ENERGY STAR Computers v8

ITI Industry Presentations

Washington DC, June 18, 2019

EPA Agenda

ENERGY STAR. The simple choice for energy efficiency.

Agenda for Today

9:30 – 9:45	Introductions
9:45 – 11:30	Discussion of Categorization, Base TEC, and Allowances
11:30 – 11:45	Break
11:45 – 12:15	Full Network Connectivity
12:15 – 12:30	Energy Efficient Ethernet
12:30 – 1:00	Lunch
1:00 – 1:30	Internal Power Supplies
1:30 – 2:30	Resume Time & Testing Implications
2:30 – 3:00	Test Method & Notebook Recertification
3:00 – 3:15	Version 8.0 Schedule
3:15 – 3:30	Closing Remarks
3:30 – 4:00	Parking Lot

Discussion of Categorization, Base TEC and Allowances

Stephen Eastman - Intel

ITI Proposal for DT/AIO Category and Adders

Major Findings

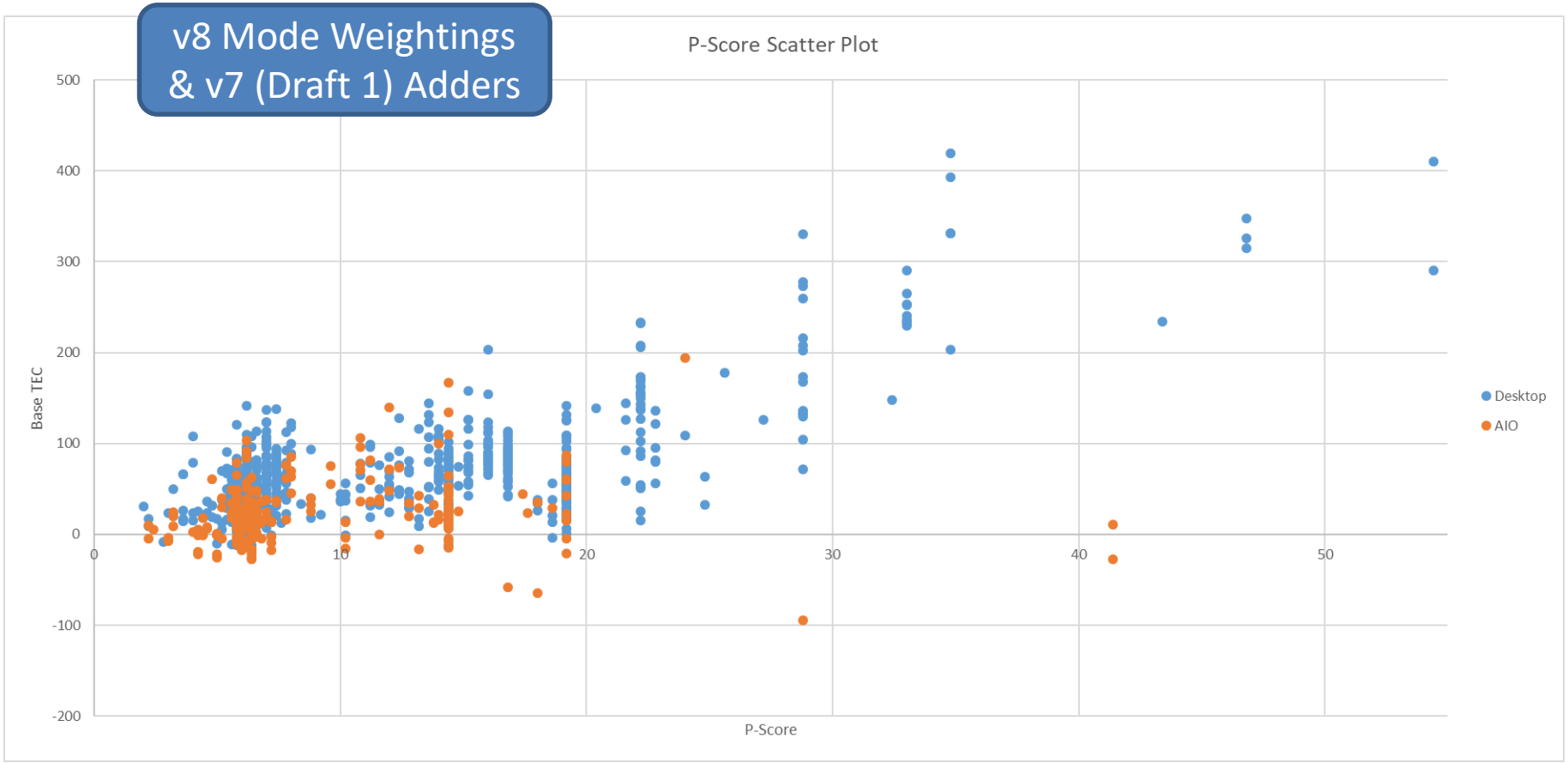
- ITI looked at 5 different category options during this analysis
  - Final proposal is 6 categories for Desktops & Integrated Desktops
- Biggest conclusion is that Integrated Desktops should be in their own category
  - The majority of Integrated Desktops computers today use a mixture of Notebook and Desktop components
- TEC Adders needed to be adjusted to the new V8 Mode Weightings

Database updates

- Found some discrepancies for how systems were categorized from EPA
  - 6 systems show discrete Graphics, but list switchable
  - 3 systems are in the wrong category because of P Score
  - 3 systems are in Desktop but have Display information and Model information has word “Touch” should be Integrated Desktop
  - Under CEC Data, there was 48 data points that had duplicate power values even with different model numbers, these data points need to be removed
- All systems moved to fixed category for ITI Analysis

Scatter Plot of All DT & Integrated Desktops

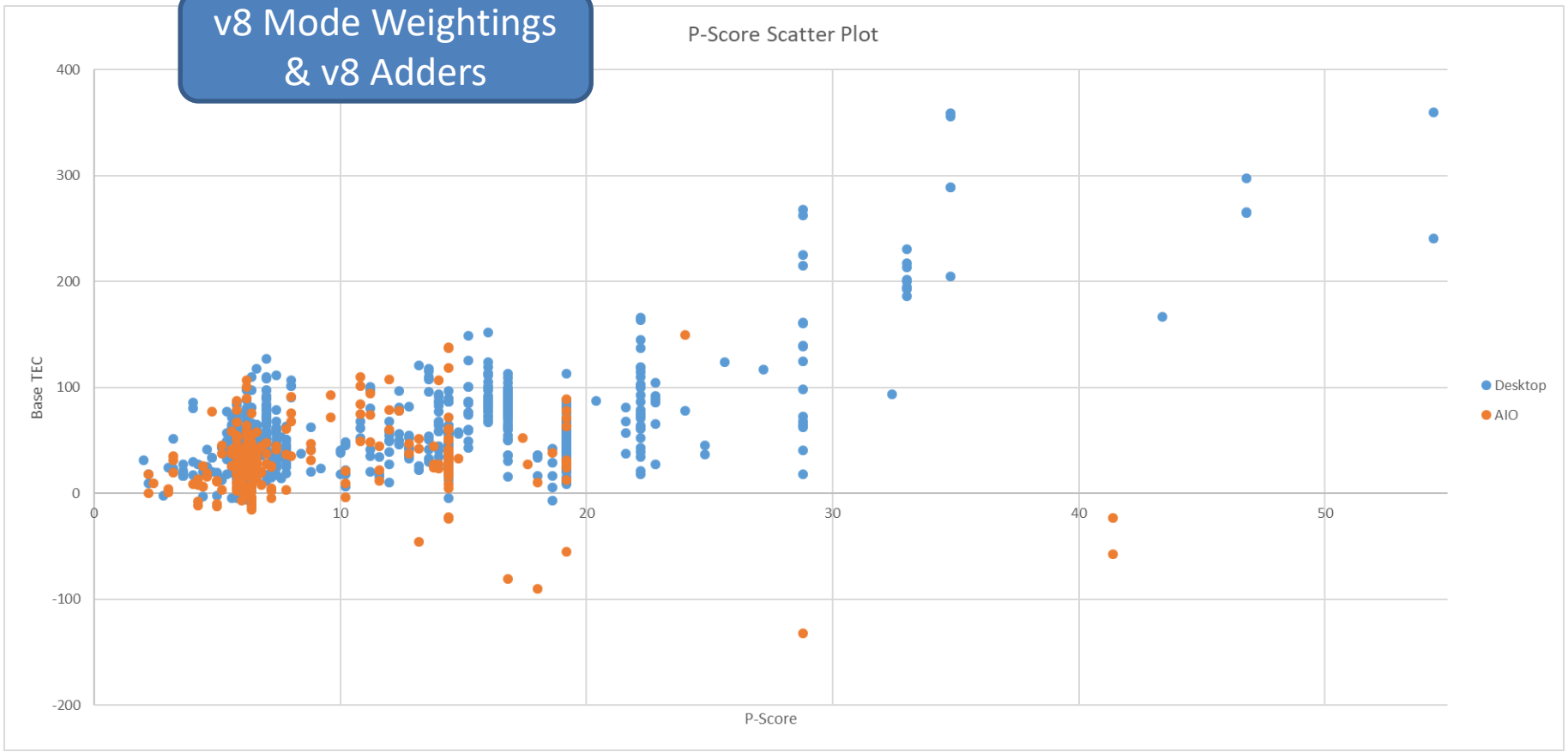
v8 Mode Weightings & v7 (Draft 1) Adders



Data plots shown for ES v8 Draft 1 method

Scatter Plot of All DT & Integrated Desktops

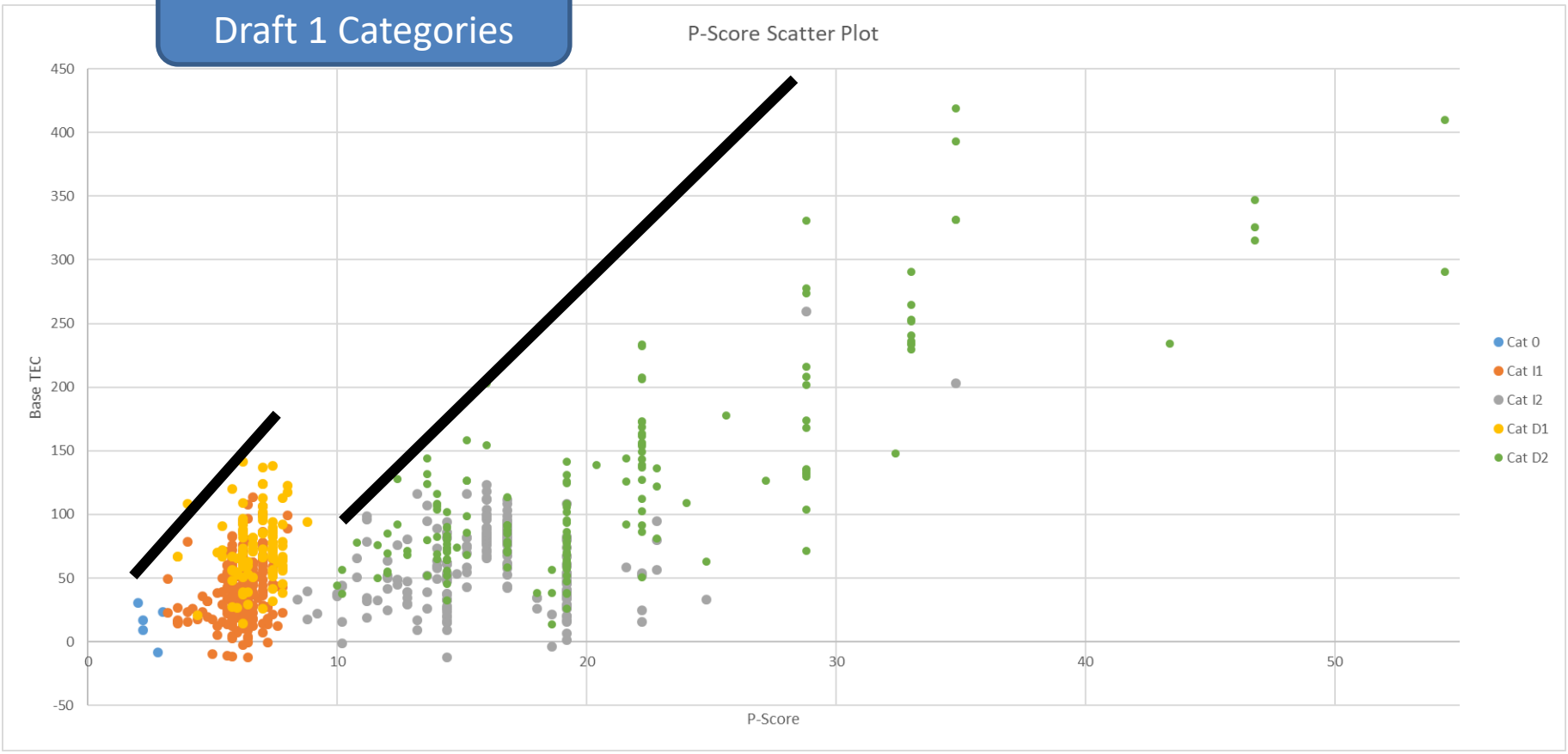
v8 Mode Weightings & v8 Adders



New adders reduces the differences in the 2 groups

Scatter Plot – Categories – DT Only-V8 Adder

Colors Based on ES v8 Draft 1 Categories



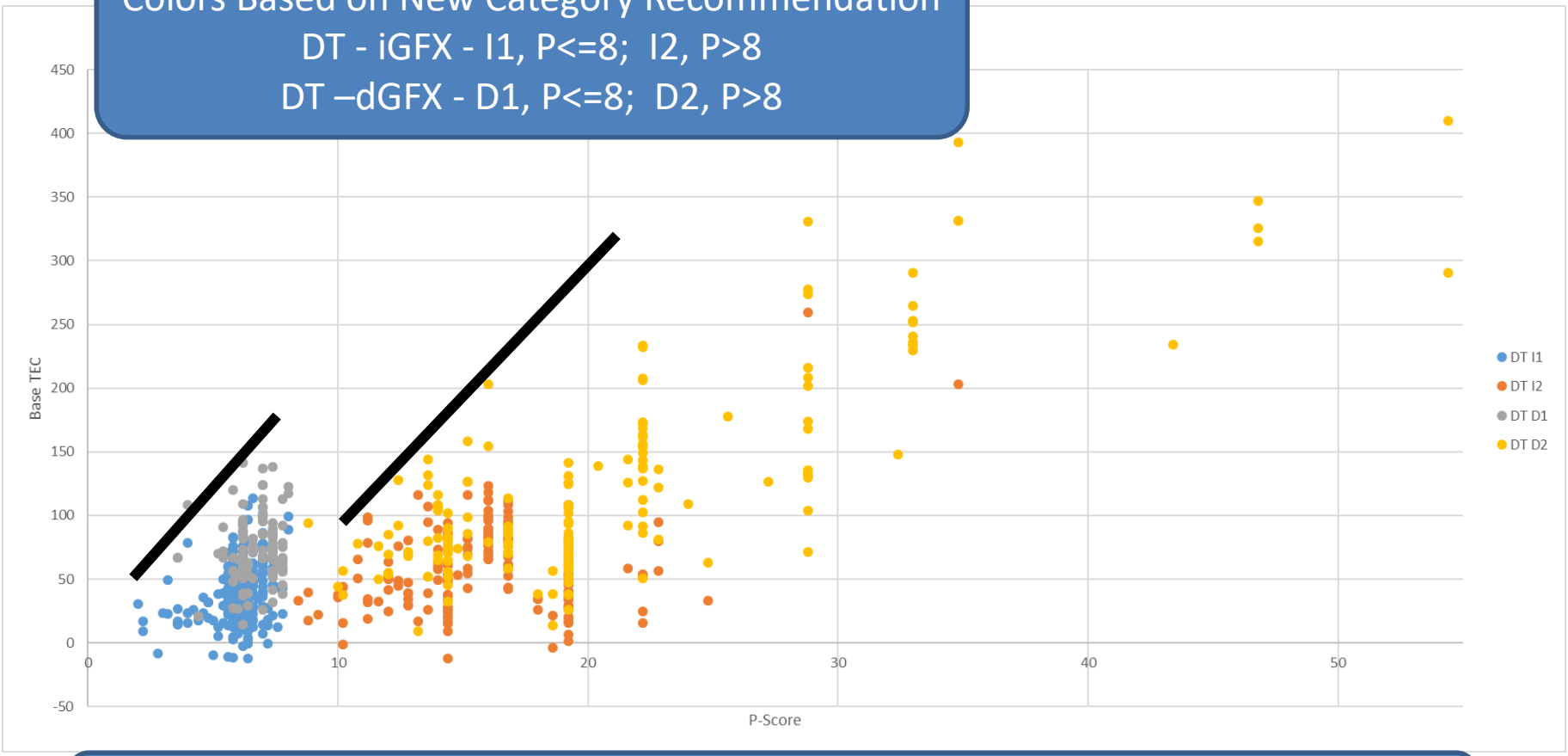
Desktop only shows a much better slope inside each category

Proposed ITI Desktop Categories

- Removed Cat 0 and merged systems into appropriate DT & AIO Category
  - Cat 0 had 10 systems, 5 DT & 5 AIO
  - No longer need Cat 0 for only 5 systems
- Keeping Desktop Categories based on P Score and Graphics type
- Moving Discrete Graphics P Score line to 8, same as Integrated Graphics

Scatter Plot – Categories – DT Only – V8 Adders

Colors Based on New Category Recommendation
DT - iGFX - I1, P<=8; I2, P>8
DT –dGFX - D1, P<=8; D2, P>8

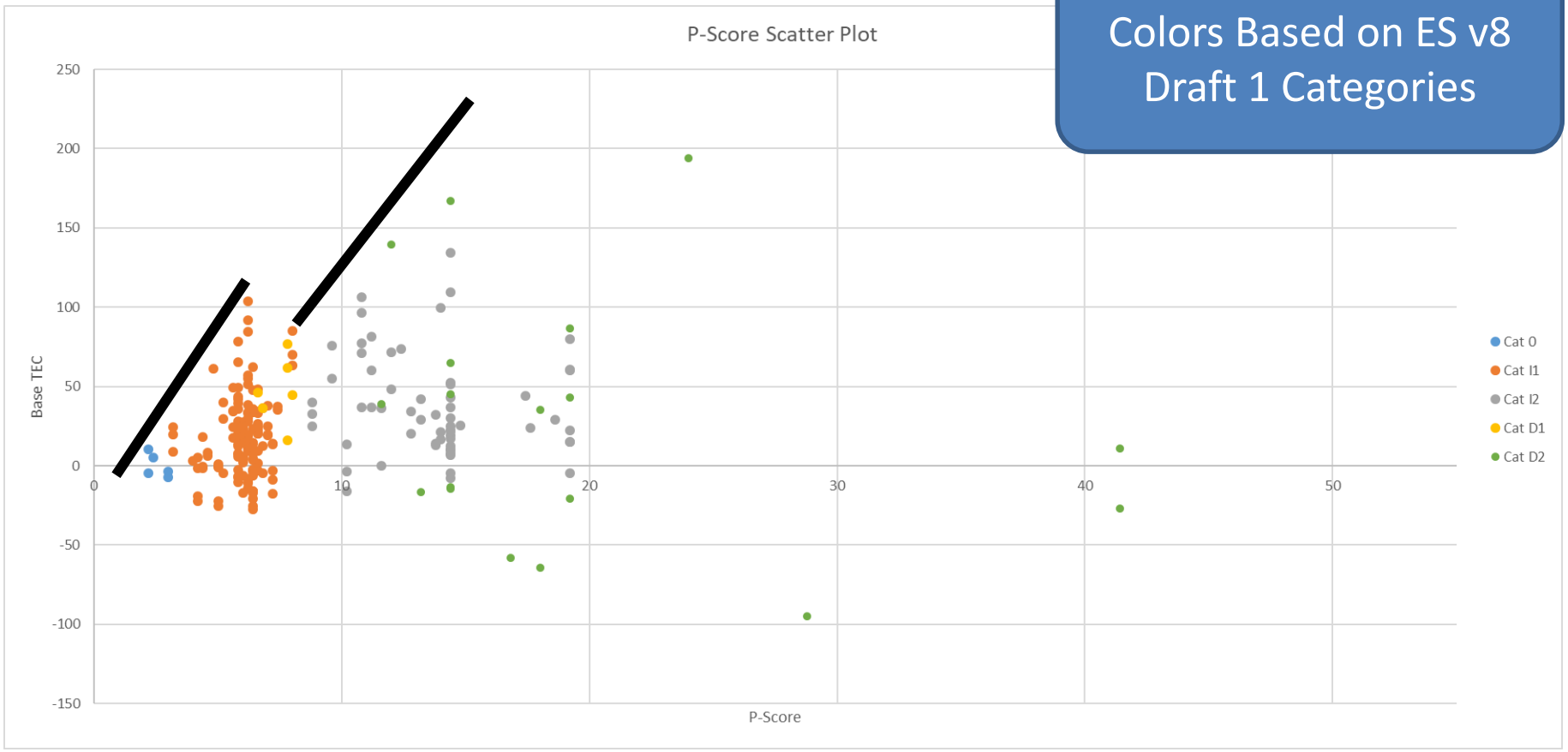


Desktop only shows a much better grouping
& slope inside each category

Next Chart shows Integrated Desktop systems

How Integrated System plot looks

Scatter Plot – Categories – AIO only – V8 Adders



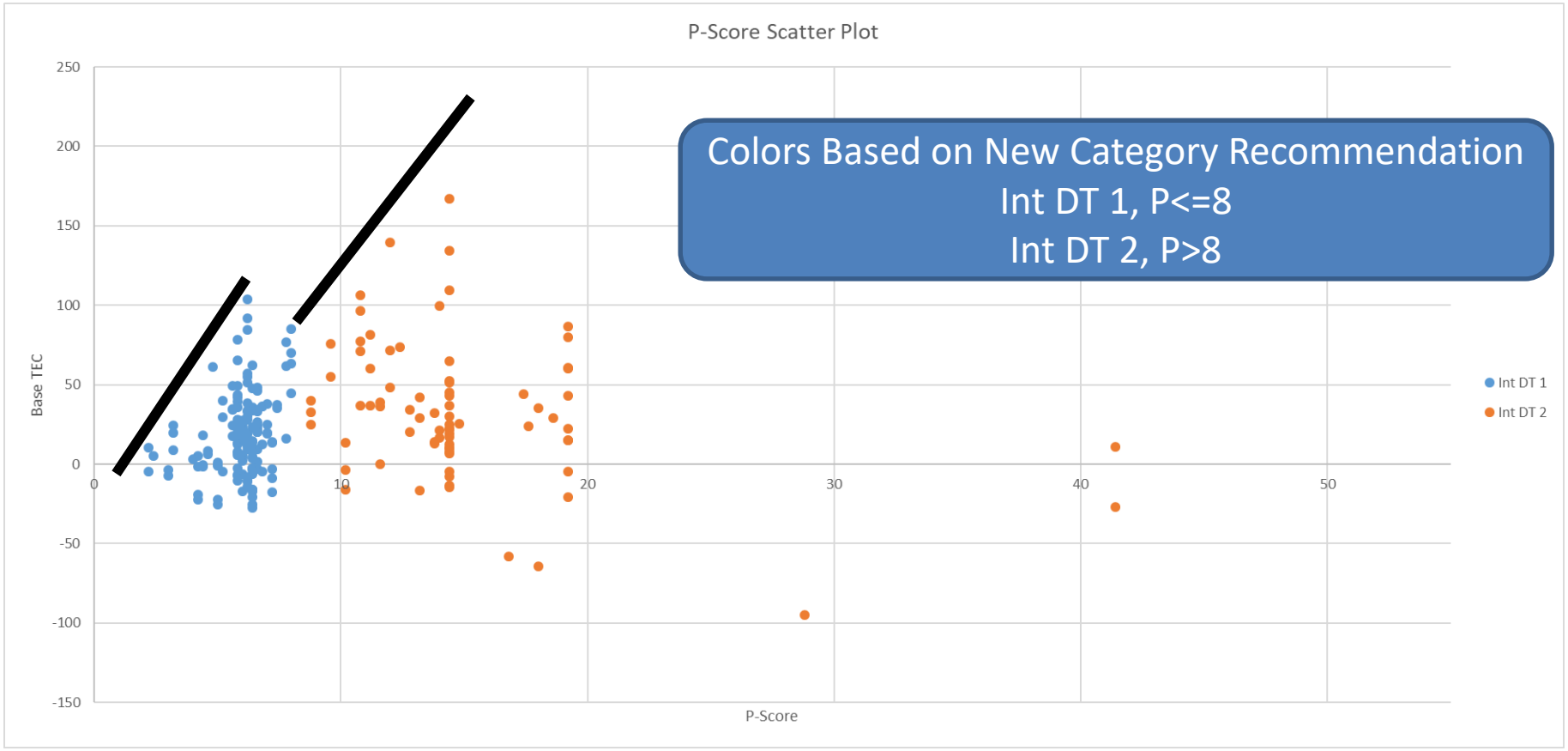
Colors Based on ES v8 Draft 1 Categories

Int. Desktop Only shows a much better grouping & slope

Proposed ITI Integrated Desktop Categories

- Removed Cat 0 and merged systems into appropriate DT & AIO Category
  - Cat 0 had 10 systems, 5 DT & 5 AIO
  - No longer need Cat 0 for only 5 systems
- Created 2 categories based on P score
  - P Score line at 8, same as Desktops
  - Graphics type doesn't determine category for Integrated Desktops

Scatter Plot – Categories – AIO only – V8 Adders



Int. Desktop Only shows a much better grouping & slope

Converting Adders to new V8 Mode Weightings

- Most adders were converted using Idle Mode Weighting changes
- Storage Adders
  - Converted existing adder to a Idle Wattage value then converted to new V8 Mode Weightings
  - Storage adder applied beyond Main Storage, Main Storage = OS Drive

Storage Type	ES v8 Draft 1 (kWh)	Wattage AC Equivalent	New V8 Mode Weighting Adder (kWh)
3.5” HDD + Other	26	5.9 w	21
2.5” HDD	2.6	0.6 w	2.1
Hybrid Drive	1.0	0.23 w	0.8
SSD (+M.2 Storage devices)	0.5	0.11 w	0.4

Converting Adders to new V8 Mode Weightings

- Most adders were converted using Idle Mode Weighting changes
- Display Adder
  - Reduced adder values by 15% for new Mode Weightings, similar to overall TEC Reduction going from V7 to V8

Display Area	ES v8 Draft 1 (kWh)	New V8 Mode Weighting Adder (kWh)
A < 190	[(4.00*r)+(0.172*A)+1.5]*1+EP	[(3.43*r)+(0.148*A)+1.3]*1+EP
190<=A<210	[(4.00*r)+(0.02*A)+30.4]*1+EP	[(3.43*r)+(0.018*A)+26.1]*1+EP
210<=A<315	[(4.00*r)+(0.091*A)+15.4]*1+EP	[(3.43*r)+(0.078*A)+13.2]*1+EP
315<=A	[(4.00*r)+(0.182*A)-13.2]*1+EP	[(3.43*r)+(0.156*A)-11.3]*1+EP

Converting Adders to new V8 Mode Weightings

- Most adders were converted using Idle Mode Weighting changes
- Graphics Adders
  - Switchable Graphics was given a 20% Reduction
    - Technology improvement & new Mode Weighting
  - Discrete Graphics was given a 14% TEC reduction
    - Average TEC Reduction for Measured TEC in database was ~13%, this adder keeps the same slope

Graphics Adder	ES v8 Draft 1 (kWh)	New V8 Mode Weighting Adder (kWh)
Switchable Graphics	18	14.4
Discrete Graphics	58.6*tanh(0.0038*B-0.137)+26.8	50.4*tanh(0.0038*B-0.137)+23

Converting Adders to new V8 Mode Weightings

Memory Adder converted using Data collection activity

- Experiment Scope
  - Many different memory types, all same speed, 4 sticks each type
    - Brands = Corsair, Kingston, G.Skill, ADATA, Crucial, and Nemix RAM
  - Testing was done in the same motherboard (Asrock H370M Pro4) with 1 → 2 → 4 sticks
    - Used 4GB, 8GB, and 16 GB memory stick of same type
  - AC & DC Power was both measured
  - Short Idle, Long Idle, and Sleep power was measured to determine TEC (kWh) value
  - Testing took 2+ months to collect data

Data Collection showed that ES v8 D1 adder very appropriate for V7 Mode Weightings

Memory Used for Experiment

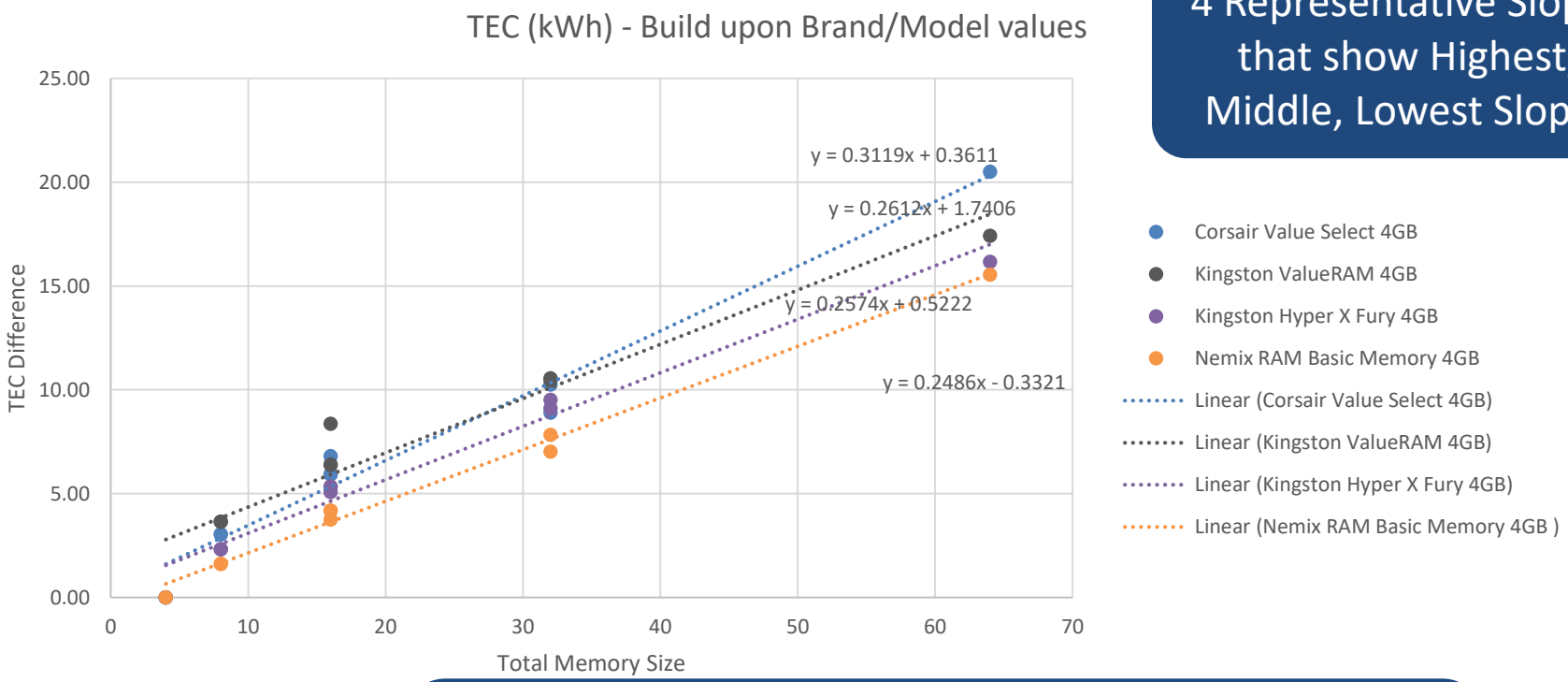
Memory Brand	Model	Part Number	Speed	Size
Corsair	Value Select	CMV4GX4M1A2666C18	2666	4
		CMV8GX4M1A2666C18	2666	8
		CMV16GX4M1A2666C18	2666	16
	Vengeance LPX	CMK16GX4M4A2666C16	2666	4
	Dominator Platinum	CMD32GX4M4A2666C15	2666	8
	Vengeance LPX	CMK64GX4M4A2666C16	2666	16
Kingston	ValueRAM	KCP426NS6/4	2666	4
		KVR26N19S8/8	2666	8
		KVR26N19D8/16	2666	16
	Hyper X Fury	HX426C15FBK2/8	2666	4
		HX426C16FB2K2/16	2666	8
		HX426C16FBK2/32	2666	16
G.Skill	Value Series	F4-2666C19S-8GNT	2666	8
	Ripjaws 4	F4-2666C16Q-16GRB	2666	4
		F4-2666C16Q-32GRB	2666	8
ADATA	XPG Gammix D10	AX4U266638G16-DBG	2666	8
Crucial	Basic Memory	CT2K16G4DFD8266	2666	16
Nemix RAM	Basic Memory	4GB DDR4-2666MHz PC4-19200	2666	4
		8GB DDR4-2666MHz PC4-21300	2666	8
		16GB DDR4-2666MHz PC4 21300	2666	16

Example of Data Collected

Brand	Size per stick	# of sticks	Total Mem	AC Short	AC Long	AC Sleep	TEC (v8)	TEC Delta	TEC Slope	AC Δ Short	DC Δ Short
Nemix RAM Basic Memory	4	1	4	20.72	19.78	1.26	77.42				
		2	8	21.15	20.21	1.29	79.04	1.62	0.20	0.43	0.31
		4	16	21.72	20.71	1.34	81.17	3.75	0.23	1.00	0.70
	8	1	8	20.78	19.95	1.31	77.91				
		2	16	21.48	20.50	1.37	80.47	2.56	0.16	0.7	0.44
		4	32	22.18	21.10	1.49	83.30	5.40	0.17	1.4	0.99
	16	1	16	20.67	19.74	1.40	77.77				
		2	32	21.53	20.60	1.55	81.41	3.64	0.11	0.87	0.69
		4	64	23.39	22.36	1.88	89.13	11.35	0.18	2.72	2.14

Red - TEC Slope is multiplier part of the Adder Equation
Yellow – First number (TEC of 1 stick) in Adder Equation

TEC (kWh) Charts – V8 Mode Weightings - That builds upon Brand/Model Values



4 Representative Slopes that show Highest, Middle, Lowest Slopes

Corsair Value Select = 3.05 + (0.312*GB)
Kingston Value Ram = 3.65 + (0.261*GB)
Kingston Hyper X = 2.32 + (0.257*GB)
Nemix RAM = 1.62 + (0.248*GB)

Memory Adder for V8 Mode Weighting

- Recommendation for new V8 Mode Weighting
- Use the Lower Memory equation found during this study

Memory Adder	ES v8 Draft 1 (kWh)	New V8 Mode Weighting Adder (kWh)
Based on GB installed in System	2.4 + (0.294 * GB)	1.7 + (0.24 * GB)

New Adders – 2.5G LAN (1G<LAN<10G)

- Desktop systems will have the option to increase LAN speed in 2019 as Wi-Fi speed increase to 1G Transfer rates (Wi-Fi 6)
- The First 2.5G LAN Chip was released in the market at the end of 2018
- Data Collected on first board in market with 2.5G LAN
- Recommended Adder for LAN >1G, but less than 10G = 8 kWH

Test Condition	Short Idle	Long Idle	Sleep	Off	V7 TEC	V8 TEC
No Network	20.06	19.2	3.43	0.93	91.90	84.28
2.5G Switch Connection	22	21	3.95	1.56	102.94	93.84
2.5G Diff from No Network	1.94	1.8	0.52	0.64	11.04	**9.56**
Based on old Estimate of 1G WOL power consumption (0.5w)	1.44	1.3	0.52	0.64	8.00	**7.81**

New Adders – LAN >= 10G

- Very few systems use 10G LAN for Desktop today, Market for this does look to increase in the near future
- Data Collected on one of the few Desktop products with 10G LAN
- Recommended Adder for LAN >= 10 G = 18 kWH

Test Condition	Short Idle	Long Idle	Sleep	Off	V8 TEC
OEM System w/ 1G LAN	11.0	9.08	1.07	0.329	41.6
OEM System w/10 G LAN	15.03	11.95	2.26	0.361	59.4
Difference					17.8

Summary of Proposed Adders

V7 Mode Adders

- Memory = 2.4 + (0.294*GB)
- Storage: 3.5”=26; 2.5”=2.6
  Hybrid Drive=1.0, SSD=0.5
- dGFx =58.6*tanh(0.0038*B-0.137)+26.8
- Switchable Graphics – 18
- Display – A<190=
  [(4.00*r)+(0.172*A)+1.5]*1+EP
- 190<=A<210 =
  [(4.00*r)+(0.02*A)+30.4]*1+EP
- 210<=A<315 =
  [(4.00*r)+(0.091*A)+15.4]*1+EP
- 315<=A = [(4.00*r)+(0.182*A)-
  13.2]*1+EP

V8 Mode Adders

- Memory = 1.7 + (0.24*GB)
- Storage: 3.5”+ Other =21; 2.5”=2.1
  Hybrid Drive=0.8, SSD=0.4
- dGFx = 50.4*tanh(0.0038*B-0.137)+23
- Switchable Graphics – 14.4
- Display – A<190=
  [(3.43*r)+(0.148*A)+1.3]*1+EP
- 190<=A<210 =
  [(3.43*r)+(0.018*A)+26.1]*1+EP
- 210<=A<315 =
  [(3.43*r)+(0.078*A)+13.2]*1+EP
- 315<=A = [(3.43*r)+(0.156*A)-
  11.3]*1+EP
- >=1 and <10 G LAN = 8 kWh
- >=10G LAN = 18 kWh

Proposed Category Base TEC Limits

- Separate Categories for Integrated Desktops & Desktops
- All Categories split via P Score line of 8
- Desktop keeps category based on P Score and Graphics
- Recommendations based on 30th Percentile on new dataset

Integrated Desktop	P Score	Count	Category TEC Limit
Int DT 1	P<=8	144	12
Int DT 2	P>8	79	24

Desktop	P Score	Count	Category TEC Limit
I1	P<=8	269	26
I2	P>8	235	50
D1	P<=8	106	34
D2	P>8	180	44

Full Network Connectivity

Shahid Sheikh – Intel

Luc Bisson - NVIDIA

Full networking proxy allowances - Overview

Problem statement: EPA is proposing not to provide any mode weighting incentives for DT/AIO systems for V8.0 (Draft 1), due to lower idle achieved with new mode weightings

Issue: TEC reductions due to new mode weighting do not fully make up for Version 7.1 Network proxy allowances.

EPA Concerns:

- Changes in the market, particularly around greater usage of power management warrants only the conventional mode weighting
- Do not see benefits for ENERGY STAR -- not convinced that connected modern standby is something EPA should incentivize given that it appears to use more energy than traditional sleep.
- Industry needs to provide clear justification

Industry Comments

- ENERGY STAR benefits: S3/Connected Modern Standby systems
  - This incentive is for both S3 and ALPM supported systems
  - **S3 based systems** that go beyond v8 mode weightings i.e., residing even longer time in sleep mode are actually consuming less energy (good for environment) and should be incentivized
    - 40% of DT/AIO systems spend 60% (14 hours plus per day) in sleep mode (vs. 45% mode weighting)
  - **Connected Modern Standby systems:**
    - With Full network connectivity option 2 – DT/AIO systems have a very high bar to meet <2W. Majority of these systems will default to conventional mode weightings.
    - Incentivizing connected modern standby systems could reduce power over time.
- TEC reductions due to new mode weighting do not fully make up for Network proxy incentives provided in version 7.
  - ~13%* TEC reductions going from v7 to v8 mode weightings changes
  - Up to 30% TEC allowance for v7 (conventional vs. full capability)
  - Industry is no longer proposing new network proxy allowances for v8, but simply maintaining existing v7 proxy weightings (translates into lower than v7 level proxy allowances for v8– see next slide)

*Average TEC % change based on EPA dataset

Revised Proposal

TEC Analysis: Desktop/AIO

	Short Idle	Long Idle	ModS	Sleep	Off
Desktop (W)	17	16	4	1.5	0.6
NB (W)	6.9	4.4	0.6	0.64	0.47

	Conventional	Base Capability	Remote Wake	Service Discovery/ Name Discovery	Full Capability
DT -V7.1 TEC (option 1)	76.17	70.04	66.93	63.42	58.65
DT - V7.1 TEC (option 2)					>2W (not Applicable)
DT - V7.1 TEC Allowance$_{CAP}$	None	0.09	0.14	0.20	0.30
NB -V7.1 TEC (option 1)	24.98	23.22	22.35	21.47	20.59
NB - V7.1 TEC (option 2)					20.59
NB - V7.1 TEC Allowance$_{CAP}$	None	0.08	0.12	0.16	0.21
Use V8.0 mode weightings for conventional and V7.1 mode weightings for Network proxy					
V8.0 TEC (option 1)	65.39	70.04	66.93	63.42	58.65
V8.0 TEC (option 2)					>2W (not Applicable)
% TEC Red (V7->V8)	-0.14	0.00	0.00	0.00	0.00
(Based on new mode weightings)					
V8 TEC Allowance$_{CAP}$	None	-0.07	-0.02	0.03	0.12
(Based on new mode weightings)					

V7.1 Allowance

V8 Allowance

From 30% to 12% reduction

Proposal: Use Version 8 mode weightings for conventional and maintaing v7.1 mode weightings for Network Proxy

V8 TEC Capability Allowance$_{CAP\ (Desktops/AIO)}$

	Conventional	Base Capability	Remote Wake	Service Discovery/ Name Discovery	Full Capability
Option 1 allowance	0	0.00	0.00	0.03	0.12
Option 2 allowance	0	N/A	N/A	N/A	0.12

$$E_{TEC\_MAX} = (1 + ALLOWANCE_{PSU} + ALLOWANCE_{CAP}) \times (TEC_{BASE} + TEC_{MEMORY} + TEC_{GRAPHICS} + TEC_{STORAGE} + TEC_{INTEG\_DISPLAY} + TEC_{SWITCHABLE} + TEC_{MOBILEWORKSTATIONS})$$

Recommendations

- Only incentivize DT/AIO systems that meet full capability definition for option 1 and option 2 (incentivizes both S3 and cModS systems). Proposed TEC incentives @~12%
- No changes to notebooks incentives in version 8 – address those in version 9 after new mode weightings are implemented (similar to above framework).
- Adopt Constant Network Connectivity definition *(required in second option for certifying products for Full capability incentives)*
  - "Constant network connectivity means the system having wake capabilities that enable system OS or SW to facilitate communication and downloads from the network (for example, instant messaging, email, management and maintenance tasks, etc.)"

Energy Efficient Ethernet

Ngozi Lawanson – HP, Inc

Industry Comments

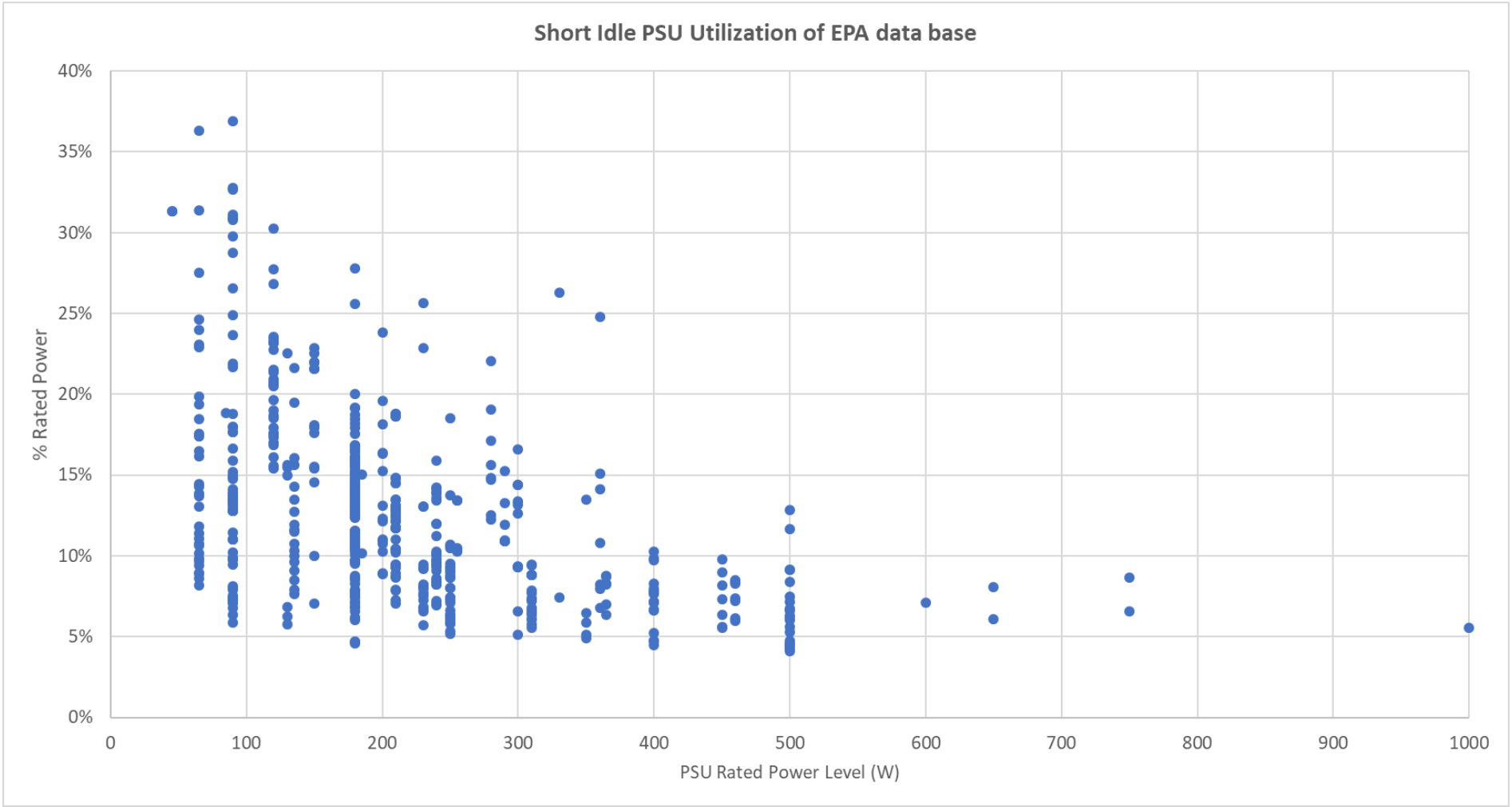
Industry agrees with the product trends moving to EEE and supports removing the allowance, however disagrees that it should be a requirement for ENERGY STAR certification at this time.

- 268 (~31%) models from the EPA dataset do not have EEE enabled (73 of which would otherwise qualify for ENERGY STAR 8 per draft 1).
  - 256 of these have 1 or 2 gigabit ethernet ports
- 178 (~32%) notebook/thin client models on the current ENERGY STAR QPL do not have EEE enabled
  - This would remove some notebooks from ENERGY STAR qualification in ENERGY STAR 8.0 that were already certified to 7.0/7.1

Internal Power Supplies

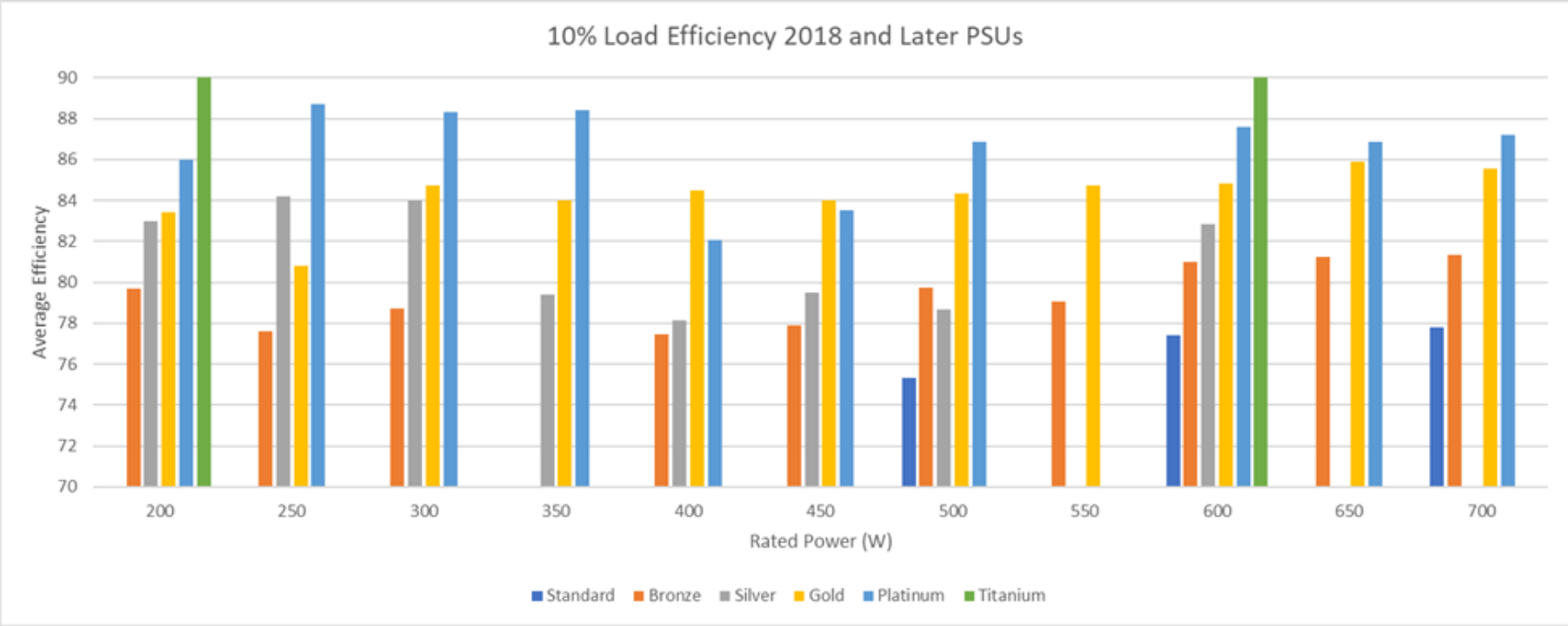
Gary Verdun (Dell)

EPA data set Short Idle PSU loading



- Significant number of systems have power levels near 10% PSU rated power during short idle conditions
- Very few have short idle power levels near or below 5% of PSU rated power

80 Plus 115V Internal PSU evaluation



	200	250	300	350	400	450	500	550	600	650	700
Bronze to Gold	3.71	3.21	6.03		7.04	6.10	4.58	5.65	3.82	4.64	4.20
Gold to Platinum	2.61	7.92	3.56	4.41	-2.45	-0.48	2.52		2.77	0.99	1.65

- Figure shows the difference in average efficiency for 2018 and later PSUs segmented by rated output power for changing from Bronze to Gold and for changing from Gold to Platinum.
- For a change from Bronze to Gold we see generally around a 4.9% increase in efficiency at 10% rated load.

Lifetime Energy Cost savings of Changing from Bronze to Gold

	Off	Sleep	Long Idle	Short Idle	Annual Energy use in active modes (kWh)	Annual Energy Cost in active at .15/kWh	3 yr lifetime Energy Savings ($)
All Desk Tops in data set	0.68	1.86	23.81	25.21	87.11	13.07	$1.96
Integrated Graphics Only	0.71	1.97	22.47	23.84	82.33	12.35	$1.85
External Graphics Only	0.59	1.56	27.57	29.07	100.53	15.08	$2.26

- 3 Year Lifetime Energy Savings of changing from Bronze to Gold ~ $2

Efficiency Levels being compared	270 Watts OEM Cost/Consumer Cost	300 Watts OEM Cost/Consumer Cost	460 Watts OEM Cost/Consumer Cost
Bronze to Gold	6.05/9.85	6.8/11.1	10/16.25
Bronze to Silver	2.3/3.75	2.65/4.35	3.45/5.6

- Above data presented to CEC and industry believes is still accurate
- End user cost of changing from Bronze to Gold ~ $9 to $16

Internal Power Supplies Proposal

- Require Bronze PSU with minimum efficiency of 78% at 10% rated load for rated output power <=500W

PSU Rated Output Power	10%	20%	50%	100%
<=500W	78%	82%	85%	82%
>500W		87%	90%	87%

Resume Time and Test Methods

Adrian Liga – Apple

Stephen Eastman - Intel

Resume time from Sleep -Overview

Key Message: Industry strongly believes that the sleep mode definition is outdated and needs to be changed.

Two key issues:

- **Resume time latency of less than or equal to 5 seconds:**
  - The original intent to ensure that resume times were sufficiently short that users would not disable sleep states due to excessive resume time, is largely met based new mode weighting study adopted in Draft 1 (PCs spending less time in idle mode and more time in sleep mode, as compared to a previous study).
  - One-size-fits-all approach is not workable due to large resume time variations (within and across form factors – key discussion item today)
- **Definition remains vague:**
  - 'System becoming fully usable' part of the definition is very vague especially when establishing the resume time test procedure.

Proposed Sleep Mode Definition:

A low power mode that the computer enters automatically after a period of inactivity or by manual selection. A computer with sleep capability can quickly "wake" in response to network connections or user interface devices from initiation of wake event to a readable display. For systems where ACPI standards are applicable, sleep mode most commonly correlates to ACPI system level S3 (suspend to RAM) state. The requirements apply to computers utilizing an alternative sleep mode

Sleep Definition

Sleep Mode: A low power mode that the computer enters automatically after a period of inactivity or by manual selection. A computer with Sleep capability can quickly "wake" in response to network connections or user interface devices with a latency of less than or equal to 5 seconds from initiation of wake event to system becoming fully usable including rendering of display. For systems where ACPI standards are applicable, Sleep Mode most commonly correlates to ACPI System Level S3 (suspend to RAM) state. P_{SLEEP} represents the average power measured when in the Sleep Mode.

Sleep to Wake Test (v8 draft 1)

6.7 Sleep to Wake Latency Test

The definition of Sleep Mode in the ENERGY STAR Eligibilty Criteria for Computers specifies that a unit can "wake" with a latency less than or equal to 5 seconds. In order to verify that a state meets the definition of Sleep Mode, perform the following steps.

A) Place the UUT in Sleep Mode.

B) For computers without integrated displays ensure the display does not enter Sleep Mode or other Low Power Mode.

C) Wake the computer and start time measurement.

D) As soon as the screen is displaying content from the computer, stop the time measurement. This time measurement is the sleep to wake latency of the UUT.

Note: DOE had received concerns that the wake time latency was not clearly defined, and there may be some confusion on the interpretation of this requirement. In response, DOE has added a test to measure the wake latency in a consistent way. DOE requests feedback on this test method and approach.

Resume Time Data – 2018-19

Collected by many different Manufacturer Labs

	All WS	1S WS	2S WS	NB + Slate/Tablet	Int DT (AIO)	Desktop
System Count	39	20	19	98	17	151
Resume Time (sec)						
Average	9.62	6.93	12.45	2.45	4.03	6.75
Median	7.3	6.0	8.1	1.9	3.8	6.5
70%	9.0	7.16	10.0	2.97	4.41	7.5
80%	10.0	8.2	23.5	3.77	4.57	9.0
90%	23.5	9.9	24.5	4.9	4.92	9.1
Max	27.5	18	27.5	10.5	6.7	13.8

Without Controlled experiments difficult to follow sources of variation

Summary of DT data from OEM1

- 1 desktop system in 4 configs and 4 different monitors
  - Resume time follows the monitor
- Thin client range
  - AIO = 1.5s – 4.2s
  - NB = 3.8s – 10.9s
  - DT = 2.8s – 7.3s
- Modern Standby NB, Avg = 0.5s

Storage type	Graphics	Min	Max	Avg
SSD	iGFx	3.7s	5.8s	4.7s
3.5” HDD	iGFx	6.6s	12.2s	8.15s
SSD	dGFx	4.5s	10.7s	5.8s
3.5” HDD	dGFx	7.2s	11.9s	8.3s

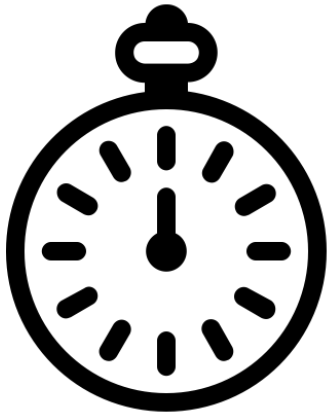
Resume time in a controlled testing shows variations with Storage, Graphics, and Display.

Summary of data from OEM2

- 1 WS system with 21 different monitors, each system tested multiple times to check repeatability (10 to 20 times)
  - Repeatability ranges from 1.7s to 9.6s, standard dev 0.5s to 2.8s
  - Avg shows range of different monitors from **6.6s to 10.8s**
- Over multiple WS tests range is 3 to 18 sec, avg = 7.4s
- DT systems tested with multiple monitor & connections and memory size
  - Range 2.5s to 5.0s
  - Avg = 3.6s

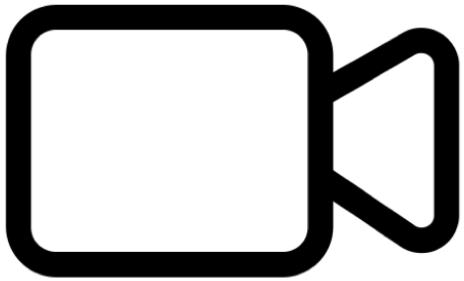
Variation due to monitor type is huge, while test the repeatability is not good→ 5 sec spec is consumed by big margin of error alone

Test method



Manual

VS



Video

Resume time | Manual vs Video

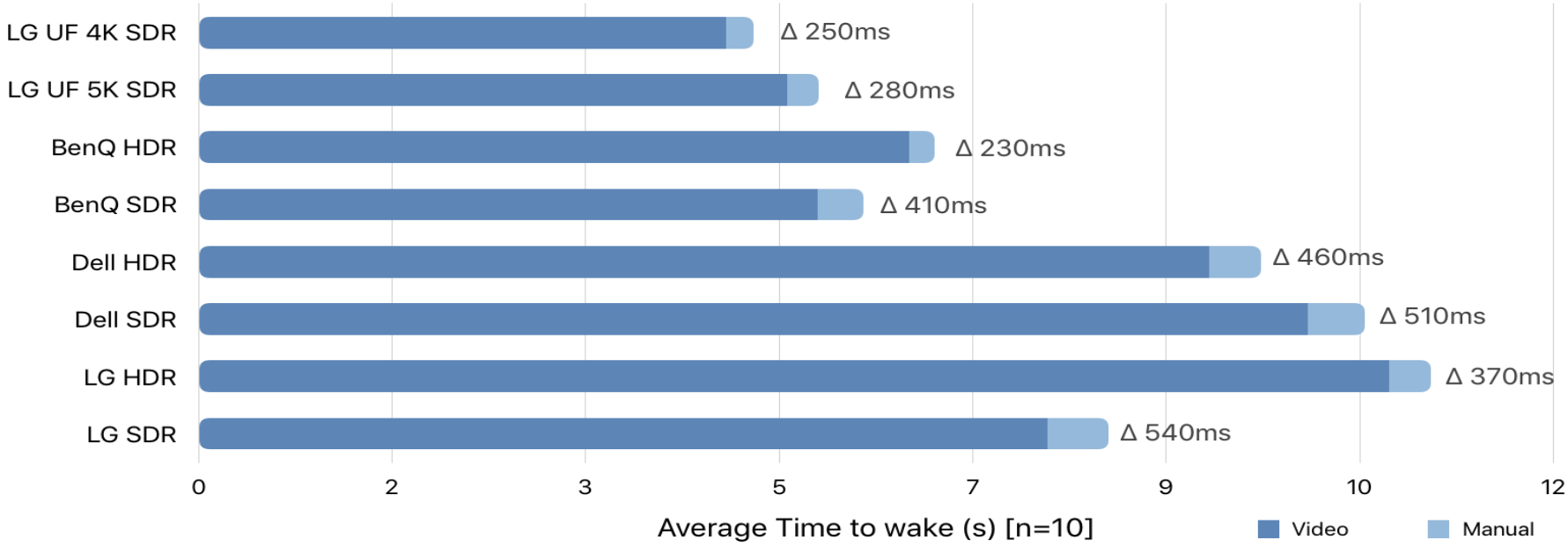
- Manual testing - dependent on tester's reaction time
- Inconsistency of "stop point" (It could be to screen half lit, full lit, wake gradient etc)

Manual: t = 4.94 s

Video t = 4.68 s

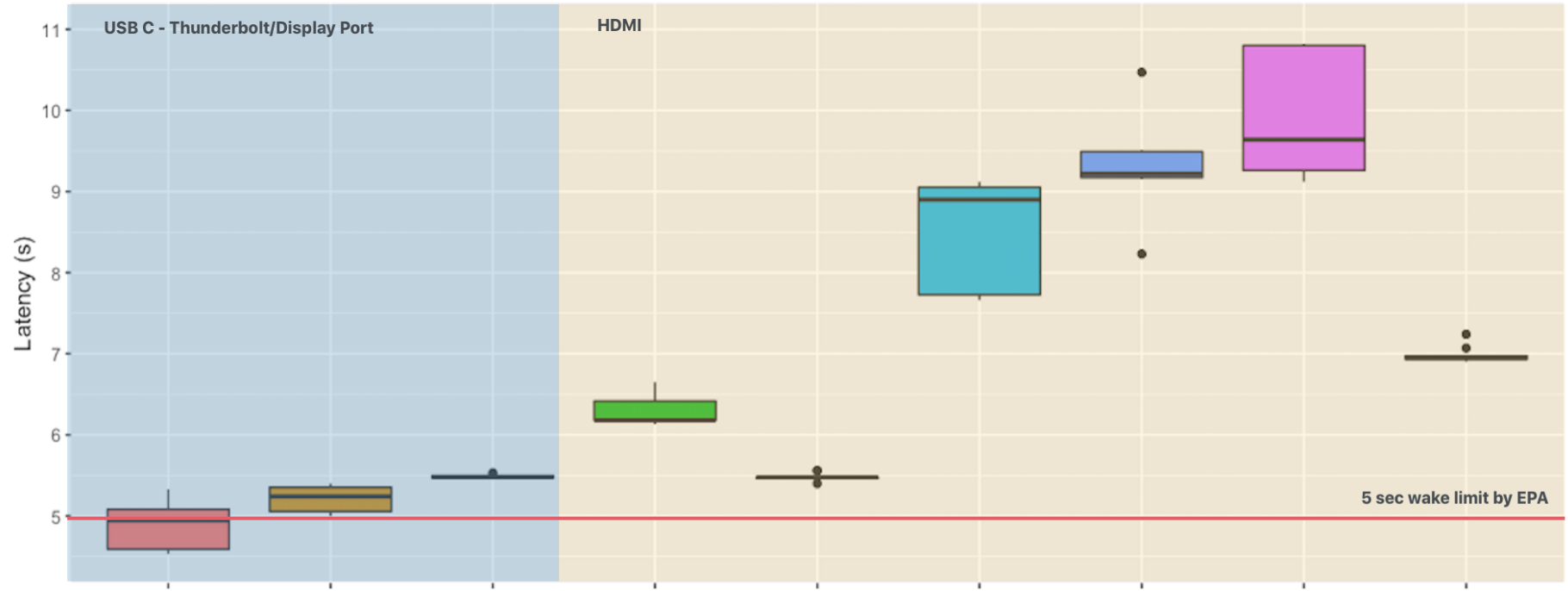
Resume time | Manual vs Video

- Variability of manual measurements: 230-540ms (reaction delay)
- Video measurements are more consistent and does not rely on reaction time
- Recommend that the “stop” point be when the first sign of the log in/readable screen is seen (needs to be consistent point)



Variation due to Displays

Resume time | Display Variance

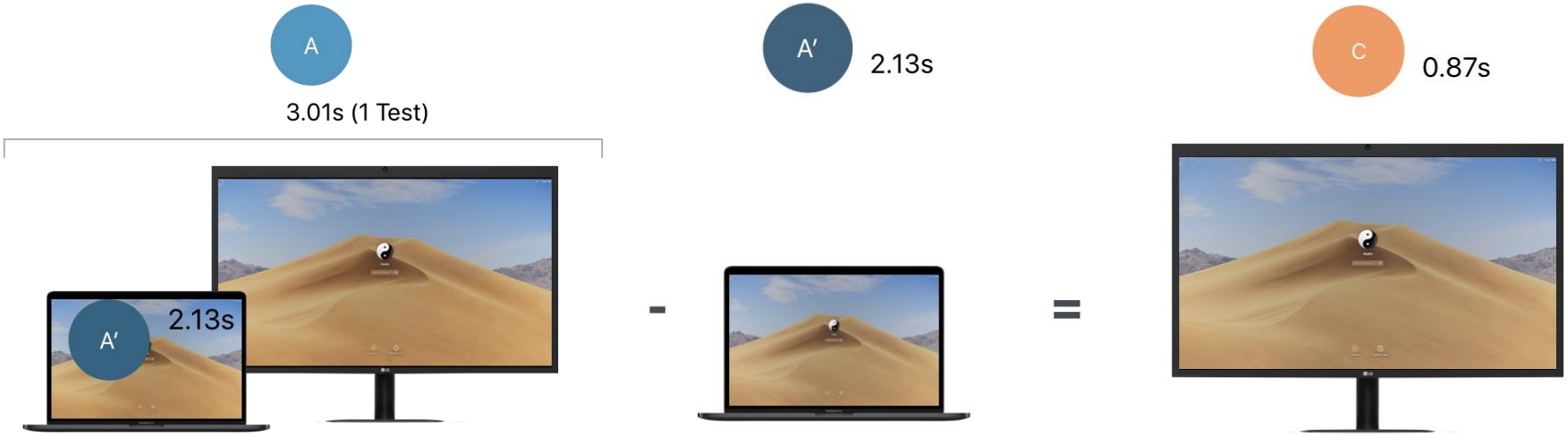


Display Testing: Used a MacBook Pro 15" and the in box cables from the display. For HDMI displays, a USB-C Digital AV Multiport Adapter is used

Option to Eliminate Display Contribution

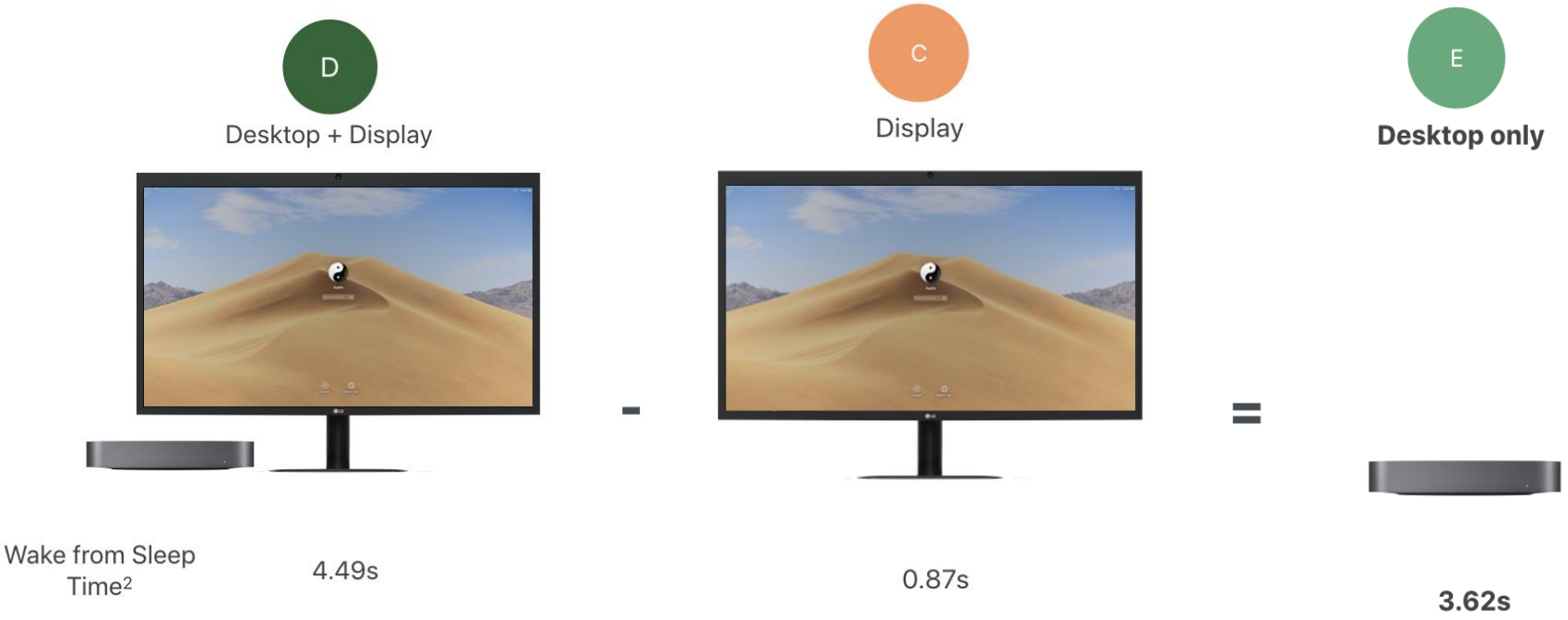
- Video showing the total resume time using a Laptop with integrated display with lid open and a display: Time A
  - Measure the resume time of the laptop: Time A’

- Display resume up time: Time C = Time A – Time A’



Option to Eliminate Display Contribution

- Measure the resume time for the desktop + Display (C): Time D
- Calculate the resume time of desktop: Time E = Time D – Time D
- Display wake up time: Time C = Time A – Time A’



[2] Tested with Mac mini Intel i5 2.5GHz/6C & LG UF (SDR) 4K

Option to Eliminate Display Contribution

LG UF 4K SDR - USB C A A′ C

Hosts	Total System (s)	Laptop only (s)	Display only (s)
15″ MacBook Pro	4.71	3.32	1.39
13″ MacBook Pro	3.01	2.13	0.87
MacBook Air	2.96	2.05	0.91

15″ MacBook Pro: Intel i9 2.4GHz/8C
13″ MacBook Pro: Intel i7 3.5GHz/2C
MacBook Air: intel i5 1.8GHz/2C
Mac mini: Intel i5, 2.8GHz/6C

N=5

Option to Eliminate Display Contribution

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MacBook Air	2.96	2.05	0.91

BenQ HDR - USB C

Hosts	Total System (s)	Laptop only (s)	Display only (s)
15″ MacBook Pro	6.87	3.63	3.24
13″ MacBook Pro	4.65	2.18	2.47
MacBook Air	4.81	2.42	2.39

15″ MacBook Pro: Intel i9 2.4GHz/8C
13″ MacBook Pro: Intel i7 3.5GHz/2C
MacBook Air: intel i5 1.8GHz/2C
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13″ MacBook Pro	4.65	2.18	2.47
MacBook Air	4.81	2.42	2.39

BenQ HDR - HDMI

Hosts	Total System (s)	Laptop only (s)	Display only (s)
15″ MacBook Pro	6.68	3.53	3.14
13″ MacBook Pro	5.48	3.01	2.47
MacBook Air	5.27	2.75	2.52

15″ MacBook Pro: Intel i9 2.4GHz/8C
13″ MacBook Pro: Intel i7 3.5GHz/2C
MacBook Air: intel i5 1.8GHz/2C
Mac mini: Intel i5, 2.8GHz/6C

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N=5

Option to Eliminate Display Contribution

LG UF 4K SDR - USB C

Hosts	Total System (s)	Laptop only (s)	Display only (s)
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15″ MacBook Pro	6.68	3.53	3.14
13″ MacBook Pro	5.48	3.01	2.47
MacBook Air	5.27	2.75	2.52

D

Hosts	Total System (s)
Mac mini	4.49

Hosts	Total System (s)
Mac mini	5.43

Hosts	Total System (s)
Mac mini	6.15

Traditional method without eliminating the display

Observe the variability in results (4.5s – 6.15s)

15″ MacBook Pro: Intel i9 2.4GHz/8C
13″ MacBook Pro: Intel i7 3.5GHz/2C
MacBook Air: intel i5 1.8GHz/2C
Mac mini: Intel i5, 2.8GHz/6C

N=5

Option to Eliminate Display Contribution

LG UF 4K SDR - USB C

Hosts	Total System (s)	Laptop only (s)	Display only (s)
15″ MacBook Pro	4.71	3.32	1.39
13″ MacBook Pro	3.01	2.13	0.87
MacBook Air	2.96	2.05	0.91

BenQ HDR - USB C

Hosts	Total System (s)	Laptop only (s)	Display only (s)
15″ MacBook Pro	6.87	3.63	3.24
13″ MacBook Pro	4.65	2.18	2.47
MacBook Air	4.81	2.42	2.39

BenQ HDR - HDMI

Hosts	Total System (s)	Laptop only (s)	Display only (s)
15″ MacBook Pro	6.68	3.53	3.14
13″ MacBook Pro	5.48	3.01	2.47
MacBook Air	5.27	2.75	2.52

Desktop resume time 3-3.6 s (fairly consistent)
USB C wakes faster than HDMI

	D	C	E
Hosts	Total System (s)	Display only (s) (Avg MBPro 13″ & MBAir)	Desktop only (s)
Mac mini	4.49	0.9	3.59

Hosts	Total System (s)	Display only (s)	Desktop only (s)
Mac mini	5.43	2.42	3.01

Hosts	Total System (s)	Display only (s)	Desktop only (s)
Mac mini	6.15	2.49	3.65

15″ MacBook Pro: Intel i9 2.4GHz/8C
13″ MacBook Pro: Intel i7 3.5GHz/2C
MacBook Air: intel i5 1.8GHz/2C
Mac mini: Intel i5, 2.8GHz/6C

N=5

Option to Eliminate Display Contribution

LG UF 4K SDR - USB C

Hosts	Total System (s) (A)	Laptop only (s) (A′)	Display only (s) (C)
15″ MacBook Pro	4.71	3.32	1.39
13″ MacBook Pro	3.01	2.13	0.87
MacBook Air	2.96	2.05	0.91

Hosts	Total System (s) (D)	Display only (s) (Avg MBPro 13″ & MBAir) (C)	Desktop only (s) (E)
Mac mini	4.49	0.9	3.59

BenQ HDR - USB C

Hosts	Total System (s)	Laptop only (s)	Display only (s)
15″ MacBook Pro	6.87	3.63	3.24
13″ MacBook Pro	4.65	2.18	2.47
MacBook Air	4.81	2.42	2.39

Hosts	Total System (s)	Display only (s)	Desktop only (s)
Mac mini	5.43	2.42	3.01

BenQ HDR - HDMI

Hosts	Total System (s)	Laptop only (s)	Display only (s)
15″ MacBook Pro	6.68	3.53	3.14
13″ MacBook Pro	5.48	3.01	2.47
MacBook Air	5.27	2.75	2.52

Hosts	Total System (s)	Display only (s)	Desktop only (s)
Mac mini	6.15	2.49	3.65

15″ MacBook Pro: Intel i9 2.4GHz/8C
13″ MacBook Pro: Intel i7 3.5GHz/2C
MacBook Air: intel i5 1.8GHz/2C
Mac mini: Intel i5, 2.8GHz/6C

N=5

Display elimination| Other possibilities

HDMI Multi View (reducing display latency)

- Takes up to 4 HDMI images and combines image for one monitor to display
- 1 computer will put out an image to keep the display awake
- UUT will use connection #2, with monitor already displaying an image from computer 1, SUT will now wake and not have to wait for monitor to turn on

Picture in Picture (PnP)

- 1 Monitor can take 2 images from 2 different computers. Same as Multi View, 1 computer keeps the monitor awake, then measure wake time from SUT

Other possibilities: Sample data

System	Samsung 4K w/ PnP				Samsung – 23"			Asus – VE208T		Viewsonic VS15052	
	1 Connect	2 Connect (PnP)	HDMI Multi – 1 Connect	HDMI Multi – 2 Connect	Default	Power Saving	HDMI Multi – Pwr Save	Default	HDMI Multi	Default	HDMI Multi
OEM1-A	8.01	4.33	3.09	2.82	5.05	5.02	2.88	4.52	2.94	5.62	2.95
OEM1-B	7.42	3.54	2.29	2.09	4.25	4.42	2.1	3.61	2.22	4.83	2.09
OEM2-A	5.69	1.85	<1	<1	2.82	2.74	<1	2.16	<1	3.66	<1
OEM2-B	8.3	4.45	3.08	2.88	5.29	5.57	2.94	4.5	3.01	5.62	2.94
OEM3-A	8.24	3.02	3.53	3.48	12.74	11.2	2.03	5.84	2.09	4.47	
OEM3-B	7.46	3.67	2.76	2.62	4.96	4.6	2.57	3.09	2.56	5.0	2.76
OEM4i	11.1	7.3	5.9	5.8	8.5	8.2	5.9	7.5	6.4	9.4	6.0
OEM4d	11.1	7.3	6.5	6.3	8.2	8.4	6.4	7.7	6.4	9.7	6.3
WS	19.09	19.01	19.01	15.22	19.1	19.05	18.77	17.82	19.17	18.4	

Workstation system had a blue screen turn on between 6.62 seconds to 11.54 seconds, Numbers reported are when log on screen was displayed

Resume time | Conclusion

- ENERGY STAR Display spec does not have a minimum response time from sleep required for displays (not regulated or controlled)
- Desktop computer manufacturers have no control of response time of displays (factors affecting wake up latency includes: type of connection, number of tiles per panel, etc.)
- Different Video connections have different resume times
    - Even on the same monitor
- Large variability of results due to the type of displays, operator measurement variability, even if the test method is consistent
- Removal of display contribution is complicated

Insert slide #'s

Resume time | Recommendations

- **Remove resume time requirement for computers**
  - User experience takes precedence (self regulating)
  - New mode weightings indicate that 45-60% of the time the systems are in sleep → Disabling system sleep does not seem to be an issue anymore
  - Technological advancements allows systems to sleep faster (saving energy)

- Should EPA/DOE require resume time to be part of the spec:
  - Need Collaboration on a test procedure to ensure test repeatability and consistency before discussing resume time specs

Test Methods and Notebooks Recertification

Shahid Sheikh – Intel

Dave Cassano - Google

Test Methods & Qualification

- Industry appreciates DOE adding a section in short idle testing to address systems that exhibit any cyclical behavior. Industry proposed some refinements to the DOE text for completeness (see back-up). Industry is looking forward to DOE and EPA input.
- Industry position is that notebook systems that exhibit cyclical behavior and are already certified for v7.1 should get recertified for v8.0, but not be required to be retested, similar to other notebook re-certification. The new test should only apply to new models in v8.0 that exhibit cyclical behavior.

Notebooks Recertification

- EPA has proposed not to make any changes to notebooks for ENERGY STAR v8.0, and wait until V9.0 to apply the new mode weightings for notebook PCs. Industry agrees that EPA should not make changes to V8 which would negatively impact notebooks capable of qualifying for V7.1. Any re-testing of notebook PCs currently being certified to the V7.1 specification would be unnecessarily burdensome and must be avoided.
- Industry requests clarification as to how notebooks already certified to ENERGY STAR v7.1 will be recertified for ENERGY STAR v8.0. If EPA believes that re-certification of notebooks cannot be avoided we would like to engage in additional discussions. As part of these discussions, we would propose that EPA consider resetting notebook base TEC targets based on the new mode weightings using the same dataset used for setting version 7.1 limits.

Back-up

Testing for systems with cyclical behavior

Proposed Version 8.0 Text: Short Idle Mode Testing:

- For Short Idle Mode Testing (Section 6.4),the UUT shall be allowed no more than five minutes from the point of ceased user input before measurements must be taken. Display sleep settings shall be disabled for Short Idle Mode Testing. If any other default settings cause the UUT to exit Short Idle during the measurement time, extend the settings so that the UUT remains in short idle for the duration of the measurement.

- If the UUT is demonstrating cyclical behavior during the short idle mode measurement, it is required to use an extended measurement capturing one or more full charging cycles per IEC 62301, section B.2.3. The extended test shall be conducted by keeping the unit in short idle through minimal user input such as moving the mouse or pressing a key that does not perform any action (e.g. shift, ctrl, tab, etc.) at a minimum of every 5 minutes. The UUT must remain in short idle during the entire time of the extended test. The short idle test can either be conducted one time or multiple times. If conducted multiple times, then the average of all runs should be reported.

Testing for systems with cyclical behavior

Justification: For short idle testing, a continuous integration of power measurement for at least one full charge/discharge cycle in the charging algorithm will provide the most accurate average efficiency value and provide a means of charting the power data in a single continuous chart. By requiring user interaction every 5 minutes or less, the UUT will be kept in a representative short idle condition that aligns with the intent of the original 7.1 test method.

The proposed text above should address EPA's concerns that:
A. If cyclical behavior is present, extended measurement must be conducted (for accuracy and repeatability); and
B. Prevent short idle from transitioning to an artificially low power mode over an extended measurement period by requiring some minimal user interaction every 5 minutes or less.

ENERGY STAR* for Computers v7.1 – Network Proxy definitions

Option 1: ENERGY STAR for Computers 7.1 lists the definitions of 4 different types of Network Proxy that relate to ECMA 393 (Section 1.E.3 – page 5) – Option #1. For a computer to use different mode weightings than Conventional Mode, the computer must meet the definitions below.

Network Proxy Type	Definition
Base Capability	To maintain addresses and presence on the network while in LPM, the system handles IPv4 ARP and IPv6 NS/ND
Remote Wake	While in LPM, the system is capable of remotely waking upon request from outside the local network. Includes Base Capability.
Service Discovery / Name Services	While in LPM, the system allows for advertising host services and network name. Includes Base Capability.
Full Capability	While in LPM, the system supports Base Capability, Remote Wake, and Service Discovery/Name Services

Option 2: Products shall be capable of Sleep Mode or an Alternative Low Power Mode which maintains constant network connectivity with energy consumption less than or equal to 2 Watts in order to qualify for full capability mode weightings

ENERGY STAR* for Computers and Network Proxy

- ENERGY STAR* for Computers ver. 7.0 has two options for computers to claim Network Proxy - Full Capability mode weightings (per Section 3.5.1 - page 10-11)
- **Option #1:** Products shall meet a non-proprietary Full Network Connectivity standard such as ECMA 393… and be configured by default upon shipment
- **Option #2:** Products shall be capable of Sleep Mode or an Alternative low power mode (ALPM) which maintains constant network connectivity with energy consumption less than or equal to 2 watts.

Windows* OS Type	Full Network Connectivity - Option #2
Connected Modern Standby	Meets "Constant Network Connectivity" Definition (ALPM needs to be ≤2 watts)
Disconnected Modern Standby	Does not Qualify – because of mode definition
ACPI S3 sleep	Does not Qualify – per EPA guidelines, could only meet Option #1

ENERGY STAR* for Computers v7.0 – Network proxy full capability mode weightings

	Option 1 Meet non proprietary Full Network Connectivity standard	Option 2 maintains constant network connectivity in sleep or ALPM	Remark
S3 without WOL	No	No	Network disconnected
S3 with WOL	Supported if Ethernet LAN meets requirements of 4 different types of Network Proxy that relate to ECMA 393	No	
Connected Modern Standby	Supported if Ethernet LAN meets requirements of 4 different types of Network Proxy that relate to ECMA 393	Supported, if ALPM meets energy consumption less than or equal to 2 watts	Instant on and always connected
Disconnected Modern Standby	Not supported	No	Instant on only
Other ALPM implementations	Supported if Ethernet LAN meets requirements of 4 different types of Network Proxy that relate to ECMA 393	Needs to meet "maintains constant network connectivity" and energy consumption less than or equal to 2 watts	Need Chrome* OS and Apple* iOS details

Definitions

According to Microsoft's latest specification on Modern Standby (MS), there are two modes of Modern Standby:

(1) Modern Standby with Network Connected

- Identical to "Connected Standby" in Windows 8.1 and Windows 10, including "Fresh Data" support with "Wake on Pattern Match".

(2) Modern Standby with Network Disconnected

- A subset of the Windows Connected Standby (CS) capabilities at a lower cost (allows BOM flexibility of legacy S3), which depends on the system's low power state (ACPI S0 idle)
- In case of (1), the shared capabilities of MS and CS are: "Instant On" and "Wake on Pattern Match". However, unlike CS (in case 1), there is no support for "Fresh Data" in case 2.

https://docs.microsoft.com/en-us/windows-hardware/design/device-experiences/modern-standby

Database updates - Details

- As Compared to how systems were categorized from EPA found a few discrepancies
  - 6 systems show discrete Graphics, but list switchable
    - 636 Dell Inc. D24M
    - 653 HP Inc. HP ProDesk 600 G3 SFF Business PC (ENERGY STAR)
    - 656 HP Inc. HP EliteOne 800 G3 23.8-in Touch GPU All-in-One PC (ENERGY STAR)
    - 764 Dell Inc. D24M
    - 781 HP Inc. HP ProDesk 600 G3 SFF Business PC (ENERGY STAR)
    - 786 HP Inc. HP EliteOne 800 G3 23.8-in Touch GPU All-in-One PC (ENERGY STAR)
  - 3 systems are in the wrong category because of P Score
    - 754 MSI MS-1T31 3.6
    - 798 MSI MS-A625 3.6
    - 883 Asrock H270M PRO4 5.8
  - 3 systems are in Desktop but have Display information and Model information has word “Touch”
    - ELO Touch Computer ESY17X2
    - ELO Touch Computer ESY17X2
    - ELO Touch Computer ESY15X2