77	31%
	25<=d<30	96	35	36%
	30<=d	21	3	14%
	ALL	637	193	30%
>5 MP non-EPD	d<20	0	0	
	20<=d<23	1	0	0%
	23<=d<25	6	1	17%
	25<=d<30	23	9	39%
	30<=d	5	0	0%
	ALL	35	10	29%

Comparing V8 Draft 1 to CEC and EcoDesign

- The following tables show the pass rate of V8 Draft 1 if the bottom of the market moves up to meet the EU EcoDesign and CEC requirements effective in 2018 and 2019 respectively

  - Pass rate increases by up to 8% as less efficient models exit the market

  - ENERGY STAR continues to remain relevant

V8 Draft 1 Criteria Area Bin	Diagonal Screen Size (in)	Total Models in Dataset	Meets EU 2018	Meets ES and EU 2018	%ES assuming on mode power drops down to EU 2018 level (after July 1, 2018)	Meets EU 2018 and CEC	Meets ES and EU 2018 and CEC	%ES assuming on mode power drops down further to CEC level (after July 1, 2019)
A < 171	d<20	90	87	32	37%	80	32	40%
171 ≤ A < 226	20<=d<23	191	172	51	30%	121	50	41%
226 ≤ A < 385	23<=d<25	279	258	86	33%	204	84	41%
	25<=d<30	166	130	48	37%	129	48	37%
A ≥ 385	30<=d	50	35	4	11%	35	4	11%
	ALL	776	682	221	32%	569	218	38%

Clarification of Occupancy Sensor Definition

- In response to a stakeholder query, EPA is proposing a minor clarification to the definition of Occupancy Sensor:

Section 1D)3) -

Occupancy Sensor: A device used to detect human presence in front of or in the area surrounding a Display.

- Note: An Occupancy Sensor is typically used to switch a Display between On Mode and Sleep Mode by detecting human presence or a combination of human presence and a signaling device such as Bluetooth device.

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SIGNAGE DISPLAYS
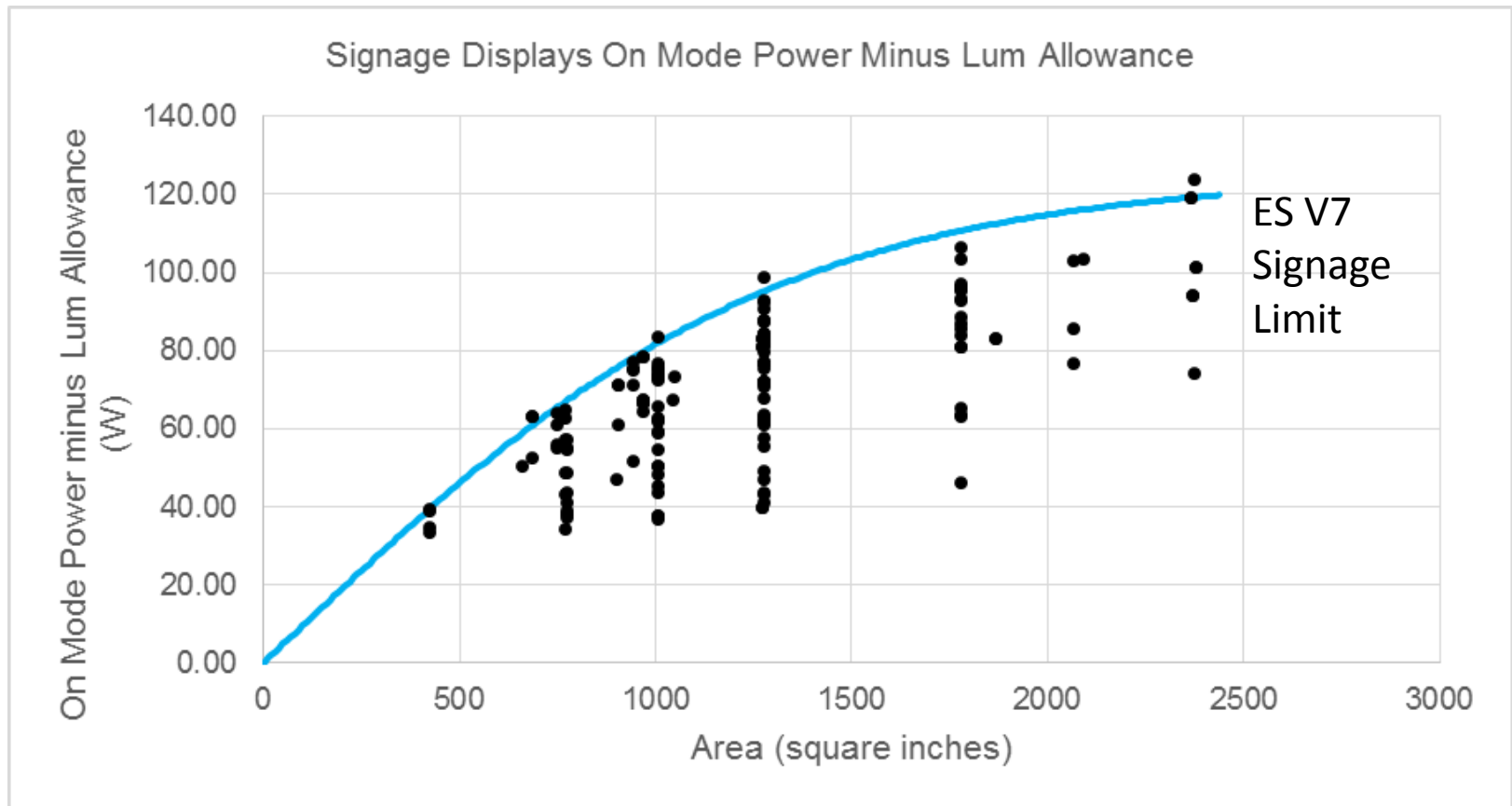## Proposed Draft 1 Criteria and Analysis

Signage Displays On Mode Power V7 Dataset

Signage Displays Current Dataset Continued

Signage Displays On Mode Power Minus Lum Allowance

ES V7 Signage Limit

V7 Signage Display Criteria

- Given low market penetration (13%) of ENERGY STAR signage displays in 2016, V8 Draft 1 proposes maintaining the existing V7 criteria.

- Signage Display V7 criteria are similar to ENERGY STAR TV requirements in the following ways:

  - Requirements expressed in modal power (W) for On Mode and Sleep Mode

  - On Mode limit is a continuous hyperbolic tangent function

  - Signage Display is tested at 65% or greater of manufacturer/brand reported maximum luminance (screen brightness)

- Signage Displays V7 differs from ENERGY STAR TV requirements in the following ways:

  - Does **not include a MP Total Resolution or UHD allowance**

  - Includes a **luminance (screen brightness) allowance** in an effort to accommodate models designed for a variety of environments (dimmer office environments vs. bright retail or outdoor environments)

V7 Signage Display On Mode Requirements

Equation 6: Calculation of Maximum On Mode Power (P$_{ON\_MAX}$) in Watts for Signage Displays

$$P_{ON\_MAX} = (4.0 \times 10^{-5} \times \ell \times A) + 119 \times tanh(0.0008 \times (A - 200.0) + 0.11) + 6$$

Where:
- $P_{ON\ MAX}$ *is the Maximum on Mode Power, in watts;*
- *A is the Screen Area in square inches;*
- ℓ *is the Maximum Measured Luminance of the Display in candelas per square meter, as measured in Section 6.2 of the test method;*
- *tanh is the hyperbolic tangent function; and*
- *The result shall be rounded to the nearest tenth of a watt for reporting.*

Equation 7: On Mode Power Requirement for Signage Displays

$$P_{ON} \leq P_{ON\_MAX} + P_{ABC}$$

Where:
- P_{ON} *is On Mode Power in watts, as measured in Section 6.3 or 6.4 of the Test Method;*
- $P_{ON\ MAX}$ *is the Maximum On Mode Power in watts, per Equation 6; and*
- P_{ABC} *is the On Mode power allowance for ABC in watts, per Equation 8.*

- P$_{ABC}$ allowance is 5% for models with ABC that can reduce On Mode power by 20%

Size and Brightness in Draft 1 Dataset

Diagonal (in)	Total	Dataset
<48	36	26%
48>=d<56	72	52%
>=56	30	22%
ALL	**138**	

Luminance	Total	Dataset
<300	72	52%
300<=lum<400	42	30%
>400	24	17%
ALL	**138**	

As-tested luminance

Features in Draft 1 Dataset

Resolution	Total	Dataset
Non-UHD	115	83%
UHD	23	17%
ALL	**138**	

Touch	Total	Dataset
No Touch	125	91%
Touch	13	9%
ALL	**138**	

ABC	Total	Dataset
No ABC	128	93%
ABC	10	7%
ALL	**138**	

Sleep Mode Power Requirements

Equation 9: Sleep Mode Power Requirement for Signage Displays

$$P_{SLEEP} \leq P_{SLEEP_{MAX}} + P_N + P_{OS} + P_T$$

Where:

- P_{SLEEP} is Measured Sleep Mode Power in watts;
- P_{SLEEP_MAX} is the Maximum Sleep Mode Power requirement in watts per Table 5;
- P_N is the Full Network Connectivity allowance in watts per Table 6;
- P_{OS} is the Occupancy Sensor allowance in watts per Table 7; and
- P_T is the Touch allowance in watts per Table 7.

	0.5 W
	3.0 W
	0.3 W
≤ 30 in:	0 W
> 30 in:	1.5 W
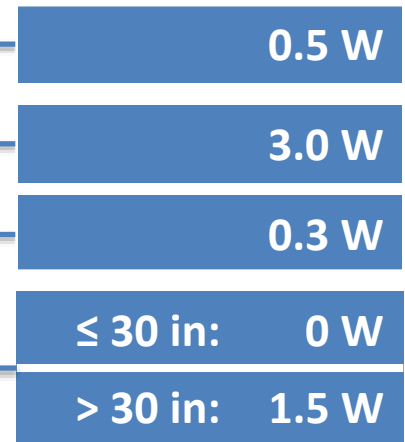
Base Allowance

Sleep Mode Allowances for Signage Displays

Full Network Connectivity Energy Allowance (P_N)

- Same as in Version 7, a full network connectivity allowance (P_N) of 3.0 watts is proposed in Version 8.

Occupancy Sensor Energy Allowance (P_{OS})

- Same as in to Version 7, an occupancy sensor allowance of 0.3 watts is proposed for all screen sizes in Version 8.

Touch Technology (P_T) Allowance

- Same as in to Version 7, for products tested with Touch Technology active in Sleep Mode, a touch allowance (P_T) of 1.5 W is proposed in Version 8.
- The touch allowance is only applicable to signage displays with screen size greater than 30 inches.

Signage Displays Discussion

- What are the most popular screen sizes for various types of applications? And for single display vs. video wall installations?
  - Are there features of video wall installations that need to be considered?

- There is one ENERGY STAR certified signage display model with maximum reported brightness above 800 nits
  - Model has maximum brightness of 3000 nits and is marketed for outdoor environments
  - Does the existing ENERGY STAR criteria recognize a range of energy efficient models including those intended for outdoor environments?

- Does the existing Full Network Connectivity definition and test adequately capture the function of maintaining a network presence while in sleep?
  - In large installations of displays, is it typical for displays to wake and sleep via network command? Are software updates common?

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Peripherals and Network Connections

- EPA and DOE received a question from a stakeholder asking whether speakers are considered peripheral device or not?
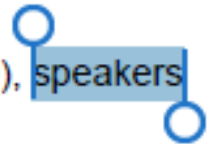
Clarification

- Speakers are included in the list of external peripheral devices in Section 5.2C)1)a).

C) <u>UUT Configuration and Control</u>:

1) <u>Peripherals and Network Connections</u>:

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

Power Drawn from the UUT

- EPA and DOE received a question from a stakeholder asking whether to include power drawn from the UUT during On Mode power measurement

Clarification

- If any device/product, including host machine, draw power from the UUT then the power drawn shall be included in the On Mode power measurement.

On Mode Testing

- EPA and DOE propose additional requirement in Section 6.3A)3) to ensure that the luminance level is maintained during On Mode testing.

Requirement
- At any point during the test if the input were changed from the video content to a three-bar pattern, the luminance, as measured per Section 6.2 but without 10 minute stabilization period, shall not be
  - less than 65% of the manufacturer-reported maximum luminance for signage displays
  - less than 200 cd/m^2 for all other products.
- EPA welcomes feedback on this proposed requirement.

Additional Testing

EPA requests further feedback from stakeholders regarding whether the following changes to settings/software could have an impact on power consumption:

- Manual adjustments of brightness and contrast potentially disabling ABC or changing other picture settings

- Software updates affecting power draw in Sleep Mode or On Mode

EPA is considering additional tests that could measure the impacts of these changes on power draw.

Questions?

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Open Discussion

- DOE and EPA would now like to open up the line for any general comments from stakeholders.

Written Comments

- In addition to making verbal comments during today's call, stakeholders are encouraged to submit written comments to displays@energystar.gov.

Comment Deadline
Monday, May 21, 2018

Specification Development Timeline

- EPA is proposing the following Version 8.0 specification development timeline:

Event	Date
May 21	Draft 1 Comments Due
Summer 2018	Draft 2 Published
October 2018	Final Specification Published
July 2019	Version 8.0 Effective

Contact Information

Please send any additional comments to displays@energystar.gov or contact:

For questions regarding the specification, you may contact James Kwon at Kwon.James@epa.gov or (202) 564-8538.

For questions regarding the test procedures, you may contact Jeremy Dommu at Jeremy.Dommu@ee.doe.gov or (202) 586-9870.

Thank you for participating!

www.energystar.gov/productdevelopment