August 16, 2019

To: computers@energystar.gov
From: Information Technology Industry Council (ITI)
Re: Draft 2, Version 8.0 ENERGY STAR Computer specification and test method

The Information Technology Industry Council (ITI) appreciates the opportunity to provide comments for EPA's ENERGY STAR® for Computers, v8 Draft 2 specification. Our comments address the following topics:

- Adders and Base TEC calculation including market pass rate justification
- Full network connectivity
- IPS allowance
- EPS allowance
- Display connection priority
- Display resolution
- LAN Adder >1G to <10G
- NB adders
- NB and workstation recertification

Base TEC Calculation Including Market Pass Rate

Per conversation with the EPA, it is apparent that market penetration rate is based on models for sale as opposed to actual shipments. As limits become increasingly stringent, it is becoming ever more important to ensure that performance limits accurately reflect the energy policy goals of the ENERGY STAR program. If our calculations are based on a slice of what is already the best performing devices on the market, the QPL will reflect the "best of the best", but not the top 25% of products on the market. Industry recognizes that this requires longer-term work and that multiple factors must be weighed. To start this effort, enclosed is Appendix A "ENERGY STAR Qualified Products List (QPL) vs Market Pass Rate", an analysis for EPA's consideration.

Based on this analysis, industry recommends a pass rate of 33.7%. The table below reflects the proposed Base TEC allowance based on both 33.7% pass rate and reducing the 3.5" HDD adder from 21 kWh to 16 kWh (see detailed HDD analysis below). We look forward to further discussion.

Integrated Desktops	P Score	Base TEC Allowance (33.7% Pass Rate and new 3.5"HDD adder=16 kWh)
Int DT 1	P<=8	14
Int DT 2	P>8	27

Desktops	P Score	Base TEC Allowance (33.7% Pass Rate and new 3.5 HDD adder=16 kWh)
I1	P<=8	32
I2	P>8	55
D1	P<=8	38
D2	P>8	50

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Hard Disk Drive (HDD) Adder Analysis:

ITI conducted a study using various 3.5" HDDs as the 2nd Drive in the computer with 2 different computer models. The hard drives tested consisted of 11 Western Digital Drives and 15 Seagate Drives with different drive type and sizes. Both short and long idle DC power was measured for each secondary drive while the AC power was calculated. Table 1 below shows the average measured DC Power for the dataset (52 data points) and average AC power calculated by dividing the measured DC power by the PSU efficiency. With both Short Idle and Long Idle measured and PSU efficiency, the TEC Value (kWh) is then calculated.

Since the 2nd drive sometimes does spin down during the long idle test, the energy consumption of the 2nd drive is lower than the main storage device, as shown in Table 1 below. The current adder approach, based on the main storage energy consumption, needs to be reduced for an additional 3.5" HDD in line with the test results.

Table 1: (Sample size: 52 HDDs)

	Short Idle	Long Idle	PSU Efficiency	TEC Value
DC Power	4.10 w	2.49 w	79%	16.5 kWh
AC Power	5.21 w	3.21 w		

Recommendation: Based on these values, ITI is recommending a 3.5" HDD & 'Other' adder for Desktop and Integrated Desktop to be 16 kWh. Similar analysis may be warranted for Notebooks computers in the next ENERGY STAR Version 9.0.

This adder should also be listed as 3.5" HDD & Other storage devices like the way CEC references this adder. An example of "Other" storage devices would be NVMe or PCI Express add in card storage devices or use of the U.2 storage interface. These storage devices have a very high bandwidth and similar power consumption as a 3.5" HDD and is appropriate that these other devices receive the same adder.

Full Network Connectivity

1. **TEC Analysis of Desktops and Integrated Desktops (S3 sleep mode vs. Alternative Low Power Mode):**

Introduction: EPA, based on prior stakeholder discussion, agreed to consider further incentivizing desktops PCs, with ALPM, to be able to reduce ALPM power down to a limit, that while challenging may be achievable. Industry had proposed such a limit be set at 3W instead of current 2W. Industry had proposed the same plan for integrated desktops. While integrated desktops use some of the notebook components the energy consumption and power management for integrated desktops is not a match for notebooks. The notebook power management is driven by mobile usages and battery life considerations, which is not the case for integrated desktop systems. Hence there is a need to provide integrated desktops incentives similar to desktops to further reduce integrated desktop power in ALPM mode. EPA in its Draft 2 of the specification, raised the Option 2 power limit from 2W to 2.5W to incentivize desktops PCs but no such incentives were provided for integrated desktops. During the follow-up webinar, EPA argued that 2.5W for desktops was based on analysis that any number above that limit (e.g. 3W) will reduce the energy savings potential for ALPM based systems when compared with S3 based desktop systems, and should not warrant an incentive higher than 2.5W. Regarding integrated desktop PCs, EPA contended that providing a similar allowance for integrated desktops would

have an unintended consequence of increasing system TEC as compared to similar S3 based systems. EPA was open to industry analysis on this issue.

Analysis: Industry conducted its analysis using the Draft 2 dataset and came up with the different conclusions based on average of all desktops and integrated desktops respectively.

Option 2: ALPM Power threshold for Incentive – (Breakeven Analysis)

Average Values Per Category	Off	Sleep	Long Idle	Short Idle	TEC (S3)	ALPM Value to have same TEC	TEC (ALPM)	ALPM (Incentive)	TEC (ALPM)
All systems (Average based on measured power)									
DT-ALL	0.66	1.85	23.24	24.5	92.96	5.75	92.99	2.5 / 3.0	77.3 / 79.7
Int DT ALL	0.62	1.82	13.30	27.39	91.63	3.9	91.59	2.5 / 3.0	84.8 / 87.3
All Passing systems (Average based on measured power)									
DT-ALL	0.54	1.28	14.29	15.28	58.44	3.65	58.45	2.5 / 3.0	52.9 / 55.3
Int DT ALL	0.39	1.25	10.02	21.16	69.82	2.85	69.85	2.5 / 3.0	68.2 / 70.6

Summary: While the industry analysis looked at average of all system and average of all passing systems, the recommendation is based on the passing systems that meet the Draft 2 TEC limits. The breakeven point where S3 and ALPM systems have the same TEC is 3.65W for DT systems and 2.85W for integrated desktop systems, with a caveat that this breakeven number may vary by each system within a category, or when looking at average of each Desktop and Integrated Desktop categories. To account for this variation industry is proposing to lower the ALPM power thresholds, which could maintain some advantage over the S3 based systems at the aggregated level.

Recommendations: Industry recommends Integrated Desktop ALPM power threshold to be set at ≤ 2.5W and Desktops ≤ 3.0W, to use the TEC proxy allowance provided in Equation 2.

2. Full Network Connectivity Options and Allowances:

Summary: Since the TEC incentive framework for Desktops and Integrated Desktops is now different from Notebooks in ENERGY STAR Version 8, section (3.5.2), sub-section (iii) need to be modified to address these changes. The current Draft 2 language under Option 1 and Option 2 is confusing and does not adequately address all the form factors. Industry is proposing to keep notebooks requirements for option 1 and option 2 unchanged (same and ENERGY STAR v7.1), while addressing the option 1 and option 2 changes for Desktops and Integrated Desktops separately.

Recommendations: Industry recommends that EPA adopt the following summary table in conjunction with current option 1 and option 2 definitions and simply reference this or a similar table for the requirements and TEC allowance approach.

	Notebooks					Desktops/ Integrated Desktops		
	Option 1 (Full Network Connectivity)				Option 2	Option 1	Option 2	
Require-ments	Base Capability	Remote Wake	Service Discovery/ Name Services	Full Capability	Constant network connectivity and Sleep or ALPM power ≤ 2W	(DT/Int DT) Full Capability	(Int DT) Constant network connectivity and Sleep or ALPM power ≤ 2.5W	(DT) Constant network connectivity and Sleep or ALPM power ≤ 3.0W
TEC Allowance Approach	Table 5 Mode Weightings	Table 5 Mode Weightings	Table 5 Mode Weightings	Table 5 Mode Weightings	Table 5 Full Capability Mode Weightings	Proxy allowance of 0.12 in Equation 2	Proxy allowance of 0.12 in Equation 2	Proxy allowance of 0.12 in Equation 2

Internal Power Supplies (IPS) Allowance

ITI recommends (1) combining desktops with integrated desktops; (2) changing the power supply unit allowance to align with 80 PLUS levels & limits by power supply output; and (3) specifying an efficiency of 80% at 10% load for all cases except 80 PLUS Titanium at > 500 W which requires 90%.

Current EPA requirements for Internal Power Supplies (IPS) are as follows:
ENERGY STAR IPS must achieve: ≤ 500W = 80 PLUS Bronze & >500W = 80 PLUS Gold (not including the 80% eff. @ 10% load as not required by 80 PLUS for either).

The Adders in Table 6 align largely with the Platinum & Titanium levels, which is more achievable for IPS > 500W.

Proposed modifications to Allowance$_{PSU}$:

Draft 2 - Table 6: Internal Power Supply Efficiency Allowance

Power Supply Type	Computer Type	Minimum Efficiency at Specified Proportion of Rated Output Current				Allowance$_{PSU}$
		10%	20%	50%	100%	
IPS	Desktops	86%	90%	92%	89%	0.015
		90%	92%	94%	90%	0.03
	Integrated Desktops	86%	90%	92%	89%	0.015
		90%	92%	94%	90%	0.04

ITI proposal for Table 6: Internal Power Supply Efficiency Allowance (Align with 80 PLUS levels & limits while including 80% eff. @ 10% for all except Titanium which requires 90%).

Power Supply Type	Power Supply Output	Minimum Efficiency at Specified Proportion of Rated Output Current				Allowance$_{PSU}$	80 PLUS Equivalent
		10%	20%	50%	100%		
IPS	≤ 500W	80%	85%	88%	85%	0.015	Silver
		80%	87%	90%	87%	0.03	Gold
	>500W	80%	90%	92%	89%	0.015	Platinum
		90%	92%	94%	90%	0.04	Titanium

ENERGY STAR 8.0 2nd Draft supporting information:

(Page 8 of the Draft 2 Specification)
Table 1: Requirements for Internal Power Supplies with Rated Output of 500 Watts and Below

Loading Condition (Percentage of Nameplate Output Current)	Minimum Efficiency	Minimum Power Factor
10%	80%	
20%	82%	
50%	85%	90%
100%	82%	

Table 2: Requirements for Internal Power Supplies with Rated Output Above 500 Watts

Loading Condition (Percentage of Nameplate Output Current)	Minimum Efficiency	Minimum Power Factor
10%	80%	
20%	87%	
50%	90%	90%
100%	87%	

External Power Supplies
EPA removed $allowance_{PSU}$ from ENERGY STAR version 7.0 that was previously available, as illustrated below, in version 6.0.

Table 5: Power Supply Efficiency Allowance

Power Supply Type	Computer Type	Minimum Efficiency at Specified Proportion of Rated Output Current[ii]				Minimum Average Efficiency[iii]	$Allowance_{PSU}$
		10%	20%	50%	100%		
IPS	Desktop	0.81	0.85	0.88	0.85	-	0.015
		0.84	0.87	0.90	0.87	-	0.03
	Integrated Desktop	0.81	0.85	0.88	0.85	-	0.015
		0.84	0.87	0.90	0.87	-	0.04
EPS	Notebook or Desktop	0.83	-	-	-	0.88	0.015
		0.84	-	-	-	0.89	0.03
	Integrated Desktop	0.83	-	-	-	0.88	0.015
		0.84	-	-	-	0.89	0.04

Recommendation: So that system manufacturers utilizing External Power Supplies have the same allowance opportunities as those with Internal Power Supplies, ITI is proposing the following adders be included in version 8 for Desktops, Integrated Desktops and Thin Clients.
Note: Industry would like to revisit a similar approach for NBs in ENERGY STAR 9.

Power Supply Type	Computer Type	Minimum Average Efficiency @ 10% Load[i]	The average active-mode efficiency at the highest nameplate output voltage[ii]	AllowancePSU
External Power Supply (EPS)	Desktop / Integrated Desktop / Thin Client	80%	1% more efficient than US DOE Level VI	0.04

[i] EPSs shall meet the specified requirements when tested using the *Uniform Test Method for Measuring the Energy Consumption of External Power Supplies, Appendix Z to 10 CFR Part 430.* IPSs shall meet the specified requirements when tested using the *EPRI 306 Generalized Internal Power Supply Efficiency Test Protocol, Rev. 6.6*.

[ii] Average efficiency is the arithmetic mean of efficiencies tested at 25%, 50%, 75%, and 100% of the highest nameplate rated output voltage. EPSs shall meet the specified requirements when tested using the *Uniform Test Method for Measuring the Energy Consumption of External Power Supplies, Appendix Z to 10 CFR Part 430.*

Display Connection Priority

EPA & DOE have proposed the following display connection priority for testing of computers: Thunderbolt, Display Port, USB-C, HDMI, DVI, and VGA.

This may have been acceptable for external monitors to use this display interface connection priority, however for the computers providing these display interfaces it is very different. When a computer uses the Thunderbolt display interface the computer is in a higher power state as compared to using an HDMI display interface. Should EPA & DOE insist on the above display connection priority, any computer using the Thunderbolt connection would warrant a 10 kWh adder.

For the sake of analysis, two different computers were tested that have both an HDMI and Thunderbolt connection. Using a monitor that can provide HDMI and Thunderbolt connections was used with each computer. The table below shows the difference in power values for both computers using different display interfaces

	Difference between Thunderbolt and HDMI power values and TEC				
Desktop Computer	Short Idle (w)	Long Idle (w)	Sleep (w)	Off (w)	TEC (kWh)
#1	2.6	0.5	0	0	7.3
#2	3.2	1.9	0	0	10

Display Resolution

DOE seeks feedback on the value of adding a display resolution requirement to test the maximum supported resolution the computer supports. Almost all computers that require external monitors can support a 4K resolution. However all the testing conducted on computers that the EPA is using to determine TEC Levels, was done using 1080p monitors. If all computers were required to be tested at

4K monitor resolution the computer power at idle would increase by ~ 1 watt for short idle, warranting new analysis and revising base TEC targets.

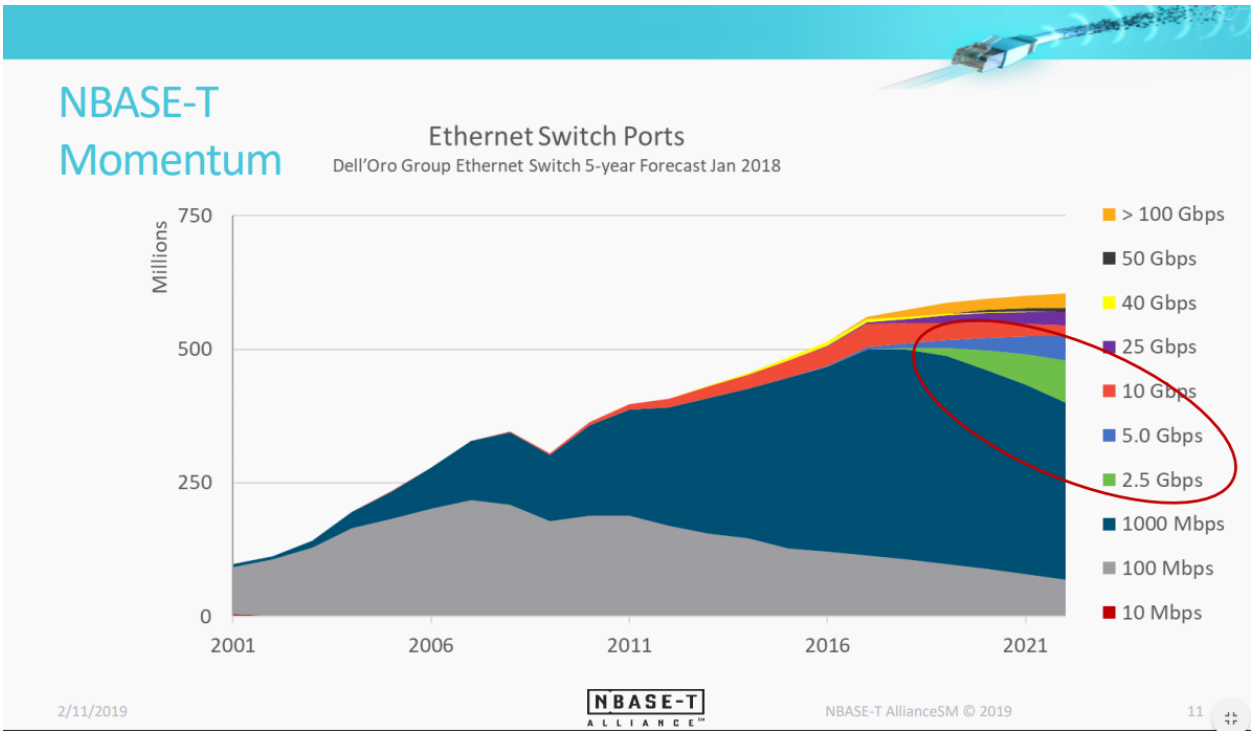
Recommendation: For both **Display Interface** and **Display Resolution** used during testing of Computers that require external monitors, ITI recommends alignment with the California Energy Commission computer standard as follows:

> (D) A computer monitor used in the testing of desktop computers shall have a native resolution of at least 1920x1080 pixels and use progressive scanning. The computer operating system shall be set to operate at a minimum of 1920x1080 pixels and progressive scanning. If multiple display connections are available on the computer, choose the correct connection using the following criteria:
>
> 1. If hybrid graphics is available, choose the port that enables hybrid graphics.
>
> 2. If a discrete GPU is installed, choose a connection to the first GPU, except for where it conflicts with subdivision (D)(1) of this section.
>
> 3. If no discrete GPU is installed, choose a connection to a port integrated into the motherboard.
>
> 4. If there are multiple connector ports to choose from pursuant to subdivisions (v)(5)(D)1. through (v)(5)(D)3. of this section, connect the display to a port using the first available from the port types listed below:
>
> a. Display Port
>
> b. HDMI
>
> c. DVI
>
> d. VGA
>
> e. Other
>
> (E) An integrated desktop computer, mobile gaming system, or notebook computer shall be tested using the integrated display's native resolution.

LAN Adder >1G to <10G:

ITI had proposed an adder of 8 kWh in Draft 1 comments, for computers that can support LAN speeds greater than 1Gbps up to 10 Gbps. The data provided at that time was based on the one LAN chip that is currently in the market at 2.5G. That device is the first of more to come LAN chips that will support network speeds of greater than 1 Gbps and up to 10 Gbps over the next few years.

EPA had inquired about the market penetration of these type of computers that will support high LAN speeds. There is a public report from the NBASE-T Alliance with analysis showing market adoption of different network speeds for computers. https://archive.nbaset.ethernetalliance.org/wp-content/uploads/2019/02/NBase-T-Webinar-Intel-Corporation-Feb-19-1.pdf. Below is from excerpt (page 11) of this report:



Network devices with 2.5 Gbps and 5.0 Gbps will start to come into the market over the next few years. As shown, the adoption of these LAN devices will increase over time. As that happens the penetration of 1 Gbps and below devices will decrease. The chart shows what is expected to happen during the first few years of the ENERGY STAR for Computers Version 8 program.

Page 12 of this report shows how the adoption of these network speeds will be easy for the market to adopt because existing Cat5e & Cat 6 cables that are already installed in great numbers can be used at these increased speeds. These networks speeds will be needed as Wi-Fi access points increase their speed to 1 Gbps. Page 10 of the report shows how 802.11 ax (aka Wi-Fi 6) adoption rates will reach close to 20% of new devices in Q2 of 2019. Wi-Fi 6 can achieve speeds over 1 Gbps.
In another report from Cisco in November 2018 - https://wifinowevents.com/news-and-blog/wi-fi-6-adoption-will-outpace-5g-by-a-wide-margin-says-abi-research/ shows that by the year 2022, 56% of new devices will use Wi-Fi 6.

Recommendation: ITI is recommending that EPA incentivize LAN chip manufactures to decrease power at these speeds between 1 Gbps and 10 Gbps from their initial designs that required an 8 kWh adder. ITI is recommending an adder that is one half of what current devices consume, from Draft 1 proposal of 8 kWh to an adder of 4 kWh. These new network speeds do increase functionality for the computer just like the other adders the EPA has already approved as part of the ENERGY STAR for Computers program.

Adder Type	TEC Adder Value
LAN Adder for connection speed >1G to > 10G	4 kWh

Notebook Storage Adder

Since we're not changing mode weightings for NBs, we recommend keeping the storage adder per v7.1 which was 2.6 for all storage types.

558 559 **Table 10: Functional Adder Allowances for Desktop, Integrated Desktop, Thin Client, and Notebook Computers**

Function		Desktop	Integrated Desktop	Notebook
TEC_{MEMORY} (kWh)[vi]		1.7 + (0.24 × *GB*)		2.4 + (0.294 × *GB*)
$TEC_{GRAPHICS}$ (kWh)[vii, viii]		50.4 × tanh(0.0038 × FB_BW – 0.137) + 23		29.3 × tanh(0.0038 × FB_BW – 0.137) + 13.4
$TEC_{SWITCHABLE}$ (kWh)[ix]		14.4		N/A
$TEC_{STORAGE}$ (kWh)[x]	3.5" HDD	21		26
	2.5" HDD	2.1		2.6
	Hybrid HDD/SSD	0.8		1.0
	SSD (including M.2 port solutions)	0.4		0.5

Recertification

Notebooks

EPA has indicated a willingness to clarify in the cover memo for the Final Specification when recertification is necessary versus retesting, providing direction to CBs. It is expected that only a small number of notebook computers that exhibit cyclical behavior will require retesting.

WorkStations

Based on earlier conversations, while mode weightings have changed, the pass rate has increased, hence retesting should not be necessary for Workstations already on the QPL.

Sincerely,

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Appendix A: ENERGY STAR® Qualified Products List (QPL) vs Market Pass Rates

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The ENERGY STAR program has a stated goal that the number of systems able to pass the specification criteria will represent approximately 25% of the total market at the initiation of a new specification. We will refer to this as a target penetration rate. Calculation of performance limits ti achieve the target penetration rate can only be performed on the QPL data base or a modified version of the QPL data base which has additional system measurements added to it. For the purposes of this analysis we will assume the QPL data without modifications or additions as modifications to the QPL make the analysis nearly un implementable.

The first thing we need to reconcile is that the only data available for calculating the penetration rate is the annual Energy Star reported sales data and total market data such as that published by IDC. It is not possible when analyzing the QPL data base to factor in the expected volume of each individual model in the data set as this data is not publicly available. When analyzing the QPL data base the only option for making this assessment is evaluating the ratio of passing to failing systems. It is therefore necessary to establish some correlation between the QPL pass rate and the expected Energy Star market penetration.

First we need to deal with the market volume penetration versus the pass fail rate of the QPL. The QPL is a set of data for each model certified to the current Energy Star specification. We therefore have to assume an even distribution of sales volumes across the QPL data set. This assumes that if half the QPL systems pass the proposed limits then the passing systems in the market would be half of the total QPL systems in the market by sales volume.

Next we have to deal with the fact that the number of systems in the QPL is not the total number of systems available in the market. We therefore cannot set limits that pass 25% of the QPL systems since the QPL systems are not the total market and the actual pass rate for the total market would be lower.

We will determine the necessary QPL data base pass rate required to achieve the desired 25% pass rate in the market.

Equation 1

$$\frac{X}{Total\ Market} = 0.25$$

Where:

X = number or quantity of passing systems

Total Market = number or quantity of systems in the whole market

Equation 2

$$\frac{X}{QPL} = A$$

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Where:

QPL = number or quantity of systems in the QPL data base

Equation 3

$$\frac{QPL}{Total\ Market} = B$$

Solving Equation 1 for Total Market, substituting this value into Equation 3 and then solving the resulting equation for A or X/QPL yields the following:

$$A = \frac{X}{QPL} = \frac{0.25}{B}$$

Where:

A = Required QPL pass rate to achieve 25% pass rate in total market.

0.25 is desired total market pass rate.

B = QPL percentage of the total market

If the QPL represents 80% of the total market then the required pass rate of the QPL data set in order to achieve a 25% pass rate in the total market is 0.25/0.8 = 31.3%.

This of course assumes that all systems not currently in the QPL will also not be in the QPL after the new requirements are in place.

2018 reported total Energy Star desk top sales volume was 9.963 million units. The IDC reported desk top sales volume is 15,914,592 or 15.915 million. That shows the QPL percentage of the market (B) to be

62.6%. This means that the EPA should target a 0.25/.626 = 39.9 % pass rate using the current QPL data only data set to hit their stated target of 25% pass rate in the market.

The current analysis database being used for ENERGY STAR Computers version 8.0 is a mixture of QPL data and non QPL data. If it is desired to use the entire existing data set then some adjustment is necessary to get a target data set pass rate that will correlate to a 25% of the total market. The QPL data is 853 data points out of a total of 1011 data points. That results in the QPL being 84.4% of the current dataset.

When factoring in the amount of QPL systems in the dataset and the market penetration of Energy Star computers in the market the 39.9% pass rate is multiplied by 84.4% (QPL % of the dataset). The result is a value of **33.7%** which could be an alternate method of calculating base values using the entire existing data set and not just the QPL portion systems. This method could also provide a mathematically justifiable method of achieving the intended goal of top 25% of the shipping systems in the market.