ENERGY STAR® Computers (Ver. 6)

Product Specification – Draft 2

ITI Presentation

May 23, 2012

Agenda

Topic	**Company**	Duration
Computers Draft 2 – ITI Comment Summary	**Intel**	10 min
Desktops, AIO, and Notebooks (Dataset, base TEC targets, display adders, alternative category proposal)	**Intel/Apple**	30 min
Slates and Mobile Computing approach	**Intel/Apple**	10 min
Client Discrete Graphics (classes, adder approach)	**AMD**	15 min
Workstations	**Intel/Dell**	10 min
Small-scale servers	**Dell**	10 min
Thin Clients	**HP**	10 min
Test methodology	**Intel**	10 min
Additional Considerations/Opens	**Intel**	10 min

Computers Draft 2 – ITI Summary

- While draft 2 client dataset has improved, serious issues remain; Industry reserving judgment on base TEC limits
  - Pending resolution on display and graphics adders methodology
- Industry is concerned on new TEC methodology V6 readiness
- Industry supports new client category system
- Slates should be covered under separate BCS program, and not be part Energy Star Computers program
- SPECWorkstation benchmark is not validated for Ver. 6.
- Thin Clients approach needs to be in line with product category and usage models
- Industry welcomes moving NEA in the Partner commitment doc

Desktops, Integrated Desktops, and Notebook PCs

(Dataset, base TEC targets, display adders, alternative category proposal)

Display Adder/ Base TEC Observations

- Display Adder:
  - New Display adder equation appears to be expressed in W, not TEC (kWh) as stated
  - The new display adder equation was used by Industry to understand it's correlation with (Psidle-Pidle) delta. The equation generated display adders on average to be 1.25 times the (Psidle-Pidle) delta. We were expecting display contribution to be > 50% but <100%.
  - This error leads to artificially setting lower base TEC values. The display adder equation needs to be further tuned, as it needs to correlate well with (Psidle-Pidle) delta.
- Desktop/AIO systems:
  - Current display adder equation is approximate at best, it is imperative for display adder to be accurate for AIO and DT systems to be comparable for TEC calculations.
  - AIO systems use display adders while the DT systems don't; any display adder error will impact DT systems more for base TEC calculations.

Display Adder/ Base TEC Observations

- Concerns:
  - Energy Star V5 data (~90% of dataset) without the display adder adjustment, will overestimate the base TEC of these systems. These older systems with higher base TEC will further put these systems in the bottom 75% quartile for TEC target setting. Need to understand how this would impact the final TEC targets.
    - Proxy for short idle is approximate at best
  - New Display adder equation does not appear to have be used in the latest EPA dataset (on website). Need to understand how display adders were calculated
- Recommendation:
  - Finalize dataset with revised display adder equations (check [psidle-pidle] correlation)
  - Apply the dataset to ITI proposed performance based category system, and compare outcome
  - Set up accurate TEC targets for DT/AIO and NB systems

Is new TEC methodology ready for Energy Star V6?

Display Adder Formulas

Information Technology Industry Council
Leading for the Innovation Economy

	DT	NB
Tsidle	0.35	0.3

Source	Diag Size	Equations	A	R	Constant
Draft 1 spec	d<12	TEC = (1971/250)*(0.1167*A + 2*r + 1)	0.92	15.77	7.88
	12<=d<25	TEC=(657/125)*(0.00725*A + 3*r + 2)	0.04	15.77	10.51
	25<=d<30	TEC=(657/125)*(0.09*A +3*r - 20)	0.47	15.77	-105.12
Draft 1 equation	d<12	8.76*NBTsidle*[0.05*A + 6*r +3])	0.13	15.77	7.88
conv to energy	12<=d<25	8.76*NBTsidle*(0.0145*A + 6*r + 4)	0.04	15.77	10.51
	25<=d<30	8.76*NBTsidle*(0.18*A + 6*r - 40)	0.47	15.77	-105.12
	d<12	8.76*DTTsidle*(0.05*A + 6*r +3)	0.15	18.40	9.20
	12<=d<25	8.76*DTTsidle*(0.0145*A + 6*r + 4)	0.04	18.40	12.26
	25<=d<30	8.76*DTTsidle*(0.18*A + 6*r - 40)	0.55	18.40	-122.64

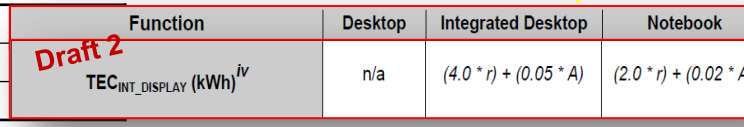
- EPA Formulae's for display adder are wrong
  - Spreadsheet is calculating power (not energy, see blue equations above)
  - Draft 1 spec gives TEC equations using wrong Tsidle constant (uses notebook value for all systems, see green/correct and red/wrong formulas)
    - Creates artificially high display adders for integrated desktops

Formula changed, calculates power not TEC; need further validation

- Should be:

d<12	8.76*Tsidle*[0.05*A + 6*r +3])
12<=d<25	8.76*Tsidle*(0.0145*A + 6*r + 4)
25<=d<30	8.76*Tsidle*(0.18*A + 6*r - 40)

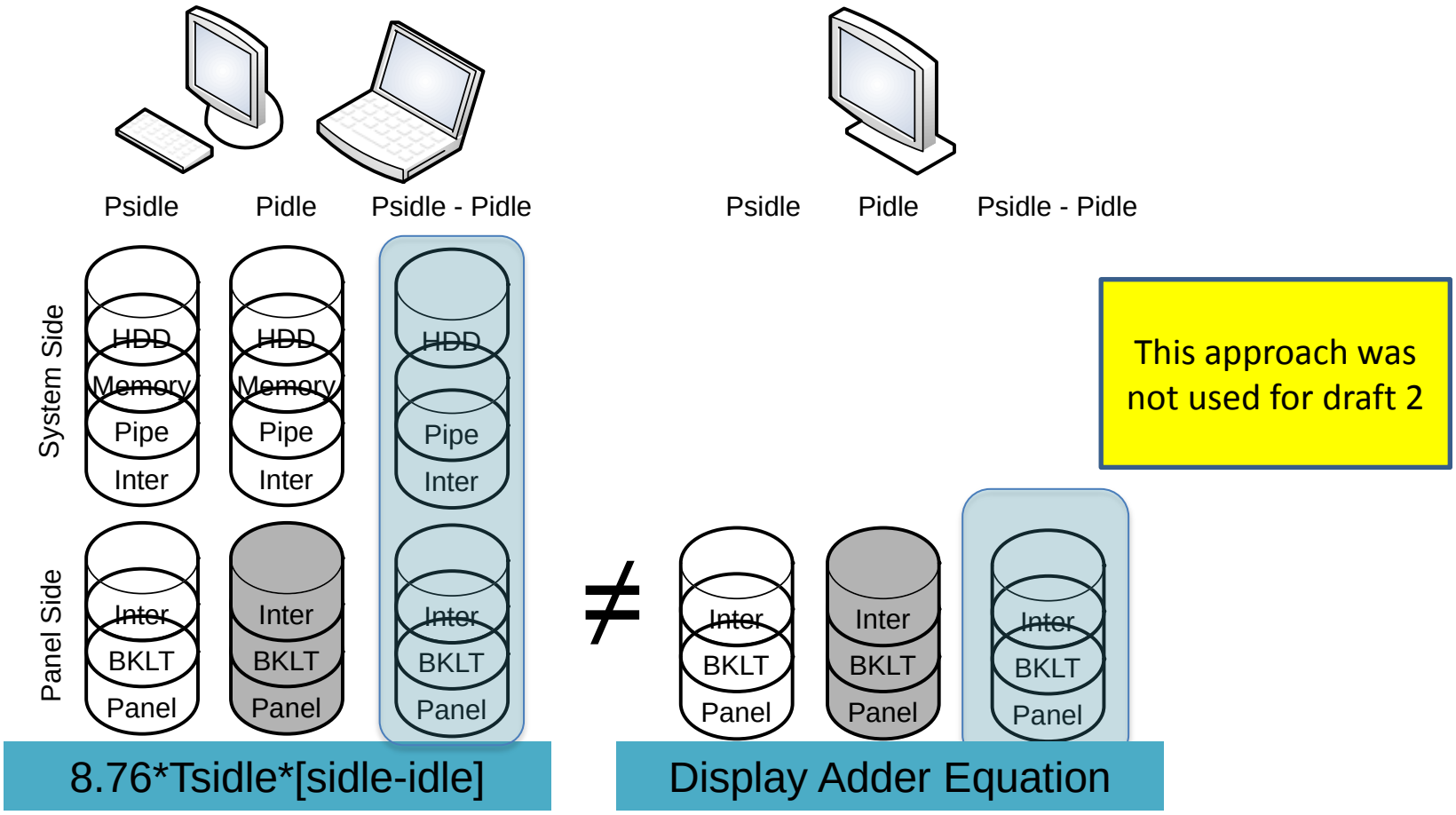
No 8.76*Tsidle Multiplier??



- Formulas seem to generate very high display adder values
  - What brightness level are they tuned for?
  - Same as client computer spec?

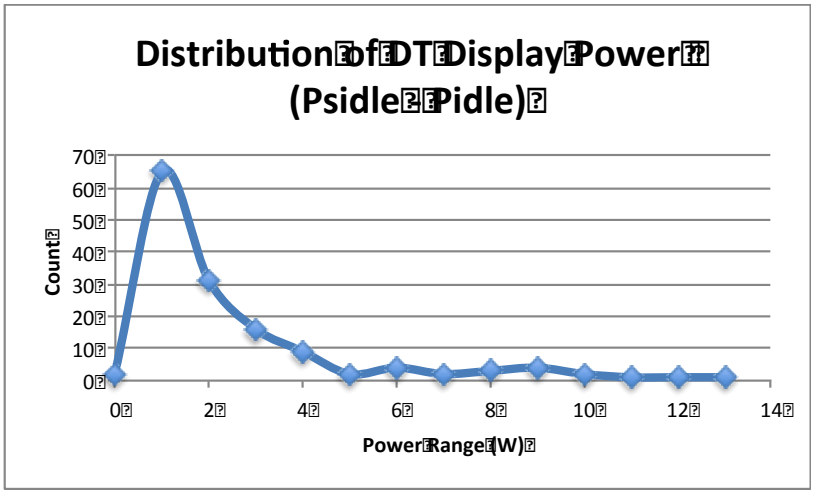
V5.2 record Display Adder Energy Correction

(issues with use of [Tsidle-Tidle] correction)

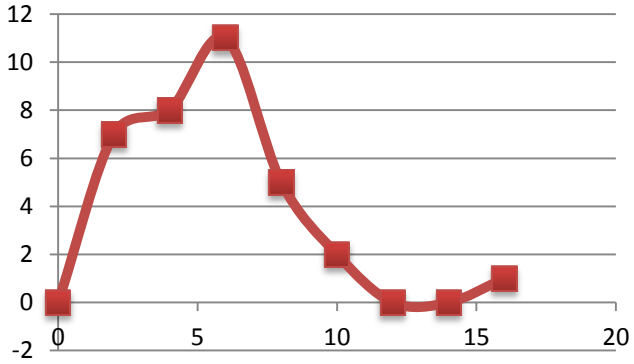


- [sIdle-Idle] Over-estimates the panel impact (used to correct V5.2 data records)
  - Most of the power are non-panel related items (HDD spinning, memory, pipe, interface power)
  - It obviously doesn't correlate to the display equations
- Display equations only estimate impact power adder due to panel side of equation

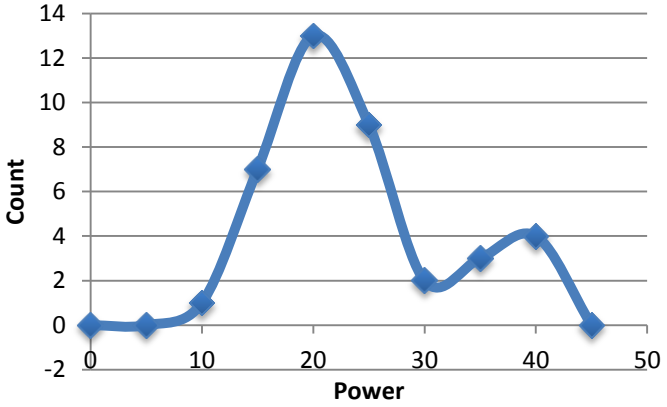
AIO/NB Display Power Distribution



NB Display Power Distribution
(Psidle-Pidle)

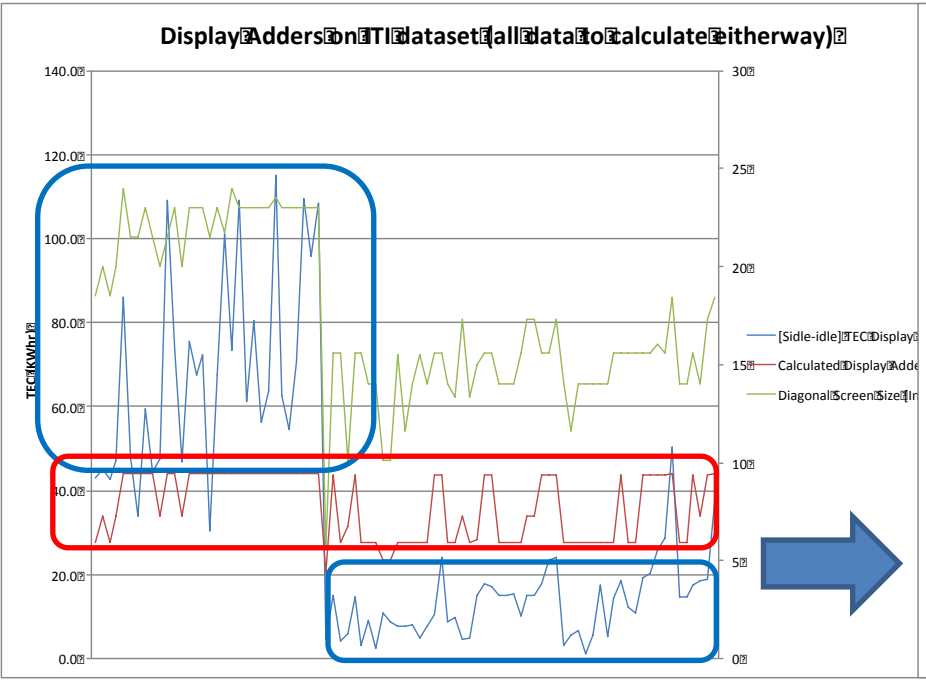


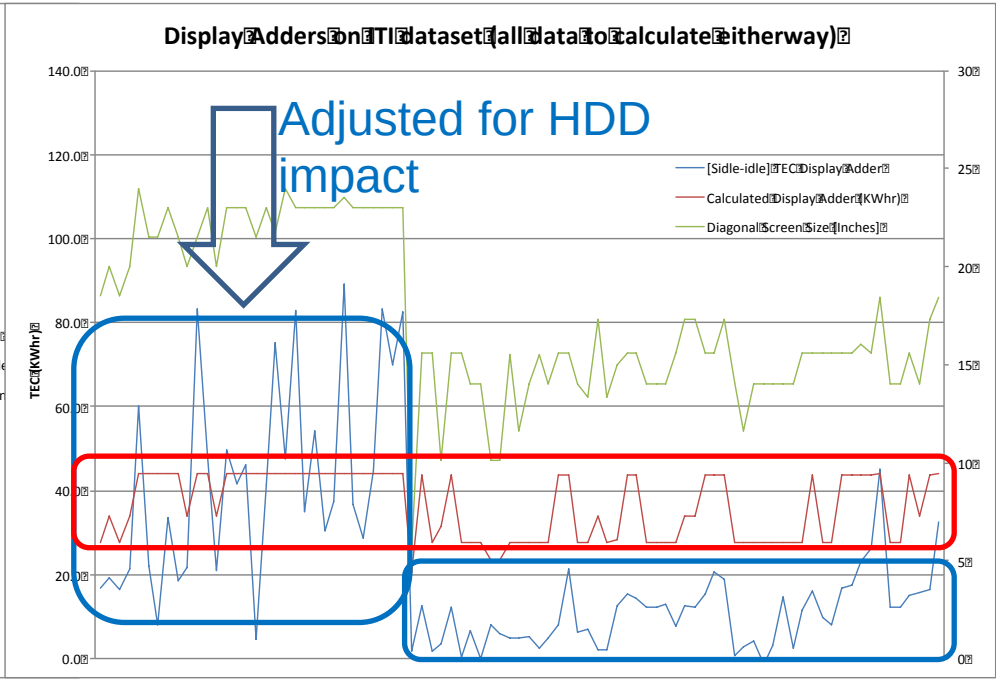
AIO Display Power Distribution
(Psidle-Plidle)



- Shows range of [Tsidle-Tidle] for different platforms
  - Should break NB/AIO by display size
  - Desktop has a non-zero power delta (~2-5W),
    - treating as zero for setting limits is OK
- Not all of this power delta is attributed to the display

Display Adder [sidle-idle] Correction





This approach was not used for draft 2. Ver. 6.0

Proposed Approach:

- Display Adder: still start with (Tsidle-Tidle) but:
  - Remove HDD power from system (2.5” for notebook, 3.5” for desktop) (right)
  - Remove the HDD power from a 2nd HDD (if present)
  - Remove estimated memory, pipe and interface power
- Right side graph shows corrections added (see how blue line is balancing)
- Red “Display Adder” energy still seems high

Display Impact due to technology and size

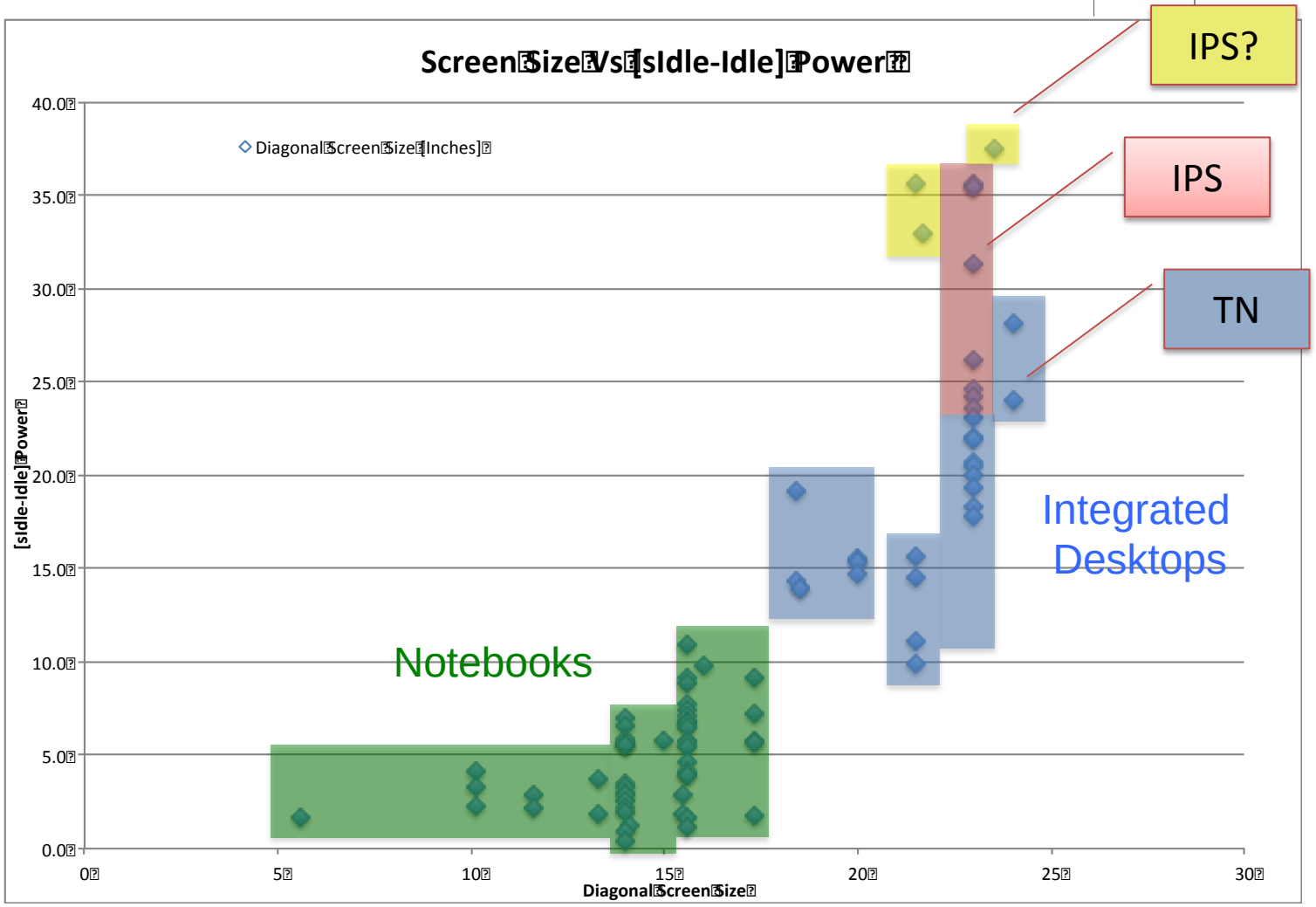
- ITI Data clearly shows impact due to newer display technologies (such as IPS panels versus traditional TN panels)
  - For the same size/resolution, the IPS panels have a much higher power impact
  - Unless an adjustment is available (adder), systems with such panels will not be available to ENERGY STAR systems
- Data
  - ITI dataset has a number of systems with IPS panels (will show this analysis) and display size
  - ITI is showing new data of IPS Versus TN panels (will show this analysis) and display size

Proposal:

- Create a technology specific adder for IPS displays (based on data)
- Investigate bringing in display size to the V5.2 data (EPA can only do this as they have model numbers) to better match display sizes (we show there is distinct correlation between display size and power)

Need to understand how EPA came up with 1.2 multiplier

Display Analysis



- Display Power is highly influenced by Size and Type

Data shows 1.2 multiplier is not sufficient

Category Issues & Alternative Category Proposal

Why a New Client Category Proposal

Issues & Learning

- Entry Errors in dataset (testers are entering wrong data)
  - Graphics Classes
  - Attributes are too complex to understand by tester (Example -Memory Channels)
- Need to separate the lower capability systems from higher capability systems (categories)
  - Current category system based on cores/memory channels as proxy for high-end/low-end is not always workable
- Learning from Energy Star V5: Fix dGfx definition issue (Done), and coverage to ensure broad dGfx representation for V6
  - Today V5 systems are approaching 25%
  - Issue replicated globally (ErP, Japan, …)
- Ecma has defined new discrete Graphics Classes and system categories
  - dGfx based on frame buffer bandwidth (as proxy for GPU performance)

Proposed Resolution

- Automate category enumeration (SW program)
  - Attributes are available in current ENERGY STAR dataset
  - Can write a program to access attributes automatically for future testers
- New Category based on a CPU Perf proposal to separate lower capability systems from higher capability systems

  CPU Perf = [# of CPU cores]*[CPU base freq.]
    - Possibility for easy automation (Both attributes in current ENERGY STAR dataset)
  - Like graphics classes, perf category is a range of Perf values
- Separate iGfx and dGfx categories to allow appropriate dGfx system representation
  - Not competing with lower energy iGfx systems
- No Changes to dGfx classes; Ecma process allows system category changes through the Ecma 383 category registry
  - Similar to graphics class change control

Key Elements of Methodology

Information Technology Industry Council
Leading Policy for the Innovation Economy

Categorization Goal: Establish system categories based on like products with similar capability, within each category.

Today's System Category

- Category separation based on product attributes
  - Memory Channels, number of CPU cores, Memory Size, etc. are used
  - Analysis shows this no longer works
- Graphics Class separation based on discrete graphics capability (Ecma-383)
  - Bandwidth ranges as a proxy for performance
- Other capabilities that distinguish power
  - Display size and technology (new for V6)
- Additional allowances for other capabilities
  - Hard drives; Audio, networking, TV Tuner (new for V6)

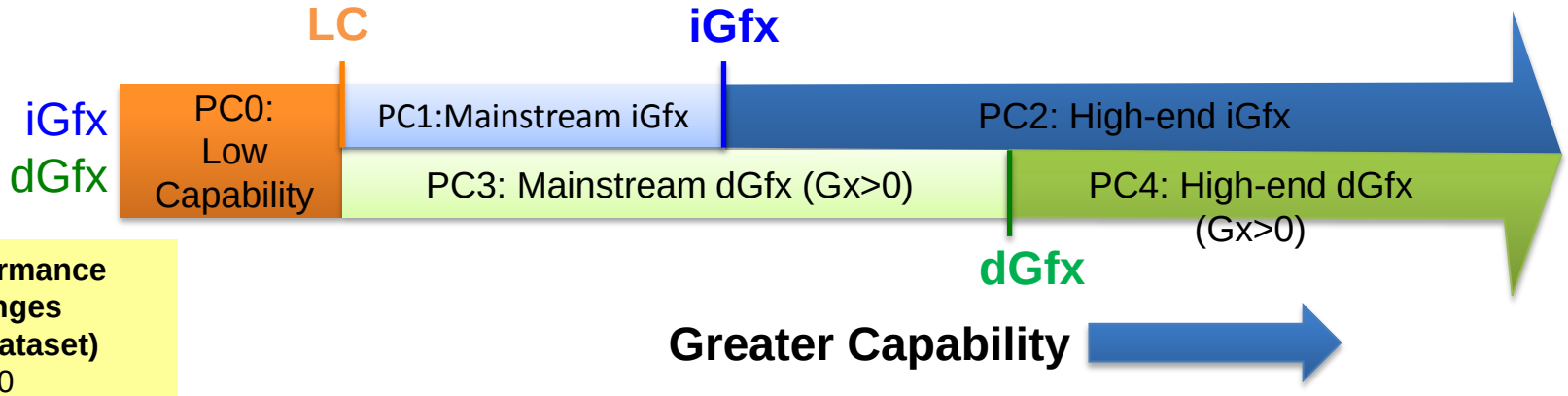
Proposed System Category Changes

- Product Capability (category) based on new CPU Performance Class proposal
  - Ranges of performance based on [# CPU Cores]*[Base CPU Freq]
  - Not a criteria for pass fail, but a system for categorizing products
- Consistent category approach across Notebooks, AIO and Desktop computers
  - Cat0: Lower capability systems(iGfx and dGfx systems)
  - Cat1-Cat2: All mainstream and high-end integrated graphics based systems
  - Cat3-Cat4: All mainstream and high-end discrete graphics based systems

No Change to System Categorization Goal

New System Categories Concept (based on Performance Classes)

- Similar to dGfx approach, each system category gets its own Performance Class (range of performance within each system category)
  - NB, AIO or DT



Performance ranges (ITI dataset)
NB: 1 – 10
DT: 1.6 – 33.6
AIO: 3.2 – 13.6

Performance Class	Performance Range	System Description
PC0	P < LC	LC=Low Capability
PC1	LC <= P < iGfx	Main stream iGfx
PC2	P > iGfx	High-end iGfx
PC3	LC <= P < dGfx	Main stream dGfx
PC4	P > dGfx	High-end dGfx

ITI discussing whether to keep AIO separate from DT

V6 Category Proposal (Details)

Information Technology Industry Council
Leading Policy for the Innovation Economy

Current Ecma Categories

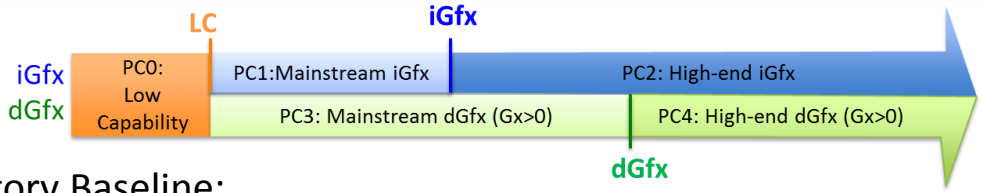
V6 Original Categories

Notebook	NB0	NB1	NB2	NB3	NB4
Market	netbook	lowend	mainstream	performance	high-end
cores	N/A	cores ≤ 2	cores = 2	cores ≥ 3	cores ≥ 3
Mem Channels	ch mem = 1	ch mem = 2	ch mem ≥ 2	ch mem ≥ 2	ch mem ≥ 2
Screen Size	screen size ≤ 12.1	Screen size ≤ 13.3"	Any screen size	Any Screen size	Any screen size
Base Memory (GB)	1	2	2	2	4
Base Gfx	igfx	igfx	igfx	igfx	G3
Gfx Adders	dGfx ≤ G7	dGfx ≤ G7	dGfx ≤ G7	dGfx ≤ G7	G3 < dGfx ≤ G7

Desktop/AIO	DT0	DT1	DT2	DT3	DT4
Market	Entry	Mainstream	Performance	Highend	Very high end/enthusiast
cores	N/A	cores ≤ 2	cores ≥ 3	cores ≥ 4	cores ≥ 5
Mem Channels	ch mem = 1	ch mem = 2	ch mem ≥ 2	ch mem ≥ 2	ch mem ≥ 2
Base Memory (GB)	1	2	2	4	4
Base Gfx	igfx	igfx	igfx	dGfx ≥ G5	dGfx ≥ G5
Gfx Adders	dGfx ≤ G7	dGfx ≤ G7	dGfx ≤ G7	dGfx ≥ G6	dGfx ≥ G6
PCIe					PCIe ≥ 2

New Energy Star V6 Client Category proposal (CPU Perf based)

Description	CAT 0	CAT 1	CAT 2	CAT 3	CAT 4
NB Performance (p)	p<NBLC	NBLC<=p<NBiGfx	p>=NBiGfx	NBLC<=p<NBdGfx	p>=NBdGfx
DT Performance (p)	p<DTLC	DTLC<=p<DTiGfx	p>=DTiGfx	DTLC<=p<DTdGfx	p>=DTdGfx
AIO Performance (p)	p<AIOLC	AIOLC<=p<AIOiGfx	p>=AIOiGfx	AIOLC<=p<AIOdGfx	p>=AIOdGfx
Graphics Class	Any	G0	G0	Gx>0	Gx>0
Graphics Baseline	G0	G0	G0	G1	G1
Memory Baseline	1GB	1GB	1GB	1GB	1GB
Note: p =[# of CPU cores]*[CPU base freq.]					



Example

Notebook Range		
NBLC	NBigfx	NBdgfx
2	5.2	9

Desktop Range		
DTLC	DTigfx	DTdgfx
3	7	9

AIO Range		
AIOLC	AIOigfx	AIOdgfx
4	6.6	10

- Perf Category Baseline:
  - iGfx baseline TEC: 1 GB Memory, No TV Tuner, No discrete Audio, 1 HDD,
  - dGfx baseline TEC: iGfx baseline + G1 class adder
  - Additional adders adjusted to above baseline
- Performance Range: Separate tunable ranges for DT, NB, AIO

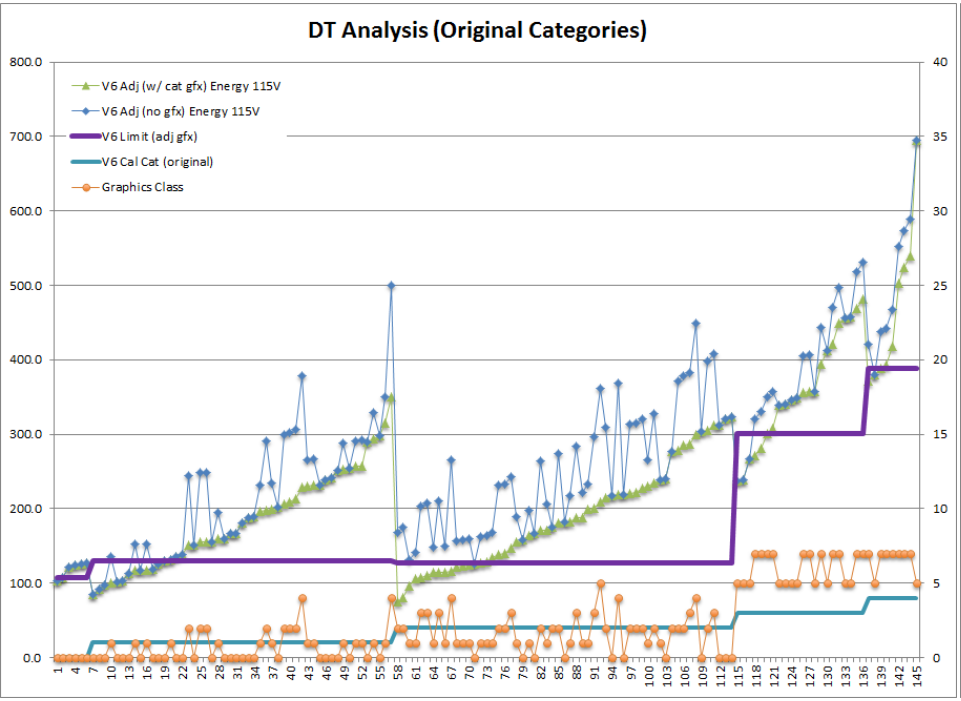
Setting Performance Range

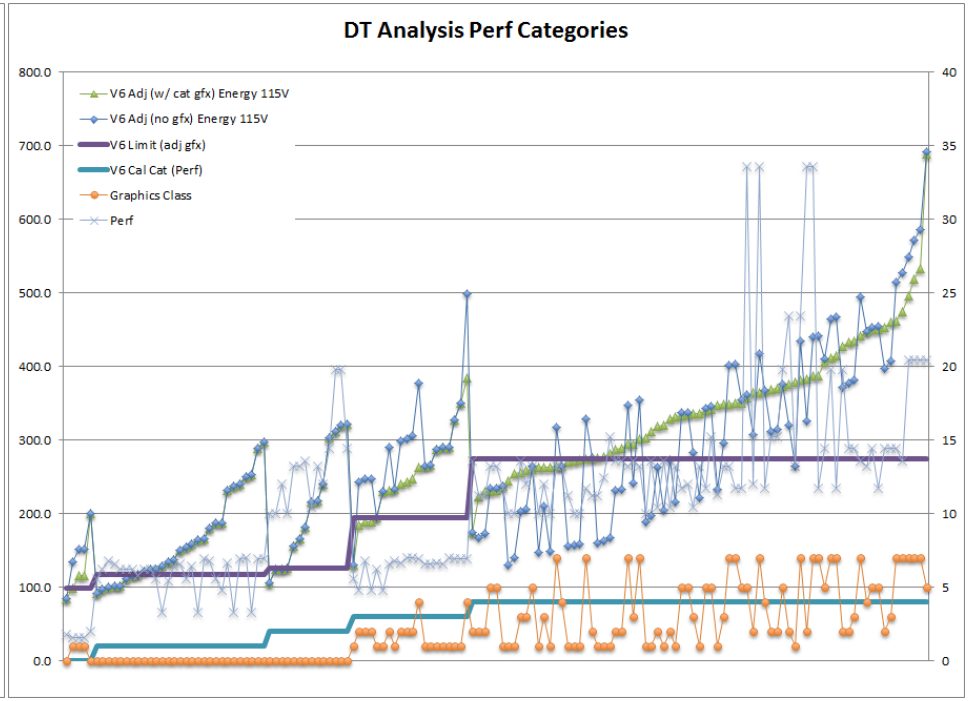
- Low-Capability(LC)
  - Set range such that low capability systems are grouped together
- Main-stream Vs. High-end
  - Set range to get even a distribution between main-stream and high-end systems (in separate iGfx and dGfx categories)

Data Analysis

- Example DT charts (original vs. new)
  - Focus on well-behaved TEC trending
  - Distribution of system in each category
- Pass/fail distribution table (original vs. new)

Performance Categories/Desktops





- Original Categories
  - Same TEC Limits for DT1 and DT2
  - Similar TEC dynamic ranges between DT1 and DT2
  - Very few systems in DT0 and DT4

- Performance Categories
  - Good separation of TEC limits
  - Even distribution of systems across categories
  - Increasing TEC dynamic range – from low to high energy categories

Current Issues

- Limited ITI dataset
  - Not enough Notebook and AIO systems
- Recommendations
  - Apply full EPA's V6 data set to new methodology to validate methodology, and get kinks out

Category Summary

- Current Ecma-383 system category approach has challenges; need a fix similar to dGfx fixes
- ITI is proposing system categorization based on CPU performance, and separating lower capability, and iGfx from dGfx categories.
- Early results are encouraging.
- Will require full EPA V6 dataset to validate methodology and get agreement.

Slates and Mobile Computing

Slates/Tablets

- Slates should be out of scope for Energy Star for Computers for battery charger efficiency, since BCS is already being addressed by several programs:
  - CEC Battery Charging System
  - DOE NOPR – BCS & EPS
  - Energy Star for BCS (with inclusion of slates)
- Energy Star should cover slates under separate BCS spec.

Desktops, Integrated Desktops, and Notebook PCs
Discrete Graphics Adders

Leveraging V5 Dataset for Graphics

- Draft 1: Leveraged V5 data was used where unidentified GPUs were assumed to be G3
  - Most identified GPUs were 64-bit ➔ Predominantly G1 graphics. Was this fixed for draft 2?
  - Impact: Lower base TEC for these systems (subtracting G3 instead of G1 adders)
- Need clarification on GPU adders impact with AIO/DT mix?

Graphics Adders in Draft 2

EPA Comment on Draft 2:

- GPU DC Long Idle Power = 66% * measured Desktop GPU DC Short Idle Power

Industry Question:

- Reducing GPU allowances by 33% create unachievable levels
  - GPU power difference between short/long idle is negligible
  - Presumably to account for switchable graphics?

Conversion Efficiency for Graphics

EPA Comment on Draft 2:

- DC to AC conversion: losses of 18% (based on PSU efficiency criteria) – i.e., (AC Equivalent Power) = (1+.18) * (DC Power)

Industry Comment:

- 82% conversion efficiency is used by EPA to calculate AC power
- Industry is using 75% since PSU load points are less than 20% (where actual efficiency is not defined/mandated)
- Need to understand if other data is being used to arrive @ 82%

Average Desktop Idle Load Points from ENERGY STAR v5 Data Set

Desktop Category	Top 25% systems w/ 80+ PSU	All submissions with 80+plus & >= x128 discrete graphics	All submissions with 80+plus & x256 discrete graphics	High-end systems with discrete graphics and 80+ PSU > 500W	High-end systems with discrete graphics and 80+ PSU > 600W
A	14.6%	NA	NA	NA	NA
B	15.9%	NA	NA	NA	NA
C	NA	15.7%	NA	14.6%	14.2%
D	18.5%	16.7%	16.7%	15.5%	15.3%

Notebook Allowances

EPA Comment on Draft 2:

- Equivalent Notebook GPU Short Idle DC Power = 38% * measured Desktop GPU DC Short Idle Power

Industry Comment:

- EPA and industry acknowledge that dataset did not provide insight into notebook GPU allowances
- Need to agree on reasonable desktop GPU adders before converting to notebook
- Need to understand how switchable graphics is being treated for GPU adder calculation

Workstations

Key Issues:

- EPA's request to publish a performance benchmark, SPECWorkstation- not validated.
  - No single benchmark stresses or displays the full capability of the system.
  - Use of SPECWorkstation would significantly underestimate performance capability vs. energy consumption.
- No idle power allocation for compute capacity add-in cards. (e.g. GP/GPU)
  - Add-in cards are not stressed during Pmax determination.

Impact :

- Association of energy to an underestimated capacity would create a database that incorrectly measures the efficiency of high capability systems.
- Compute systems with add-in cards may fail the limits.

Recommendation:

- Keep V5.x workstation definition unchanged.
  - V5.x definition is sufficient to maintain the integrity of the product group.
- V5.x criteria and the use of TEC relative to Pmax under maximum performance conditions remains effective and appropriate for this product group.
  - Less than 10% Energy Star WS market penetration.
  - Decline in average power and general increase in productivity (performance)
- Industry to demonstrate options to address compute add-in cards (e.g. GP/GPU)
  - Have Pmax (Linpack, SPECViewPerf) stress this feature
  - Compliance test without add-in card

Small-scale servers

Key Issues/Impact:

- While Industry appreciates EPA's intention to simplify the category system from 2 categories in V5 to a single category in V6, there is an inherent issue with this approach. With a single base idle power value, and an adder for >1 storage device, it limits Industry's flexibility to offer a wide range of small-scale servers with server OS's installed.
- What was the source of 0.4W WOL adder data – not achievable and applicable?
- Current Pidle_Max and Poff_Max limits appear insufficient for Industry to offer a whole array of small-scale server systems

Recommendation:

- Use DT like TEC categories and adder methodology – weighted for 100% short idle (no sleep and off) . Provision should be made for additional HDD adder

Thin Clients

Key Issues/Impact:

- **Off limit**: Using the Lot 6 Tier II 0.5 watt Off limit as the base S5 limit for Thin Clients is inappropriate. The Lot 6 Tier II limit is obtained by drastically reducing the feature set of a normal Off. For example, PCIe slots, the south bridge and the Super I/O are often unpowered to attain 0.5 watts.
- **Idle limit**: The Thin Client market is rapidly transitioning to the use of power managed operating systems. However there is a sizeable customer base that demands operating systems that are not power managed. A 12 watt idle is inadequate.
- **Discrete Graphics Solution**: Some customers are demanding a richer graphics experience from Thin Clients. For these users, higher powered discrete graphics solutions are utilized. Energy Star 6.0, in its current form, does not take this into account.

Recommendation:

- **Off/WOL limit:** Industry would like the opportunity to work with EPA in the determination of reasonable, yet challenging, Thin Client S5/WOL limits.
- **Idle limit:** To simplify the Thin Client energy regulation paradigm, Industry suggests using a 15 watt idle limit for all Thin Clients that employ internal graphics.
- **Discrete Graphics Solution**: Industry recommends either a separate category or adders for Thin Clients with discrete graphics.

ITI has data - will share with draft 2 response

Test Procedure Comments

Dark Room Conditions

Section 4. G) Line 53 & 54

Dark Room Conditions

- After reading the Test Method for Energy STAR for Displays, the Dark Room Condition is part of that test procedure. But the Dark Room Conditions are not part of the ENERGY STAR* for Computer test procedure.

- The Recommendation is to remove this wording from the Computer Ver 6.0 specification since it not used during the test procedure. Why have mention of something during the Test Setup, but not use it during the actual Test Procedure.

30 minutes for Display Warm-up

Section 5.2 C) Allow 30 minutes for Display Warm-up

- This causes a problem with the test procedure for Computers. This looks to be an exact copy from the Display Specification and has good reason to be in that specification, but there is less of a need for this in the Computer Specification.
  - Set Display brightness @ 30 minutes
  - Short Idle measurement is taken from 5-10 minutes after system is turned on
- If display brightness is set during warm up period and then reboot to start test time, then display brightness will be need to be set again

Overall Comment about units of Brightness

- There should be mention in the Version 6.0 Specification that NITS is equivalent to "cd/m^2".
  - Meters to measure display brightness reference cd/m^2, not NITS.
  - Although some websites list that a NIT is the same thing as cd/m^2,
- The recommendation is that the ENERGY STAR* Standard list both are equivalent just to be clear.

Additional Considerations

Issue: Increased global trend for adopting voluntary Energy Star or stringent product limits for mandatory regulations

Impact: 100% of products must meet – high market access risk, impacting industry business and consumer choice

Proposed Approach:

- EPA to consider adding a clause regarding potential use of the ENERGY STAR Program Requirements in mandatory energy regulations
- By design, ENERGY STAR Program Requirements are intended to recognize only the most efficient products within product segment. ENERGY STAR program requirements should not be adopted in their entirety as the basis for regulation, without appropriate modifications such that the requirements are appropriate for other regulations. Specific product level examples are:
  - Scope & categories
  - Establishing limits (pass/fail criteria)
  - Treatment of adders, and exclusions for high-end systems (High-end DT; Mobile workstations)
- Aspects for regulator's to consider include (but are not limited to): Individual customers' need for choice to satisfy a the broad array of customers' computing needs (including configurability and performance requirements), and the cost versus benefit.

Opens

- Energy Star Computers V6 schedule
- Direction setting on categories, TEC methodology; display adders
- IPS/EPS – Incentives; awaiting more details to form ITI position
- Results of the EPA surveillance program

Back-up

Non Energy Attributes

- ITI appreciates the recent high level discussions that we've had with EPA on ENERGY STAR and limiting the inclusion of non-energy attributes;
- ITI believes both the new VGP and the placement of the RoHS and recyclability provisions within the Partner Commitments of Computers Draft 2 Version 6.0 are consistent with those discussions;
- It is very important that the RoHS and recyclability provisions within the Partner Commitments are not subject to ENERGY STAR third-party certification;
- We may have further thoughts on how to better harmonize these two provisions with EU RoHS and IEEE 1680, with the understanding that ITI and EPA both wish to ensure against the creation of independent, competing standards
- ITI also looks forward to the EPA/ITI road mapping exercise now being planned, for this exercise should help ensure that the ICT industry, EPA, and other key stakeholders establish a shared vision for ENERGY STAR (as it relates to ICT), its focus on energy efficiency, and limited inclusion of non-energy related criteria

Desktop categories used for V6 D1/D2 analysis

Table 3: Categorization of Desktop and Integrated Desktop Computers

Category	DT 0	DT 1	DT 2	DT 3
CPU Cores	Cores ≤ 2	Cores ≤ 2	Cores ≥ 3	Cores ≥ 3
Channels of Memory	Channels = 1	Channels = 2	Channels ≥ 2	Channels ≥ 2
Base Memory	1 GB	2 GB	2 GB	4 GB
Base Graphics	Integrated Graphics	Integrated Graphics	Integrated Graphics	Discrete Graphics = G5
Graphics Adders	Discrete Graphics ≤ G7	Discrete Graphics ≤ G7	Discrete Graphics ≤ G7	G5 < dGfx ≤ G7 (greater than G5 and less than or equal to G7)

Notebook categories used for V6 D1/D2 analysis

Table 4: Categorization of Notebook Computers

Category	NB 0	NB 1	NB 2	NB 3	NB4
CPU Cores	Cores ≤ 2	Cores ≤ 2	Cores = 2	Cores ≥ 3	Cores ≥ 3
Channels of Memory	Channels < 4	Channels < 4	Channels ≥ 2	Channels ≥ 2	Channels ≥ 2
Screen Size	Screen Size ≤ 11.6" (Diagonal)	11.6 < Screen Size ≤ 13.3" (Diagonal)	-	-	-
Base Memory	1 GB	2 GB	2 GB	2 GB	4 GB
Base Graphics	Integrated Graphics	Integrated Graphics	Integrated Graphics	Integrated Graphics	Discrete Graphics = G3
Graphics Adders	Discrete Graphics ≤ G7	Discrete Graphics ≤ G7	Discrete Graphics ≤ G7	Discrete Graphics ≤ G7	G3 < dGfx ≤ G7 (greater than G3 and less than or equal to G7)

System Distribution (Original vs. New)

Original category- system distribution

Original Categories			
Cat	# NB Sys	# DT Sys	# AIO Sys
0	1	6	8
1	1	51	17
2	20	57	14
3	8	22	0
4	4	9	0

New category – system distribution

Perf Categories			
Cat	# NB Sys	# DT Sys	# AIO Sys
0	2	5	6
1	8	29	10
2	3	14	9
3	10	20	9
4	11	77	5

Notebook Range		
NBLC	NBigfx	NBdgfx
2	5.2	9

Desktop Range		
DTLC	DTigfx	DTdgfx
3	7	9

AIO Range		
AIOLC	AIOigfx	AIOdgfx
4	6.6	10

- Performance Class allows finer tuning of the system distribution through performance range

Pass/Fail distribution (Original vs. New)

Original Category

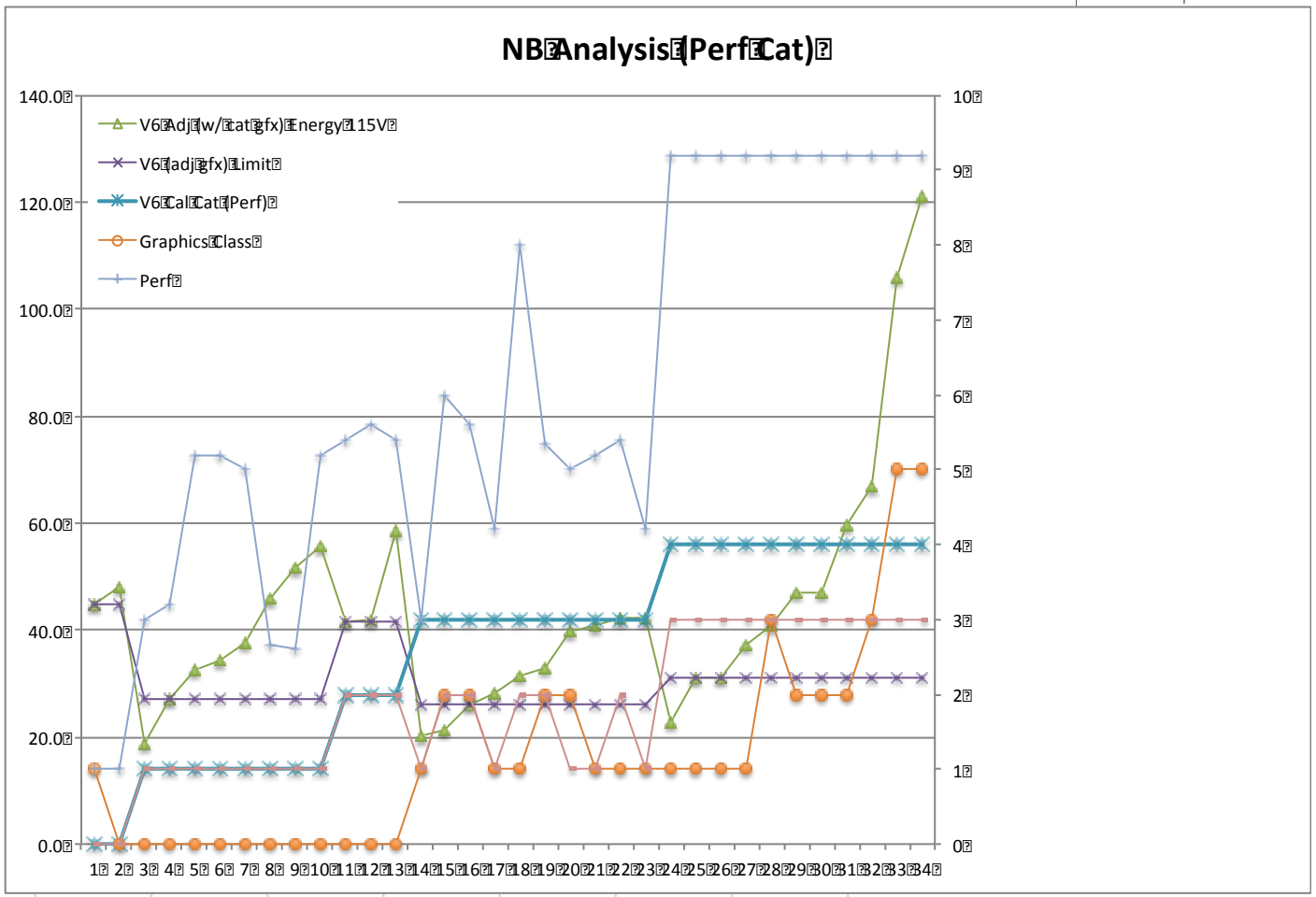
	DT Category (Pass Count)						
Gx	Total Pass	DT0	DT1	DT2	DT3	DT4	Total
0	14	2	10	1	25	0	45
1	11	0	3	8	0	0	32
2	2	0	0	2	0	0	23
3	3	0	0	3	0	0	8
4	2	0	0	1	4	0	5
5	3	0	0	0	3	1	14
6	0	0	0	0	0	0	0
7	4	0	0	0	3	2	18
	39						145

Performance Category

	DT Category (pass count)						
Gx	Total	DT0	DT1	DT2	DT3	DT4	Total
G0	13	1	8	4	0	0	45
G1	11	1	0	0	2	8	32
G2	6	0	0	0	3	3	23
G3	3	0	0	0	0	3	8
G4	1	0	0	0	0	1	5
G5	3	0	0	0	0	3	14
G6	0	0	0	0	0	0	0
G7	2	0	0	0	0	2	18
	39						145

- Graphics class distribution across system Categories
  - Shows good distribution of graphic classes across system categories
  - Graphics adders appear about right

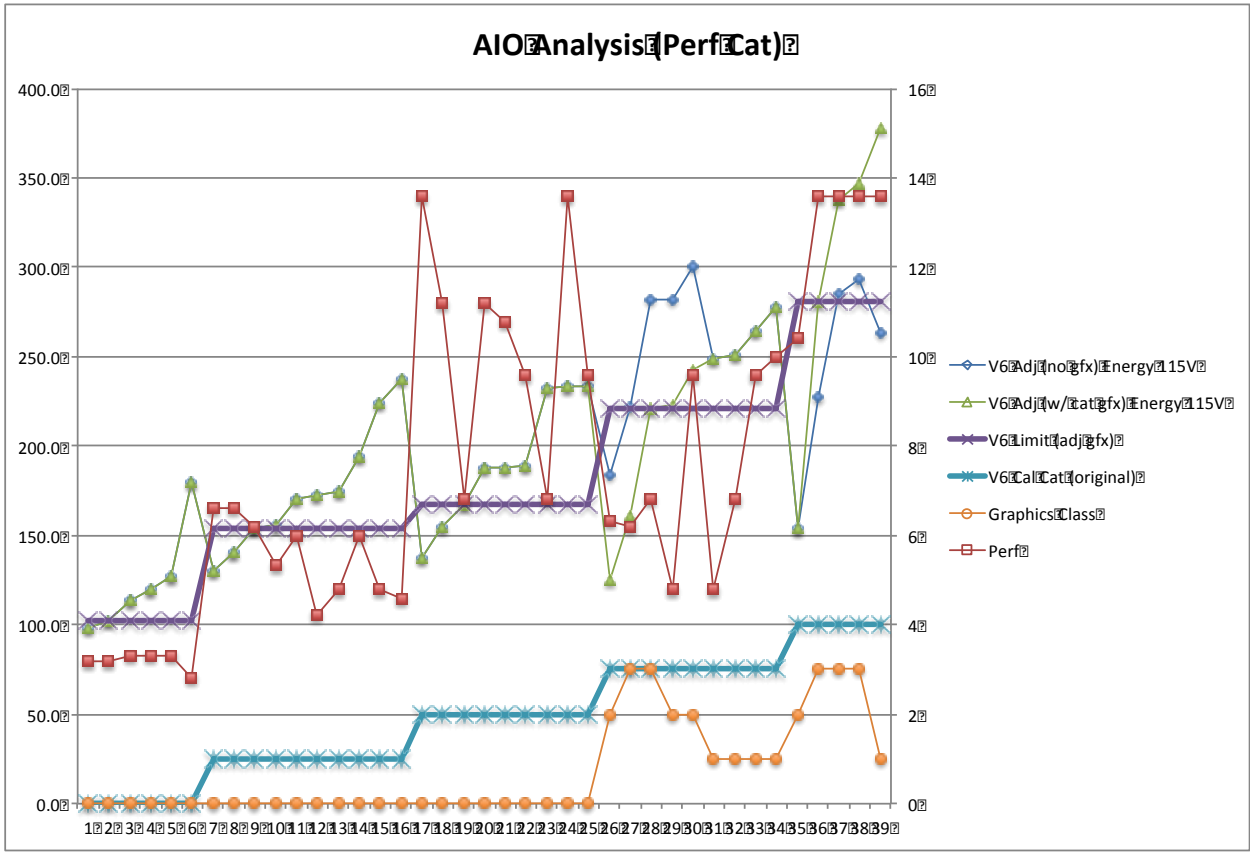
Performance Categories/Notebook



	NB Category (pass count)						
Gx	Total	NB0	NB1	NB2	NB3	NB4	Total
0	3	0	2	1	0	0	12
1	5	1	0	0	1	3	11
2	2	0	0	0	2	0	7
3	0	0	0	0	0	0	2
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	2
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0

- No G3 or G5 cards passing
  - Limits might be to low

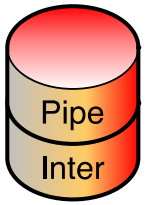
Performance Categories/AIOs



	AIO Category (count)						
Gx	Total	AIO0	AIO1	AIO2	AIO3	AIO4	Total
0	8	2	3	3	0	0	25
1	0	0	0	0	0	0	5
2	2	0	0	0	1	1	4
3	3	0	0	0	2	1	5
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0

- Systems with most graphics cards are passing!
- G1 cards not passing!
  - But many pass in DTs

Display pipe, interface, memory



- Power impact of display interface based on display resolution
  - 100mw for 1386x768 (x1 displayport)
  - 200mW for 1920x1080 (x2 displayport)
  - 400mW for 2500x1600 (x4 displayport)
- Impossible to correct V5.2 records (no display information to estimate impact)

Energy Star V5.0 and V6.0 D1/D1.5* & D2 Comparison

Platform	Power Supply	Requirements	Capability Adjustments
Notebooks & Tablets *draft 1.5 where it applies	No change	TEC (kWh)/V6 D1&D2 Cat A: ≤40.0/(NB 0,1,2 ≤ 25) /(NB 0,1, ≤ 24(26)*; NB2 ≤ 30 Cat B: ≤53.0/(NB3 ≤ 27) /(NB3 ≤ 32) Cat C: ≤88.5/(NB4 ≤30.5) /(NB4 ≤55)	Memory: 0.4 kWh (per GB over 4 GB)/(0.80 kWh over base) (D1 & D2) Discrete GPU (FB Width): CAT B 3kWh (>64-bit) V6 D1 & D2: G1 9kWh; G2 12kWh; G3 20kWh; G4 25 kWh; G5 38kWh; G6 38kWh; G7 48 kWh Additional storage: 3 kWh/(2.6 kWh) (D1 & D2)
Desktop, Integrated DT	82-85-82% eff *(20-50-100% load)* + ≥0.9 PFC @100% rated output	TEC (kWh)/V6 D1;D2 Cat A: ≤148 /(DT0 ≤100; 67*;74) Cat B: ≤175/(DT1 ≤103; 128) Cat C: ≤209/(DT2 ≤135; 145) Cat D: ≤234/(DT3 ≤190; 205)	Memory: 1 kWh (per GB over base)/(0.80 kWh over base) (D1 & D2) Base Memory: CAT A, B, and C 2GB; CAT D 4GB Discrete GPU (FB Width): CAT A, B: 35 kWh (≤ 128-bit); 50 kWh (>128-bit); CAT C, D: 50 kWh (>128 bit) V6 D1 & D2: G1 29kWh; G2 41kWh; G3 64kWh; G4 83 kWh; G5 125kWh; G6 125kWh; G7 157 kWh Additional storage: 25 kWh/ (26 kWh) (D1 & D2)
Thin Client **Small-scale servers**		Idle State / Off Mode / Sleep Mode: (if applicable) / WOL: (if shipped with WOL enabled) Cat A: ≤12.0/12.0W ≤2.0 W/0.5W ≤2.0 W/NA 0.7W/0.4W (Off WOL/NA Sleep) (D1 & D2) Cat B: ≤15.0/15.0W ≤2.0 W/0.5W ≤2.0 W/2.0W 0.7W/0.4W(Off and Sleep WOL) (D1 & D2) 24W (Idle Base) 1.0W (Base) --- 0.4W 8.0W (Idle HDD) (D1 & D2)	
Workstations		$P_{TEC} \leq 0.28*[P_{MAX}{}^{1} + (\#\ HDD's * 5)]W$ (No change) (D1 & D2)	

[1]Notes: P_{MAX} = Max Power based on Linpack & SPECviewperf BMs

ES V6.0 Draft 1&2 (No proxy Weightings)

Type	Idle %	Short Idle	Long Idle	Sleep	Off
Notebook	40%	30%	10%	35%	25%
Desktop/AIO	50%	35%	15%	5%	45%
Existing ENERGY STAR* V5 Values					
ENERGY STAR v5 Notebook	30%	0%	30%	10%	60%
ENERGY STAR v5 Desktop	40%	40%	0%	5%	55%

TEC Weighting

ES V5.0

	Desktop		Notebook		Workstation
	Conventional	Proxying	Conventional	Proxying	Conventional
Toff	55%	40%	60%	45%	35%
Tsleep	5%	30%	10%	30%	10%
Tidle	40%	30%	30%	25%	55%

Draft 1

$TEC_{INT\ DISPLAY}$ (kWh)[iv]	d < 12.0	n/a	(1971/250) * (0.1667 * A + 2r + 1)
	12.0 ≤ d <	n/a	(657/125) * (0.00725 * A + 3r + 2)

Draft 2

Function	Desktop	Integrated Desktop	Notebook
$TEC_{INT\_DISPLAY}$ (kWh)[iv]	n/a	(4.0 * r) + (0.05 * A)	(2.0 * r) + (0.02 * A)

Display adder

Energy Star V5.0 Computers Criteria (Final)

Platform	Power Supply	Requirements	Capability Adjustments
Notebooks & Tablets	No change	**TEC (kWh)** Cat A: ≤40.0 Cat B: ≤53.0 Cat C: ≤88.5	Memory: 0.4 kWh (per GB over 4 GB) Discrete GPU (FB Width): CAT B 3kWh (>64-bit) Additional storage: 3 kWh
Desktop, Integrated DT	82-85-82% eff *(20-50-100% load)* + ≥0.9 PFC @100% rated output	**TEC (kWh)** Cat A: ≤148 Cat B: ≤175 Cat C: ≤209 Cat D: ≤234	Memory: 1 kWh (per GB over base) Base Memory: CAT A, B, and C 2GB; CAT D 4GB Discrete GPU (FB Width): CAT A, B: 35 kWh (≤ 128-bit); 50 kWh (>128-bit); CAT C, D: 50 kWh (>128 bit) Additional storage: 25 kWh
Thin Client		**Idle State** / **Off Mode** / **Sleep Mode:** (if applicable) / **WOL:** (if shipped with WOL enabled) Cat A: ≤12.0 W / ≤2.0 W / ≤2.0 W / 0.7W Cat B: ≤15.0 W / ≤2.0 W / ≤2.0 W / 0.7W	
Workstations		$P_{TEC} \leq 0.28*[P_{MAX}{}^{1} + (\#\ HDD's * 5)]W$	

[1]Notes: P_{MAX} = Max Power based on Linpack & SPECviewperf BMs

Notebooks	Cat C	Cat B	Cat A
CPU	≥ 2 Cores	N/A	All systems not in CAT B or C
Gfx	Discrete GPU FBW> 128-bit (G3)	Discrete GPU	
Memory	≥ 2 GB memory	N/A	

Thin Client	Cat B	Cat A
	Support Local multimedia (Encode/decode)	All systems not in CAT B

DESKTOP	Cat D	Cat C	Cat B	Cat A
CPU	≥ 4 Cores	>2 Cores	= 2 Cores	All systems not in CAT B. C or D
Gfx (One or Both)	Discrete GPU FBW > 128-bit (G3)	Discrete GPU	N/A	
Memory	≥ 4 GB memory	≥ 2 GB memory	≥ 2 GB memory	

TEC Weighting

	Desktop		Notebook		Workstation
	Conventional	Proxying	Conventional	Proxying	Conventional
Toff	55%	40%	60%	45%	35%
Tsleep	5%	30%	10%	30%	10%
Tidle	40%	30%	30%	25%	55%