



Ernest Orlando Lawrence Berkeley National Laboratory

MEMORANDUM

To: Christopher Kent (US EPA)
From: Marla Sanchez, Bruce Nordman (LBNL)
Re: On Mode power analysis to support Draft 2 ENERGY STAR Display specification Version 5.0
Date: 10/20/2008

This memo summarizes key changes to the Draft 2 ENERGY STAR Displays specification Version 5.0.

Sleep and Off Mode Requirements

Table 1. Draft 2 ENERGY STAR Sleep and Off Modes Requirements: Tier 1

Product Type	Sleep Mode (W)	Off Mode (W)
Less than 30" viewable diagonal screen size	≤ 2	≤ 1
Greater than or equal to 30" viewable diagonal screen size	≤ 4	≤ 2

Table 2. Draft 2 ENERGY STAR Sleep and Off Modes Requirements: Tier 2

Product Type	Sleep Mode (W)	Off Mode (W)
All displays	≤ 1	≤ 1

Key Change: Tier 1 requirements for displays greater than or equal to 30" viewable diagonal screen size relaxed to 4 W (Sleep) and 2 W (Off) in order to maintain a 25% pass rate. Tier 2 Sleep and Off mode requirements are 1 W for all products.

Sleep Mode definitions as well as language in testing protocol was revised to ensure that all displays qualifying under the specification meet the On, Sleep, and Off Mode requirements.

Luminance Testing Requirements for On Mode Power

Prescribed luminance settings were established for displays. Prescribed settings were set in order to better represent use conditions, while ensuring that the vast majority of displays' luminance ranges would allow for testing at the new ENERGY STAR prescribed luminance settings. This will ensure that lower resolution monitors are not given an advantage over higher resolution monitors.

Table 3. Prescribed luminance settings for Draft 2 specification

Product	Cd/m²
CRTs only (all)	100
< 30", ≤ 1.1 MP	175
< 30", > 1.1 MP	200
≥ 30"	350

*MP = megapixel

Currently, plasmas in the dataset have luminance settings significantly lower than the proposed 350 nits. We are awaiting additional data on plasma displays to further review this effect.

Automatic Brightness Control

The Draft 2 specification recognizes models with automatic brightness control (ABC). To account for the power savings achieved through ABC, where the feature is activated by default when shipped to the customer, On Mode power consumption will be determined as follows:

Power = 0.8 * Power1 + 0.2 * Power2. This assumes the display will operate in low ambient light conditions 20% of the time. Power1 is the average On Mode power in watts rounded to the nearest whole number and tested with a minimum ambient light level of 300 lux entering the sensor directly; and Power 2 is the average On Mode power consumption in watts rounded to the nearest whole number, and tested with an ambient light level of 0 lux entering the sensor directly.

The test procedure has been updated in the Draft 2 specification to account for ABC.

On Mode Power Requirements

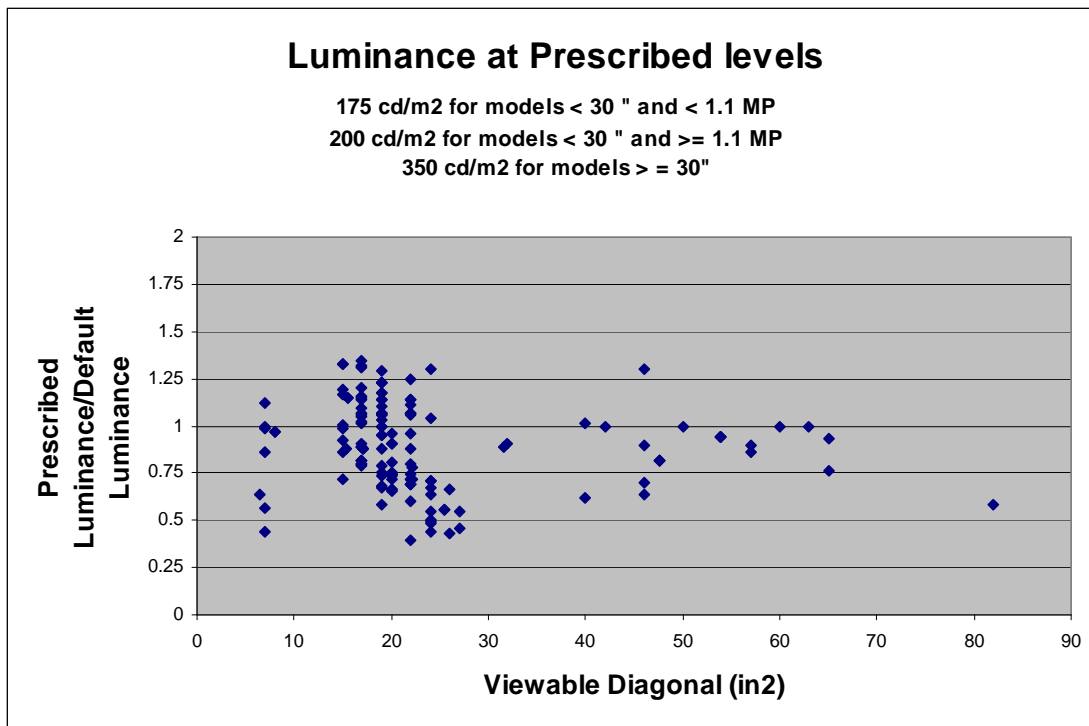
On Mode power requirements were established using the prescribed luminance settings in Table 3. For units to be tested at 175 cd/m², we used Partner-submitted data corresponding to the On Mode power testing result under the current ENERGY STAR setting (175 nits). This applies to all models of less than 30 inches viewable diagonal screen size and less than or equal to 1.1 megapixel resolution.

Our objective was to scale up power consumption for the population of models to be tested at the new settings of 200 and 350 nits in a systematic way. For models to be tested at 200 or 350 nits, we used the Partner's four submitted data points (Monitors specification Version 4.2 luminance setting of 175 cd/m², minimum luminance, default luminance, and maximum luminance) to determine a luminance to On Mode power relationship. We used this relationship on a model-by-model basis to adjust the On Mode power consumption to the appropriate prescribed luminance setting. We checked the accuracy of our estimated relationship by calculating the On Mode power at the current ENERGY STAR setting and then checking this estimate against the Partner-submitted

On Mode power data. We found high levels of consistency with a +2% difference in predicted vs. actual across the entire dataset, meaning that overall we observed a greater tendency to overestimate as opposed to underestimate power consumption.

Out of the 149 models whose data Partners submitted, we flagged nine models where the difference exceeded 10%.

To illustrate how representative the new settings are when compared to the default settings, we prepared Figure 1, below. If a data point has a prescribed/default luminance ratio of 1, this indicates the default luminance is exactly equal to the new ENERGY STAR prescribed luminance. If the ratio is greater than 1, the prescribed setting is higher than the default setting. If the ratio is less than 1, the prescribed setting is lower than the default setting.



Note we factored ABC into the specification line. We applied the 80/20 breakdown by summing the estimated power consumption at the ENERGY STAR prescribed luminance setting multiplied by 0.8 and the reported power consumption at minimum luminance multiplied by 0.2 for models in the dataset with ABC. Overall, this resulted in a 6% savings across the 25% of models in our dataset that had ABC. We believe this is a conservative estimate, but it is the only estimate we can make with the data we have.

Based on this analysis, the new specification equations are as follows:

Table 4. Draft 2 specification requirements, On Mode

Product	On Mode Power Requirement (W)
< 30", ≤ 1.1 MP	$P = 0.05 * A + 6 * MP + 3$
< 30", > 1.1 MP	$P = 0.05 * A + 9 * MP + 3$
≥30"	$P = 0.12 * A + 35 * MP + 4$

The following is a summary of pass rates:

Table 5: Pass Rates

Product	Count (n)	Pass On Mode (n)	% Pass On Mode	Pass All Modes (n)	% Pass All Modes
Digital Frames	9	2	22	1	11
15 & 16" Monitor	12	4	33	4	33
17 and 19" Monitor	48	10	21	10	21
> 19" Monitor	49	12	24	12	24
Professional Displays	23	7	30	6	26
All	141	35	25	33	23

Note: CRT models removed from analysis. CRT models are unable to meet the proposed specification.

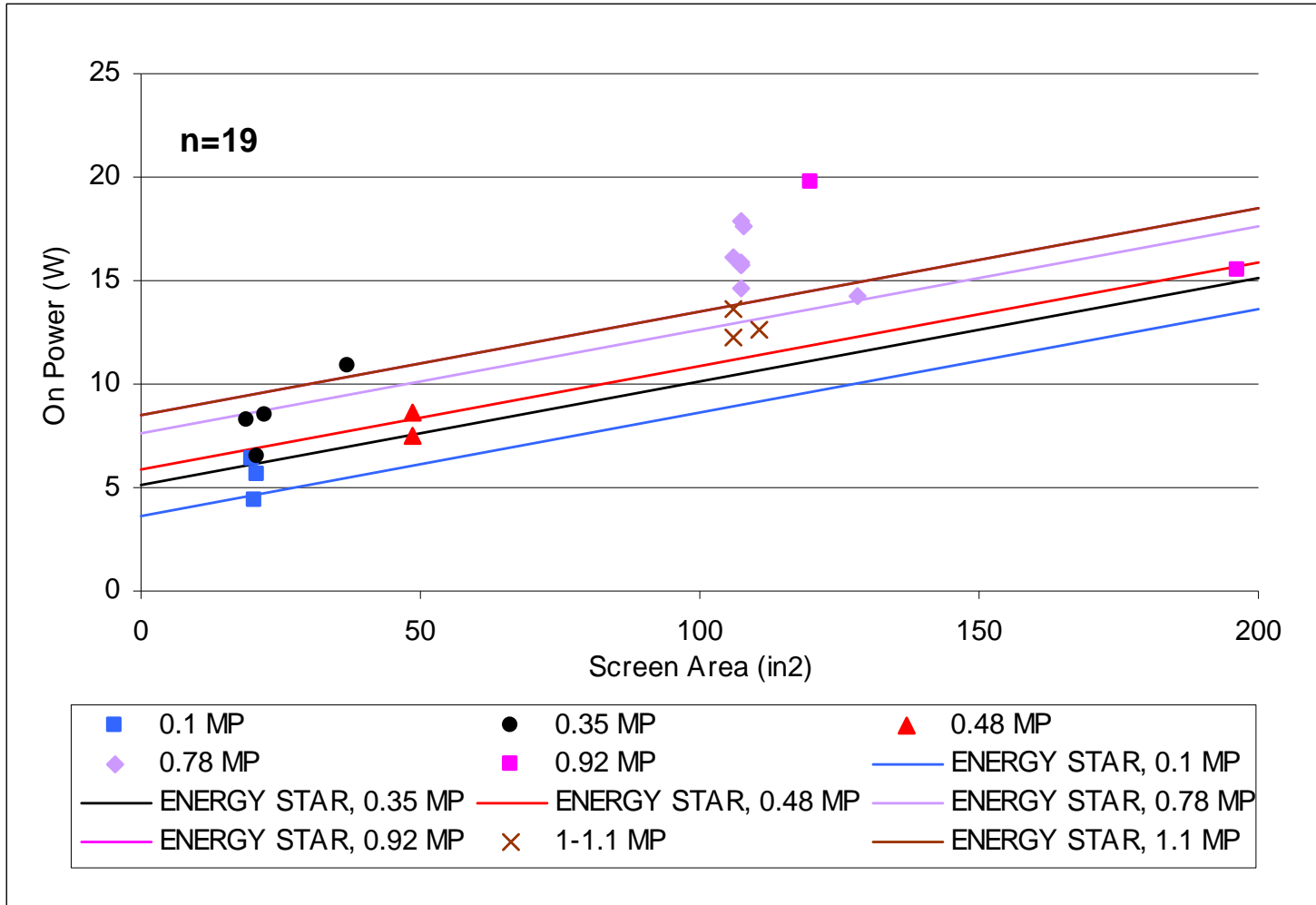
The following summarizes expected savings for the Draft 2 specification

Table 6. Expected ENERGY STAR Displays Savings.

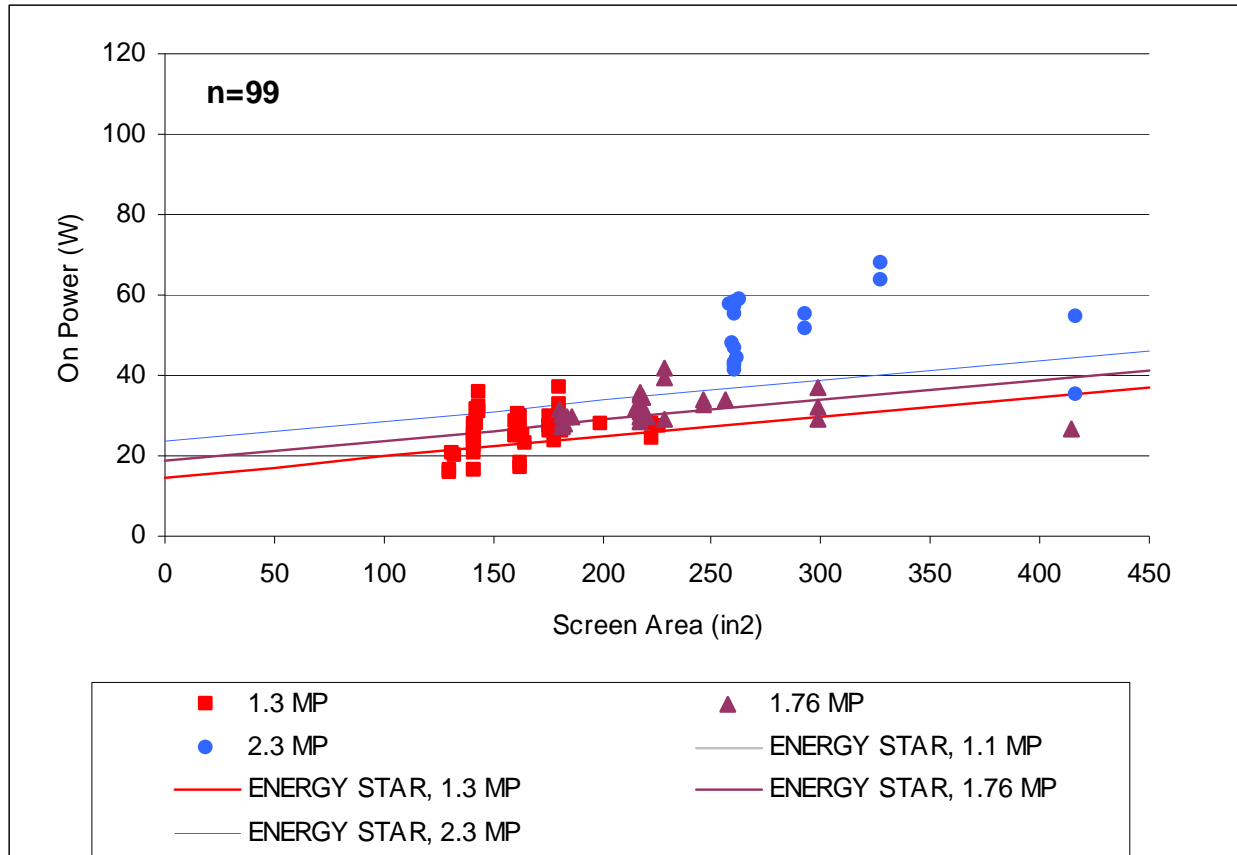
	Average Market Energy Star Case				Per Unit % Reduction
	count (n)	On (W)	On (W)	Delta On (W)	
Digital Picture Frames, All	9	7.4	6.2	1.2	17%
Professional Displays, All	23	281	225	55.6	20%
LCD Monitors, All	109	30	26	4.7	16%
All Included Displays	141	70	57	12.8	18%

Product Type	Expected 2009 US sales (000)	Base kWh/yr	ESTAR (kWh/yr)	UES (kWh/yr)	Percent Savings	Lifetime Savings (kWh)	Lifetime lbs CO2
Professional Displays	2800	2460	1973	486.7	20%	1947	2,998
Digital Picture Frame		64.9	54.0	10.8	17%	43	67
Office LCD Monitor							
-15 and 16"	212	36.0	32.1	3.9	11%	15	24
-17"	3480	54.0	48.8	5.2	10%	21	32
-19"	25293	63.1	52.8	10.3	16%	41	63
-Greater than 19"	13452	85.8	72.4	13.4	16%	54	82
-Shipment Weighted LCD Monitors	42437	69.4	58.6	10.8	16%	43	67

Less than 30" viewable diagonal, less than or equal to 1.1 MP resolution



Less than 30" viewable diagonal, greater than 1.1 MP resolution



Greater than or equal to 30" viewable diagonal

