California Statewide Business and Consumer Electronics Program New Products Baseline

Prepared for:

PACIFIC GAS AND ELECTRIC, SOUTHERN CALIFORNIA EDISON, AND SAN DIEGO GAS AND ELECTRIC

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1. STRUCTURE OF THIS REPORT

This report covers a series of memos submitted to the BCE Statewide Program Evaluation Team (comprised on PG&E, SCE, and SDG&E) over the fourth quarter of 2010. Throughout 2010 calendar year, the Opinion Dynamics Evaluation Team examined the Business and Consumer Electronics market using in-depth interviews with market actors and a comprehensive secondary data review. The data collected was compiled into measure-specific memos to generate a market baseline. Specifically, we delivered our findings for the following six measures in six individual memos:

1. Business to Business and Business to Consumer Notebook Computer
2. Business to Business Server
3. Business to Business Imaging Equipment
4. Business to Consumer Set-top Boxes
5. Business to Consumer Game Consoles
6. Business to Business Commercial Televisions

This document combined these memos with an over-arching summary for the purposes of future research and posting on CALMAC.

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OVERARCHING FINDINGS

Opinion Dynamics delivered six measure-specific memos that cover each of the six target measures discussed in this section. As an added-value to the program teams, we synthesize our key findings provided in the measure-specific memos in this document. Specifically, we discuss the following: (1) key trends in the BCE market overall; (2) recommendations for program expansion and future research; and (3) baseline findings on energy efficiency penetration and practices for each measure. At the end of this memo, we provide a summary of the study.

Considerations for Program Development:

Unlike traditional white goods, the electronics category presents unique challenges and opportunities for utility programs. Here, we discuss over-arching trends in this industry that set it apart from traditionally rebated product categories.

Our findings indicate that the market is receptive, overall, to a per-unit based incentive for high efficiency products. However, there are challenges to program design and development that we outline here.

End-User Experience is Driving Rapid Innovation

- **The electronics market is performance and innovation-driven.** Electronics OEMs place a high premium on end user's experience and performance experience, actively aiming to differentiate themselves by delivering an enhanced end user experience. For this reason, the electronics category innovates rapidly to accommodate the ever-increasing performance expectations of its end users.
- **The electronics market is moving towards greater convenience and multi-functionality.** End users are looking for single solutions to meet their data processing, management, and entertainment needs. Thus, demand for multi-function products is increasing. In this process, two things are occurring: (1) products that serve one end use are being replaced by single, multi-function devices; and (2) multi-function devices (MFDs) are increasingly more power-intensive as they perform many end uses. Further, MFDs may be more power intensive when compared to single end-use devices, however these technologies may reduce demand overall by eliminating additional plug load. In this respect, the efficiency market is shifting as technologies converge, creating challenges in predicting market trends and specifying a comprehensive efficiency standard for MFDs.
- **End users are unwilling to "wait" for more efficient product.** Increasingly, end users want instantaneous access to their consumer electronics. For this reason, gains in energy efficiency are often limited to end users' demand for constant, uninterrupted connection - a desirable feature in this product category. Thus, potential efficiency gains in power management must be highly customized and "smart" enough to anticipate end user demand to gain acceptance in this access-driven market.

Policy Burden is Great

Overall, policy makers do not have the data tracking and market intelligence to effectively

adapt to the electronics market. For this reason, energy efficiency policies and standards are often not aligned with electronics market conditions, often generating frustration among OEMs and channels. The business and consumer electronics category differs from other categories in the following key ways, posing significant challenges to policy makers and program implementers:

- **ES's updated regulatory requirements may slow down the introduction of new models to market.** To remain competitive in electronics, OEMs move new product lines to market as quickly as possible. For this reason, many OEMs indicated that the new ES testing requirements would significantly impede their market delivery process, so much in fact that many indicated that they may forgo submitting models for qualification in the future.
- **Computer and TV innovation is outpacing ES standards in their efficiency gains.** The electronics market innovates rapidly year-over-year, and in key entertainment categories, such as notebook computers and televisions, model turn over may occur as often as quarterly. Thus challenging policy makers to obtain and process market data faster to effectively adapt to market gains in efficiency.
- **ES standard development does not align with research and development timelines of larger, multi-faceted categories, such as imaging equipment.** Of all categories, the imaging equipment category has the longest research and development timeline, reaching nearly eight years at its maximum market delivery timeline. In this respect, bi-annual announcements of ES specifications do not allow the market to adapt its product roadmaps in time to meet the new standards.
- **ES standards do not account for the unique markets of certain electronics categories, such as game consoles.** In the case of game consoles, ES overlooked the unique market attributes of this category, namely: there are three OEMs in the market selling only three unique game console models. Further, the variation in features and offers between game consoles have very different energy demands, however the standard treated all products as equal in the standard. Recognizing that such market conditions do not allow for a true "best-in-class" option for each OEM, OEMs rejected the specifications.

Monitoring and Verification is Challenging

- **OEMs and Channels do not track the sales of ENERGY STAR and/or high efficiency models.** In most cases, OEMs could not accurately identify the proportion of their sales that qualify for ES. Further, all indicate that they could not accurately estimate to what extent their units, on average, exceeded ES's efficiency levels. For this reason, the burden of determining ES and ES+ qualified shipments may rest on program implementers.
- **Distribution channels can customize computing equipment, often altering the efficiency of the unit.** In the B2B channels, namely VARs and distributors, often customize computing equipment after the OEMs have released it to market. For this reason, it is difficult to determine which units remain energy efficient when moved through these channels without enlisting VARs and distributors in the program.
- **Model naming conventions differ across OEMs and within OEM product lines, requiring independent research and verification to determine the efficiency level of computing equipment.** OEMs often use alpha numeric prefixes and suffixed to indicate features within a given product line. These conventions are not consistent with ES-approved models nor are the additions transparent; program implementers have to investigate

these conventions to determine whether the names indicate features that alter energy use in order to verify model eligibility.

Recommendations to Enhance Per-Unit Incentive Program Success:

Based on our research, we offer the following recommendations to increase program success among market actors:

- **Actively engage market actors in a dialogue before determining a specification.** Market actors are receptive to collaboration and coordination with program implementers in scoping and defining program-qualifying efficiency requirements. This effort will ensure that program goals are grounded in the market while also preventing frustration among market actors who might otherwise feel overlooked in the process.
- **Provide OEMs with predictable and reasonable standards.** OEMs are often unwilling to invest in efficiency technologies if they believe that the standards are likely to change in the near future. In addition, many products' market delivery timelines require greater lead time on standards to meet requirements. For this reason, programs should keep OEMs informed of forthcoming standards and anticipated changes to ensure that the market will and is able to adapt their practices to participate.
- **Invest in primary research for baseline data collection for targeted measures.** As a growing category of interest, consumer electronics remains relatively under-researched in terms of residential and business market saturation and penetration studies. Program implementers should consider investing in a comprehensive, baseline study with nested on site visits to determine the current state of the market for measures of interest. This information, combined with engineering estimates, may provide adequate data for a market potential study and insight into opportunities to obtain gross savings.
- **Invest in and track secondary data on market trends.** For all measures that the programs intend to target, program implementers should invest in and retain secondary documenting market trends overall and among ES units over time. This data should be collected as frequently as twice a year, or at a minimum annually.
- **Consider working outside of ES standards in markets where the specification has not made traction.** Certain markets are less receptive to ES standards. For this reason, the program should consider developing a per-unit efficiency standard that is not reliant on ES specifications to better meet the needs of such markets.

Opportunities for Program Expansion

While the unique attributed of the electronics industry pose challenges to policy makers and program designers, there are a number of opportunities for programs to work outside of the per-unit approach to savings. Here, we outline a few potential areas for program development and expansion.

Software and Power Management

- **Consider incentive for advancements in power management development and other similar technologies.** Currently, power management is under utilized in design due to concerns of end user rejection of the technologies. However, there are many potential

technological solutions that could enhance the uptake of these technologies without compromising the end user experience. However, efforts to develop and refine these technologies are often de-prioritized among other features in development.

- **Networked devices present opportunities for power management applications.** In most B2B markets and select B2C markets, equipment is continually networked to a central system and often left "active" or running during non-work hours. These systems offer an opportunity for programs to promote power management software within businesses to reduce the over-all demand of a given organization.

Performance-based Goals

- **Businesses are moving towards an integrated, systems-based approach to meeting their IT needs, and may not prioritize per-unit efficiency in the procurement process.** Increasingly, medium-large enterprises are reviewing their IT needs from a systems perspective, rather than a per-unit approach, to manage their IT needs. As part of this systems-focused perspective, we observed the following trends:
  - **Emphasis on multi-function devices (MFDs):** CIOs are increasingly selecting MFDs over single function units in procurement. While these units are more energy intensive, they may reduce the total plug load of a given office space.
  - **Space management and integration of severs and space cooling can dramatically reduce demand.** The overall efficiency of servers can be enhanced through smarter HVAC and computing feedback systems to reduce burden on the unit. In addition, technologies such as virtualization can dramatically reduce power draw by managing and shifting energy use based on the demands placed on the server.
  - **CFOs and CIOs do not align on procurement and operating costs.** Often, CIOs select technology solutions without considering the operating costs of the solution. Through end user education, programs can promote enhanced efficiency in as businesses seek to upgrade and optimize their computing and imaging equipment fleet.

Summary of Baseline Findings

Below we provide high-level summaries of our findings by measure in **Table 1.** comprehensive picture of each measure is available in the measure specific memos.

Table 1. Summary of Baseline Findings by Measure

	Measure	Estimated 2010 ES Market Penetration[1]	Importance of EE in Market Actor Business Practices[2]			Recommended Market Target	Potential Market Points for Efficiency Gains	EM&V Risk[3]
			Upstream	Midstream	End-user			
B2B	*Servers*	I.D.[4]	H	M-H	M-H	SMBs	SMB market, volume servers, virtualization	M-H
B2B	*Notebooks*	74%	H	M	M	SMBs	SMBs, power management	M
B2B	*Imaging Equipment*	41% (MFDs) 75% (Printers)	M-H	M-H	M-H	SMBs, Upstream for MFDs	SMBs, MFDs	M
B2B	*Commercial TVs*	I.D.	M-H	M	M	High Volume End Users, such as Hotel Chains	Moderate tech gains, aligned with standard TVs	L-M
B2C	*Notebooks*	74%	H	L	L	Retailers and e-tailers	Gains among end users, power management	L-M
B2C	*Game Consoles*	NA – no standard to date	M	M-L	L	--	Power management and incremental gains	H
B2C	*Set-top Boxes*	57% (Satellite) 43% (IP) 0% (Cable)	H	M	L	Service Providers	Power management, device consolidation	L-M

[1] Estimates draw for current ES standard (as of January 2010) through secondary data sources.

[2] Based on market actor in-depth interviews. "H"= high importance (8-10 on a 10 point scale), "M" = medium importance (4-7 on a 10 point scale), "L" = low importance (1-3 on a 10 point scale).

[3] EM&V risk is based on availability of baseline data, free-ridership risk, and current market trends in energy efficiency. High (H), Medium (M), and Low (L) assessments were generated qualitatively by the Opinion Dynamics Energy Evaluation Team.

[4] I.D. = insufficient secondary data to estimate a baseline.

SUMMARY OF THE STUDY DESIGN

The Statewide Business and Consumer Electronics (BCE) targets mid and upstream market actors with a per-unit incentive to promote high efficiency[5] business and consumer electronics. As an extension of work conducted in 2008-2009, Opinion Dynamics Corporation conducted a baseline study for the statewide electric investor owned utilities (IOUs), Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and San Diego Gas and Electric (SDG&E) (henceforth the "Statewide BCE team").

The goal of this baseline study is to provide the Statewide BCE team with an understanding of overall market conditions, market actor business practices related to energy efficiency, and sales of ENERGY STAR (ES) units. Table 2. BCE Baseline Study Measures of Focus, details the target measures and the proposed efficiency level (if specified by the program to date).

Table 2. BCE Baseline Study Measures of Focus

Measure	Target Market	Proposed Efficiency Level
Notebook Computers	Business to Business	ENERGY STAR +20%
Servers	Business to Business	TBD
Imaging Equipment	Business to Business	ENERGY STAR +50%
Commercial TVs	Business to Business	TBD
Game Consoles	Business to Consumer	TBD
Notebook Computers	Business to Consumer	ENERGY STAR +20%
Set-top Boxes	Business to Consumer	TBD

In the following section, we briefly outline our data collection approach.

Methodology

This study consisted of two key data collection efforts: (1) secondary data review of publicly available market baseline data; and (2) primary data collected through in-depth interviews with key market actors for each of the measures outlined in Table 3. We describe our approach to both efforts below.

Secondary Data Review for Market Characterization

Opinion Dynamics conducted a formal review of publicly available secondary data for this effort. The data collected was drawn from multiple sources including, but not limited to, the following: (1) previously commissioned reports generated by the Statewide BCE teams through either program implementers or 3rd party evaluators; (2) news releases from preeminent market data sources such as IDC and Gartner; and (3) ES and/or other energy industry-specific sources. Drawing on these data sources, we approximated baseline market penetration curves for each measure.

[5] High efficiency units are those models that exceed ENERGY STAR by a program-defined percentage, e.g. 50%.

Market Actor Interviews

Opinion Dynamics conducted 42 in-depth interviews with midstream and upstream market actors. These interviews included in-depth interviews with component manufacturers, original equipment manufacturers (OEMs) or "major brands," and the relevant channels for each market. Channels include big box retailers, distributors, or value-added resellers (VARs).

Table 3. Number of Market Actors Interviewed for Each Measure

Sector	Measure	Upstream		Downstream	Total[a]
		Component Manufacturers (CMs)	Original Equipment Manufacturers (OEMs)	Retailers/VARs	
B2B	Commercial TV	0	3	1	4
	Imaging Equipment	0	4	1	5
	Notebooks	2	5	2	9
	Servers	3	4	1	8
B2C	Game Consoles	0	2	2	4
	Notebooks	2	3	2	7
	Set-top boxes	0	4	1	5
Total[a]		7	25	10	42

[a] The sub-totals appearing in this column represent the number of unique market actors interviewed per measure.
[b] The sub-totals appearing in this row indicate the number of measure-market perspectives captured per market actor type. The same respondent could be represented more than once within the total.

For each interview, we targeted market leaders, namely representatives from those organizations that maintained the greatest market share in a given category. Within these organizations, we specifically targeted decision-makers who have the authority to make decisions related to energy efficiency within their organization. For all contacts, we attempted to contract each market actor up to 10 times through a combination of emails and phone calls.

In addition to our conversations with market actors, we interviewed a total of 15 experts in consumer electronics and energy efficiency to supplement our knowledge and identify additional contacts for this study.

ATTACHMENT 1: NOTEBOOKS

MEMORANDUM

TO: BCE Statewide Program Evaluation Team

FROM: Opinion Dynamics Evaluation Team

DATE: 12/2010

RE: FINAL Business to Business (B2B) and Business to Consumer (B2C) Notebook Computer Findings Memo

NOTEBOOKS

This memo first discusses notebooks (NBs) in general, and then focuses on the business-to-business (B2B) and business-to-consumer (B2C) sectors in particular.

The findings in this memo are based largely on interviews with five original equipment manufacturers (OEMs). Three produce NBs for both sectors, and two produce NBs for only the B2C sector. Three of the five OEMs are major NB OEMs and are among the top five OEMs by U.S. retailer sales (see **Table 4**). The remaining two OEMs would likely be recognized as a medium and small OEM in the B2B sector, and do not appear among the top 10 by U.S. retailer sales (see **Table 4**).

Introduction

NBs are computers designed for portability. These computers may be powered by a battery without a direct connection to an AC power source, or may be powered by an external power supply, which also charges the battery. NBs have similar functionality to desktops. When used in an office setting, B2B NBs may be set in docking stations and connected to monitors (EPA, 2009). Our focus does not include netbooks, which are also primarily designed for portability but have significantly less processing power and functionality than notebooks. Netbooks are smaller than notebooks and are used primarily for web browsing, email, word processing, spreadsheets, and basic photo editing (Kyrnin, Mark, n.d.). Since they use low-power microprocessors, netbooks are not a focus of utility programs.

NBs, both commercial and consumer, are forecasted to steadily increase through 2014. According to recent reports, the number of portables (i.e., notebooks, netbooks, and tablets) shipments within both the U.S. consumer and business sectors increased sharply in the first

quarter of 2010, with 24% year-on-year growth (IDC, 2010). One reason cited for the strong growth was that businesses restarted refresh cycles that had been frozen in previous years due to a weak economy (Trefis Team, 2010).

One report estimated that while 42.6 million units were shipped in 2009, 95.8 million units would be shipped in 2014, for an average year-over-year growth of 19% (IDC, 2010). Paraphrasing Forrester Research analysts (Epps, 2010), another analyst reported that laptops will make up 42% of the worldwide computer market in 2015 (Martel, 2010), but this percentage was not broken down into B2B and B2C NB numbers.

Table 4. lists the top-ten notebook original equipment manufacturers (OEMs) by U.S. sales at retailers, which include both B2B and B2C sales (Research Into Action [RIA], Inc., 2010). These ten OEMs represent 99% of those machines sold by retailers in 2009 (This Week in Consumer Electronics (TWICE), 2009), and, therefore, may under-represent OEMs in the B2B sector. We interviewed three of the top five OEMs appearing in the table.[6]

Table 4. Rank by U.S. Retailer Sales (2009, Q1)

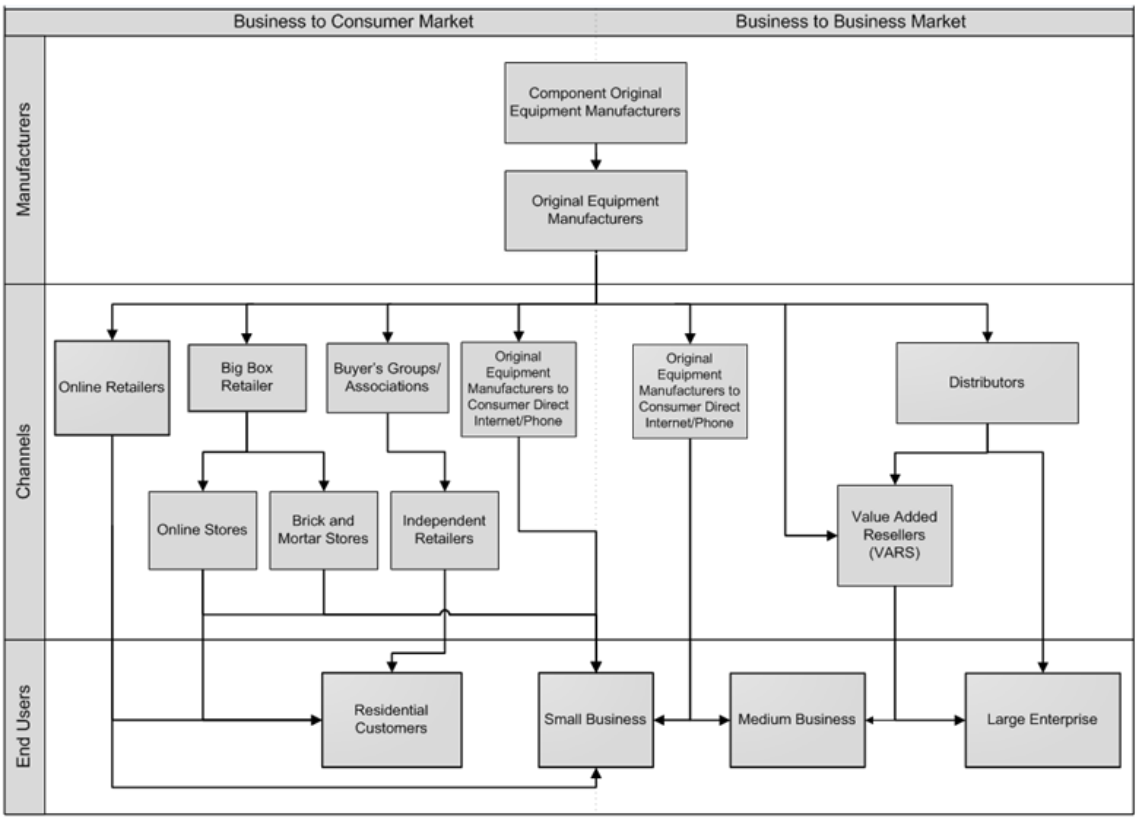
Rank	OEM
1	Apple
2	HP
3	Toshiba
4	Dell
5	Sony
6	Acer
7	Compaq
8	Asutek
9	Gateway
10	Lenovo

Business and Consumer Electronics Industry Market

The electronics industry structure can be divided into two primary end-user markets: Business-to-Business (B2B) and Business-to-Consumer (B2C). Figure 1 (Opinion Dynamics [ODC], 2009) provides a protypical snapshot of the business and consumer electronics industry structure for NBs. We discuss the main differences between the B2B and B2C structures in the following sections.

[6] In addition, we interviewed two smaller OEMs that do not appear in the table.

Figure 1. The Business and Consumer Electronics Industry Structure



ENERGY STAR NBs

The current ENERGY STAR 5.0 specification became effective in July 2009 and specifies the maximum base kWh allowance across three categories (i.e., A, B, and C). Each category reflects increasing numbers of energy-critical hardware components such as discrete graphic processor units (GPUs), physical cores, and system memory.[7] Further, Version 5.0 requires efficient power supplies, power management (i.e., system sleep mode, display sleep mode), wake on LAN, and wake management. This is summarized in the table below.

[7] Notably, there are inconsistencies with model numbering conventions that make it difficult to determine exactly which units qualify for ES. Specifically, OEMs submit one model that represents the least efficient unit I a series, with the assumption that all other units that exceed the units efficiency will qualify. However, the naming conventions for these units is not immediately evident and requires investigation to ensure that the models meet ES

Table 5. ENERGY STAR Specifications for Notebooks

Effective Date	Energy Star Specification	Notebook-Specific Specifications
July 1, 2009	ES version 5.0	• Allows annual allowance of 40 kWh for base functionality (Category A); 53 kWh for those with a discrete GPU (Category B); and 88.5 kWh for those with 2 physical cores, system memory greater than or equal to 2 GB, and a discrete GPU (Category C). • Specifies the annual allowance for additional functionalities (i.e., memory, premium graphics and storage). • Requires specific, efficient external power supplies. • Requires power management (i.e., system sleep mode, display sleep mode). • Requires wake on LAN and wake management.

The following table outlines the estimates of B2B and B2C NB shipments to California. Below the table, we indicate the assumptions we used to generate our estimates.

Table 6. Estimated Number of Notebooks Shipped per Year within California

	2009	2010	2011	2012
B2B	2,249,280	2,787,840	3,373,920	3,954,720
B2C	2,862,720	3,548,160	4,294,080	5,033,280

To obtain the total number of notebooks shipped per year in California, we began with IDC's estimates of national notebook shipments (IDC, 2010) which includes netbooks and subnotebooks. We then applied the ratio of the California population to the U.S. population (12%) based on census data (U.S. Census Bureau, 2009). Finally, we determined the residential/commercial split using Gartner's forecasts, attributing an average 56% of units shipped to consumers based on shipment and segment growth from 2009 to 2010 (Patrizio, 2010).

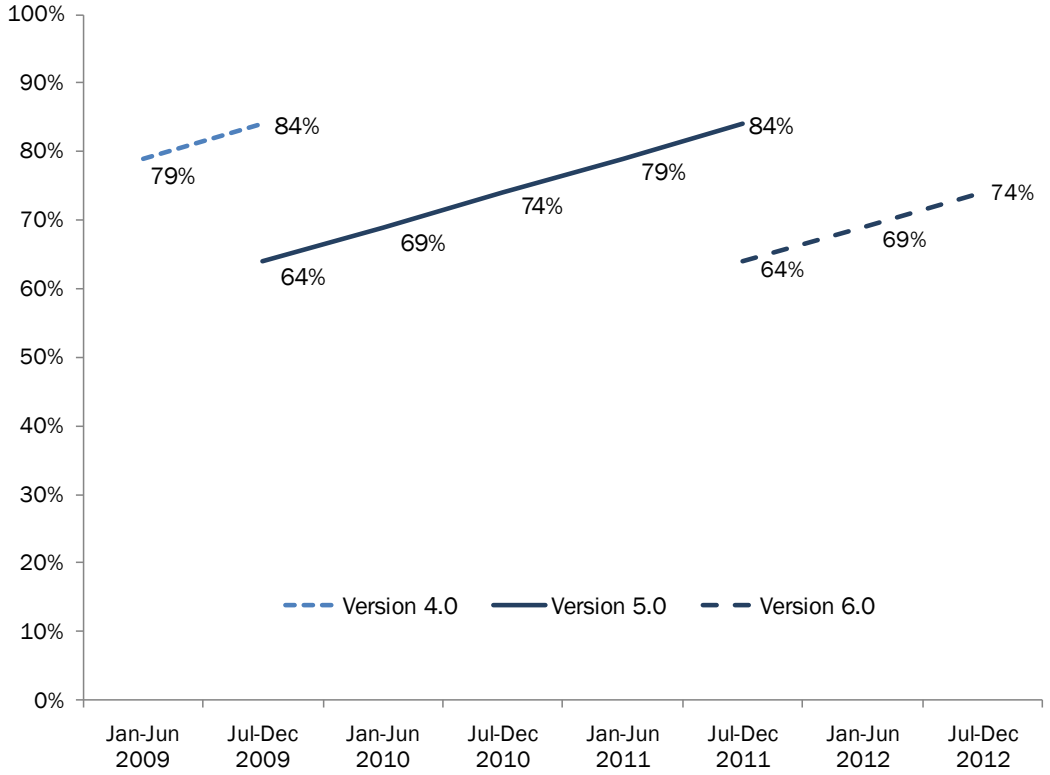
Estimated Baseline of ENERGY STAR Qualified NBs[8]

To date, the program has identified B2B and B2C NBs that exceed ENERGY STAR by 50% as their target in this category. While OEMs track their percentages of ENERGY STAR models and sales, most do not track whether NBs exceed ENERGY STAR specifications. However, ENERGY STAR market penetration numbers indicate that in 2009, 74% of the total U.S. shipments to consumer and business end-users were ENERGY STAR-qualified units (EPA, 2010).[9] Based on this data, and making certain assumptions, we estimate the shipment penetration of ENERGY STAR-qualified NBs to California in **Figure 2**. Below the figure, we indicate the assumptions we used to generate our estimates.

[8] This section estimates a baseline in shipments as opposed to a baseline of installed NBs.

[9] EPA reporting takes into account the versions changing mid-year in their presentation of ES penetration data. Also, the EPA highlights that since there was a new specification effective July 1, 2010 (Version 5.1), market penetration will likely be lower following the new specification.

Figure 2. ENERGY STAR Shipment Penetration in California Notebook[10] Market



Note: We estimated the ENERGY STAR shipment market penetration throughout 2012 based on two ENERGY STAR data points for each device (EPA, 2010) (EPA, 2009). See Appendix for the assumptions we used to create the estimates.

According to the OEMs we interviewed, there are several reasons why NBs generally become more and more efficient over time. First, because notebooks are designed for portability, OEMs are always considering ways to increase battery life and in particular have been "very aggressive in power management." Energy efficiency is a byproduct of the process to extend battery life. Second, innovations in technology result in smaller, faster, higher performing processors about every two years (i.e., 'Moore's Law').[11] As a result, not only does the overall power consumption typically decrease, but the performance and speed per watt of energy use increases. Further, overall power consumption decreases because power management is often designed into the newest chipsets. Third, since many government customers are required to purchase energy efficient machines (i.e., ENERGY STAR- or EPEAT[12]-qualifying),

[10] Most OEMs we interviewed stated that the same percentage of their B2C NBs met ENERGY STAR specifications as their B2B NBs did. However, at least one OEM stated that about 60% of the B2C models met ES specifications as opposed to about 80 to 100% of their B2B models. We do not delineate B2B and B2C penetration in this figure because we did not have reliable data to do so.

[11] Although NB efficiency per performance may increase over time, the average total energy products may also increase. This is especially true of NBs that include a greater number of functionalities.

[12] "The Electronic Product Environmental Assessment Tool (EPEAT) is a procurement system that helps purchasers in the public and private sectors evaluate, compare and select products based on environmental

OEMs focus on meeting requests for quotes (RFQs). This creates spillover in design and manufacturing as OEMs operate on economies of scale making many of the same energy efficient NBs available to the B2B and the B2C markets.

> *"The energy efficiency of computers improves more rapidly than any other type of electricity-using equipment. As a consequence the best (way of)... practicing energy efficiency ... is to regularly replace older computers with new ones."*

According to one component manufacturer (CM), microprocessor models tend to be completely redesigned every three years resulting in increased energy efficiency. This three-year cycle includes two 18-month cycles in which transistor size decreases as the result of technological innovation. Size decreases mean that it is possible to design and manufacture chips that are smaller, faster, and use less energy. Not only are new microprocessor model designs more efficient because they contain two iterations of decreased transistor size, but they tend to also affect the overall efficiency of the NB because chip manufacturers take the opportunity to embed power management features that allow the chip to turn itself on or off when not in use. Given the ever-increasing efficiency of NBs, OEMs believe that newer average models are generally more efficient than older models that met high-efficiency criteria in the past.

BUSINESS TO BUSINESS NOTEBOOK COMPUTERS

Market Players

There are three main types of B2B NB market players. First, component manufacturers (CMs) and OEMs work together to manufacture B2B NBs. Second, distributors and value added resellers (VARs) in the enterprise channels facilitate purchasing of large-volume orders by business customers. Depending on the needs and knowledge of their clients, VARs' roles range from taking and placing orders to deciding which equipment best suits clients' needs and installing and servicing the technology. Third, organizations' CFOs and CIOs make procurement decisions. CFOs typically consider the financial ramifications to the procurement, while CIOs focus on how well the technology will meet the computing needs of the organization.

attributes. EPEAT is managed by the Green Electronics Council, a non-profit organization. EPEAT has three levels of product registration: Bronze, Silver and Gold. Product registration is based on a comprehensive set of environmental criteria. The ENERGY STAR program and the European Union's RoHS directive are two of the required criteria for EPEAT-registered products. Silver and Gold registration require additional optional criteria above and beyond those at EPEAT registration (registration status is EPEAT Bronze, which also requires points to be achieved, including ENERGY STAR and RoHS). Silver requires achievement of 50% of the optional points, and Gold requires 75% of those points. (Dell)"

Market Delivery Timeline

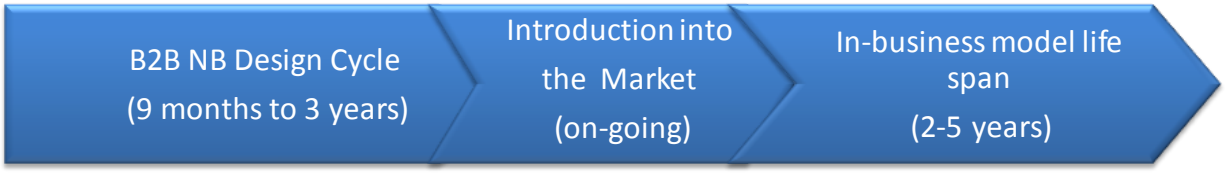
> *"We'll have staggered introductions through the year and then on top of that we'll have multiple, literally thousands of different configurations. So you could have essentially the same base model lasting for perhaps as long as 2 years, but the configuration in that 2nd year could be completely different and not even very closely resemble the 1st year, and that affects the product utility and performance."*

Respondents indicated the B2B NB product design cycle can span nine months to three years, because OEMs produce varying levels of "new" product. For example, on the short end, a new model may be very similar to a previous one differing only in how it is configured. On the long end, OEMs create NBs with completely new chips sets. Given that the product cycle is "continually refreshing," some OEMs negotiate with CMs on a monthly basis primarily around cost and supply. Once the product is manufactured, but before it is shipped, OEMs must deliver it to regulator facilities safety and compliance testing, a process that can take up to four months.

B2B NBs are often purchased in the fourth quarter for delivery in the first quarter of the following year. Respondents indicated that commercial organizations want a product that will last over a two-to-five year period because it is expensive and "painful" for companies, especially larger ones, to refresh their technology too frequently. Thus, business customers tend to focus on high-performing product that is reliable and durable.

Respondents reported that OEMs continually bring new models or new configurations to market throughout the year, even though B2B NB sales peak in the first quarter. Some reported using a 'roadmap'[13] to outline and focus the set of features over the following one to two years.

Figure 3. B2B NB Market Delivery Cycle



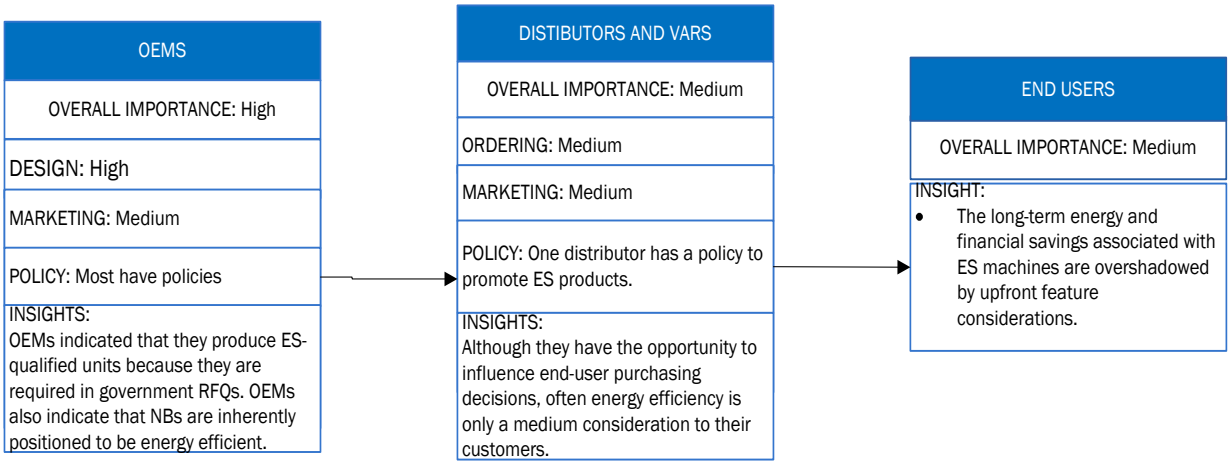
- *B2B NB design cycles span 9 months to 3 years, which includes continual iterations and re-design of chipsets, and compliance and safety testing. Some OEMs use roadmaps to focus design over the following 1 to 2 years.*
- *Although there are peak sales periods, particularly when orders are placed in the 4th quarter for delivery in the 1st, OEMs continually release new configurations and new models throughout the year.*
- *B2B NBs have a life span of about 2 to 5 years.*
- *The bigger the commercial organization, the more focus there is on the product's reliability and durability.*

[13] A roadmap is a plan that matches short-term and long-term goals with specific technology solutions to help meet these goals, including but not limited to feature selection, energy, and aesthetic requirements.

Importance of Energy Efficiency in Business Practices

Currently, B2B NB design is driven by the energy efficiency criteria of the ENERGY STAR and EPEAT programs because government customers are usually mandated to buy these products. Operating on economies of scale, OEMs produce the same NBs for both government and business end users.

Figure 4. Importance of Efficiency in Market Actor Practices



For OEMs in the current U.S. marketplace, energy efficiency is generally a high consideration among other feature considerations in product roadmap including the following (cited in approximate order of their stated importance in the market): cost, performance, reliability, and durability. In one recent analysis, eight of the top ten NB OEMs ranked by sales were ENERGY STAR partners (Research Into Action [RIA], Inc., 2010). However, respondents in the channels report that energy efficiency is usually only a medium consideration for business end-users, compared to up-front cost, performance, reliability, and durability, which are the most important considerations. Channel respondents' discussions with business clients occasionally cover efficiency topics as a byproduct of end-user concerns for long battery life or how hot the machine becomes.

Channel respondents report that business end-users generally do not tend to look closely at the long-term costs of owning less efficient NBs, because, compared to other business electronics such as desktop computers and servers, laptops do not use much energy. However, both OEM and channel respondents report that some large business customers understand the long-term savings that can result from efficient B2B NBs, and therefore place higher priority on this feature. Respondents reported that the efficiency of B2B NB is most often made a priority when CFOs are part of the model decision making. CFOs may recognize that a high-volume order of energy efficient B2B NBs may yield significant energy and thus financial savings. One OEM respondent provided an example of a close collaboration between a CFO and a CIO, which resulted in a procurement purchase that was both energy efficient and met the computing needs of the company's department.

Based on our interviews with all B2B NB market actors, the importance of energy efficiency in the current market is very similar to that in the past (2008) market. One main difference is that end-user focus on energy efficiency has increased a little over the last two year. Some

OEM and channel respondents believe that business end-user focus on the energy efficiency of NBs may continue to increase a little in the future (2012), but most believe that they will still be focused on the most important feature considerations and the efficiency of other business electronics that use much more energy than NBs.

Some OEM respondents indicated that their motivation to manufacture and promote energy efficient products was influenced not only by the importance of ENERGY STAR and EPEAT standards in government RFQs, but also by green trends and branding opportunities in general. Although many OEMs referred to Climate Savers[14], which is focused on efficiency, some also referred to having a total ecological view rather than an energy-only view. In addition, some respondents we interviewed reported having a corporate "policy", "goal", or "concern" which bolstered their focus on energy efficient NBs to meet higher efficiency standards.

Insights for Increased Efficiency Gains

Two key findings within this study inform the insights for increased efficiency gains in the B2B NB market. First, even without incentives, NBs are generally energy efficient and are positioned to stay that way. Second, among business end-users, long-term savings associated with energy efficient machines may be overshadowed by short-term feature considerations. There are opportunities to increase efficiency through the B2B NB marketplace. Below we provide our preliminary insights into potential opportunities in the B2B NB market to promote energy efficiency:

1. **Investigate incenting end-users to purchase notebooks in place of desktops.** In most cases, notebooks provide the same functionality as desktops and so could easily replace them. Since notebooks are much more efficient and use much less energy than desktops, they are a good energy-saving alternative. Such a strategy should be investigated considering all market factors. While it is possible that the transition toward laptops is already occurring, utility intervention might increase the speed at which it is occurring
2. **Encourage downstream collaboration between CIOs and CFOs.** CFOs and CIOs should be encouraged to work together to make decisions on technology procurement and upgrades since product efficiency can translate into large energy and financial savings, especially among large enterprise end-users.
3. **Encourage Power Management During the Non-Work Day.** Unlike consumer NB computers, B2B notebooks often remain connected to a central network when not in use. Through targeting end user CIOs, programs may be able to dramatically reduce power draw through employing power-down software in the evenings and weekends.

[14] The Climate Savers Computing Initiative is a nonprofit partnership of the World Wildlife Fund and computer manufacturers and IT companies. It focuses on reducing green house gases through the reduction of energy waste and efficiency.

4. **Incent on Vintage and not only ENERGY STAR qualification.** Since new versions and new models tend to be inherently more efficient than the preceding ones, vintage tends to be a more accurate predictor of efficiency than whether a NB meets ENERGY STAR specifications—although ENERGY STAR is still a good indicator of efficiency. Consider both vintage and ENERGY STAR status if incenting end-users. For example, it may be beneficial to incent the replacement of units more than three years old.

BUSINESS TO CONSUMER NOTEBOOK COMPUTERS

Overall, B2C NBs are very similar to those sold as B2B NBs. The main differences between the two tend to be 1) how they are sold; 2) how they are marketed; and 3) end users' computing activities.

Market Players

The consumer PC market contains four main players (1) CMs; (2) OEMs; (3) brick and mortar retailers; and (4) online retailers. CMs supply component parts to OEMs who then supply four primary B2C channels: (1) direct to consumers via the Internet or phone; (2) through big box retailers such as Best Buy; (3) through buyers' groups and associations representing small, independent retailers; and (4) through online-only retailers such as Amazon.com. Retailers are the primary link between OEMs and residential consumers.

Over the last few years, more and more sales have shifted from direct to retail. Dell, built on direct to consumer sales, began offering models in retail stores in 2007, while Gateway shifted completely from direct to retail sales in 2008. Gartner estimates that by 2012, 80% of worldwide PC shipments will be through channel partners (up from 74% in 2009) (Gartner, 2009). Consumers and small offices are driving consistent growth in the retail channel. According to Gartner, "In mature markets, the direct channel comes second to retailer store fronts, with a sales volume of less than 10 percent of the segment."

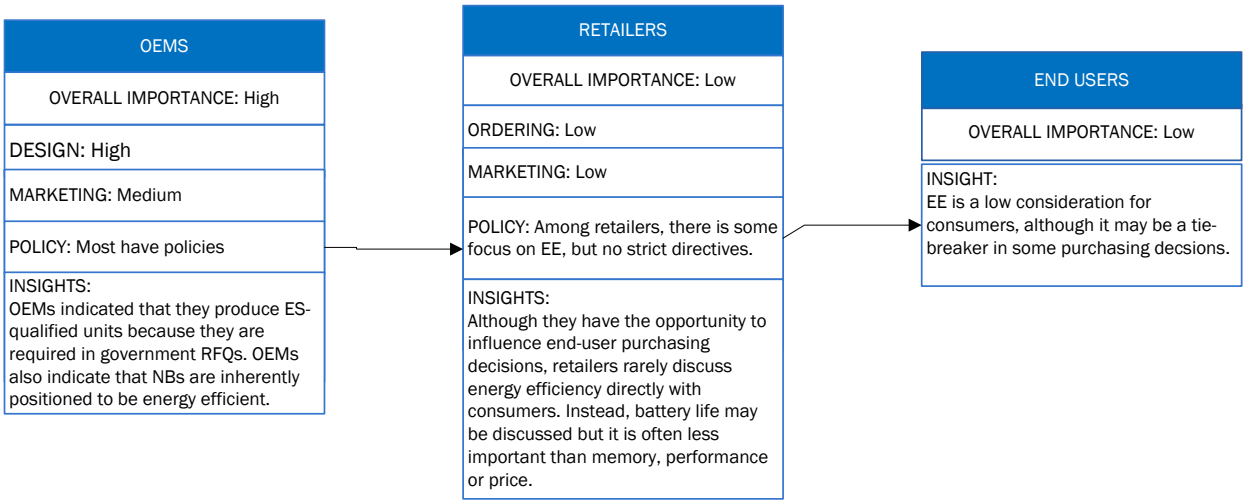
Within each organization, there are key decision-makers that determine how energy efficiency is treated within the organization. Within OEMs, these actors are part of one of the following groups: regulatory compliance, marketing, or social and environmental responsibility. Within retailers, key decision-makers are the category buyers or those in charge of social and environmental responsibility.

Importance of Energy Efficiency in the Market

While energy efficiency may be important to OEMs for the reasons discussed above, in the consumer market the OEMs and retailers we interviewed perceived there to be low consumer demand for energy efficient notebooks. While residential end-users may be open to energy efficiency promotions, others (e.g., gamers) who rely on high performing systems for their computing activities may interpret efficiency as being contradictory to their necessary system functionality. In most cases, energy efficiency may only be touched on when there is any discussion about battery life. This ambiguity about efficiency in the market is reflected in the websites of three of the OEMs we interviewed. Only one had prominently

depicted the ENERGY STAR symbol for qualifying B2C notebooks, while for the other two, it was necessary to look on several pages before there was any mention of the ENERGY STAR qualification. **Figure 5** outlines the importance of efficiency in the B2C NB market.

Figure 5. Importance of Efficiency in Market Actor Practices



Market Delivery Timeline

B2C NBs are released into the market, on average, four times throughout the year. New models are generally released for the following peak sales periods: spring graduation, back to school, and holiday. Once on shelf, a product may stay there for three to six months, depending on popularity. Because of this relatively quick turnover of product, NB computers are designed continuously throughout the calendar year. However, it is important to note that the market does not experience a full turnover; models that have large sales volume may be continually restocked irrespective of the date the model was originally released to market.

Overall, the time from model concept to first customer ship is approximately 1.5 years. For the OEMs, this process includes time for model design, retailer negotiations, and regulatory compliance testing.[15] As part of this process, retailers assess their needs and work with manufacturers about four months prior to the desired shelf date. It takes about four weeks to produce a product, and up to eight weeks to ship it. Retailers may issue a purchase order in the range of two weeks prior to ship date or eight weeks prior to shelf date. Some cycles are longer than others; for example, early November orders deliver January shelf product because of delays due to the holiday schedule.

[15] The regulatory testing process can take up to four months, and units may be submitted to as many as 173 different regulatory bodies for approval.

Figure 6. B2C NB Market Delivery Cycle

- *B2C NB design cycles span 9 months to 3 years, which includes continual iterations and re-design of chipsets, and compliance and safety testing. Some OEMs use roadmaps to focus design over the following 1 to 2 years.*
- *Although there are peak sales periods, particularly during holiday and the beginning and end of the school year, OEMs continually release new configurations and new models throughout the year.*
- *Retailers negotiate and place orders for NBs quarterly.*
- *Like other consumer electronics, market actors believe that consumers replace their NBs once every 2 to 3 years.*

Insights for Increased Efficiency Gains

While many B2C NBs are energy efficient for the same reasons that the B2B ones are, there may be some potential in the consumer market to promote efficiency and increase the share of ES NBs in it. Below, we provide our preliminary insights into potential opportunities in the B2C NB market to promote energy efficiency:

1. **Capitalize on social responsibility efforts at the OEMs and retailers.** Market actors looking to promote energy efficiency still struggle with low end-user demand. The program can help reduce price to the customer, allowing an end user to choose an energy efficient model in a "tie-breaker" situation.
2. **Help OEMs contextualize energy efficiency to their customers.** Some OEMs who have a corporate focus on efficiency are interested in ways to help get the word out to their customers about the importance of ENERGY STAR or ENERGY STAR+. A program that helps with marketing in this way may be able to assist them.
3. **Investigate more ways to educate midstream market actors**. Those who make purchasing decisions at retailers may not be familiar enough with ENERGY STAR. At least one retailer assumes that high-end models are automatically efficient, indicating that programs should couple program participation with education at this level.

4. **Consider incenting the choice of laptops over desktops.** Laptops use considerably less energy than desktops. While some consumer computing activities (e.g., gaming, audio and video manipulation, etc.) require the higher processing speeds and performance inherent to desktop machines, laptops are sufficient for many consumer computing activities.

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APPENDIX A. NB EFFICIENCY CODES AND STANDARDS

Table 7. Recent Codes and Standards for Notebook Efficiency

• Effective Date	• Codes and Standards	• Mandatory/ • Voluntary	• Notebook-Specific Specifications
2004	80 Plus	Voluntary	• Requires power supplies at 80% of higher levels of efficiency. • Includes three tiers (e.g., bronze, silver, and platinum) for increasing levels of power supply efficiency.
2005-2010	European Union's Eco-Label	Voluntary	• Power management through sleep state specifications. • Specifies energy consumption in off-mode, and in advanced configuration and power interface mode (ACPI).
2006	EPEAT	Voluntary	• Requires ENERGY STAR efficiency levels.
7/20/2007	ES version 4.0	Voluntary	• Requires specific, efficient external power supplies. • Requires power management (i.e., standby, sleep mode, and idle modes). • Requires wake on LAN and wake management.
2007	Climate Savers Computing Initiative	Voluntary	• Based on ENERGY STAR specifications including efficient power supplies and TEC. • Includes advanced power management features such as the low power S3 or "sleep" mode settings. • Includes three tiers (bronze, silver, and platinum) for increasing levels of power supply efficiency. • Includes minimum purchasing commitments for participants.
4/8/2009	ECCC Version 4 (External Power Supplies)	Voluntary	• Specifies, efficient external power supplies.

• Effective Date	• Codes and Standards	• Mandatory/ • Voluntary	• Notebook-Specific Specifications
7/1/2009	ES version 5.0	Voluntary	• Allows annual allowance of 40 kWh for base functionality (Category A); 53 kWh for those with a discrete GPU (Category B); and 88.5 kWh for those with 2 physical cores, system memory greater than or equal to 2 GB, and a discrete GPU (Category C); • Specifies the annual allowance for additional functionalities (i.e., memory, premium graphics and storage) • Requires specific, efficient external power supplies; • Requires power management (i.e., system sleep mode, display sleep mode); • Requires wake on LAN and wake management.
2011	ES version 6.0	Voluntary	• TBD

APPENDIX B. ASSUMPTIONS USED TO CREATE Figure 2 ESTIMATES

For ENERGY STAR shipment market penetration, we relied on ENERGY STAR data (Environmental Protection Agency [EPA], 2010) (Environmental Protection Agency [EPA], 2009). ENERGY STAR reported market penetration of 49% in 2008 and 74% in 2009. Because ES version 5.0 went into effect in July 2009, we chose a pair of 2009 percentages before and after the version that would have yielded 74%. We used 84% before and 64% after. Although we could have used other pairs of numbers, the pair we chose seemed reasonable based on the 2008 and 2009 penetration data. Thus, we assumed that the penetration under version 4.0 reached 84% and then dropped to 64% under version 5.0. We then assumed a flat, conservative 10% year-to-year increase in penetration for 2010 and 2011. The 6.0 version is expected to come out at the end of 2011 (Kaplan, 2010), so for 2012, we dropped the market penetration back down to 64% because this is what happened when version 5.0 became effective.

ATTACHMENT 2: SERVERS

MEMORANDUM

TO: BCE Statewide Program Evaluation Team

FROM: Opinion Dynamics Evaluation Team

DATE: 12/2010

RE: FINAL Business to Business (B2B) Server Findings Memo

B2B SERVERS

This memo discusses business to business (B2B) servers. Please note, that like CTVs, there is insufficient secondary data publicly available to approximate an up-to-date baseline for this category. For this reason, program staff may want to consider conducting a baseline study drawing on primary data to determine the baseline and opportunity for a server-based program in the California market.

The findings in this memo are based largely on interviews with four original equipment manufacturers (OEMs). Two of the four OEMs would likely be recognized as major server OEMs and are among the top five by world shipments (see

Table 9). These two OEMs represent more than 30% of the shipments. The two remaining OEMs would likely be recognized as a small and a medium server OEM.

Introduction

B2B servers are those servers used by commercial end-users. To paraphrase the Environmental Protection Agency's (EPA's) ENERGY STAR (ES) definition (EPA, n.d.), a server is a computer that provides services and manages networked resources for client devices (e.g., desktop computers, notebook computers, thin clients, wireless devices, PDAs, IP telephones, other servers, and other networked devices). Servers are mainly sold through enterprise channels for use in data centers and office/corporate environments. They are primarily accessed via network connections, and not through direct user input devices such as a keyboard or mouse. As servers are computers, they generally contain the same essential components as (desktop?) computers, including processors, hard drives, motherboards, power supplies, etc. Since servers tend to run continuously, their efficiency is an important focus.

Generally, the industry categorizes servers into three types based on price. "High-end" servers cost over $500K; "mid-range" servers cost between $25K and $500K; and "volume" servers cost less than $25K.

International Data Corporation (IDC) data show that the worldwide server market is growing. In 2Q2010, year-over-year server unit shipments increased by 23%, and in 3Q2010, they increased by 13% (TMCnet, 2010). However, year-over-year 3Q2010 revenue increases were different by server type. Volume server systems increased by 28% and mid-range servers increased by 20%, yet high-end servers decreased by 10%, which was the eighth consecutive quarter of contraction for high-end servers (TMCnet, 2010). As shown in Table 8, volume servers account for most of the U.S. market.

Table 8. Summary of Server Type in U.S. (2005)

Server Type	Percent of Market[a]	Servers Sold (2005)[a]	Market Trends (2010)[b]
Volume	90%-95%	2,721,000	Increasing
Mid-range	4%-5%	62,000	Increasing
High-end	0.2%	2,600	Decreasing

[a] These data are from 2005 (Koomey, 2007)

[b] These are based on 2010 data (TMCnet, 2010)

As shown in

Table 9, top original equipment manufacturers (OEMs) of servers include HP, Dell, and IBM, with approximately 68% of the worldwide 2Q2010 shipments (Gartner, 2010). Over the last year, HP has increased its market share by 2.5%, "led by strong demand for its x86 ProLiant servers (TMCnet, 2010)," a blade server currently not covered by ENERGY STAR specifications.

Table 9. Worldwide Server Shipments 2Q2010

OEM	Shipments	Market Share	Type of Servers Sold[a]
HP	644,172	30%	• Volume • Mid-range • High-end
Dell	542,799	25%	• Volume • Mid-range • High-end
IBM	267,614	13%	• Volume • Mid-range • High-end
Fujitsu	60,974	3%	• Volume • Mid-range • High-end
Sun/Oracle	47,968	2%	• Volume • Mid-range • High-end
Other OEMs	581,512	27%	-
Total	2,145,039	100%	-

[a] based on a review of OEM websites and RIA reporting (Research Into Action (RIA), Inc., 2010)

In framing the energy use of servers, it is important to note that many elements affect server-related power consumption. This includes both hardware and software, as well as the environment in which the servers are housed.

Table 10 describes some of these elements that OEMs and component manufacturer (CM) respondents mentioned.

Table 10. Elements that Affect Energy Efficiency of Servers

	Design Elements that Affect Efficiency	Description
Hardware	Power Supply	The efficiency of the server depends on the efficiency of a power supply, which can range from as low as 70% to as high as 96%. Offering multiple power supplies for a single server is prohibitively expensive because each configuration would require separate testing and regulatory oversight per the various jurisdictions in which the server is sold.
	Processor	According to OEMs, processors account for a substantial portion of server demand. One OEM noted that a few years ago, processors accounted for 35-40% of server platform power consumption
	Form Factor	Blade servers[16] provide more computing power with less energy use.
	Vintage	Replacing 2005 servers with 2009 ones can reduce the number of necessary servers by a ratio of about 9 to 1.
Software	Power Management	Put unused resources to sleep, thus saving significant amounts of energy.
	Virtualization[17]	Average server utilization is 15%. Through virtualization, 1 server can replace 4 servers.
Space Management	Cooling efficiency and economizers	The power used to cool servers makes up a large part of overall consumption.
	Hot/cold isle containment	The organization of servers can affect the energy use of cooling systems and fans.
	Consolidation[18]	When operators start running out of space to house servers, they may become interested in consolidation strategies. Through consolidation, 1 server can replace up to 9 servers, especially when replacing old servers with new ones.

[16] "A Computer Server consisting of, at minimum, a processor and system memory that relies on shared resources (e.g., power supplies, cooling, etc.) for operation. Blade Servers are designed to be installed in a Blade Chassis, are hot-swappable and are incapable of operating independent of the chassis… A Blade Chassis features multiple slots which can be populated with blades of different types…Blade Systems are designed as a scalable solution to efficiently package and operate multiple Computer Servers or Storage units in a single enclosure, and are designed for technicians to be able to easily add or replace hot-swappable Computer Server boards (e.g., Blade Servers) in the field (Environmental Protection Agency (EPA), n.d.)." "Hot-swappable means that the drive can be plugged in and out of your host computer system, and be recognized by the system, without having to turn the host computer off. With servers, this is an especially important consideration (Olixir Technoligies, n.d.)."

[17] "Server virtualization is the masking of server resources, including the number and identity of individual physical servers, processors, and operating systems, from server users. The server administrator uses a software application to divide one physical server into multiple isolated virtual environments. The virtual environments are sometimes called virtual private servers, but they are also known as guests, instances, containers or emulations (searchservervirtualization.techtarget.com, n.d.)."

[18] "Server consolidation is an approach to the efficient usage of computer server resources to reduce the total number of servers or server locations that an organization requires. The practice developed in response to the problem of server sprawl, a situation in which multiple, under-utilized servers take up more space and consume more resources than can be justified by their workload (SearchDataCenter.com, n.d.)"

ENERGY STAR Servers

The EPA has developed an ES specification for enterprise servers with at most four processor sockets. The current ES Version 1.0 (effective as of May 15, 2009) specifies different maximum base idle[19] power consumption depending on server type; provides additional allowances for additional components; and specifies efficiency and power factor levels for power supplies.[20] As the ES specification for servers is relatively new, ES does not yet have any data on shipment penetration of ES models. This data will likely not be released until fall 2011. In addition to the current ES version, Table 11 shows specifications that may be included in Version 2.0.

Table 11. Current ENERGY STAR Version Applicable to Servers

ENERGY STAR Version	Effective Date	Specifications
1.0	May 15, 2009	• Limited to servers having at most four processor sockets. • Specifies power supply efficiency levels depending on type (multi- or single-output), rated output power, and load. • Specifies power factor levels depending on type (multi-or single-output), rated output power, and load. • Specifies base idle power consumption limits depending on server type (standard vs. managed, and single vs. dual). • Provides additional allowances for extra components (e.g., power supplies, hard drives, memory, etc.). • Three and four socket servers must enable processor-level power management to reduce power use of the processor during times of low utilization such as idle. • Servers with three and four sockets must be shipped with processor-level power management functionality enabled.
2.0	TBD	• Limited to servers having at most four processor sockets; • Specifies power supply efficiency levels prior to shipment, depending on type (multi-or single-output), rated output power, and load; • Specifies power factor levels prior to shipment, depending on type (multi-or single-output), rated output power, and load; • Working toward power allowances for blade chassis in idle state and at full load; • Working toward active mode efficiency criteria; • Servers must enable processor level power management to reduce power use of the processor during times of low utilization such as idle; • Servers must be shipped with processor-level power management functionality enabled.

[19] "An operational state in which the operating system and other software have completed loading and the Computer Server is capable of completing workload transactions, but no active workload transactions are requested or pending by the system (i.e., the Computer Server is operational, but not processing any useful work)." (Environmental Protection Agency (EPA), n.d.)

[20] Note that small-scale servers (featuring desktop components in a desktop form factor, but designed as a storage host for other computers) may qualify for ENERGY STAR under the Version 5.0 computer specifications. In addition, EPA has data center initiatives.

The main differences between Version 1.0 and the Version 2.0 draft (April 9, 2010) are fourfold. First, the current draft proposes qualifying "blade, rack-mounted[21], or pedestal[22] form factor computer servers with no more than four processor sockets (EPA, n.d.)." This essentially extends the ES label to cover blade servers. However, resilient servers[23] and multi-node servers[24] may also be covered. Second, Version 2.0 will increase the efficiency requirements for power supply units (PSUs). Third, all ES-qualified servers will meet power management requirements. Finally, Version 2.0 will expand to include active mode efficiency requirements that will likely be based on a Standard Performance Evaluation Corporation (SPEC) efficiency rating tool still under development. The goal effective date for this version was fall 2010, but the version is still in development.

There are several challenges associated with the current ES specification, some of which may be addressed in Version 2.0. First, ES Version 1.0 does not include active mode efficiency. According to manufacturers, servers are not typically idle, so having a specification based on energy consumption at idle does not represent standard performance very well. While Version 2.0 is supposed to address active mode, the stakeholder process has been slow around this issue[25] and appears to have delayed release of the new version. Second, ES Version 1.0 covers only a small portion of OEMs' product lines; Version 2.0 should improve this, especially with the addition of blade servers.

However, OEMs have also expressed difficulty with the enhanced testing and verification process required in Version 2.0 for the following reasons:

- OEMs expected that the expense of the testing would limit the number of systems qualified, and present excessive difficulties for smaller OEMs. The addition of workload testing in Version 2.0 will further the problem.
- The timeline of the ES process may also limit qualifications. Many OEMs did not submit platforms in 2009 because they knew they would have new ones to qualify in 2010. With a new standard on the horizon, submissions for the current version may also be limited, especially as a server development cycle time is 3-4 years.

[21] "A computer server that is designed for deployment in a standard 19-inch data center rack as defined by EIA-310, IEC 60297, or DIN 41494 (Environmental Protection Agency (EPA), n.d.)."

[22] "A self-contained computer server that is designed with PSUs, cooling, I/O devices, and other resources necessary for stand-alone operation. The frame of a pedestal server is similar to that of a tower client computer (Environmental Protection Agency (EPA), n.d.)"

[23] "A computer server that is designed with resiliency, RAS, and self-correction features integrated in the micro-architecture of the CPU and chipset to ensure data resiliency and accuracy. A resilient server is often used for a limited set of workloads that may include business processing, decision support, or handling of virtualized workloads, and is often operated at higher levels of utilization compared to a standard server (Environmental Protection Agency (EPA), n.d.) ."

[24] "A computer server that is designed with two or more independent server nodes that share a single enclosure and one or more power supplies. In a multi-node server, power is distributed to all nodes through shared power supplies. A multi-node server is not designed to be hot-swappable (Environmental Protection Agency (EPA), n.d.)."

[25] based on questions of how to address testing amid various configurations of hardware and utilization, especially for blade servers

To date, it is unclear the extent to which these ES versions have been adopted. Market actors were unable to provide clear indications of the percent of servers on the market that qualify for ES.

Market Players

Similar to other B2B electronics markets, there are three main types of players in the server market. First, component manufacturers (CMs) and OEMs work together to manufacture B2B servers. Second, distributors and value added resellers (VARs) in the enterprise channels facilitate purchasing by business customers. Depending on the needs and knowledge of their clients, VARs' roles range from taking and placing orders to deciding which equipment best suits clients' needs and installing and servicing the technology. Third, organizations' CFOs and CIOs make procurement decisions. CFOs typically consider the financial ramifications to the procurement, while CIOs focus on how well the technology will meet the needs of the organization. One key difference between the server market and other B2B electronics markets is that OEMs often sell servers directly to commercial clients. Another key difference is that OEMs and VARs may bundle software packages with the servers when they sell them; hence, they may sell server systems, as opposed to just a server.

Some OEMs have programs in the market that either purposefully address efficiency or increase it as a byproduct of other goals. For example, trade-in programs encourage customers to replace old equipment with new equipment. This may encourage early retirement and therefore more sales for OEMs, but by replacing older servers with newer servers, efficiency of the market increases. Furthermore, at least one OEM offers a service as part of purchasing to help respondents order a machine for the same cost but with more performance per watt—based on power supplies and organization of memory chips, for example.

VARs may also have a role in efficiency in that they provide custom configurations for their clients. This role has been addressed by ES standards through "Partner Commitments" which depend on how the configurations change from the qualified models. Thus, there are requirements for how products maintain ES labels through OEMs, and when VARs have to become ES partners to qualify products.

Market Delivery Timeline

The market delivery timeline for servers is longer than that of other computing products, as servers are significantly more complex. A roadmap[26] for servers is approximately three to four years. For this reason, OEMs must anticipate the needs of their customers years in advance, and they may have trouble designing for ES standards if the specifications continue to change frequently.

Greater server efficiency is inherent to each new design and manufacturing cycle because innovations in technology result in smaller, faster, higher-performing processors about every two years (i.e., 'Moore's Law'). Similar to other electronics, the performance and speed per watt of energy use increases. Further, overall power consumption decreases because power management is often designed into the newest chipsets.

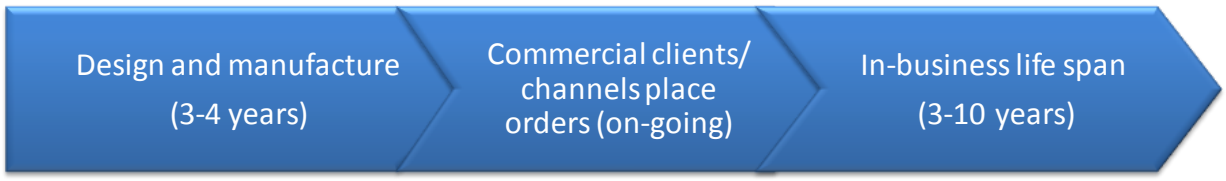
According to one component manufacturer (CM) who also supplies notebook chipsets, microprocessor models tend to be completely redesigned every three years resulting in increased energy efficiency. This three-year cycle includes two 18-month cycles in which transistor size decreases as the result of technological innovation. Decreases in size mean that it is possible to design and manufacture chips that are smaller, faster, and use less energy. Not only are new microprocessor model designs more efficient because they contain two iterations of decreased transistor size, they tend to also affect the overall efficiency of the server. This is because chip manufacturers take the opportunity to embed power management features that allow the chip to turn itself on or off when not in use. Given the ever-increasing efficiency of servers, OEMs believe that newer average models are generally more efficient than older models.

A new product is launched in each category about once a year. For example, each year an OEM or CM may have a separate launch for models that have a different number of processor sockets. Similar to other electronics, once a server model is manufactured, but before it is shipped, OEMs must deliver it to regulator facilities safety and compliance testing, a process that can take up to four months.

Although orders for servers occur throughout the year, purchasing patterns can follow traditional commercial procurement with purchasing occurring in the fourth quarter for delivery in the first quarter of the following year. Following purchase, servers can remain in businesses for a range of 3 to 10 years. OEM and VAR reports suggested that some servers are refreshed after 3 to 5 years, especially among those end-users who understand that later vintages typically mean more efficiency. Yet according to QDI, data center servers can remain in use for 3 to 10 years (QDI Strategies, Inc., 2010). **Figure 7** outlines the server market delivery cycle.

[26] A roadmap is a plan that matches short-term and long-term goals with specific technology solutions to help meet these goals, including but not limited to feature selection, energy, and aesthetic requirements.

Figure 7. Market Delivery Cycle



- *Depending on the complexity and relevance of existing models, design and manufacture can range from 3 to 4 years. Chip set design may take up a major portion of this time.*
- *Commercial clients and channels purchase equipment throughout the year.*
- *Servers have an in-business life span depending on, some extent, on server type. For example, the refresh cycle for high end servers in a data center setting may be as long as ten years.*

Importance of Energy Efficiency in Business Practices

Among business and consumer electronic products, the server market places the highest premium on energy efficiency relative to other measures. Servers are in use constantly, so many customers understand that energy efficiency can generate large cost savings.[27] As a result, end-users have demanded efficient servers for quite some time, and OEMs place efficiency as an important component of product design. However, the focus on efficiency does vary across OEMs. Many OEMs feel that the ES specification, at least in its current version, does not properly address the current efficiency of the market and that virtualization and end-user education have a large role to play in increasing overall server efficiency.

2. End-User Demand for Efficient Servers Drives the Market

Commercial end-user demand for efficiency is high and has held steady or increased since 2008, especially among large enterprise customers. OEMs report an increase in RFQs that specify efficiency requirements, and many customers have started looking at power consumption or performance per watt over performance alone.[28] Some end users believe efficiency is important because they recognize servers are relatively big consumers of electricity among office electronics, are on continuously, and thus impact operating costs. One OEM noted:

> *So it's just an incumbent design requirement in this day and age whether it be 2010 or 2008, (an OEM) better (pay) attention to energy efficiency… Inefficiency is clearly overhead and people don't want to buy overhead…they just want the answer on their spreadsheet.*

[27] Note that barriers exist in the procurement processes that cause customers to overlook efficiency. We discuss this in greater detail in the following section.

[28] In our interviews, OEMs referenced performance generally, but did not operationalize performance.

Most OEMs we interviewed stated that efficiency, along with price and performance, has been one of customers' top three considerations. However, VARs report that there is some difference in the valuation of efficiency among small and medium-sized businesses (SMBs) and enterprise end-users. Large enterprise end users find the long-term energy and financial savings associated with efficient servers important and compelling, while small and medium end-users focus more on price and performance. VARs attributed this difference to disparate priorities between CFOs and CIOs (those usually engaged in technological procurement) among SMBs. Namely, CIOs are not considering the "bottom line" or operational costs in selecting units, and thus operational costs are not a chief concern in procurement. Thus, efficiency is often de-prioritized as well.

Similarly OEM perceptions of demand for efficiency vary. One OEM noted that "cost is still king," while another said, "I'd say the number one criteria [in servers] is efficiency…Because those applications are on 24 hours a day, 7 days a week."

3. Efficiency Plays an Integral Role in Product Design

Because of end-user demand, efficiency has become an integral part of model design along with price and performance. Generally, OEMs reported that the importance of efficiency in design and manufacturing has increased since 2008 and will likely remain important into the future. OEMs stated that efficiency has been among the top requirements discussed with market partners including CMs and VARS, since 2008.

Unlike some other electronics products, for servers, energy efficiency seems more likely to be a standard part of the package for no additional cost.

> *"We've come to the conclusion that in fact you need to build these (efficiency) standards into your product as normal and not charge a penny more… It's expected now by most customers. Back in '08 we were still debating that internally."*
>
> *"If you go look at [our mainstream servers], both of them have Climate Saver's gold level power supplies in them…We believed a long time ago that the efficiency promise was what customers wanted."*
>
> *"The industry overall has come a long way in…the past five to ten years on making those improvements… Everybody has got their gold power supplies falling over their silver power supplies and their platinum power supplies and you know it's definitely kind of gone isotonic from that standpoint."*

While all manufacturers focus on energy efficiency, only one had a corporate policy with specific goals in that arena. The policy made energy efficiency one of the top three priorities of the most senior management team and included three-year plans with commitments to power consumption reductions. Another component manufacturer did not have a specific corporate policy regarding energy efficiency but has used it has a point of differentiation in the server market since 2003.

4. Efficiency Gains May Occur Best Outside of the ENERGY STAR Space

While efficiency gains have been occurring fast and furiously in the server market, the ES standard seems to be struggling to catch up. The first version of the specification did not include blade servers, an up-and-coming form factor that has inherent efficiency capabilities. In addition, the second version, still forthcoming, is struggling with issues regarding standard testing procedures for servers (especially blades) that may have a wide range of possible configurations and loadings.

Furthermore, as mentioned in the previous section, OEMs do not believe that the idle mode requirements accurately reflect the market, as servers are hardly ever idle. This should be addressed in Version 2.0. However, OEMs also consider the testing and verification process onerous and expensive, and believe that it will limit the number of models the industry submits for qualification.

This is not to say that efficiency gains are not still taking place outside of the ES space. OEMs noted that across Tier 1 companies in the industry, great gains are being made with focus on fan control and platform-level power efficiency. However, another OEM thought that energy efficiency gains available in the future will be less than what has been available in the recent past, which could limit the effectiveness of ES: "You know at some point there's only so much blood you're going to squeeze out of a little two-use server rack from an efficiency standpoint and you've got to look elsewhere."

5. End-user Behavior Remains an Important Component of Server Energy Use

Decreasing server-related power consumption may depend heavily on end-user behavior and purchasing, which is not addressed through the per unit discussion. Some OEMs and CMs believe that upstream incentives should be combined with downstream education, or the program should focus downstream on data center operators:

> *"If there's an upstream incentive for a server manufacturer, like HP or Dell, to provide a more efficient model than maybe an older model that their customer might currently be using, they may pass along that incentive in the form of a discount on the server to the data center operator, but there's no linkage to say that the server should use virtualization and consolidation and should, you know, basically take the workload off the 5 year old servers and move it onto this one. It is an incomplete program.*[29]*"*

In fact, while the ES model is based on one-to-one replacement, virtualization and consolidation can result in approximately a nine-to-one replacement. Focusing on ES misses this opportunity for significant energy savings.

Additional opportunities for savings occur in end-user education during purchase. At least one OEM provides this education as a standard service:

[29] It should be noted that one OEM had a different opinion, in that it is not worthwhile to try to convince purchasers to replace servers that still work, i.e., IT staff may be of the opinion, "if it ain't broke, don't fix it."

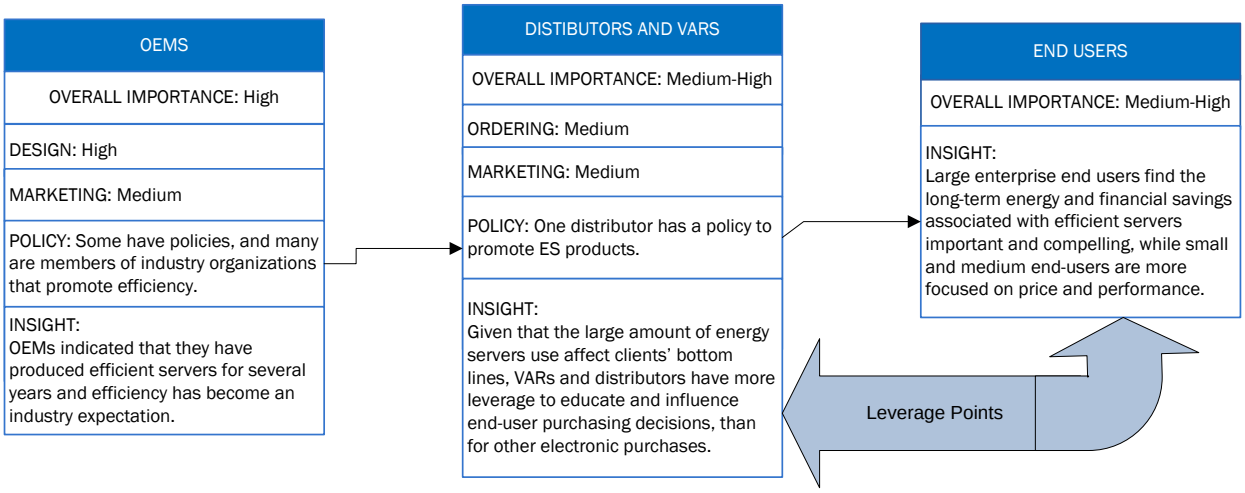
> *"We can show people, and we do this as part of purchasing, how they can simply make different configuration options in their servers, order power supplies that have a higher efficiency, order different organization of memory chips in the machine and order a different CPU that gives them the same performance but uses less power for the same price. So there's two ways of ordering the machine, and for their needs we can show them another way of ordering it that doesn't cost them any more money, gives them the same performance but uses less power. That's just education."*

Furthermore, one OEM noted, "You can't be more efficient if you don't know where you're at today." End-user education may be difficult if IT staff do not know their baseline, or how much energy their current system uses. Helping potential purchasers monitor and evaluate their current setup may enable the selling of more efficient equipment and systems.

6. Summary

Figure 8 summarizes the preceding paragraphs and offers a snapshot of the importance of efficiency in market actor practices. It also includes "leverage point" arrows, which, based on the discussion above, indicate where we believe utility intervention in the market may best create more efficient practices among market actors. We discuss these possibilities in the following section.

Figure 8. Importance of Efficiency in Market Actor Practices



Risks Associated with Developing a Server Program

For several reasons discussed previously in this memo, development of a server program may be risky. We have summarized some of the key risks here.

There is a lack of baseline data for this measure. This is a new ES measure and there is no pre-existing data for market penetration. Additionally, server categories are not uniform across the industry and servers may be customized to meet clients' needs. Thus, it would be difficult to apply consistent metrics to different products.

The ES requirement may not offer a solid standard upon which to incent. The current ES

requirement is undeveloped for the market because it is primarily based on the server idling power consumption, as opposed to active mode power consumption. The upcoming Version 2.0 may address some of these concerns, but there appears to be little interest by the industry to submit items for qualification.

The industry does not fully support the ES standard. Some potential ES partners are concerned that the standard is based on a one-to-one replacement of machines and therefore does not include energy savings potential resulting from virtualization. Additionally, some potential ES partners find the testing requirements onerous.

Manufactures report that efficiency is already a very important consideration in the research and development of servers, with the exception of volume servers. Programs should carefully scope their efforts to those server markets that have not adopted efficiency, namely volume servers sold to SMBs.

Insights for Increased Efficiency Gains

Despite these risks, there may be some potential in the B2B server market to promote efficiency and increase the share of energy efficient servers. Below, we provide our preliminary insights into potential opportunities to promote energy efficiency:

5. **Target volume servers only.** Volume servers are the only category where efficiency gains are not occurring naturally in the market. For this reason, they are the most logical choice for a per-unit based incentive.

6. **Consider performance-based incentives for businesses.** On average, businesses are selecting efficient servers; however, there are opportunities to enhance the overall efficiency of servers through space management, AC-server communication and synchronized cycling, virtualization, and power management. For commercial customers with large data management requirements, consider incenting on a performance basis to encourage the integration of these elements.

7. **Encourage downstream collaboration between CIOs and CFOs.** CFOs and CIOs should be encouraged to work together to make decisions on technology procurement and upgrades since product efficiency can translate into large energy and financial savings, especially among large enterprise end-users. Future studies should engage end users and facilities to better determine the extent of these barriers among businesses.

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ATTACHMENT 3: IMAGING EQUIPMENT

MEMORANDUM

TO: BCE Statewide Program Evaluation Team

FROM: Opinion Dynamics Evaluation Team

DATE: 12/2010

RE: Imaging Equipment Findings Memo

IMAGING EQUIPMENT

The findings in this memo are based largely on interviews with four original equipment manufacturers (OEMs). Two of the four would likely be recognized as major Imaging Equipment (IE) OEMs and are among the top five IE OEMs by U.S. hardcopy peripheral market share (see Table 14). We cannot state the percent of the market share these two OEMs represent without undermining our sources' confidentiality. The remaining two OEMs would likely be recognized as medium OEMs, although we have no easy, quantifiable way to categorize them.

Introduction

B2B IE includes imaging devices sold through business channels to commercial clients, and covers a wide range of products such as copiers, printers, duplicators, fax machines, scanners, and multifunction devices (MFDs), which integrate two or more of the functionalities of the preceding devices.

In this memo, we focus on select business printers and MFDs, likely to be considered for the Statewide BCE Program, as specified in a recent work paper (Pacific Gas & Electric Company (PG&E), 2010). While California Investor-Owned Utilities (IOUs) focus on four specific categories of ENERGY STAR+ (ES) monochrome and color laser printers and MFDs, this memo includes laser printers and MFDs more broadly to capture important market context and trends that may affect high-efficiency models.

In Table 12, we use Environmental Protection Agency (EPA) definitions of IE (EPA, 2008) to further clarify our focus. The table indicates which devices we include and exclude. Notably, the devices included in the table are limited to those using laser or electrophotography (EP), marking technology. Laser marking technology "is characterized by illumination of a photoconductor in a pattern representing the desired hard copy image via a light source, development of the image with particles of toner using the latent image on the

photoconductor to define the presence or absence of toner at a given location, transfer of the toner to the final hard copy medium, and fusing to cause the desired hard copy to become durable. Color EP is distinguished from monochrome EP in that toners of at least three different colors are available in a given product at one time (EPA, 2008)."

Table 12. Imaging Devices Included and Excluded in Our Focus

Imaging Device	EPA Definition
Included	
Printer	A commercially available imaging product that serves as a hard copy output device, and is capable of receiving information from single-user or networked computers, or other input devices (e.g., digital cameras).
MFD	A commercially available imaging product, which is a physically integrated device or a combination of functionally integrated components, which performs two or more of the core functions of copying, printing, scanning, or faxing. The copy functionality as addressed in this definition is considered to be distinct from single sheet convenience copying offered by fax machines.
Excluded	
Copier	A commercially available imaging product whose sole function is the production of hard copy duplicates from graphic hard copy originals.
Digital Duplicator	A commercially available imaging product that is sold in the market as a fully automated duplicator system through the method of stencil duplicating with digital reproduction functionality.
Fax Machine	A commercially available imaging product whose primary functions are scanning hard copy originals for electronic transmission to remote units and receiving similar electronic transmissions to produce hard copy output. Electronic transmission is primarily over a public telephone system, but also may be via a computer network or the Internet. The product also may be capable of producing hard copy duplicates.
Mailing Machine	A commercially available imaging product that prints postage onto mail pieces.
Scanner	A commercially available imaging product that functions as an electro-optical device for converting information into electronic images that can be stored, edited, converted, or transmitted, primarily in a personal computing environment.

Note: The list of imaging devices included in this table is exhaustive, such that each device included in the ES specification is included under either the "included" or "excluded" subheadings. All devices listed in the table above "must be capable of being powered from a wall outlet or from a data or network connection," according to ES criteria.

After device type (cited above), the IE industry further categorizes units by pages per minute (ppm) into seven print speed segments. Print speeds range from 1 to over 90 ppm (BuyerZone, n.d.), with recommended print speeds for typical commercial clients falling into the range of 21 to 69 ppm, or Segments 2-4 (BuyerZone, n.d.).[30] **Table 13** lists print speed ranges for each of the segments.

30 Images per minutes (ipm) is another device speed metric and reflects a device that is able to print on both sides of a page. Thus the ipm is roughly twice the ppm as two images are created for every one page. The EPA measures print speed in ipm even for non-duplex machines.

Table 13. Device Speed in PPM by Segment

Segment	PPM
PC[a]	1-10
1	11-20
2	21-30
3	31-40
4	41-69
5	70-90
6	91+

[a] PC stands for personal computing

Given the number of IE categories, it is difficult to collect data in support of market share analysis for any one subtype. However, based on general U.S. market share, we estimate that HP, Canon, Epson, Lexmark, and Brother are among the top five Original Equipment Manufacturers (OEMs) with respect to laser printer and MFD B2B markets[31]. These OEMs' shares of the U.S. hardcopy peripheral market, for both B2B and B2C, are shown in **Table 14**.

Table 14. OEM U.S. Hardcopy Peripherals Market Share (2Q 2009 and 2010)

OEM	2Q2009 Market Share (n=24,244,229)	2Q2010 Market Share (n=29,095,934)
HP	50%	53%
Canon	15%	14%
Epson	7%	7%
Lexmark	9%	7%
Brother	6%	6%
All others	13%	13%
Total	100%	100%

Source: (Dignam, 2010)

ENERGY STAR IE

The EPA has developed an ES specification that accounts for variation in end-use capabilities across IE. The ES specification is complex, encompassing many configurations in IE. The current ENERGY STAR Versions 1.1/1.2[32] (effective as of July 1, 2009) specify a different maximum base kWh allowance depending on duplexing capability, device type (i.e.,

[31] We also confirmed that each of the OEMs produces laser printers and MFDs.

[32] Versions 1.1 and 1.2 appear to contain identical specifications, but are organized differently in the specification text (Environmental Protection Agency (EPA), n.d.).

non-MFD or MFD), marking technology, and print speed, with additional allowances made per feature (e.g., interface type, storage, lamp type, etc.).

The EPA also uses two testing approaches: for some devices, the Operational Mode (OM) approach is used to qualify an ES product, while for other devices, the Typical Electricity Consumption (TEC) approach is used. The OM approach is "a method of comparing product energy performance via an evaluation of power (measured in watts) in various operating states;" and the TEC approach is "a method of comparing product energy performance via an evaluation of typical electricity consumption (measured in kilowatt-hours) during normal operation over a specified period of time" (EPA). The four IE types discussed in this memo all qualify under the TEC approach. Table 11 shows recent and current ES specifications affecting devices selected by PG&E. Version 1.1/1.2 is different from 1.0 (EPA, n.d.) in that it decreases the maximum kWh/week allowed as part of the TEC approach. Additionally, version 1.1/1.2 indicates a more efficient External Power Supply (EPS).

Table 15. Recent and Current ENERGY STAR Versions Applicable to Monochrome and Color Laser Printers and MFDs

ENERGY STAR Version[a]	Effective Date	Specifications
1.0, Tier 1	4/1/2007	• Specifies ES-qualified EPS. • Must have ES-qualified cordless handsets, if MFD has fax capability. • Specifies speed-defined duplexing requirements. • Specifies maximum power use requirements using the typical electricity consumption (TEC) test method.
1.1, 1.2	7/1/2009	• EPS must meet International Efficiency Marking Protocol Level V requirements. • Must have ES-qualified cordless handsets, if MFD has fax capability. • Specifies speed-defined duplexing requirements. • Specifies maximum power use requirements using the typical electricity consumption (TEC) test method.

[a] Versions 1.1 and 1.2 appear to contain identical specifications, but use different organizational approaches.

Estimated ENERGY STAR IE Baseline

To estimate baseline shipments of ES units, our team used publicly available secondary data sources as well as program-provided data (Gartner, 2009).

To begin our estimates, we calculated the number of B2B IE shipments of printers and MFDs to California, which serves as the base for the following market penetration estimates. We indicate the assumptions we used to generate our estimates in the Appendix.

Table 16. Estimated Number of Printers and MFDs Shipped per Year within California B2B IE Market

IE Device	2009	2010	2011	2012
Color Laser Printer	1,389	1,306	979	911
Monochrome Laser Printer	1,389	1,306	979	911
Color MFD	9,146	8,597	6,448	5,996
Monochrome MFD	21,764	20,459	15,344	14,270

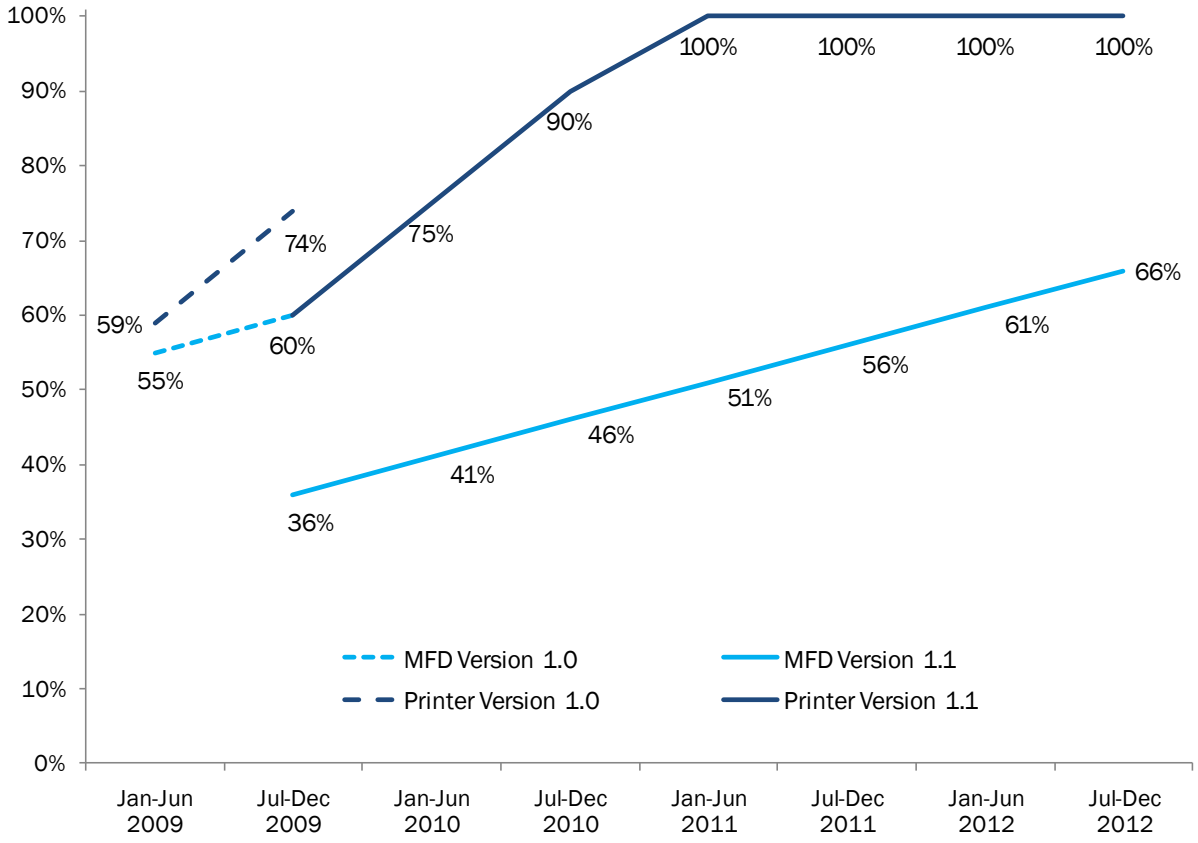
Note: See Appendix for assumptions used to create the estimates.

While OEMs track ENERGY STAR models and sales, most do not track whether IE exceeds ENERGY STAR specifications. ENERGY STAR market penetration numbers indicate that in 2009, 67% of the total U.S. printer shipments to business end-users were ENERGY STAR-qualified units, along with 48% of MFDs (EPA, 2010).

Based on these data, and making certain assumptions, we estimated the shipment penetration of ENERGY STAR qualified imaging equipment to California businesses in **Figure 9**. We indicate the assumptions we used to generate our estimates in the Appendix. Notably, OEMs stated that demand for energy efficient IE tended to be somewhat higher in California compared to the national average: "We do see more sensitivity (to energy efficiency and other 'green' features) amongst those in California, …but that's not to say that other parts of the country are very far behind." Since the OEM representatives we interviewed did not quantify this finding, we did not include it in our estimates and thus the ES penetration figures are likely to underestimate penetration in California.

Also, it is important to note that these estimates apply the 2009 growth rate to subsequent years. In the case of printers, this growth rate projects the ES market penetration at 100% in 2011. Market actors indicated that the efficiency gained in IE has likely been "plucked off" to date, meaning that the least costly changes affecting energy efficiency in design and manufacturing have already been implemented. Thus, this curve may over-estimate ES market penetration in the future. However, the market actors could not provide metrics around this qualitative assessment, so we retained the available, documented growth rates.

Figure 9. ENERGY STAR Shipment Penetration in California B2B IE Market



Note: We estimated the ENERGY STAR shipment market penetration throughout 2012 based on two ENERGY STAR data points for each device (EPA, 2010) (EPA, 2009). See Appendix for the assumptions we used to create the estimates.

Market Players

There are three main types of B2B IE market players. First, component manufacturers (CMs) and OEMs work together to manufacture B2B IE. Second, distributors and Value Added Resellers (VARs) in the enterprise channels facilitate purchasing of large-volume orders by business customers. Depending on the needs and knowledge of their clients, VARs' roles range from taking and placing orders to deciding which equipment best suits clients' needs and installing and servicing the technology. Third, organizations' CFOs and CIOs make procurement decisions. CFOs typically consider the financial ramifications to the procurement, while CIOs focus on how well the technology will meet the needs of the organization. Finally, managed print service (MPS) providers are recent and developing market actors who have both mid and upstream origins.

Market Delivery Timeline

There is a wide range in IE model complexity, which considerably impacts the variability of the design and manufacture process. For example, one OEM stated, "Redesigning a product varies within the (B2B) segment. It could be as short as nine months, it could be as long as five years. It just depends on the product."

In model redesign, the chip design is an especially time-consuming component. One OEM explained the stages for which chip design manufacture and testing are critical:

> *"We're designing the components and the architectures for machines 3 to 5 years out. So what takes the time is … a specific processor or control chip. …Those things take a while, because you've got to design the chip, then you've got to design the board that the chip works on. You've got to cut your teeth on manufacturing that chip with the chip manufacturer. You've got to make sure it all works right. The code has to be written to work with that chip, and then you've got to get that chip and that board in a product."*

During redesign, OEMs carefully weigh the costs associated with research and design and how future ES versions may categorize the resultant models. Similar to other categories, some OEMs find it difficult to invest in new energy efficient technologies that may become unrecognized by newer ES standards:

> *"There is a risk factor (in trying to meet ES). …Let's say you have three (OEMs) that decide they are going to try to meet this requirement, and are going to develop proprietary (energy efficient) solutions through their own efforts. The EPA may embrace (these solutions), but then may flip the (specification) in a year and now the products are out of alignment with the specification. (The OEMs) track back to that initial decision and start to make a judgment about whether the investment is really going to be worth the effort particularly if the marketplace isn't asking for it…"*

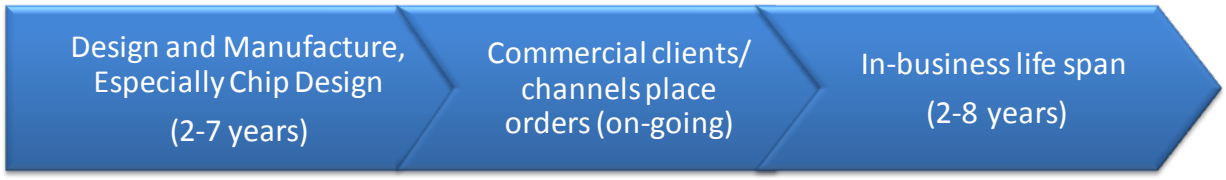
> *"One of the issues with ENERGY STAR is they're changing every two years. You make an investment in 2002 or launch a product in 2007 based on the levels probably in 2003 or 2004, and some of these products are very long life products, and the way they ratchet down ENERGY STAR so fast, you have to hit the target or you've made a lot of investment that you're not going to be able to reap because you won't be able to make that product ENERGY STAR."*

In addition, there is indication that the duration of a given unit in the market may be extended to maximize profit gains. Namely, OEMs may extend the shelf life of a product, especially complex devices, to ensure a desired return on investment:

> *"The turnaround in redesigning something and replacing it may typically be around two years. If you have a much more complex high end product, that could sometimes be technically done in three to four years. But from an economic point of view you can't always – even though you can technically replace it, if you are doing a new design you may not be able to get your money out of it in that period of time. So it is made to linger in the marketplace longer to get the return on your investment."*

Finally, there is a wide range in how often IE is refreshed by commercial end users. The OEMs we interviewed stated that refresh cycles could span several years depending on the client. For example, the range may span 2-8 years, with the cycle having increased recently due to the economic downturn. **Figure 7** summarizes the B2B IE product cycle.

Figure 10. B2B IE Market Delivery Cycle



- *Depending on the complexity of the imaging equipment design and manufacture can range from 2 to 7 years.*
- *Commercial clients and channels purchase equipment throughout the year.*
- *There is considerable variability in the life span of the imaging equipment among commercial end users, ranging from 2 to 8 years.*

Importance of Energy Efficiency in Business Practices

Overall, energy efficiency is an important consideration for most B2B IE market players. Below, we describe four themes that may impact efficiency in the IE market: (1) ENERGY STAR high baseline demand and government spillover; (2) potential limits to enhanced efficiency; (3) end-user focus on total cost of ownership (TCO); and (4) power management applications for legacy models.

ENERGY STAR Demand and EPEAT Spillover

Two primary factors influence OEMs' design of B2B IE: (1) spillover from government standards; and (2) demand for energy efficient units among medium to large enterprise customers.

First, government customers are usually mandated to buy ES- or EPEAT33-qualifying products. While there is currently no EPEAT standard for IE, there is expected to be one for IE

[33] "The Electronic Product Environmental Assessment Tool (EPEAT) is a procurement system that helps purchasers in the public and private sectors evaluate, compare, and select products based on environmental attributes. EPEAT is managed by the Green Electronics Council, a nonprofit organization. EPEAT has three

in 2011 (EPE). These mandates create spillover in design and manufacturing as OEMs operate on economies of scale making many of the same energy efficient IE available to the B2B markets.

Second, large businesses often demand energy efficient IE for a few different reasons. As OEMs report, one reason is that most large businesses want to green their profiles. Since the ES brand is well known within the B2B sector, requiring ES as part of the bid has "been a very easy thing for (a client) who doesn't quite understand the technology or nuances, (to do to improve their profile)."

> *"ENERGY STAR is what we would call 'table stakes', meaning you have to have compliant models within the product family or you don't get into a vast majority of the business…"*

OEMs report that size factors into business buying practices. Large businesses such as Fortune 1000 organizations and larger behave differently than Small and Medium Businesses (SMB) in the market, in that larger businesses focus on energy efficiency as part of greening their profiles; saving money; and anticipating future electricity price structuring. Our data indicate that large businesses are preparing for the possibility of stricter energy pricing or regulation caused by smart grid technologies that will indicate customers' energy use at smaller time intervals. Thus, one OEM explained that large commercial clients' interest in ES-qualifying IE and energy efficiency in general, is a kind of "risk management" of potential capital costs. For the reasons outlined above, most OEMs believe having ES-qualifying IE has become a necessary condition for meeting large businesses' orders.

Potential Limitations in Per-Unit Efficiency Gains

Despite high demand among large enterprise customers, there is some indication that significant energy savings coming from technology innovations may have reached a ceiling with respect to hardware such as lamps, processors, and power supplies. The primary considerations are: (1) incremental costs for efficient power supplies; (2) a plateau in low-cost technologies that can enhance efficiency; and (3) end-user demand for instantaneous access to equipment.

Across all respondents, we found that OEMs have developed and included the most efficient power supplies in their product lines within the optimum market price:

> *"The problem is cost versus performance. I can make a very efficient power supply (and faster processors), but it costs a lot of money. It's an exponential rise in cost. (At first,) I can spend a little to get a large improvement, (but then) the higher up the efficiency curve, the more it costs me… You can get very efficient products that cost too much for the market."*

---

levels of product registration: Bronze, Silver, and Gold. Product registration is based on a comprehensive set of environmental criteria. The ENERGY STAR program and the European Union's RoHS directive are two of the required criteria for EPEAT-registered products. Silver and Gold registration require additional optional criteria above and beyond those at EPEAT registration (registration status is EPEAT Bronze, which also requires points to be achieved, including ENERGY STAR and RoHS). Silver requires achievement of 50% of the optional points, and Gold requires 75% of those points. (Dell)"

In addition, some OEMs also stated that significant energy savings coming from technology innovations are limited:

> *"I think the biggest gains have already been squeezed out of technology."*
>
> *"In terms of the (efficiency of the individual product) I think we are reaching the end."*

Although OEMs focus on energy efficiency, they believe there is a tension between efficiency and clients' "ease of use" or "productivity" in the workplace. OEMs perceive that customers will not tolerate devices that take too long to wake up or return to active modes from energy saving sleep or auto-off modes.[34] Some OEMs believed that customer demand for instantaneous productivity will likely increase:

> *"A potential decrease in productivity is one of the major concerns that a customer has and this is a trend. It's not going to go down, it's always going up because everything in office environments is always (about the) instantaneous solution. … So the customer (will continue to) get more impatient…"*

Reflecting this trend, another OEM stated that they will try to design around customer impatience in future devices:

> *"Coming up in 2012, we're beginning to incorporate some automatic off features into our imaging equipment where it would behave somewhat like sleep mode as much as it can but it would actually go to much lower power levels. One of the big tricks is can the product wake from some kind of input so that it's not an inconvenience to the customer so they don't disable that function…. you'll see more products (that will be able to do) that in the future and I think there'll be ongoing development to try to enhance the wake capability in time, assuming we can get over technical hurdles."*

Thus, aside from B2B clients for whom energy efficiency is a necessary procurement criterion, for many others, "*overall their main focus is on the productiveness and if that has ease of use then they'll consider energy."*

[34] One OEM cited the results of a recent survey they had conducted: 75% of customers are willing to wait up to 10 seconds for a device to become usable; but less than a third are willing to wait up to 30 seconds for a device to become usable.

Efficiency and Total Cost of Ownership

OEMs also report that some clients are beginning to look at energy efficiency within the context of TCO which may or may not lead them to select ES-qualifying equipment. Clients consider factors such as the upfront costs of the machines, the costs of toner, energy costs, and the number of machines they buy. Per these factors, OEMs report that some clients choose MFDs even if they do not qualify for ES. One OEM explained:

> *"TCO is getting more important in terms of the customer's perception. …in order for us to meet those emerging requirements of the TCO reduction we're looking at not just a single device efficiency but also looking at the fleet management…maybe they may not need that many machines. For example if they have a bunch of local single function devices such as 50 printers and then 20 copiers and 10 fax machines then they can reduce the number by consolidating into like 30. At the same time you can keep the productivity so I think the fleet optimization is emerging to achieve the customer's energy consumption reduction or energy efficiency[35]….So sometimes it makes more sense to take a look at overall energy intake rather than just single machines' energy efficiency. Sometimes it's more economical and more efficient that way to achieve the goal. It's more [of] a multi layered approach."*

Another OEM reiterated this, indicating that device consolidation may be a way to increase energy savings:

> *"It seems like what makes the most sense is to… somehow incent the customer for purchasing the device that prints, copies, scans, and faxes for twenty people rather than four separate devices that print, copy, and scan for one or two people. The biggest reduction in the energy usage is what we call 'device consolidation'."*

Power Management Opportunities

Beyond ES criteria, OEMs suggested other ways to realize efficiency gains. They stated that additional energy savings may be realized through device management/user behavior. For example, one OEM stated that getting customers to install power management in legacy equipment may offer simple, but significant gains:

> *"The legacy system that is already out there in the offices (is) your greatest opportunity in my view of energy efficiency gains in the market place that can be captured really quickly because right now when EPA makes a claim about energy star it is just paper. It is an academic exercise that talks about potential but it doesn't really get at all to what is actually being done in the market place, because if you look at the numbers that they have done in a couple of studies, the utilization of power management is like 5% or less. That is a lot of energy efficiency just sitting there waiting to be harvested."*

[35] It was unclear whether the OEM was referring to fleet optimization happening at the time of sale, or as part of MPS.

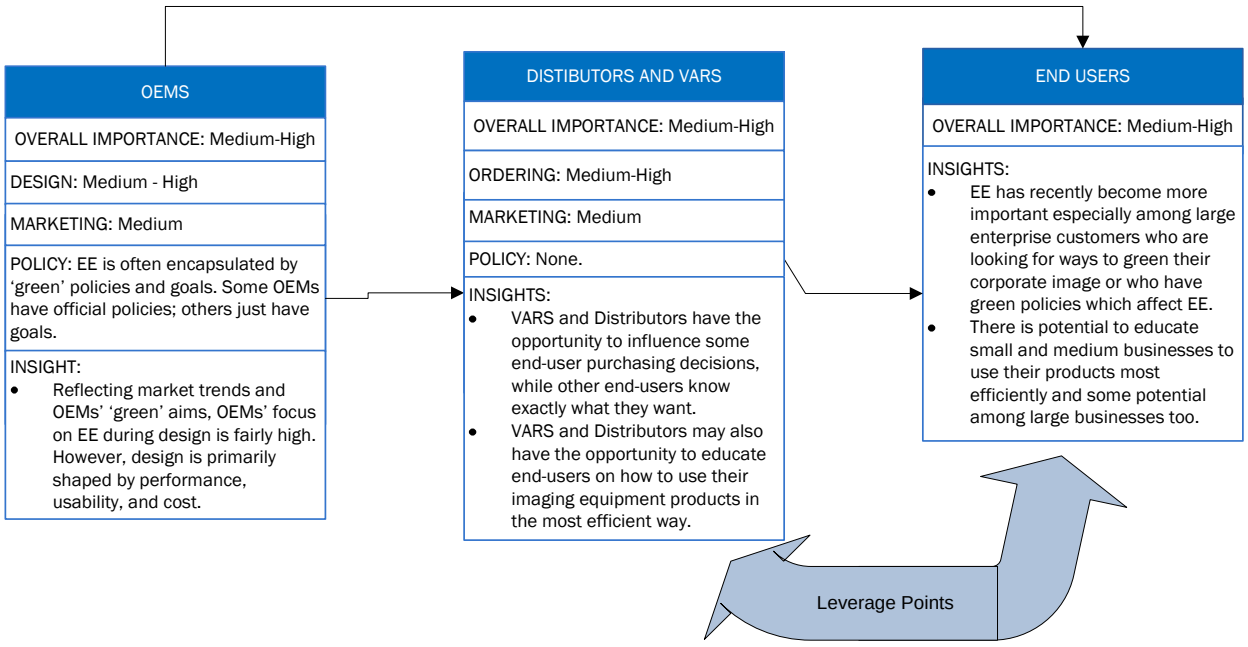
Citing the purported current low utilization of power management, the OEM explained:

> *"I would guess the majority of enterprises from large all the way down to the mom and pop shop aren't energy efficient because they don't know how to do it. Or else there are misperceptions that if they do turn on power management then they are going to get disconnected from the network. There is very basic messaging that could go on or that could take place in a constructive and a collaborative fashion between government, industry, and the utility industry that I think can really change the perception in the marketplace."*

OEMs cited the possibility of increased efficiency through sharing devices in a network. For example, several retailers at a mall could share the same remote printer. Such networking would also allow for "*a centralized administration software program that automatically powers down or shuts off.*"

Figure 11 summarizes the preceding paragraphs and offers a snapshot of the importance of efficiency in market actor practices. It also includes "leverage point" arrows which, based on the discussion above, indicate where we believe utility intervention in the market may best create more efficient practices among market actors. We discuss these possibilities in the following section.

Figure 11. Importance of Efficiency in Market Actor Practices



Insights for Increased Efficiency Gains

There may be some potential in the B2B IE market to promote efficiency and increase the share of ES IE. Below, we provide our preliminary insights into potential opportunities to promote energy efficiency:

1. **Consider Focusing on Small Business Customers:** There is significant investment and interest in energy efficient IE devices among medium to large commercial customers. However, small commercial customers are not as aware of the savings associated with efficient IE. For this reason, the program should consider targeting this business class.

2. **Incent on High-Volume Orders that Preference Efficiency.** Ensure that clients understand the long-term financial savings that result from efficient IE, particularly those large enterprise customers who may be looking to replace or expand their existing fleet. Consider incenting on high-volume purchases where a predefined percent of devices ordered meets program standards.

3. **Create Tools to Communicate Trade-offs and Savings for IE Equipment.** There is indication that B2B customers are looking for a better way to understand the cost savings associated with energy efficient IE relative to the TCO. The program may want to consider ways to provide business end users with tools to effectively communicate the value of ES IE devices in the procurement process, such as calculators.

4. **Educate Commercial Clients on Power Saving Settings.** ES-qualifying IE is shipped with default automatic brightness sleep mode activated controls. However, these features may be turned off by end-users without understanding how they affect energy savings. End users may be educated to retain or add these settings to greatly reduce energy demand.

5. **Encourage Power Management during the Non-Work Day.** Commercial end-users are increasingly networking their offices so that fewer devices can serve multiple users, saving on procurement costs. Additionally, networked devices can be controlled remotely which affords commercial end-users the potential to manage the power consumption of these machines more efficiently. Through targeting end-user CIOs, programs may be able to dramatically reduce power draw through employing power-down software in the evenings and weekends.

6. **Offer or Incent Training and Education Aimed at CIOs and IT Staff.** Consider designing curriculum for seminars or trade/community colleges that inform IT personnel about energy savings and associated financial saving potential available in the business sector. Incent businesses to send personnel to attend and complete courses.

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APPENDIX A. ASSUMPTIONS USED TO CREATE Table 16 ESTIMATES

To obtain the total number of B2B imaging equipment units shipped per year in California, we first obtained the total number of U.S. business establishments from U.S. Census data (U.S. Census Bureau, 2005-2007). We used the census data to calculate the ratio of businesses in California to the country (12%) and to calculate an establishment growth rate based on years 2005-2007 (1.4%).

We also used IDC's estimates of national imaging equipment shipments to businesses for 2009 (IDC, 2010). We applied the business growth rate to these numbers to estimate shipments in 2010–2012, and we applied the ratio of California to U.S. businesses to arrive at the estimate of California B2B shipments in 2009-2012.

Finally, we used the negative year-over-year growth rates found in the Gartner data (Gartner, 2009) when we filtered the data for dye sublimation printers and MFDs in the U.S. We multiplied the number of shipments by these year-to-year decreases to arrive at the final estimates.

APPENDIX B. ASSUMPTIONS USED TO CREATE Figure 9 ESTIMATES

We estimated the ENERGY STAR shipment market penetration throughout 2012 based on two ENERGY STAR data points for each type of imaging device (EPA, 2010) (EPA, 2009).

For printers, ENERGY STAR reported market penetration of 43% in 2008 and 67% in 2009. Because ES version 1.1 went into effect in July 2009, we used a pair of 2009 percentages before and after the version that would have yielded 67%; we chose 74% before and 60% after. Although we could have used other pairs of numbers, the pair we chose seemed reasonable based on the ES 2008 and 2009 penetration figures. Thus, we assumed that the penetration under version 1.0 reached 74% and then dropped to 60% under version 1.1. We then assumed the same linear 30% year-to-year in penetration for 2010–2012 We are not aware of any forthcoming ES revisions that affect these devices.

For MFDs, ENERGY STAR reported market penetration of 49% in 2008 and 48% in 2009. Because ES version 1.1 went into effect in July 2009, we chose a pair of 2009 percentages before and after the version that would have yielded 48%; we chose 60% before and 36% after. Although we could have used other pairs of numbers, the pair we chose seemed reasonable based on the 2008 and 2009 penetration figures. Thus, we assumed that the penetration under version 1.0 reached 60% and then dropped to 36% under version 1.1. We

then assumed the same linear 10% year-to-year increases in penetration for 2010–2012. We are not aware of any forthcoming ES revisions that affect these devices.

ATTACHMENT 4: SET-TOP BOX FINDINGS MEMO

MEMORANDUM

TO: BCE Statewide Program Evaluation Team

FROM: Opinion Dynamics Evaluation Team

DATE: 11/8/10

RE: FINAL Set-top Box Findings Memo

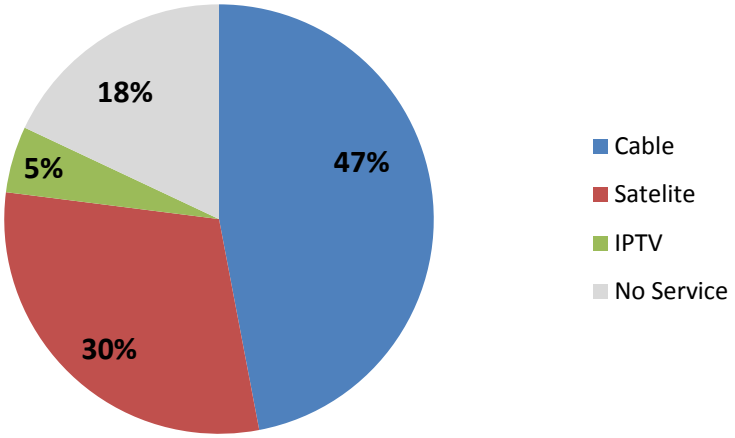
SET-TOP BOXES

The findings in this memo are based largely on interviews with four original equipment manufacturers (OEMs) and one service provider. All four OEMs are among the top ten U.S. set top box (STB). These four represent about 25% of total sales. The service provider is the top provider in one of the three kinds of pay-TV service (i.e., cable, service, and IPTV).

Introduction

A set-top box (STB) is a device that receives a signal from a source such as cable or satellite and converts it to a format for viewing on an end user's television. As of 2009, 82% of U.S. households subscribing to cable or satellite TV have at least one or two STBs for cable, satellite, or internet protocol TV services (Research Into Action (RIA), Inc., 2010). **Figure 12** provides a snapshot of pay-tv service providers by technology type in 2010 indicating the relative share of these technologies among households.

Figure 12. Percent of US Households with Pay-TV Service by Type (2010)



ENERGY STAR Specifications

While market penetration of STB is estimated to peak in 2012 (ABI Research, 2008), respondents and data indicate that the per-unit power draw is likely to increase as STBs begin to serve multiple end uses, including digital video recording (DVR) (up to 30% of all STBs on the market)[36] and internet access (internet protocol (IP)) (Research Into Action (RIA), Inc., 2010).

To address the multi-functionality of STB units and their corresponding energy demand, the Environmental Protection Agency (EPA) has developed an ENERGY STAR specification that accounts for variation in end use capabilities across units. The current ENERGY STAR Version 2.0 Tier 1 (effective as of January 1, 2009) and forthcoming Tier 2 (January 1, 2011) specify a different maximum base kWh allowance depending on STB type (i.e. cable, satellite, or IPTV), with additional allowances made per feature (e.g., DVR, high definition, additional tuners, etc.).[37] Recently, the EPA announced Version 3, Draft 2 (Environmental Protection Agency (EPA), 2010) whose specifications further update maximum allowances; specify auto power down settings; reward service providers for deploying 'thin clients' and products with 'deep sleep' capabilities; and reward OEMs for enabling deep sleep as a default. These specifications are summarized in **Table 17** below.

Table 17. ENERGY STAR Specifications for Set-top Box Units

Effective Date	Energy Star Specification	Unit-Specific Specifications
January 2009	ES version 2.0, Tier 1	• Allows annual allowances of 70 kWh/year for base functionality, 88 for satellite, and 45 for IPTV;

[36] RIA report, pg. 66

[37] For example, a cable STB with high definition and a DVR would qualify under Tier 1 at 165 kWh/y or less, and would qualify under Tier 2 at 94 kWh/y or less (Environmental Protection Agency, 2009)

		• Specifies the annual allowances for additional functionalities (e.g., additional tuners, DVR, DOCSIS, etc.) • Requires specific, efficient external power supplies; • Awards credit for auto power down capability.
January 2011	ES version 2.0, Tier 2	• Allows annual allowances of 50 kWh/year for cable base functionality, 56 for satellite, and 36 for IPTV; • Specifies the annual allowance for additional functionalities (e.g., additional tuners, DVR, DOCSIS, etc.) • Requires specific, efficient external power supplies; • Awards credit for auto power down capability.
(September to December) 2011	ES version 3.0 (draft 2)	• Allows annual allowances of 60 kWh/year for cable base functionality, 70 for satellite, and 45 for IPTV; • Includes additional allowances of 35 kWh/year for cable / satellite digital tuner adapter base functionality; 22 for terrestrial; and 35 for thin client/ remote; • Specifies the annual allowance for additional functionalities (e.g., additional tuners, DVR, DOCSIS, etc.) • Limits the time the machine uses to exit 'deep sleep' mode to reconnect to the network to perform maintenance activities; • Specifies auto power down settings • Requires specific, efficient external power supplies; • Rewards partners for machines that use deep sleep and that are thin clients.
2013 (month: TBD)	ES version 4.0 (per version 3.0 draft)	• The draft outlines updated allowances; • And announces that the version may focus on removing irrelevant options from the Typical Energy Consumption (TEC) assessment, and implementing a mandatory deep sleep requirement for qualifying STBs.

Service Providers Specifications

In addition to a specified maximum base kWh, STBs must be distributed by a participating Pay-TV service provider in order to qualify as an ENERGY STAR product. To qualify as a participating service provider, ENERGY STAR specifies that providers must meet or exceed

one the following specifications: (1) 50% of all new purchases must be ENERGY STAR in a calendar year; or (2) at least 10% and 25% of all existing fleet are ENERGY STAR by 2009 and 2010 respectively, including refurbished and newly installed units ((EPA), 2008). While the ENERGY STAR (Environmental Protection Agency (EPA)) website indicates that five service providers participate in the program, our research indicates that only two operate in California: DirectTV and AT&T.[38]

The two-part requirement may underestimate the number of energy efficient units in the marketplace, if formally defined as ENERGY STAR-qualified. Our respondents indicated that more models on the market meet ENERGY STAR's maximum base kWh but do not qualify as ENERGY STAR due to a lack of program participation among service providers.[39] The estimates of our OEMs indicate the proportion of newly designed (2010) set-top boxes could be as low as 40% to 100%, based on the specific policies of the manufacturer.

Estimated Baseline of Installed ENERGY STAR Qualified STBs

Drawing on the self-report of our respondents and secondary data sources, we estimate the market penetration of ENERGY STAR qualified STBs in California households (**Figure 13**) and the proportion of ENERGY STAR qualified STBs in California by pay TV service technology (**Figure 14**).

The figures below are projected through the triangulation of multiple data sources, cited in the bibliography of this document. Below each figure, we indicate the primary sources and assumptions we made to generate our estimates. Note that these estimates are for units that qualify for both the per-unit and service provider specifications.

[38] The remaining three are EPB, Cequel III, dba Suddenlink Communcations, and Ecocyn Energy Inc. Ecocyn Energy Inc appears to have been recently acquired by Cerrao, but operation within CA is unclear.

[39] However, the Version 3.0 Draft 2 indicates that the OEMs can use the ES label on boxes

Figure 13. ENERGY STAR Penetration in California STB Market
(Base: Estimated Number of STBs Installed in California)

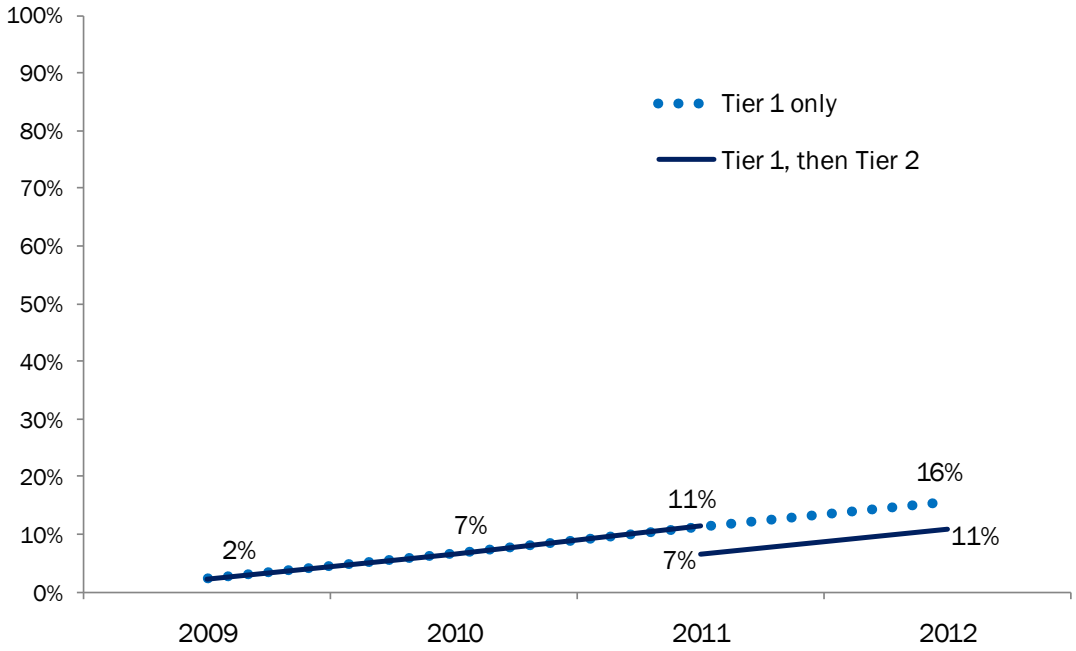


Table 18. Estimated Number of STBs Installed in California per Year[40]

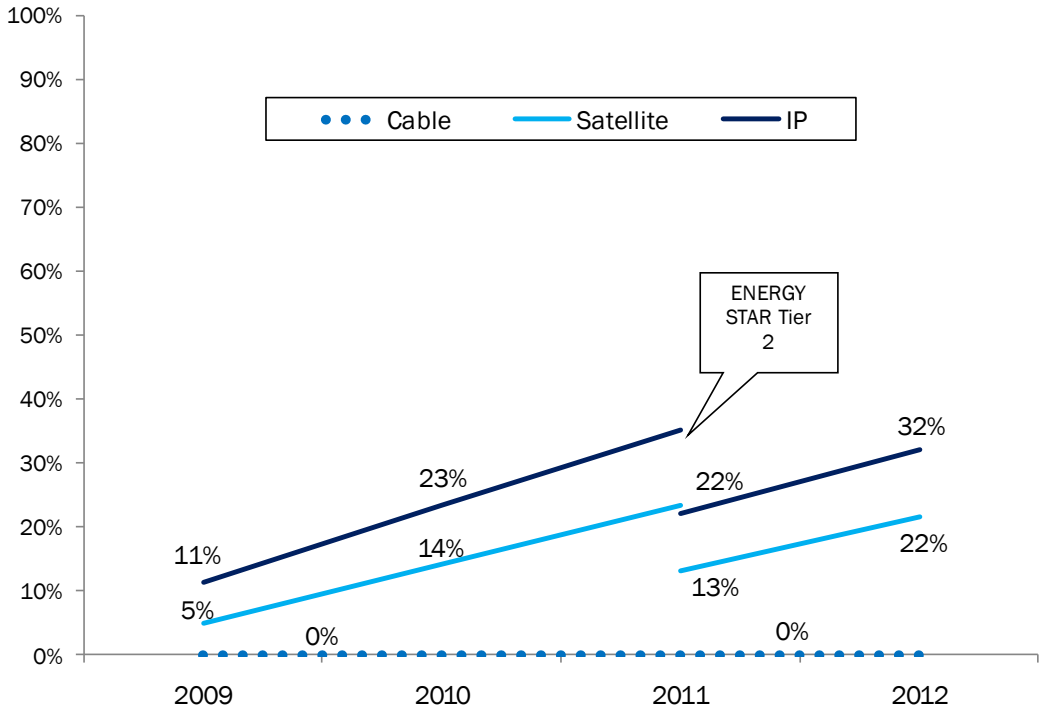
	2009	2010	2011	2012
Cable	9,180,491	9,037,193	8,896,131	8,722,717
Satellite	5,416,561	5,557,187	5,701,465	5,861,079
IPTV	610,032	749,120	919,920	1,124,411
Total	15,343,500	15,517,515	15,810,453	16,011,984

We estimated the growth of ENERGY STAR STBs across the years through a combination of: 1) recent growth in STBs (National Cable & Telecommunications Association (NCTA), 2009) (Environmental Protection Agency, 2009), (National Cable & Telecommunications Association (NCTA), 2010); 2) projected overall decline in the STB marketplace (ABI Research, 2008); 3) current practices of ENERGY STAR partners (AT&T, 2008), (DirecTv, 2010), (Environmental Protection Agency (EPA), 2010) and 4) turnover based on annual household resident changes (Avrick, 2010). To scale national subscribers numbers down to number of STBs within California, we used a proportion of the CA population to the national population (U.S. Bureau of the Census, 1996), (U.S. Census Bureau, 2009), and a study that showed the number of STB per CA household (Gilmore Research Group, 2004). Finally, we assumed that in 2011, only 25% of the existing STBs in customer homes would meet Tier 2 criteria, following the goals of ENERGY STAR program market penetration levels.

[40] Note in our final version, we will attempt to go to the utility level with these estimates.

Please note that we have not confirmed any cable TV provider participants in the ENERGY STAR program. For this reason, the market penetration of ENERGY STAR-qualified STBs is low, given cable TV's relative high market share.

Figure 14. ENERGY STAR Penetration in California by STB Type
(Base: Estimated Number of STBs Installed in California)[41]



It is important to note here that OEMs indicated that there is spill-over in design practices from European Commission Codes and Conduct (ECCC) standard requirements, which have more stringent power-draw requirements than ENERGY STAR, promoting increases in learning and design practices in the global STB market. With new standards coming into effect (January 2013), ECCC requirements have the potential to increase efficiency gains in U.S. markets.[42] However, due to the service provider requirements of the ENERGY STAR program, the recent ENERGY STAR data (see next section) may underestimate the number of energy efficient STBs installed or sold in the market.

Estimated Baseline of ENERGY STAR Qualified STBs Sales (in Shipments)

[41] Note we applied the same assumptions for Figure 12 and Figure 16, but used different bases to derive these estimates.

[42] See Appendix for detailed listing of international STB standards.

In estimating ENERGY STAR sales (in shipments) within California we considered various secondary sources. First, the EPA recently released its 2009 U.S ENERGY STAR unit shipment and 'market penetration'[43] report which includes STB data. The report estimated that 50% of the 14.8 M units shipped to the U.S. in 2009 were ENERGY STAR units. Note that only five OEMs were surveyed presumably because these were the only OEMs supplying ENERGY STAR service provider partners in 2009. While we use the EPA estimates of the total number of national shipments to estimate sales in California (see **Table 19**), we cannot use their ENERGY STAR proportion because it is based on cable service provider partners who do not participate in California. Instead, we use the market share of the two ENERGY STAR partner service providers who do operate in California (see **Figure 15**), gathered from NCTA data and apply the rates (100%) at which these partners state they manufacture and deploy ENERGY STAR STBs.

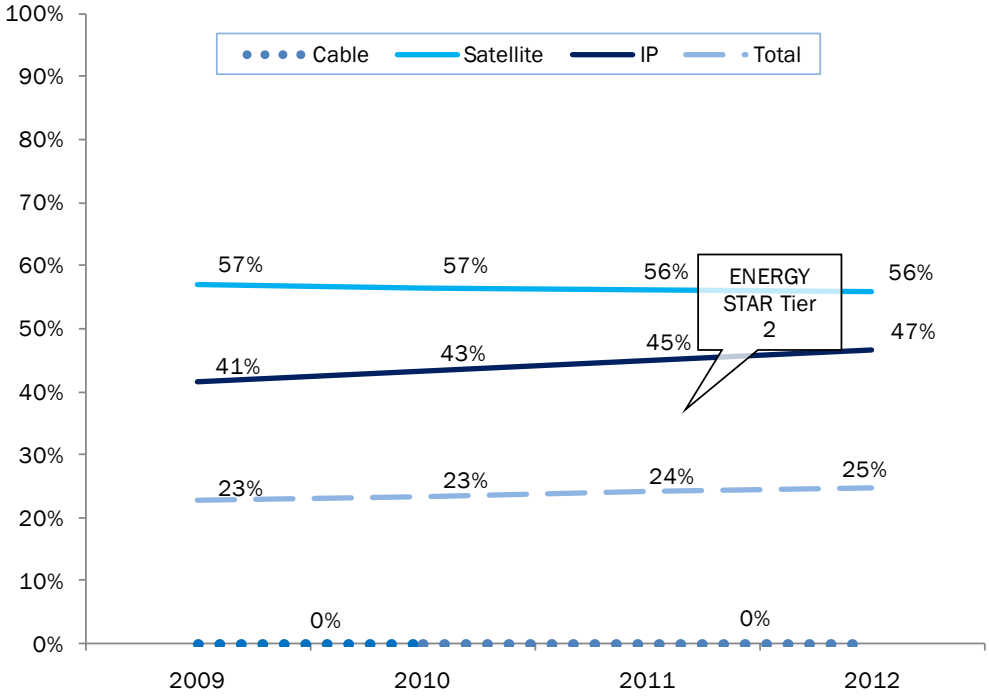
Table 19. Estimated Number of STBs Sold (Shipped) in California per Year

	2009	2010	2011	2012
Cable	1,065,508	1,048,876	1,032,504	1,012,378
Satellite	628,658	644,979	661,724	680,250
IPTV	70,802	86,944	106,768	142,368
Total	1,764,967	1,780,800	1,800,997	1,834,996

Note: The data is this table are extrapolated from EPA's data regarding 2009 total U.S. shipments (14, 840,000). First, we applied the total growth national subscriber growth rates (NCTA 2009, 2010) year over year. Second, we multiplied the year totals by the proportion of extrapolated subscriber type during each year (NCTA 2009, 2010). Finally, we applied the proportion of the CA population to the national population (U.S. Bureau of the Census, 1996) to arrive at totals for the state.

[43] The EPA defines market penetration as the number of ES units shipped divided by total U.S. shipments.

Figure 15. Estimated Number of ENERGY STAR STBs Sold (Shipped) in California per Year



We note here that the Satellite and IP ENERGY STAR participants interviewed indicated that they would ensure that 100% of all future STBs. For this reason, we do not ratchet down the market penetration of ENERGY STAR units among these providers when Tier 2 is released. In addition, we note that the ENERGY STAR qualified cable service providers do not provide services in California. For this reason, the market penetration for Cable providers is 0%.

Effects of Technology and Configuration Design Trends on Efficiency

While STB design has been incorporating features that increase energy use, there are two technology and configuration trends that may help mitigate increased energy use: 1) deep sleep; and 2) thin clients. As mentioned earlier, both features are specified in the recent ENERGY STAR Version 3.0. Draft 2 specifications. We describe both technologies in the following paragraph.

A thin client is a machine smaller than a conventional STB which processes content for a viewing device (e.g., TV, monitor, etc.) per room. One or more thin clients work with a central STB in a network to distribute content across one or more rooms. The central STB interfaces with the service provider directly and directs content to the thin client(s). Since thin clients do not have as many functions to perform as the central STB, they typically do not use as much energy. Thus, configurations employing thin clients use less energy than configurations consisting of multiple STBs.

Deep sleep is a functionality that dramatically reduces power draw during times the STB is not being used by disconnecting from the network and by increasing the amount of time allowed for the machine to return to full on mode. Service providers generally have not endorsed the functionality because they 1) believe that customers are not willing to wait a

minute or more for their devices to warm-up and 2) do not want to limit connectivity to the service network which allows for programming, upgrades, and various forms of marketing to take place. Yet, significant energy savings gains can be realized with this functionality. For example, in a recent 2010 study (NRDC Study performed by Ecos Consulting, 2010), machines with the same power consumption profile in on- and sleep- mode, had markedly different energy draw when one was equipped with deep sleep functionality (114 vs. 202 kWh/yr).

Market Players

Pay-tv service providers serve as the gatekeepers of energy efficiency in the STB market. As the supplier to end users, they dictate which units move to market based on their perceptions of end user demand. Among providers, the largest cable and satellite providers drive the market because they place a large volume of orders with OEMs. They also promote newer features (e.g., digital video recorder [DVR], high definition [HD] TV, etc.) to end users. Consumers do not chose STBs specifically, rather they choose a package of features and a particular STB accompanies it. End users generally buy or lease STBs through their service providers and do not choose the STB themselves. For these reasons, pay-tv service providers serve as the logical target for program intervention.

Market Delivery Timeline

Typically, a pay-tv service provider will submit a roadmap[44] to OEMs. Once a product is designed, the pay-tv provider will approve the STB and submit it to third parties to manage and install the units' software needs. When a pay-tv service provider places an order, it can take 1.5 to 3 years before the model enters the U.S. market. Chip design accounts for a significant portion of the total product cycle, and may take over a year. Following design, it can take some service providers another six months to evaluate the design and clear it for manufacture. It can take up to one additional year after manufacturing for third parties to manage software that is loaded onto the machines prior in installation in homes.

[44] A roadmap is a plan that matches short-term and long-term goals with specific technology solutions to help meet those goals, including but not limited to feature selection, energy, and aesthetic requirements.

Figure 16. Set-top Boxes Market Delivery Cycle

- *Chip design accounts for a significant portion of the total product cycle, and may take over a year.*
- *Following design, it can take some service providers another half a year to evaluate the design to clear it for manufacture.*
- *It sometimes takes another year for third parties to manage software that is loaded onto the machines before service providers place them in consumers' homes.*
- *Following this timeline, respondents indicated that models designed in 2008 may just now be entering the market (2010).*

While some OEM respondents indicated that they were designing units to meet ENERGY STAR TIER 1 requirements as early as 2008 (one year prior to the specification launch), they indicated that the prolonged market delivery process creates delays in the installation of increasingly efficient technologies.

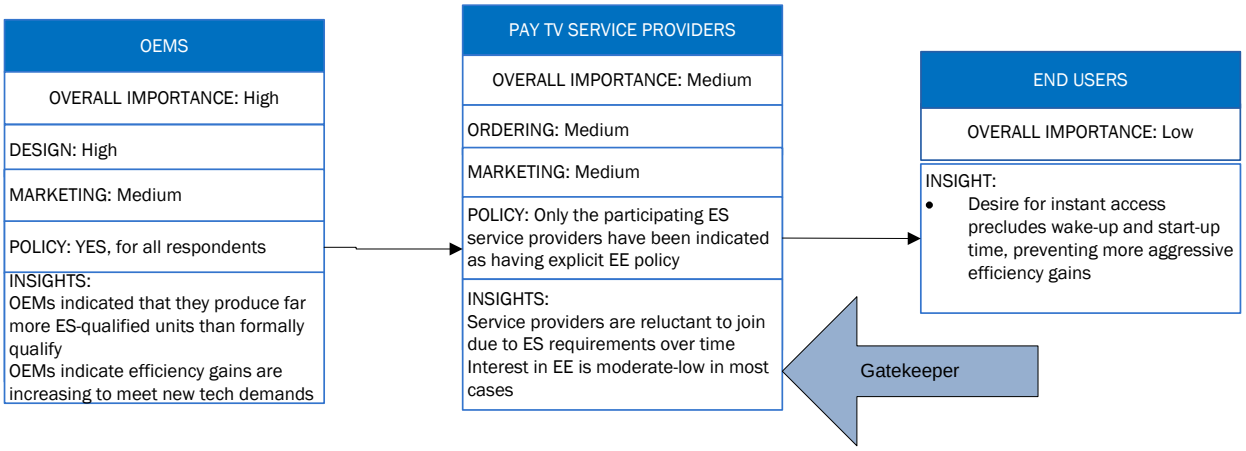
> *"The number of (efficient) models is probably actually larger (than service provider estimates). The problem is that some of our newer models haven't reached full ramp-up yet and we're winding down some of the older models."*

Further, our data indicates that those models that are being rotated out of end-users homes are more often refurbished by service providers than replaced with new, efficient units. We do not have sufficient data to indicate the frequency of this practice relative to the installation of new boxes, but we hypothesize that the trend towards new, multi-function units may accelerate the removal of repurposed devices from homes.

Importance of Energy Efficiency in Business Practices

Currently, STB design is driven by end users need for instantaneous access to services, often requiring that units remain on and in constant communication with the pay-TV service network for instant access to channels, pay-per-view, and DVR options. Efficiency gains among STBs are typically a byproduct of an increased need for unit stability and reliability under the strain of advanced technology and near-constant use.

Figure 17. Importance of Efficiency in Market Actor Practices



In the current U.S. marketplace, energy efficiency is generally only a medium consideration among other feature considerations that generally take precedence over energy efficiency in product roadmap including the following (cited in approximate order of their stated importance in the market): meeting service providers unique network specifications (e.g., media format; satellite signal characteristics, etc.); reliability; cost; and processing power to support ever-increasing feature load.

In the past (2008), energy efficiency was relatively off the radar in the U.S. market. This has changed with the introduction of ENERGY STAR standards in 2009. Namely, efficiency and ENERGY STAR qualifications are entering the feature negotiations between OEMs and service providers. This movement towards increased efficiency standards in STB design is coming from both OEMs and service providers as companies are looking to become better corporate citizens.

Some respondents indicated that their motivation to promote their products as energy efficient was influenced not only by the entrance of ENERGY STAR standards, but also by green trends and branding opportunities in general. Concerns range from maintaining innovation in lock-step with ECCC codes and standards (which exceed ENERGY STAR) to maintaining a "total ecological view" rather than an energy-only view. In addition, some respondents we interviewed reported having a corporate 'policy', 'goal', or 'concern' which bolstered their focus on energy efficient STBs to meet higher efficiency standards.

> *"It's to our benefit for (our clients) to be partners and to want to buy efficient boxes so that we can label them (and) get credit for putting all this effort into designing a box that's energy efficient."*

Insights for Increased Efficiency Gains

There are opportunities to increase efficiency in the STB marketplace. Below we provide our preliminary insights into potential opportunities in the STB market to promote energy efficiency:

1. **Consider Incenting on a Performance basis rather than through Per-unit Incentives.** Currently, market actors indicated that the ENERGY STAR service provider and per-unit requires does not fully address the potential for energy

savings in the STB market. They site multiple reasons for this:

a. **Service Providers are Reluctant to Participate:** Because the ENERGY STAR service provider specifications require projects of purchasing or existing fleet penetration into the future, providers are uncomfortable making commitments to meet require levels. In addition, the extended market delivery timeline (as long as 3 years) makes it difficult to plan and adjust to forthcoming specifications and participants do not want to enter to program if they may be "disqualified" at a future date.

b. **STB Power may be Better Managed Through Software and Network Solutions:** Currently, STB run almost constantly in order to remain connected to the network to allow for instantaneous end user access. However, this two-way connection also provides a direct line from service providers to existing fleet. Such access may be leveraged to implement power-management software to end users without compromising the end-user experience or requiring existing fleet upgrades.

2. **Consider Incenting on Technologies that Reduce the Number of STBs in the Home:** Currently, many end users have multiple STBs in their home, one for each television. However wireless and clone technologies can reduce or eliminate the need for such additional units. Rather than incenting the installation of multiple energy efficient STBs, savings may be gained by removing extra units and replacing them with a household network solution.

3. **Leverage Service Calls:** Due to the extended market delivery timeline for STBs and the use of existing fleet, savings may be gained through leveraging service calls to either replace inefficient units with ENERGY STAR qualified units, or through the installing power management software on existing systems.

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APPENDIX A. STB EFFICIENCY CODES AND STANDARDS

Table 20. Recent Codes and Standards for STBs

Effective Date	Codes and Standards	Mandatory/ Voluntary	Main Specifications
1/1/2007	ECCC[b] Version 7, Tier 1	Mandatory	• Requires specific, efficient external power supplies; • Passive standby mode (for complex STBs) should not exceed 3 W for cable, satellite, or IPTV • Active standby mode should not exceed 7W for cable, 8W for satellite, or 6W for IPTV • the total maximum power consumption in standby active mode should not exceed 15 W
2008	Canadian Standards Association	Mandatory	No detailed data found

1/1/2009	ECCC Version 7, Tier 2	Mandatory	• Requires auto power down; • Requires specific, efficient external power supplies; • Passive standby mode should not exceed 3 W for cable, satellite, or IPTV • Active standby mode (for complex STBs) should not exceed 6 W for cable, 7W for satellite, or 5W for IPTV • the total maximum power consumption in standby active mode should not exceed 13 W
1/1/2009	ES version 2.0, Tier 1	Voluntary	• Allows annual allowance of 70 kWh/year for base functionality, 88 for satellite, and 45 for IPTV; • Specifies the annual allowance for additional functionalities (e.g., additional tuners, DVR, DOCSIS, etc.) • Requires specific, efficient external power supplies; • Awards credit for auto power down capability.
7/1/2009	e-Standby Program[a]	Voluntary, but mandatory labeling indicating whether or not the product meets the standard	• Minimize standby power; • Enter sleep mode during the standby
1/1/2010	ECCC Version 8 Tier 1	Mandatory	• Requires specific, efficient external power supplies; • Requires auto power down; • Allows annual allowance of 60 kWh/year for cable base functionality, 60 for satellite, and 40 for IPTV; • Specifies the annual allowance for additional functionalities (e.g., additional tuners, DVR, EuroDOCSIS, etc.)

1/1/2011	ES version 2.0, Tier 2	Voluntary	• Allows annual allowance of 50 kWh/year for cable base functionality, 56 for satellite, and 36 for IPTV; • Specifies the annual allowance for additional functionalities (e.g., additional tuners, DVR, DOCSIS, etc.) • Requires specific, efficient external power supplies; • Awards credit for auto power down capability.
1/1/2013	ECCC Version 8 Tier 2	Mandatory	• Requires specific, efficient external power supplies; • Requires auto power down; • Allows annual allowance of 53 kWh/year for cable base functionality, 53 for satellite, and 31 for IPTV; • Specifies the annual allowance for additional functionalities (e.g., additional tuners, DVR, EuroDOCSIS, etc.)

[a] Korea

[b] European Commission Code of Conduct

ATTACHMENT 5: GAME CONSOLES

MEMORANDUM

TO: BCE Statewide Program Evaluation Team

FROM: Opinion Dynamics Evaluation Team

DATE: 12/2010

RE: FINAL Game Consoles Findings Memo

GAME CONSOLES

Here, we present our baseline findings for Game Consoles (GC). The findings are based on interviews with two of the three GC manufacturers.

This category differs from other measures in our study in that the proposed ENERGY STAR specifications have been indefinitely suspended. In light of this, we present an overview of the market and discuss the implications of implementing a voluntary standard for GCs. A GC is a specialized computer used to play video games. Game software is available on CDs or DVDs, although earlier game machines used cartridges containing read only memory (ROM) chips. GCs require a TV or monitor for display functions (PC Magazine 2010).

According to PC Magazine, GCs' operating systems and CPUs differ from desktop computers, in that they are under the control of their respective manufacturers, and the software is designed to the machine's specific capabilities. In this respect, their applications (games) are entirely proprietary. Games are not interchangeable with other game consoles or desktop computers, although software publishers may develop games for more than one platform (PC Magazine 2010).

Market Summary

The GC market is also unique in that it comprises three primary manufacturers who produce three proprietary units for market, listed in order of their market share: (1) Nintendo's Wii; (2) Sony's PlayStation; and (3) Microsoft's Xbox. **Figure 18** below details the market share of these three OEMs, as cited by NPD (NPD 2009).

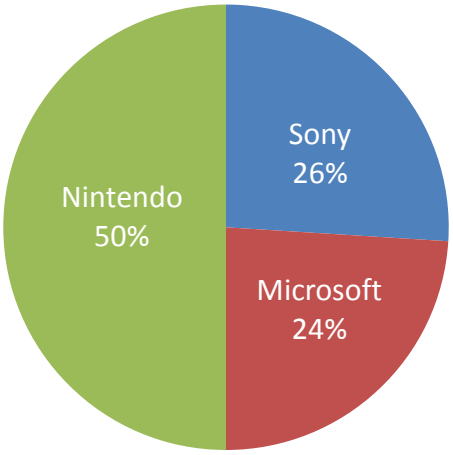
Each game console differs in its functionalities; Play Station and Xbox[45] both offer a wide range of features including High Definition (HD) content and DVD players, whereas Nintendo's Wii has limited functionality and standard definition but offers a different gaming experience through hand-motion controlled gaming.

As

45 Xbox recently released the Kinect gaming console that has similar, hand-driven functionality as the Wii, but also offers high definition gaming. Based on its high definition features, we assume this unit is more similar to previous iterations of Xbox than the Nintendo Wii, which is not high definition.

Table 21 indicates, the Sony PlayStation has the highest install base (45%), but the Nintendo Wii is currently leading in sales, representing as 50% of all GC sales in the U.S. in 2009. Below, we discuss the implications of these market trends on codes and standards.

Figure 18. 2009 Game Console OEM Market Share



Nintendo's Wii has captured a large market share, attributed in part to its appeal among nontraditional gaming segments, such as consumers over 45 and young families.

Table 21. Summary of Game Console Devices

Console	U.S. Install Base (millions)[46]	Percent of Install Base[47]	Features
PlayStation 3	3.2	5%	3.2 GHz Processor, HD, DVD and Blu-ray Disc Playback, Wi-Fi, Netflix Streaming, Bluetooth compatibility
PlayStation 2	25	40%	300 MHz Processor, DVD Playback, Ethernet Connection
Xbox 360	9.2	15%	3.2 GHz Processor, DVD Playback, HD, Wi-Fi, Netflix Streaming
Nintendo Gamecube	8	13%	486 MHz Processor
Wii	7.4	12%	729 MHz Processor, Wi-Fi

ENERGY STAR Market Penetration

ENERGY STAR (ES) developed a GC draft standard that is indefinitely postponed. This standard was included in the ENERGY STAR Program Requirements for Computers, Version 5.1. This version had three tiers, Tier 1 (formerly scheduled to be launched July 2010), Tier 2 (formerly scheduled to go into effect in July 2011), and Tier 3 (formerly scheduled to go into effect in July 2012). The table below summarizes the maximum based consumption as outlined in the draft specifications.

[46] Horowitz. *Lowering the Cost of Play.* http://www.nrdc.org/energy/consoles/files/consoles.pdf

[47] Ibid.

Table 22. ENERGY STAR Draft Game Console Requirements[48]

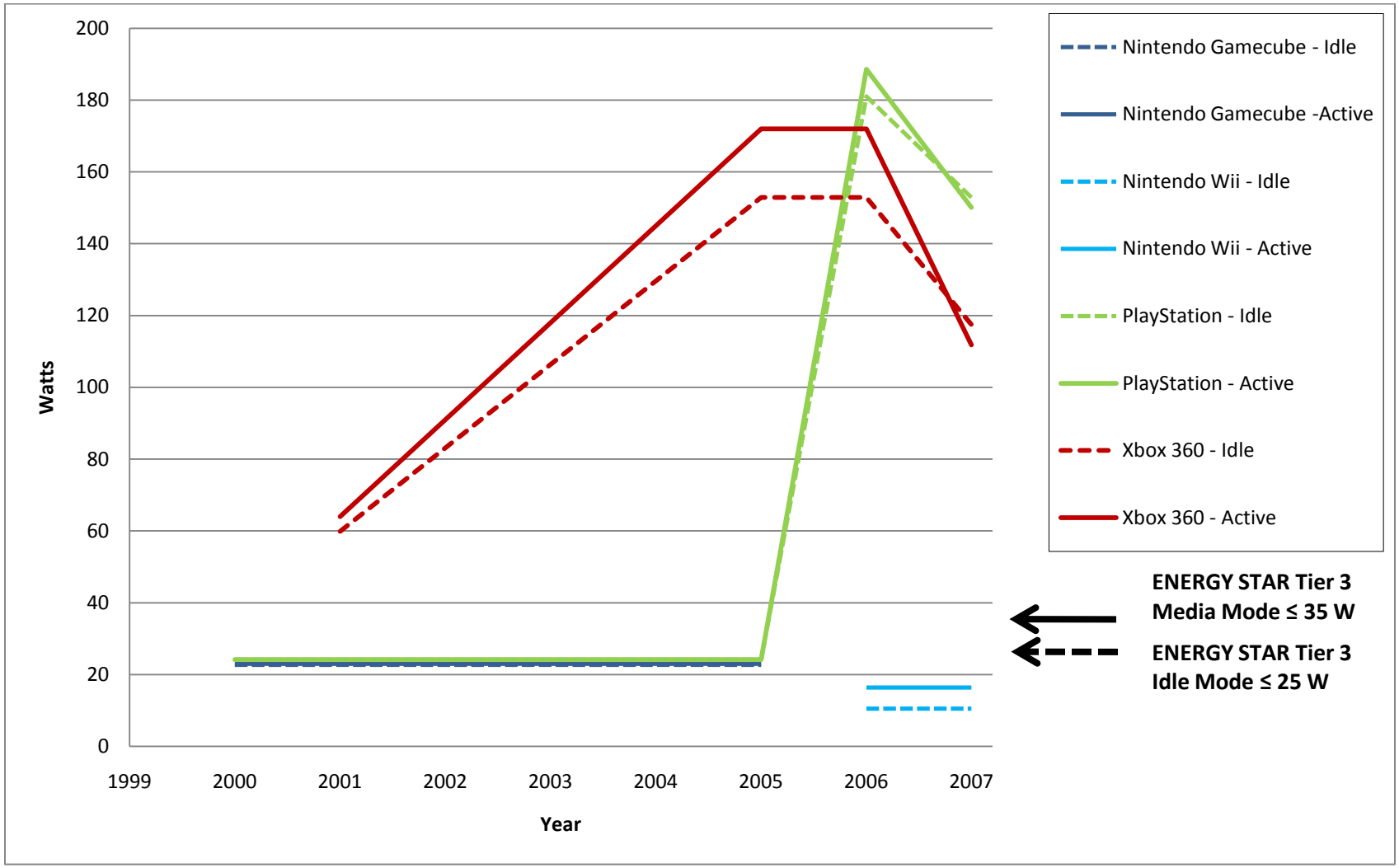
Tier	Requirements
Tier 1 (July 2010)	• Less than 2.0W in sleep mode when wireless AP/router functions are not engaged • Less than 10.0W in sleep mode when wireless AP/router functions are engaged • Game consoles not in active mode must power down within 1 hour of user inactivity
Tier 2 (July 2011)	• Less than 1.0W in sleep mode when wireless AP/router functions are not engaged • Less than 5.0W in sleep mode when wireless AP/router functions are engaged • When idle, the system maximum power draw is 45.0 • When serving STB functions, the device should come within 10% of the Tier 2 Version 2.0 Specification for STBs.
Tier 3 (July 2012)	• Less than 1.0W in sleep mode when wireless AP/router functions are not engaged • Less than 5.0W in sleep mode when wireless AP/router functions are engaged • When idle, the system maximum power draw is 25.0 • When serving STB functions, the device should come within 10% of the Tier 2 Version 2.0 Specification for STBs. • For Media functions, the unit should not exceed 35.0W.

In **Figure 19. Game Console Power Consumption by Manufacturer and Mode**, we plot the energy consumption by game console over time in both active and idle modes. In 2004-2006, there is a dramatic increase in energy use among these consoles. This is likely due to the introduction of high definition game consoles, representing a new generation of units on the market.

Note that the only units that fall near the ES Tier 2 requirements are Nintendo's Wii. As the Consumer Electronics Association's 2009 letter to the EPA indicates, game consoles have "significantly different functions and capabilities and should not be considered a standardized product . . . some systems are high definition, multi-function, entertainment centers while others are used as almost exclusively traditional game consoles." In this respect, the standard would require that Microsoft and Sony adopt similar functionality as the Wii (a traditional game console), effectively requiring that they abandon their primary value propositions, HD gaming and multi-functionality. In addition, the Nintendo Wii alone represents 50% of 2009 sales, and thus already exceeds ES's broadly stated goals of generating a best-in-class brand (covering no more than 25% of the market) (**Figure 18**). For these reasons, ES's GCs standard met substantial resistance and was indefinitely placed on hold.

[48] Environmental Protection Agency ENERGY STAR Program Requirements for Computers, Version 5.1, Game Console Requirements – Draft Final.

Figure 19. Game Console Power Consumption by Manufacturer and Mode[49]



[49] Horowitz. *Lowering the Cost of Play.* http://www.nrdc.org/energy/consoles/files/consoles.pdf

Market Actors

As noted earlier, the GC market comprises three main OEMs (Sony, Nintendo, and Microsoft). These OEMs design and deliver GCs to market and generally have complete control over the process from end-to-end, including maintaining licenses for the games created for their consoles. Game developers generate proprietary content designed for the unique operating systems of each console. The games and the game licenses are the primary revenue source for the GC industry. GC units are sold to end users through standard retail and online channels. For this effort, we focused on OEMS and channels, which are the primary decision makers in the GC market. Note that we excluded game designers; our research indicated that the game designers do not have much influence over the GC units; rather the GC units determine the specific attributes of games released on the market.

Market Delivery Timeline

New game consoles are typically released every 7 to 8 years—consider "generations" of GCs. Within these generations, OEMs continue to enhance the internal components to reduce manufacturing costs and product size, while also maintaining performance. Energy efficiency is a byproduct of this process. Within a generation, efficiency gains can be dramatic, with one OEM indicating that they reduced the energy consumption from 180 watts to 80 watts within one GC generation. These intra-generational changes to GC design may occur as frequently as once a year. However, it is unclear how quickly these units make it to market, as retailers will move existing stock before offering newer units to end users.

Figure 20. Game Console Market Delivery Cycle

- *New game consoles are typically released every 7 to 8 years.*
- *After release, OEMs make continual improvements to the internal components to reduce manufacturing costs without reducing performance. Energy efficiency is s byproduct of this process.*
- *Game consoles tend to have long in-home life spans because OEMs generally release new customer-facing GCs only once every several years. Also, end-users are focused on the latest versions of the game, and not the console.*

In the home, GCs tend to have long life spans, similar to the generation life span (7 to 8 years), with increases in sales upon the release of a new generation of console. For the most part, end users' purchase behaviors are driven by access to new games for a given console, rather than obtaining the latest version of a console. New consoles are desired only in so far as they offer a new gaming experience.

Importance of Energy Efficiency in Business Practices

When developing a new game console, energy efficiency is not a primary consideration. Performance is the chief priority, so much so that OEMs will tolerate high manufacturing costs on new consoles in order to drive the production and purchase of new games. In the process of intra-generation upgrades, energy efficiency is a byproduct of increasing performance while decreasing costs. One OEM notes:

> *"The cost of the hardware is associated with the amount of computing power you get per watt…. If it takes a lot of energy to play a game, then the components that make up a game console need to be heavier, bigger, more expensive, better at dissipating heat. So there are a lot of business drivers associated with the reduction of energy that parallel the reduction of cost. For the most part the two are directly related."*

As part of this process, the primary function of the GC is to promote a better gaming experience. DVD and other features are secondary considerations, and the units are not optimized for efficiency with respect to these functionalities. Research indicates that these components may be enhanced in terms of efficiency, but are not a central concern to OEMs.

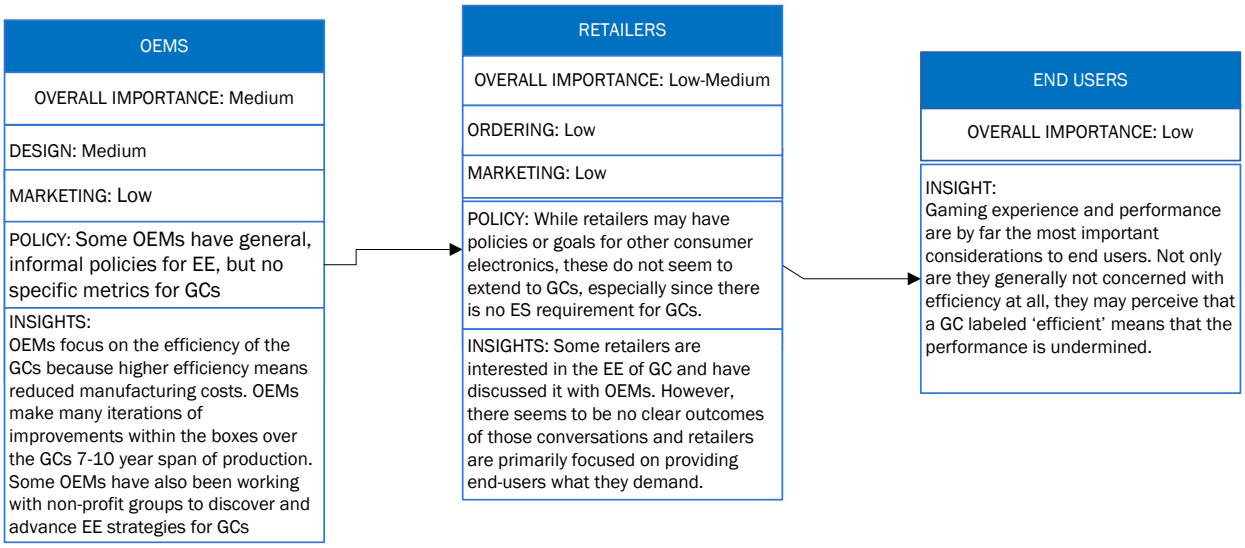
Once the game console is on the market, profits are reinvested into continual iterations of the design that do not affect the customer-facing or functionality of the device but that do result in higher efficiency and lower manufacturing costs.

According to OEMS, some retailers appear somewhat interested in the efficiency of game consoles and have spoken with OEMs about it. However, retailers are unsure how to request enhanced efficiency without an ES specification or how to market efficiency to end users.

For end users, gaming experience and performance are important considerations in buying a GC. Not only are they generally not concerned with efficiency at all, but they may perceive that a GC labeled "efficient" means that its performance is undermined, and therefore be less interested.[50]

[50] Note that this information is anecdotal, and to the best of our knowledge, market actors have not studied this directly.

Figure 21. Importance of Efficiency in Market Actor Practices



Key Issues in Developing Codes and Standards for Consoles

The GC market has a number of attributes that present serious barriers to the development of standards, codes, and programs for this category. Based on our in-depth interviews and secondary data review, we have identified the following barriers in this category:

- **The game console market consists of three OEMs who issue one to twotwo unique consumer products:** ES specifications require a best-in-class approach to develop the standards, aiming for approximately 25% of the markets' shipments (sales) qualifying for the standard. In the case of GCs, the data described above indicates that if a given GC unit qualifies for ES, it alone will likely exceed the best-in-class goals.

- **Current game console technologies are diverse in their performance and end uses, resulting in dramatically different power draw across popular models:** The 2006 Nintendo Wii is estimated to draw 16.4 watts in active mode compared to the 2007 Play Station 3, which draws nearly ten times as much power as the Wii. These two units offer different end uses, with the Play Station 3 offering additional end uses (such as Blu-ray DVD) and high definition capabilities, ultimately placing the technology in a different class than the Wii. Thus, a single standard is not appropriate.

- **Generating a single standard for diverse GC units would require that OEMs engineer a product that sacrifices their market position with gamers.** The functionality of the energy-intensive units (Xbox and Play Station 3) is the core of the OEM's value proposition. Significantly reducing their power draw to the levels of the Wii will require eliminating their core functionalities (such as high definition gaming) and compromise their market position. As such, the current standards are antithetical to the OEMs' business practices.

- **Game console OEMs are hesitant to submit to a standard that may hinder innovation in the future:** Unlike many consumer electronics categories, GC OEMs have a shared interest in protecting GC innovation in the future. Because the category is almost exclusively performance driven, GC OEMs do not want to submit to a standard that might position them at a competitive disadvantage in the future. GC OEMs are skeptical of submitting to a standard that may not accurately reflect the industry's ability to meet the efficiency goals in the future.

- **Promoting energy efficiency may actually serve as a disadvantage in selling GCs to end users.** GCs are designed to provide end users with a fundamentally performance-based experience—highly interactive, graphically rich, and increasingly innovative games. Some OEMs indicated that promoting the efficiency of GCs to end users may undermine the value proposition of the product. To paraphrase one OEM, you wouldn't try to sell a Prius to someone looking for the performance and experience of a Corvette.

Key Issues in Developing a Per-Unit Based Incentive Program

- **Game consoles are a loss leader for OEMs.** Unlike similar consumer electronics, the primary revenue source for game console manufacturers are licenses generated for game developers, not the consoles themselves. PlayStation 3 and Xbox 360 are loss leaders for their manufacturers, meaning they are sold at a significant discount to drive sales and generate a wider market for their games. For this reason, market actors indicated that a per-unit incentive may have little leverage with OEMs.

- **New game console technologies are introduced every 5 to 7 years.** The core functionality and design of GCs are developed once every 5 to 7 years, representing a new generation of product. As noted earlier, the units are upgraded on an ongoing basis to enhance performance and reliability. While these enhancements have an effect of efficiency, efficiency is perceived as a byproduct of these goals. Incentives could aim to affect these iterations, but due to their loss-leader status, it is unlikely that efficiency will be prioritized if the associated incremental costs do not directly enhance performance.

- **There is no single standard for efficiency enhancements among game consoles.** The Wii and PlayStation 3/Xbox 360 are in separate classes of performance and functionality. If the IOUs choose to incent on a per-unit basis, they may need to consider console-specific efficiency goals. However, doing so while insuring equity may be challenging. Utilities should consider approaches to maximize the efficiency of each game console, rather than setting a blanket standard to apply to all units.

Insights for Increased Efficiency Gains

- **Consider building informal relationships with OEMs to drive efficiency gains.** Despite the barriers to standard development in the GC market, there are clear opportunities to drive the efficiency of these units. Currently, the GC OEMs are engaged in a working group with the National Resource Defense Council to determine and develop technologies that allow for more aggressive auto power-down features without compromising end users' gaming experience.

- **Consider ways to educate gamers on smarter console use.** Many gamers regularly read gaming-specific publications and resources, representing an opportunity for education and information on GC energy use and behavior-based approaches to reducing energy consumption, such as saving and turning off games when not in use.

ATTACHMENT 6: COMMERCIAL TELEVISIONS

MEMORANDUM

TO: BCE Statewide Program Evaluation Team

FROM: Opinion Dynamics Evaluation Team

DATE: 12/2010

RE: Final Commercial Televisions Findings Memo

COMMERCIAL TELEVISIONS

This memo represents our third memo of six, with the following three memos: (1) imaging equipment; (2) game consoles; and (3) servers. Note that this memo, commercial television, does not include market penetration estimates due to a lack of data available in the literature.

The findings in this memo are based largely on interviews with three original equipment manufacturers (OEMs). Two of the three OEMs would are among the top three LCD OEMs by U.S. shipments in both the standard and commercial LCD markets (see Table 23). We cannot state the percent of the LCD commercial market share these two OEMs represent without undermining our sources' confidentiality. The remaining OEM would likely be recognized as a small to medium TV OEM.

Introduction

CTVs are those televisions designed for and installed in commercial locations such as hotels, airports, restaurants, etc. They are commonly referred to by industry as "hospitality" or "commercial grade" televisions and are purchased in large volume. The Environmental Protection Agency (EPA) defines hospitality televisions as having (1) "a control port for bi-directional communication;" and (2) "activated hospitality protocol software… for the purpose of direct access to Video-On-Demand (VOD) systems or a digital media player designed for hospitality-specific applications" EPA, 2010). For the purposes of this study, we choose to use the term "commercial TVs (CTVs)." Note that we did not include those devices used for signage that display relatively static images such as menu options at a restaurant or departure/arrival information at an airport.

Generally, CTVs differ from standard TVs in two main ways. First, they have features that allow for connectivity to a central programming source controlled by the business. This is

advantageous to commercial customers for several reasons. First, they allow many "clone" CTVs (e.g., 200 in a hotel) to be programmed and set up at one time and allow user access to VOD (e.g., "pay-per-view") or other business-specific programming (e.g., business amenities, local weather, etc.). Second, the CTV user interface is different from a standard TV interface. Namely, CTVs often lack controls on the faceplate so that the CTV can be accessed by remote only. This feature is useful to commercial customers because it prevents patrons from changing the programming in the commercial setting. The CTV interface may also include a touch-sensitive display for use in lobbies, or information kiosks. Hence, CTVs allow commercial customers to create a highly customized viewing experience for their patrons.

Original Equipment Manufacturer (OEM) market share in the CTV market mirrors that in the standard TV market. As shown in **Table 23**, Sony, Samsung, LG, and Sharp are pre-eminent in both markets. In addition, CTV innovation and designs align with trends in the television market overall and do not have unique roadmaps or design parameters. For example, in both the standard and CTV market, manufacturers' designs are trending toward bigger, LCD screens with enhanced definition.

Table 23. Ranking of Top LCD TV OEMs in Standard and Commercial U.S. TV Markets (Q32009)

OEM	Rank in LCD Commercial Market [a]	Rank in LCD Standard Market [b]	LCD Commercial Market Share [b] (n=205,404) [c]
Sony	1	2	37%
Vizio	2	7	17%
Samsung	3	1	16%
LG	4	3	8%
Sharp	5	4	7%

Note: LCDs in the commercial market also include those used for signage.

[a] per Q3 2009 data of U.S. shipments of 26"+ LCDs Through Commercial Distribution (DisplaySearch, 2009).

[b] per dollar share data collected from retailers for the six-month period of November 2008 through April 2009 (This Week in Consumer Electronics (TWICE), 2009).

[c] The source does not imply that the 205,404 figure represents 1,000s or other factor of units. It appears to be 205,404 single units.

In addition, some OEMs stated that they have dissolved their CTV divisions due to increased competition within the CTV market over the last few years. One form of competition arises from standard TVs. Over the last two years, OEMs have sharply increased[51] their sale of standard TVs through commercial channels for delivery to the commercial market (DisplaySearch, 2008; DisplaySearch, 2009). According to one market analyst, the trend is "end-market driven since both commercial end users and VARs have pushed (OEMs) into offering products at lower price points" (DisplaySearch, 2008). **Table 24** breaks down the percent of TV types sold to the commercial market by major OEMs.

[51] "September data shows that TVs shipped through commercial distribution channels also rose to record levels with TVs selling commercially in Q3'09 up 85% Y/Y" (DisplaySearch, 2009).

Table 24. Ranking of Top LCD TV OEMs in Standard and Commercial U.S. TV Markets

Rank in LCD Commercial Market [a]	OEM	Percent of TV Types Sold through Commercial Market [b]		
		Standard	Hybrid [c]	Commercial
1	Sony	99%	-	1%
2	Vizio	100%	-	-
3	Samsung	48%	-	52%
4	LG	43%	34%	23%
5	Sharp	92%	-	8%

[a] per Q3 2009 data of U.S. shipments of 26"+ LCDs Through Commercial Distribution (DisplaySearch, 2009)

[b] per May 2009 data (DisplaySearch, 2009)

[c] 'Hybrid' is an industry term used to describe TVs that are meant for both consumer and commercial markets.

Additionally, the OEMs and market analysts (Grimes, 2010; PRWeb, 2010) believe that both TV types are moving from cold cathode fluorescent light (CCFL) backlighting to LED backlighting, which greatly enhances the efficiency of the TV. One analyst projects CCFL LCD TVs will decline from 150 to less than 40 million units from 2010 to 2014, while LED LCD TVs will increase from about 40 to nearly 250 million units during the same period worldwide (PRWeb, 2010). This may have a dramatic effect on the overall efficiency of TVs in both the commercial and standard markets.

ENERGY STAR CTVs

Table 20 outlines the current ENERGY STAR (ES) 4.1 specification, effective as of May 2010, and applicable to both standard and commercial TVs. This standard sets guidelines on the power consumption in standby/sleep mode; the power consumption in on-mode, per TV size and definition level; the default settings used to ship; the external power supply efficiency; and the power consumption associated with downloading program guide data. The table also outlines the future ES 5.1 specification, effective as of May 2012, and applicable to both standard and commercial TVs. The future specification reduces the number of kWh/day the units may use in download acquisition mode (DAM).

Table 25. Current and Future ENERGY STAR Versions Applicable to Commercial TVs

ENERGY STAR Version	Effective Date	Specifications
4.1	5/1/2010	• TVs must consume 1 watt or less in standby/sleep mode; • Sleep mode must be the default for the TV as shipped to consumers • Home and retail luminance modes cannot differ by more than a set percentage • OEMs must include user information on the benefits of keeping the TV in the default settings • On-mode power requirements are set according to screen area and whether or not the unit has automatic brightness control • External power supplies (EPS) must meet all ENERGY STAR requirements for EPS devices • Hospitality TVs must not use more than .08 kWh/day while downloading program guide data in download acquisition mode (DAM)
5.1	7/1/2011 (tentative)	• TVs must consume 1 watt or less in standby/sleep mode • Sleep mode must be the default for the TV as shipped to consumers • Home and retail luminance modes cannot differ by more than a set percentage • OEMs must include user information on the benefits of keeping the TV in the default settings • On-mode power requirements are set according to screen area and whether or not the unit has automatic brightness control • External power supplies (EPS) must meet all ENERGY STAR requirements for EPS devices • Hospitality TVs must not use more than .02 kWh/day while downloading program guide data in download acquisition mode (DAM)

Estimated Baseline of ENERGY STAR Qualified CTVs

OEMs found it difficult to estimate how many of their CTVs qualify and will qualify for ES under the new on-mode requirements. In the past, many CTVs could meet ES criteria because there was only a standby power consumption standard. With the introduction of on-mode requirements, many CTVs can still meet ES because they are based on ES-qualifying consumer models. However, many OEMs were unclear as to whether their CTVs would meet present and future ES criteria because they did not know how the procedure for DAM testing would be defined.[52]

[52] In DAM mode, TVs download data to update such things as electronic programming guides (EPGs), setup data, channel maps, and firmware (Procedure for DAM Testing: For TVs, 2010). Power usage levels in DAM mode are greater than those of the TV in sleep, but less than those in on-modes. Since CTVs are centrally connected and receive content from the commercial server, DAM mode is a necessary feature of CTVs. An ongoing issue is how the EPA will define testing requirements for TVs in DAM modeand thus OEMs stated they could not estimate the current or future proportions of their CTV models and sales that would qualify for ES.

Due to difficulty estimating market penetration, OEMs generally provided us estimates of standard TV efficiency levels because CTVs are based on standard TV design. For example, in 2008, OEMs estimated 80-100% of their models, and 90-100% of their sales met ES requirements for both standard TVs and CTVs. Given that 2008 EPA ES market penetration (EPA, 2009) data indicates that 79% of the TV shipments met ES criteria, OEMs' estimates may be overstated or more accurately represent current models rather than specific trends in shipments to end users.

Market Players

There are three main types of CTV market players. First, component manufacturers (CMs) and OEMs work together to manufacture CTVs. Second, distributors and value added resellers (VARs) in the enterprise channels facilitate purchasing of large-volume orders by business customers. Depending on the needs and knowledge of their clients, the role of VARs may include taking and placing orders; deciding which equipment best suits clients' needs; and installing and servicing the technology. Third, commercial clients may approach OEMs directly to procure CTVs for their organizations.

We spoke with multiple OEMs, two of which, combined, make up over 50% of the LCD commercial market share in Table 23. One respondent stated they have a CTV division within the organization while two stated they do not. The OEMs without CTV divisions do not actively promote CTVs but instead negotiate with those commercial clients who approach the organizations directly. These OEMs then modify existing standard models to meet clients' orders. The OEM with a CTV division stated that the organization designs and manufactures a relatively low number of CTV models per year compared to its standard TV design and manufacture process.

Opinion Dynamics conducted a review of leading OEMs' websites to determine if/how CTVs are sold and promoted as efficient. Table 26 below summarizes our findings.

Table 26. Emphasis on Commercial TV Efficiency Among Major Brands

OEM	Do they have a Commercial TV Web Presence?	Who is it geared towards?	Is the Energy Saving Promotion noticeably displayed?	No. of CTV models
Sony	Yes	Broadcast, Corporate, Digital Cinema, Digital Cinematography, Digital Photofinishing, Education, Government, House of Worship, Industrial automation, Intelligent Traffic, Medical, Recordable Media, Security, Sports	No	42 (2 Critical Evaluation monitors; 4 Broadcast evaluation monitors; 9 public display monitors; 26 video production monitors)
Vizio	No	Consumer	Yes	N/A
Samsung	Yes	Business, Healthcare, Education, and Government	No	45 + 16 (specific to hospitality)
LG	Yes	Healthcare, Transportation, Education, Financial, Retail, Hospitality, Public Venues, QSR/Foodservices, Government	No; on their pdf brochure only	46
Sharp	Yes	Corporate accounts, Education, Government, Healthcare, Hospitality, House of Worship	No	5 Professional grade + 35 consumer grade (both types are promoted for commercial use)

Market Delivery Timeline

CTV design is based on TV design, and OEMs report that the product cycle for the standard TV has been getting shorter over the last few years such that new models are introduced to the market once to twice a year. Some OEMs with CTV divisions may produce a few CTV models once a year.

OEMs stated that commercial clients place CTV orders throughout the year. Some OEM respondents believe that the trend in which fundamental changes in TV design (e.g., CRT to DLP to LCD) occur every three years will continue to occur over the next few years.

Figure 22. CTV Market Delivery Cycle[53]

- *Many TV OEMs do not market commercial televisions; instead they tend to be approached by commercial clients who place orders.*
- *Many TV OEMs do not have a commercial television product, but modify existing models to fit commercial clients needs.*

Importance of Energy Efficiency in Business Practices

Based on our interviews, energy efficiency is becoming more important to commercial clients. As described earlier, clients' orders determine the efficiency of the CTVs they order even though the CTV models reflect existing TV efficiency. When commercial clients place orders, OEMs report that they mainly focus on the model's connectivity to their system, the feature set/performance, and the price. However, OEMs also report that efficiency has become more important to commercial clients recently who occasionally ask about it directly.

Midstream, VARs generally focus on clients' expressed needs and appear to rarely actively promote energy efficiency for CTVs. However, if there is an increased trend in the commercial markets for efficiency, VARs are likely to start discussing it with their clients.

OEMs also reported the importance of energy efficiency in their marketing and outreach as medium to high. Thus, they are in a position to respond to clients' increased interest in efficiency. One OEM stated that they promoted the energy efficiency of their products whenever they had an opportunity to do so, mainly by focusing on potential financial savings to the client and, to a lesser extent, by focusing on the product's environmental impact (e.g., greenhouse gas emissions).

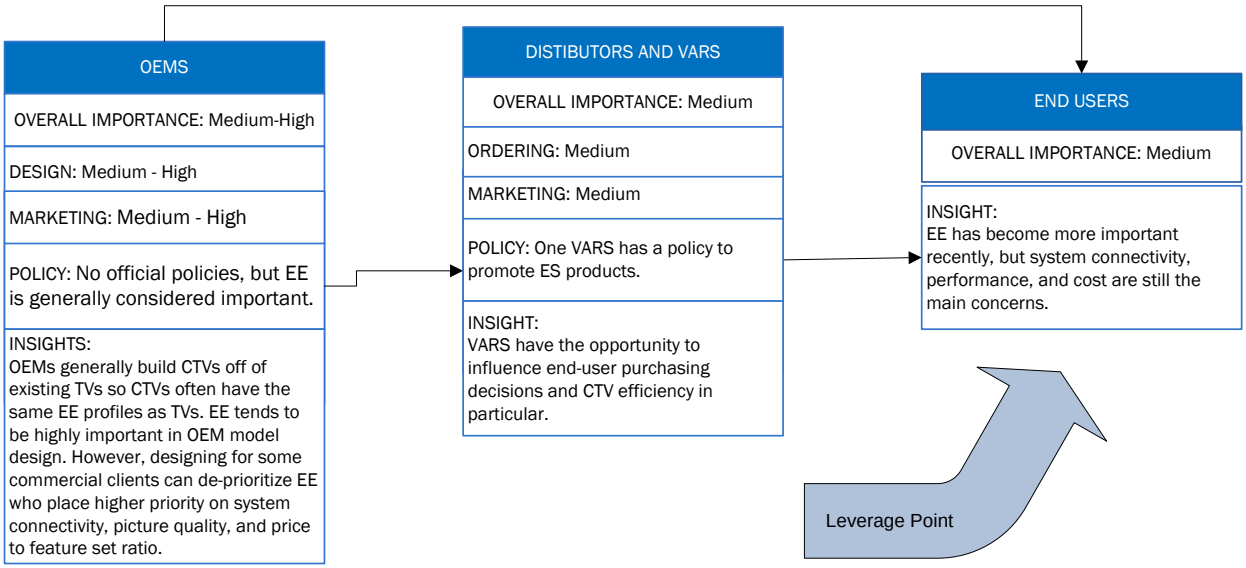
> *"I believe [EE] is in the top tier of all manufacturers' (design) concerns and in ours in particular…I am sure when you get to price, design, and energy efficiency, there are obvious tradeoffs between those three things…We always want to meet ENERGY STAR if we can. [But in the end, it is] a business decision."*

Aside from any commercial client demand for efficiency, all OEMs we interviewed regularly try to meet ES levels, and two also stated that efficiency was very important to their organizations. They try to exceed ES levels to stay competitive or to be "good corporate citizens," yet there are no internal corporate policies mandating certain efficiency levels.

[53] Note that we are currently investigating the average "refresh" cycle end users, e.g., hotels, to determine the average lifespan of these units.

These OEMs believe energy efficiency, sometimes along with other "green" actions (e.g., product recycling), will continue to be important to their corporations into the future.

Figure 23. Importance of Efficiency in Market Actor Practices



Insights for Increased Efficiency Gains

While some CTVs may be energy efficient because they are based on standard TVs that are energy efficient, there may be some potential in the commercial market to promote efficiency and increase the share of ES CTVs in it. Below, we provide our preliminary insights into potential opportunities in the CTV market to promote energy efficiency:

1. **Educate commercial clients on power saving settings.** ES-qualifying televisions are shipped with default automatic brightness controls and sleep mode activated. However, end users may turn off these features without understanding how they affect energy savings. Offering in-depth education on system and network management may prove effective in reducing energy use in commercial facilities.
2. **Conduct additional research on commercial TV end users.**
    a. **Understand different end-use patterns across commercial end-users.** The usage patterns of commercial TV end users can vary dramatically depending on their application (e.g., hotels, airports, restaurants, etc.). However, little to no research exists on commercial TV end-user behaviors by sector, thus making it difficult to estimate the savings attributable to such installations.
    b. **Determine whether commercial TV end users represent a more effective target for program incentives.** This study specifically focused on up and midstream actors. However, our data indicate that commercial TV end users determine the state of efficiency in this marketplace. For this reason, it may be more effective to offer incentives on bulk purchases of ENERGY STAR and ENERGY STAR + units downstream.

3. **Consider targeting downstream.** Based on our interviews, there are barriers to energy efficiency among upstream and midstream market actors. Rather, commercial customers dictate how models are designed and specified to meet their unique end uses. Since there is no indication of a supply-side concern, incentives may be more appropriate for end users to ensure that bulk orders meet ENERGY STAR or ENERGY STAR + specifications.

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APPENDIX A. TELEVISION EFFICIENCY CODES AND STANDARDS

Table 27. Recent ENERGY STAR Versions Applicable to Commercial TVs

ENERGY STAR Version	Effective Date	Specifications
3.0 (Tier 1)	11/1/2008	• TVs must consume 1 watt or less in standby/sleep mode. • Sleep Mode must be the default for the TV as shipped to consumers. • On-mode power requirements vary according to screen area, whether the unit is non-high, high, or full-high definition, and whether or not the unit has automatic brightness control. • OEMs must include user information on the benefits of keeping the TV in the default settings. • External power supplies (EPS) packaged with TV products must meet all ENERGY STAR requirements for EPS devices.
4.1	5/1/2010	• TVs must consume 1 watt or less in standby/sleep mode. • Sleep mode must be the default for the TV as shipped to consumers; • Home and retail luminance modes cannot differ by more than a set percentage. • OEMs must include user information on the benefits of keeping the TV in the default settings. • On-mode power requirements are set according to screen area and whether or not the unit has automatic brightness control. • External power supplies (EPS) must meet all ENERGY STAR requirements for EPS devices. • Hospitality TVs must not use more than .08 kWh/day while downloading program guide data in download acquisition mode (DAM).
5.1	5/1/2012	• TVs must consume 1 watt or less in standby/sleep mode. • Sleep mode must be the default for the TV as shipped to consumers. • Home and retail luminance modes cannot differ by more than a set percentage. • OEMs must include user information on the benefits of keeping the TV in the default settings. • On-mode power requirements are set according to screen area and whether or not the unit has automatic brightness control. • External power supplies (EPS) must meet all ENERGY STAR requirements for EPS devices. • Hospitality TVs must not use more than .02 kWh/day while downloading program guide data in download acquisition mode (DAM).