California Energy Commission
DOCKETED
12-AAER-2A
TN 73833
OCT 13 2014

California Energy Commission
Dockets Office, MS-4
Re: **Docket No. 12-AAER-2A**
1516 Ninth Street
Sacramento, CA, 95814-5512

October 9, 2014

Dear Sir/Madam,

CLASP respectfully submits the attached technical reports and memo for CEC's consideration regarding Docket #12-AAER-2A, Consumer Electronics – Computers, Displays, Game Consoles, Set-top Boxes, and Network Equipment.

As CEC is developing draft energy efficiency regulations for computers, the ENERGY STAR Qualified Product List is an obvious source of information for energy consumption of computers in the US. This product list, however, provides only a partial view of overall computer energy consumption in the US. A significant number of desktop and notebook models on the US market are not typically registered under the ENERGY STAR program for a variety of reasons such as manufacturer marketing strategy, qualification costs, and non-qualifying power supplies. To fill this gap, CLASP has collected technical specifications and power consumption data for desktop and notebook computers that may not be registered under the ENERGY STAR program. We recommend that CEC reference this data during the rulemaking process to attain a more complete and accurate picture of the US computer market.

Due to the scarcity of public data available on non-ENERGY STAR qualifying computers in the US, CLASP collected data on China's computer market, which significantly overlaps with the US in terms of manufacturers and models, and can thereby serve as a useful proxy. We also surveyed a number of manufacturers, collected information from online reviews to supplement the information gaps. The results of our research are described in the attached three documents, the main points of which are summarized below.

- Technical Study*: Implications of Chinese Computer Energy Consumption in the US Computer Market*.
- Technical Study: *Typical Energy Consumption of Gaming Computers*
- Memo: Description of Australia's Deemed to Comply mechanism, which aims to reduce the burden of testing costs on small manufacturers.

Implications of Chinese Computer Energy Consumption in the US Computer Market

Due to the nature of China's appliance energy efficiency program, all computers available in the Chinese market – at every level of energy efficiency – are required to be registered in a public online database. A full 47% of manufacturers listed in this database are also listed in the US ENERGY STAR database for computers, and account for 79% of Chinese models. China's complete dataset is therefore a good proxy for assessing the status of the US computer market. CLASP assessed the performance of computers in this database, compared it to the ENERGY STAR list, and determined the following:

- 92% of desktops and 98% of notebooks on the Chinese market could meet ENERGY STAR v5.2 typical energy consumption (TEC) limits.

- 49% of desktops in the China market would meet energy consumption limits 30% lower than ENERGY STAR v5.2., which is roughly equivalent to ENERGY STAR v6.0.

- 57% of notebooks meet energy consumption limits 40% below ENERGY STAR v5.2, which is roughly equivalent to ENERGY STAR v6.0.

These results suggest that a large share of computers in the U.S. market likely already meet ENERGY STAR v6.0 levels. It is important to note, however, that our study only examined energy consumption levels and did not include other ENERGY STAR requirements such as power supply efficiency and power management requirements.

Typical Energy Consumption of Gaming Computers

The objective of this study was to assess the potential impact of standards on high-performance gaming computers. CLASP gathered data from online reviews and component manufacturer websites for 122 desktops models and 6 laptop models. While not representative of ENERGY STAR testing conditions, the study provides insights on the energy consumption of gaming computers relative to ENERGY STAR v6.

The data shows no significant correlation between computing or graphic performance and overall system energy consumption. Despite the differences in test methodology, which overstate energy consumption in the study's dataset relative to ENERGY STAR, over half of motherboards in the sample are within 20% of ENERGY STAR v6.0 TEC limits, and some of the highest performance computers, such as units with the X79 chipset configurations, were able to meet v6.0 TEC requirements.

Due to its origin from technical review websites, much of the test data used in this study is not reflective of ENERGY STAR test conditions. For example, some testing was performed in low-intensity active mode ("2D mode") instead of idle mode, and some models were tested in boosted performance mode ("overclocking"). Therefore, comparisons with ENERGY STAR are indicative only and are conservative; in other words, more computers on the market are likely to pass than we observed.

Minimizing Burden on Small Manufacturers

In addition to our two analyses above, CLASP has also appended a memo explaining the Deemed to Comply approach utilized by the Government of Australia, which DOE may wish to consider as a mechanism for minimizing the financial burden on small manufacturers from having to test computers that are manufactured in small production volumes. Australia's Deemed to Comply mechanism allows manufacturers who produce only 200 or less of a computer model to only meet power supply and reporting requirements instead of undergoing the full test procedure.

Thank you for the opportunity to comment on this docket. We look forward to working with CEC and other stakeholders on this important rulemaking. Please contact us if you have any questions or require any further information.

Respectfully submitted,

My Ton
Director of Global Research

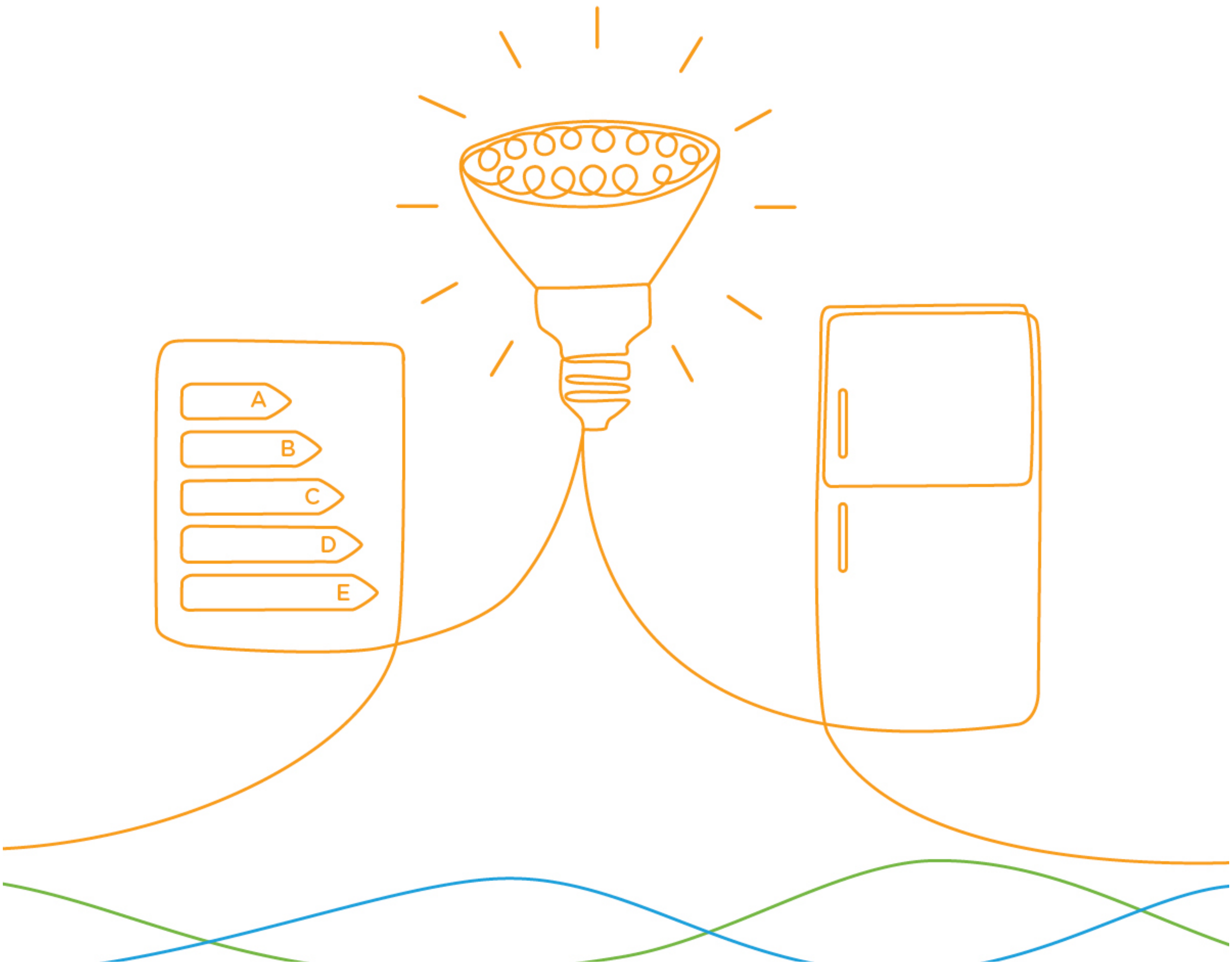
CLASP

Implications of Chinese Computer Energy Consumption in the US Computer Market

International Computer Project

October 9, 2014

Fiona Brocklehurst, Ballarat Consulting
Jonathan Wood, Tenvic



Acknowledgments

This report was authored by Fiona Brocklehurst of Ballarat Consulting and Jonathan Wood of Tenvic Ltd., with support from Pierre Delforge of the Natural Resources Defense Council (NRDC). Chinese data was collected by Anson Wu of Hansheng Ltd. The project was managed by My Ton, Director of Global Research at CLASP, and James Edward McMahon of Better Climate Consulting. We are grateful for the additional support of Christopher Wold and Kathleen Callaghy at CLASP.

Executive Summary

To support the California Energy Commission (CEC) in their rulemaking process on computers, CLASP conducted market research studies to identify the energy efficiency levels found in desktop and notebook computers currently on the US market.

The Environmental Protection Agency (EPA)'s ENERGY STAR dataset only provides a partial view of the US computers market, since it only covers ENERGY STAR-qualified models. No database is available that provides energy consumption information for the complete US market. Since computers are traded internationally, CLASP sought large datasets from other economies and accessed a public database of computers commercially available on the Chinese market that was developed as part of China's mandatory requirements for computers. The Chinese database covers all computers sold on the Chinese market[1] and so provides a complete picture of computer energy performance.

In cooperation with Hansheng Ltd, CLASP extracted all the relevant data from this database to facilitate analysis on computer energy consumption in the US market. There is significant overlap in the US and Chinese markets regarding manufacturer presence, although the share of desktop computers is larger in China compared to the US, and the share of notebook computers is smaller. The pattern of distribution of models listed between ENERGY STAR categories is different; however, there are sufficient models in each category to provide a meaningful basis for comparison. A full 47% of manufacturers listed in China's database are also listed in the US ENERGY STAR database for computers, and these manufacturers account for 79% of Chinese models. China's complete dataset is therefore a good proxy for assessing the status of the US computer market. This document explains the analysis that CLASP conducted on the Chinese data to identify the estimated shares of computers that meet the ENERGY STAR energy limits in the US.

Our analysis of the Chinese database suggests that 92% of desktop and 98% of notebook computers on the Chinese market could meet the ENERGY STAR v5.2 Typical Energy Consumption (TEC) limits.[2] This suggests that EPA's 2012 Unit Shipment and Market Penetration Report's market penetration rates for the US of 21% for desktops and 69% for notebooks may be significantly underestimated.

Furthermore, even when the TEC levels are reduced significantly below those required under ENERGY STAR v5.2, the proportion of computers that meet the energy requirements remain high. For example, 49% of desktop and 67% of notebook computer models on the Chinese market would still meet energy limits 30% lower than ENERGY STAR v5.2. Additionally, 17% of desktop models and 57% of notebook models would meet energy limits 40% below ENERGY STAR v5.2.

Analysis & Results

CLASP analyzed Chinese database in a number of ways in an attempt to identify how many products on the Chinese market meet the ENERGY STAR v5.2 specifications. The original extracted Chinese data can be found in the Excel worksheet "CLASP China ENERGY STAR Comparison Computer Data 2013," available on CLASP's website.[3]

[1] In principle – the compliance rate is not known.

[2] The database did not include information on PSU efficiency so it wasn't possible to check compliance against the full ENERGY STAR v5.2 specification

[3] URL: http://clasponline.org/~/media/Files/SLDocuments/2014/2014-10_US-Computer-Reports/CLASP-China-ENERGY-STAR-Comparison-Computer-Data_2013

The Chinese data was entered into the database between January 15 and August 22 2013 the database was accessed between the August 19 and August 27, 2013.

The project team used the following methods when analyzing the Chinese database for ENERGY STAR coverage levels:

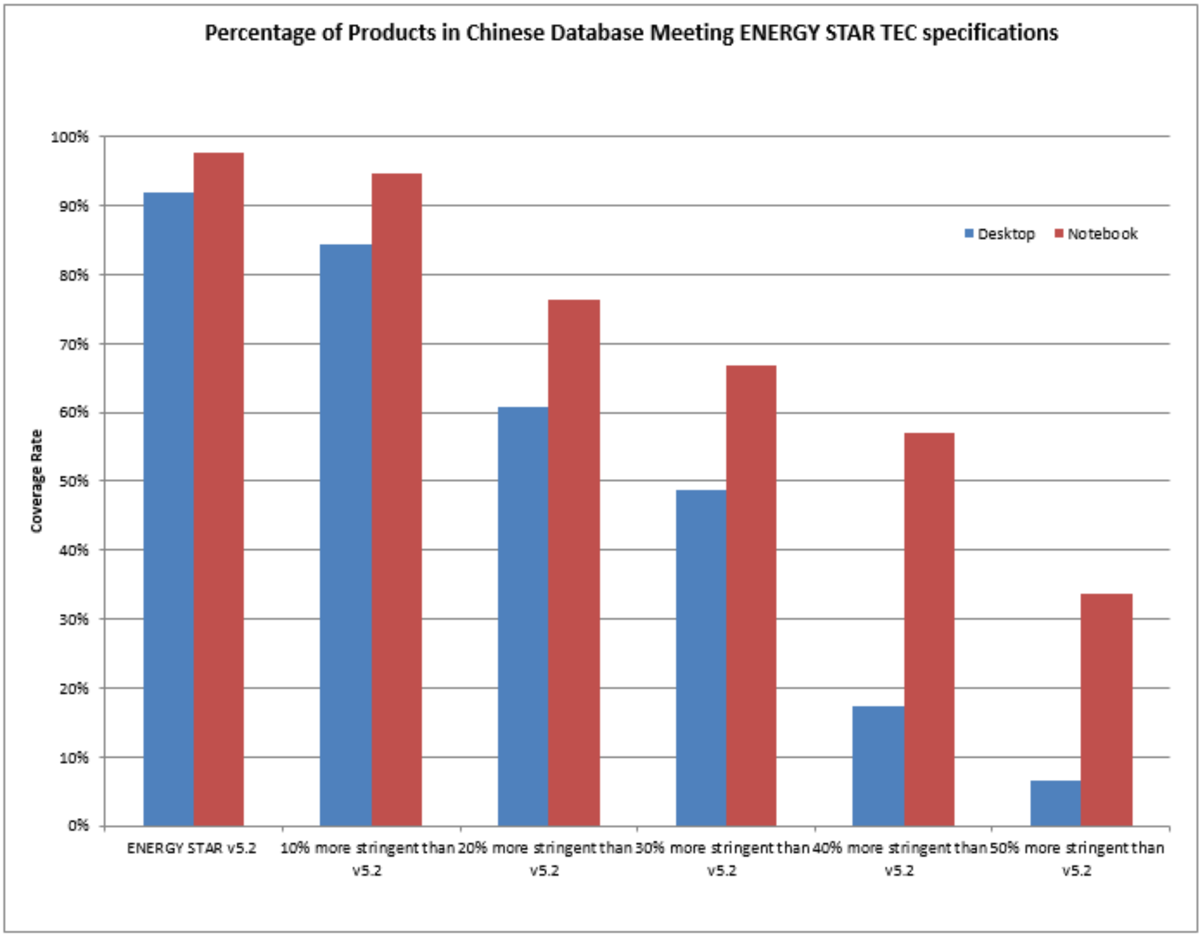
1. All duplicated entries (over 11,000) were removed. In addition, a total of 10 entries with clear data errors – such as missing typical energy consumption (TEC) values – were also removed. These product removals did not impact the number of manufacturers found in the database.
2. Each entry was classified as either desktop, notebook, or other computer (the original Chinese database did not include this information).
3. The actual TEC was compared with the ENERGY STAR v5.2 TEC base allowance. The results of this analysis can be seen on the “Analysis-all” worksheet of the Excel data and are discussed in the results section below.
4. Expected adders were calculated for each product based on average extra allowances given to each product type (at the category level) within the ENERGY STAR v6.0 dataset. In other words, using the technical information in the ENERGY STAR v6.0 dataset, we calculated an average additional ENERGY STAR v5.2 TEC allowance for each type of product in the Chinese database. The adder allowance calculations can be found on the “Adders-Analysis” worksheet of the Excel data.
5. Each of the products in the database were then assessed to see if they met the estimated total ENERGY STAR v5.2 TEC allowances with the adders. The results of this analysis can be seen on the “Analysis-all” worksheet of the Excel data and are discussed in the results section below.
6. To test the potential impact of more stringent efficiency levels, the ENERGY STAR v5.2 TEC allowances were reduced by 10, 20, 30, 40 and 50%, and products in the database were then assessed to see if they met these revised TEC allowances with the adders. The calculations are found in the “Chinese-Dataset-No-Duplicates” worksheet, the findings detailed on the “Analysis-all” worksheet, and a final high level summary included on the “Summary” worksheet of the Excel data.

The level of specification information in the Chinese database is limited; it includes only the manufacturer name, model name, Chinese energy class, ENERGY STAR category, and TEC value. The lack of information about power supply unit (PSU) efficiency means that it is not possible to check compliance against the full ENERGY STAR v5.2 specification – only with the TEC limits.

Comparison with ENERGY STAR Coverage Levels

Figure 1 illustrates the estimated percentage of models in the Chinese database that would meet the ENERGY STAR v5.2 TEC allowances using the proxy analysis described above. It is clear from the analysis that a very high proportion of models in the Chinese database meet ENERGY STAR v5.2 TEC levels. The graph also shows that many models still meet the requirements when TEC levels are made progressively more stringent by 10, 20, 30, 40, and 50%, respectively. For example, almost half of desktops meet the requirements with the TEC level reduced by 30%, and more than half of laptops meet the requirements with the TEC level reduced by 40%.

Figure 1: Estimated number of models in the Chinese Database meeting ENERGY STAR v5.2 TEC levels with varying stringency



Comparing TEC levels between ENERGY STAR v5.2 and ENERGY STAR v6.0

EPA finalized the ENERGY STAR v6.0 specifications in September 2013, and they took effect in June 2014. It would have been interesting to compare compliance of the Chinese data against these new ENERGY STAR energy limits; however, the lack of technical information about components for each computer – such as the number of cores in each CPU, processor frequency, GPU frame buffer bandwidth, etc – meant that this was not possible.

Instead, the project team conducted an assessment of expected TEC reductions from ENERGY STAR v5.2 levels associated with increased ENERGY STAR v6.0 stringency. The analysis focused on identifying the average maximum TEC limits (measured against the ENERGY STAR v5.2 test methodology) for products in the ENERGY STAR v6.0 dataset that met both the ENERGY STAR v5.2 and ENERGY STAR v6.0 requirements.

This analysis shows that, when measured against the ENERGY STAR v5.2 methodology, desktop PCs on average[4] would have to consume approximately 30% less energy, and notebooks 40% less energy, in order to meet the ENERGY STAR v6.0 requirements.

Note that this is not the same as saying that a desktop that has a TEC level of 30% less energy than ENERGY STARv5.2 would pass ENERGY STARv6.0; the test methodologies of the two versions are significantly different, and the difference for a specific model could vary considerably from these values, depending on its configuration. This just gives an indication of the average difference for a specific set of data.

Based on the estimated difference between the ENERGY STAR v6.0 and ENERGY STAR v5.2 energy limits, the analysis of the Chinese dataset shows that almost half of desktops, and more than half of notebooks, meet v5.2 energy limits that (on average) are equivalent to the estimated ENERGY STAR v6.0 levels of stringency (when measured with the ENERGY STAR v5.2 test methodology).

Comparison of Manufacturers and Number of Models in both Chinese and US ENERGY STAR Databases

The project team utilized the following process when analyzing the Chinese database to identify numbers of manufacturers active and products sold on the US market:

1. Each manufacturer listed on the Chinese database was reviewed to identify whether or not it sold desktop and/or notebook computers on the US market. In the first instance, where possible, the website of each manufacturer was reviewed to identify whether or not the company was active on the US market. This analysis was followed up by a review of the latest ENERGY STAR v5.2 database, which lists which manufacturers have desktop and/or notebook computers registered as being sold on the US market. This analysis can be seen on the "Analysis-Manufacturers-1" worksheet of the Excel data file. It should be noted that this analysis was completed at the manufacturer level rather than the individual product level. That is, the analysis is only concerned with whether or not a manufacturer sells desktops and/or notebooks on the US market. The team also checked whether or not each manufacturer sold ENERGY STAR-qualified products in the US.
2. To enable a comparison between the US and Chinese markets, the team reviewed the latest available version of the US ENERGY STAR v5.2 database was to identify the share of ENERGY STAR-qualified desktop and notebook PCs.

Error! Reference source not found. illustrates the estimated share of desktop and notebook computer models in the Chinese database that are sold by manufacturers who also supply the US market. It shows that the manufacturers who supply most of the models[5] in the Chinese database also sell in the US.

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[4] Across all ENERGY STAR performance categories

[5] It is noted that the manufacturer proportion of product listing may not be reflected in market share. Manufacturers differ in their approach to registering a product – some do so at the family level – others at configuration level. The latter results in a higher number of registrations.

Figure 2: Estimated share of computer models in the Chinese database sold by manufacturers who also sell to the US market

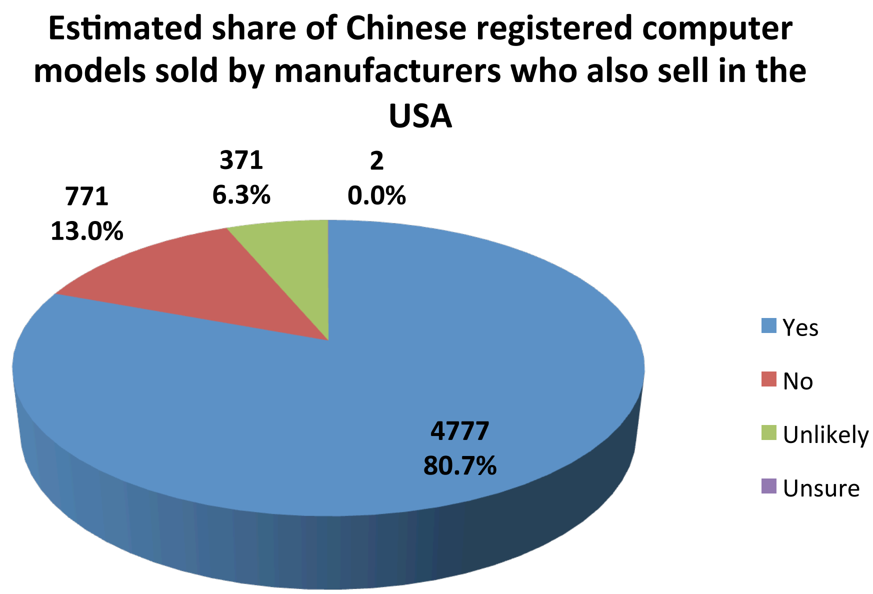

Figure 4: Share of computer models in the Chinese database that are sold by manufacturers who are listed on the US ENERGY STAR database

below depicts the share of Chinese manufacturers that are listed in both the Chinese database and the US ENERGY STAR database. Approximately half of the manufacturers listed in the Chinese database are also registering ENERGY STAR products in the US. However, Error! Reference source not found. shows that nearly 80% of Chinese-registered computer models are sold by manufacturers who are also listed in the US ENERGY STAR database. That is, the manufacturers who have the largest number of computer models listed in the China database are also listed in the US ENERGY STAR database.

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Figure 3: Share of Chinese manufacturers listed on the Chinese database found on the US ENERGY STAR database

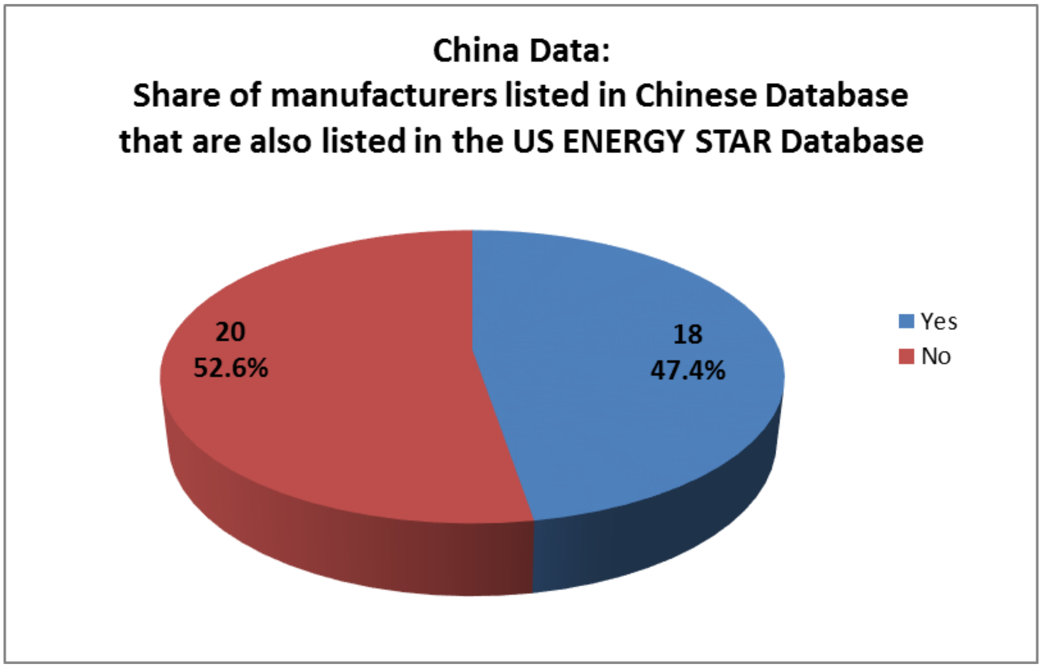
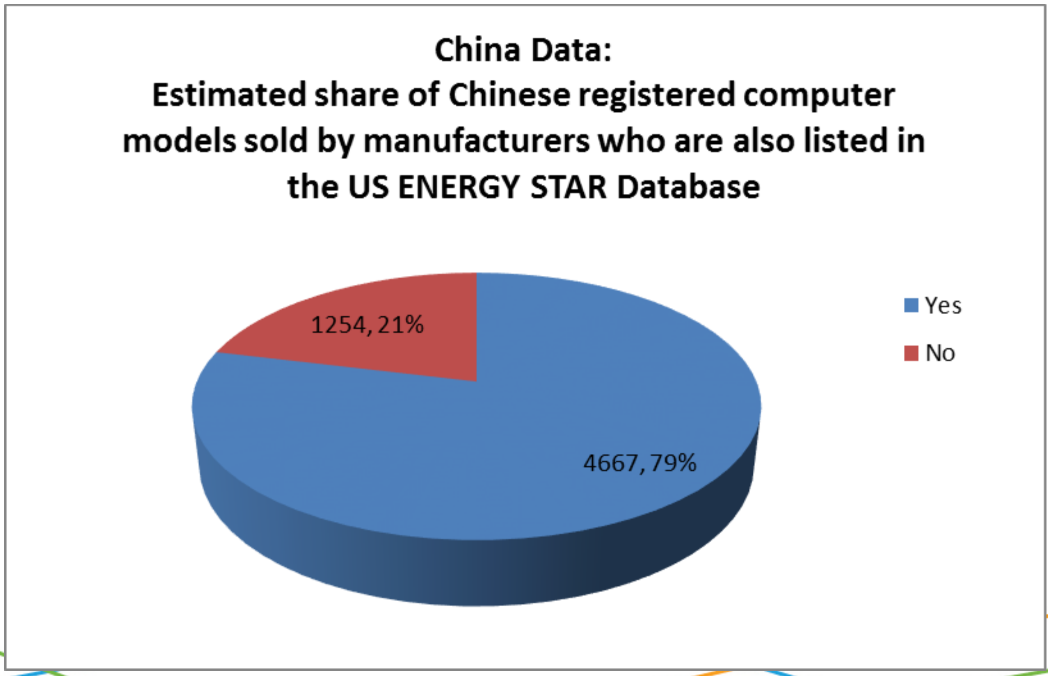


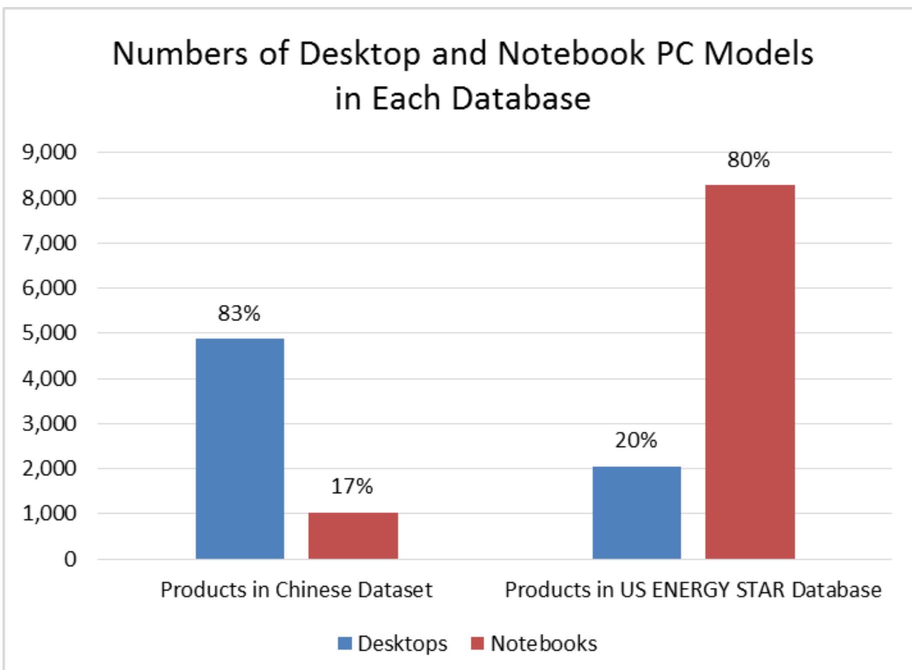
Figure 4: Share of computer models in the Chinese database that are sold by manufacturers who are listed on the US ENERGY STAR database



Together these results suggest that the Chinese database can provide some insights into the possible range of energy consumption for products on the US market.

illustrates the share of desktops and notebooks in the Chinese and US ENERGY STAR databases. It is evident that there is a clear dominance of desktops over notebooks in the Chinese database, whereas the opposite is true in the US ENERGY STAR database. This indicates that there are considerable differences in form factors between the two markets. However, there are still sufficient numbers in each category to provide a meaningful basis for comparison.

Figure 5 - Estimated share of desktop and notebook computer models in the Chinese and ENERGY STAR databases



The distribution of models by ENERGY STAR category for the Chinese and US ENERGY STAR databases is shown for desktop computers in

Figure 7: Distribution of notebook computer models by ENERGY STAR categories in the Chinese and US ENERGY STAR databases and for notebooks in **Error! Reference source not found.** below.

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Figure 6: Distribution of desktop computer models by ENERGY STAR categories in the Chinese and US ENERGY STAR databases

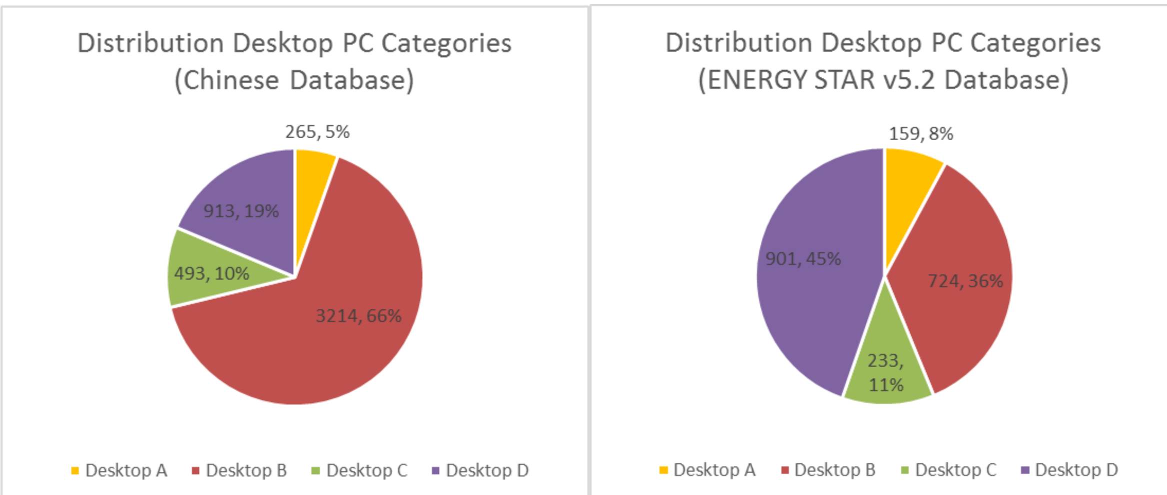
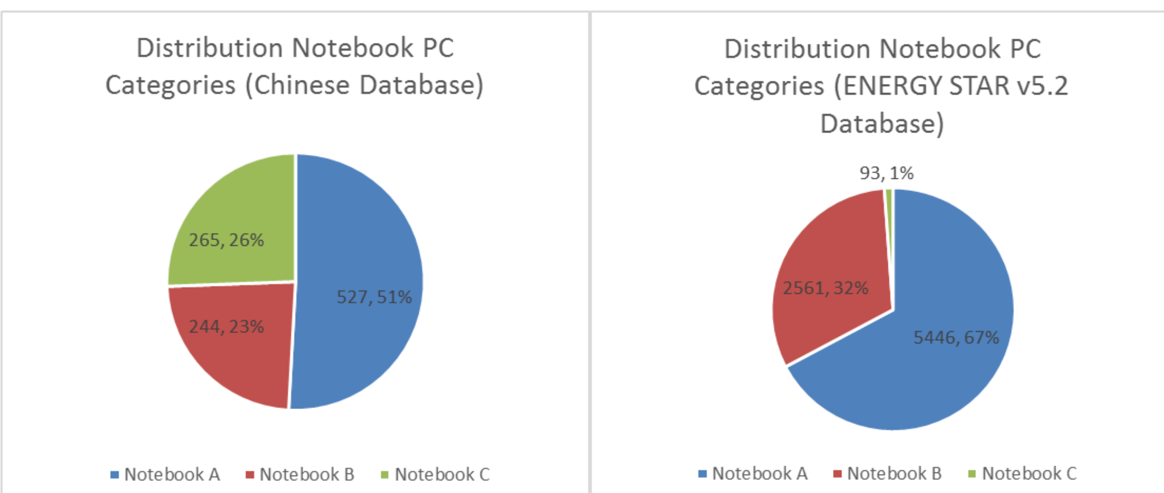


Figure 7: Distribution of notebook computer models by ENERGY STAR categories in the Chinese and US ENERGY STAR databases



In both cases, the distribution of models by category is different. For desktops, the USA database has significantly more of the higher performing categories listed. For notebooks, the reverse is true. However, in all cases there are sufficient numbers in each category to provide a meaningful basis for comparison.

Conclusions

Our analysis of the Chinese database suggests that 92% of desktop and 98% of notebook computers on the Chinese market could meet the ENERGY STAR v5.2 Typical Energy Consumption (TEC) limits[6]. This suggests that EPA's 2012 Unit Shipment and Market Penetration Report's market penetration rates for the US of 21% for desktops and 69% for notebooks may be significantly underestimated.

Furthermore, even when the TEC levels are reduced significantly below those required under ENERGY STAR v5.2, the proportion of computers that meet the energy requirements remain high. For example, 49% of desktop and 67% of notebook computer models on the Chinese market would still meet energy limits 30% lower than ENERGY STAR v5.2; 17% of desktop models and 57% of notebook models would meet energy limits 40% below ENERGY STAR v5.2.

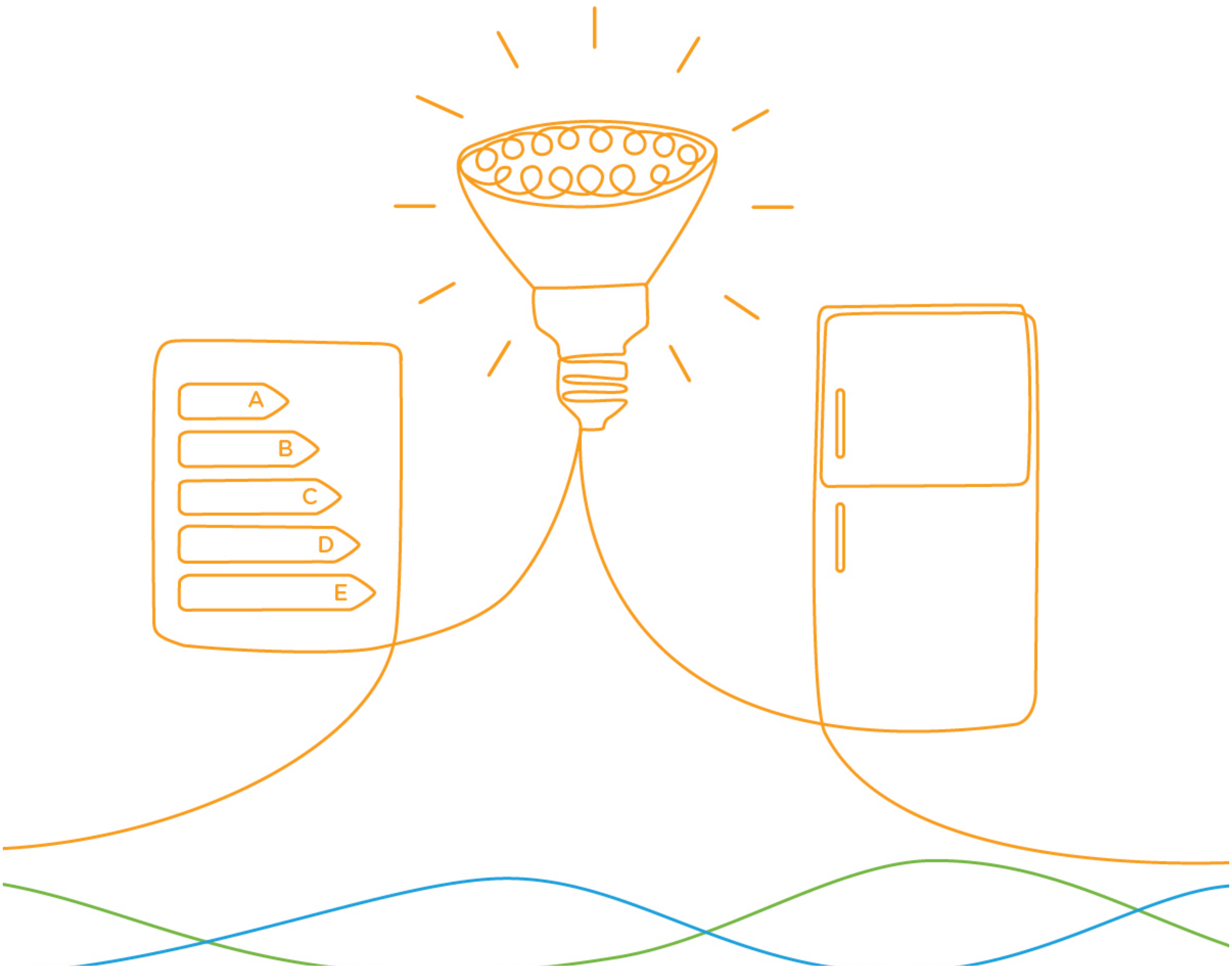
[6] The database did not include information on PSU efficiency so it wasn't possible to check compliance against the full ENERGY STAR v5.2 specification

Typical Energy Consumption of Gaming Computers

CLASP International Computer Project

October 9, 2014

Fiona Brocklehurst, Ballarat Consulting
Jonathan Wood, Tenvic



Executive Summary

To support the California Energy Commission (CEC) in their rulemaking process on computers, CLASP analyzed the energy use of a selection of gaming desktop computers.

The energy performance of gaming computers was calculated based on information from technical reviews and component manufacturer sites. Estimates of energy performance were compared to ENERGY STAR levels.

ENERGY STAR share: 21% of desktop models in the study's sample meet the ENERGY STAR v6.0 Typical Energy Consumption (TEC) levels. Key factors were components (specifically, CPU and motherboards) and over-clocking (see Limitations below). However, this study suggests that high-end gaming computers, including some of the highest performance X79 chipset configurations, might be able to meet ENERGY STAR v6.0 levels if tested according to ENERGY STAR requirements. Many of the very highest performing gaming computers in the study were very close to meeting the ENERGY STAR v6.0 limits. The 'pass-rate' in this study may be much lower than in reality, due to the uncertainties in testing conditions that may have led to overly high TEC estimates. In other words, more computers on the market are likely to pass than we observed.

Performance: The data shows no significant correlation between computing or graphic performance and overall system energy consumption. Some computers that are close to meeting the ENERGY STAR levels include some of the configurations with the highest ENERGY STAR performance scores, as well as relatively high-specification discrete GPUs.

Potential explanatory factors: There are many variables potentially influencing computers' power demand and their ability to meet ENERGY STAR levels, including CPU performance (described by the ENERGY STAR performance score), graphics performance, product setup, power management settings and other internal components such as motherboards, which are not directly taken account of in the ENERGY STAR performance score calculations.

Motherboard chipsets: A few, older, motherboards (8%) were associated with 69% of the models that failed to meet the ENERGY STAR specification, as well as with the largest differences from ENERGY STAR levels. Excluding these three motherboards, the pass rate increased to 47%, and a further 14% of models were within 10% of ENERGY STAR v6 levels.

Test conditions: Of those systems least likely to meet ENERGY STAR TEC allowances, most were tested while overclocked and in 2D mode. This combination, together with the effects of motherboard age and test conditions, makes it difficult to determine whether older motherboards consume more energy than new ones under comparable test conditions. More testing is needed under ENERGY STAR conditions.

Limitations: Due to its origin from technical review websites, much of the test data used in this study is not reflective of ENERGY STAR test conditions. For example, some testing was performed in low-intensity active mode ("2D mode") instead of idle mode, and some models were tested in boosted performance mode ("overclocking"). Therefore, comparisons with ENERGY STAR are indicative only and are conservative; in other words, pass rates in this study are likely significantly lower than those on the market.

Acknowledgments

This report was authored by Fiona Brocklehurst of Ballarat Consulting and Jonathan Wood of Tenvic Ltd., with support from Pierre Delforge of the Natural Resources Defense Council (NRDC). The project was managed by My Ton, Director of Global Research at CLASP, and James Edward McMahon of Better Climate Consulting. We are grateful for the additional support of Christopher Wold and Kathleen Callaghy at CLASP.

Introduction

In support of the California Energy Commission (CEC)'s rulemaking process on computers, CLASP conducted market research studies to identify the energy efficiency levels found in desktop and notebook computers currently on the U.S. market. This analysis focuses on high performance gaming computers.

The ENERGY STAR dataset of computer performance and energy efficiency only provides a partial view of the U.S. market since it only covers models that comply with ENERGY STAR specifications. Thus, as part of this work, CLASP secured technical specifications and power draw data for desktop and notebook computers that are not typically found registered under the ENERGY STAR program – predominantly gaming computers. These gaming computers are less frequently found in the ENERGY STAR database for two main reasons. Firstly, purchasers of these products are more likely to be concerned with gaming performance than energy efficiency, meaning that manufacturers have less incentive to apply for the ENERGY STAR label for these products. Secondly, gaming computers tend to be of a higher performance specification due to the needs for higher-end central processing units (CPUs) and graphics processing units (GPUs) to support game playing, and may not meet ENERGY STAR requirements – especially v5.2, which has very limited allowances for discrete graphic cards.[1]

Given the lack of power data available in public datasets for gaming computers, data were gathered from online reviews along with their technical specifications. The sample included 112 desktop and 6 notebook computers. The data were analyzed and compared with ENERGY STAR v6.0 energy levels.

Methodology and Dataset

Gaming personal computers are sold primarily based on their gaming performance rather than energy efficiency performance. As such, these types of products are rarely listed in the databases of environmental schemes such as ENERGY STAR. Therefore, it was necessary to look further afield in order to collect performance and energy efficiency data for these products.

Gaming computers are often tested by external organizations who want to understand and communicate the relative performance of gaming computers and sub-components to interested parties, primarily consumers of these products. These organizations frequently measure the power demands of gaming PCs at the same time as gaming performance, and the test results are routinely communicated on technical review websites.

The project team therefore collected data from as many technical review sites as possible to inform the analysis. CLASP conducted an initial review in late 2013 during which we collected data for 98 desktop gaming computers and six gaming notebook computers.[2] At least four of the 98 desktops were original equipment manufacturer (OEM) devices, with the majority appearing to be custom-built. The team then conducted further research on the highest performance products by collecting data for an additional 14 gaming desktop PCs, all of which were based on the X79 motherboard chipset.

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[1] A 2012 study by CLASP and NRDC examines the data on discrete graphics card energy consumption in desktop computers, which was gathered to support the establishment of effective energy consumption allowances (or "adders") for graphics cards in the Version 6.0 ENERGY STAR computer specification. The report is available on CLASP's website at: http://clasponline.org/en/Resources/Resources/PublicationLibrary/2012/Impact-of-Graphics-Cards-on-Desktop-Computer-Energy-Consumption.aspx

[2] Power demand for notebook computers is less often tested because battery life testing is the predominant energy test for these products.

We do not have data to indicate whether or not custom machines perform better or worse than OEM products in terms of energy; however, OEMs have the opportunity to set power management settings upon shipping – likely making it easier for the products to meet any energy performance specifications when they are first shipped.

All reviews for products that were described as "gaming computers" were conducted in 2013 and 2014. CLASP collected data for as many of the following fields as possible:

- Review Date
- Computer Type
- Manufacturer
- Model Name
- Operating System
- Motherboard
- CPU details (name, number of cores and CPU frequency)
- RAM details (type, numbers, memory size and speed)
- Hard drive details (number, capacity and speed)
- PSU details (name, load rating and efficiency)
- GPU details (type, numbers, memory size and speed, bit width and frame buffer bandwidth)
- Power demands (active and idle modes)

CLASP then added all collected data to a database to evaluate each model with reference to the ENERGY STAR v5.2 and v6.0 performance requirements. Some assumptions were required because the collected data did not provide enough detail for complete evaluation against the ENERGY STAR specifications. These included assumptions about:

Long idle mode - None of the products in our database were tested according to the ENERGY STAR v6.0 test methodology, and only two products were tested in long idle mode. As such, it was necessary to make assumptions about how much power the products would draw in long idle. Our assumptions are based on the average reduction observed between short idle and long idle mode for products in the ENERGY STAR v6.0 dataset, where long idle was measured. Specifically, long idle power is, on average, 96% of short idle power.

Sleep mode – No products were tested in sleep mode, so we assume a value of 4W for all products in the dataset.

Off mode – No products were tested in off mode, so we assumed a value of 2W for all products.[3]

Additionally, information about GPU technical features was missing from some of the product entries. However, we knew the name of the GPU for each product, so we sourced the technical data from other websites – mainly those of component manufacturers.

Many of the desktop gaming computers also included CPUs that had been "overclocked;" in other words, their base frequencies have been increased to enhance performance. In order to calculate ENERGY STAR performance scores, and therefore understand which category products fall into, it is necessary to know the base frequency of the CPU. To resolve this, we collected the base frequencies of the CPUs that had been overclocked from manufacturer websites.

[3] The values for sleep and off modes are expert assumptions based on experience with this type of product. Both have low impacts on the TEC values.

We do not know if these systems were overclocked by the OEMs when they were shipped, or if they were overclocked by the testing organization. In any case, the energy requirements measured in our dataset are likely higher than they would have been if they had not been overclocked.

With all necessary data entries complete it was then possible to estimate the allowed Typical Energy Consumption (TEC) for each product under both ENERGY STAR v5.2 and v6.0. We then compared these allowances to the calculated TEC values for each gaming computer in the database.

When reviewing the power demand results for the gaming computers, it became obvious that not all systems were tested under the same conditions. These variations in the way testing was conducted could have impacted the power demand results and consequently resulted in higher- or lower-than-expected calculated TEC (kWh/year) values. For example, testing a desktop PC with the case open can reduce cooling requirements and consequently reduce power demand.

Another possible caveat to our TEC estimates arises from the software that was running on the products during idle testing. Some of the products appear to have been tested with just the desktop displayed – i.e., no additional programs loaded after the computer was booted – as required under the ENERGY STAR v5.2 and v6.0 test methodologies; however, others were tested in a “2D mode” (i.e. with some programs running and providing some basic functionality). Supporting basic functionality would likely not have major impacts on power demand in systems with integrated GPUs, but it may cause discrete GPUs (where present) to become active and therefore increase idle mode power demand more significantly. Whether or not CPUs and GPUs are power managed[4] can also significantly impact idle power demand. Furthermore, differences in the way each organization tested the products could impact the power demands. It is estimated that these measurement differences would be in the region of ± 20% but could be greater depending on test conditions.

Results

Overall Results

The results in Table 1 show that **as reported** 38% of the high specification desktop computers would meet the ENERGY STAR v5.2 TEC levels (Missing PSU efficiency data prevented determining whether all of the ENERGY STAR v5.2 requirements were met for all the computers). In addition, 21% of desktops were found to meet the estimated ENERGY STAR v6.0 TEC levels. The analysis also suggested that, 83% of high end notebooks were found to meet the ENERGY STAR v5.2 TEC levels. This fell to 33% when compared against the estimated ENERGY STAR v6.0 TEC levels.

Table 1: Number of Computers in Database Meeting ENERGY STAR TEC levels

Product Type	Meet ENERGY STAR v5.2 TEC levels			Meet ENERGY STAR v6.0 TEC levels		
	Yes	No	% meeting requirements	Yes	No	% meeting requirements
Desktop	42	70	38%	24	88	21%
Notebook	5	1	83%	2	4	33%

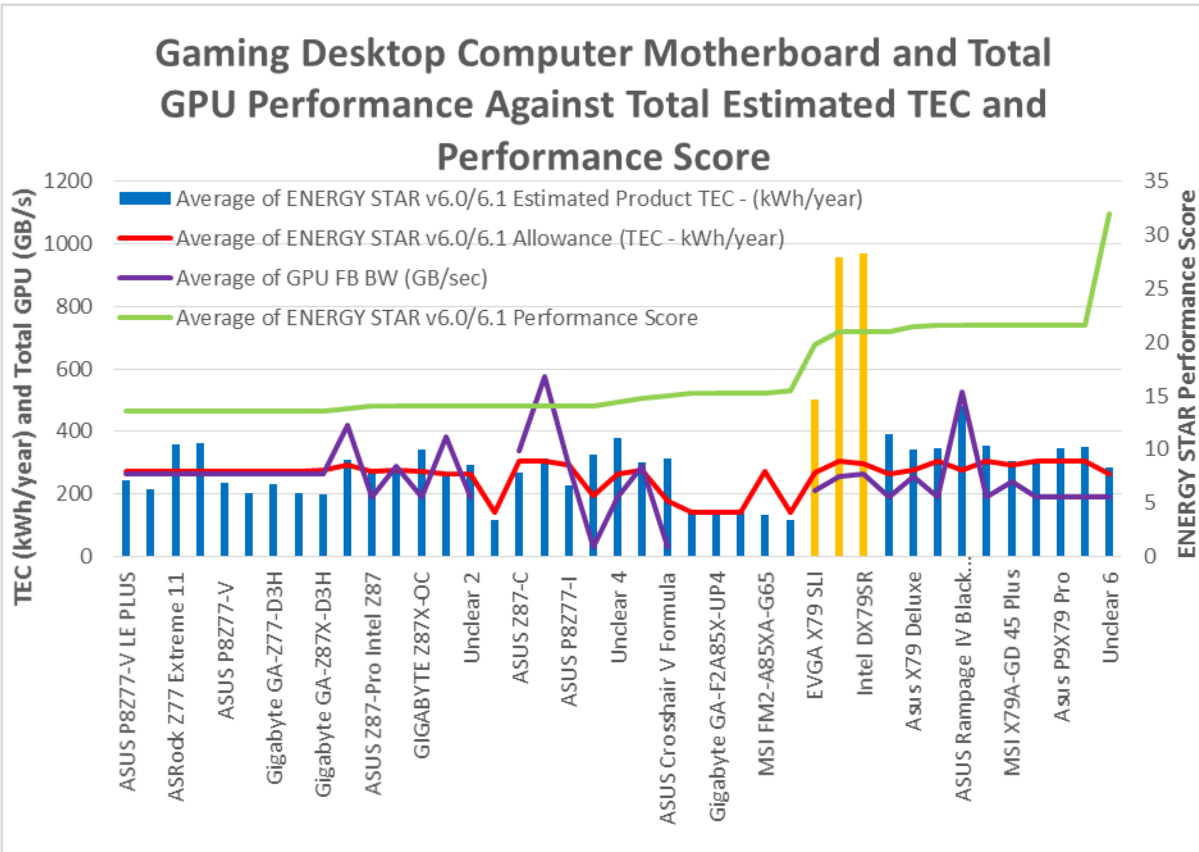
The analysis focused on desktop computers, as the numbers of notebook computers in the database was limited. We also decided to focus on ENERGY STAR v6.0, as the ENERGY STAR v5.2 specification is

[4] Power management is an optional feature that, in order to save energy, automatically places the computer in a lower power mode after some period of inactivity. All of these computers are expected to have power management capability, but the extent to which that capability is enabled for each is not known.

relatively old. The choice of motherboard included in a product, combined with the test conditions, likely had a stronger impact on overall energy use than the impact from any other single component. More detail on the performance of the computers against ENERGY STAR v5 and v6 TEC specifications and performance scores is given in Annexes II and III.

Figure 1 below shows the average estimated ENERGY STAR v6.0 TEC measured values and allowances for each desktop computer motherboard found in the database alongside ENERGY STAR v6.0 performance scores and GPU performance (measured in GB/sec). In addition, Figure 2 shows the motherboard chipset (the label above each data point).

Figure 1: Desktop Motherboard Types, average TEC, and Average Performance Scores



The results indicate that the average TEC values for two motherboards are considerably higher than other motherboards despite having similar (or lower performance scores) than other products.

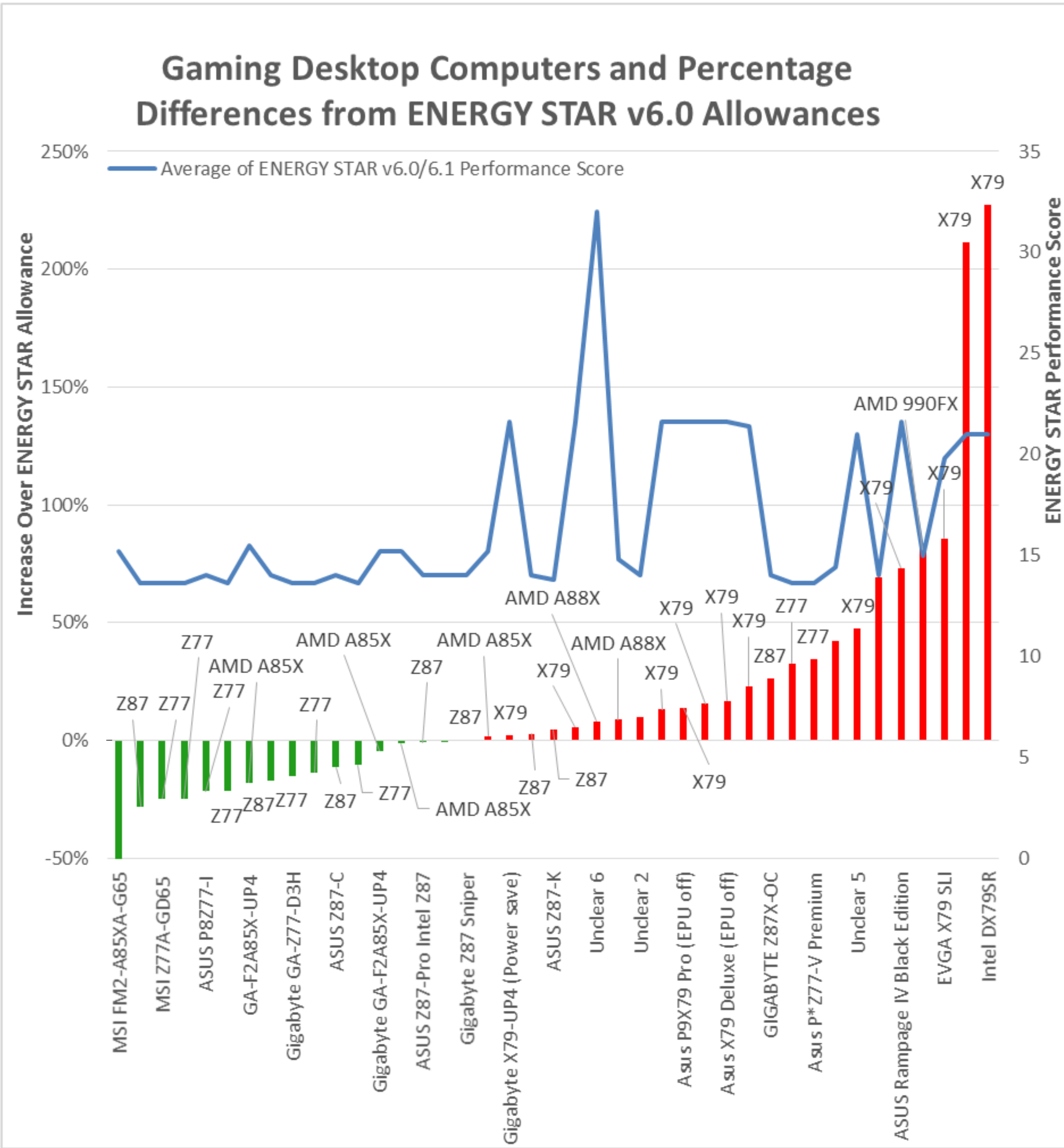
Figure 1 shows these two motherboards, as well as the third motherboard that contributed to 69% of products that failed to meet the ENERGY STAR v6.0 (in orange).

On closer inspection of the test data, it was revealed that the systems with these two motherboards were all overclocked during testing, compared to one third of other systems. As noted in the Methodology and Datasets section, overclocking can have a significant effect on energy use. Detailed data on overclocking and energy performance is provided in Annex I. Additionally, virtually all (26 out of 30) were tested in a “2D mode,” where editing documents in Microsoft Word or web surfing was taking place at the time of testing, rather than being tested in a true idle mode where no programs were running other than those launched when the computer first starts – as dictated under the ENERGY STAR v6.0 test methodology. This suggests that the estimated total TEC for these products is higher than it would have been had the products been tested in line with the ENERGY STAR v6.0 test procedure.

Conversely, the systems with the motherboards named “Unclear 5” and “Unclear 6” were tested with all power-saving technologies enabled and consequently had relatively low estimated TEC values despite their high performance scores. It is unclear whether the differences between the higher energy-using and the lower energy using high performance products can be entirely attributable to testing and power management settings. It is likely that some of the motherboards are also demanding more power than others.

Figure 2 below shows the average percentage divergence from the ENERGY STAR v6 allowances for desktop gaming computers with different motherboards, with the motherboard chipset shown above each bar. There is considerable divergence in the amount of difference from the ENERGY STAR v6 allowances. The lowest average difference from the ENERGY STAR v6 allowances is minus 51%; i.e. the average energy use by products with that motherboard is 51% less energy than allowed under the ENERGY STAR v6 specification, and the highest average increase over the ENERGY STAR v6 specification is 227%.

Figure 2 - Desktop Motherboards Average Difference from ENERGY STAR v6 Allowances



CLASP conducted further research on the impact that the motherboards had on the energy use of the desktop computers in the database. In assessing the data, CLASP identified the ENERGY STAR v6.0 compliance rates for each type of chipset[5] in the updated dataset. The results of this analysis can be seen in Table 2. The results show two important considerations. Firstly, the majority of high specification gaming desktop PCs for which data was sourced include motherboards utilizing the Intel

[5] A chipset is a set of electronic components that manages data flow between crucial components such as the processor, memory and peripherals. Most internal computer components are designed for a specific chipset. The chipset plays a crucial role in determining system performance.

X79 chipset. Secondly, the results show that all but one of the 73 desktop computers with X79 chipset based motherboards are unable to meet the ENERGY STAR v6.0 specifications (as tested for review).

Table 2 Desktop computer chipset type and ENERGY STAR v6.0 compliance

Desktop Chipset Type	Number of Models	Meet ENERGY STAR v6.0 TEC levels		
		Yes	No	% meeting requirements
X79	73	1	72	1%
Z87	10	6	4	60%
A85X	10	9	1	90%
Z77	9	7	2	78%
Unknown	4	1	3	25%
AMD 990FX	4	0	4	0%
A88X	2	0	2	0%
All	**112**	**24**	**88**	**21%**

Terminology

The **motherboard** is the main circuit board found in a computer (also known as the mainboard, system board, planar board or logic board). Major components such as the CPU, ROM, memory RAM expansion slots, PCI slots, and USB ports are all attached to the motherboard. In addition the motherboard includes controllers for devices such as hard drives, DVD drive, keyboard, and mice. Each motherboard includes a collection of chips and controllers which is known as the "chipset". The **chipset** manages the data flow between the processor, memory and peripherals. Chipsets are normally designed to work with specific families of microprocessors (CPUs) and as they control communications between the main components they have a strong influence on overall system performance. Thus different motherboards can have the same chipset, and have some aspects in common, but if they have different major components (CPU and/or RAM etc), the computing and performance can be quite different.

Results for Desktop computers with X79 Chipset Motherboards Only

Given the prevalence of the X79 chipset in high-performance systems and the low pass-rate for this chipset, CLASP performed further analysis on motherboards using this chipset in order to identify the factors that most impacted energy use.

The X79 chipset was launched to market in November 2011 and was designed to support "extreme" gaming desktop computers offering the very highest gaming performance. These X79 chipset motherboards remain popular amongst extreme gaming enthusiasts since they still offer higher levels of functionality than newer types of motherboards on the market. CLASP conducted a full review of the technical characteristics found in the three highest performing motherboards in the dataset. The most significant differences (in terms of functional characteristics that are likely to impact energy use) between these three highest performing types of motherboard can be seen in Table 3 below.

Table 3 – Highest Motherboard Specifications Found in Dataset

Desktop Chipset Type	A88X (AMD)	Z87 (Intel)	X79 (Intel)
Highest Spec CPU Supported	A10-7850K	Intel Core i7-4770K	Intel Core i7-4960x
Max CPU (cores)	4	4	6
Max CPU frequency (GHz)	3.7	3.5	3.6
Memory Channel	Dual	Dual	Quad
DIMM Slots	4	4	8
Max Memory (GB)	64	32	128
Total Max PCI Lanes	20	32	40

It is clear from this analysis that the X79 chipset based motherboards can support significantly higher gaming performance than the other types of motherboards. This increased functionality comes about due to the fact that the X79 chipset supports the highest specification Intel CPUs on the market, which are primarily designed for performance products; quad channel memory – meaning that the CPU memory controller can access four DIMMS of memory at the same time; large amounts of RAM; and an enhanced number of Peripheral Component Interconnect (PCI) lanes – hence they would be able to support more graphics cards at highest speeds.

Figure 1 above shows the relationship between motherboard type, average GPU performance, estimated average TEC and ENERGY STAR performance scores. A number of salient points can be drawn from

Figure 1:

- X79-based desktop computers dominate the right hand side of the graph, which represent higher ENERGY STAR performance scores.
- Average GPU performance does not have a major impact on the measured TEC of products.
- TEC results for X79-based products varies significantly with two of the motherboards assessed (those shown in orange) using considerably more energy despite having lower specification CPUs included and lower than average GPU performances.

These points suggest that while desktop computers with motherboards with X79 chipsets use more energy on average, the amount of energy used by these products varies widely. However, it is also clear from Figure 1 that there is considerably less variance in energy use within the newer X79-based computers than there is between the products with the older Intel motherboards (those shown in orange) and these newer products. This suggests newer motherboards with the X79 chipset may be considerably more efficient. This energy use variance in X79-based systems is shown in more detail within Figure 3 below.

Figure 3: Desktop Computers with Motherboards Based on the X-79 chipset, Average GPU Performance, Average TEC, and Average Performance Scores with CPU Details Added

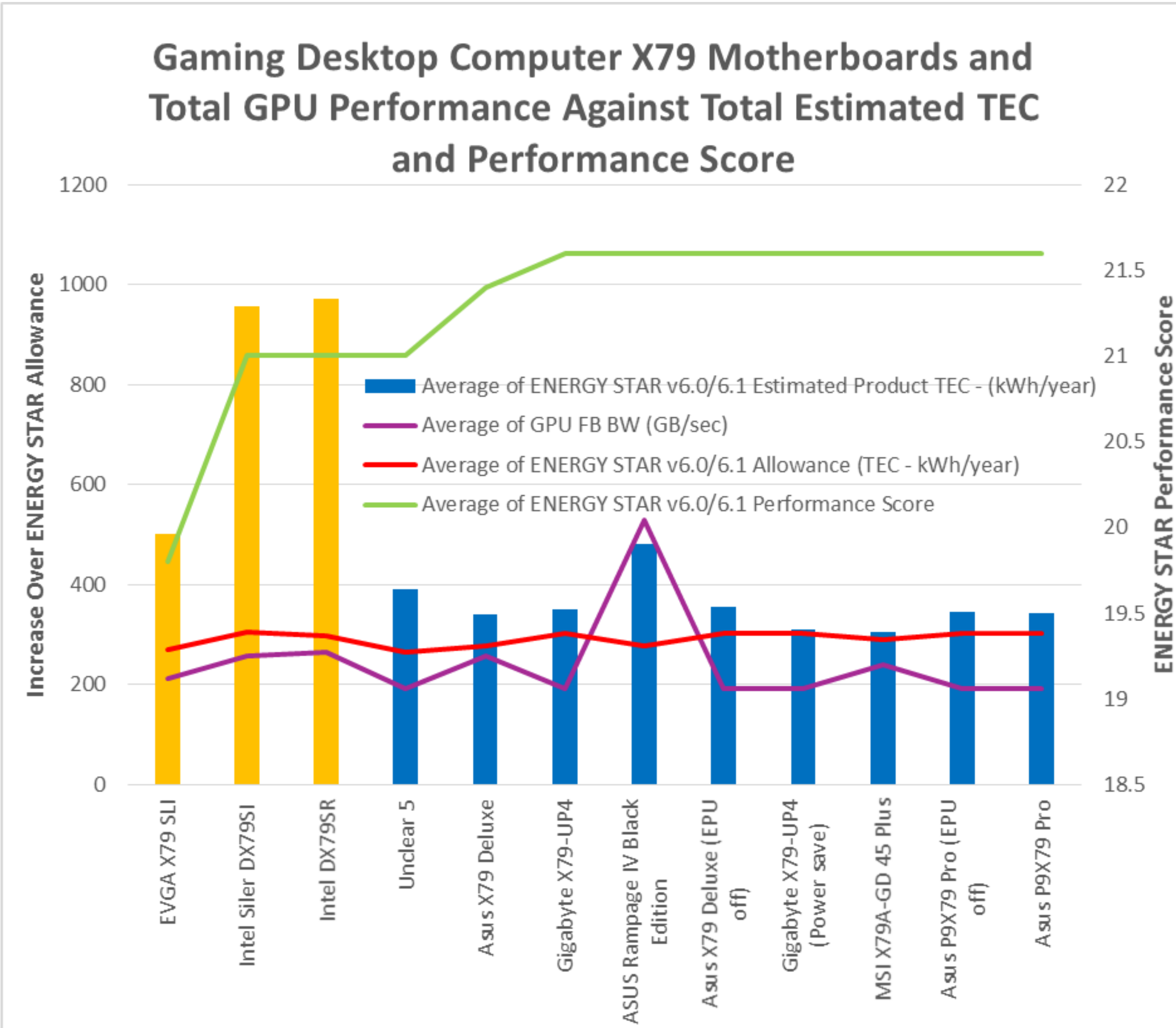
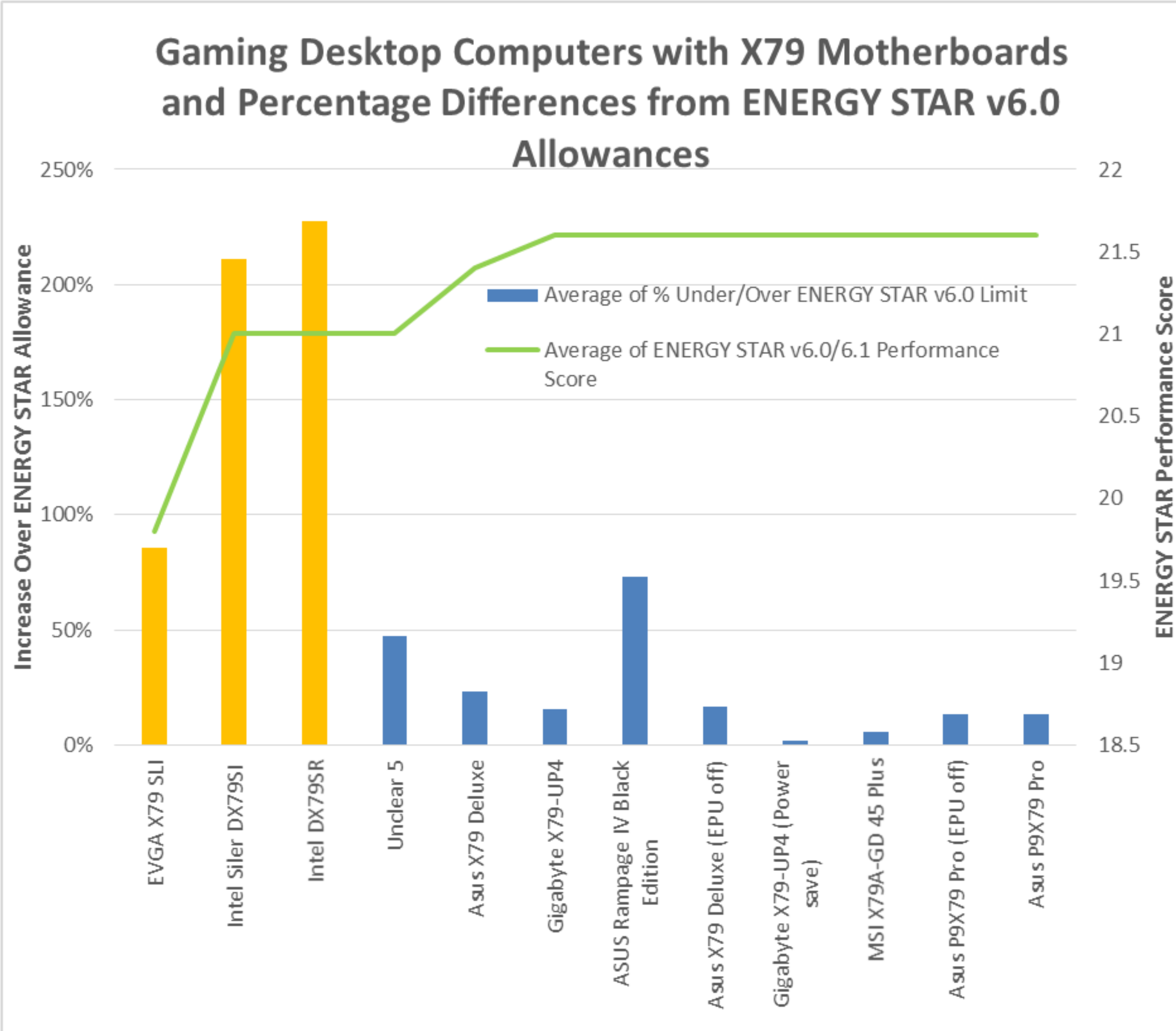
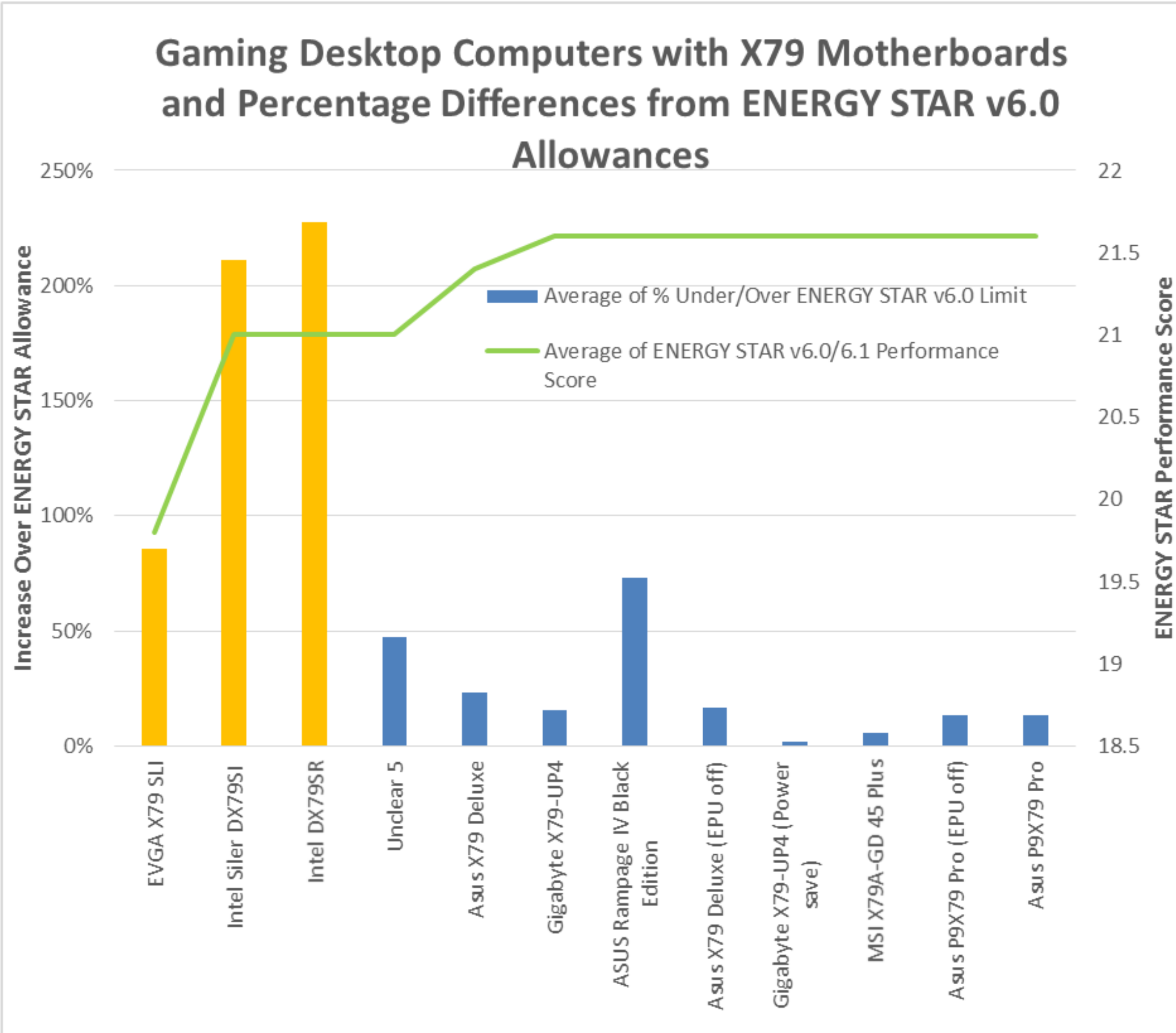


Figure 4: Desktop X79-based Motherboards, Average Difference from ENERGY STAR v6 Allowances



below shows how far above (in percentage terms) the ENERGY STAR v6.0 allowances the estimated average TEC values were for the X79 systems. It is clear from the figure that many of the newer and highest ENERGY STAR performance scoring X79 systems are significantly closer to the ENERGY STAR allowances than the older X79 systems (as tested for review).

Figure 4: Desktop X79-based Motherboards, Average Difference from ENERGY STAR v6 Allowances



CLASP sought to further understand the factors behind the significant variance in the energy consumption of the X79-based motherboards found in the dataset, and to assess whether performance is a primary factor in energy consumption. To do this the technical features of all of the X79-based motherboards in the dataset were collected and then compared.[6] The results of this analysis can be seen in Table 4 below.

[6] It was not possible to collect details on the EVGA X79 motherboard as the review website did not specify exactly which EVGA motherboard was included in the tested product.

Table 4 – Comparison of Technical Features of X79 Motherboards in Dataset

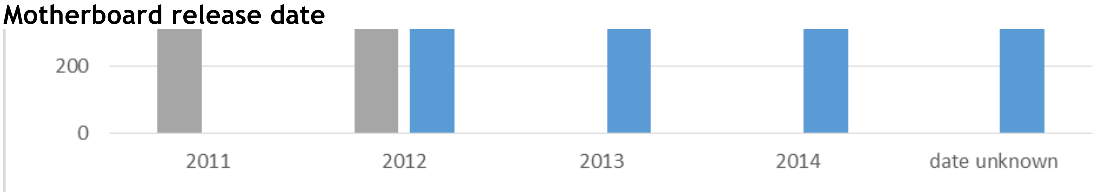
	X79 Motherboards						
Specification	Asus P9X79 Pro	ASUS Rampage IV Black Edition	Asus X79 Deluxe	Gigabyte X79-UP4	Intel DX79SR	Intel Siler DX79SI	MSI X79A-GD 45 Plus
Date Motherboard Launched to Market	Mar-13	Feb-14	Sep-13	Dec-12	May-12	Oct-11	Feb-13
Motherboard Chipset	Intel X79						
CPU Socket	LGA 2011						
Highest Spec CPU Supported	Intel Core i7-4960x						
Max CPU (cores)	6						
Max CPU frequency (GHz)	3.6						
CPU manufacturing process (nm)	22						
Max DDR3 Memory Speed (MHz)	2400	2800	2800	2133	2400	2400	2400
Memory Channel	Quad						
DIMM Slots	8						
Max Memory (GB)	64	64	64	64	64	64	128
PCI Express 3.0 x16	3	4	3	2	3	3	3
PCI Express 3.0 (x8 mode)	1			2			
PCI Express 3.0 (x4 mode)			1				
PCI Express 2.0 x16 (x4 mode)							2
PCI Express 2.0 x1	2	2	2	2	2	2	1
Total Max PCI Lanes	40	40	36	40	40	40	40
PCI				1	1	1	
SATAIII	3	2	2	2	4	2	2
SATAII	4	4	4	4	4	4	4
RAID (0/1/5/10) Supported	Y	Y	Y	Y	Y	Y	Y
USB 3.0 ports	6	8	8	4	6	6	2
USB 2.0 ports	2	10	12	14	14	12	6
Integrated GPU included	N	N	N	N	N	N	N
Nvidia 3-way SLI (2 way)	Y	Y	Y	Y	Y	Y	Y
Nvidia 3-way SLI (3 way)	Y	Y	Y	Y	Y	Y	Y
Nvidia 3-way SLI (4 way)		Y		Y			
AMD CrossFire (2 way)	Y	Y	Y	Y	Y	Y	Y
AMD CrossFire (3 way)	Y	Y	Y	Y	Y	Y	Y
AMD CrossFire (4 way)	Y	Y	Y	Y			
Bluetooth	Y	Y	Y		Y		

The differences in the products boil down to differences in:

- Motherboard release date
- CPU
- Memory speed
- RAM supported
- GPU performance
- Number of SATA III and USB 3.0 connections
- Support for CPU overclocking

Each of these was considered as the possible source for significant differences in energy use in turn, as discussed below:

Motherboard release date



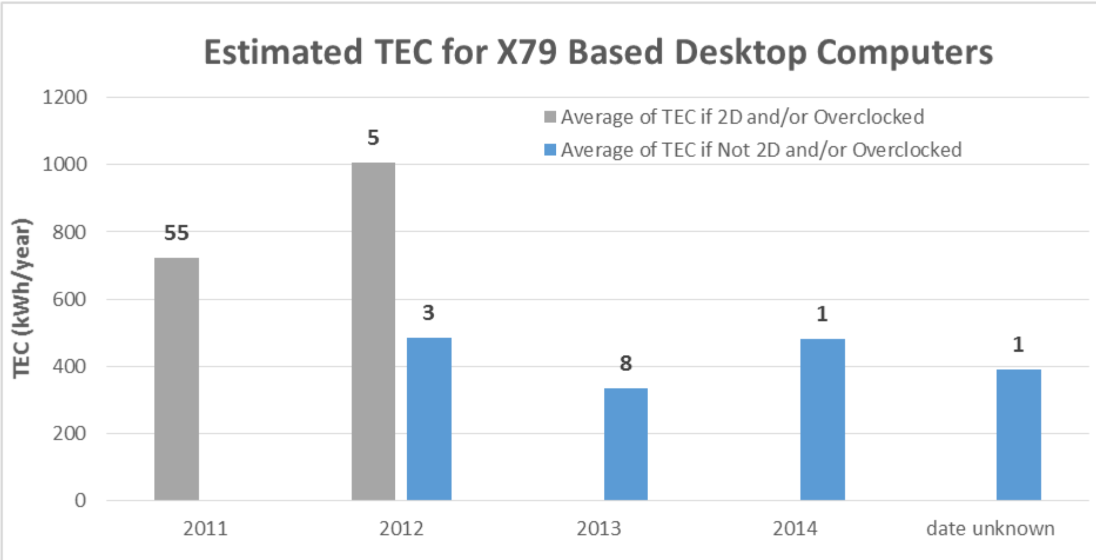
SI) included
e any of the
. The Intel
s age[7].

shows the average TEC for each type of X79 chipset motherboard in the database by age and test conditions – with computers measured in 2D mode and/or overclocking separated from those that weren't. (Sample size is shown above each bar). The column labelled, "date unknown" is the data from one desktop gaming computer with a X79 chipset based motherboard whose release date was not given in the test review. As the testing conditions for the computers with older motherboards, in 2D mode and/or with overclocking are likely to increase the energy use measured it is not possible to separate out the effects of motherboard release data and test conditions.

Figure 5 – Estimated Average TEC for the X79-based Desktop Computers in the Database by Release Date and Test Conditions

Sample size is shown in brackets above each bar

[7] Intel have announced that they are to stop manufacturing desktop computer motherboards



Mkm,CPU

Moving through the rest of the technical features in Table 4, it is clear that the X79 chipset motherboards all share the same level of CPU support. That is, X79 chipset motherboards support the highest specification desktop CPUs available from Intel. In general CPUs can significantly impact the energy used by computers. However, given that all X79-based desktop PCs are using only one of two high specification CPUs these components are unlikely to cause a large difference in energy use.

Figure 6 shows the measured TEC of two desktop computers with X79 chipset motherboards which are identical except for the CPU. The inclusion of a different CPU had very little impact on overall energy use (a difference of 11.7kWh, about 3.5%). In fact, the newer Intel Core i7-4960x provided more functionality for less energy.

Figure 3: Desktop Computers with Motherboards Based on the X-79 chipset, Average GPU Performance, Average TEC, and Average Performance Scores with CPU Details Added

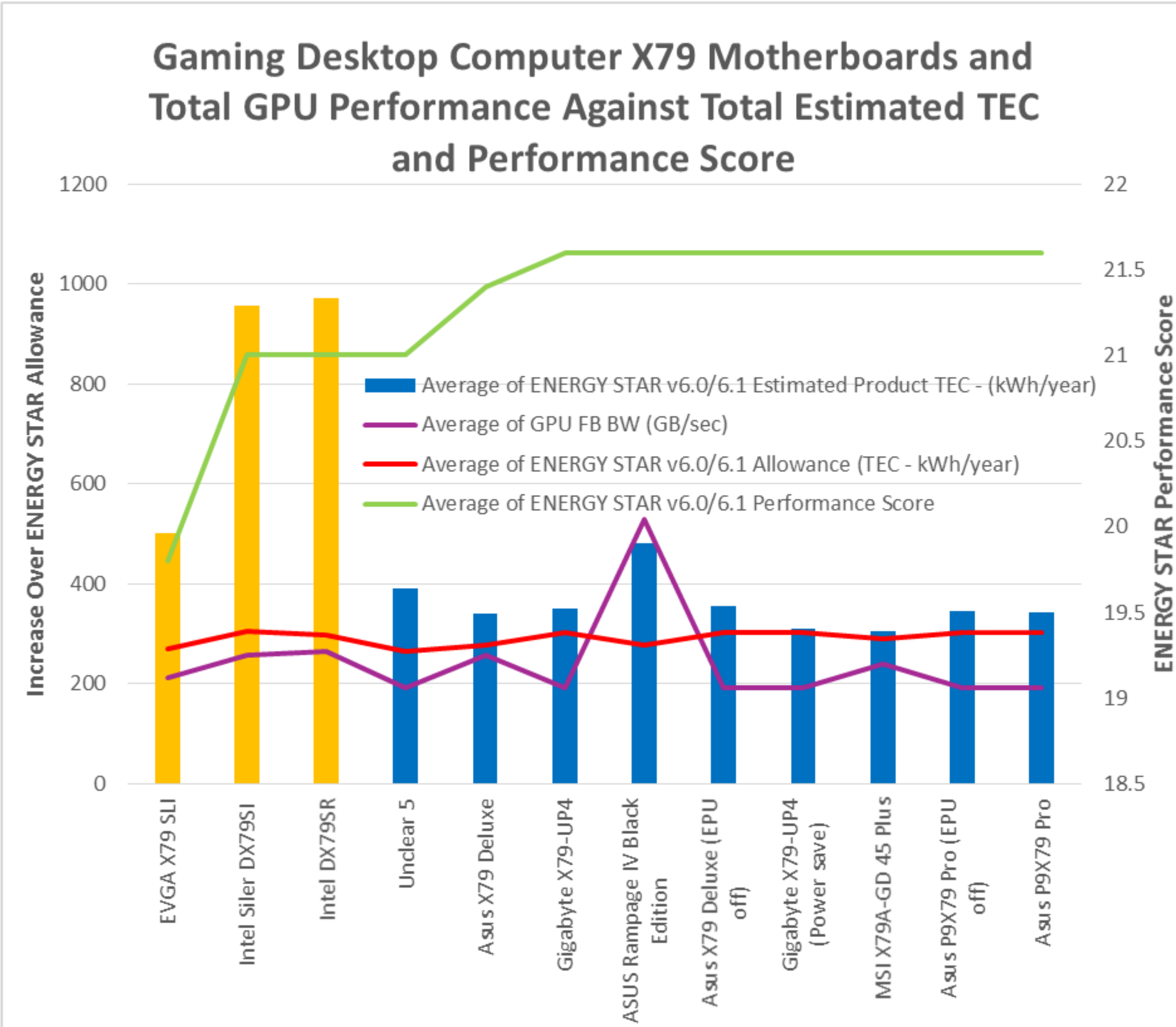
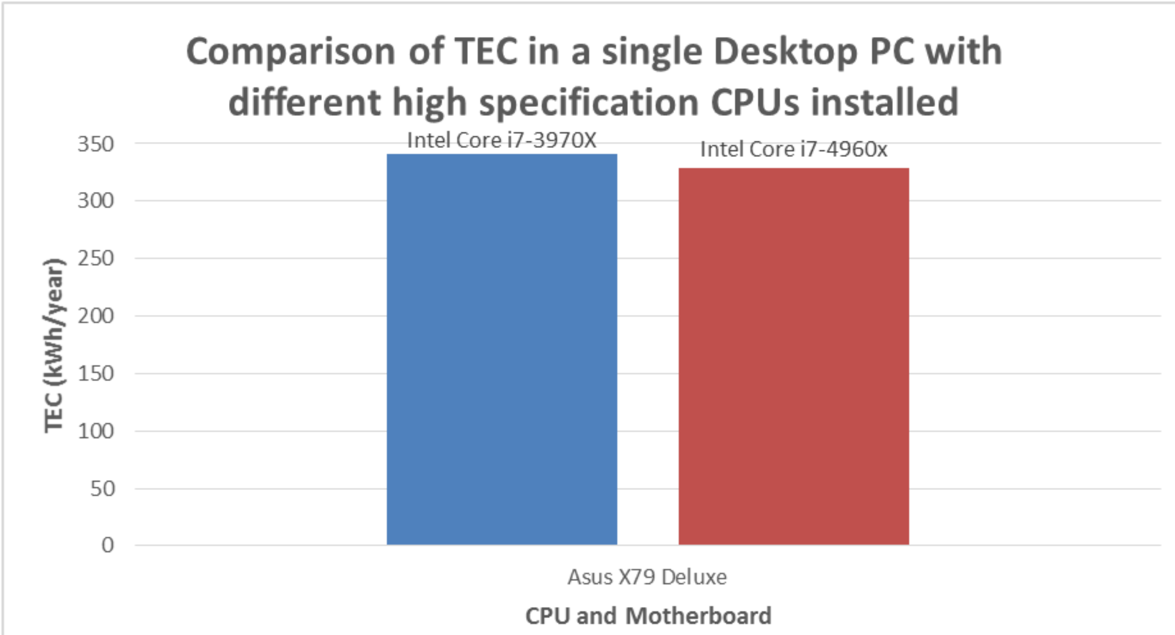


Figure 6 – Estimated TEC for a Single Desktop Computer Tested with Different CPUs Included



tel Core i7-
r Intel Core
in

suggests that the CPU installed is not a significant factor in the difference of power use between X79 systems.

Memory

All the X79 chipset motherboards support quad-channel memory. A clear difference between the boards in terms of memory is that most support memory speeds of 2400MHz with outliers at the lower end (2133MHz) and higher end (2800MHz). These differences in supported memory speed are unlikely to have a significant impact on overall energy use.

All but one of the motherboards support a maximum of 64GB of RAM, with one board claiming support for 128GB RAM (all systems had between 8GB and 32GB of RAM installed during testing. All the desktops with X79 motherboards had between 16GB and 32GB of installed RAM during testing). RAM uses relatively little energy in comparison to other components: ENERGY STAR v6.0 provides 0.8 W allowance per GB of RAM. For 16 GB, of difference seen in the X79 systems this corresponds to 12.8 watts. Therefore the difference in energy use seen amongst the X79-based systems is highly unlikely to be due to differences in installed RAM.

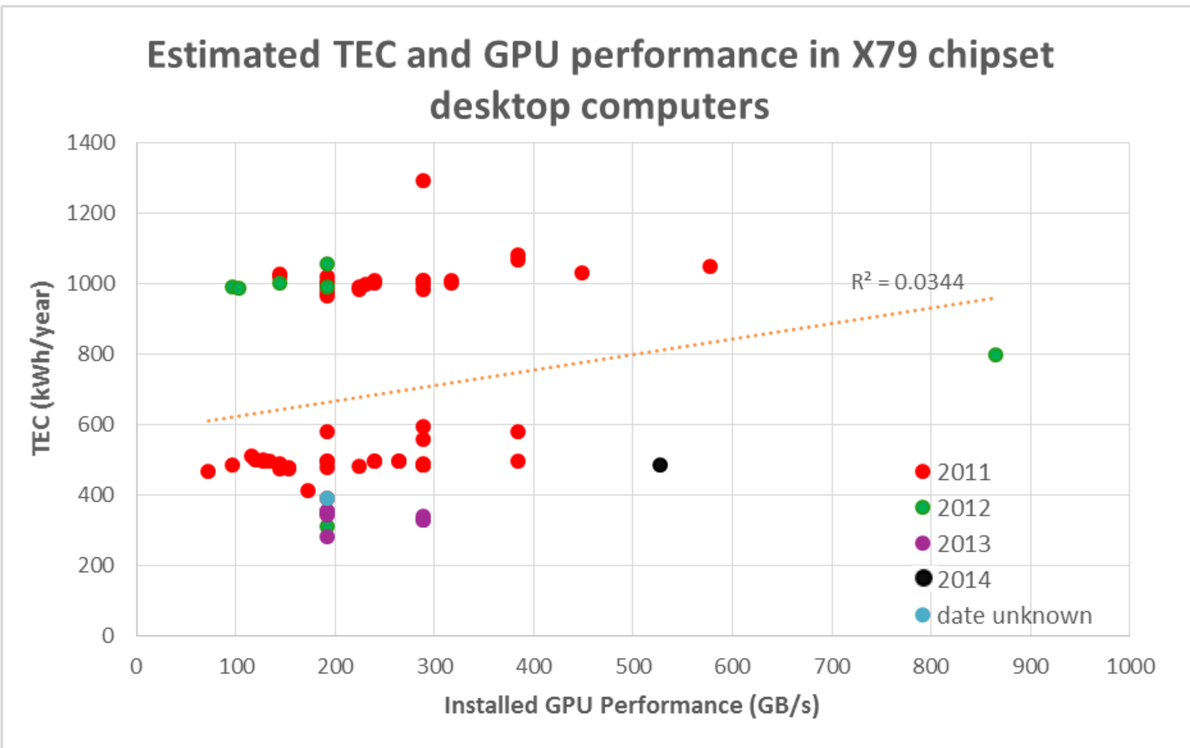
Graphics card support

Support for graphics cards also varies with most motherboards providing up to 40 PCI lanes to support multiple graphics cards. However, some motherboards can only support 4 graphics processing units (GPUs) when dual GPUs are included on a single discrete graphics card whereas other motherboards such as the ASUS Rampage IV Black Edition can support four separate discrete graphics cards (dGfx). Figure 7 shows the relationship between installed graphics performance (measured in GB per second) and TEC as tested within each of the X79 chipset desktop PCs. The year in which the motherboard included in each system was first placed on the market is also shown.

There are two clear populations of computers within the sample in terms of TEC, both with a wide range of GPU performance: those with higher energy use (generally those with older motherboards, tested while overclocked) and those with lower energy use (generally those with newer motherboards with fewer overclocked when tested).

Considering the full set (both populations together), there does not appear to be a relationship between graphics performance and energy use. The very low R^2 value (0.0344) of the linear fit line shown on the graph indicates a poor correlation between energy use and total graphics performance. Therefore, it is suggested that the amount of graphics performance included within the desktop PCs found in the database is not the determining factor in overall energy use.

Figure 7 – Estimated TEC for the X79-based Desktop Computers in the Database by GPU Performance



Number of SATA III and USB 3.0 connections

All X79 chipset motherboards in the dataset support SATA III connections with the Intel DX79SR providing the most. However, it is unlikely that these extra SATA III connections would account for the large amount of extra energy used by the desktop computer containing this motherboard. ENERGY STAR v6.0 allows for a total of 26 kWh/year extra allowance for additional hardrives (beyond the first). This suggests that the addition of extra hard drives is unlikely to increase energy use significantly. Therefore, the simple inclusion of extra SATA III connections with no hardrive connected is likely to have a very minimal impact on overall energy use of desktop computers. Similarly, it is unlikely that extra USB 3.0 connections (where not used to power external peripherals) on any motherboard would add significantly to overall power demand (the USB 3.0 specification dictates a maximum power draw of 2.5mA for each USB connection when in suspend mode (i.e. when no products are connected) which equates to significantly less than 1W).

CPU Overclocking

All of the X79 motherboards support CPU overclocking, therefore overclocking support is not a differentiating factor. Some motherboards have additional functionality to support overclocking. For example, the ASUS Rampage IV Black Edition motherboard has a separate component that plugs into the motherboard, which provides users with the ability to overclock the CPU and monitor system conditions such as temperature and fan speeds via a physical display. This type of device is likely to use more than a nominal amount of extra power and could therefore go some way to explaining why the Asus Rampage based desktop had a higher power demand. Although this product also provides higher graphics performance which may also use more energy, it is not possible to determine how much of the extra power is due to graphics vs. the overclocking monitor.

Conclusions

The range of testing conditions used in the data collected appeared to have a major effect on the resulting TEC values (possibly decreasing TEC in the case of testing without the case on or increasing TEC when overclocked or not in idle mode, as defined in the ENERGY STAR specification). More test results under ENERGY STAR conditions are needed.

About 21% of 112 desktop gaming computers analyzed meet the ENERGY STAR v6.0 TEC levels. No clear relationship was found between performance and energy consumption; some high performance models (especially newer chipsets tested without overclocking) had lower energy consumption. Most (69%) of the models not meeting the ENERGY STAR levels were associated with only 3 of 39 motherboards analyzed. None of the models having these three motherboards met ENERGY STAR v6.0 TEC levels. Overclocking was also associated with failure to meet the ENERGY STAR TEC levels. Variation in testing conditions contributes to uncertainty in the energy values (perhaps +/-20%). Had these models been tested under ENERGY STAR conditions (instead of in 2D mode and with overclocking), it is likely that more models would have met the ENERGY STAR v6.0 TEC levels.

ENERGY STAR share: 21% of desktop models in the study's sample meet the ENERGY STAR v6.0 TEC levels. Key factors were components (specifically, CPU[8] and motherboards) and over-clocking. This study suggests that high-end gaming computers, including some of the highest performance X79 chipset configurations, might be able to meet ENERGY STAR v6.0 levels, if tested according to ENERGY STAR requirements. Many of the very highest performing gaming computers in the study were very close to meeting the ENERGY STAR v6.0 limits. That is, the 'pass-rate' in this study may be much lower than in reality, due to the uncertainties in testing conditions which may have led to overly high TEC estimates.

Performance: A clear relationship between performance and energy consumption was not observed. Some computers close to meeting the ENERGY STAR levels included some of the configurations with the highest ENERGY STAR performance scores (and relatively high specification discrete GPUs).

Potential explanatory factors: There are many variables potentially influencing computers' power demand and their ability to meet ENERGY STAR levels, including CPU performance (described by the ENERGY STAR performance score), graphics performance, product setup, power management settings and other internal components (such as motherboards) which are not directly accounted for in the ENERGY STAR performance score calculations.

Motherboard chipsets: Three motherboards (8%) were associated with 69% of the non-ENERGY-STAR models. This analysis includes 112 models with 38 different motherboards. Of those, 24 models (with 18 different motherboards) meet ENERGY STAR v6.0 TEC levels. 88 models (with 22 different motherboards) did not meet ENERGY STAR v6.0 TEC levels.

On analyzing the data it became clear that newer versions of the high performance gaming desktop computers (those based on the X79 chipset) used significantly less energy than the older high performance products in the dataset. The newer products provided either the same or higher levels of functionality than the older high performance products.

However these results were confounded by the test conditions, in that most of the models having the three older motherboards were tested while overclocked and in 2D mode, and those with newer motherboards not, making it difficult to separate the effects of motherboard age from overclocking.

Non-ENERGY STAR test conditions: There were significant sources of uncertainty in testing conditions for all these data, which do not support precise quantitative conclusions. The largest uncertainty surrounded the use of 2D mode testing, which likely resulted in an increased power demand vs short

[8] As described above the CPU had little effect on energy use for the X79 chipset motherboards but these are only a subset of the sample of gaming computers with only two CPU installed. Over the whole range of gaming computers in the sample the CPU varies more widely and will have a significant effect on energy use.

idle mode. Had these products been tested under ENERGY STAR v6.0 test procedures their short idle power demand, and consequently the calculated TEC values, would likely have been lower. In addition, many of the systems in the database were tested with their CPUs overclocked (i.e. the frequency of the CPU was increased to increase performance). 88% of models that contained an overclocked CPU failed to meet the ENERGY STAR v6.0 TEC levels, compared to 59% of products with non-overclocked CPUs. Again, had these products been tested with their CPUs operating at base frequencies their short idle mode power demand would likely have been lower. These two deviations from the ENERGY STAR test methodology could have led to higher TEC values, and therefore fewer models meeting ENERGY STAR TEC levels than if tested with the ENERGY STAR test method.

ANNEX I: Overclocking

A high proportion of desktop computer models were tested with overclocked CPUs (74 of 112). Overclocking is the process of running a CPU, memory, motherboard chipsets or GPUs above the frequency that the component manufacturer intended. Overclocking improves computer performance, especially for activities like gaming, but comes at the cost of increased power demand. The increased power demand is a result of both running the components faster and as a result of the need for increased cooling to remove extra heat from the computer chassis.

Figure 8 – Desktop Computer Overclocking and ENERGY STAR v6.0

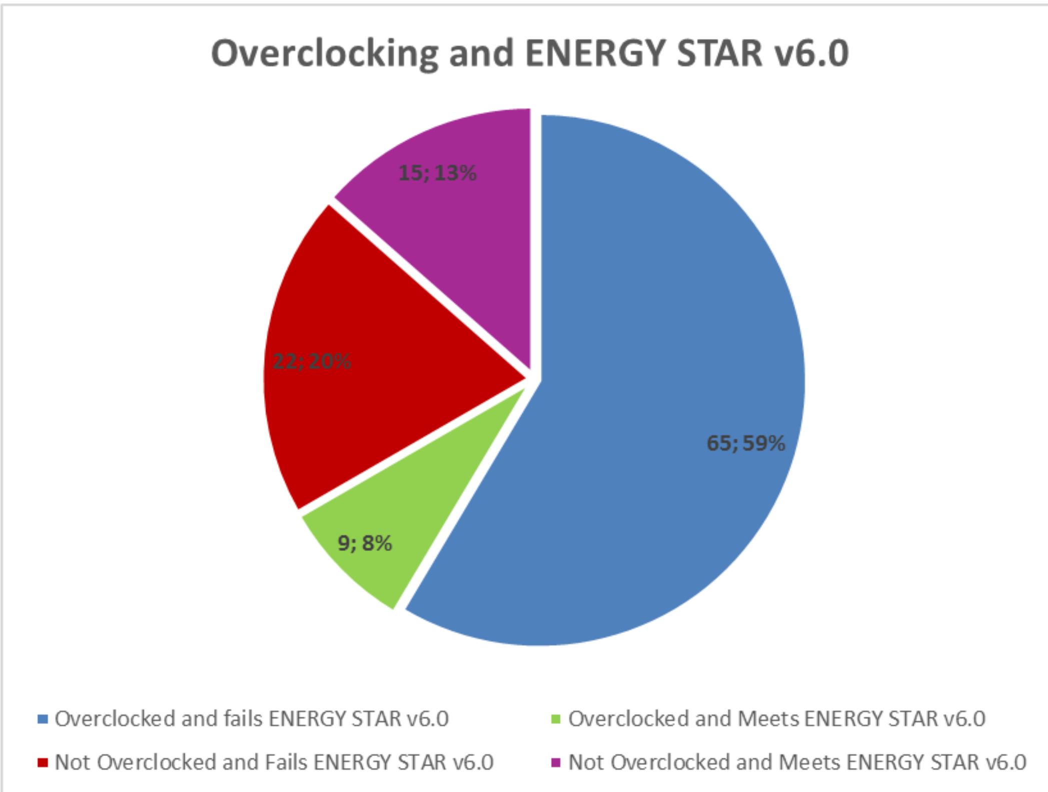


Figure 8 shows the number of desktop computers that included overclocked CPUs and identifies how many of these met the ENERGY STAR v6.0 levels. A significant percentage of products with overclocked CPUs did not meet the ENERGY STAR v6.0 levels (88%), while a lower percentage, 59%, of the models that were not overclocked did not meet the ENERGY STAR v6.0 TEC levels.

ANNEX II: **TEC and ENERGY STAR Performance Score**

Figures 9 and 10 below show the average TEC and performance scores (calculated using the ENERGY STAR v6.0 approach) for desktops and notebooks respectively. For desktops they show the wide range in average TEC for products with similar performance scores. This may be partly due to the testing conditions used, as discussed above.

Figure 9 – Average Desktop ENERGY STAR v6.0 TEC Against Performance Scores

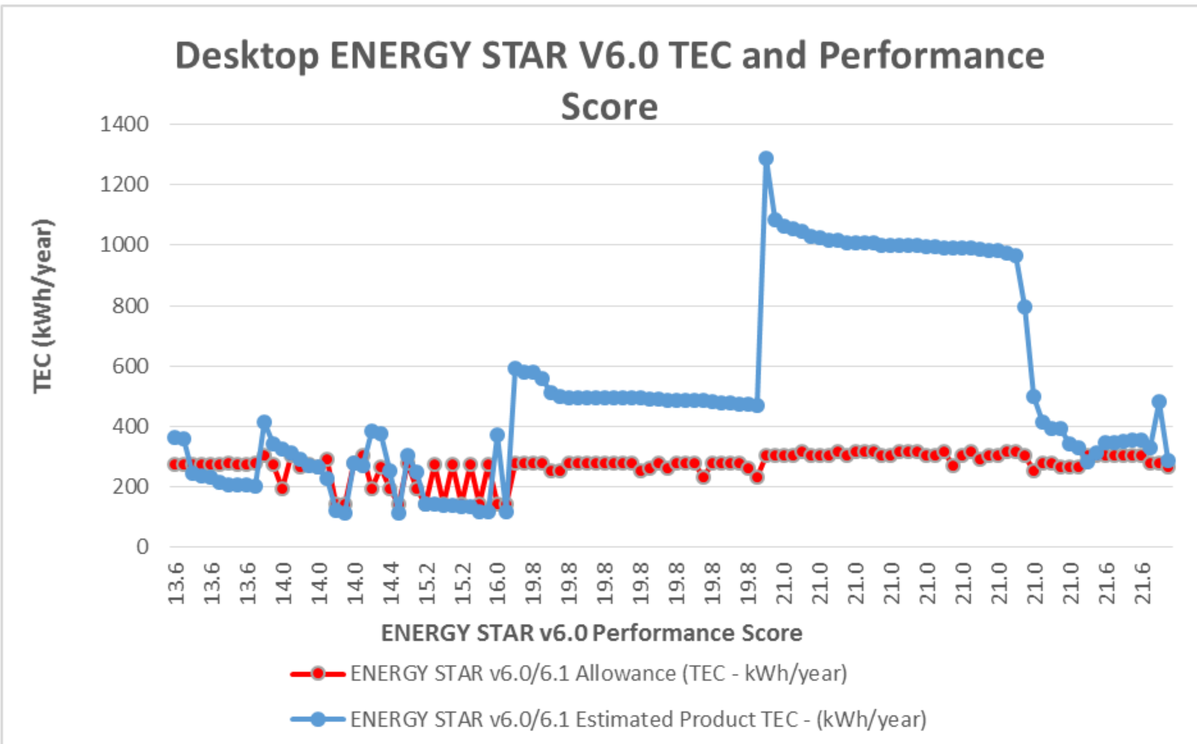
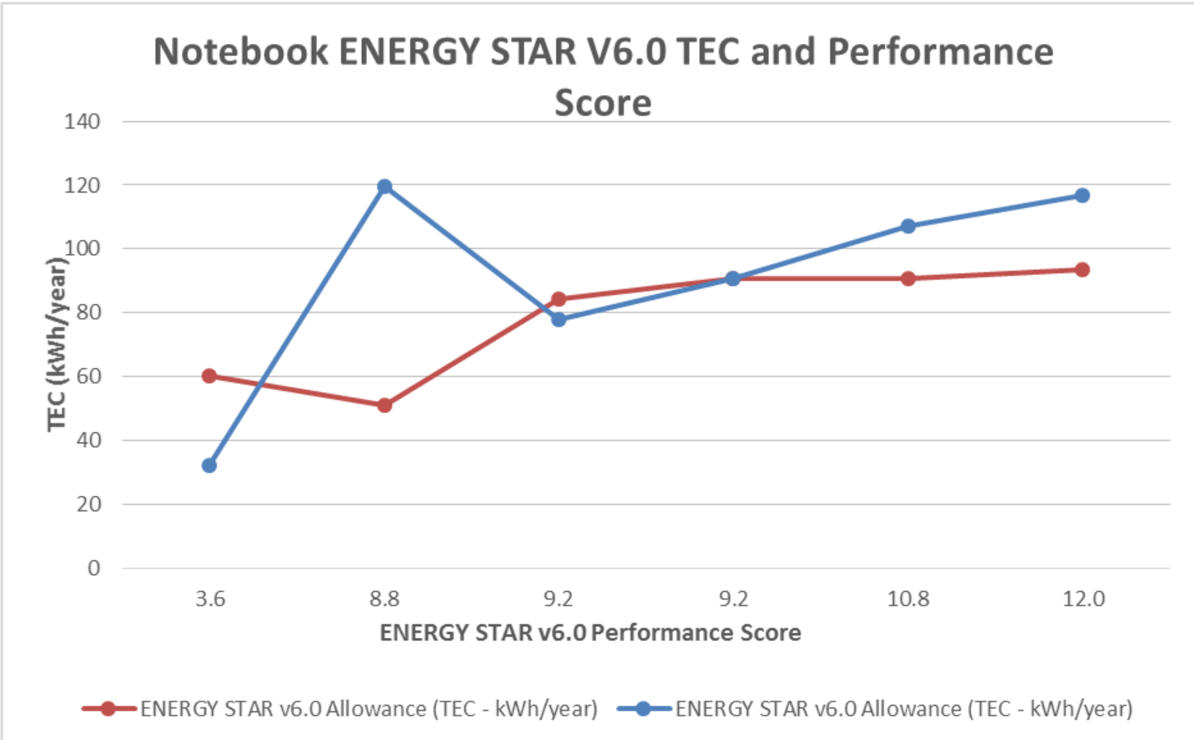


Figure 10 - Average Notebook ENERGY STAR v6.0 TEC Against Performance Scores



ANNEX III: **ENERGY STAR v5.2 and ENERGY STAR v6.0 Comparison**

Figure 11 and Figure 12 show the ENERGY STAR v5.2 and v6.0 allowances for desktops and notebook computers included in the database. It is important to note that the usage profiles behind ENERGY STAR v5.2 and v6.0 differ but this difference is minimal for desktop computers. The results shown in Figure 11 therefore suggest that the ENERGY STAR v6.0 allowances for high end desktop computers are not significantly more stringent than the ENERGY STAR v5.2 allowances for most desktop computers found in the database.

Figure 11 - Desktop ENERGY STAR v5.2 and v6.0 TEC Allowances for Products in the Database

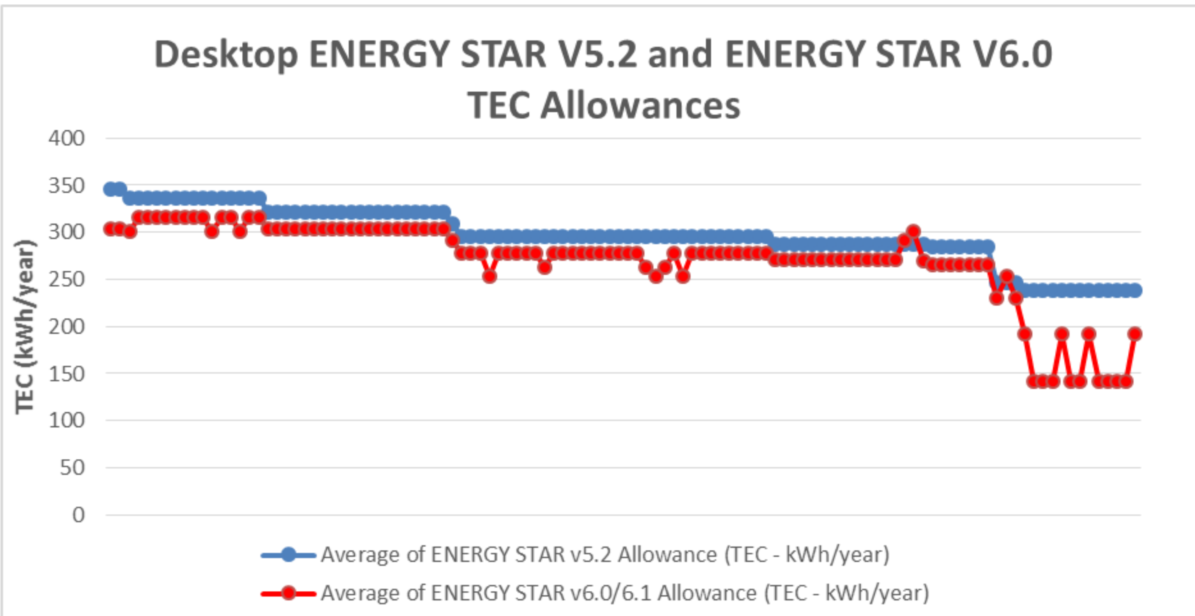
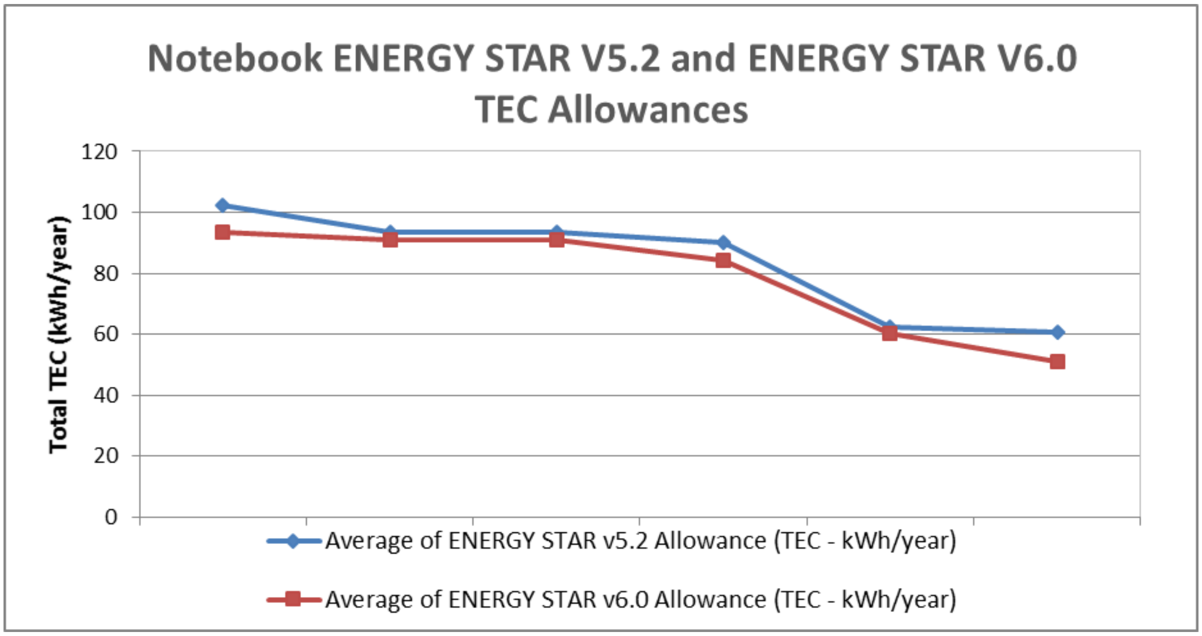


Figure 12 - Notebook ENERGY STAR v5.2 and v6.0 TEC Allowances for Products in the Database



MEMO

TO: My Ton, CLASP Director of Global Research and Jim McMahon, CLASP Senior Technical Advisor

FROM: Fiona Brocklehurst and Jonathan Wood, CLASP

DATE: May 27, 2014

SUBJECT: Australia's rules for "deemed to comply" for low production volumes for computers

Australia has included a “deemed to comply” clause in its computer minimum energy performance standards in order to minimize compliance testing costs for low-volume computers. This memo provides information about this approach.

<u>*Question:*</u> Australia's rules for "deemed to comply" for low production volumes – what are the rules about when this applies? What (if anything) do small producers have to do?

<u>*Answer:*</u>

“GEMS[1] level requirements for deemed-to-comply computers (2) A computer is a deemed-to-comply computer if no more than 200 computers of the same model have been or will be supplied:

(a) in the year which commences on the date after this Determination commences on which the first computer of the same model was supplied; and

(b) for each year after the date mentioned in paragraph (a), the year ending on the date of the anniversary of the date mentioned in paragraph (a).

(3) The energy use requirements for a deemed-to-comply computer are the requirements set out in clause 4.4 of AS/NZS 5813.2:2012.

Conducting tests

(4) The requirements for conducting tests for products covered by this Determination, other than deemed-to-comply computers, are the requirements mentioned in section 2 (General Conditions for Measurement) and section 3 (Measurement Approach) of AS/NZS 5813.1:2012.

(5) The requirements for conducting tests for deemed-to-comply products are:

(a) for products with a direct connection to mains power—the requirements mentioned in sections 2 (General Conditions for Measurement), 3 (Loading Criteria for Testing Efficiency) and 4 (Measurement Approach) of AS/NZS 5814.1:2012; and

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[1] GEMS = Greenhouse and Energy Minimum Standards. Refers to Australian legislation, the GEMS Bill of 2012. http://www.energyrating.gov.au/regulations/legislation/commencement-of-gems-legislation/

(b) for products powered by an external power supply—the requirements mentioned in subsections 6(2) to 6(4) of the Greenhouse and Energy Minimum Standards (External Power Supplies) Determination 2012"[2].

That is, manufacturers putting 200 computers or less of a given model need to meet PSU efficiency levels (only) for this model and to register the model on the database. In Australia they are required to pay a fee to register. Anecdotally it is thought that some small manufacturers are not doing this, in violation of the regulation, in order to avoid the fee.

As such it is likely to be difficult to work out what percentage of the computers on the Australian market come from these small manufacturers (it is likely that the number of small manufacturers of notebooks and integrated desktops to be very small, since these products are not easily manufactured from commonly available parts; it is more difficult to comment on desktop computers as they can be assembled from components more easily and thus very low volume manufacture is more feasible and likely). There are no registration fees in New Zealand so it may be better to ask the New Zealand government for this information.

In Australia manufacturers with models which qualify under the 'deemed to comply' rule can self-certify for these models – that is, while the tests (power supply unit efficiency only) need to be performed to the requirements of the stated test methodology (AS/NZS 5814.1:2012) and the companies need to be able to provide these to the Australian Government, (or their representatives) on request, they do not need to be tested by a third party.

If other economies allowed small manufacturers to self-certify but required them to meet Total Energy Consumption (TEC) requirements it is thought that the cost of testing for desktops would be low, as companies are likely to be able to complete power testing in house. However for integrated desktop and notebook computers, if you have to include display power mode (as per ENERGY STAR v6) this includes measuring screen luminance, which companies may need to hire a professional testing house to do or purchase more specialist equipment. This will increase the cost. A professional test house has given us a quote for testing against the ENERGY STAR v6.0 specification, for desktops, notebooks and integrated desktops of US$900-1000 per unit, with workstations expected to be a little higher.

[2] Text on http://www.comlaw.gov.au/Details/F2013L00726/Download