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Final Report

Electronics and Energy Efficiency: A Plug Load Characterization Study

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Prepared For:

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Prepared By:

research/into/action inc

Jane S. Peters, Ph.D.
Marti Frank, Ph.D.
Joe Van Clock
April Armstrong

Research Into Action, Inc.

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EXECUTIVE SUMMARY

Electronic devices now consume more electricity in U.S. buildings than any other single end-use, including space heating and cooling, water heating, and lighting.[1] The products in this category are diverse, their individual energy use ranges from negligible to off-the-charts, and as a group they are driving significant increases in residential and commercial building energy consumption.

The purpose of this study was to develop a market characterization for eight electronics products identified as having potential for inclusion in Southern California Edison's 2010-2012 Business and Consumer Electronics Program: set-top boxes, servers, game consoles, imaging equipment, home audio receivers, "smart" power strips and surge protectors, uninterruptible power supplies, and external power supplies. TVs, PCs, and displays (monitors) were excluded from the study because similar research was being undertaken by other utilities.

The report which follows is based on a review of secondary literature and in-depth telephone interviews with 54 energy efficiency and utility program staff, manufacturers, and industry trade organizations. Although this study was designed to address the specific needs of one utility, data was collected at a national level and therefore will likely be useful to other utilities and policymakers. The report begins with a summary of key findings across all products, followed by a chapter with sections on each product.

BARRIERS

Programs will face several barriers to improving the energy efficiency of electronics products. Each product market has its own unique barriers, but several are common to electronics products in general:

- **The variety and number of electronic devices presents one of the biggest challenges to the energy efficiency industry**. The average household now has 25 to 30 of them – compared to 13 or 14 in 1995.[2]

[1] Energy Information Administration. *Annual Energy Outlook 2007*. Electronics are the largest electricity consumers in U.S. buildings when defined broadly, as the EIA does, to include the entire plug-load.

[2] Consumer Electronics Association. (1995, 2009). *Annual Household CE Ownership and Market Potential Study*. Suzanne Foster Porter, Laura Moorefield and Peter May-Ostendorp. (2006). *Final Field Research Report*. Prepared for California Energy Commission by Ecos Consulting.

- **Most products are in a near constant state of change**. The new models manufacturers introduce every year may employ entirely new technologies, or incremental changes to existing technologies.
- **Some products, like servers, are very complex, making it difficult to develop energy efficiency standards for them**.
- **Federal voluntary efficiency standards (ENERGY STAR®) have yet to be developed for some important products and other voluntary standards are incomplete or not aggressive enough**.
- **There is a lack of comprehensive, measured data on the energy performance of many electronics products**.
- **The best opportunities for market intervention may require changes to typical utility program operating requirements**, for example, reporting methods, time constraints, and limitations on geographic territory.

PROGRAM DESIGN CONSIDERATIONS

Program managers and policymakers will want to consider several aspects of an electronics product when designing a program. The key aspects are listed below, though programs should consult the report for a full discussion of each issue and its impact on individual products.

- **What is the product's development timeline?** The time from conception to market varies significantly by product type, from a few months (external power supplies) to nearly five years (game consoles). The duration of the product development cycle determines how quickly energy efficiency improvements resulting from program interventions can be realized.
- **What are the inputs to product design**? Each product's design requirements, including energy efficiency, are determined by a unique set of inputs. For example, PC design requirements come directly from end-users when they order a customized product, and indirectly from end-users and retailers when manufacturers conduct market research on customer needs. Programs should consider the inputs to product design and develop tactics applicable to each.
- **Is there an "ascendant" product?** In nearly every product type there are one or two products whose sales are growing far faster than others. For example, in the first quarter of 2009, sales of multifunction devices ("all-in-one" copiers/printers/fax machines) grew, while sales of all other types of imaging equipment declined. Programs may want to pay attention to these "ascendant products," as they will likely represent an increasing share of the market in coming years.
- **Who are the key manufacturers?** Although there are thousands of manufacturers in the electronics arena, a relatively small number dominate most product types, often

accounting for upwards of 80% of total sales. By targeting the top manufacturers, programs can reach much of the market by working with only a few players.

- **What are the distribution channels?** Each product is distributed through a different set of channels. TVs, PCs, and displays are sold at bricks and mortar and online retailers, as well as direct from the manufacturer; PCs and displays are also distributed by dealers or value added resellers (VARs). The distribution channels for set-top boxes, servers, and external power supplies differ significantly from other electronics products studied.
- **How is the product marketed?** Marketing messages and mediums differ by product. Marketing for consumer electronics tends to focus on product features rather than energy efficiency. Messages for business electronics typically include a discussion of energy use. Mediums vary as well, with each product marketed through its own "bundle," including mass media, personalized communications, trade shows/events, and point-of-sale materials.
- **What are the applicable energy efficiency standards?** In the U.S., ENERGY STAR is the predominant (voluntary) energy efficiency standard for electronics. However, the specifications do not apply to every product studied and vary greatly in the level of efficiency required, comprehensiveness, and the frequency with which they are updated. Program managers should maintain close relationships with the relevant ENERGY STAR program manager to stay apprised of changes to specifications, and can look to the many international standards for another point-of-view on energy efficiency requirements.
- **How engaged and committed is the product market to energy efficiency?** Programs should tailor their outreach strategies to the product market's level of engagement with, and commitment to energy efficiency. For example, the manufacturers of displays and PCs are currently more engaged with and committed to energy efficiency than manufacturers of home audio products or set-top boxes.

OPPORTUNITIES

There are opportunities for programmatic interventions in the electronics market, although they vary slightly by product, and all will be familiar to energy efficiency program implementers:

- **Work with manufacturers to increase the energy efficiency of devices.**
- **Raise awareness among end-users and business-to-business customers about the benefits and availability of energy-efficient products.**
- **Provide financial incentives to increase the adoption of energy-efficient devices.**
- **Increase end-user activation of a device's existing power management settings.**

The first two, working with manufacturers and raising awareness, are applicable to every product studied. The use of financial incentives to increase device adoption is applicable to nearly every

product – it may not be effective in the game console market because product choice is so limited. Effective use of power management settings may be a good way to increase the energy efficiency of several devices, including imaging equipment, servers, and game consoles.

The conventionality of the opportunities in the electronics market masks a far more complicated reality. Perhaps the key finding of this study is that **electronics are different from other products with which the energy efficiency industry is familiar**. Their great variety – in technologies, manufacturers, distribution methods, and intervention points – should not be underestimated. In fact, it likely makes them unsuitable for a one-size-fits-all program design. Unlike the approach often taken with building energy efficiency measures, for example, this research suggests it will not be prudent to design one overarching electronics program and add device types to it.

Success in transforming the electronics market will require careful consideration of the unique elements of each product's supply chain. It will be further expanded if program managers strive towards goals that have not typically been part of a utility program strategy: coordinating with other utilities and programs to develop programs that apply to as broad a geographic territory as possible; being flexible enough to allow the program to evolve at the same rapid pace as the products; and working closely with manufacturers to involve them in setting energy efficiency targets and designing the program processes.

RECOMMENDATIONS

The findings from this study include several specific recommendations for program design and strategy. The key recommendations are summarized below. The full report contains additional details and recommendations.

Program Design and Implementation

- **Manufacturers' national and international markets require cooperation among programs to promote unified standards that apply to the broadest possible geographic area**.
- **Decisions about product design are made at the very beginning of the development process, thus market transformation programs must focus their efforts on intervening at these early stages of product design**.
- **Product development cycles vary from three months to five years, thus market transformation effects will take at least as long to be realized**.
- **Manufacturers design products to meet the needs of different types of customers, and effective programs will consider each and design elements to address them**. Customers include end-users, retailers, private label customers, business-to-business customers, and the manufacturers themselves.

- **Sales of some products are growing more quickly than others**. Paying attention to these "ascendant products" will help programs plan ahead and increase their effectiveness.
- **The incremental cost of efficiency may be measured in dollars or even pennies, depending on the product**. When programs consider this cost in relationship to the manufacturer's profit margin on a product, they will be better positioned to understand the manufacturer's perspective and develop program requirements that meet their needs.
- **Manufacturers may make effective program targets** because electronics markets are consolidated and programs may be able to reach much of the market by targeting the few manufacturers with the most market share.
- **Efficiency targets that mirror the electronics industry's own goal-setting processes are most likely to be effective**. This includes standards set in a "roadmap" format, with goals determined several years into the future.
- **The great variance in distribution channels among products means no single program design will work for all electronic devices**.
- **ENERGY STAR specifications do not apply to all, or even most, electronic devices and the absence of a specification may be a barrier to including these products in an efficiency program**.
- **Programs should maintain close relationships with ENERGY STAR program managers in order to stay apprised of impending changes to standards,** as ENERGY STAR specifications for each product have been revised at different times and at varying intervals.
- **Programs may want to take ENERGY STAR penetration data into account when selecting which efficiency level(s) to incent**.
- **Programs can use activities taking place abroad to inform energy efficiency targets and capture lessons learned,** as there are several international energy efficiency labeling programs that apply to consumer and business electronics products.

Program Marketing

- **Energy efficiency *is not* currently a key product feature for consumer electronics products, thus programs should consider efforts to increase awareness of and demand for energy efficiency in consumer electronics products**.
- **Energy efficiency *is* a key product feature for business electronics products, thus programs targeting these products should adjust their marketing efforts accordingly**.

- **Manufacturers employ multiple marketing mediums for their products so programs should consider the ways in which each product is marketed when designing its outreach strategy**.
- **Across all products, the most common energy efficiency messages focus on cost savings and/or are tied to a manufacturer's corporate social responsibility efforts**. Programs should consider that consumers, at least in the view of manufacturers, are most responsive to messages centered on cost savings related to energy efficiency.
- **The limited nature of energy efficiency messaging means programs have an opportunity to work with manufacturers and distribution partners to improve efficiency messaging and product labeling to include a description of the benefits of efficiency**.

Codes and Standards Activities

- **Many products have high ENERGY STAR penetration rates**. To capture additional savings, programs may need to incentivize an efficiency level more aggressive than ENERGY STAR and/or an ENERGY STAR tier that is not yet in effect.
- **Because the lack of an ENERGY STAR specification can serve as a barrier to including a device in a program, programs should consider advocating for ENERGY STAR specifications for a greater number of plug load devices**.

NEXT STEPS

Many research gaps remain in the electronics market. Current needs include:

- **Baseline studies for product types to be included in energy efficiency programs**. These should determine, at a minimum, the installed base, market share, and current sales levels of efficient versus "traditional" products.
- **Electronics saturation surveys to study the number and type of devices in U.S. households**. Surveys should be conducted every other year, funded and organized at a national level (perhaps in coordination with the Consumer Electronics Association), and include both telephone/email surveys and in-building tallies for both residential and commercial buildings.
- **End-use metering and load profiling studies of electronic devices**. Like saturation surveys, these studies need to be conducted on a regular basis for devices used in both residential and commercial buildings.
- **Investigation of the technical potential for efficiency improvements in electronics devices**. Energy efficiency organizations need to understand where to set aggressive, but reachable, targets. Depending solely on manufacturers and their industry lobbying groups

for this information will likely result in targets that are not nearly aggressive enough. In this effort, international efforts can provide guidance, including those taking place in the European Union, Japan, and Australia.

- **Additional research on the retailer-manufacturer relationship**. A deeper understanding of the influences on both parties will aid program design, particularly around the role of retailers in product development.
- **Additional research on consumer decision-making**. Programs will benefit from, at the least, a review of the most recent decision-making research to determine the potential effects of incentivizing purchases at the customer or retailer level. For example, will this lead to "take back," with customers purchasing bigger devices than they would have otherwise?

1 INTRODUCTION

Electronic devices now consume more electricity in U.S. buildings than any other single end-use, including space heating and cooling, water heating, and lighting.[3] The products in this category are diverse; their individual energy consumption ranges from negligible to off-the-charts and, as a group, they are driving significant increases in residential and commercial building energy consumption.

It is difficult to generalize about electronics, a fact apparent from the names typically applied to them as a group: *miscellaneous*, *other*, and *plug load*. There has also been some inconsistency in the way electronic products are categorized. While certain devices are always included – TVs and PCs, for example – portable lighting may or may not be listed. White goods – like refrigerators, clothes washers, and dishwashers – are typically excluded, but not always.

The variety and number of electronic devices presents one of the biggest challenges to the energy efficiency industry. The average household now has 25 to 30 of them – compared to 13 or 14 in 1995.[4] Previous studies identified more than 50 different product types, ranging from those found in nearly every home (rechargeable devices like cell phones, small kitchen appliances, TVs) to the less common (waterbed heaters, pool pumps).[5] Products are often grouped into subsets based on end use – for example, home entertainment, information technology (IT), or office equipment – but some inevitably fall into yet another "other" basket.

Despite being an unwieldy category, electronics are now at the forefront of the energy efficiency industry because of their significant share of total building electricity use. The numbers vary, but electronics likely consume 20% to 28% of household and 13% to 39% of commercial building electricity.[6] The product categories of key importance in residential buildings are entertainment

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3 Energy Information Administration. *Annual Energy Outlook 2007: With Projections to 2030* (*http://tonto.eia.doe.gov/ftproot/forecasting/0383(2007).pdf)*. Electronics are the largest electricity consumers in U.S. buildings when defined broadly, as the EIA does, to include the entire plug load.

4 Consumer Electronics Association. (1995, 2009). *Annual Household CE Ownership and Market Potential Study*. Suzanne Foster Porter, Laura Moorefield and Peter May-Ostendorp. (2006). *Final Field Research Report*. Prepared for California Energy Commission by Ecos Consulting.

5 Foster Porter, *Final Field Research Report*. K. Roth, K. McKenney, R. Ponoum, and C. Paetsch. (2007). *Residential Miscellaneous Electric Loads: Energy Consumption Characterization and Energy Savings Potential*. Prepared for U.S. DOE by TIAX LLC.

6 Household data from Alex Chase, Ryan Ramos and Ted Pope. (2006). *Consumer Electronics: Market Trends, Energy Consumption and Program Recommendations, 2005-2010*. Prepared for PG&E by Energy Solutions; and Energy Information Administration. (2009). *Annual Energy Outlook 2009*. Commercial data from *Annual* Energy *Outlook 2009* and California Energy Commission. (2006). *California Commercial End-Use Survey*. CEC-400-2006-005. Prepared by Itron, Inc. (noted here as "CEUS").

and IT equipment, which make up 38% to 91% of plug-load energy.[7] Data on commercial buildings is less detailed, but IT and office equipment appear to account for up to 25% to 55% of the total plug load.[8]

In 2009, there are several efforts underway to improve the energy efficiency of electronics. A handful of utility programs are being launched, focused on TVs, PCs, displays (monitors), and set-top boxes. New ENERGY STAR voluntary standards are being developed to identify top energy performers among an expanded list of products that includes servers, game consoles, and set-top boxes. Several industry-led organizations are setting efficiency roadmaps, developing measurement and benchmarking protocols, and encouraging their customers and partners to get on board. Manufacturers have come to see energy efficiency as an important, if not *the* most important element of their internal sustainability goals, and many believe being green can be a potent marketing tool.

Yet many gaps remain. Voluntary efficiency standards have yet to be developed for some important products and others are incomplete or not aggressive enough. Despite the high quality of previous research, there is a lack of comprehensive, measured data on energy performance. Only one study to date performed in-home measurements of device energy use and no comparable research exists for commercial buildings.[9] Even this first-of-its-kind effort, completed in 2006, is fast becoming out-of-date. For example, only one of ten cable set-top boxes metered in the study included digital video recording capability – currently 30% of all boxes ship with this feature.[10] There are no studies of the load profile of electronic devices and even the definition of the operating modes of these products is in flux, with each study more or less defining them for itself and the complexity of some products requiring the identification of entirely new operating modes.

The proliferation of consumer electronics and IT equipment, the complexity of the products, and their rapid pace of change suggest this market will continue to be an important but challenging one for years to come. Successful intervention by utilities and government agencies will require new strategies, exceptional adaptability, and unprecedented cooperation among efficiency organizations.

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7 The great variance in these figures is due to the different number of device types counted. The lower figure is found in the *Annual Energy Outlook 2009* and includes only energy used by TVs and PCs. The higher figure is found in Foster Porter, *Final Field Research Report*, and includes multiple entertainment and IT device types.

8 *Annual Energy Outlook 2009*, CEUS.

9 Foster Porter, *Final Field Research Report*. CEUS includes tallies of plug load electronics in commercial buildings, but the results may be unreliable due to the data collection method. Multiple researchers asked on-site informants about devices in use, but there is no guarantee of completeness, consistency, or accuracy.

10 Reuters. (June 8, 2009). DVR-equipped set-top box shipments contract 20% year-over-year in the first quarter of 2009, according to Dell'Oro Group. Retrieved from *http://www.reuters.com/article/pressRelease/idUS112672+08-Jun-2009+BW20090608*.

STUDY GOALS AND APPROACH

This market characterization was undertaken to support Southern California Edison's 2010-2012 Business and Consumer Electronics (BCE) program. Unlike previous studies, which primarily addressed the energy use of electronics products, this research aimed to describe how manufacturers design and market energy-efficient products, and the factors that influence product design decisions.

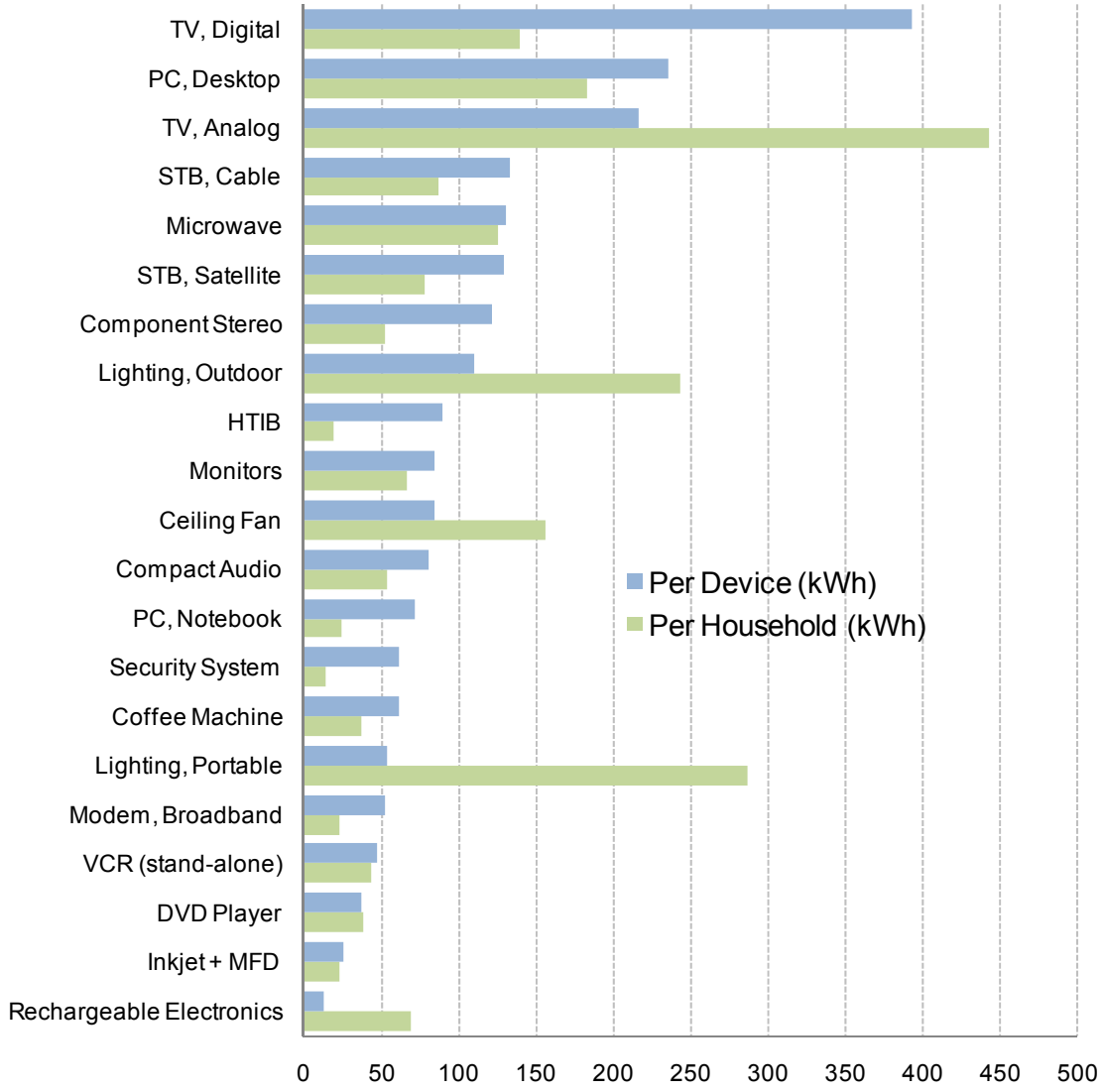
The study focuses on eight electronics products:

- Set-top boxes
- Servers
- Game consoles
- Imaging equipment
- Home audio receivers
- "Smart" power strips and surge protectors
- Uninterruptible power supplies
- External power supplies

TVs, PCs, and displays were excluded from the study because similar research was being undertaken by other utilities. A brief summary of available data and a resource list is included for these products at the beginning of *Chapter 3: Product Characterizations*.

The products selected for this study were identified as having potential for inclusion in the BCE program because of their high per-unit energy use, high penetration rate, and/or potential for energy savings. Figure 1.1 shows the average annual energy consumption of key plug load devices in 2006, the most recent year for which such comparative data is available.

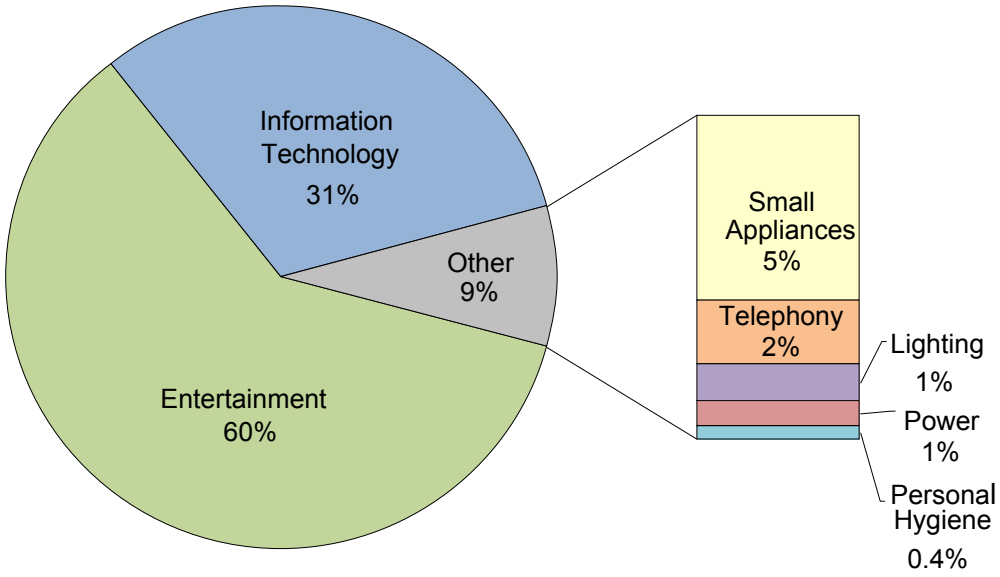
Figure 1.1: Average Annual Energy Consumption of Key Plug Load Devices, 2006



Data from: Roth et al. *Residential Miscellaneous Electric Loads*

All of the devices listed in Figure 1.1 are either included in the 2010-2012 BCE program or in this study, with the exception of kitchen appliances, lighting, ceiling fans, and modems. These devices were excluded because the decision was made to focus on plug load devices in the information technology and entertainment categories, which have been found to constitute more than 90% of the typical residential plug load, as shown in Figure 1.2.

Figure 1.2: Average Share of Plug Load Energy Use by Product Category



Data from: Foster Porter, *Final Field Research Report*

For each selected product, the study describes:

- Market characteristics and trends
- The supply chain and key market players
- Relevant energy efficiency standards in the U.S. and internationally
- Estimates of penetration of energy-efficient products
- Manufacturers' attitudes towards energy efficiency, how they prioritize it relative to other product features, and factors influencing these decisions
- Marketing approaches to energy-efficient versus standard products
- Barriers and opportunities specific to the market

The findings are based on a review of secondary literature and in-depth telephone interviews with 54 energy efficiency and utility program staff, manufacturers, and industry trade organizations. A detailed explanation of the study methodology, including interview questions, is found in *Appendices B, C,* and *D*.

Although this study was designed to address the specific needs of one utility, data was collected at a national level and therefore will likely be useful to other utilities and policymakers.

REPORT CONTENTS

The main body of the report contains the following sections:

- Section 2 summarizes key findings and program implications for the electronics market generally and each product individually.
- Section 3 presents detailed characterizations of the market for each product.

Appendices offer further details:

- Appendix A: List of Acronyms
- Appendix B: Methodology
- Appendix C: Interview Guide – Energy Efficiency Program Staff
- Appendix D: Interview Guide – Manufacturers and Trade Organizations
- Appendix E: Four Energy Use Studies
- Appendix F: Set-Top Boxes
- Appendix G: Servers
- Appendix H: Video Game Consoles
- Appendix I: Imaging Equipment
- Appendix J: Home Audio Equipment
- Appendix K: “Smart” Power Strips and Surge Protectors
- Appendix L: External Power Supplies

2 KEY FINDINGS & IMPLICATIONS FOR PROGRAM DESIGN

Electronics are different from other products with which the energy efficiency industry is familiar. Their great variety – in technologies, manufacturers, distribution methods, and intervention points – makes them unsuitable for a one-size-fits-all program design. Unlike the approach often taken with building energy efficiency measures, for example, this research suggests it will not be prudent to design one overarching electronics program and add device types to it.

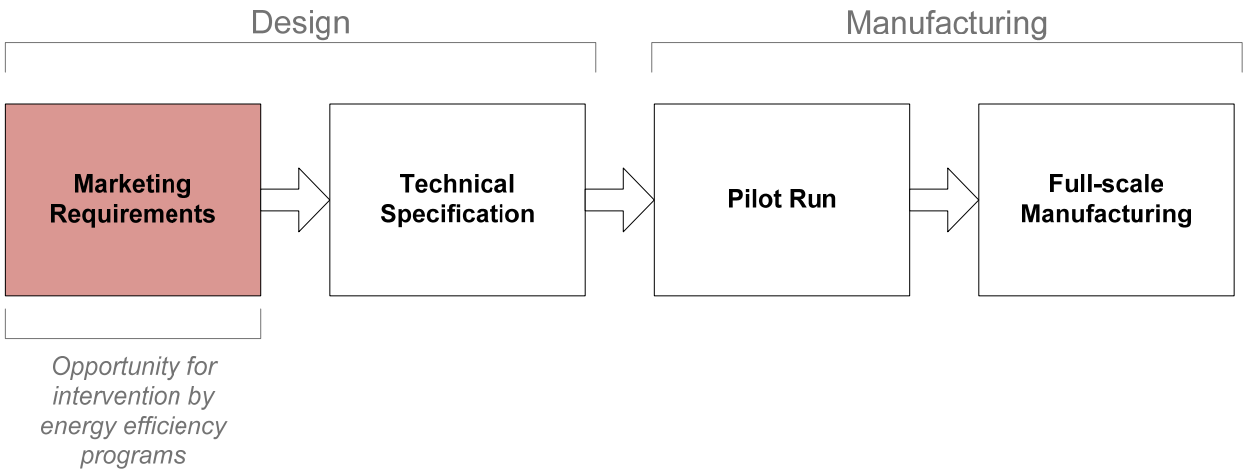
Nonetheless, this research produced key findings that hold true across the eight products studied, and likely many others as well. These are summarized below, followed by potential implications for program design.

PRODUCT DEVELOPMENT PROCESS

Process

Most products follow a similar development process, although the terminology used among individual manufacturers may differ. The two stages in the development process are *design* and *manufacturing*. Figure 2.1 provides a diagram of the product development process.

Figure 2.1: The Product Development Process



Product development begins with design, in which the product's marketing requirements (capabilities, features, cost) are defined. All elements of the product development process flow from this document and there are several potential inputs to it. It is important to note that

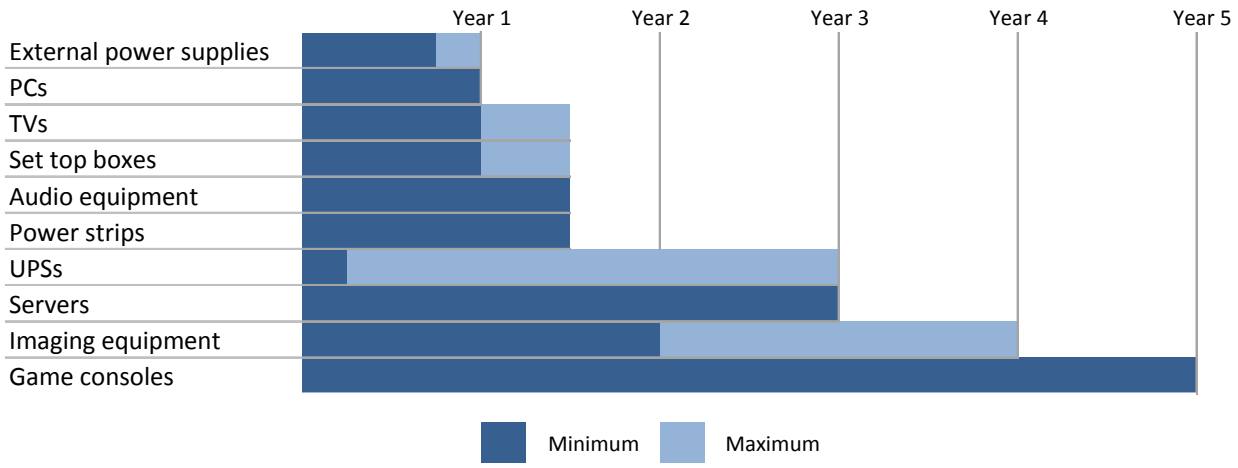
decisions made at this point are difficult to change later and thus it is here that market transformation programs have the opportunity to intervene in support of energy efficiency (see Figure 2.3), although the window of opportunity may be short. Next, a more detailed technical or engineering specification is produced, based on the marketing requirements. This document is used to guide the manufacturing process.

Often a pilot run of products are manufactured before manufacturing begins on a large scale. The pilot products may be evaluated by the manufacturer or its customers, and a third-party certification is required for some products. Product manufacturing occurs both in facilities owned by the manufacturers and in contracted facilities – which may be located in the U.S., Latin America, Western Europe, and Asia – with the majority of products manufactured in China and Taiwan. Most manufacturing is really "assembly," with components purchased from suppliers. Very few manufacturers maintain a vertically integrated supply chain.

Development Timelines

The amount of time manufacturers require to design and manufacture a product varies from less than one year to five years. Figure 2.2 shows development timelines for the product types studied here.

Figure 2.2: Product Development Timelines



Note: Displays are not included because data were unavailable.

Development time is determined in large part by the complexity of the product and whether it is an incremental change on an existing product or an entirely new product. External power supplies and PCs are the quickest to market, typically taking one year or less to move from concept to the sales floor. On the opposite end of the spectrum, imaging equipment and game

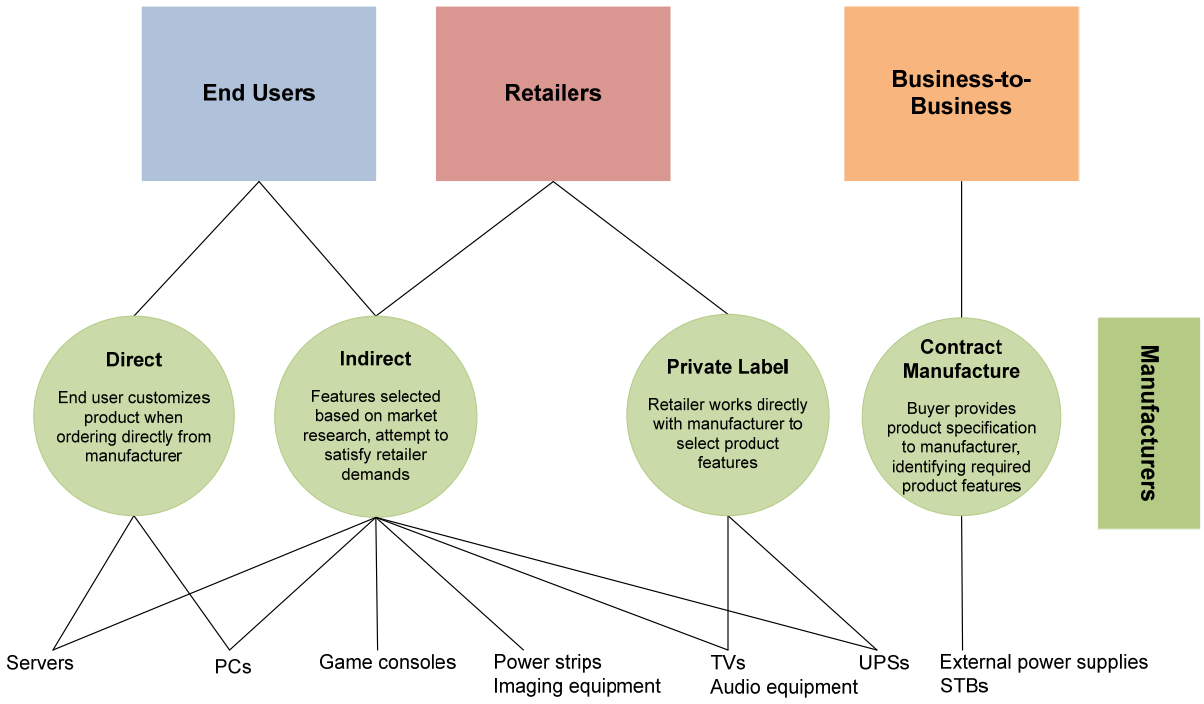
consoles have the longest development cycle at four to five years. The majority of products fall somewhere in between, with development times of one-and-one-half to three years.

Product development cycles represent both a barrier and an opportunity for market transformation efforts. Efficiency improvements resulting from program interventions can be realized quickly in products with shorter turnaround times. But in products with development times over two years, program impacts on product design may not be observable by the end of a three-year program cycle.

Inputs to Product Design

All manufacturers interviewed design their products in-house, sometimes with the assistance of suppliers or consultants. Most noted they design products based on their identification of market needs. "We sell what the consumer wants" was a commonly voiced sentiment. "The consumer" may include end-users (both individuals and businesses), private-label customers (businesses that purchase the product and sell it under their own brand, rather than that of the manufacturer), retailers, and business-to-business customers (businesses that bundle the product with others before selling it to an end-user). Programs should consider tactics applicable each group. Figure 2.3 diagrams these inputs to the product design process and the products to which they apply.

Figure 2.3: Inputs to the Product Design Process



Note: Displays are not included, because data were unavailable.

Individual and business end-users affect product design, both directly (when they purchase customized products) and indirectly (through the manufacturer's market research assessment of their demands).

Private label and business-to-business customers work closely with the manufacturer to determine the product specifications and may often be equal partners in the design process. Private labeling, a common practice in the food industry, is on the rise in consumer electronics. Retailers prefer to keep details about their private label practices confidential, so hard numbers are hard to find, but these products were estimated to account for upwards of 20% of all consumer electronics sales in 2000.[11] Best Buy, Target, and Wal-Mart all sell private-label electronics.

Business-to-business customers are the primary markets for set-top boxes (STBs) and external power supplies. Pay-TV service providers purchase STBs and sell or rent them to subscribers. Manufacturers of all types of electronics purchase external power supplies and bundle them with the principal product (for example, a mobile phone).

Among the 15 interviewees whose products are sold primarily at retail, seven mentioned the effect of retailers on the product design process. All but one believed retailers do affect product design, primarily by demanding low-priced products.

- Six manufacturers (of home audio products, imaging equipment, PCs, power strips, and TVs) noted their companies need to produce products that retailers will stock and sell, and identified cost and/or features as the determining factors. Some believed the higher cost of energy-efficient products servers as a barrier to retailers stocking them. One noted that some retailers may require specific "green" features and gave Wal-Mart as an example.
- A manufacturer of uninterruptible power supplies (UPSs) stated retailers have little influence over the company's own products, but are very involved in designing private label products.

Ascendant Products

Sales of some products are growing more quickly than others. In 9 of the 11 product types in this study (including TVs, PCs and displays), at least one product grew, or showed potential for growth, at a rate that set it apart from the rest. Programs may want to pay attention to these "ascendant products," as they will likely represent an increasing share of the market in coming years. Table 2.1 summarizes these ascendant products.

[11] Bill Roberts. (January 24, 2007). "A Peek At Private Label Consumer Electronics Trends." *Electronic News*. Retrieved from *http://www.edn.com/article/CA6409673.html.*

Table 2.1: Ascendant Products, by Type

PRODUCT TYPE	ASCENDANT PRODUCT(S)	NOTE(S)
Set-Top Boxes	• High Definition (HD) STBs • Digital Video Recorder (DVR) STBs	• By 2010, as much as 30% of all STBs shipped will decode HD signals. • DVR-equipped STBs are currently one-third of all STB shipments.
Servers	Blade Servers	• Shipments of blade servers are expected to reach 2.4 million units by 2011, compared to 620,000 units shipped in 2006. • Server consolidation, virtualization, and power savings are contributing to the increase in blade server sales.
Game Consoles	None	
Imaging Equipment	Multi-Function Devices (MFDs)	• In Q1 2009, color laser MFD shipments grew 6% over the previous year while, overall, imaging equipment shipments shrank by 18%. • In Q1 2009, MFDs made up 62% of total shipments of imaging equipment.
Home Audio Equipment	MP3 Player Docks	• Unit sales of products with MP3 player docks increased 35% in 2008. • Almost one-third of all home theater in a box (HTIB) systems sold in 2008 included MP3 player docks.
"Smart" Power Strips	None	
Uninterruptible Power Supplies	Fiber-to-the-Home Installations	• Fiber-to-the-home service providers must install a UPS in each subscriber's home to maintain telephone service during a power outage. Fiber-to-the-home service is growing at a rate of approximately 1.5 million homes per year.
External Power Supplies	Universal Adapters	• Two organizations – GSMA in Europe and the Alliance for Universal Power Supplies in the U.S. – are working to develop standards allowing external power supplies to be used with multiple devices.
TVs	Liquid Crystal Display (LCD)	• In Q1 2009, LCD TV shipments rose 23% over their level in Q1 2008, while plasma TV shipments fell by 5% over the same period.
PCs	• Laptops • Netbooks • Integrated Computers	• Low-priced laptops are leading growth in the U.S. PC market. • Increasing numbers of manufacturers are producing all-in-one desktop computers following the model of Apple's iMac.
Displays	LCD displays	• CRT (cathode ray tube) displays (the most common alternative to LCDs) are expected to decline at a rate of 27% annually through 2010, while shipments of LCD displays are expected to increase.

Sources:

STBs: ABI Research. (June 3, 2009). High-Definition set-top boxes to account for nearly one-third of total STB shipments next year. Press Release. Retrieved from *http://www.abiresearch.com/press/1434-High-Definition+Set-Top+Boxes+to+Account+for+Nearly+One+Third+of+Total+STB+Shipments+Next+Year*. Dell'Oro Group. (June 8, 2009).

DVR-equipped set-top box shipments contract 20 percent year-over-year in the first quarter. Press Release. Retrieved from *http://www.delloro.com/news/2009/STB060809.htm*.

Servers: Joseph P. Kovar. (November 8, 2007). Blade server sales to explode – report. ChannelWeb. Retrieved from *http://www.crn.com/hardware/202804076;jsessionid=YBSOVJ3VWTMQAQSNDLPSKH0CJUNN2JVN*.

Imaging equipment: IDC. (June 2, 2009). In the midst of a challenging global economy, color MFP remains the worldwide hardcopy market's bright spot. Retrieved from *http://www.reuters.com/article/pressRelease/idUS101686+02-Jun-2009+BW20090602*.

Home audio equipment: Joseph Palenchar. (December 2, 2008). Economy Hits Audio Hard: NPD. TWICE. Retrieved from *http://www.twice.com/article/236347-Economy_Hits_Audio_Hard_NPD.php*.

UPSs: FTTH Council. (April 7, 2009). All-Fiber Networks Now Reach 4.4 Million Homes as North American FTTH Deployment Continues. Press Release. Retrieved from *http://www.ftthcouncil.org/en/newsroom/2009/04/07/all-fiber-networks-now-reach-44-million-homes-as-north-american-ftth-deployment-*.

External power supplies: Information on GSMA efforts available at: *http://www.gsmworld.com/our-work/mobile_planet/universal_charging_solution.htm*. Information on Alliance for Universal Power Supplies efforts available at: *http://www.allianceforuniversalpower.org/home.php*.

TVs: Greg Tarr. (May 18, 2009). Rising Q1 LCD TV Sales Push Vizio to the Top. TWICE. Retrieved from *http://www.twice.com/article/245613-Rising_Q1_LCD_TV_Sales_Push_Vizio_To_The_Top.php?q=television*.

PCs: IDC. (April 14, 2009). HP Takes the Lead in U.S. PC Market as Consumer Shipments Beat Expectations, According to IDC. Press Release. Retrieved from *http://www.idc.com/getdoc.jsp?containerId=prUS21797609*. Stephen Wildstrom. (June 23, 2009). Touch Gives Desktop PCs new Life. *Business Week*. Retrieved from *http://www.businessweek.com/magazine/content/09_27/b4138000420444.htm?chan=technology_tech+maven+page+-+new_this+week's+column*.

Displays: Rajani Baburajan. (November 7, 2008). Worldwide Computer Monitor Sales to Exceed 210 Million Units by 2012. TMCNet. Retrieved from *http://it.tmcnet.com/topics/it/articles/44839-worldwide-computer-monitor-sales-exceed-210-million-units.htm*.

MANUFACTURERS

Market Share

Although there are thousands of manufacturers in the electronics arena, a relatively small number dominate most product types, often accounting for upwards of 80% of total sales. Precise market-share information is hard to obtain, as most manufacturers consider it confidential.

For energy efficiency programs, consolidated markets offer some distinct advantages: there are fewer manufacturers to target; much of the market can be reached by working with even one manufacturer; and gaining the participation of a single manufacturer may lead others to join, given the highly competitive nature of this space.

Table 2.2 shows, for each product type, the combined market share of the top 10 manufacturers, the number of manufacturers comprising 80% of the market, or both, depending on what data were available.

Table 2.2: Market Share of Top Manufacturers, by Product Type

PRODUCT TYPE	MARKET SHARE OF TOP 10 MANUFACTURERS	NUMBER OF MANUFACTURERS WITH 80% MARKET SHARE
Servers	—	4
Game consoles	100%	3
Displays	86%	—
Home Audio	60%	—
Amplifiers	95%	—
Shelf Systems	88%	5
Imaging equipment (MFDs)	100%	5
PCs		
Desktops	99%	—
Notebooks	99%	—
TVs	93%	—
UPSs (<20 kVA)	82%	9

Note: Set-top boxes, power strips, and external power supplies are not included because data were unavailable.

Key Players

Among the 93 manufacturers mentioned in this report, 40 make more than one of the products studied. It is most common for manufacturers to produce multiple products in a single category (home entertainment, office equipment, or power supplies), but there is significant overlap between manufacturers of home entertainment and office electronics, driven largely by manufacturers who produce both TVs and displays. Energy efficiency programs may thus find that building a relationship with a single manufacturer allows them to target multiple product types. For example, nine manufacturers (Dell, HP, LG, Panasonic, Philips, Samsung, Sharp, Sony, and Toshiba) make four or five of the products covered in this study.

Figure 2.4 shows the 40 key players and the product categories in which they are active.

Figure 2.4: Manufacturers of Multiple Products, by Category

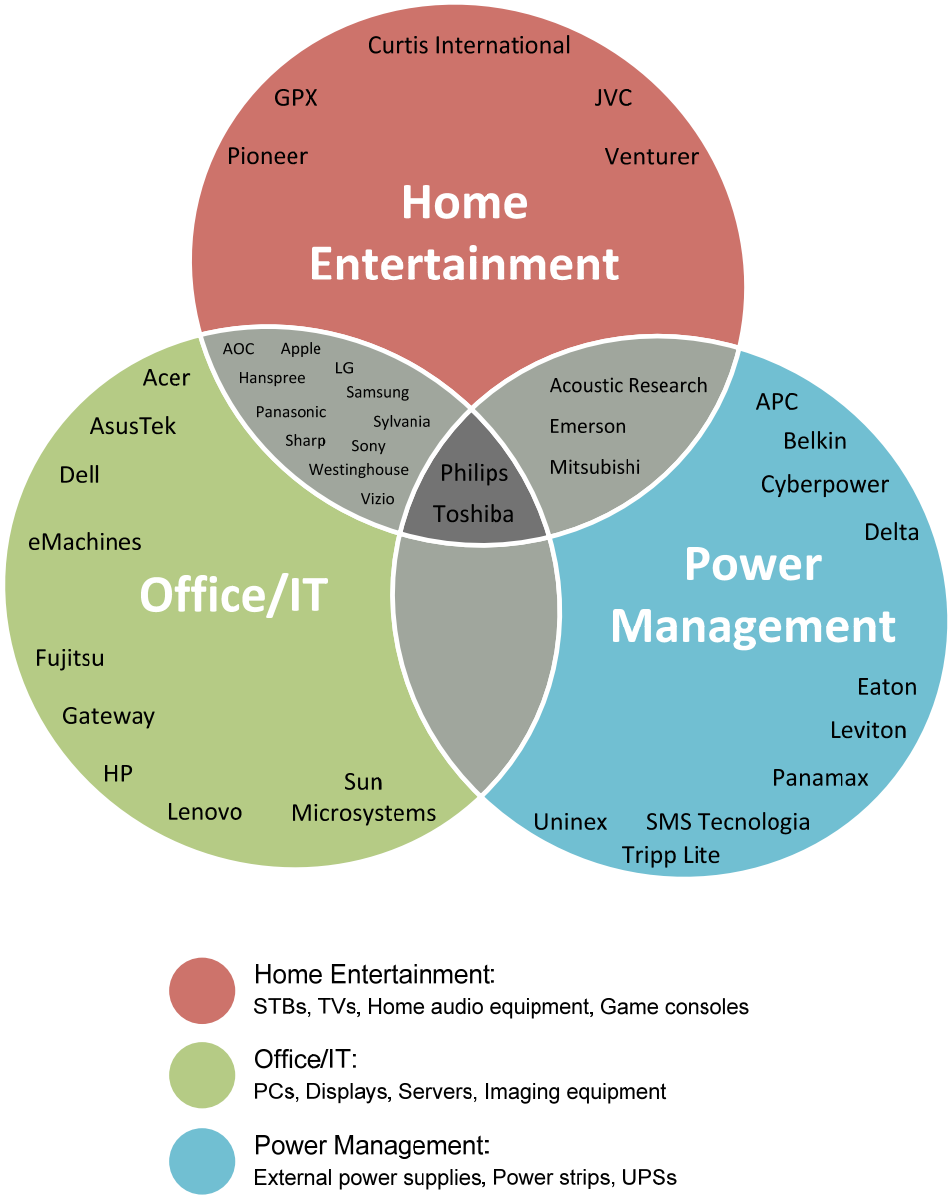


Table 2.3 provides a detailed breakdown of each manufacturer's product types and market share rank, when available. In this table, an "X" indicates the manufacture of a specific product type for which market share rank was unavailable.

Table 2.3: Manufacturers of Multiple Products, by Type and Market Share Rank

MANUFACTURER	HOME ENTERTAINMENT				OFFICE ELECTRONICS				POWER MANAGEMENT			NUMBER OF PRODUCTS
	TVs	Set-top Boxes	Home Audio	Game Consoles	Displays	PCs	Servers	Imaging Equipment	Power Strips	UPSs	External Power Supplies	
Acer					2	7	X					3
Acoustic Research			X						X			2
AOC	X				X	X						3
APC									X	1		2
Apple		X			9	1						3
AsusTek					X	10	X					3
Belkin									1	8		2
Curtis International	X		X									2
CyberPower Systems									X	6		2
Dell					4	3	3	X				4
Delta Electronics										X	X	2
Eaton									X	X		2
eMachines					X	6						2
Emerson			7							9	X	3
Fujitsu						X	X	X				3
Gateway					X	4						2
GPX	X		X									2
Hannspree	X				X	X						3
HP					1	2	2	1				4
JVC	X		X									2
Lenovo					X	9	X					3
Leviton									X	X		2
LG	4	X	9		5							4
Mitsubishi	8									9		2
Panamax									X	X		2
Panasonic	3	X	X			X		X				5
Philips	X		10		X				3			4

Continued

MANUFACTURER	HOME ENTERTAINMENT				OFFICE ELECTRONICS				POWER MANAGEMENT			NUMBER OF PRODUCTS
	TVs	Set-top Boxes	Home Audio	Game Consoles	Displays	PCs	Servers	Imaging Equipment	Power Strips	UPSs	External Power Supplies	
Pioneer	10	X	X									3
Samsung	1		X		3			X				4
Sharp	5		X		X	X		X				5
SMS Tecnologia									X	X		2
Sony	2	X	1	2		8						5
Sun Microsystems						X	X					2
Sylvania	X				X	X						3
Toshiba	6					5		X		5		4
Tripp Lite									2	4		2
Uninex									X		X	2
Venturer	X		X									2
Vizio	X		X		X							3
Westinghouse	X				X							2

Note: Numbers indicate market share rank for the relevant product type; "X" indicates manufacture of the product, but unknown rank.

Sources:

TVs, PCs, Home Audio, Displays: TWICE. (July 6, 2009). Market Share Reports By Category. TWICE. Retrieved from: *http://www.twice.com/article/307509-Market_Share_Reports_By_Category.php*. Notes: ranks are for Q1 2009, audio rankings are for shelf systems, PC rankings are for desktop computers, TVs and monitors are totals for product type.

Servers: Larry Dignan. (February 24, 2009). IDC: Server sales tank globally; IBM still leader of the pack IDC. Posted to *http://blogs.zdnet.com/BTL/?p=13412*. Note: ranks are for Q4 2008.

Game Consoles: for source see Table 3.11 below.

Imaging Equipment: IDC. (June 2, 2009). In the midst of a challenging global economy, color MFP remains the worldwide hardcopy market's bright spot. Retrieved from *http://www.reuters.com/article/pressRelease/idUS101686+02-Jun-2009+BW20090602.* Note: ranks for all product types for Q1 2009.

Power Strips: Brian Greenberg. (July, 2008). 2008 Power Protection Market Intelligence Program: Plug-In and Hard-Wired Powerline Surge Suppressors. VDC Research Group. Retrieved from: *http://www.vdcresearch.com/PurchasedDownloadFile.asp?type=executivebrief&id=2221*. Note: ranks for 2008.

UPSs: Brian Greenberg. (August, 2008). *2008 Power Protection Global Market Demand Analysis Market Intelligence Program: Volume 1: UPS 20 KVA and Under, Americas*. VDC Research Group. Note: ranks for 2008.

DISTRIBUTION CHANNELS

The electronics products in this study reach end-users through four primary distribution channels: retailers; dealers/value-added resellers (VARs); direct from the manufacturer; or from a cable, satellite, or telecom service provider.

Table 2.4 shows which products are distributed through each channel. The importance of each channel to a particular product type is discussed in the relevant chapter.

Table 2.4: End-User Distribution Channels, by Product

PRODUCT TYPE	RETAILERS		DEALERS/ VARS	DIRECT FROM MANU-FACTURER	SERVICE PROVIDERS		OTHER
	BRICK AND MORTAR	ONLINE			TELECOM	CABLE/ SATELLITE	
Set-Top Boxes					X	X	
Servers			X	X			
Game Consoles	X	X		X			
Imaging Equipment	X	X	X	X			
Home Audio Equipment	X	X	X	X			
Power Strips	X	X	X	X			
Uninterruptible Power Supplies	X	X	X	X	X		
External Power Supplies							With purchase of another, primary product
TVs	X	X		X			
PCs	X	X	X	X			
Displays	X	X	X	X			
Number of Product Types Moved Through Each Channel	**5**	**5**	**7**	**9**	**2**	**1**	**1**

While consumer electronics are sold through multiple channels, including retailers, other products are not typically obtained through this channel. Set-top boxes, for example, are obtained from cable or satellite service providers and servers are most often purchased from dealers/VARs or direct from the manufacturer.

Dealers/VARs distribute imaging and IT equipment, primarily to business customers, and may be effective partners for energy efficiency programs because they often act as consultants, assisting customers in making purchasing decisions.

Top Retailers

Best Buy, Wal-Mart, and Target are often considered to be key electronics retailers: Best Buy because it is the largest, and Target and Wal-Mart because they straddle both the electronics and mass-market categories. Circuit City, the number three electronics retailer in 2007, declared bankruptcy in early 2009. Its brand name was purchased by Systemax, Inc. and it currently operates as an online-only retailer. It is unclear how the new Circuit City ranks among the other major retailers. Table 2.5 shows top mass-market and consumer electronics retailers, ranked by sales volume.

Table 2.5: Top Consumer Electronics and Mass Market Retailers

RANK	TOP 10 CONSUMER ELECTRONICS RETAILERS (2007)	TOP 10 MASS-MARKET RETAILERS
1	**Best Buy**	**Wal-Mart**
2	**Wal-Mart**	Kroger
3	Circuit City*	CostCo
4	Dell	**Target**
5	**Target**	Walgreens
6	Costco	Albertsons
7	GameStop	Safeway
8	Apple Retail Stores	CVS
9	RadioShack	Ahold USA
10	Sears	Loblaws

Sources: Top CE retailers from Dave Taylor (June 2, 2008). Top twenty consumer electronics retailers of 2007. Posted to *http://www.intuitive.com/blog/top_twenty_consumer_electronics_retailers_of_2007_1.html*. Top mass market retailers from *Mass Market Retailers*. Website. Retrieved July 27, 2009 from *http://www.massmarketretailers.com/*. Detailed reports on the top CE retailers are available annually for purchase from TWICE: *http://www.twice.com/article/250004-TWICE_Online_Store.php*.

* Circuit City declared bankruptcy and liquidated its stores in 2009. As of 2010 the brand is owned by Systemax and operates as an online-only retailer

MARKETING

Key Features

Energy efficiency does not appear to play a leading role (or even any role at all) in the marketing and sale of most consumer electronics. It is, however, an important feature for products typically used in business environments. Table 2.6 shows key features noted by manufacturers, by product.

Table 2.6: Key Features, by Product

PRODUCT TYPE	KEY FEATURES
CONSUMER PRODUCTS	
Game Consoles	• User experience • Performance
Home Audio Equipment	• Cost • Compatibility/connectivity with accessories like TV or DVD player • HDMI or Blue-Ray ready • Ease of use
Power Strips	• Number of outlets • Surge protection capability (number of joules) • Warranty • Cord length • Size
Uninterruptible Power Supplies (<5 kVA)	• Cost • Run time • Availability
BUSINESS PRODUCTS	
Servers	• Reliability • Performance • Flexibility/customization • **Energy efficiency** • Low total cost of ownership
Uninterruptible Power Supplies (<5 kVA)	• Redundancy • Reliability • Flexibility / scalability • **Energy efficiency**
CONSUMER AND BUSINESS PRODUCT	
Imaging Equipment	• Quality • Reliability • Environmental attributes (including **energy efficiency**) • Total cost of ownership
BUSINESS TO BUSINESS PRODUCTS	
External Power Supplies	• Size • Cost • Low standby / no-load power consumption • **Energy efficiency**

Continued

PRODUCT TYPE	KEY FEATURES
BUSINESS TO BUSINESS PRODUCTS – CONT.	
Set-Top Boxes	• DVR • Cost • HD • Video-on-demand • Internet connectivity • Reliability • **Energy efficiency**

Note: PCs, TVs, and displays are not included because data were unavailable.

No manufacturers mentioned energy efficiency when asked an open-ended question about the key features they use to market consumer products. Manufacturers of office or IT electronics, however, do believe energy efficiency to be an important selling point for their products. This is consistent with manufacturers' assessment that businesses, government, and institutional customers factor environmental or sustainability concerns into their purchasing decisions more often than individual consumers. This suggests that raising awareness of the value of energy efficiency will be more important among individual consumers than business purchasers, and that the latter may be better supported with efforts to assist them in purchasing more efficient products, something many already acknowledge as a priority.

Marketing Mediums

Marketing mediums vary by product type and include mass media, personalized communication, tradeshows/events, and point-of-sale materials. Table 2.7 lists mediums identified by interviewees when asked an open-ended question about how they promote their products. Multiple mediums are employed for all but one of the products studied and no two employ exactly the same "bundle." Tradeshows/events and print advertisements were the most commonly mentioned mediums, followed by the manufacturer's website, one-on-one sales discussions, mailings, and product packaging. Programs will thus need to consider the ways in which each product is marketed when designing its outreach strategy.

Table 2.7: Marketing Mediums Identified by Interviewees, by Product Type

PRODUCT TYPE	MASS MEDIA						PERSONALIZED COMMUNICATION				TRADESHOWS / EVENTS	POINT-OF-SALE	
	TV	RADIO	PRINT	ONLINE ADS	MANUFACTURER'S WEBSITE	PRODUCT SPECIFIC MAGAZINE	ONE-ON-ONE SALES	WORD-OF-MOUTH	MAIL	E-MAIL		IN-STORE DISPLAYS	PRODUCT PACKAGING
Set-Top Boxes							x						
Servers			x					x	x	x	x		
Game Consoles	x	x	x	x					x	x	x		
Imaging Equipment					x						x		
Home Audio Equipment				x		x						x	x
"Smart" Power Strips			x								x	x	x
Uninterruptible Power Supplies			x		x		x		x		x		x
External Power Supplies			x		x		x				x		
Total Number of Product Types Using Each Medium	**1**	**1**	**5**	**2**	**3**	**1**	**3**	**1**	**3**	**2**	**6**	**2**	**3**

Note: This chart shows only marketing mediums named by interview subjects. Manufacturers may engage in activities in addition to those listed. TVs, PCs, and displays are not included because data were unavailable.

ENERGY EFFICIENCY LABELS

ENERGY STAR

ENERGY STAR is the predominant energy efficiency label in the U.S. and is widely used abroad. Among the products covered by this study, ENERGY STAR specifications apply to all but UPSs and "smart" power strips.

Applicable ENERGY STAR Specifications

Table 2.8 provides details on applicable ENERGY STAR specifications.

Table 2.8: ENERGY STAR Specifications for Selected Products

PRODUCT	CURRENT SPECIFICATION	EFFECTIVE DATE	UNDER REVISION (Expected Revision Date)	MARKET PENETRATION OF QUALIFIED PRODUCTS (YEAR)	ENERGY STAR PARTNER DATA (DATE)		NOTE
					QUALIFIED PRODUCTS	MANUFACTURERS	
Set-Top Boxes	Version 2.0, Tier 1	January 1, 2009	Yes (January 1, 2011)	None available	**CABLE (JUNE 29, 2009)**		
					4	3	
					SATELLITE (JUNE 29, 2009)		
					12	1	
					IPTV (JUNE 29, 2009)		
					8	2	
Servers	Version 1.0, Tier 1	May 15, 2009	Yes (2010)	None available	4 (June 1, 2009)	1 (June 1, 2009)	
Game Consoles	None	N/A	Yes (July 1, 2010)	N/A	N/A	N/A	Game consoles will be incorporated into the current computer specification.
Imaging Equipment	Version 1.1	July 1, 2009	No	26% (2008)	**COPIERS (JULY 13, 2009)**		Penetration data reflects products meeting the specification when it was announced. Penetration will likely increase over time.
					110	9	
					MFDS (JULY 13, 2009)		
					721	22	
					PRINTERS (JULY 13, 2009)		
					486	20	
					SCANNERS (JULY 13, 2009)		
					136	12	

Continued

PRODUCT	CURRENT SPECIFICATION	EFFECTIVE DATE	UNDER REVISION (Expected Revision Date)	MARKET PENETRATION OF QUALIFIED PRODUCTS (YEAR)	ENERGY STAR PARTNER DATA (DATE)		NOTE
					QUALIFIED PRODUCTS	MANUFACTURERS	
Home Audio Equipment	Version 1.0, Phase II	January 1, 2003	Yes (May, 2010)	36% (2007)	**RECEIVERS (JULY 15, 2009)**		Component systems listed as "Rack Systems," Shelf systems listed as "Mini/Midi systems"
					222	11	
					COMPONENT SYSTEMS (JULY 15, 2009)		
					3	2	
					SHELF SYSTEMS: (JULY 15, 2009)		
					161	7	
Power Strips	None	N/A	N/A	N/A	N/A	N/A	
Uninterruptible Power Supplies	None	N/A	N/A	N/A	N/A	N/A	
External Power Supplies	Version 2.0	January 1, 2009	No	56% (2007)	**AC-AC (JULY 15, 2009)**		
					48	9	
					AC-DC (JULY 15, 2009)		
					2,437	120	
TVs	Version 3.0, Tier 1	November 1, 2008	Yes (Version 4.0: May 1, 2010) (Version 5.0: May 1, 2012)	53% (2007)	**LCD (AUGUST 2, 2009)**		Partner data reflects component television units, televisions, television monitors, and TV/DVD combination units combined. CRT listed as "Standard"
					906	29	
					PLASMA (AUGUST 2, 2009)		
					176	7	
					CRT (AUGUST 2, 2009)		
					2	2	

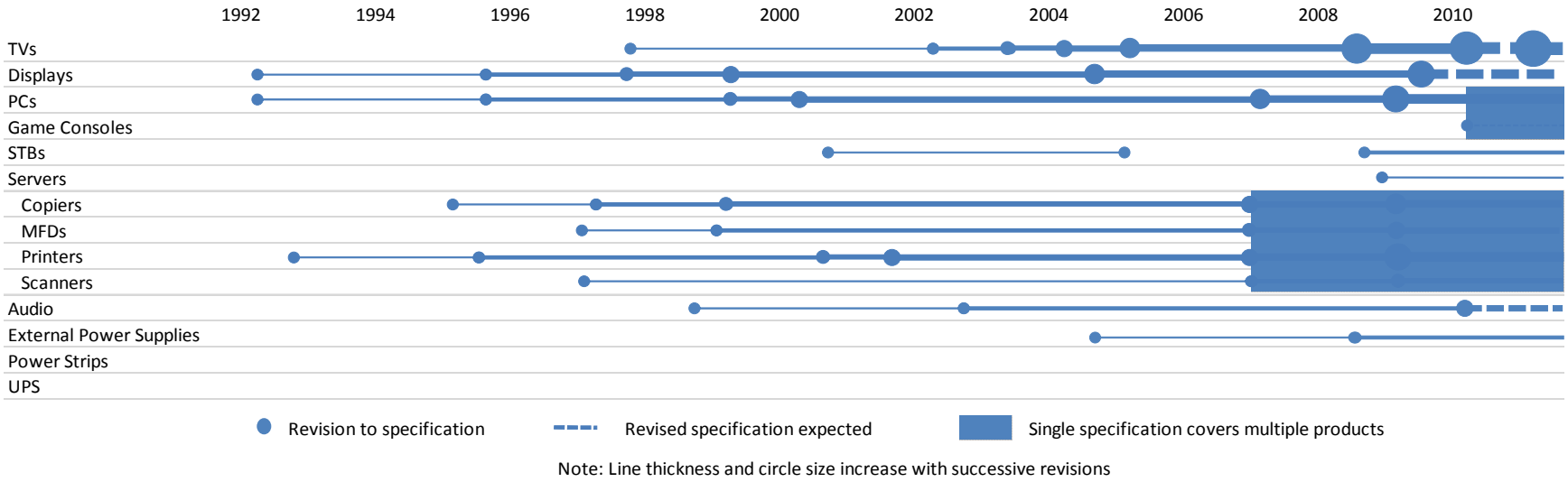
Continued

PRODUCT	CURRENT SPECIFICATION	EFFECTIVE DATE	UNDER REVISION (Expected Revision Date)	MARKET PENETRATION OF QUALIFIED PRODUCTS (YEAR)	ENERGY STAR PARTNER DATA (DATE)		NOTE
					QUALIFIED PRODUCTS	MANUFACTURERS	
PCs	Version 5.0	July 1, 2009	No	N/A	**DESKTOP (JULY 28, 2009)**		Partner data is for products designed for 115 V power.
					124	14	
					INTEGRATED COMPUTER (JULY 28, 2009)		
					26	7	
					LAPTOP (JULY 28, 2009)		
					552	17	
Displays	Version 4.1	January 1, 2005	Yes (Version 5.0 Tier 1: October 30, 2009. Tier 2: October 30, 2010)	CRT: 11% LCD: 95% (2007)	**CRT (AUGUST 2, 2009)**		Effective date listed for Version 5.0, Tier 1 specification applies to displays with diagonal screen size <30 inches. Effective date for displays with diagonal screen size 30-60 inches is January 30, 2010.
					4	2	
					LCD (AUGUST 2, 2009)		
					2491	42	

Timeline of Revisions to ENERGY STAR Specifications

ENERGY STAR specifications for some products have been revised more often, or more times in total, than others. The TV, display, PC, and printer specifications have been revised most often, and were also some of the first products to be covered by ENERGY STAR. The newest specifications are for game consoles, set-top boxes, and servers. Building and maintaining close relationships with ENERGY STAR program managers will allow programs to stay informed about specification developments. Figure 2.5 shows when revisions have occurred for each product, from the founding of ENERGY STAR in 1992 to revisions expected to occur in 2011.

Figure 2.5: Revisions to ENERGY STAR Specifications, by Product Type, 1992-2011



Note: Line thickness and circle size increase with successive revisions

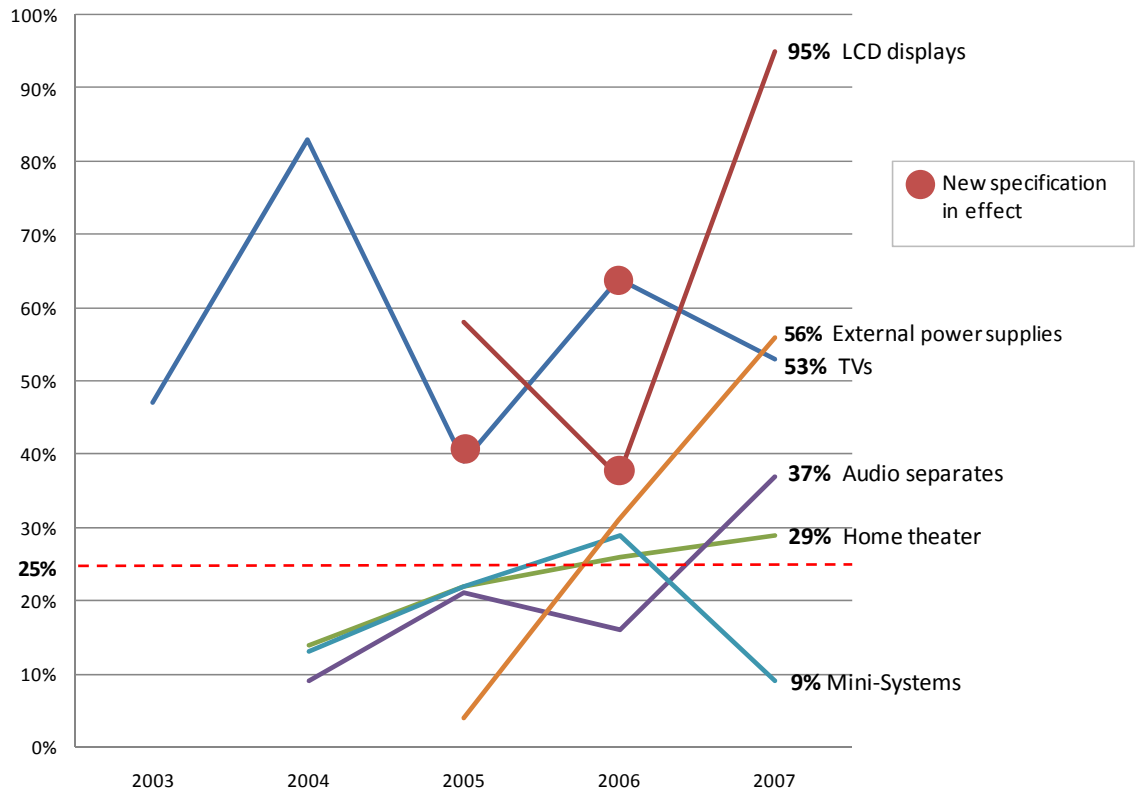
Penetration of ENERGY STAR-Qualified Products

Penetration of ENERGY STAR-qualified products varies considerably. In 2007, nearly all LCD monitors shipped were ENERGY STAR. Just over half of all TVs and external power supplies were ENERGY STAR. The penetration of audio products was surprisingly low (9% for mini-systems, 29% for home theaters, and 37% for audio separates), considering the specification has been in effect about as long as TVs and nearly as long as displays, both of which have much higher penetration rates. Although ENERGY STAR aims to recognize the top 25% of products, penetration rates for five of the six products are above this level.

Programs may wish to use ENERGY STAR penetration rates to assist in determining the level of efficiency they are willing to incentivize. ENERGY STAR LCD displays, for example, would not appear to merit an incentive.

Figure 2.6 shows penetration rates for products for which data is available from 2003 to 2007.

Figure 2.6: Penetration of ENERGY STAR-Qualified Products, 2003-2007



Note: Game consoles, imaging equipment, PCs, servers, and set-top boxes are not included because data were unavailable.

The effective date of a revised specification is noted for TVs and LCD displays, the only two products for which revisions occurred during this time period. The effect of the revision is clear:

immediately upon its release, the percent of qualified products decreases, but a rebound occurs within one year. The figure also includes a reference line at 25%. ENERGY STAR seeks to recognize the highest-performing 25% of the market, although certain products have penetration rates that are considerably higher.[12]

Other Energy Efficiency Labels

Organizations in a variety of countries maintain energy efficiency labels relevant to this study. Table 2.9 provides information about international labels applicable to more than one product discussed here. Details about labeling requirements applicable to each product, as well as information on programs applicable to only one of the products included in this study, are included in the relevant chapter. Programs may want to stay informed about developments in these specifications to assist in setting energy efficiency targets and capturing lessons learned.

Table 2.9: International Energy Efficiency Standards

PROGRAM	GEOGRAPHIC AREA	DESCRIPTION	PRODUCTS COVERED
Blue Angel Program *www.blauer-engel.de/en/index.php*	Germany	Voluntary labeling system formed by environmental and consumer groups, unions, industry groups, and government. Standards focus on resources used during production, hazardous material content, and environmental impacts of product disposal, as well as energy efficiency.	• Displays • Imaging equipment • TVs
Canadian Standards Association *www.csa.ca/cm/home?language=English*	Canada	Coalition of business, government, and consumers that issues standards related to energy efficiency, as well as to public health and safety, and other environmental concerns.	• External power supplies • Set-top boxes • UPSs
European Commission Code of Conduct *re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative.htm*	Europe	A voluntary agreement between manufacturers, trade associations, and governments. Standards are motivated by a desire to eliminate standby power consumption, but may also set limits on power use in other operating modes.	• External power supplies • Game consoles • Home audio equipment • Set-top boxes • Servers • UPSs

Continued

[12] Christopher Kent. (May 7, 2008). ENERGY STAR Imaging Equipment Stakeholder Meeting: Draft 1 Version 1.1 Specification. U.S. EPA. PowerPoint Presentation. Retrieved from *http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/img_equip/EPA_Presentation.pdf.*

PROGRAM	GEOGRAPHIC AREA	DESCRIPTION	PRODUCTS COVERED
e-Standby Program *www.kemco.or.kr/web/kcms/main/kcms.asp?c=PAGEML000000739*	Korea	A labeling system focused on reducing standby power use to 1 W or less. It is currently voluntary, but is transitioning to a mandatory policy to take effect in 2010, when products failing to meet the standard will be required to carry a warning label.	• Displays • External power supplies • Home audio equipment • Imaging equipment • Set-top boxes • TVs
Minimum Energy Performance Standards (MEPS) *www.energyrating.gov.au/man1.html*	Australia, New Zealand	Mandatory energy efficiency standards for products sold in Australia and New Zealand. Standards are included in state government legislation and regulations.	• External power supplies • Game consoles • Home audio equipment • Set-top boxes
Nordic Swan *www.svanen.nu/Default.aspx?tabName=StartPage*	Norway, Sweden, Finland, Iceland, Denmark	A voluntary labeling system focused on environmental quality and health. Products must meet a variety of environmental criteria in addition to energy efficiency and certified product categories extend to soap and furniture.	• Imaging equipment • Home audio equipment
Top Runner	Japan	Mandatory energy efficiency standards based on the performance of the most energy-efficient product available at the time the standards are set.	• Imaging equipment • PCs • Servers • TVs

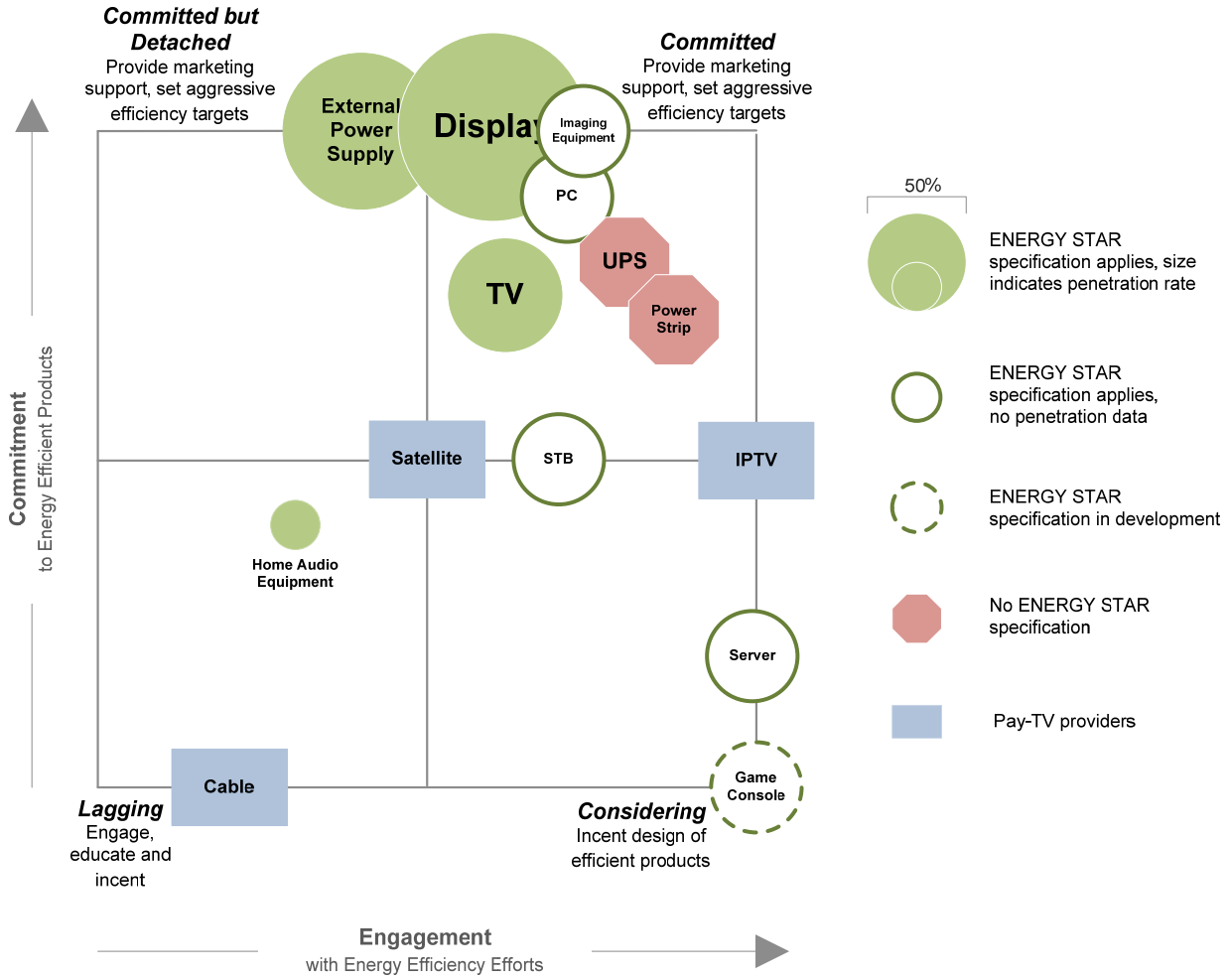
ENERGY-EFFICIENT PRODUCTS

Quadrant Analysis of Energy Efficiency Engagement and Commitment Among Top Manufacturers

Manufacturers vary in their level of engagement with energy efficiency efforts and implementation of energy efficiency in their products. Figure 2.7 is a quadrant analysis showing how the top manufacturers of each product type compare, as well as the penetration of ENERGY STAR products. The analysis suggests product types fall into one of four types, each of which may require its own approach to improving efficiency.

This assessment showed manufacturers of most product types to be *Committed* to energy efficiency because the majority of top manufacturers are both engaged in efficiency efforts and manufacture at least one efficient product (either an ENERGY STAR-qualified product or a product designated by the manufacturer as efficient). Programs may want to assist these manufacturers with marketing support and encourage them to meet increasingly aggressive energy efficiency targets.

Figure 2.7: Quadrant Analysis, by Product Type



Note: *Engagement* measured by percent of top manufacturers to participate in development of ENERGY STAR specifications or in non-ENERGY STAR energy efficiency efforts. *Commitment* measured by percent of top manufacturers to make at least one ENERGY STAR-qualified product or one self-identified energy-efficient product. ENERGY STAR penetration data for 2007.

Manufacturers in the set-top box, server, and game console markets appear to be *Considering* energy efficiency, but their implementation of efficient products is low. They may be well served by efforts to incent the design of efficient products.

Manufacturers of home audio products are clearly *Lagging*, with lower participation and implementation than the rest. They may need to be engaged in the energy efficiency effort, educated about its goals and values, and incented to design more efficient products.

It is interesting to note that all manufacturers of products in which ENERGY STAR specifications have been in effect for several years (displays, external power supplies, imaging

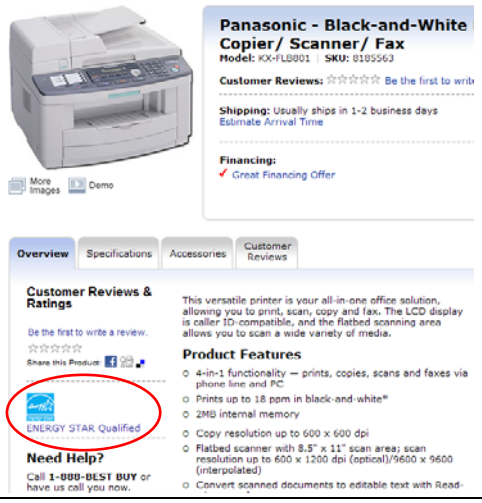
equipment, PCs, TVs) show a high level of implementation, except manufacturers of home audio equipment. Manufacturers of products with relatively new ENERGY STAR specifications (servers, set-top boxes) show high levels of engagement, but lower levels of implementation. The manufacturers of the two products without ENERGY STAR specifications (power strips and UPSs) show levels of engagement and implementation comparable to their ENERGY STAR-qualified counterparts. Finally, among pay-TV providers, it is clear that Internet protocol television (IPTV) providers lead and cable providers lag in the energy efficiency arena.

Buying Efficient Products Online

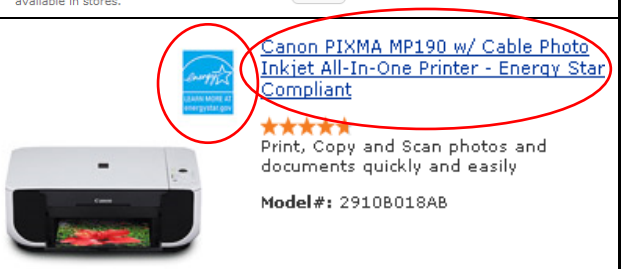
Identification of ENERGY STAR MFDs

The ease of identifying ENERGY STAR-qualified and/or energy-efficient products on retailer websites varies. Table 2.10 shows how ENERGY STAR multi-function devices are identified at three major retailers' websites.

Table 2.10: Means of Identifying ENERGY STAR Multi-Function Devices on Three Major Retailers' Websites

RETAILER	MEANS OF IDENTIFYING ENERGY STAR OR EFFICIENT PRODUCTS			SCREEN SHOTS
	ENERGY STAR NOTED ON CATALOG PAGE	ENERGY STAR LOGO ON PRODUCT DETAIL PAGE	REFERENCE TO ENERGY STAR IN TEXT	
Best Buy	X	X		

Continued

RETAILER	MEANS OF IDENTIFYING ENERGY STAR OR EFFICIENT PRODUCTS			SCREEN SHOTS
	ENERGY STAR NOTED ON CATALOG PAGE	ENERGY STAR LOGO ON PRODUCT DETAIL PAGE	REFERENCE TO ENERGY STAR IN TEXT	
Target				
Wal-Mart	X	X	X	

ENERGY STAR multi-function devices are easiest to identify at Wal-Mart and Best Buy, which note ENERGY STAR-qualified products on catalog pages using either the ENERGY STAR logo or colored text. Both retailers place the ENERGY STAR logo on product detail pages. Wal-Mart also includes “ENERGY STAR Compliant” in the product name. Target does not identify ENERGY STAR multi-function devices.

Two factors are important to note in regard to labeling of energy-efficient products online. First, practices vary by product type. Wal-Mart, for example, does not label ENERGY STAR TVs, even though it prominently identifies ENERGY STAR products of other types. In addition, none of the retailers mention the benefits of energy efficiency to the consumer. Programs may want to work with retailers to ensure that not only are ENERGY STAR or energy-efficient products clearly labeled on both product catalog and product detail pages, but that retailer websites make the case for the benefits of efficient products.

Marketing Messages for Energy-Efficient Products

Manufacturers use a variety of messages to differentiate products from others. Table 2.11 lists these messages and shows how they differ between the home entertainment, office electronics, and power management categories.

Cost savings and ties between energy efficiency and corporate sustainability are the most common messages manufacturers use to market energy efficiency. These messages are more common among office electronics than home entertainment products, suggesting manufacturers believe consumers of the latter care less about energy when making their purchase decisions.

Table 2.11: Messages Used to Market Efficient Products

PRODUCT TYPE	ENERGY EFFICIENCY MESSAGING (PRODUCT)	NOTES
HOME ENTERTAINMENT		
Set-Top Boxes **Game Consoles** **Home Audio Equipment**	• Displays ENERGY STAR logo with no additional mention of energy efficiency. (STBs, Home Audio) • Mentions energy-efficient product features without reference to efficiency benefits. (STBs) • Energy efficiency messages tied to manufacturer's corporate social responsibility efforts. (Game Consoles)	• Marketing of energy efficiency largely limited to use of ENERGY STAR labels. • In some cases, ENERGY STAR is not mentioned in the marketing of qualified products. • No use of cost savings and environmental benefits associated with efficiency.
OFFICE EQUIPMENT		
Servers **Imaging Equipment**	• Messages center on cost savings associated with efficiency. (Servers, Imaging equipment) • Energy efficiency messages tied to manufacturer's corporate social responsibility efforts. (Servers, Imaging Equipment) • Marketing promotes energy efficiency with no direct mention of other benefits like cost or environmental impact. (Servers) • Messages promote non-energy benefits of efficiency. (Servers) • Messages focus on environmental benefits of energy efficiency. (Imaging Equipment) • Some products display ENERGY STAR logo with no additional mention of energy efficiency. (Imaging Equipment)	

Continued

PRODUCT TYPE	ENERGY EFFICIENCY MESSAGING (PRODUCT)	NOTES
POWER MANAGEMENT		
"Smart" Power Strips **Uninterruptible Power Supplies** **External Power Supplies**	• Messages center on cost savings associated with efficiency. (Power Strips, UPSs) • Messages focus on environmental benefits of energy efficiency. (Power Strips, UPSs) • Manufacturers incorporate explanation of efficient features into marketing materials. (Power Strips, UPSs) • Manufacturers have created logos to differentiate efficient products. (UPSs) • Manufacturers may display ENERGY STAR logo with no additional mention of energy efficiency. (External Power Supplies) • Energy efficiency messages tied to manufacturer's corporate social responsibility efforts. (External Power Supplies)	• No ENERGY STAR standards exist for UPSs and power strips. • Unlike other categories, messages incorporate explanation of energy-efficient features and technologies. • Some manufacturers have created logos to differentiate their own efficient products.

It is interesting to note that manufacturers of UPSs and "smart" power strips, the two products without ENERGY STAR specifications, go the furthest to describe the energy benefits of their products, explain why the product is more efficient, and have even created their own internal brands to differentiate efficient products.

BARRIERS

Several barriers to increasing the energy efficiency of electronics were either noted explicitly by interviewees or concluded by the authors on the basis of interviewees' comments and secondary research. Table 2.12 shows barriers by product type and provides sample statements made by interviewees. The barriers include those familiar to energy efficiency professionals, as well as barriers newly identified. They include:

- ➡ The higher manufacturing cost of efficient products and thus the higher price to end-users
- ➡ End-users' lack of awareness of the value/importance of energy efficiency
- ➡ An incomplete, weak, or non-existent ENERGY STAR specification
- ➡ Efficiency features that interfere with product features/usability
- ➡ Lack of advance notice/planning in the development of energy efficiency targets/ standards

- Scarcity of components required for efficient products
- Absence of energy efficiency requirements in product specifications received by manufacturers from product buyers

The most common barriers are: the higher cost to consumers of efficient products; a weak, new, or non-existent ENERGY STAR specification; a lack of awareness on the part of end-users of the value of energy efficiency or the existence of efficient products; and a belief that energy efficiency may interfere with product features or usability. Programs will want to consider which barriers apply to each product type when developing implementation strategies, as well as barriers common to multiple product types.

OPPORTUNITIES

Manufacturers identified several ways in which utilities could assist their efforts to improve product efficiency and increase the penetration of efficient products. They include:

- Financial incentives provided to either business-to-business customers, manufacturers, retailers, or end-users
- Raising awareness of energy efficiency by educating business-to-business customers and end-users
- Providing marketing support to manufacturers, including co-funding for marketing campaigns, marketing products to utility customers, and providing utility endorsement of specific products
- Endorsing/incentivizing an efficiency standard more aggressive than ENERGY STAR

Table 2.13 shows each item and the products about which it was mentioned by respondents. Financial incentives were noted by nearly all manufacturers as an effective intervention strategy, with most suggesting the incentive be paid to the manufacturer or the end-user. Manufacturers also desired utility support in raising awareness of the benefits of energy efficiency and efficient products, and in providing marketing assistance for efficient products.

Table 2.12: Barriers to Energy Efficiency, by Product Type

PRODUCT	BARRIERS TO ENERGY EFFICIENCY (PART 1)			
	Efficient Products Cost More to Manufacture and Result in a Higher Price to Buyers	End-Users Are Not Aware of the Value / Importance of Efficiency	ENERGY STAR Specification Is Incomplete, Weak, or Non-Existent	Efficiency Interferes with Product Features / Usability
Set-Top Boxes	X	X	X	X
Servers	X		X	
Game Consoles			X	X
Imaging Equipment	X	X		X
Home Audio Equipment	X	X	X	X
Power Strips	X	X	X	
Uninterruptible Power Supplies	X		X	
External Power Supplies	X	X		
PCs	X	X		X
Number of Product Types In Which Each Barrier Was Identified	**8**	**6**	**6**	**5**

Continued

PRODUCT	BARRIERS TO ENERGY EFFICIENCY (PART 1)			
	EFFICIENT PRODUCTS COST MORE TO MANUFACTURE AND RESULT IN A HIGHER PRICE TO BUYERS	END-USERS ARE NOT AWARE OF THE VALUE / IMPORTANCE OF EFFICIENCY	ENERGY STAR SPECIFICATION IS INCOMPLETE, WEAK, OR NON-EXISTENT	EFFICIENCY INTERFERES WITH PRODUCT FEATURES / USABILITY
Example Statements	• *Some things we could manufacture now would be too expensive for our customers to buy. But they will once the cost goes down.* • *Our power supply to increase efficiency may cost a penny or two pennies more. [The customer] may get those two pennies back in one month, but the consumer doesn't see the equation.* • *It's a very cost-sensitive market. When there's no cost effect, we make as efficient a product as possible. Even if it has not been specified.* • *There's a threshold. You've got to get to a certain efficiency. No one is paying extra for more.* • *Things that make [the product] green cost more money. So by the time you get to a product it's not price competitive, it's say $5 more.*	• *There's not enough products out there that support energy efficiency, and people aren't aware of simple things they can do.* • *It's pervasive that [business-to-business customers] don't even know what the standards are. We're waiting to get the level of awareness raised.* • *A lot of people still don't know what [efficiency feature] is and why it's going to help them or the environment.* • *One problem we have, I think it's industry-wide, is how to motivate retailers to focus on energy efficiency.* • *[End-users] have seen ENERGY STAR, that symbol, for several years. They typically apply it to appliances. But people don't think about it with [consumer electronics products] consuming power.*		• *1 watt [standby] is not achievable if you want to maintain user expectations of the product. You don't want the consumer to defeat the process by not putting it in standby because they don't want it to take a long time to warm up.* • *We need to keep in touch with user experience. The user expects it to go on right away, they don't want to wait for it to boot up.* • *Sometimes configurations that meet ENERGY STAR don't meet the customers' needs.*

Continued

PRODUCT	BARRIERS TO ENERGY EFFICIENCY (PART 2)		
	Components Required By Efficient Products May Not Be Available In Sufficient Quantities	Lack of Advance Notice/Planning In Energy Efficiency Targets/Standards	Specifications Received From A Buyer Do Not Include Efficiency Requirements
Set-Top Boxes	X	X	X
Servers	X	X	
Game Consoles			
Imaging Equipment			
Home Audio Equipment	X	X	
Power Strips			
Uninterruptible Power Supplies			
External Power Supplies			X
PCs	X	X	
Number of Product Types In Which Each Barrier Was Identified	**4**	**4**	**2**

Continued

PRODUCT	BARRIERS TO ENERGY EFFICIENCY (PART 2)		
	COMPONENTS REQUIRED BY EFFICIENT PRODUCTS MAY NOT BE AVAILABLE IN SUFFICIENT QUANTITIES	LACK OF ADVANCE NOTICE/PLANNING IN ENERGY EFFICIENCY TARGETS/STANDARDS	SPECIFICATIONS RECEIVED FROM A BUYER DO NOT INCLUDE EFFICIENCY REQUIREMENTS
Example Statements	• *Some people claim there are [components] that are super efficient. They are in development process, not ready and available for all manufacturers. Demand for such a product would be so high that as a nascent technology, no company would be ready to produce it in massive quantities.* • *From a technology point-of-view, if it's the latest technology released, some of the components are very expensive. That would discourage us from manufacturing the highest efficiency part. Once the volume of them, the demand for these highest efficiency parts, increases and becomes more significant, the costs go down.* • *We are constrained by what's available on the market…There is only so much supply.* • *The problem is getting in touch with suppliers and getting them to make enough for you with the correct quality and reliability.*	• *The key is to look ahead. We have 2-4 years between a good idea and selling a product. If standards don't look that far ahead, we won't change things. If we only look a year ahead, we can't drive a significant improvement because nobody will react to it.* • *We need aggressive limits for the future so we can drive our suppliers.* • *Anything that happens this year is already planned. It's the ones after that where I've got the chance to say, "If I spend another $1, could I save the consumer," etc.* • *In Japan the approach is to set goals several years out. It's hard to change energy characteristics because they are tied to mechanical design. We need to have enough warning of what targets are so we have clear-cut specs for the mechanical [components].* • *We hit [the efficiency target] with a number of products, we would have had more hits if the target was known earlier. In the case of [utility] program, the lead time was just three months. ENERGY STAR is nine months ... nine months is the minimum.*	• *We set out with a goal to meet the specification. On the energy side, as long as we're meeting the spec, we don't try to do much more than the spec. Other factors become more important, like cost and timing.* • *Our incentive is to be as cheap as possible and still meet requirements.* • *Customer requirements would increase our efforts and/or resources, but so far our customers never demand more if they need to pay a price for it.*

Note: Displays and TVs were note included because data were unavailable.

Table 2.13: Assistance Desired by Manufacturers, by Product

PRODUCT	ASSISTANCE DESIRED TO IMPROVE ENERGY EFFICIENCY BY PROVIDING FINANCIAL INCENTIVES . . . (PART 1)			
	…TO BUSINESS-TO-BUSINESS CUSTOMERS	…TO MANUFACTURERS	…TO RETAILERS	…TO END-USERS
Set-Top Boxes	X	X		
Servers		X		X
Game Consoles				
Imaging Equipment		X		
Home Audio Equipment		X	X	
Power Strips				X
Uninterruptible Power Supplies		X		X
External Power Supplies	X			
PCs		X		X
Number of Product Types In Which Each Barrier Was Identified	**2**	**6**	**1**	**4**
Example Statements	• *Need to start at the top of the food chain, that's where the campaign needs to come from.* *Cont.*	• *Utilities could do an 80 PLUS thing for [product]. .* *Cont.*	• *The incentive could push things over the hump. They're going to do some in-store branding around them. There's a chance the sales people on the floor will be able to use that.* *Cont.*	• *For consumer products, the best incentives are aimed at consumers. It becomes difficult when trying to influence businesses…* *Cont.*

Continued

PRODUCT	ASSISTANCE DESIRED TO IMPROVE ENERGY EFFICIENCY BY PROVIDING FINANCIAL INCENTIVES . . . (PART 1)			
	…TO BUSINESS-TO-BUSINESS CUSTOMERS	…TO MANUFACTURERS	…TO RETAILERS	…TO END-USERS
Example Statements – cont.	• *I can imagine if [utility] gave us a higher power goal and agreed to pay an amount per [product], it would be a strong motivator for us. Right now, there is no motivator other than meeting ENERGY STAR guidelines and meeting quality.* • *The utility needs to approach the largest [business-to-business customers]. Manufacturers are just fulfilling what [the buyers] are asking for. If they came in tomorrow and asked for 100% to meet ENERGY STAR, then that's what everyone would be working on.* • *If [utility] can work with [company], say we will help subsidize the cost of [product], we'll put brochures out and advertise to customers that you can save energy, your bill will go down. We will go back to manufacturers and request every [product] to be [more efficient].*	• *Money [would incentivize more efficient products.] The [lower-end product] is $39.99 retail. Everyone has that price-point. There's a lock on that price-point. In order to make it [more efficient] we need to include $2.85 worth of components, and that would eat up our profit.* • *The normal advice is, the higher up the food chain, the more effective it is. $1 off retail has little effect, but $1 off manufacturing is $5 off retail…If I'm getting $0.90 incentive to spend $0.67, it's easy. My argument is harder when I have to reduce the profit margin.* • *It's a good gesture and may help a little. If the extra cost was $10 and we got back $5, it would be a nicety, a good direction to go, but it doesn't really compensate manufacturers for all the production.*	• *The incentive could push things over the hump. They're going to do some in-store branding around them. There's a chance the sales people on the floor will be able to use that.*	• *…If we want to try to process rebates associated with our purchases, it would cost us more to process. Plus manufacturers can't count on it, and it's a lot of paperwork for them.* • *We need [utility's] endorsement by developing a rebate program so others will follow suit.* • *I think programs that incentivize people to purchase more energy-efficient stuff on the next purchase is good. In reality, a lot of people won't take out something that works.* • *[Utility] made concessions to end-users/ business about moving towards [more efficient] products. That caused customers to ask us, caused us to build specific bundles of products to meet the demand. If the utility offers some kind of rebate it causes customers to ask us for it.*

Continued

PRODUCT	OPPORTUNITIES TO IMPROVE ENERGY EFFICIENCY (PART 2)		
	RAISE AWARENESS • *EDUCATE END-USERS AND BUSINESS-TO-BUSINESS CUSTOMERS ABOUT BENEFITS OF EFFICIENT PRODUCTS* • *RAISE AWARENESS ABOUT EFFICIENT PRODUCTS IN GENERAL*	PROVIDE MARKETING SUPPORT • *CO-FUND MARKETING CAMPAIGNS* • *MARKET PRODUCTS TO UTILITY CUSTOMERS* • *PROVIDE UTILITY ENDORSEMENT OF SPECIFIC PRODUCTS*	ENDORSE / INCENTIVIZE AN EFFICIENCY STANDARD MORE AGGRESSIVE THAN ENERGY STAR
Set-Top Boxes	X	X	X
Servers	X	X	X
Game Consoles			
Imaging Equipment	X	X	X
Home Audio Equipment	X	X	X
Power Strips	X	X	
Uninterruptible Power Supplies	X	X	
External Power Supplies	X		
PCs	X		
Number of Product Types In Which Each Barrier Was Identified	**8**	**6**	**4**

Continued

PRODUCT	OPPORTUNITIES TO IMPROVE ENERGY EFFICIENCY (PART 2)		
	RAISE AWARENESS • *EDUCATE END-USERS AND BUSINESS-TO-BUSINESS CUSTOMERS ABOUT BENEFITS OF EFFICIENT PRODUCTS* • *RAISE AWARENESS ABOUT EFFICIENT PRODUCTS IN GENERAL*	**PROVIDE MARKETING SUPPORT** • *CO-FUND MARKETING CAMPAIGNS* • *MARKET PRODUCTS TO UTILITY CUSTOMERS* • *PROVIDE UTILITY ENDORSEMENT OF SPECIFIC PRODUCTS*	**ENDORSE / INCENTIVIZE AN EFFICIENCY STANDARD MORE AGGRESSIVE THAN ENERGY STAR**
Example Statements	• *The utility company has a big opportunity to advertise and raise awareness to the consumer, drive them to a store to purchase that energy-efficient product.* • *The more advertising/ awareness, the better off we'll be. Anything they could do to get the word out there.* • *Tell them how much they'll be saving. Give them a way to know how much they'll save per year.* • *Educate people to look for the ENERGY STAR qualification.* • *Education, not just awareness that the product exists, but that there is a real dollar savings, an economic benefit to buying it.*	• *Almost definitely subsidizing marketing efforts is something that would play well.* • *The bottleneck is in getting the mind share. If you can piggyback on the utility's ability to reach out once/month, that's a win-win.* • *We can work with [the utility] on direct marketing to customers. If [utility] is working on marketing efforts for ENERGY STAR we can get collateral to them or help them with images or text for inserts for bills. We can support with artwork and details on our ENERGY STAR products.* • *If the utilities validate as a testimonial in a letter with [company], where they evaluate our unit, concur that we're saving power, use [utility] logo and testimonial in our advertising.* • *If there's an interest in cross-promotion, we'd welcome that.*	• *Have an additional threshold to cross. Any time there's a higher rating because of a more aggressive threshold, we'll look closely at it.* • *[Efficiency program] put some dollars behind arbitrary goal lines. When there's a rebate that's dangling out there when you hit a particular level, that's appealing.*

Potential Program Strategies

Interviews with manufacturers, program managers, and secondary research suggested four potential program strategies applicable across multiple product types, and several relevant to each product individually. They include:

- Increasing end-user demand for efficient products by improving awareness, knowledge, and attitudes of end-users through education and training
- Working with manufacturers to increase device efficiency – encourage them to design increasingly efficient products that exceed ENERGY STAR specifications; provide incentives only to products that greatly exceed ENERGY STAR
- Incenting sales of efficient products – use an incentive to motivate purchasing behavior; for example, the purchase of the most energy-efficient product
- Increasing end-user activation of power management settings, thus generating energy savings through behavioral changes – for example, setting a device to turn off automatically when not in use

Table 2.14 shows each strategy and the product types to which it applies.

Table 2.14: Potential Program Strategies, by Product

PRODUCT	ENERGY EFFICIENCY STRATEGIES				
	PROGRAM IMPLEMENTATION		MARKETING		OTHER
	ENCOURAGE MANUFACT-URERS TO INCREASE EFFICIENCY OF NEW PRODUCTS	INCENT SALES OF EFFICIENT PRODUCTS	INCREASE END-USER DEMAND FOR EFFICIENT PRODUCTS BY EDUCATING ABOUT POWER USE	INCREASE END-USER ACTIVATION OF EXISTING POWER MANAGEMENT SETTINGS	
Set-Top Boxes	X	X	X		• Encourage service providers to specify more efficient products
Servers	X	X	X	X	• Encourage the decommissioning of older, less efficient servers • Encourage the use of virtualization software • Encourage data center managers to redistribute workload to the most efficient servers

Continued

PRODUCT	ENERGY EFFICIENCY STRATEGIES				
	PROGRAM IMPLEMENTATION		MARKETING		OTHER
	ENCOURAGE MANUFACTURERS TO INCREASE EFFICIENCY OF NEW PRODUCTS	INCENT SALES OF EFFICIENT PRODUCTS	INCREASE END-USER DEMAND FOR EFFICIENT PRODUCTS BY EDUCATING ABOUT POWER USE	INCREASE END-USER ACTIVATION OF EXISTING POWER MANAGEMENT SETTINGS	
Game Consoles	X		X	X	• Encourage manufacturers to provide a downloadable software patch for existing consoles to reduce energy use and activate power management features
Imaging Equipment	X	X	X	X	• Encourage end-users to reduce the number of devices per user in office settings.
Home Audio Equipment	X	X	X		
Power Strips	X	X	X	X	
Uninterruptable Power Supplies	X	X	X	X	
External Power Supplies	X	X	X		• Encourage manufacturers to specify/purchase more efficient power supplies
TVs	X	X	X		
PCs	X	X	X	X	
Displays	X	X	X	X	

IMPLICATIONS FOR PROGRAM DESIGN

Four Program Design Guidelines

This research produced many findings with program design implications and from them we synthesized four key program design guidelines. The guidelines are general goals rather than specific implementation strategies. Although the guidelines may not be achievable in the short term, programs that make continued progress towards them will increase their effectiveness in transforming the electronics market.

1. **Broad geographic territory requires cooperation among utilities**. Manufacturers design and market products for a national, even international market. They are already faced with country-specific requirements and strongly dislike "patchwork" requirements. In fact, many manufacturers stated they were unlikely to comply with energy efficiency program requirements that apply at municipal levels. Thus, programs will have the greatest impact on the electronics market if they coordinate with one another in setting energy efficiency targets, incentive levels, and program participation requirements.

2. **Programs must be flexible enough to evolve at the same rapid pace as the products**. Consumer electronics products change continuously. As soon as one product is designed, the next product design process begins, and manufacturers note energy efficiency often improves in each successive model. Programs thus need to reevaluate energy efficiency targets and the levels at which incentives are provided to ensure that only the most efficient products qualify. For example, a set-top box manufacturer suggested efficiency standards for set-top boxes should be tightened every one or two years.

3. **Manufacturers should be engaged with the process and educated about utility goals**. Manufacturers praise ENERGY STAR for its inclusive specification development process and nearly all interviewees were interested in working with utilities to promote energy-efficient products. Programs should draw on manufacturers' expertise and leverage their distribution channels.

4. **Programs need to understand and design to each product's unique supply chain**. Each electronics product type has its own technical challenges, development timeline, supply chain, end-users, barriers, and opportunities. Although there are similarities across product types, programs should treat each product individually when designing an implementation strategy. It is not advisable to treat electronics products as measures to be included in a single, overarching program design.

Key Findings

Table 2.15 summarizes the key findings discussed above and identifies potential implications for program design.

Table 2.15: Summary of Findings and Potential Implications for Program Design

FINDING	POTENTIAL IMPLICATIONS
PRODUCT DEVELOPMENT PROCESS	
Manufacturers design products for national and international markets.	• Manufacturers want efficiency standards that apply to the broadest possible geographic area and dislike "patchwork" standards and program requirements. • Manufacturers are unwilling to make products that will be sold only in a small geographic territory. • Manufacturers may be unwilling to comply with program requirements involving product labeling.
Decisions about product design are made at the very beginning of the process and are difficult to change later.	• Market transformation programs should focus their efforts on intervening in the early stages of the product development process to encourage energy efficiency requirements in the manufacturer's marketing requirements document. • For any one product, the window of opportunity for intervening in this process will be quite short, possibly as little as a few months.
The majority of products have development cycles of at least one year and as many as three to five years.	• For each product type, market transformation efforts will take at least as long as the product development cycle to be realized, and possibly longer, depending on when the program cycle intersects the manufacturer's development timeline.
Manufacturers design products to meet the demands of their customers – be they end-users, retailers, private-label customers, or business-to-business customers.	• Programs need tactics that apply to each group. Some options include: • **End-users**: educate about value of energy-efficient products and/or behavioral changes; identify products at point-of-sale; provide incentives for efficient purchases - **Retailers**: educate buyers and sales staff on value of energy-efficient products; incent sales of efficient products - **Manufacturers**: incent shipment of efficient products; coop marketing campaigns. - **Private label customers**: incent the design and sale of efficient products - **Business-to-business customers**: incent purchases of efficient products; coop marketing campaigns
Sales of some products are growing more quickly than others; for example, sales of multi-function devices are outpacing sales of copiers and printers.	• Programs should pay close attention to these products and should always be on the lookout for the "ascendant products" of the future.
Pennies count, especially when it comes to a manufacturer's lowest-priced / highest-volume products.	• The difference in cost, to the manufacturer, between the less efficient and more efficient product may be relatively small compared to the retail price of the product. • The incremental cost of energy efficiency represents a higher percent of the overall product cost in low-cost products and thus it is these products where manufacturers appear most likely to compromise on efficiency.

Continued

FINDING	POTENTIAL IMPLICATIONS
MANUFACTURERS	
A relatively small number of manufacturers account for the majority of products sold within each product type.	• Programs may be able to reach much of the market by targeting the few manufacturers with the most market share. • Programs may find that signing a single manufacturer leads others to join.
A handful of manufacturers make multiple products of interest to energy efficiency programs.	• Programs may be able to capitalize on this overlap by targeting manufacturers that make two or more of the products targeted by energy efficiency programs. • Building a relationship with a single manufacturer may allow programs to target multiple product types.
Manufacturers who make multiple product types most commonly produce products within a single category and these products are often complementary (PCs and displays, for example).	• An opportunity may exist for programs to work with manufacturers to target multiple products within the same category.
There is significant overlap between manufacturers of home entertainment products and manufacturers of office electronics products, largely driven by manufacturers who produce both TVs and displays.	• The technology underlying televisions and computer displays is similar and parallels may exist in opportunities for energy efficiency in the two product types.
Manufacturers engage in long-term planning, both individually and collectively.	• Many manufacturers are comfortable with product "roadmaps" and accustomed to setting goals for product evolution several years into the future, including improvements to energy efficiency. • Manufacturers may prefer the "roadmap" approach to energy efficiency standards, as opposed to one-time standard-setting. This is the model used by the two industries that have set their own efficiency goals: PCs/servers and external power supplies.
Manufacturers are willing to engage with energy efficiency programs.	• Most manufacturers interviewed expressed a willingness, even an eagerness, to discuss energy efficiency opportunities with utilities. • Programs should engage manufacturers in the discussion, even if the program design does not target them directly.

Continued

FINDING	POTENTIAL IMPLICATIONS
DISTRIBUTION	
Each product is distributed through a unique combination of channels, including retailers, dealers/VARs, direct from the manufacturer, and service providers.	• Programs cannot reach every product through a single channel and thus need tactics that apply to the appropriate channel for each product. Some options include: - **Bricks and mortar retailers**: identify products at point-of-sale; educate sales staff on the value of efficiency; coop marketing campaigns; provide incentives for sales of efficient products; incent design of efficient private label products - **Online retailers and manufacturer websites**: provide content for websites on the value and benefits of efficiency; assist in identifying and clearly labeling efficient products on catalog and product detail pages; coop marketing campaigns; provide incentives for sales of efficient products - **Service providers/dealers/VARs**: coop marketing campaigns; provide incentives for sales of efficient products
Best Buy, Target, and Wal-Mart are the top electronics retailers, as well as Dell, Costco, GameStop, Apple Retail Stores, RadioShack, and Sears.	• These retailers present ideal targets for programs focused on the retail channel. • Programs should also obtain the detailed and up-to-date rankings of electronics retailers that are available for a nominal fee from *TWICE.com*.
MARKETING	
Energy efficiency is not currently a key product feature for consumer electronics products.	• Programs should consider efforts to increase awareness of and demand for energy efficiency in consumer electronics products.
Energy efficiency is a key product feature for business electronics products.	• Programs should consider efforts to support business, government, and institutional purchasers in purchasing more efficient products.
Manufacturers employ multiple marketing mediums for their products, with tradeshows/events and print advertising the most commonly noted, followed by the manufacturer's website, one-on-one sales discussions, mailings, and product packaging.	• Programs should consider the ways in which each product is marketed when designing its outreach strategy.

Continued

FINDING	POTENTIAL IMPLICATIONS
ENERGY EFFICIENCY	
There are no ENERGY STAR specifications for UPSs and "smart" power strips.	• The absence of an ENERGY STAR specification may be a barrier to including these products in an efficiency program, as there is no federal standard for evaluating their efficiency. • Programs should consider advocating for ENERGY STAR specifications for these and other plug load devices.
ENERGY STAR specifications for each product have been revised at different times and at varying intervals.	• Programs should maintain close relationships with ENERGY STAR program managers in order to stay apprised of impending changes to standards.
Although ENERGY STAR aims to recognize the top 25% of products, actual penetration rates vary greatly, from over 90% (LCD displays) to less than 10% (mini-systems) as of 2007.	• Programs may want to take ENERGY STAR penetration data into account when selecting which efficiency level(s) to incent. • Programs may need to incentivize an efficiency level more aggressive than ENERGY STAR and/or an ENERGY STAR tier that is not yet in effect in order to capture additional savings.
There are several international energy efficiency labeling programs that apply to consumer and business electronics products.	• Programs can use activities taking place abroad to inform energy efficiency targets and capture lessons learned.
Manufacturers of most products studied here (TVs, displays, external power supplies, imaging equipment, PCs, UPSs, and power strips) are both engaged in, and implementing energy efficiency.	• Programs may find partnership opportunities with manufacturers of these products, as they appear to have acknowledged the importance of energy efficiency, at least in their level of engagement with ENERGY STAR or other efficiency efforts and in their product design practices.
Home audio manufacturers are lagging in the energy efficiency arena.	• These products may present an appealing target for programs, as their household penetration rates are high, an ENERGY STAR specification is in effect, but penetration rates are low, as is manufacturer engagement and implementation.
Manufacturers of set-top boxes, servers, and game consoles have high interest in energy efficiency, but low implementation.	• Programs may wish to target these manufacturers, as they have demonstrated interest in efficiency, but have not yet begun to design efficient products to the same degree as manufacturers of other products, like TVs and displays.
Across all products, the most common energy efficiency messages focus on cost savings and/or are tied to a manufacturer's corporate social responsibility efforts.	• Consumers, at least in the view of manufacturers, are most responsive to messages centered on cost savings related to energy efficiency. • By producing energy-efficient products, manufacturers gain an opportunity to improve their corporate image.
Marketing messages for energy-efficient consumer electronics, and home entertainment products in particular, are typically limited to use of the ENERGY STAR logo or a list of energy-efficient features.	• Programs have an opportunity to work with manufacturers and distribution partners to improve efficiency messaging and product labeling to include a description of the benefits of efficiency.

Continued

FINDING	POTENTIAL IMPLICATIONS
ENERGY EFFICIENCY – CONT.	
Marketing messages for energy-efficient business electronics focus on the benefits of energy efficiency.	• Manufacturers believe business customers recognize the value of energy efficiency and evaluate its benefits when making a purchase. • Programs may wish to focus on incentivizing purchases of products rather than strictly promoting an awareness-building campaign.
Marketing messages for the two energy-efficient power supply products for which there is no ENERGY STAR specification display sophisticated efficiency messaging.	• Programs may want to look to these products for examples of efficiency messaging.
Opportunities exist to improve energy efficiency through the use of a device's power management capabilities.	• Encourage end-users to activate power management settings through increased awareness and marketing campaigns.
BARRIERS AND OPPORTUNITIES	
Barriers to energy efficiency include both familiar and new barriers, and vary by product type.	• Programs will want to consider the barriers applicable to each product type when developing implementation strategies.
Manufacturers identified several ways in which utilities could support the adoption of energy-efficient products, including financial incentives, awareness raising, and coop marketing.	• Programs should consider the support requested by manufacturers in relation to particular product types.

Recommendations

The following recommendations for inclusion in programs (Table 2.16) are based solely on the market characteristics discussed in this report and not on their potential for energy savings.

Energy Solutions also provided recommendations for devices to include in a voluntary program and the type of program that should be used to address computers, monitors, televisions, set-top boxes, home entertainment systems, and personal electronic chargers.[13]

[13] Alex Chase, Ryan Ramos, and Ted Pope. (December, 2006). Consumer Electronics: Market Trends, Energy Consumption, and Program Recommendations 2005-2010. Prepared for Pacific Gas and Electric Company. Their recommendations can be found on page 92 of their report in Table 5.2-1.

Table 2.16: Recommendations for Program Inclusion

PRODUCT	PRIORITY FOR INCLUSION IN PROGRAM	POTENTIAL INTERVENTION POINT(S)				POTENTIAL IMPACT
		MANUFAC-TURER	RETAILER	END-USER	OTHER	
Set-Top Boxes	High				Pay-TV service providers	Get to implement ENERGY STAR version 2.0 ahead of effective date
Servers	High	X		X	VARs	Big savings available
Imaging Equipment	High	X	X	X	Dealers / VARs MPS providers	Big savings available, can impact many purchases by working with MPS providers
Home Audio Receivers	High	X	X	X		Greater participation in ENERGY STAR offering consumers more choices; increase energy efficiency marketing
Game Consoles	Moderate	X	X	X		Influence next generation of consoles to be more efficient; long-term, as follow-on generation will likely not be released until 2016
Uninterruptible Power Supplies	Moderate	X	X	X	Telephone service providers	No ENERGY STAR specification
External Power Supplies	Moderate	X				Requires different program design due to need to target organizations that buy EPS; need to figure out how to reach them, diverse group
"Smart" Power Strips	Moderate	X	X	X		No ENERGY STAR specification

3 PRODUCT CHARACTERIZATIONS

Three products of great interest to energy efficiency programs, TVs, PCs, and displays (monitors), were excluded from this study. Below is a brief summary of key market trends, technologies, top manufacturers, and resources for program managers.

TVS

Key Market Characteristics and Trends

- ENERGY STAR cites the Consumer Electronics Association (CEA) in predicting the U.S. will receive shipments of about 36 million TVs in 2009, with growth to 39 million shipments in 2012.[14]
- In 2006, Energy Solutions noted the following trends related to televisions:[15]
    - Soon there will be more televisions than people in the United States.
    - The average household watches 8 hours and 11 minutes of TV per day, an increase of 12.5% from ten years ago.
    - Digital technology is driving change in the TV market, leading to a decrease in the prevalence of cathode ray tube (CRT) TVs in favor of LCD and plasma models.
    - As prices of TVs decreased, consumers are buying models with larger screen sizes, which use more energy than smaller models.
- In 2007, TIAX estimated:[16]
    - The U.S. installed base of analog televisions was 237 million and the installed base of digital televisions was 38 million.
    - The market penetration of analog televisions was 89% and the penetration of digital televisions was 24%.

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[14] Katharine Kaplan and Bijit Kundu. (April 24, 2009). *ENERGY STAR TV Stakeholder Meeting: Draft 1 Version 3.1 Specification*. PowerPoint Presentation. Accessed July 6, 2009 from: *http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/tv_vcr/EPA_Presentation.pdf*

[15] Alex Chase, Ryan Ramos, and Ted Pope. (December, 2006). *Consumer Electronics: Market Trends, Energy Consumption, and Program Recommendations 2005-2010*. Prepared for Pacific Gas and Electric Company.

[16] Kurt W. Roth et al. (July, 2007). *Residential Miscellaneous Electric Loads: Energy Consumption Characterization and Savings Potential*. Prepared by TIAX for Building Technologies Program.

- Overall, 99% of households owned at least one TV.
- The average U.S. household owned 2.4 TVs.

Product Types

There are currently three primary television technologies. These descriptions were adapted from Energy Solutions.[17]

➡ **Cathode Ray Tube (CRT)** televisions produce an image by projecting a beam of electrons across a vacuum tube onto the back of a specially coated screen. Historically, this has been the dominant technology in televisions. The size of CRT televisions is limited because when screen size increase beyond 37 inches the devices becomes too big and heavy to be practical for home use.

➡ **Liquid Crystal Display (LCD)** televisions contain a light source that sits behind a flat panel containing liquid crystals that let more or less light pass through them, creating an image. These televisions may use fluorescent lamps as a light source or LEDs.

➡ **Plasma** televisions consist of a panel containing a layer of pixels, which each contain three gas-filled cells that create blue, red and green light.

Top 10 Manufacturers

Table 3.1 outlines the top ten manufacturers in key television categories.

[17] Chase, Ramos and Pope. *Consumer Electronics*.

Table 3.1: Top 10 Television Manufacturers

COMPANY	OVERALL RANK (2009)	RANK IN LCD TV MARKET (2009)	RANK IN PLASMA TV MARKET (2009)	REVENUE IN US$ (YEAR)	KEY FACTS	ENERGY STAR-QUALIFIED PRODUCTS?		
						CRT	LCD	PLASMA
Samsung *www.samsung.com*	1	1	2	$573 M (2007)	Founded 1938. Based in Korea. Makes a wide variety of consumer and business electronics.	Yes	Yes	Yes
Sony *www.sony.com*	2	2		$89.6 B (2008)	Founded 1946. Based in Japan. Produces a range of audio, video, television, communication / information, semiconductor, and electronic component products.	No	Yes	No
Panasonic *www.panasonic.com*	3	9	1	$91 B (2008)	Founded in 1918. Based in Japan. Offers a wide range of electronics products for consumers, business, and industrial sectors.	No	Yes	Yes
LG Electronics *www.lge.com*	4	3	4	$24.7 B (2008)	Founded 1958. Based in Korea. Products include mobile phones, home entertainment devices, appliances, and computers.	No	Yes	Yes
Sharp Electronics *www.sharpusa.com*	5	4		$34 B (2008)	Founded 1962. Based in Japan. Products include appliances, business electronics, notebook PCs, and solar products.	No	Yes	No
Toshiba *www.toshiba.com*	6	5		$77 B (2008)	Founded 1875. Based in Japan. Major products include personal computers, mobile communications equipment, electronic devices and components, social infrastructure systems, and home appliances.	No	Yes	No
Hitachi *www.hitachi.com*	7		5	$113 B (2008)	Founded 1910. Based in Japan. Products include appliances, A/V products, personal computers, and a range of commercial and industrial electronic products.	No	Yes	Yes
Mitsubishi Electric *global.mitsubishielectric.com*	8			$41 B (2008)	Founded 1921. Based in Japan. Products include electronic equipment for energy and electric systems, industrial automation systems, information and communication systems, and home appliances.	No	Yes	No

Continued

COMPANY	OVERALL RANK (2009)	RANK IN LCD TV MARKET (2009)	RANK IN PLASMA TV MARKET (2009)	REVENUE IN US$ (YEAR)	KEY FACTS	ENERGY STAR-QUALIFIED PRODUCTS?		
						CRT	LCD	PLASMA
Vizio *www.vizio.com*	9	7	6	$2.0 B (2007)	Founded 2003. Based in California. Products include TVs, multimedia displays, and home theater systems. Focuses on low-cost products.	Yes	Yes	No
Pioneer *www.pioneerelectronics.com*	10		3	$7.8 B (2008)	Founded 1938. Based in Japan. Offers audio and video products for home, car, professional DJs, and business.	No	No	Yes
Phillips *www.philips.com*		10	7	$37.2 B (2008)	Founded 1891. Based in the Netherlands. Product categories include healthcare, consumer lifestyle, and lighting. Wide range of consumer products from TVs, to toothbrushes, to earphones.	No	Yes	No
Westinghouse *www.westinghouse.com*		8			Founded 1886.	No	No	No
Sylvania *www.sylvania.com*	7	6		$633 M (2007)	Founded 1909. Based in Massachusetts. Owned by Siemens. Products include lighting, televisions, audio products, computers, appliances, and digital timers.	No	Yes	No
Curtis International *www.curtisint.com*			8	$96.9 M (2008)	Based in Canada. Manufactures electronics, GPS units, telephones, and appliances under the Curtis, Sylvania, RCA, and Igloo brands. TVs are sold only under Curtis brand.	No	No	No
Venturer *www.venturer.com*			9	$6.4 M (2008)	Founded 1988. Based in Canada. Products include home and portable audio, car entertainment, televisions, DVD players, set-top boxes, and digital picture frames.	No	No	No
Element *www.elementelectronics.com*			10		Products include televisions, mp3 players, Blu-Ray players, and digital picture frames.	No	No	No

Source: Rankings from: TWICE. (July 6, 2009). Market Share Reports by Category. Retrieved July 7, 2009, from *http://www.twice.com/article/307509-Market_Share_Reports_By_Category.php*. Revenue data from *http://www.hoovers.com*. Key characteristics from manufacturer websites.

Energy Efficiency

Efficiency Standards

The current ENERGY STAR specification for televisions, Version 3.0, came into effect on November 1, 2008. The specification requires qualified televisions to meet energy use requirements in *on* mode, taking into account screen size and whether or not the television offers high definition. The specifications also include requirements for energy use in *standby* mode and in *download-acquisition* mode (when the product is downloading channel listings from a network).

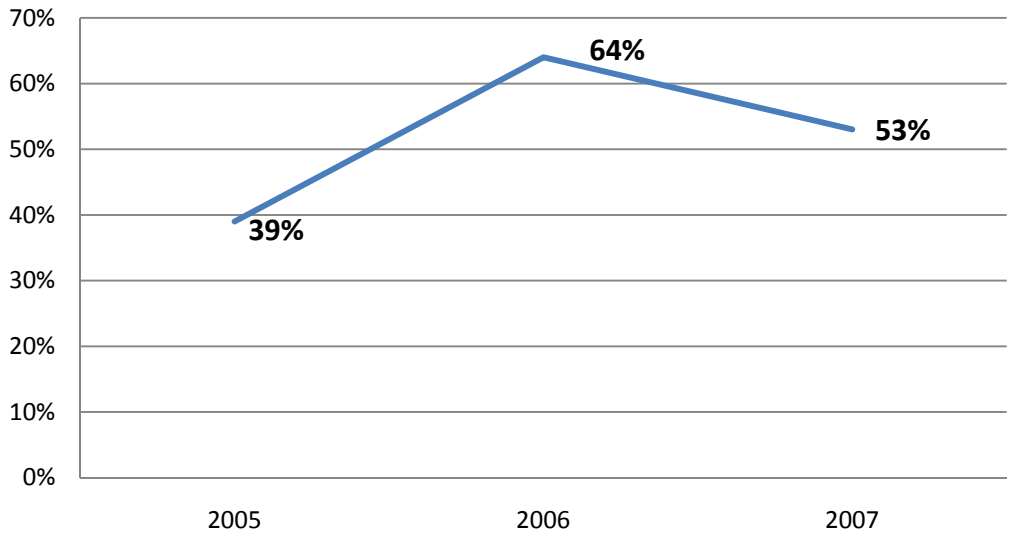
The ENERGY STAR specifications for televisions are currently under revision. Tiers two and three of the current standard will be renamed Version 4.0 and Version 5.0, with Version 4.0 expected to take effect on May 1, 2010, and Version 5.0 anticipated to take effect May 1, 2012.

The Version 4.0 and Version 5.0 specifications do not differentiate between high definition and standard definition televisions in their *on* mode energy use requirements. However, the Version 5.0 specification departs from the Version 3.0 and Version 4.0 requirements in that it no longer makes allowances for screen size in *on* mode energy consumption for televisions larger than 50 inches.

ENERGY STAR Penetration

As of July 2, 2009, 25 manufacturers make a total of 877 models of ENERGY STAR-qualified televisions. Figure 3.1 shows market penetration data for ENERGY STAR-qualified televisions from 2005-2007.

Figure 3.1: Penetration of ENERGY STAR-Qualified TVs, 2005-2007



Resources

- Chase, Alex, Ted Pope, and David Canny. 2008. "Consumer Electronics Efficiency Programs: The Next Big Challenge." In *Proceedings of the 2008 ACEEE Summer Study on Energy Efficiency in Buildings*. Washington, D.C.: American Council for an Energy-Efficient Economy.
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- Roth, K., K. McKenney, R. Ponoum, and C. Paetsch. 2007. *Residential Miscellaneous Electric Loads: Energy Consumption Characterization and Energy Savings Potential*. Prepared for U.S. DOE by TIAX LLC. Washington, D.C.: U.S. Department of Energy.

PCS

Key Market Characteristics and Trends

- In 2007, TIAX estimated:[18]
  - The installed base of desktop computers was 85 million.
  - The market penetration of desktop computers was 64%.
  - Use of PCs has grown as broadband Internet access has become increasingly common.
  - It is most common for a household to have only one PC.

Manufacturers

Table 3.2 shows the top ten PC manufacturers for both desktop and laptop computers.

[18] Kurt W. Roth et al. (July, 2007). *Residential Miscellaneous Electric Loads: Energy Consumption Characterization and Savings Potential*. Prepared by TIAX for Building Technologies Program.

Table 3.2: Top Ten PC Manufacturers

COMPANY	U.S. MARKET SHARE BY SHIPMENTS OF DESKTOPS & NOTEBOOKS (Q1 2009)	RANK BY US$ SALES (Q1 2009)		REVENUE IN US$ (YEAR)	KEY FACTS	MAJOR PRODUCTS	ENERGY STAR-QUALIFIED PRODUCTS?	
		DESK-TOPS	NOTE-BOOKS				DESK-TOPS	NOTE-BOOKS
HP *www.hp.com*	27.6%	2	2	$118 B (2008)	Founded 1939. Based in California.	Personal and mobile computing devices, imaging and printing devices, and technology products for business.	Yes	Yes
Dell *www.dell.com*	26.3%	3	4	$61.1 B (2009)	Founded 1984. Based in Texas.	Primarily produces computers for home and business use, other products include monitors, electronics and accessories.	Yes	Yes
Acer *www.acer-group.com*	10.5%	7	6	$16.7 B (2008)	Founded 1976. Based in Taiwan.	Produces a variety of personal computers and equipment under the brand names Acer, Gateway, eMachines, and Packard Bell.	Yes	No
Apple *www.apple.com*	7.6%	1	1	$32.5 B (2008)	Based in California. Founded 1977.	Desktop and laptop computers and accessories, mp3 players, and mobile phones.	Yes	Yes
Toshiba *www.toshiba.com*	6.6%		3	$77 B (2008)	Founded 1875. Based in Japan.	Personal computers, mobile communications equipment, electronic devices and components, social infrastructure systems, and home appliances.	N/A	Yes
Gateway *www.gateway.com*		4	9				No	No
Compaq *www.compaq.com*		5	7				Yes	Yes

Continued

COMPANY	U.S. MARKET SHARE BY SHIPMENTS OF DESKTOPS & NOTEBOOKS (Q1 2009)	RANK BY US$ SALES (Q1 2009)		REVENUE IN US$ (YEAR)	KEY FACTS	MAJOR PRODUCTS	ENERGY STAR-QUALIFIED PRODUCTS?	
		DESK-TOPS	NOTE-BOOKS				DESK-TOPS	NOTE-BOOKS
eMachines *www.emachines.com*		6					Yes	No
Sony *www.sony.com*		8	5				Yes	Yes
Lenovo *www.lenovo.com*		9	10		Founded 1984. Based in China. Acquired IBM's personal computing division in 2005.	Desktop and laptop computers, servers, and accessories.	Yes	Yes
Asustek *www.asus.com*		10	8		Founded 1990. Based in Taiwan.	Mobile phones, desktop and laptop computers, servers, monitors, computer components and accessories.	Yes	Yes

Sources: U.S. Market Share from IDC. (April 14, 2009). HP takes the lead in U.S. PC market as consumer shipments beat expectations, According to IDC. Press Release. Retrieved from *http://www.idc.com/getdoc.jsp?containerId=prUS21797609*. Rank from TWICE. *http://www.twice.com/article/307509-Market_Share_Reports_By_Category.php*. ENERGY STAR-qualified products, list current as of July 28, 2009.

Energy Efficiency

Efficiency Standards

Three organizations have set standards that apply to PCs in the U.S.:

- **80 Plus** is a program that focuses on the energy efficiency of internal power supplies. The program, which began in 2004, certifies internal power supplies that achieve 80% or higher energy efficiency at 20%, 50%, and 100% of their rated load. In 2008, the 80 Plus program added Gold, Silver, and Bronze levels to recognize products that achieved efficiency levels above 80%.
- **ENERGY STAR**'s current standard, Version 5.0, came into effect on July 1, 2009. The specification includes desktop computers, laptop computers, workstations, game consoles, and small-scale servers. Since the previous specification, Version 4.0, took effect July 20, 2007, ENERGY STAR has required that computers with internal power supplies meet 80 Plus standards, with Version 5.0 requiring products to meet the more stringent 80 Plus Bronze standard. In addition to requirements related to the devices' power supplies, ENERGY STAR specifies limits on the amount of energy the device can consume across all operating modes in a set time period, requires certain power management capabilities, and requires manufacturers to inform users of the benefits of using the equipment in an energy-efficient way.
- **EPEAT** is a labeling system that focuses on desktop and laptop computers, workstations, and computer monitors. The system – which has Bronze, Silver, and Gold levels – focuses on a range of environmental characteristics in the products it evaluates. To qualify for EPEAT a product must meet ENERGY STAR standards and comply with a variety of other requirements, including using recycled materials, reducing the use of hazardous materials, and being easily recycled.

ENERGY STAR Penetration

As of July 28, 2009:

- Fourteen manufacturers had qualified a total of 124 desktop computers.
- Seventeen manufacturers had qualified a total of 552 notebook computers

DISPLAYS

Key Market Characteristics and Trends

➡ In 2007, TIAX estimated:[19]

- The U.S. installed base of displays was 90 million.
- U.S. market penetration of displays was 64%.

Manufacturers

Table 3.3 lists the top display manufacturers.

Table 3.3: Top Display Manufacturers

COMPANY	2009 RANK	REVENUE IN US$ (YEAR)	KEY FACTS	ENERGY STAR-QUALIFIED PRODUCTS?	
				CRT	LCD
HP *www.hp.com*	1	$118 B (2008)	Founded 1939. Based in California. Major products include personal and mobile computing devices, imaging and printing devices, and technology products for business.	Yes	Yes
Acer *www.acer-group.com*	2	$16.7 B (2008)	Founded 1976. Based in Taiwan. Produces a variety of personal computers and equipment under the brand names Acer, Gateway, eMachines, and Packard Bell.	No	Yes
Samsung *www.samsung.com*	3	$573 M (2007)	Founded 1938. Based in Korea. Makes a wide variety of consumer and business electronics.	No	Yes
Dell *www.dell.com*	4	$61 B (2008)	Founded 1984. Based in Texas. Produces a wide range of computers and peripherals for home and business use.	No	Yes
LG Electronics *www.lge.com*	5	$24.7 B (2008)	Founded 1958. Based in Korea. Products include mobile phones, home entertainment devices, appliances, and computers.	No	Yes

Continued

[19] Kurt W. Roth et al. (July, 2007). *Residential Miscellaneous Electric Loads: Energy Consumption Characterization and Savings Potential*. Prepared by TIAX for Building Technologies Program.

COMPANY	2009 RANK	REVENUE IN US$ (YEAR)	KEY FACTS	ENERGY STAR-QUALIFIED PRODUCTS?	
				CRT	LCD
Hannspree *www.hannspree.com*	6	$5.2 M (2008)	Founded 2002. Based in Taiwan. Produces LCD displays for televisions, monitors, laptops, and other products.	No	Yes
Gateway *www.gateway.com*	7		Founded 1985. Based in California. Owned by Acer. Products include laptop and desktop computers, displays, and accessories.	No	Yes
eMachines *www.emachines.com*	8	$2.1 B (2007)	Founded 1998. Based in California. Owned by Acer. Products include desktop computers designed for home use and monitors.	No	Yes
Apple *www.apple.com*	9	$32.5 B (2008)	Founded 1977. Based in California. Products include desktop and laptop computers and accessories, mp3 players, and mobile phones.	No	Yes
AOC *www.aoc.com*	10		Founded 1967. Based in California. Produces LCD monitors, TVs, and multi-function displays.	No	Yes

Source: Manufacturer rankings from TWICE. (July 6, 2009). Market Share Reports by Category. TWICE. Retrieved from *http://www.twice.com/article/307509-Market_Share_Reports_By_Category.php*.

Energy Efficiency

Efficiency Standards

The current ENERGY STAR standard for displays, Version 4.0, Tier 2, came into effect on January 1, 2006, creating more stringent standards than those described in Version 4.0, Tier 1, which took effect January 1, 2005.

The previous version of the ENERGY STAR specification, Version 3.0, took effect July 1, 1999, and limited power consumption only in *sleep* and *off* modes. By July 2004, penetration of qualified displays had been estimated at approximately 95% of all units shipped.

The current specification limits *on* mode energy consumption based on screen resolution. It also sets limits on *sleep* and *off* mode energy consumption that are constant across all displays.

A new ENERGY STAR specification covering displays, Version 5.0, takes effect on October 30, 2009, for displays less than 30 inches. The specification will take effect for displays between 30 and 60 inches on January 30, 2010.

Version 5.0 expands the ENERGY STAR specification to include digital photo frames and large displays (with screen sizes larger than 30 inches), which are typically used as signage or in other business settings.

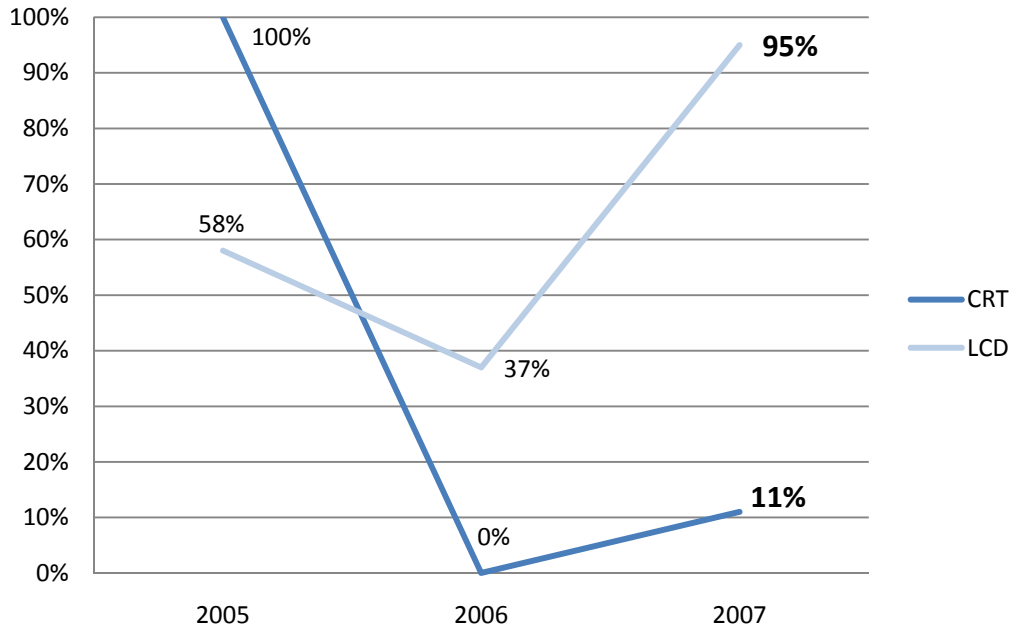
Version 5.0 sets limits for *on* mode energy use by screen size and resolution for products under 30 inches. Energy use targets for products with screens larger than 30 inches take into account only screen size.

In addition to ENERGY STAR, displays are covered under EPEAT standards. EPEAT is a labeling system that recognizes products that reduce environmental impact across a variety of areas, including reduction of hazardous materials, use of recycled materials, and the potential to recycle the device when it is no longer needed. To qualify for EPEAT, a product must meet ENERGY STAR standards.

ENERGY STAR Penetration

As of July 2, 2009, 40 companies produce 2,438 ENERGY STAR-qualified monitors. The ENERGY STAR penetration data (Figure 3.2) demonstrates the effects of increasingly stringent standards on penetration levels. Notably, when Tier 2 of the current standard took effect in 2006, the penetration rates of qualified products decreased sharply. In 2007, the most recent year for which data are available, nearly all LCD displays shipped in the U.S. were ENERGY STAR-qualified.

Figure 3.2: Market Penetration of ENERGY STAR-Qualified Displays



SET-TOP BOXES

Set-top boxes (STBs) convert television signals from an external source into a format compatible with the user's television. Some STBs fill a technological gap between broadcast technology and the user's television receiver, as is the case with digital converter boxes.[20] But the majority of STBs allow users to view content provided by cable, satellite, or IPTV service providers. These *pay-TV* services use STBs to store user information and security codes to ensure that only paid subscribers have access to content.

In 2006, there were an estimated 147 million cable and satellite STBs in U.S. homes, and that number appears to have grown.[21] As of March 2009, nearly 82% of all households subscribed to cable or satellite TV service and most have at least one and often two or more STBs.[22]

The STB supply chain differs from other consumer electronics products in that end-users have little choice about the make and model of the device installed in their home. Pay-TV service providers typically lease STBs to the subscriber (end-user) as part of the service agreement.

Satellite STB

Cable STB

IPTV STB

A set-top box (STB) is a device that receives a signal from a source like cable, satellite, or over-the-air digital transmissions, and converts it to a format that can be viewed on the user's television. Increasingly, these devices are capable of delivering high-definition video content and include digital video recorders.

(Images: *www.motorola.com, www.thomson.com, www.cisco.com*)

A 2009 ENERGY STAR specification for STBs combined with their high annual energy use and high penetration in U.S. households make this device an important target for energy efficiency

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20 Although the switchover from analog to digital broadcasting, which occurred in the United States on June 12, 2009, has driven demand for STBs, this type of STB is not a primary focus of this report. The demand for STBs to convert over-the-air digital signals for viewing on analog TVs will likely be short-lived, since all new televisions sold in the United States now contain the technologies necessary to process digital signals without an STB.

21 Roth et al. *Residential Miscellaneous Electric Loads: Energy Consumption Characterization and Savings Potential.* Of the 147 million total STBs, an estimated 77 million were cable STBs and 70 million were satellite STBs.

22 National Cable & Telecommunications Association (NCTA). Industry data. Retrieved June 29, 2009, from *http://www.ncta.com/Statistics.aspx*.

programs. STBs' one-of-a-kind supply chain will require programs to establish relationships with pay-TV service providers, a task that may prove challenging. However, both STB manufacturers and pay-TV service providers recognize several non-energy benefits of energy-efficient STBs and thus may be interested in participating in energy efficiency programs.

Key Market Characteristics and Trends

- **Two key technological innovations have driven demand for STBs in recent years: high definition (HD) TV and digital video recorders (DVRs).** As flat panel televisions and home theaters capable of displaying high-resolution images have become more prevalent, demand for HDTV content has increased. Industry analysts expect that by 2010, as much as 30% of all STBs shipped will decode HD signals, and as the cost of HD set-top boxes declines, cable providers may begin supplying them as the default STB type.[23] DVRs (also known as personal video recorders or PVRs) allow users to record specific shows for later viewing. In addition, some models constantly record, allowing users to pause and rewind live TV. DVR-equiped STBs currently make up one-third of all STB shipments.[24]

- **The trend toward greater functionality in STBs has resulted in dramatically increased energy use.** STBs with HD and DVR functionality use more energy than STBs without these features because they require faster processors, more integrated chips, larger memories, and, in some models, additional tuners. A 2007 study of STB energy use found the energy use of a digital cable STB increases 57% with the addition of HDTV capability and 107% with both HDTV capability and a DVR.[25]

- **While the market for STBs has been growing, analysts expect STB shipments to peak this year and begin to decrease gradually.**[26] This decline is expected to occur as many countries complete the transition from analog to digital television broadcasting and as TVs, game consoles, and other devices increasingly take on functions that are currently available only through STBs.[27]

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23 ABI Research. (June 3, 2009). *High-Definition set-top boxes to account for nearly one-third of total STB shipments next year*. Press Release. Retrieved from *http://www.abiresearch.com/press/1434-High-Definition+Set-Top+Boxes+to+Account+for+Nearly+One+Third+of+Total+STB+Shipments+Next+Year*.

24 Dell'Oro Group. (June 8, 2009). *DVR-equipped set-top box shipments contract 20 percent year-over-year in the first quarter*. Press Release. Retrieved from *http://www.delloro.com/news/2009/STB060809.htm* .

25 Roth et al. *Residential Miscellaneous Electric Loads*.

26 ABI Research. *High-definition set-top boxes to account for nearly one third of total STB shipments next year*.

27 ABI Research. (November 19, 2008). *Set-top box shipments to peak in 2012*. Press Release. Retrieved from *http://www.abiresearch.com/press/1305-Set-Top+Box+Shipments+to+Peak+in+2012*.

- **Hybrid STBs, which combine IP (Internet protocol) video with traditional cable or satellite functions, are growing in popularity.** IP video delivers television content over a high-speed Internet connection. Satellite service providers will likely play a strong role in the growth of IP video, since the technology allows them to offer services that require two-way communication between the user's STB and the service provider.[28] Analysts expect that shipments of hybrid STBs for satellite viewing will increase to ten times their current levels in 2011.[29]

- **Manufacturers believe "place shifting" will become an increasingly common feature of STBs.** Technologies currently in development will allow content recorded on an STB to be accessed from another location, a phenomenon known in the industry as *place shifting*. Place shifting can occur within a household through networked STBs, which will allow material recorded on an STB in one room to be played back in another room. STBs connected to the Internet will make content recorded on an STB available to the user from any location with Internet access.

Supply Chain

There are two key players in the STB supply chain:

- **Pay-TV service providers** determine the specifications of the STBs, select a manufacturer to produce them, purchase the STBs from the manufacturer, and either lease or sell the STBs to their consumers.

- **Manufacturers** design STBs based on specifications provided by the pay-TV service provider and manage their manufacture. The STBs are then sold to the service provider. The manufacturer's brand, the service provider's brand, or both appear on the product.

Cable and Satellite Service Providers

Table 3.4 provides details on the top 10 cable service providers in the U.S. Together they serve 90% of U.S. cable subscribers.

Table 3.5 provides details about the two U.S. satellite providers.

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[28] Unlike cable, satellite technology does not allow for two-way communication between the user's STB and the service provider; the user can only receive signals from the satellite, they cannot transmit information back. This type of two-way communication is necessary for video-on-demand services and customizable program guides.

[29] ABI Research. (September 19, 2006). *Satellite operators will drive high growth rates for the hybrid set-top box*. Press Release. Retrieved from *http://www.abiresearch.com/press/725-Satellite+Operators+Will+Drive+High+Growth+Rates+for+the+Hybrid+Set-Top+Box*.

Table 3.4: Top 10 U.S. Cable Providers

COMPANY	RANK	OVERALL COMPANY SALES IN US$ (YEAR)	NUMBER OF CABLE SUBSCRIBERS	SERVICE AREAS	ENERGY STAR PARTNER?
Comcast *www.comcast.com*	1	$34.3 B (2008)	24,182,000	National (39 states and District of Columbia)	No
Time Warner *www.timewarnercable.com*	2	$17.2 B (2008)	13,069,000	Primarily New York State, the Carolinas, Ohio, Southern California, and Texas	No
Cox Communications *ww2.cox.com*	3	$15.0 B (2007)	5,328,304	Provides service to select cities in 19 states	No
Charter Communications *www.charter.com*	4	$6.5 B (2008)	5,045,700	Operates in 27 states	No
Cablevision Systems Corp *www.cablevision.com*	5	$7.2 B (2008)	3,108,000	New York metropolitan area	No
Bright House Networks *www.mybrighthouse.com*	6	Unknown	2,307,778	Florida, Alabama, California, Indiana, and Michigan	No
Mediacom Communications *www.mediacom.com*	7	$1.4 B (2008)	1,318,000	Operates in 23 states, mainly in the Midwest and South.	No
Suddenlink Communications *www.suddenlink.com*	8	$1.5 B (2008)	1,268,674	Texas, West Virginia, North Carolina, Louisiana, Arkansas, Oklahoma, Missouri, and California	No
Insight Communications *www.insight-com.com*	9	$1.4 B (2007)	707,600	Primarily Louisville, KY, also reaches customers in Indiana and Ohio	No
CableOne *www.cableone.net*	10	Unknown	669,469	Operates in 19 states, primarily in rural communities in the Midwest, South, and West	No

Sources: Rankings and number of cable subscribers from National Cable and Telecommunications Association (NCTA). Top 25 MSOs. Retrieved June 29, 2009 from *http://www.ncta.com/Stats/TopMSOs.aspx*. Sales data from *http://www.hoovers.com*, Service area data from cable provider websites. ENERGY STAR data from U.S. EPA/ENERGY STAR. ENERGY STAR Partner List Results. Retrieved July 14, 2009 from *http://www.energystar.gov/index.cfm?fuseaction=estar_partner_list.showPartnerResults&s_code=ALL&partner_type_id=CSTSP&cntry_code=ALL&award_search=N*.

Table 3.5: U.S. Satellite Providers

COMPANY	RANK	OVERALL COMPANY SALES IN U.S.$ (YEAR)	NUMBER OF SUBSCRIBERS	ENERGY STAR PARTNER?
DirecTV *www.directv.com*	1	$19.7 B (2008)	18,080,000	Yes
Dish Network *www.dishnetwork.com*	2	$11.6 B (2008)	13,584,000	No

Source: Satellite service provider websites. Rankings based on number of subscribers.

IPTV Service Providers

Although IPTV technology has existed for more than ten years, far fewer Americans subscribe to IPTV services than to cable or satellite services, and the technology has grown more slowly in the U.S. than it has in other parts of the world.[30] The majority of IPTV service providers in the U.S. are telecommunications companies, many of which have entered the market to compete with the bundled television, Internet, and phone services that cable providers offer.[31] Verizon and AT&T dominate the U.S. IPTV market, and both have worked to quickly expand their subscriber base over the last few years.[32] Table 3.6 gives details of the top U.S. IPTV service providers. Most other service providers operate over a much smaller area and reach far fewer subscribers than these industry leaders.

Table 3.6: Top U.S. IPTV Service Providers

COMPANY	RANK	OVERALL COMPANY SALES IN U.S.$ (YEAR)	NUMBER OF SUBSCRIBERS	ENERGY STAR PARTNER?
Verizon *http://www22.verizon.com/*	1	$97 B (2008)	2,217,000 (2009)	No
AT&T *http://www.att.com/*	2	$124 B (2008)	1,329,000 (2009)	Yes
SureWest Communications *http://www.surewest.com/*	3	230.4 M (2008)	19,657 (2007)	No

Sources: Company rankings from David Cotriss. Top IPTV Providers. Daily IPTV. Retrieved July 21, 2009, from *http://www.dailyiptv.com/news/top-iptv-providers-012607/*. Revenue data from *http://www.hoovers.com/*. Subscriber data from Telco IPTV View. Retrieved from *http://telcotv-view.blogspot.com/*.

Manufacturers

Table 3.7 provides details on top STB manufacturers.

30 Tim Hills. (December 8, 2008). "IPTV in the USA: IPTV Boom or Doom?." *Light Reading*. Retrieved from *http://www.lightreading.com/document.asp?doc_id=167595&page_number=1*.

31 Hills. IPTV in the USA.

32 Dell'Oro Group. (March 11, 2009). *Surging IPTV subscriber base drives set-top box sales in the fourth quarter of 2008.* Press Release. Retrieved from *http://www.delloro.com/news/2009/STB031109.htm*.

Table 3.7: Top U.S. Set-Top Box Manufacturers, 2008

COMPANY	OVERALL COMPANY SALES IN U.S.$ (YEAR)	KEY FACTS	TYPE OF SET-TOP BOXES PRODUCED			ENERGY STAR-QUALIFIED SET-TOP BOXES?		
			CABLE	SATELLITE	IPTV	CABLE	SATELLITE	IPTV
Motorola *www.motorola.com*	$30.1 B (2008)	Founded 1928. Based in Illinois. Produces a wide range of networking and communications equipment.	X		X	Yes	N/A	Yes (listed on ENERGY STAR as Motorola H&NM, Inc.)
Cisco *www.cisco.com*	$39.5 B (2008)	Founded 1984. Based in California. Produces a wide range of products focused on communications networks. Produces STBs under the brand name Scientific Atlanta.	X		X	No	N/A	Yes
EchoStar *www.echostar.com*	$2.15 B (2008)	Separated from DISH Network in 2008. Based in Colorado. Produces STBs, DVRs, and equipment to enable place-shifting.	X	X	X	No	No	No
Pioneer Electronics *www.pioneerelectronics.com*	$7.8 B (2008)	Founded 1938. Based in Japan. Products include audio and video equipment for residential and business use, car audio and navigation products, portable audio products, and professional DJ products.	X			No	N/A	N/A
Pace Micro *www.pace.com*	$1.1 B (2008)	Founded 1982. Based in the UK. Produces set-top boxes and DVRs. Acquired Philips Electronics' STB business in 2008.	X	X	X	Yes	Yes	No

Continued

COMPANY	OVERALL COMPANY SALES IN U.S.$ (YEAR)	KEY FACTS	TYPE OF SET-TOP BOXES PRODUCED			ENERGY STAR-QUALIFIED SET-TOP BOXES?		
			CABLE	SATELLITE	IPTV	CABLE	SATELLITE	IPTV
Thomson *www.thomson.net*	$6.8 B (2008)	Founded 1893. Based in France. Business segments include management of video-related services for media content producers, production of home networking products, including set-top boxes and software applications.	X	X	X	No	Yes	No
LG *www.lge.com*	$44.7 B (2008)	Founded 1958. Based in Korea. Produces home entertainment, mobile communications, home appliance, air conditioning, and business solution products.	X	X	X	No	Yes	No
Sanmina-SCI Corp. *www.sanmina-sci.com*	$7.2 B (2008)	Founded 1980. Based in California. EMS provider of manufacturing products for use in areas including communications, defense and aerospace, industrial and semiconductor systems, and medical instrumentation.		X		N/A	No	N/A
Sony *www.sony.com*	$89.6 B (2008)	Founded 1946. Based in Japan. Produces a range of audio, video, television, information and communication, semiconductor, and electronic component products.	X		X	No	N/A	No
Panasonic *www.panasonic.com*	$91 B (2008)	Founded 1918. Based in Japan. Offers a wide range of electronics products for consumer, business, and industrial sectors. Formerly known as Matsushita Electric Industrial Co.	X			No	N/A	N/A

Sources: Revenue data from *http://www.hoovers.com/*. Company information from manufacturer websites. ENERGY STAR data from ENERGY STAR. (June 29, 2009). Set-top Box qualified product list. Retrieved from *http://www.energystar.gov/ia/products/prod_lists/set_top_boxes_prod_list.xls*. ENERGY STAR lists all qualified satellite STBs under the brand name and company name DirecTV. The table assumes that each of DirecTV's STB suppliers (Pace Micro, LG, and Thompson) provide ENERGY STAR-qualified models.

- **Cable STB market share**. As of May 2008, Motorola and Cisco held most of the market for cable STBs, constituting what *Business Week* called an effective *duopoly*.[33] Most of the rest was held by Pioneer and Pace Micro, with a small market share held by Sony and Panasonic.
- **Satellite STB market share**. Although the market share of satellite STB manufacturers is not publicly available, interview subjects provided some information on which manufacturers supply STBs to U.S. satellite service providers. According to interview subjects, DirecTV obtains its STBs from Pace Micro, LG and Thomson. Dish Network obtains its STBs from EchoStar. The two companies, now separate business entities, were jointly owned by EchoStar Communications Corporation until 2008, when they were separated.

Product Development Process

The development timeline and process for cable and satellite STBs is similar. Development time ranges from 6 to 18 months, depending on the complexity of the product and the extent to which it uses new technologies. One interviewee estimated that design takes two-thirds of total development time, with much of the rest spent testing the device to ensure that it will be compatible with the service provider's network.

Product Design

Service providers and manufacturers each play a role in the design of STBs. Service providers specify the features and functions that the device must provide, in some cases basing these specifications on a *marketing requirements* document. For example, a service provider may specify that: a box should provide HD capabilities or DVR functions; the amount of memory available to record video; the number of tuners; the number and type of input and output jacks; and the device's audio capabilities. Manufacturers, working closely with integrated circuit suppliers, then design a device that meets the service provider's specifications.

While manufacturers must maintain a relationship with service providers to receive product specifications, service providers generally purchase STBs through a competitive bid process in which manufacturers compete to meet the specification at the lowest cost. Service providers generally select a minimum of two and as many as five manufacturers to produce the STB. In the cable STB market, it is common for one of the manufacturers of any particular box to be either Motorola or Cisco.

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[33] Stephen Wildstrom. (May 28, 2005). Will Sony's cable deal kill the set-top box? *Business Week*. Retrieved from *http://www.businessweek.com/the_thread/techbeat/archives/2008/05/will_sonys_deal.html?campaign_id=rss_tech*

Until recently, service providers faced significant barriers to changing STB manufacturers because these manufacturers (primarily Motorola and Cisco) maintained ownership of the conditional access (CA) technology that secures the pay-TV content. Today, Motorola and Cisco license their CA technology to other STB manufacturers, like Pace, eliminating one of the service provider's most significant barriers to changing suppliers.

CableLabs, the cable industry's research and development consortium, also plays a role in the design process for cable STBs. In an effort to standardize equipment across cable systems, CableLabs creates generic STB specifications, which serve as a base for most of the specifications that cable service providers issue. CableLabs also tests STBs to ensure that they will operate across cable networks, a process that can add three months to the product development timeline.

In rare cases, the manufacturer may produce devices to a service provider's specifications without a contract, or build devices to a generic specification published by CableLabs and then try to sell the devices to service providers. However, building to a generic specification may result in a more expensive STB than one designed specifically to meet a service provider's specifications.

Manufacturing

The majority of STB manufacturing takes place in Asia and Latin America. Manufacturers produce STBs both in factories they own and through contracts with original design manufacturers (ODMs) and equipment manufacturing suppliers (EMSs) – firms that manage manufacturing and sometimes design activities based on the STB manufacturer's specifications. According to industry analysts, the role of ODMs and EMSs in STB production has grown recently, with about 70% of STB manufacturing estimated to be outsourced to this type of supplier.[34] Motorola, for example, has contracted with two EMSs, Flextronic and HomeHigh, and Cisco has outsourced some design functions to an ODM called Gemtek.

Outsourcing production and design for entry-level and mid-range products allows manufacturers to deliver products to service providers more quickly. This is important, as service providers typically demand large number of STBs, as many as 100,000 at a time, and may require manufacturers to produce them quickly.

Distribution

End-users obtain STBs when they subscribe for cable or satellite services. Typically, the subscriber requests a box with one of four feature sets (basic, basic with DVR, HDTV, HDTV with DVR) and the service provider supplies the appropriate STB. Like cell phone service

[34] Jeffrey Wu. (November 19, 2008). *Set-top box outsourcing deciphered!: A Global OEM Manufacturing & Design Analysis for Set-top boxes Webinar*. iSuppli Webinar.

providers, cable and satellite service providers subsidize the cost of STB's for their subscribers in exchange for a commitment to maintain service for a set period of time. Service providers typically lease STBs to subscribers for between $4 and $10 per month. DirecTV subscribers purchase one of four STB models from the company for between $69 and $199. The wholesale price of an HD STB was estimated by one publication at $400 to $500. [35]

Marketing

STB marketing occurs at two places in the supply chain:

- **Manufacturers market their design and manufacturing capabilities to service providers.** This type of marketing occurs primarily through the cultivation of relationships with service providers, meetings, and one-on-one contacts. Manufacturers may also produce brochures, one-page product descriptions, or presentations to convey information about their products or capabilities to service providers. In addition, manufacturers maintain websites demonstrating the products they produce and touting the benefits of those products to service providers. Marketing messages at this stage focus on the product's costs and benefits to the service provider, as well as product features that will help increase the end-user's satisfaction.
- **Service providers market STBs to end-users in conjunction with programming packages**. While service providers' marketing typically describes features integral to the STB – like DVRs and the ability to deliver HD programming – marketing messages generally include little or no information about the device itself and focus on the programming offered. Service providers use a wide variety of mass media advertising to attract end-users, including television and radio ads, online advertising, print ads, and billboards.

Industry Organizations and Events

Six organizations influence and/or study the STB market:

- **ABI Research –** a market research firm specializing in mobile and networking technologies.
- **American Cable Association –** a trade association for small and medium-sized independent cable, phone and fiber to the home service providers. Its members largely serve rural areas.

[35] American Cable Association. (June 2, 2009*). ACA applauds FCC for issuing set-top box waivers*. Press Release. Retrieved from *http://www.americancable.org/node/1342*.

- **CableLabs –** a non-profit research and development consortium founded by cable service providers that conducts research into cable and STB technologies, and issues specifications to ensure STB compliance with multiple cable networks.
- **Dell'Oro Group –** a market research firm focused on the networking and telecommunications industries.
- **National Cable & Telecommunications Association** – the largest cable industry trade association in the United States. Its members serve more than 90% of American cable subscribers. The organization hosts an annual tradeshow for the industry.
- **X Media Research –** a technology research and events firm that has organized conferences focused on STB technologies and the STB industry.

Energy Efficiency

Manufacturer Attitudes towards Energy Efficiency

Four of the five STB manufacturers and the satellite service provider interviewed stated that energy efficiency was a high priority for product design. Interviewees cited two primary motivations driving them to improve the energy efficiency of STBs.

First, more energy-efficient STBs produce less heat, eliminating the need for fans or other components to cool the boxes and therefore reducing their cost. Heat also stresses an STB's components, so energy-efficient devices further reduce service provider costs by requiring fewer service calls and less frequent replacement.

The second motivation manufacturers cited for pursuing energy efficiency is a demand on the part of service providers for efficient products. According to one manufacturer, this demand was driven by end-users asking service providers why their STBs were so hot and by service providers' corporate social responsibility programs, which incorporate energy efficiency. In addition, cable and satellite service providers have recently become willing to pay slightly more for energy-efficient STBs at the same time that technological advances have driven down the cost of energy efficiency.[36]

Despite their stated commitments to energy efficiency, relatively few manufacturers offered ENERGY STAR-qualified

[36] Steve Bush. (September 2, 2008). Pace cuts power in digital TV set-top boxes. *Electronics Weekly*. Retrieved from *http://www.electronicsweekly.com/Articles/2008/09/02/44424/pace-cuts-power-in-digital-tv-set-top-boxes.htm*.

products as of June 1, 2009, and few service providers had become ENERGY STAR partners. This relative scarcity of ENERGY STAR-qualified products is likely a result of the relatively short time that the standard has been in effect.

Efficiency Standards

Manufacturers

The current ENERGY STAR standard, Version 2.0 Tier 1, took effect January 1, 2009. The standard consists of two tiers, both limiting the overall energy use of qualifying products. A more stringent Tier 2 will come into effect on January 1, 2011. (This specification is available at: *http://www.energystar.gov/index.cfm?fuseaction=products_for_partners.showSetTopBoxes*.)

The previous ENERGY STAR standard, Version 1.0, took effect January 1, 2001, but was suspended on February 2, 2005. The EPA suspended the standard because, at the time, STB energy consumption varied little between manufacturers and across operating modes. The incorporation of a *sleep* mode for STBs offered an opportunity for significant energy savings, but in 2005, the technology did not exist to allow STBs to maintain their full functionality if they entered a *sleep* mode while not in use.

The EPA began the process of revising standards for STBs in 2007 in response to technological changes and the ENERGY STAR program's increased experience in achieving energy savings with related products like computers and imaging equipment. This process resulted in the current standard.

Internationally, the potential for energy savings associated with STBs has drawn a great deal of attention. The International Energy Agency (IEA) held a workshop on energy-efficient set-top boxes and digital networks in 2007, drawing participants from 15 countries. In addition, a variety of countries and regions have developed voluntary standards or mandatory requirements. These include:

- **The European Commission Code of Conduct –** limits power consumption of STBs in both active and passive modes. Like the ENERGY STAR standard, the current version consists of two tiers. The first tier took effect on January 1, 2007, with the second tier bringing more stringent standards into effect on January 1, 2009. (These specifications are available at: *http://re.jrc.ec.europa.eu/energyefficiency/pdf/CoC%20Digital%20TV-version%207.pdf*.)
- **MEPS (Australia and New Zealand) –** STB standards took effect December 1, 2008, in Australia, and April 1, 2009, in New Zealand. (These requirements are available at: *http://www.energyrating.gov.au/stb2.html*.)
- **Canadian Standards Association –** standards for STBs were published in 2008. (The standards are available at: *http://www.shopcsa.ca/onlinestore/GetCatalogItemDetails.asp?mat=2419084&Parent=4712*.)

- **e-Standby Program (Korea) –** a voluntary partnership between manufacturers and the Korean government started in 1999. Standards target standby power reduction.

Service Providers

With the release of its Version 2.0 specification for STBs, ENERGY STAR also set standards for pay-TV service providers. To qualify, a service provider must ensure that either a minimum of 50% of the new STBs it purchases in a calendar year are ENERGY STAR-compliant or that 10% of all STBs used by its subscribers in 2009 and 25% of all STBs used by subscribers in 2010 are ENERGY STAR-compliant. In addition, service providers must meet a variety of requirements regarding product settings at installation, consumer education, and education of installers.

ENERGY STAR Penetration

As of June 29, 2009, there were few ENERGY STAR-qualified STBs. They included:

- Twelve ENERGY STAR-qualified satellite STBs, all sold under the DirecTV brand
- Four ENERGY STAR-qualified cable STBs, produced by three manufacturers
- Eight ENERGY STAR-qualified IPTV STBs, produced by two manufacturers
- Four service providers listed as ENERGY STAR partners

The low number of qualified STBs is likely due to the recent enactment of the specification. All manufacturers interviewed anticipated that all or almost all of the STBs they produce would be compliant with the ENERGY STAR Tier 1 specification. Some manufacturers elaborated that the Tier 1 specification did not require significant changes in their STB design. However, manufacturers anticipate the Tier 2 specification will be more difficult to meet.[37] They expressed concern that available technology and components (primarily silicon) will not allow them to produce an STB that meets the specified energy use while maintaining current functionality, a problem particularly for devices with DVRs. Despite these concerns, manufacturers reported they aim to produce products compliant with the Tier 2 standard when it comes into effect.

Marketing Energy-Efficient Products

The manufacturers interviewed recognized that energy efficiency offered them the potential to differentiate their products. Manufacturers stated that energy-efficient STBs would be a desirable feature that service providers could use to attract end-users. However, energy efficiency currently plays no role in service providers' marketing of STBs to end-users and a minimal role

[37] In the specification, ENERGY STAR gives the example of a high-definition cable STB with DVR. Under Tier 1, the device is allowed a total annual energy consumption of 165 kWh. Under Tier 2, the device would be allowed only 94 kWh of annual energy consumption.

in manufacturers' marketing materials directed toward cable and satellite providers. While a review of consumer-facing STB marketing by the top five cable providers and both satellite services found no mention of energy efficiency, marketing materials manufacturers created for cable and satellite providers included the following minimal references to energy efficiency:

- The Motorola DTA 100 and DCX 3400 STBs display the ENERGY STAR logo on their product detail websites, but the product descriptions make no mention of energy efficiency.
- Cisco's line of NTSC addressable analog cable STBs contains a sleep timer which automatically turns the device off after a set period of inactivity. This feature is listed on page three of a six-page product brochure under *Other Features Subscribers Value*, with no direct reference to its energy efficiency benefits.

Utility Program Activity

A working group of Canadian utilities led by BC Hydro is currently sponsoring a market transformation program aimed at STBs. The utilities are seeking to work with pay-TV service providers because of their role in determining which STBs end-users will install. The effort began in 2008 and work to-date includes a feasibility study and an in-person, full-day meeting between utilities, manufacturers, and service providers. As of August 2009, each utility in the working group was beginning to engage with its respective service providers to find an appropriate and feasible program design. Marbek Resource Consultants is assisting with program design and service provider negotiations.

New Jersey Clean Energy is also developing a pilot program targeting STBs. The program was expected to issue an RFP in August 2009 and kick off a program in September 2009.

Barriers and Opportunities

Barriers

- **There is a significant split incentive toward energy efficiency in the STB market.** While end-users would see the greatest benefit from energy-efficient STBs, they currently have almost no control over which STB is installed in their home.
- **A few large service providers dominate the STB supply chain**. Unlike other consumer electronics products, nearly all STBs are obtained through only one channel: the pay-TV service provider. These companies have not shown a willingness to engage with energy efficiency efforts to-date.
- **Critical STB functionality contributes to increased energy use.** In order to maintain the security of the content and to download program guides and other content, STBs must maintain contact with the service provider's network. As a result, STBs use a relatively

large amount of energy, even when the user is not watching TV. Manufacturers indicated that reducing energy use may require some sacrifice in functionality.

Opportunities

- **Manufacturers perceive a demand for energy-efficient products.** Manufacturers interviewed identified demand for energy-efficient products on the part of both consumers and service providers, and stated that this demand drives their efforts to develop more efficient products.
- **The non-energy benefits of more efficient STBs are important to service providers.** By producing less heat, energy-efficient STBs are less expensive. They require fewer components and last longer. These qualities are important to service providers because the cost of providing servicing and replacing STBs is considerable.
- **Relatively few stakeholders influence the type of STB installed in end-users' homes.** Because service providers generally determine the type of STB that they will provide to end-users, efficiency programs could reach large numbers of households by partnering with relatively few service providers.
- **Energy-efficient STBs may help service providers meet future end-user needs.** Cable and satellite service providers face significant expenses when new technologies force them to replace end-users' STBs. As a result, they seek devices that will meet end-user needs into the future. Energy use has recently become increasingly important to end-users and service providers may be able to respond to end-users' future energy concerns by providing efficient STBs now.
- **An ENERGY STAR standard exists for service providers.** Although few service providers have become ENERGY STAR partners, the standard provides a framework for service providers to follow and a concrete benefit to the service provider for pursuing energy efficiency.
- **The pay-TV industry trend toward *place shifting* may lower energy requirements for some STBs.** Currently, recorded content is stored on an STB with DVR capability and is accessible to the end-user only when viewed from the TV connected to that STB. Thus end-users must have a DVR-enabled STB in every room where recorded content will be watched. Place shifting will allow end-users to view content recorded on one STB from multiple locations, thus reducing the need to install several DVR-enabled STBs in a single household and lowering the overall STB energy use in the household.

SERVERS

Thirty to forty percent of the world's servers are housed in the U.S.[38] The U.S. EPA estimated servers and data centers consumed about 61 billion killowatt-hours of electricity annually by 2006, 1.5% of the total national energy consuption and equal to the energy used by 5.8 million typical households.[39] Server energy use doubled from 2000 to 2005 and is expected to increase as demand for Internet services rises.[40]

Although energy has become a hot topic among IT manufacturers, data center managers, and businesses, progress toward reducing consumption has been slow for several reasons: energy usage data is often proprietary, making it difficult to estimate how much energy servers are consuming; server technology changes rapidly, making it difficult to create energy efficiency standards;[41] and developing standards is further complicated by the fact that server configurations are highly variable, ranging from $300 home units to the massive, multi-unit devices used in large businessess.

The recent release of the first ENERGY STAR specification for servers is expected to draw increased attention to energy issues. Industry-led groups and one long-running utility-sponsored program have also been effective in raising awareness. However, both manufacturers and industry observers acknowledge that much work remains, and there are several opportunities to improve efficiency in this market.

Volume Server

Mid-Range Server

High-End Server

A server is a computer used to store data and transmit it to other computers connected to a network. Servers vary widely in size, speed, memory and appearance, with some models designed for homes or small offices and others designed for use in large organizations.

(Images: *www.hp.com*)

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38 Jonathon G. Koomey, PhD. (2007). *Estimating Total Power Consumption by Servers in the U.S. and the World*. Retrieved from *http://enterprise.amd.com/Downloads/svrpwrusecompletefinal.pdf*.

39 U.S. EPA. (August 2, 2007). *EPA Report to Congress on Server and Data Center Energy Efficiency*. Retrieved from *http://www.energystar.gov/ia/partners/prod_development/downloads/EPA_Report_Exec_Summary_Final.pdf.*

40 Koomey, PhD. (2007). *Estimating Total Power Consumption*.

41 Koomey, PhD. (2007). *Estimating Total Power Consumption*.

Key Market Characteristics and Trends

- **The number of servers in the U.S. has been increasing steadily since the late 1990s.** In 2007, there were 11.8 million servers in the U.S., almost five times more than a decade earlier.[42] Although spending on servers stalled in 2008 and early 2009, analysts predict a rebound by 2010, with blade servers expected to be the next major sales growth area.[43]

- **The smallest, least expensive servers account for the most energy waste.** Server electricity use doubled from 2000 to 2005. Almost all of this growth is attributed to volume servers – the cheapest, most common and least energy-efficient of all server types (see Table 3.8).[44] In addition, volume server energy use is rising. In 2006 the average volume server used 225 watts, up 20% from 2000. For these reasons, ENERGY STAR has identified volume servers as the "low hanging fruit" for energy efficiency efforts.[45]

- **Cloud computing will decrease the need for volume servers, but increase the importance of efficiency in large-scale servers.** As *cloud computing* (the outsourcing of computing functions from an in-house server to a data center) becomes more common, the need for volume servers will decrease and the need for large-scale servers will increase.

- **Reducing energy use is fast becoming a priority for data center facility managers and IT staff.** Data center energy use is rising despite growing concerns. If consumption rates for all server classes maintain their post-2000 growth rates, total server electricity use in 2010 will be an estimated 76% higher than it was in 2005.[46] Over half of all data centers already have insufficient power supplies and over the next few years, predicted supply limitations and power failures may cause operating difficulties in 90% of all data center operations.[47] Industry-sponsored, collaborative organizations like The Green Grid have been formed to address this problem by developing standards and educational materials.

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42 Michael Graham Richard. (June 19, 2008). Number of the day. *Treehugger*. Retrieved from *http://www.treehugger.com/files/2008/06/data-centers-computer-servers-energy-usage-statistics.php*

43 IDC. (June 17, 2009). *Worldwide server market spending will decline 22.1% in 2009, but market shows signs of stabilization, according to IDC*. IDC Press Release. Retrieved from *http://idc.com/getdoc.jsp;jsessionid=WN00XPFS55HHECQJAFICFGAKBEAUMIWD?containerId=prUS21890009*

44 Koomey. *Estimating Total Power Consumption*.

45 Chris Preimesberger. (September 17, 2007). EPA targets the yeoman server first for ENERGY STAR. *eWeek*. Retrieved from http*://www.eweek.com/c/a/Data-Storage/EPA-Targets-the-Yeoman-Server-First-for-Energy-Star/*

46 Koomey. *Estimating Total Power Consumption*.

47 Chris Preimesberger. (May 15, 2009). EPA sanctions ENERGY STAR specification for servers. *eWeek*. Retrieved from *http://www.eweek.com/c/a/Green-IT/EPA-Launches-Energy-Star-Specification-for-Servers-205135/*

Table 3.8: Server Types

DEVICE TYPE	OTHER NAMES	SYSTEM COST	PERCENT OF TOTAL SERVERS	TYPICAL END-USER	EXAMPLE
Volume Server	Home server, desktop-derived server, blade server	<$25,000	90%-95%	Home office or small business, several volume servers together may support a larger business	**MediaSmart Home Server**  (*Image: www.ArsTechnica.com*)
Mid-Range Server		$25,000-$500,000	4%-5%	Small to medium-sized office	**Altix 350 Server**  (*Image: www.nasi.com*)
High-End Server	Enterprise server, high performance server, scientific server	>$500,000	0.2%	Large business or data center	**Single Width Server Cabinet**  (*Image: www.Comms-Express.com*)

Source: Koomey. *Estimating Total Power Consumption*.

Product Definitions and Categorization

What Is A Server?

A server is a computer used to send, receive, store, or relay data to other computers on a network.[48] Servers come in various shapes and sizes, and differ in their speed, memory, and appearance. Servers also vary by functionality and may be designed specifically to serve one or more purposes. Some of the most common include application servers, communications servers, database servers, file servers, mail servers, storage servers, and web servers.

Server Components

Servers are highly customizable, but most include a motherboard, processor, memory, hard drives, a network connection, power supply, and a video card. A paradigm shift has occurred in server design, moving away from the PC-like rectangular box with internal fans, power supply and other components to a more open configuration where power supplies and cooling equipment is physically separated from the processors.

Categorization

This report defines three types of servers based on price and expected end-user: *volume*, *mid-range*, and *high-end*, as described in Table 3.8. Definitions of terms found in this table are in the Glossary in *Appendix G*.

The term *server* can refer to various configurations of the components and any categorization scheme will be somewhat fluid. The categorization process is made more difficult by the servers' complexity and rapid pace of evolution. In fact, how categories are defined may depend primarily on who is defining and for what purpose:

- **Manufacturers –** Each manufacturer categorizes servers in its own way**.** For example, Sun Microsystems uses the terms *entry level*, *mid-range*, and *high-end* to describe their servers, each of which is defined by the machine's processing power and price, as well as the expected needs of its user.[49] IBM groups servers by price and purpose, while Dell offers customized servers to meet each user's needs.
- **Regulatory Agencies –** ENERGY STAR groups servers by how many sockets they have (which determine how many processors they can house) in order to set efficiency

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48 David Risley. Build your own server. *PCMech*. Retrieved June 18, 2009 from *http://www.pcmech.com/byos/*

49 Sun Microsystems. Company website. Retrieved June 24, 2009 from *http://www.sun.com/servers/index.jsp?tab=1*

standards.[50] But as the ENERGY STAR program manager acknowledges, the fact that servers are highly customizable makes even this categorization subject to exceptions because a multi-socket server may be sold with only a single processor.

- **Researchers –** The research firm IDC and a widely-cited 2007 study by Jonathan Koomey, *Estimating the Total Power Consumption by Servers in the U.S. and the World*, group servers into the categories used here: *volume*, *mid-range*, and *high-end*. These categories are defined primarily by the server's cost.

Supply Chain

The primary players in the server market are manufacturers, component suppliers, value added resellers (VARs), and retailers.

- **Manufacturers**: Manufacturers design products and manage their manufacture. Manufacturers sell servers directly to the end-user and through VARs and retailers.
- **Component Suppliers**: Each manufacturer may depend on numerous suppliers; the makers of processors and power supplies have perhaps the greatest effect on a server's energy efficiency.
- **Value Added Resellers (VARs)**: Most customers obtain servers through VARs, who assist with product selection, installation, and maintenance.
- **Retailers**: Small servers may reach customers through retailers, depending on the complexity of the system and the level of expertise needed to install it.

Manufacturers

Table 3.9 lists the top manufacturers of all server types. Each of these companies makes at least one server in every cost range and type.

[50] Server efficiency depends on the ratio of processors to workload, or how much energy the server consumes compared to the amount of work accomplished.

Table 3.9: Selected Major Server Manufacturers

COMPANY	FOURTH QUARTER 2008 MARKET SHARE	SERVER REVENUE IN MILLIONS OF US$ (2008)	KEY FACTS	PARTICIPATED IN DEVELOPMENT OF ENERGY STAR SPECIFICATION?	PARTICIPATION IN "GREEN" ORGANIZATIONS (*On Board of Directors)	ENERGY STAR-QUALIFIED ENTERPRISE SERVERS?
IBM *www.ibm.com*	36.3%	$16,988 M	Founded 1986. Based in New York. Overall revenue from 2008 totaled $103.6 B. Manufactures servers of all types.	Yes	Green Grid*	No
HP *www.hp.com*	29.0%	$15,751 M	Founded 1939. Based in California. Among the world's largest IT companies with overall revenue totaling $118.4 B in 2008. Manufactures servers of all types.	Yes	Green Grid* Climate Savers* 80 PLUS	Yes
Dell *www.dell.com*	10.6%	$6,199 M	Founded 1984. Based in Texas. Had $61 B in revenue in 2008. Advertises only mid-range and high-end servers on its website.	Yes	Green Grid* Climate Savers* 80 PLUS	No
Sun Microsystems *www.sun.com*	9.3%	$5,377 M	Founded 1911. Based in California. Reported $13.9 B in revenue in 2008. Manufactures servers of all types, from volume to high end.	Yes	Green Grid* Climate Savers	No
Fujitsu / FSC *www.fujitsu.com*	4.2%	$2,566 M	Founded 1935. Based in Japan. Supports customers in 70 countries and reported consolidated revenue of $47 billion for 2008. Manufacturers servers of all types, from volume to high end.	Yes	Climate Savers	No

Continued

COMPANY	FOURTH QUARTER 2008 MARKET SHARE	SERVER REVENUE IN MILLIONS OF US$ (2008)	KEY FACTS	PARTICIPATED IN DEVELOPMENT OF ENERGY STAR SPECIFICATION?	PARTICIPATION IN "GREEN" ORGANIZATIONS (*On Board of Directors)	ENERGY STAR-QUALIFIED ENTERPRISE SERVERS?
Others	10.6%	$6,451	Others include: 3Com, Acer, Airlink, Buffalo, Compaq, IOGear, Iomega, LaCie, Lantronix, Lenovo, Sans Digital, Seagate, Netmedia, Netgear, Nokia, Overland, Perle, QNAP, Quanta Computer Inc., Systems, Rackable Systems, SGI, SonicWall, Supermicro, Toshiba			No

Sources: Market share and server revenue data from: Larry Dignan. (February 24, 2009). IDC: Server sales tank globally; IBM still leader of the pack IDC. Posted to *http://blogs.zdnet.com/BTL/?p=13412*; ENERGY STAR-qualified product data from U.S. EPA/ENERGY STAR. (June 1, 2009). ENERGY STAR computer server qualified product list. Retrieved from *http://www.energystar.gov/ia/products/prod_lists/enterprise_servers_prod_list.xls*.

Industry Organizations and Events

Research Firms

- **Gartner** is a leading technology research firm. Gartner's Dataquest publishes IT and telecom market data for technology manufacturers to assist with market strategy and product planning (*www.gartner.com*).
- **IDC** is a market research and consulting firm focused on the information technology, telecommunications, and consumer technology industries. Based in Massachusetts, it provides research, analysis, and forecasts with a global focus. Data on unit shipment numbers by server type and manufacturer market share are available for purchase. IDC also performs custom research (*www.idc.com*).
- **Standard Performance Evaluation Corporation (SPEC)** is a non-profit corporation that establishes, maintains and endorses PC and server benchmarks and standards. SPEC's benchmarks have focused on performance measurement (not energy use); however, a recently released benchmark is the first to include a performance/watt metric (*www.spec.org*).
- **Uptime Institute** provides education, publications, consulting, conferences, and independent research to members of the data center industry. Their focus is on the cost, reliability, and energy consumption of computing. This organization has developed innovations which have evolved into the industry standard, including advancements in Tier Classification Standards, which aid in defining operational sustainability in large data center construction (*www.uptimeinstitute.com*).

Organizations

- **Climate Savers Computing Initiative** is a non-profit, industry-based organization founded by Google and Intel in 2007 to encourage computer and component manufactures to produce more efficient products, and to encourage customers to buy them. Climate Savers established its own roadmap of increasingly stringent efficiency targets and purchase commitment levels for both PCs and volume servers. The current target/purchase levels are set from July 2007 to June 2011. Climate Savers targets incorporate both ENERGY STAR computer specifications and 80 PLUS power supply efficiency levels (*www.climatesaverscomputing.org*).
- **LinuxWorld** is an open source site where enterprise businesses can find information, white papers, product news, and networking opportunities (*www.linuxworld.com*).
- **TDWI (The Data Warehousing Institute)** is a partner to HP and IBM and works to provide education, news, and research to the data warehousing industry (*www.tdwi.org*).
- **The Green Grid** is an industry-sponsored organization working to improve the efficiency of data centers worldwide. The Green Grid is developing standards for data

center energy efficiency, which consider both the facility and the IT equipment inside. Most industry leaders are members and the Board of Directors includes AMD, APC, Dell, EMC, HP, IBM, Intel, Microsoft, and Sun Microsystems. In 2007 The Green Grid and the Department of Energy signed a Memorandum of Understanding committing them to working together to assist data centers in reducing their energy through energy management programs and improved technology (*www.thegreengrid.com*).

Events

- **Data Center Dynamics** hosts conferences and events around the world. In 2008 around 8,000 people attended these events. The largest annual conferences are held in San Francisco and New York (*www.datacenterdynamics.com*).
- **Interlop** is a global technology event which brings together professionals from diverse technology fields, including green IT (*www.interop.com*).
- **OracleWorld** is a conference which offers exhibits and networking events for the business and technology world (*www.oracle.com/us/openworld*).
- **SuperComputing** is an international conference for high performance computing, storage and analysis, and networking. The conference focuses on scientific and technical innovation (*Sc08.supercomputing.org*).
- **Uptime Symposium** is an annual event that brings together industry stakeholders from the corporate data, IT, facilities, finance, and real estate arenas to discuss enterprise computing. Information and ideas are presented for data center management and industry strategy (*uptimeinstitute.org/content/view/32/66/*).
- **VM World** is a year-round online virtualization conference offering discussions, documents, and virtual exhibits (*www.vmworld.com*).

Product Development Process

The development timeline for volume servers is 6 to 12 months. Development of a new processor takes about three years. High-end servers take longer, typically 18 months to three years, depending on the degree to which they build on existing models. Custom configurations of server components can take as little as a few weeks to ship. Interviewees note that product development is easiest when the manufacturer can anticipate the needs of consumers three to five years out, in order to design a product that will continue to be relevant.

Product Design

Manufacturers design and engineer products in-house, but work closely with suppliers during this process. Products designed to meet individual customer needs may be custom-developed or assembled using “off-the-shelf” components.

Manufacturing

The level of integration in the supply chain varies by manufacturer. Some (mostly large) manufacturers maintain "end-to-end" control over every aspect of the process, from the materials used to produce silicon processors to the marketing of the server. Others manufacture servers incorporating numerous components obtained from suppliers, either in their own factories, those owned by others, or both. Servers are manufactured in many locations including China, Japan, India, Mexico, Europe, and the U.S.

Distribution

Unlike other consumer and business electronics, servers are not sold through typical bricks-and-mortar retail channels. They are purchased through VARs, online retailers, or direct from the manufacturer.

VARs may sell servers to individuals for personal use or to businesses of any size. Typically, VARs offer customers a "package" of goods that includes server hardware, software and installation, and maintenance services.

Enterprise servers are sold through online retailers or manufacturer websites, but involve more manufacturer-to-customer contact. Manufacturers employ sales representatives to handle these large contracts and most have tools in place – including live, online customer support – to help customers select the appropriate product. These complex units can be very large and require professional installations. One manufacturer noted that direct sales account for a large percentage of total sales.

Marketing

Manufacturers tend to focus marketing activities on enterprise customers. These may include tradeshow demonstrations, mail or email campaigns, webinars, and word-of-mouth. Server marketing does not typically employ print, TV, or radio ads. Marketing messages emphasize the ability to customize servers to meet individual customer needs. Marketing outreach is often done by a sales team employed by the manufacturer.

Energy Efficiency

Manufacturer Attitudes towards Energy Efficiency

- **All manufacturers identified energy efficiency as one of their top priorities**. In relation to product features, they ranked it equal or nearly equal to other product attributes. Improving the energy efficiency of products also ranked highly among larger corporate goals, like building shareholder value and maintaining a build-to-order business model. One interviewee called energy efficiency the company's top environmental consideration. Another explained that companies now realize the energy costs of

operating their servers can be nearly as much as purchasing them, and thus they are taking energy use into consideration when making a purchasing decision.

- **Customer demand and internal corporate goals are driving manufacturers' focus on energy**. Interviewees noted that their focus on efficiency is motivated by the fact that clients, primarily large enterprises and governments, demand it. They believe these clients are in turn motivated by concerns about climate change and energy costs. One manufacturer stated that energy is their customers' top environmental concern and that many use energy savings to make a business case for new purchases. Most interviewees observed that small and medium-sized businesses place less importance on energy efficiency when selecting a server.

- **Energy efficiency is a well-recognized need in the server, processor, and data center marketplace, and nearly all major players are participating in industry-led efforts**. Manufacturers are using cooperative efforts to move their industry toward greater energy efficiency, and have embraced utility and government-led efforts as well. Participation in industry-led efforts like Climate Savers and The Green Grid is high, and all major server manufacturers contributed to the development of the ENERGY STAR specification for servers.

Efficiency Standards

There are three commonly cited energy standards for servers in the U.S., each of which varies in its energy use requirements.

- **80 PLUS** is a voluntary, utility-funded program applying only to PC and desktop-derived server power supplies. While conventional power supplies are 60% to 70% efficient, 80 PLUS has certifications for those that meet higher standards. It designates three levels of efficiency for server power supplies: Bronze (85%), Silver (89%), and Gold (92%). 80 PLUS is the longest-running of the three standards, founded in 2004. Although penetration of servers with 80 PLUS power supplies is minute, the 80 PLUS program helped standardize measurement and testing procedures, and was incorporated into the Climate Savers procurement requirements.[51]

- **Climate Savers** is also a voluntary program, but participants agree to purchase a minimum percentage of servers that meet increasingly stringent efficiency requirements. Climate Savers began in 2007 before the release of the ENERGY STAR specification for servers, but now uses the ENERGY STAR requirements as a minimum, with annual increases in power supply efficiency, as shown in Table 3.10. Four socket and blade servers are included.

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[51] 80 PLUS Program. 80 PLUS announces enterprise/data center server research project. Retrieved June 20, 2009 from *http://www.80plus.org/docs/collatrl/print/80plus_server_flyer_v1.pdf*.

➡ The Climate Savers program was identified by four interviewees (three server manufacturers, one processor manufacturer) as positively impacting the market for more efficient products. The Climate Savers website lists 430 *affiliates*, or companies that have agreed to abide by the Climate Savers purchasing requirements, and 131 qualified servers.[52]

Table 3.10: Climate Savers Volume-Server Minimum Efficiency Targets and Purchase-Commitment Levels

CLIMATE SAVERS EFFICIENCY TARGETS & DEFINITION	PURCHASE COMMITMENT LEVELS (PERCENT OF TOTAL ANNUAL PURCHASES)				
	MEMBER'S FIRST YEAR	JULY 2007 - JUNE 2008	JULY 2008 - JUNE 2009	JULY 2009 - JUNE 2010	JULY 2010 - JUNE 2011
Bronze: 85% efficient power supply unit (PSU) or most recent version of ENERGY STAR server spec (when available)	≥10%	≥20%	≥80%	≥80%	100%
Silver: 89% PSU			≥20%	≥40%	100%
Gold: 92% PSU					≥20%

Source: Climate Savers. Volume-server minimum efficiency targets and purchase-commitment levels. Retrieved June 20, 2009 from *http://www.climatesaverscomputing.org/learn/membership-information/computer-and-server-buyers*

➡ **ENERGY STAR** only recently finalized its first specification for enterprise servers after a two and one-half year development process. Version 1.0, Tier 1 took effect May 15, 2009. The specification is available at: *www.energystar.gov/ia/partners/product_specs/program_reqs/computer_server_prog_req.pdf*

No penetration data is available yet, but ENERGY STAR estimated 25% of servers shipped would qualify. Power supply efficiency requirements are in line with the tiers established by 80 PLUS, but vary based on its power level and whether the power supply is multi- or single-output. The specification only limits idle power, which interviewees felt was a state rarely obtained by most servers.

[52] Climate Savers Computing Initiative. Member directory and product catalog. Retrieved June 25, 2009 from *http://www.climatesaverscomputing.org/about/member-directory/* and *http://www.climatesaverscomputing.org/component/option,com_prosearch/Itemid,197/page,5/searchkeyword,server/task,search/*

ENERGY STAR expects to release a Tier 2 in 2010 and will consider incorporating requirements for servers excluded from Tier 1, including those containing more than four sockets and blade systems.

International energy efficiency standards relevant to servers include:

- **Top Runner Program (Japan)** – Volume servers are included in the Top Runner program's specification for computers. The specification came into effect in 2007. This specification is available at: *http://www.eccj.or.jp/top_runner/e_0713.html*.
- **European Commission Code of Conduct on Data Centres Energy Efficiency** – this came into effect in 2008. The specification, which largely applies to high-end servers, considers the energy use of data centers overall, including servers and any other equipment they contain. This specification is available at: *http://re.jrc.ec.europa.eu/energyefficiency/pdf/CoC%20data%20centres%20nov2008/CoC%20DC%20v%201.0%20FINAL.pdf*.

Marketing Energy-Efficient Products

Online versus Packaging and Point-of-Sale

Servers are not distributed in the same way as other electronics, and thus packaging and point-of-sale materials, typically key marketing tools, are rarely used. Rather, manufacturers place energy efficiency information on their websites and often discuss efficiency in conversations with, or presentations to their customers.

While manufacturers use a diversity of approaches to convey energy efficiency information, it is important to note that no manufacturer publishes a list of energy-efficient servers, as opposed to standard servers. As a result, there is no easy way for a user to distinguish the most efficient machines.

All major manufacturers feature sustainability or energy efficiency information prominently on their websites. Offerings include downloadable sustainability reports, efficient computing white papers, energy calculators, or other decision-making tools. For example:

- **IBM** has an energy efficiency section featuring links to new stories, white papers, and information about what IBM is doing to be "green." Site includes information on monitoring systems to help optimize energy consumption (*www.ibm.com*).
- **HP** labels some products to highlight their sustainability features. In some cases, but not others, servers that meet Climate Savers requirements are noted. HP also promotes power management options for servers and storage.
- **Sun Microsystems** provides an *eco* section on sustainability and datacenters, with a focus on efficiency for cooling equipment and servers. They provide an assessment kit,

optimization kit, and virtualization kit to help customers make their data centers more efficient. The *Eco Assessment Kit* includes a power calculator (*www.sun.com*).

➡ **Dell** advertised its energy savings calculator in an online banner ad (Figure 3.3). However, a link to the calculator could not be found from any of the server product pages and was identified through a Google search. The calculator is at: *roianalyst.alinean.com/DellServerSavingsCalculator/*.

Figure 3.3: Dell Banner Ad

Image: Earth2Tech. Dell banner advertisement. Retrieved April 16, 2009 from *www.earth2tech.com*

Barriers and Opportunities

Barriers

➡ **The current ENERGY STAR specification is new and not comprehensive.** Although ENERGY STAR estimates the current specification applies to about 80% of all servers sold, it does not address blade servers (for a definition see the Glossary in *Appendix G*), the fastest growing server category, nor does it include requirements for active mode energy consumption. In addition, the specification only recently took effect and it is unclear what effect it will have on the market.

➡ **Servers are a complex product and developing efficiency standards is difficult**. Servers are more varied in their hardware configurations and in the way they are used than nearly any other electronic device. For example, power supplies may be internal or external, chassis and sockets may be fully or partially loaded, and a server's computing power may be utilized at anywhere from 0% to 100%. ENERGY STAR found the diversity in hardware and utilization a significant challenge in writing its first server specification, and acknowledged there are improvements and additions it will make to the next version.

➡ **Data center managers and IT staff are a risk-adverse population.** Servers are mission critical equipment for nearly every business. It is thus not surprising that the personnel assigned to operate and maintain them are hesitant to make changes.

➡ **Obtaining energy savings from servers requires changes to behavior or operational activities, not merely hardware.** Servers are complex devices – their energy efficiency can vary depending on how they are used. Common behavioral or operation issues leading to inefficiency include the underutilization of servers, the failure to implement virtualization and power management, the failure to decommission old or unnecessary

servers, and the purchase of servers with low first costs but higher energy costs. As a result, improving server efficiency will require an educational and awareness component.

➡ **Innovation in server technology is ongoing and may outpace energy efficiency standards.** Energy efficiency improvement in servers is occurring at a faster pace than industry efficiency standards. Current ENERGY STAR standards do not include blade servers, which were the only type of server to experience a positive growth in sales in the fourth quarter of 2008 (16.1%).[53] Blade servers resisted the poor economy and represent a growing portion of the server market, but there is no effective way for them to be tested for energy consumption at this time.[54]

Opportunities

➡ **Leading manufacturers and data center professionals are aware of the need for improved efficiency, and industry organizations exist to help disseminate program information.** The need for improved efficiency in data centers is not news. Program managers will likely find opportunities for partnerships with industry organizations and manufacturers.

➡ **Server technology changes quickly and efficiency is improving.** Server technology evolves rapidly. Improvements to performance and efficiency are near constant. For example, blade servers and non-traditional server configurations with external cooling and power supplies have already expanded users' energy-efficient options. Major server manufacturers are also including power metering tools to measure power consumption of servers, which overcomes the obstacle of obtaining server consumption data.

➡ **Power management software, standard on almost all servers, is greatly underutilized and yet has the potential to produce immediate, low/no-cost energy savings**. Most, if not all, servers ship to the user with power management software. As in a PC, this software allows servers to enter a low-power idle state. However, end-users (primarily data centers) rarely utilize a server's power management features. The reasons are both behavioral and technical. IT staff have been resistant to putting servers "to sleep," believing it sacrifices performance. The process for activating power management software is not well known and manufacturers rarely provide instructional material.

➡ **Replacing outdated servers with new models delivers immediate energy savings and may have a simple payback of less than one year.** Efficiency improvements have been so rapid that replacing a three- to four-year-old volume server with a newer, more

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53 Dignan. IDC: Server sales tank globally.

54 U.S. EPA/ENERGY STAR. ENERGY STAR Program Requirements for Computer Servers, Version 1.0.

efficient product can return energy cost savings equivalent to the purchase price in as little as eight months.

- **Old, inefficient servers are often kept in operation, even though they are no longer needed.** The failure of end-users to decommission old servers is a widely acknowledged problem, resulting in energy waste. An example for a program design that addresses this problem may be found in refrigerator buy-back programs, in which consumers receive an incentive for decommissioning old, underutilized machines, and are provided with free pick-up and recycling services. However, one interviewee indicated that, in the past, data center managers were resistant to giving up hardware that was still functioning, perceiving it as risky and potentially not cost-effective.

- **Server purchases are often carefully researched and thus may be influenced by the availability of energy efficiency data.** Since server purchasers are rarely made on the fly, there is opportunity to use information and education to influence decision-making. Interviewees consistently cited the need to deliver better information to purchasers and several organizations are already working to fill this gap. For example, the *Climate Savers Product Catalogue* helps purchasers identify which units meet their requirements.

- **Manufacturers find financial incentives "appealing," as long as the reporting requirements are not too "onerous."** Several interviewees noted that rebates associated with meeting specific efficiency targets are effective in influencing product design, but recounted past opposition to utility programs because of reporting and paperwork requirements that were perceived to be too difficult or time consuming.

GAME CONSOLES

More Americans play video games now than ever before. Almost two-thirds of those people surveyed played a video game in the first half of 2009, making gaming a more popular pastime than going out to a movie.[55]

Gaming penetration rates and spending levels corroborate this trend. More than 40% of U.S. homes have a game console and, of those, 5% to 6% have more than one. In 2007, approximately 17.5 million consoles were sold in the U.S., contributing to an estimated installed base of 64 million units.[56] Thirty percent of all monthly entertainment spending goes to video games, with total sales in 2007 valued at $17.9 billion.[57]

By all estimates, the number of game consoles in use will continue to increase – sales have grown 8% per month over the past seven years.[58] Although some energy efficiency improvements have been realized, energy consumption continues to grow as games become more sophisticated, requiring additional processing power, and features like Blu-ray Disc technology are added to consoles. In late 2008, it was estimated that U.S. game consoles consume approximately 16 billion kWh annually.[59]

Microsoft Xbox

Sony PlayStation 3

Nintendo Wii

(Images: *www.xbox.com*, *us.playstation.com/ps3*, *www.nintendo.com/wii*)

The video game console market is large and growing, and has distinct barriers and opportunities. Some low-hanging energy efficiency fruit may be captured through software upgrades and improved user awareness leading to behavior changes. However, energy efficiency improvements to game console hardware may be slow and difficult

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55 NPD Group. (May 20, 2009*). More Americans play video games than go out to the movies*. NPD Group Press Release. Retrieved from *http://www.npd.com/press/releases/press_090520.html*

56 Noah Horowitz, et al. (2008). *Lowering the Cost of Play*. NRDC Issue Paper. Retrieved from *http://www.nrdc.org/energy/consoles/files/consoles.pdf*; and Roth et al. *Residential Miscellaneous Electric Loads: Energy Consumption Characterization and Savings Potential.*

57 NPD Group. More Americans play video games; and Horowitz. *Lowering the Cost of Play*.

58 Horowitz. *Lowering the Cost of Play*.

59 Horowitz. *Lowering the Cost of Play*.

to achieve, given that only a few models dominate the market, new devices are released only occasionally, and manufacturers privilege the quality of game play over all other considerations.

Key Market Characteristics and Trends

- **Nintendo, Sony and Microsoft dominate the video game console industry.** Table 3.11 shows key data for major game consoles, including percent of installed base, total sales to-date, recent sales data, and launch dates. Sony's PlayStation 2 has the largest installed base of all the consoles; not surprising, considering it has been on the market the longest. Nintendo's Wii is currently the best-selling console.

- **Video game consoles and games have shown strong growth since at least 2003 and are expected to continue their upward climb.** From 2003 to 2006, the annual growth rate of the entertainment software industry was over 17%. In 2008, the industry reported a record $22 billion in sales, of which $445.4 million was hardware sales.[60] Despite a slowdown in sales after the 2009 holiday season, the industry is expected to rebound and continue growing.

- **New game consoles are released every five to six years, with the next generation of devices expected in 2011**.[61] Console generations are defined by major changes to underlying technology or device capabilities. PlayStation 3, Xbox 360, and Wii constitute the seventh generation, and are distinguished from previous generations by their ability to read the player's physical motion as an input, as well as the use of wireless controllers.

- **Console sales peak in November and December.** Sales data for 2006, 2007, and 2008, show consoles sales were dramatically higher in the last two months of the year than at any other time. Unit sales in November and December can be two to ten times higher than other months.

- **A November 2008 study of game console energy use by NRDC and Ecos Consulting drew attention to the devices' generally high consumption and identified several potential efficiency measures.** The study, *Lowering the Cost of Play: Improving the Energy Efficiency of Video Game Consoles*, noted consoles spend a high percent of the time in active and idle modes, even when not in use, and identified power management (specifically an easily-accessible auto power-down feature) as key to reducing energy waste.

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60 James Brightman. (February, 12 2009). NPD: Nintendo domination continues as industry racks up $1.33 billion in January. Retrieved from: *http://www.gamedaily.com/articles/news/npd-nintendo-domination-continues-as-industry-racks-up-133-billion-in-january/*

61 Kevin Ohannessian. (January 23, 2009). Video Games 2009: Who will win the console war? *Fast Company*. Retrieved from *http://www.fastcompany.com/blog/kevin-ohannessian/not-quite-conversation/whats-store-gaming-industry-2009-and-beyond*

Table 3.11: Game Console Data

COMPANY	PERCENT OF INSTALLED BASE	TOTAL SALES IN UNITS TO MAY 2009	MAY 2009 SALES IN UNITS	YEAR LAUNCHED	DETAILS			ENERGY STAR COMPLIANT?
					NUMBER OF GAMES AVAILABLE	PROCESSOR SPEED	PLAYS CDS AND DVDS?	
Sony PlayStation 2 *www.us.playstation.com/PS2*	40%	44.1 M	117,000	2000	1,700	300 MHz	Yes	N/A
Microsoft Xbox *www.xbox.com/en-US*	15%	24 M	—	2001 (discontinued in 2006)	400 - 500	733 MHz	Yes	N/A
Microsoft Xbox 360 *www.xbox.com/en-US/hardware/*	15%	15.2 M	175,000	2006	676	3.2 GHz	Yes	N/A
Nintendo GameCube *www.nintendo.com/consumer/systems/nintendogamecube/index.jsp*	13%	12.9 M (North and South America)	—	2001 (discontinued in 2008)	600+	485 MHz	No	N/A
Nintendo Wii *www.nintendo.com/wii*	12%	13.1 M (North and South America)	289,500	2005	629	729 MHz	No	N/A
Sony PlayStation 3 *www.us.playstation.com/*	5%	7.7. M	131,000	2006	457	3.2 GHz	Yes	N/A

Sources: DVDGuy's Blog@DigitalDigest. (June 13, 2009). Game consoles – May 2009 NPD sales figure analysis. Posted to *http://www.digital-digest.com/blog/DVDGuy/category/gaming/npd_analysis/*; and Tuck School of Business at Dartmouth. (2006). *Console Wars: May the Best Supply Chain Win*. Dartmouth Center for Digital Strategies. Retrieved from *http://mba.tuck.dartmouth.edu/digital/Research/AcademicPublications/GameConsoles.pdf*; Nintendo Corporation of America. Consolidated Sales Transition by Region. Retrieved July 7, 2007 from *http://www.nintendo.co.jp/ir/library/historical_data/pdf/consolidated_sales_e0806.pdf*;and Horowitz. *Lowering the Cost of Play*. ENERGY STAR data is listed as not applicable because current ENERGY STAR specifications do not cover game consoles.

- **There are now more gamers than non-gamers in the U.S.** Among respondents to an online survey, just over 50% reported playing video games more than two hours per week. Seventy-one percent of households owned a game console, a handheld game console, or a computer used to play games.[62]
- **The audience for video games continues to evolve.** Gamers have become a more diverse group. The stereotype of the gamer as a young male age 18 to 30 is a thing of the past. Two-thirds of gamers are over the age of 25, 45% are female, just over half are married, and just under half have children.[63]

Supply Chain

The primary players in the game console market are manufacturers and retailers.

- **Manufacturers:** Manufacturers design products and manage their production and marketing.
- **Retailers**: Game consoles reach customers primarily through bricks-and-mortar stores, rather than online retailers.

Table 3.11 lists the top U.S. game consoles by percent of installed base (as of 2007).

Product Development Process

The console development process has become increasingly complex over time as manufacturers added more capabilities to the devices. According to an interviewee, it takes "many years" to bring a product to market. Although small iterations to consoles may occur periodically, a "new generation" console is released every five to six years. Sony, for example, has launched only three models of its PlayStation console (excluding portable units) since 1995. Compared to other consumer electronics products, in which manufacturers release tens of new models annually, game consoles evolve at a snail's pace.[64]

Product Design

Manufacturers primarily design products in-house, but may also work with outside consultants. Product design takes place primarily in Japan (for Nintendo and Sony) or in the U.S. (for Microsoft).

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62 IGN and IPOS. (2008). *Are You Game?* Retrieved from *http://corpmedia.ign.com/corp/press_assets/AYG_booklet_final.pdf*.

63 IGN and IPOS. *Are You Game?*

64 A timeline of game console development is available at *http://www.gizmocafe.com/editors-view/console-timeline.aspx*.

In the past, there have been significant advances in the technology between console generations. For example, the Nintendo Wii differs in many ways from its predecessor, the GameCube. The Wii uses a wireless remote and requires physical activity of the gamer where the GameCube had a wired control and was played sitting down. The two units also employ very different hardware, although the Wii can operate GameCube games.[65]

There does not appear to be a continuum of energy efficiency improvements between console generations. However, energy efficiency typically improves in the iterations within each generation and has, in some cases, been motivated by cost-cutting efforts. For example, Sony expects to cut the energy use of the new PlayStation 3 model (not yet released) by almost 50% over the PlayStation 3 model released in 1996.

Manufacturing

Manufacturers may make an initial pilot run of a new product in a factory they own, but full production of the product is typically contracted to an outside manufacturer in China or Japan.

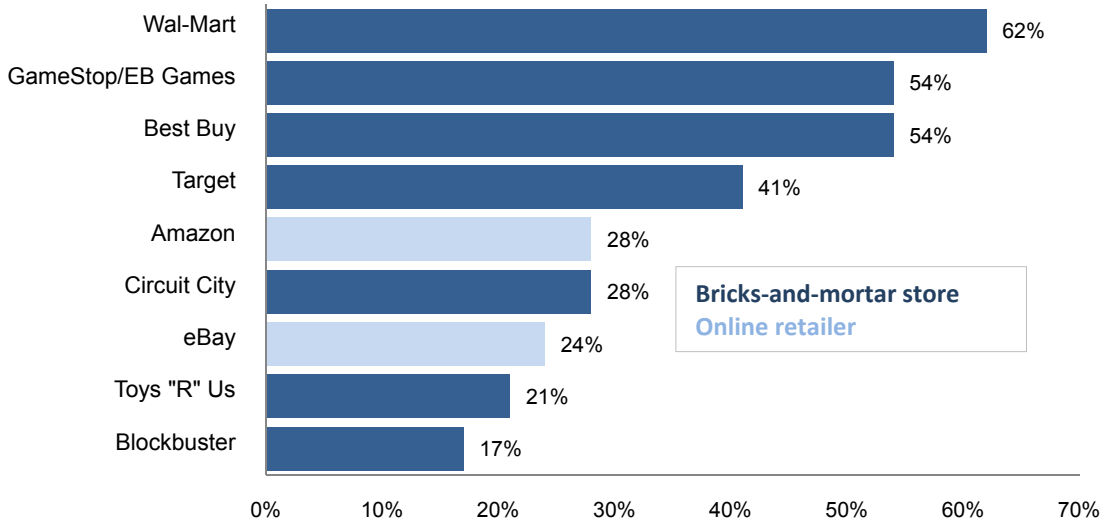
Distribution

Research studies and a manufacturer interview confirm that most game console sales take place at bricks-and-mortar retailers like GameStop, Wal-Mart, and Best Buy, with only a small part of sales conducted with online retailers. As shown in Figure 3.4, only two online retailers rank among the top nine game sellers.

GameStop, the leading game-focused retailer and the largest seller of used video games, has nearly 5,000 stores in the U.S. and Europe. As might be expected of any industry-dominant company, the chain has a poor reputation among some members of the gaming community. Complaints against it include price inflation on new merchandise, poor service, and low prices paid for used games.

[65] Alan Donahue. *How to play Gamecube games on a Nintendo Wii*. Retrieved June 25, 2009 from *http://www.ehow.com/how_2311205_play-gamecube-games-nintendo-wii.html*

Figure 3.4: Percent of U.S. Respondents Visiting Various Retailers When Shopping for Video Games (2008)



Source: IGN and IPOS. *Are You Game?* The survey included 1,997 people ages 12-54.

Industry Organizations and Events

The following organizations and events influence the video game console market.

- **Consumer Electronics Association:** The largest, most important industry organization. Their annual Consumer Electronics Show is *the* event for announcing and demonstrating new products. Nintendo, Sony, and Microsoft are all members (*www.ce.org*).
- **Electronic Entertainment Expo (E3):** The E3 Expo and Trade Show features exhibits, game demonstrations, and meeting space for industry insiders. This event is only open to members of the interactive entertainment industry. Attendees of the E3 include publishers, developers, retail buyers, and industry analysts (*http://e3insider.com/*).
- **Game Developers Conference (GDC):** The GDC features speakers from the industry on topics ranging from game design to how to ship enough games for a major holiday release. The GDC attracts over 18,000 industry professionals and provides a forum for individuals involved in all aspects of the gaming industry. There is also an exhibition hall displaying new technologies and information about companies (*http://www.gdconf.com/*).

Marketing

Game consoles are marketed in a variety of ways. Television and Internet marketing are used extensively, along with less traditional approaches (for consumer electronics, at least), like sponsoring gaming events, concerts, and sporting events. Console manufacturers also maintain a

presence at industry events such as the E3 and GDC. A great deal of video game-related advertising focuses on games rather than the consoles themselves. In fact, consoles are often packaged with a popular game to drive sales.

A large number of magazines cover the gaming industry and target gamers by printing gaming tips, descriptions of games, and news and information about specific brands.[66] Although there is some discussion among gaming blogs about the future of these print publications, at least one is doing very well. *Game Informer* is the 12th most popular magazine in the U.S., with a larger circulation than *Time*, *TV Guide*, *Sports Illustrated* and *Newsweek*.[67] Table 3.12 shows the circulation of popular gaming magazines.

Table 3.12: Top Gaming Magazines and Their Paid Subscriptions

MAGAZINE	CIRCULATION
Game Informer	3,517,598
Nintendo Power	435,000
GamePro	480,021
Official Xbox Magazine	425,000
PlayStation: The Official Magazine	252,267

Sources: *Game Informer* data from BarrellesLuce. 2009 Top Media Outlets. *Official Xbox Magazine* circulation from *Xbox Magazine*. Retrieved July 7, 2009 from *http://www.oxmonline.com/advertising*; *Nintendo Power* and *Official Xbox Magazine* data from *Nintendo Power* and *Official Xbox Magazine*. Wikipedia entries. Retrieved July 7, 2009 from *http://www.wikipedia.org*; GamePro and PlayStation: The Official Magazine data from Simon Carless. (November 14, 2006). U.S. game magazines: how's the circulation curve? Posted to *http://www.gamesetwatch.com/2006/11/us_game_magazines_hows_the_cir.php*

Energy Efficiency

Manufacturer Attitudes towards Energy Efficiency

A major manufacturer indicated that energy efficiency is a "moderate" priority and is always balanced with cost, function, and consumer demand for specific features. The manufacturer noted that the quality of the gaming experience will always be the top priority of console design and could not imagine that it would be sacrificed to improve energy efficiency. However, all three major manufacturers are participating in the development of the first ENERGY STAR specification for game consoles (see below).

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66 *Nintendo Power Magazine*. Retrieved June 29, 2009. Circulation as of 2009. *http://www.nintendopower.com/*

67 BarrellesLuce. *2009 Top Media Outlets: Newspapers, Blogs, Consumer Magazines, and Social Networks*. Retrieved July 7, 2009 from *http://www.burrellesluce.com/top100/2009_Top_100List.pdf*.

Efficiency Standards

There are no energy efficiency requirements for game consoles in the U.S. or internationally. The first ENERGY STAR console requirements are in development and are expected to become effective July 1, 2010. Game consoles requirements, when finalized, will be incorporated into the current computer specification Version 5.0, which took effect July 1, 2009. Other specifications in development include:

- **European Union Directorate-General for Energy and Transport –** Game consoles will be included in a study to begin in 2009. Consoles are also included in the EU Code of Conduct directive to achieve one watt or lower standby power by 2010.
- **MEPS (Australia)** – Game consoles were included in a 2007 study, but no action has been taken.

Marketing Energy-Efficient Products

Energy consumption is not currently marketed as a game console feature. None of the marketing materials produced by manufacturers mention energy use. Attention to energy will likely increase after the first ENERGY STAR console requirements take effect.

The big three manufacturers all maintain sections of their corporate websites devoted to corporate social responsibility, which includes energy issues. However, these sections are completely separate from the websites devoted to the companies' game consoles.

Recent Findings on Game Console Energy Use

Lowering the Cost of Play identified several key findings regarding game console energy use; they are summarized below.

Wii uses Much Less Energy than PlayStation or Xbox

The energy consumption of the big three consoles depends largely on processing power. The Nintendo Wii consumes the least energy, and has fewer features and a different style of play than the others. The most recent release of the Wii was found to consume 16.4 watts in active mode compared to PlayStation 3's 150.1 watts and Xbox 360's 118.8 watts.[68]

Effect of Mode on Energy Consumption

Consoles use nearly as much energy in idle mode as they do in active mode. Table 3.13 shows average power measurements by manufacturer in all three modes (*active, idle,* and *off*).

[68] Horowitz. *Lowering the Cost of Play*.

Table 3.13: Average Power Measurements by Console

CONSOLE AND YEAR RELEASED	OFF (W)	IDLE (W)	ACTIVE (W)
MICROSOFT			
Xbox 360 (2007)	3.1	117.5	111.8
Xbox 360 (2005)	1.1	152.9	172.0
Xbox 360 (2001)	1.7	59.9	64.0
SONY			
PlayStation 3 (2007)	1.1	152.9	150.1
PlayStation 3 (2006)	1.1	181.0	188.6
PlayStation 2 (2000)	1.7	24.2	24.2
PlayStation (1994)	1.4	6.5	8.0
NINTENDO			
Wii (2006)	1.9	10.5	16.4
Gamecube (2000)	0.7	22.7	23.0
Nintendo 64 (1996)	1.1	7.8	7.3
Super Nintendo (1991)	1.5	5.4	7.3

Source: Horowitz. *Lowering the Cost of Play*.

As *Lowering the Cost of Play* noted, the most effective way to reduce game console energy use is to turn the device off (*power down*) when not in use. Some game consoles offer an auto power-down feature that automatically turns the console off after a specified period of inactivity. Table 3.14 shows potential energy savings from this behavioral and/or software change.

Table 3.14: Savings Potential for Users Who Turn Game Consoles Off

DEVICE TYPE	ACTIVE ENERGY CONSUMPTION (WATTS)	ANNUAL SAVINGS POTENTIAL WITH 3-HOUR POWER-DOWN		ANNUAL SAVINGS POTENTIAL WITH 1-HOUR POWER-DOWN		AUTO POWER-DOWN OPTION?
		ENERGY SAVINGS (KWH)	UTILITY BILL SAVINGS (US$)	ENERGY SAVINGS (KWH)	UTILITY BILL SAVINGS (US$)	
Nintendo Wii	16	60	$6	66	$6	None
Xbox 360	119	793	$79	877	$88	6-Hour Optional
PlayStation 3	150	1053	$105	1164	$116	None

Source: Horowitz. *Lowering the Cost of Play*. The report notes projected savings would accrue to users who switch from leaving their game consoles on to turning them off (or activate an auto power-down feature that will turn them off) after use.

Effect of DVD/Blu-ray Functionality on Energy Use

Using a game console to play DVDs or Blu-ray discs is significantly less efficient than using a stand-alone DVD or Blu-ray player. A PlayStation uses 148 watts in active mode to play a DVD and an Xbox uses 110 watts – between two and ten times as much energy as required by stand-alone Blu-ray (20 to 43 watts) and DVD (10 watts) players.[69] *Appendix H* provides additional details on the power use of these features.

Barriers and Opportunities

Barriers

- **Game consoles have a long development period and life span relative to other consumer electronics devices**. New consoles are typically released every three to six years, with one manufacturer noting the company intends consoles to be used for six to 11 years. As a result, opportunities for intervening in hardware design occur less frequently with consoles than other products.
- **Game design may inhibit players' willingness to turn the console off.** Games do not always allow frequent saving and may require a player to reach a "save point" before turning the machine off. As a result, players are likely to leave consoles on or idle in order to save their game.
- **Consumers may be unaware of the energy consumed by game consoles and do not currently demand efficiency as a product feature.** Game consoles are purchased for their graphics, processing speed, and games. Although information on energy use is now available, it is unclear how it has affected consumer decision-making or behavior.
- **The number of game console choices is smaller than any other consumer electronics product.** The game console market is dominated by three products, by far the fewest among consumer electronics devices in general. In addition, consoles are the opposite of a commodity product. They are highly differentiated from one another, offering users different games and a different play experience. It seems unlikely that a user who wants to purchase a PlayStation would buy a different product on the basis of its greater energy efficiency.

Opportunities

- **Big efficiency gains are available in installed consoles by turning devices off when not in use, which can be accomplished through behavioral and/or software changes.** Game consoles use as much energy in *idle* mode as in *active* mode and may often be left

[69] Horowitz. *Lowering the Cost of Play*.

on when not in use. Thus turning the console off is the easiest, least expensive approach to reducing energy use. This may be done by the user after each play session; in which case, users need to be informed about the benefits of turning consoles off and reminded to do so. It may also be accomplished by activating a console's power management features. The two biggest energy users – Xbox 360 and PlayStation 3 – both have an auto-off feature, but the consoles ship with it turned off, it is up to the user to enable it.[70] Because many consoles are connected to the Internet, it may also be possible to implement power management with a software patch that is "pushed" to the console from the system operator (i.e., Sony or Microsoft).

➡ **The gaming community is receptive to information and the channels exist for rapid dissemination of information.** The gaming community is networked through blogs, publications, websites, online play, and social networking media. This population is "tuned in" and these channels may be utilized to educate and raise awareness.

➡ **The small number of console manufacturers and the long period between console generations means any energy efficiency improvements will be widely disseminated**. As the interviewee noted, manufacturers make only a few consoles at any given time (the newest generation device and perhaps the previous generation device as well) and if an energy efficiency improvement is adopted, it will be employed in 100% of devices moving forward. Thus, intervention by a utility program has the opportunity to affect nearly all game consoles on the market.

[70] Horowitz. *Lowering the Cost of Play*. The PlayStation 3 has four *System Auto-Off* options: one, two, three, or five hours after inactivity. The Xbox has one *Shutdown/Auto-Off* setting that turns the console off after six hours of inactivity.

IMAGING EQUIPMENT

More than 20 million imaging devices are sold in the U.S. every year and the number already in use easily exceeds 100 million.[71]

A broad range of products fall under the imaging equipment banner. They vary greatly in size, complexity, cost, and features, and are designed for a number of different uses, including homes and small offices, large business environments, and high-volume production printing.

This report focuses on three types of devices: *copiers*, *printers*, and *multi-function* devices (MFDs), which both copy and print, and often scan and fax as well. MFDs stand out in this market because of their growing popularity and strong sales during the economic downturn. As of the first quarter of 2009, MFDs represented more than 60% of total imaging device sales.[72]

A few factors suggest there are opportunities to promote energy efficiency in the imaging equipment market. Manufacturers show a high level of interest in corporate sustainability and almost all qualify products under ENERGY STAR. In addition, companies (end-users) have begun outsourcing control over their imaging equipment, opening up a new and potentially efficient channel to disseminate program information.

Copiers *make hard copy duplicates from a hard copy original, in black & white or color. Copiers come in a variety of sizes and speeds.*

Printers *make hardcopies of electronic documents or photos and are typically connected to computers.*

Multi-function devices (MFDs)*, also called "multi-function peripherals (MFPs)" or "all-in-ones," perform at least one function in addition to copying, with the majority also printing, scanning and faxing. MFDs typically employ either ink jet or laser printing technology.*

(Images: *www.tbmpanasonic.com, www.kottke.org, www.crn.com)*

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71 IDC. (June 2, 2009). In the midst of a challenging global economy, color MFP remains the worldwide hardcopy market's bright spot, according to IDC. IDC Press Release. Retrieved from *http://www.pressreleasepoint.com/midst-challenging-global-economy-color-mfp-remains-worldwide-hardcopy-market039s-bright-spot-accordi*; and Roth, et al. *Residential Miscellaneous Electric Loads: Energy Consumption Characterization and Savings Potential*.

72 IDC. In the midst of a challenging global economy, color MFP remains the worldwide hardcopy market's bright spot, according to IDC. .

Key Market Characteristics and Trends

- **Imaging equipment purchases by both consumers and businesses were down in 2008, are expected to remain steady in 2009, and begin growing again in 2010.** North American shipments of printers, copiers, and multifunction devices declined nearly 6% in 2008 as a result of the global economic downturn, and are not expected to begin growing again until 2010.[73]

- **The formerly separate functions of printing and copying have converged in the now-dominant multi-function devices (MFDs).** MFDs or *all-in-ones* have quickly become the largest segment of the imaging equipment market. They make up more than half of all imaging equipment shipments and have resisted the effects of the economic downturn better than single-function devices. Their sales decreased 12% in 2008, compared to a 24% decline for printers and 17% for imaging equipment as a whole.[74]

- **As MFDs have become dominant, sales of single-function printers have suffered.** Sales of single-function printers declined 28% in the first quarter of 2009 as a result both of the global economic downturn and customers' apparent preference for MFDs.[75] It is unclear whether newly purchased MFDs are replacing or supplementing existing devices.

- **Managed print services (MPS) are on the rise as businesses look for ways to cut costs and dealers look for new ways to improve their bottom line.** *Managed print services* is the name for an arrangement in which an outside consultant assists a business in managing its hardcopy needs. MPS are expected to grow 36% in 2009, with the biggest targets thought to be small (11 to 100 employees) and medium-sized (101 to 500 employees) businesses.[76]

- **Business of all sizes to are seeking to reduce imaging costs and take greater control over their imaging "fleet" by consolidating and streamlining purchase decisions and management.** These efforts, which are driving the growth of MPS, can be seen as a response to the fragmentation in imaging equipment purchases that occurred over the last three decades, when facilities staff managed copy machines, IT staff bought and managed networked printers, office managers bought faxes and scanners, and individual employees

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73 IDC. (March 11, 2009). Worldwide hardcopy peripherals undergo double-digit decline in the fourth quarter of 2008, according to IDC. Retrieved from *http://www.idc.com/getdoc.jsp?containerId=prUS21736109*

74 IDC. Worldwide hardcopy peripherals undergo double-digit decline.

75 IDC. (June 2, 2009). In the midst of a challenging global economy, color MFP remains the worldwide hardcopy market's bright spot. Retrieved from *http://www.reuters.com/article/pressRelease/idUS101686+02-Jun-2009+BW20090602*

76 William M. Bulkeley. (February 24, 2009). Xerox tries to go beyond copiers. *The Wall Street Journal.* Retrieved from *http://online.wsj.com/article/SB123544246272655641.html*. Infotrends. (November 6, 2008). New study identifies medium-sized businesses as prime target for managed print services. Infotrends Press Release. Retrieved from *http://www.infotrends.com/public/Content/Press/2008/11.6.2008.html*

purchased desktop printers.[77] According to industry reports, this division resulted in hardcopy costs as high as 3% of a company's total revenue.[78]

➡ **While the printer market is declining overall, manufacturers see opportunities for growth in color laser printers.** Consumers are increasingly drawn to color laser printers as their prices decline. Laser printers generally require fewer supplies and maintenance than inkjet devices (toner must be replaced less frequently than ink cartridges) and, as a result, manufacturers will likely focus on the device's lower total cost of ownership in order to attract new users to this product category.

➡ **The current economic downturn has caused consumers to extend the replacement cycle of imaging equipment beyond the three years that is typical**.[79] According to industry analysts, replacement of imaging equipment is one of the first areas targeted as companies seek to reduce their overall spending.[80] As a result, analysts suggest companies are delaying new equipment purchases, contributing to the market's overall downturn.

➡ **Digital technology and networking capabilities have shifted the roles of imaging equipment suppliers.** Copiers were historically sold through dealers who specialized only in this equipment, its parts, and maintenance. The shift to digital technology and networked machines brought value added resellers (VARs), whose business was based in IT equipment and software, into the marketplace. Today both dealers and VARs may sell or lease imaging equipment to customers. The increased competition led some dealers/VARs (and manufacturers) to offer services like MPS in order to increase revenues. Industry consultants describe the changing nature of the imaging equipment business model as a shift from one that is *hardware-centric* to one that is *service-centric*.

➡ **In 2008, environmental issues "moved to the front burner" in the U.S. imaging equipment industry**.[81] Analysts and manufacturers agree that "green" issues, including energy efficiency, are now high priority. Other environmental considerations cited as important to the industry include hazardous emissions, carbon footprints, and solid waste.

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77 For an example of this division of responsibility see Lexmark. *Health First Inc. Success Story*. Retrieved July 7, 2009 from *http://www.lexmark.com/vgn/images/portal/Hlt_HealthFirst_CaseStudy.pdf*

78 Gartner. (August 19, 2003). *Printer and Copier Fleets: The Gold Mine in the Hallway*. Retrieved from *http://www.copytronics.com/otherImages/CaseStudies/Right-Tool.pdf*

79 Michele Masterson. (March 16, 2009). Printer market Q4 2008: News that isn't fit to print. *ChannelWeb*, Retrieved from *http://www.lasercare.com/downloads/gartnergoldmine.pdf*

80 Michele Masterson. (March 23, 2009). Xerox Is on the hot seat but not alone. *ChannelWeb*. Retrieved from *http://www.crn.com/hardware/216200253;jsessionid=VXVGJ01LQALJUQSNDLRSKH0CJUNN2JVN*

81 Lyra Research, Inc. (December 2008). Punishing economy takes its toll on the printer industry. *The Hard Copy Observer* Vol. 28, no. 12.

Product Categorization

Imaging equipment is difficult to classify. Products vary widely in size, features, and price, based on the intended market. This section describes three approaches to categorizing devices.

Device Type

Imaging products can be placed in one of three broad categories: *copiers*, *printers*, or *MFDs*. Each includes products ranging from low-cost tabletop models for home use to much larger and more expensive models for use in business or commercial environments.

In general, larger, more expensive products provide greater print speeds and additional paper handling options. Many imaging devices are also sold as "workgroup" models, designed to be connected to a network of computers. These models contain faster processors and more memory than equipment designed for individual use, allowing them to manage multiple jobs at greater speeds.

Table 3.15 summarizes the three types of imaging equipment.

Table 3.15: Three Types of Imaging Equipment

CATEGORY	FUNCTIONALITY	COST	SAMPLE MANUFACTURERS
Copiers	A device whose only function is to produce hard-copy duplicates from hard-copy originals.		Canon, Konica Minolta, HP, Brother
Printers	Create hard copies from digital files. Print in black and white or color, with some models designed for specialized types of printing like photos or forms.	$50 to $12,000	HP, Epson, Lexmark, Canon, Brother
Multi-Function Devices	Perform two or more functions including copying, printing, scanning, or faxing. Devices can be either printer or copier-based, using different technology with the former tending to have a lower first-cost but higher per-page costs. More than 80% of MFDs sold have fax capabilities.	$50 to $6,000	Brother, HP, Ricoh, Epson, Canon, Samsung, Sharp Xerox

Source: ChannelWeb. 10 burning questions in print and imaging. Retrieved May 17, 2009 from *http://www.crn.com/it-channel/212400475;jsessionid=PLG0BLFAPL3YWQSNDLOSKH0CJUNN2JVN*.

Print Speed

An industry-standard classification system divides imaging equipment into seven segments based on print speed. Manufacturers typically list a device's *maximum* color and black and white print speeds in the product specification because a single device may print at varying speeds, depending on the quality of printing required and the level of color.

The maximum black and white print speed of a typical desktop printer is 17 to 35 pages per minute (ppm). Larger workgroup printers and copiers show a greater variation in print speed. Some products are comparable to desktop models, others are capable of speeds up to 90 ppm. Devices with higher print speeds are likely found only in commercial printing or corporate production departments.

Table 3.16 summarizes industry-standard segments by print speed.

Table 3.16: Industry Standard Segmentation by Print Speed

SEGMENT	PRINT SPEED (PAGES PER MINUTE)
PC	1 to 10
1	11 to 19
2	20 to 30
3	31 to 45
4	45 to 69
5	70 to 90
6	Over 90

Inkjet versus Laser

Another important point of differentiation among imaging equipment is the underlying technology. Most devices use either inkjet or laser technology for their print/copy functions:

- **Inkjet** devices apply drops of liquid ink to a page. They are able to imprint data as they receive it, which reduces the printers' memory requirements. However, inkjet devices generally have lower print speeds than laser printers. Inkjet printers are most common in residential and small office environments. They typically have a lower first cost than laser devices, but may require more frequent ink replacement, giving them a higher total cost of ownership.
- **Laser** devices use light to transfer images to an electrically-charged drum, then use static electricity to coat the drum with toner (a fine powder), transfer the toner to paper, and then melt the toner so that it bonds with the paper. Because the complete image must be

transferred to the drum, laser printers require more memory than inkjet printers, but have higher print speeds.

Supply Chain

There are four key players in the imaging equipment supply chain:

- **Manufacturers** conduct extensive research and development, design products, and manage their manufacture and distribution. Products are then sold under the manufacturer's brand, for example, Xerox or Ricoh.
- **Suppliers** provide components to manufacturers.
- **Dealers / value added resellers (VARs) / resellers / sales partners** are middlemen who sell or lease imaging equipment primarily to business customers, with varying levels of value-added services.
- **Retailers** of imaging equipment include bricks-and-mortar and online stores.

Manufacturers

Table 3.17 lists the top five U.S. manufacturers of imaging equipment across all device types and Table 3.18 provides details about additional imaging equipment manufacturers. Table 3.19, Table 3.20 and Table 3.21 list the top five manufacturers of inkjet printers and MFPs, laser printers and MFPs, and copiers.

Product Development Process

The development timeline for imaging equipment is one to three years, with larger, more complex products requiring up to four years. In addition, many manufacturers have detailed sustainability programs that may include even longer-term planning. One manufacturer described high-level corporate goal setting with targets in 2050.

Product Design

Manufacturers design and engineer products in-house, often near their corporate headquarters. Manufacturers may also operate design facilities close to major manufacturing centers. When design takes place overseas, U.S. affiliates provide input based on customer needs and regulatory requirements. Manufacturers may also work cooperatively with suppliers to define product features and design the product.

Research and development in support of product design is a focus for many companies. For example, Xerox and Fuji Xerox (a partnership with Fuji Film that sells Xerox products in the Japanese and Pacific Rim markets) together invested $1.5 billion in R&D in 2008.

Table 3.17: Top Imaging Equipment Manufacturers by US Market Share, Q1 2009

COMPANY	RANK[I] (MARKET SHARE)	REVENUE IN US$ (YEAR)	KEY FACTS	MAJOR PRODUCTS	OFFER MPS?	ENERGY STAR-QUALIFIED PRODUCTS
HP *www.hp.com*	1 (48.5%)	$118 B (2008)	Founded 1939. Based in California.	Personal and mobile computing devices, imaging and printing devices, and technology products for business.	Yes	MFDs Printers
Canon *www.canon.com*	2 (13.0%)	$39 B (2007)	Founded 1937. Based in Japan.	Business machines, cameras, and optical products.	Yes	Copiers MFDs Printers
Epson *www.epson.com*	3 (9.3%)	$13.5 B (2008)	Founded 1942. Based in Japan.	Computers and peripherals, electronic devices, watches, plastic corrective lenses, and factory automation equipment.	In EU Only	MFDs Printers
Lexmark *www.lexmark.com*	4 (8.8%)	$4.5 B (2008)	Separated from IBM 1991. Based in Kentucky.	Printers and MFDs for residential and office use.	Yes	MFDs Printers
Brother Industries *www.brother.com*	5 (5.6%)	$5 B (2008)	Founded 1934. Based in Japan.	Printing and imaging equipment, home and industrial sewing machines, content delivery systems, and network online karaoke.	No	MFDs

Source: Market share data from IDC. In the midst of a challenging global economy, color MFP remains the worldwide hardcopy market's bright spot, according to IDC.

Table 3.18: Other Imaging Equipment Manufacturers, Listed Alphabetically

COMPANY	REVENUE IN US$ (YEAR)	KEY FACTS	MAJOR PRODUCTS	OFFER MPS?	ENERGY STAR-QUALIFIED PRODUCTS
Dell, Inc. *www.dell.com*	$61.1 B (2009)	Founded in 1984. Based in Texas.	Primarily produces computers for home and business use, other products include monitors, electronics, and accessories.	Yes	MFDs Printers
IKON (owned by Ricoh) *http://www.ikon.com/*		Founded in the 1960s as Alco. Acquired by Ricoh in 2008.	Printers, copiers, MFDs.	Yes	
InfoPrint Solutions *www.infoprintsolutionscompany.com*		Founded 2007. Based in Colorado. Joint venture between Ricoh and IBM. Ricoh is in the process of taking full ownership and making InfoPrint a subsidiary.	Printers, copiers, MFDs.	Yes	MFDs Printers
Konica Minolta *www.konicaminolta.com*	$9.6 B (2009-projected)	Founded in 1936. Based in Japan.	Business products, optics technology, graphic imaging products, medical imaging products, measuring instruments and laser printers	Yes	MFDs Printers
Kyocera Mita *www.kyoceramita.com*	$2.9 B (2008)	Founded 1948. Based in Japan.	Printers, MFDs, wide format systems, parts, and supplies	Yes	Copiers MFDs Printers
Lanier *www.lanier.com*		A brand of Ricoh America.	MFDs, printers, digital duplicators, fax machines, wide format printers, scanners, and production printing equipment	No	MFDs
Oce *global.oce.com*	$4.6 B (2007)	Founded 1877. Based in The Netherlands.	Printers, copiers, scanners, software, services, and imaging supplies	Yes	Copiers MFDs Printers

Continued

COMPANY	REVENUE IN US$ (YEAR)	KEY FACTS	MAJOR PRODUCTS	OFFER MPS?	ENERGY STAR-QUALIFIED PRODUCTS
Olivetti* *www.olivetti.com*	$567 M (2007)	Founded 1908. Based in Italy.	MFDs, printers, fax machines, calculators, Microsystems, copiers, specialized printers, lottery terminals.	No	Copiers MFDs Printers
Panasonic *www.panasonic.com*	$91.3 B (2008)	Founded 1918. Based in Japan.	Home appliances, electronic components and devices, and communications devices.	No	MFDs
Ricoh *www.ricoh.com*	$22 B (2008)	Founded 1936. Based in Japan.	Document production and sharing equipment including copiers, fax machines, scanners, printers and digital cameras.	Yes	Copiers MFDs Printers
Samsung *www.samsung.com*	$105 B (2007)	Founded 1938. Based in Korea.	Produces a wide range of electronic products for consumers and business.	Yes	MFDs Printers
Sharp *www.sharp-world.com*	$34 B (2008)	Founded 1912. Based in Japan.	Audio-visual and communication equipment, home appliances, and information equipment as well as electronic components.	Yes	Copiers MFDs
Toshiba *www.toshiba.com*	$77 B (2008)	Founded 1875. Based in Japan.	Personal computers, mobile communications equipment, electronic devices and components, social infrastructure systems, and home appliances.	Yes	Copiers MFDs
UTAX* *www.utax.com*	$170.9 M (2008)	Founded 1961. Based in Germany.	Copiers, MFDs, printers, fax machines, consulting	Yes	MFDs Printers
Xerox *www.xerox.com*	$17 B (2008)	Founded in 1906 as the Haloid Company; produced first copier in 1959. Based in Connecticut.	Office imaging products and document production equipment.	Yes	Copiers MFDs Printers

* Indicates products may not be widely available in the U.S. Sources: Company data from manufacturer websites. Revenue data from *http://www.hoovers.com*.

Table 3.19: Top inkjet Printer and MFD Manufacturers by US Market Share, 2006

COMPANY	RANK	MARKET SHARE	ENERGY STAR-QUALIFIED PRINTERS?	ENERGY STAR-QUALIFIED MFDS?
HP	1	56.4%	Yes	Yes
Lexmark	2	13.0%	No	Yes
Canon	3	10.5%	Yes	Yes
Dell	4	8.0%	Yes	Yes
Epson	5	7.1%	Yes	Yes

Sources: Market share data from Gartner Research. (September 5, 2006). Gartner says United States printer and MFP shipments declined 4 percent in second quarter of 2006. Gartner Research Press Release. Retrieved from *http://www.gartner.com/it /page.jsp?id=496184*. ENERGY STAR data from ENERGY STAR Imaging Equipment Product List, current as of July 13, 2009.

Table 3.20: Top Laser Printer and MFD Manufacturers by U.S. Market Share, 2006

COMPANY	RANK	MARKET SHARE	ENERGY STAR-QUALIFIED PRINTERS?	ENERGY STAR-QUALIFIED MFDS?
HP	1	42.7%	Yes	Yes
Dell	2	9.3%	Yes	Yes
Brother	3	7.6%	Yes [l]	Yes
Canon	4	7.4%	Yes	Yes
Lexmark	5	5.6%	Yes	Yes

[l] ENERGY STAR's Imaging Equipment Product List does not include Brother laser printers. However, Brother only recently became an ENERGY STAR partner in the U.S., having previously qualified products in Japan. Brother produces laser printers that it markets as ENERGY STAR-qualified, although these products may not yet be recognized by ENERGY STAR in the U.S.

Sources: Market share data from Gartner Research. Gartner says United States printer and MFP shipments declined 4 percent. ENERGY STAR data from ENERGY STAR Imaging Equipment Product List, current as of June 15, 2009.

Table 3.21: Top Copier Manufacturers by U.S. Market Share, 2007

COMPANY	RANK	(MARKET SHARE)	ENERGY STAR-QUALIFIED COPIERS?
Canon	1	21.6%	Yes
HP	2	15.6%	No
Ricoh	3	12%	Yes
Brother	4	11.4%	No
Xerox	5	8.7%	Yes

Sources: Canon U.S.A. Imaging Systems Group. (undated). *2007 U.S. Market Share Copier/Printer/Fax. PowerPoint Presentation*. Retrieved July 2, 2009 from *http:www.bos-inc.com/Canon_2006_Market_Share_Pres.ppt . PowerPoint cites* Gartner Dataquest, February, 2008. ENERGY STAR data from ENERGY STAR Imaging Equipment Product List, current as of June 15, 2009.

Manufacturing

Imaging equipment is manufactured in many locations. The majority of facilities are in Asia, Latin American, and Eastern Europe, with more complex components manufactured in Japan or the U.S. Manufacturers typically own the factories where products are assembled and where limited manufacturing may occur.

One interviewee described a manufacturing process in which a supplier makes a machine's hardware and some electrical components, and the manufacturer makes the more complex electrical components, designs the software, and assembles the final product.

Distribution

Imaging equipment is distributed through several channels, with the particular channel determined by the customer and equipment type. Approximately 80% of copiers are leased, but most printers and MFDs are purchased.

- **Direct-To-Consumer:** Some manufacturers sell products directly to consumers. This may include sales transactions conducted online at the manufacturer's own website, by phone with a manufacturer's sales representative, or at a branch location. Interviewees noted their highest-end equipment was typically sold through this channel, rather than through dealers or VARs.
- **Dealers and Value Added Resellers (VARs):** Dealers and VARs sell or lease products to businesses, and usually provide services and parts. Although dealers and VARs may both work with networked copiers, printers and their related software, *dealer* typically refers to companies focused on copiers and *VAR* signifies companies with a foundation in IT and software.
    - **Dealers –** The number of office equipment dealers is shrinking. One interviewee estimated there are currently 2,500 to 3,000 dealers in the U.S., down from approximately 8,000 twenty years ago. Increased competition from big box stores and industry consolidation are two forces that have reduced the number of dealers. Consolidation has occurred through large dealers buying smaller dealers and manufacturers purchasing many of the biggest dealers. Today, the average dealer carries equipment from one or two manufacturers.
    - **VARs –** There is no similar information available for VARs.
- **Retailers:** A variety of retailers sell imaging equipment for home and small-office use. They include:
    - **Big Box Office Supply and Electronics Stores,** like Costco, OfficeMax, or Staples.
    - **Online-Only Retailers,** like Amazon.com or Newegg.com.

Marketing

Manufacturers market their products using print advertisements, their own websites, and in-person events for dealers/VARs where new products are introduced. Dealers/VARs also help market products, and manufacturers may provide them with marketing materials and training.

Managed Print Services

Managed print services (MPS) are a relatively new development in the imaging marketplace. While definitions are still fluid, MPS typically refers to an arrangement in which an outside consultant assists a business in managing some or all of its document production processes. The MPS provider may:

- Assist the business in purchasing or leasing new imaging equipment
- Optimize the business's use of its existing equipment
- Manage equipment maintenance

Photizo Group, a leading MPS research firm, claims businesses realize several benefits from MPS. Businesses may:[82]

- Save 30% of total hardcopy costs
- Reduce carbon emissions by 60%
- Free up 10% of IT staff's time

The benefits of MPS result from improved efficiency in the use of imaging equipment, often referred to as *right sizing* the *fleet*. Widely cited industry statistics show most imaging devices are used at less than 5% of their capacity and that MPS typically increase the ratio of devices to employees from 1:3 to 1:7. The effect of MPS on imaging equipment sales is not yet known. It would appear that an increased use of MPS may result in a decrease in overall sales as businesses use equipment more efficiently.

MPS Providers

MPS may be provided by a manufacturer or a local or national dealer. Dealers, in particular, appear to see MPS as a way to increase revenue in the face of increased competition and cutbacks in hardware purchases by businesses. However, MPS requires providers to transition to a *service-centric* business model from one that has traditionally been *hardware-centric*.

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82 Photizo Group. (June 1, 2009). *Six things you should know about managed print services*. Posted to: *http://printerindustry.blogspot.com/2009/06/six-things-you-should-know-about.html*. Data collected from 105 managed print service engagements using pre- and post-MPS engagement data.

Gartner recently categorized major manufacturers providing MPS into one of four groups: [83]

- **Leaders (Xerox, HP) –** companies offering a variety of MPS to a range of customers
- **Challengers (Pitney Bowes)** – services that cater to a narrower range of clients and may be less developed
- **Visionaries (Canon, Lexmark, Ricoh)** – companies that provide services to a variety of customers, but may be less successful in marketing and delivering their services
- **Niche Players (IKON, Toshiba) –** companies that provide a narrower range of services to less diverse customers

Market Penetration and Trends

A leading industry newsletter called 2008 "truly the year of managed print services." A study found that, as of 2008, 14% of printers, copiers, and MFDs were purchased under MPS agreements, and projected that by 2012, that number would rise to over 35%.[84]

Several developments in the first part of 2009 suggest continued growth in MPS:

- Nearly all manufacturers and dealers now offer some type of MPS.
- The first MPS Conference was held in April 2009 and the Managed Print Services Association (MPSA) launched the same month.
- Large enterprises have begun contracting for MPS. For example, Proctor and Gamble signed a $100 million agreement with Xerox.
- HP says its MPS business has been growing 38% annually since 2004.
- InfoTrends, a market research firm, launched an MPS consulting service.

Industry Players

Organizations

- **Business Technology Association (BTA):** An international non-profit trade association for dealers, VARs, system integrators and manufacturers. BTA provides legal advice,

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83 Gartner. (2008). *Magic Quadrant for Managed Print Services Worldwide*. Retrieved from *http://h20341.www2.hp.com/ERC/downloads/4AA2-2912ENW.pdf*

84 Ed Crowley. (August 24, 2008). *Hybrid dealers – the next channel evolution?* Posted to *http://printerindustry.blogspot.com/2008/08/hybrid-dealers-next-channel-evolution.html*. Data referenced from Photizo Group. *2008 MPS Market Shipments, Forecast, and Share Analysis*.

market research, news, trends, training, and publications, including *Office Technology* and *BTA Hotline Online.*

Events

- **Imaging Symposium:** An annual conference for manufacturers, founded in 1997, that covers market trends and hardware.
- **Print & Imaging Summit:** An annual conference for manufacturers, analysts, and business executives.
- **Managed Print Service Conference:** An annual conference for end-user decision-makers, resellers, and manufacturers to share best practices, standards, and case studies about managed print services. The first conference was held 2009, and future conferences will be held twice annually, in North America and in Western Europe.
- **ITex:** An annual tradeshow in Las Vegas targeted to dealers.
- **National Dealer Meetings:** Private events organized by manufacturers for their dealers. All major manufacturers hold these meetings every 12 to 18 months.

Publications

- ***Hard Copy Observer:*** The leading publication for the printing and imaging business, published by Lyra Research.
- ***Image Source:*** A trade magazine directed toward imaging equipment dealers and other distributors; it focuses on both hardware and software issues, as well as general industry trends.
- ***Office Dealer:*** A trade magazine directed toward office products, equipment, and furniture dealers not associated with any industry organization.

Market Research Firms

- **Gartner** is a leading technology research firm. Gartner's Dataquest publishes IT and telecom market data for technology manufacturers to assist with market strategy and product planning (*www.gartner.com*).
- **InfoTrends** is the leading worldwide market research consulting firm in the digital imaging industry. With a U.S. office in Massachusetts, it provides research, analysis and forecasts.
- **Lyra Research** is a consultant and market research firm focused on the digital imaging industry, publisher of the *Hard Copy Observer*, and organizer of the annual *Imaging Symposium*.

- **IDC** is a market research and consulting firm focused on the information technology, telecommunications, and consumer technology industries. Based in Massachusetts, it provides research, analysis, and forecasts with a global focus.
- **Photizo** is a consulting company specializing in managed print services that produces market research; it organized and sponsors the *Managed Print Services Conference* in North America and Europe, and the first trade organization, Managed Print Services Association.

Energy Efficiency

Manufacturer Attitudes towards Energy Efficiency

Manufacturers of imaging equipment appear to have embraced ENERGY STAR and energy efficiency. The two interviewees reported that ENERGY STAR-qualified products represent a large share of their company's total models (one stated upwards of 90% of all their products met the ENERGY STAR specification, the other believed 60% of their company's laser products were qualified). Both stated that some of their products met ENERGY STAR requirements for energy use, but failed to qualify because they did not meet other requirements; for example, that certain settings be selected as the default or that the device contain duplexing capabilities.

However, the extent of each manufacturer's commitment to ENERGY STAR is difficult to assess using publicly available data, because there is no consistency in the way manufacturers report the number of ENERGY STAR-qualified products. What can be concluded is that most major manufacturers have chosen to participate:

- Three of the top five copier manufacturers make at least one ENERGY STAR-qualified product.
- Four of the top five inkjet printer and MFD manufacturers make at least one ENERGY STAR-qualified printer, and all five make at least one ENERGY STAR-qualified MFD.
- All five of the top laser printer and MFD manufacturers make at least one ENERGY STAR-qualified printer and at least one qualified MFD.

Not surprisingly, both of the manufacturers interviewed identified energy efficiency as a high priority within their organizations. For one, energy efficiency contributes to larger corporate sustainability goals. The other believes there is high demand for ENERGY STAR products and tries to meet this demand by qualifying at least one model in each of its product families.

Importance of Energy versus Resources/Materials

Both interviewees described the importance of a broader range of environmental concerns associated with their products, including efficient use of materials and recyclability, and expressed some dismay that ENERGY STAR limited its specifications to energy use. Comments

made by manufacturers during the development of the ENERGY STAR specification reflect similar sentiments.[85]

Efficiency Standards

ENERGY STAR is the most commonly cited standard for the U.S. market. ENERGY STAR standards for printers were first introduced in 1993, followed by fax machines in 1994, copiers in 1995, and MFDs and scanners in 1997. A major review of ENERGY STAR standards for all types of imaging equipment began in 2003, culminating in the release of imaging equipment standard Version 1.0, which took effect on April 1, 2007. Version 1.0 created a single standard with provisions for printers, fax machines, copiers, MFDs, and scanners, as well as digital duplicators and mailing machines. The current standard, Version 1.1, took effect July 1, 2009, and features more stringent energy requirements than Version 1.0.

As well as bringing together multiple types of imaging equipment under a single standard, Version 1.0 introduced the typical energy consumption (TEC) method for measuring energy use. While previous standards focused on a device's power draw in certain modes (generally low-power modes like *off*, *sleep*, and *standby*), the TEC method sets limits for the total amount of energy the device can use in a set period of time. In the current standard, the performance of standard format printers, copiers, and MFDs is primarily measured using the TEC method, while large and small format devices continue to be measured based on performance in specific operating modes (the OM method).[86] Some standard format devices may qualify for ENERGY STAR using either method. The current ENERGY STAR specification is available at: *http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/img_equip/Imaging_Equipment_Specification_Final_V1.1.pdf*

Several other countries and regions have their own voluntary standards or mandatory requirements. They include:

- **Top Runner Program (Japan)** – specifications focus only on copiers. These specifications are available at: *http://www.eccj.or.jp/top_runner/e_0715.html*
- **e-Standby Program (Korea) –** the labeling program focuses on home and office electronic products. Standards target standby power reduction.

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85 For example, see Patricia Calkins. (September 18, 2008). Letter to Christopher Kent, EPA Product Manager re: Xerox's feedback on FINAL DRAFT imaging equipment specification. Retrieved from *http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/img_equip/Xerox%20Draft%20Final%20Comments.pdf*

86 Standard format devices are designed to print and/or scan standard size documents, for example letter-sized paper, legal-sized paper, or A4. Large format devices are designed to print and/or scan documents on A2 (16.5" X 23.4") paper or larger, and small format devices are designed for documents smaller than standard size, for example 4" X 6" or microfilm.

- **Blue Angel program (Germany)** – focuses on power consumption of a variety of types of imaging equipment, as well as the potential to recycle the appliance's parts. Standards are available at: *http://www.blauer-engel.de/en/products_brands/search_products/produkttyp.php?id=333*.
- **Nordic Swan program (Scandinavia)** – sets standards for imaging equipment covering both energy consumption and environmental impacts of equipment disposal. Standards are available at: *http://www.svanen.nu/Default.aspx?tabName=CriteriaDetailEng&menuItemID=7056&pgr=15*.
- **ROHS (Regulation of Hazardous Substances) Directive** – restricts the use of several substances in devices, including lead, mercury, and cadmium.

The European Commission Code of Conduct, Australia's MEPS program, and the Canadian Standards Association do not appear to have energy efficiency standards for imaging equipment. However the EU and Australia partner with ENERGY STAR, allowing products that are compliant with the US standard to use the ENERGY STAR logo in those countries. The EU's ENERGY STAR standard for imaging equipment is parallel to the US standard, while Australia's comes into effect one year after the US standard.

ENERGY STAR Penetration

Unlike other products, ENERGY STAR has not published year-by-year penetration data for imaging equipment. Data for 2007 may not be available because Version 1.0 of the specification took effect mid-year. It is expected that ENERGY STAR penetration data for 2008 will include imaging equipment.

While year-by-year data are not available, the high penetration level of imaging equipment products was a significant factor leading to the increasingly stringent standards in the Version 1.0 and Version 1.1 specifications. ENERGY STAR seeks to recognize the top 25% of performers in each product category. When the Version 1.0 specification came into effect in 2007, ENERGY STAR estimates market penetration was more than 90% for devices meeting the requirements of previous specifications.[87] Table 3.22 shows penetration data for products qualified for Version 1.0 and Version 1.1 specifications when the Version 1.1 specification was announced in October 2008.

[87] U.S. EPA/ENERGY STAR. (September, 2006). Summary of Rationale for Version 1.0 ENERGY STAR Imaging Equipment Specification. Retrieved from *http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/img_equip/Decision_Memo.pdf*.

Table 3.22: ENERGY STAR Penetration Data, October 2008

TEST PROCEDURE	PERCENT QUALIFIED PRODUCTS	
	VERSION 1.0	VERSION 1.1
TEC	51%	26%
OM	32.8%	21.4%

Source: U.S. EPA/ENERGY STAR. (October 2, 2008). Version 1.1 ENERGY STAR Imaging Equipment Specification - Data Summary. Retrieved from *http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/img_equip/Data_Summary_Final_V1.1.pdf*

Marketing Energy-Efficient Products

Interviewees noted an increased interest in energy efficiency in the last few years, both at their companies and among their customers. Where previously, energy played a minor role in their marketing, they now place a greater emphasis on a product's efficiency and environmental impact. This "green wave" may be felt more strongly among business purchasers than individual consumers, where procurement guidelines increasingly include sustainability requirements.

Inkjet printers and MFPs are one area in which manufacturers are emphasizing products' energy efficiency benefits. This may be a way for manufacturers to draw attention to inkjet products in response to the decreasing cost of color laser printers and MFPs.

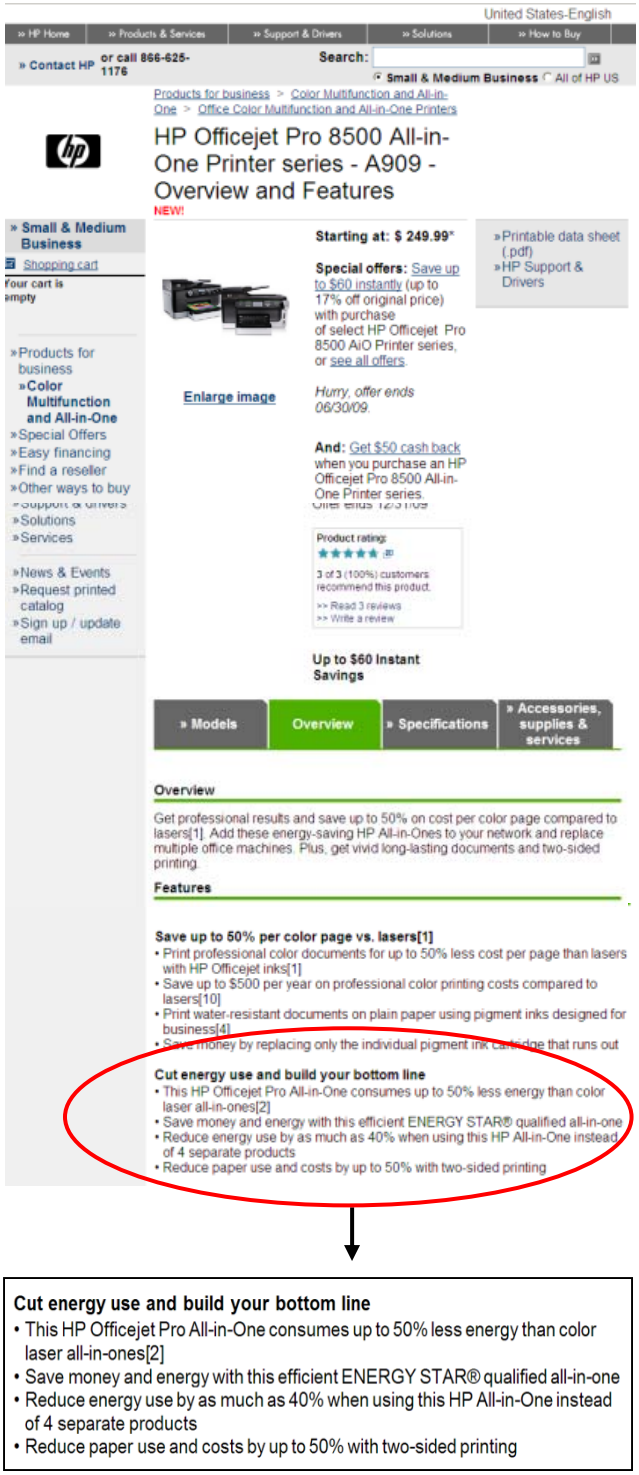
A review of manufacturer websites and online product brochures supported the interviewees' assertion that energy efficiency is beginning to play a larger role in their marketing of imaging equipment. While some manufacturers do devote attention to the energy efficiency features of their products, overall, the marketing of imaging equipment remains primarily focused on product features other than energy efficiency.

Manufacturer Websites

While the energy performance of individual products can be difficult to locate on manufacturer websites, the leading manufacturers give top billing to their broader sustainability efforts. This commonly includes a link on the manufacturer's home page to an area of the site devoted to information on the company's corporate social responsibility efforts. These usually include commitments to reduce environmental impact over time focusing on production processes and resource use.

Information on a product's energy efficiency receives less prominent placement. With a few notable exceptions (listed below), the information does not appear on the home page or product catalog pages, which list multiple products of a particular type (for example, color laser copiers). Energy efficiency information, if it appears at all, is usually included in a list of product features on a "product detail page" - a web page dedicated to a specific product. These pages may display the ENERGY STAR logo, list product features that contribute to energy savings, or call attention to cost savings associated with the equipment's energy efficiency.

Figure 3.5: Example of an HP Product Detail Page



Cut energy use and build your bottom line
- This HP Officejet Pro All-in-One consumes up to 50% less energy than color laser all-in-ones[2]
- Save money and energy with this efficient ENERGY STAR® qualified all-in-one
- Reduce energy use by as much as 40% when using this HP All-in-One instead of 4 separate products
- Reduce paper use and costs by up to 50% with two-sided printing

(Image: *www.hp.com*)

Examples of online marketing efforts in which energy efficiency features prominently include:

- **HP Office Jet Pro 8500 All-in-One Printer Series:** The product catalogue page invites consumers to "get professional results for less and save energy with this high-performance HP All-in-One series." A product detail page (Figure 3.5) includes claims about the device's energy use that are not specific and do not include information typically considered vital for consumer decision-making, like dollar savings.

- **HP's *Eco Highlights* Heading:** HP briefly included a heading entitled *Eco Highlights* on each product's overview page, along with other headings like *Overview* and *Features*. However, there was often no information listed under this heading, sometimes even if the product was ENERGY STAR-compliant. HP removed *Eco Highlights* heading from its product detail pages in June 2009.

- **The Konica Minolta Bizhub C650 Color Multifunction Laser Printer:** This is one of four products that appear in a slide show of featured *green at heart* products on the company's homepage for business products. The Bizhub C650 is noted as having received an award in Japan for its energy efficiency. Despite this promotion, the catalog page listing the device does not mention its energy-efficient features and the product detail page displays only the ENERGY STAR logo.

- **Canon's Generation Green Website:** This site lists products the company claims excel in resource and energy efficiency, comply with ENERGY STAR and ROHS standards, and promote environmental sustainability through recycling and refurbishment programs. Canon provides a link to the *Generation Green* website from catalog pages. While product detail pages list these environmental benefits among the device's other features, the catalog pages do not mention them, making it difficult for users to employ these features to sort a long list of products.
- **The Xerox ColorQube 9200 Series of MFPs:** This line of MFPs is featured on the home page of Xerox's website for the United States under the tagline *Pay less. Waste less. Stress less.* The product detail page promotes the line's ability to help businesses meet sustainability goals and produce less waste.

In general, when assessing online marketing efforts, it is important to note that manufacturer websites change frequently. The web pages described above changed over the three-month course of this study and will likely continue to change in the future.

Barriers and Opportunities

Barriers

- **The product development process for imaging equipment is longer than for most other consumer electronics products.** It may take manufacturers as many as three years to bring a product to market. Interviewees noted this long product development cycle is out of sync with ENERGY STAR, which tends to finalize a new specification less than one year before it takes effect. As a result, manufacturers find it difficult to release products that meet a new ENERGY STAR specification upon its effective date. A three-year product development process may also be a barrier for utility programs, because it is longer than a typical program cycle.
- **Energy-efficient product features may inconvenience some users by increasing the time required for the machine to enter active mode.** This fact was noted by interviewees and manufacturers engaged in the ENERGY STAR specification development process.
- **Energy efficiency improvements to imaging equipment may affect the end-user's experience and/or require behavioral changes.** While end-users interact with an energy-efficient server or UPS in the same way they would with less efficient equipment, behavior change on the part of the end-user is often necessary to take full advantage of energy efficiency features of imaging equipment. This is especially true in office environments where users may be asked to give up personal printers or other equipment in favor of a more efficient shared device. In these cases, users must be convinced of the benefits of switching to energy-efficient equipment and trained to use the equipment in a

way that compliments its energy saving features, for example not disabling the sleep mode to enable faster operation.

➡ **In business environments, a variety of groups with differing priorities influence imaging equipment purchasing decisions.** While IT staff, largely concerned with product functions and compatibility with existing equipment, play a key role in decision making, other stakeholders include executives concerned about return on investment, employees concerned with convenience, facilities managers concerned with energy use, and procurement departments concerned with policies that may limit, or promote, purchases of energy-efficient equipment.

Opportunities

➡ **Managed print service providers may be an efficient way to reach many machines through a single source.** MPS providers advise clients on the types of imaging equipment they should install and energy efficiency is complimentary to MPS providers' goal to streamline their clients' imaging capabilities. In addition, some MPS providers already use environmental messaging (for example, energy savings and reduced paper use) to gain employees' support for the changes they propose.

➡ **Dealers, VARs, and resellers are likely the most effective channel to reach business clients**. These distributors offer a wider range of products for business use than other channels (such as retail or online sales) and businesses value the support and services that VARs and dealers offer.

➡ **Imaging manufacturers appear willing to discuss products' energy efficiency on their websites, but seem to lack content**. The rapidly changing, and often empty *Energy* sections on manufacturers' websites suggests that, though they see value in promoting energy efficiency, they have not fully developed messaging around the topic. Efficiency programs may have an opportunity to play a role in the development of these messages.

➡ **Reduced lifecycle costs are a significant selling point for some types of imaging equipment.** The cost savings associated with lower energy consumption could compliment this message in manufacturers' marketing materials.

➡ **Rising energy costs and growing interest in corporate social responsibility are driving the move toward "green IT."** Many companies have identified IT functions including printing, copying, and scanning as a potential source of energy and cost savings. Companies are also interested in promoting their savings achievements in this area, especially in terms of carbon reduction.

➡ **Manufacturers may provide customers, specifically IT departments, with materials to educate them about how to operate their equipment.** These materials offer an opportunity to present information that will help users take advantage of the devices' energy efficiency features and present to users the benefits of those features.

HOME AUDIO EQUIPMENT

Despite several years of falling sales, home audio products represented more than $3.5 billion in U.S. factory sales in 2008, or an estimated $4.2 billion in retail sales.[88] At least 40% of U.S. households are estimated to have at least one compact system and/or component audio system.

Several products fall under the home audio umbrella, and together they account for about 5% of the residential plug-load and 1% of total residential energy consumption. This makes home audio products the third-largest energy consumers among consumer electronics products after TVs/set-top boxes and PCs/monitors.[89]

This report focuses on receivers and systems that include receivers because they are the largest energy users in the home audio arena.[90] Citing the Consumer Electronics Association's 2012 Industry Forecast, ENERGY STAR estimates nearly 1.5 million receivers were sold in 2008, including both models that qualify for the standard and those that do not.[91] Receivers can be purchased individually, with a CD player and speakers as a *shelf system*, or with multiple speakers and possibly a DVD player as a *home-theater-in-a-box* (HTIB).

Currently, energy efficiency plays a relatively small role in the home audio market. Fewer than half of the top

Receiver

Shelf System

Home Theater in a Box (HTIB)

Receivers *are one component of stereo and home theater systems. They amplify sound and include a tuner. AV receivers also accept video signals. Receivers are sold in three ways: individually; integrated with a CD player and speakers as a* ***shelf system****; and as part of a* ***home-theater-in-a-box (HTIB)****, a multi-speaker/DVD package for use with a TV or projector.*

(Images: *www.onkyo.com*)

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88 Joseph Palenchar. (March 30, 2009). Speaker Docks Up in 2008; AC-only Models Take Lead, *TWICE*. Retrieved from *http://www.twice.com/article/258009-Speaker_Docks_Up_In_2008_AC_Only_Models_Take_Lead.php*. Factory sales are sales of goods between manufacturers and distributors or retailers. CEA does not track retail sales data, and this number was obtained by estimating a retail markup of 20%.

89 Roth et al. *Residential Miscellaneous Electric Loads: Energy Consumption Characterization and Energy Savings Potential*.

90 Other home audio products not discussed here, but included in other studies are: portable stereos or "boom boxes," radios/clock radios, tuners, turntables, speakers/subwoofers, CD players/recorders, cassette decks, and amplifiers. DVD players are often included in the home audio category, but are not a part of this report. iPod-compatible products or "docks," a new and fast-growing home audio segment, are covered only briefly and recommended for further study, as there has not been any research on their energy use to date.

91 U.S. EPA/ENERGY STAR. (January 10, 2009). ENERGY STAR Audio/Video Specification Development: CES Update Meeting. PowerPoint Presentation. Retrieved from *http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/audio_video/AV%20CES%20Update%20Presentation%20-%202009-0110_FINAL.pdf*.

brands sell ENERGY STAR-qualified products, penetration is the lowest among all consumer electronics products, and marketing of energy efficiency as a product feature is rare. In addition, the existing ENERGY STAR specification is outdated and does not limit active mode energy consumption. A revised specification is expected in 2010.

Key Market Characteristics and Trends

- **Demand for receivers is stagnant or shrinking and competition is "fierce."** The market for most home audio products shrank considerably in 2008. Yamaha, a leading manufacturer, noted in its 2008 Annual Report that North American receiver sales may have "bottomed out." For the first three quarters of 2008, the research firm NPD Group reported double-digit declines in unit and dollar sales for HTIB and shelf systems, and single digit declines for receivers.[92]

- **The popularity of portable MP3 players is driving sales of home audio products that integrate with these devices.** The Consumer Electronics Association (CEA) reported a 35% increase in unit sales of MP3 docks (speakers or clock radios to which an MP3 player can be attached) in 2008, leading these systems to become the second largest home audio category in dollar sales (see Table 3.23). NPD Group reported that almost one-third of all HTIB systems sold in 2008 included iPod docks.[93]

Table 3.23: Home Audio Retail Sales by Category, 2008

DEVICE TYPE	US$ SALES
Component Systems	$1.28 Billion
MP3 Speaker Docks	**$995 Million**
HTIB Systems	$853 Million
Shelf Systems	$229 Million

Source: Palenchar. *Speaker Docks Up in 2008*

- **Penetration of receiver-based home audio products is high.** A 2006 study found that 40% of U.S. households have a component system, and 44% have a shelf system. Only 17% of households had an HTIB, but this number is thought to have increased.[94]

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92 Joseph Palenchar. (December 2, 2008). Economy Hits Audio Hard: NPD. TWICE. Retrieved from *http://www.twice.com/article/236347-Economy_Hits_Audio_Hard_NPD.php*.

93 Palenchar. *Speaker Docks Up in 2008*. The NPD Group also reported growth for MP3 dock sales in 2008, but at 14% rather than the CEA's 35%. The NPD data may be lower because it does not include the months of November and December, and holiday purchases account for a large share of consumer electronics sales.

94 Roth et al. *Residential Miscellaneous Electric Loads: Energy Consumption Characterization and Energy Savings Potential.*

Home Audio Product Types

Table 3.24 gives details about selected home audio products and shows that prices vary widely within each home audio product category. The manufacturers interviewed emphasized that products at lower price points are designed to be sold in much higher volume than higher-end products, and that price competition among lower-cost products is fierce. Interviewees also suggested that competition among high-end products focuses more strongly on product features than cost. Shelf systems, component audio systems, and HTIB systems are the largest energy users within the home audio category, and, as a result, they are the central focus of this report.[95]

Supply Chain

The primary players in the home audio market are manufacturers, retailers, and dealers/installers.

- **Manufacturers:** Manufacturers design products and manage production of products largely sold under their own brand, although in some cases, manufacturers may purchase the right to use a better-known brand name.
- **Retailers**: Audio receivers and other home theater products reach customers through a range of retailers, largely depending on the level of expertise required to install and use the equipment.
- **Dealers/Installers**: High-end whole home audio systems nearly always reach consumers through professionally trained dealers or installers who obtain the products from the manufacturer.

Manufacturers

Table 3.25 below lists the top U.S. manufacturers of home theater systems, shelf systems, and amplifiers in 2007, based on US$ sales.[96] It is important to note that these rankings are based on the dollar value of sales *not* number of units sold. A ranking based on the latter would differ based on each manufacturer's product mix of high and low-end products.

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[95] The type of amplifier within these devices can play a significant role in determining the device's energy use. Traditionally, home audio products use class AB amplifiers, which are approximately 50% efficient. Another type, class D amplifiers, can achieve close to 90% efficiency, but some audio enthusiasts criticize them for providing lower sound quality. Class D amplifiers are most commonly used in car and portable audio devices. However, as a result of their increased efficiency, class D amplifiers release less heat than class AB amplifiers, allowing manufacturers to eliminate the aluminum heat sinks that other types of amplifiers require. Without these heat sinks, class D amplifiers take up less space than other types, which has led to their use in devices like HTIB systems that must incorporate a great deal of functionality in a single unit.

[96] Amplifiers can be stand-alone components of a stereo system, but all receivers contain an amplifier. as well as a tuner and digital processor. Manufacturer rank by receiver sales was not available and amplifier sales are thought to be a close approximation.

Table 3.24: Selected Home Audio Products

DEVICE TYPE	DESCRIPTION	KEY FACTS	2006 MARKET PENETRATION	2006 INSTALLED BASE	BRANDS	COST RANGE
Receiver (AKA: Component Audio) 	Receivers contain a pre-amplifier, power amplifier, and tuner, and function as a control center for a larger audio or AV system. As part of a component audio system, receivers take in signals from CD players, turntables, or other audio or video inputs, amplify those signals, and send them to speakers.	Receivers consume large amounts of energy compared to other home audio devices. There is a great deal of variation in energy consumption between the best and worst performing models.	40%	50 million	Yamaha, Denon, Onkyo, Harmon Kardon, Sherwood, Marantz, Pioneer, Niles	$100-$7,000
Shelf System (AKA: Mini/Midi System, Compact Stereo System) 	Shelf systems are non-portable products that incorporate, in a single unit, an amplifier and one or more additional devices including CD players, radio tuners, cassette players, or MP3 player docks. Speakers may or may not be attached to the central unit.	Shelf systems are typically available at lower price points than other home audio products that provide similar functions. Shelf systems have a very large installed base.	44%	76 million	Sony, JVC, Panasonic, RCA, Sharp	$40-$800

Continued

DEVICE TYPE	DESCRIPTION	KEY FACTS	2006 MARKET PENETRATION	2006 INSTALLED BASE	BRANDS	COST RANGE
Home Theater in a Box (HTIB) 	HTIB is a group of devices, packaged together, designed to be connected to a television or projector. HTIBs typically include a receiver, which may have a built-in DVD player, two or more speakers, a subwoofer, and an integrated radio tuner. In addition, Australia's MEPS program specifies that all elements of a HTIB system must be powered from a single cord.	HTIB's are growing in popularity as high-definition televisions become increasingly common. HTIB products are driving growth in the home audio sector.	17%	25 million	Bose, Sony, Panasonic, Yamaha, Onkyo	$50-$4,000
Portable Stereo (AKA: Boom **B**ox) 	Portable stereos may be powered by a cord or batteries. They contain, In a single unit, an amplifier, and one or more other devices including tuners, CD players, tape players, or MP3 player docks. In most cases, portable stereos also include speakers within the central unit.	Portable stereos are increasingly incorporating docking capabilities for MP3 players. Energy consumption is low compared to other home audio products.	30%	40 million	Sony, Insignia, Philips, Emerson	$30-$140

Continued

DEVICE TYPE	DESCRIPTION	KEY FACTS	2006 MARKET PENETRATION	2006 INSTALLED BASE	BRANDS	COST RANGE
Clock Radio 	Clock radios are small units that contain a clock and provide alarm capabilities. They also contain devices, including a tuner, a CD player, or an MP3 player dock. The central unit contains speakers.	Clock radios have a high penetration rate and large installed base. Energy consumption is low compared to other home audio products.	90%	155 million	RCA, Memorex, Sony	$15-$100

Sources: Images from *www.bestbuy.com*. Market penetration and installed base data from Roth et al. *Residential Miscellaneous Electric Loads: Energy Consumption Characterization and Energy Savings Potential.*.

Table 3.25: Selected Major Audio Product Manufacturers

COMPANY	BRAND RANK BY US$ SALES (2007)			REVENUE IN US$ (YEAR)	KEY FACTS	ENERGY STAR-QUALIFIED PRODUCTS
	AMPLIFIERS	HOME THEATER SYSTEMS	SHELF SYSTEMS			
Yamaha *www.yamaha.com*	#1	#4		$5.5 B (2008)	Founded 1887. Based in Japan. Products include musical instruments, music production, professional audio, consumer audio and video, computer peripherals, LSI and thermoelectric coolers, IP conference systems, and software.	None
Denon Electronics (owned by D&M Holdings, Inc.) *www.usa.denon.com/*	#2	#8		$185 M (D&M, 2008, estimated)	Founded 1910. Based in Japan. Offers home theater, audio, and software products.	None
Sony *www.sony.com*	#3	#2	#1	$89.6 B (2008)	Founded 1946. Based in Japan. Produces a range of audio, video, television, information and communication, semiconductor, and electronic component products.	Shelf systems Component systems Receivers Amplifiers
Pioneer Electronics *www.pioneerelectronics.com*	#4			$7.8 B (2008)	Founded 1938. Based in Japan. Offers audio and video products for home, car, professional DJs and business.	Shelf systems Receivers
Onkyo *www.onkyousa.com*	#5	#5		$406.3 M (2008)	Founded 1946. Based in Japan. Offers a wide variety of home theater products, including DVD players, CD players, amplifiers, speakers, and accessories.	None
Sherwood *www.sherwoodusa.com*	#6			$1-5 M	Founded 1953. Based in California. Products include home theater systems, components, and accessories.	None
Harman Kardon *www.harmankardon.com*	#7			$90.7 M (2008)	Founded 1953. Based in California. Produces audio products for home and automobile use.	None

Continued

COMPANY	BRAND RANK BY US$ SALES (2007)			REVENUE IN US$ (YEAR)	KEY FACTS	ENERGY STAR-QUALIFIED PRODUCTS
	AMPLIFIERS	HOME THEATER SYSTEMS	SHELF SYSTEMS			
Niles *www.nilesaudio.com*	#8			$50.5 M (2007)	Founded 1978. Based in Florida. Produces whole-house audio and home theater systems.	None
Marantz (owned by D&M Holdings, Inc.) *www.marantz.com*	#9			$185 M (D&M, 2008, estimated)	Founded 1953. Based in Japan. Products include video displays, AV receivers, AV separates and components, DVD players, and remote controls.	None
JVC *www.jvc.com*	#10	#10	#3	$6.7 B (2008)	Founded 1927. Based in Japan. Produces a wide range of products in television, audio, video, camcorder, and accessory categories.	None
Bose *www.bose.com*		#1		$906.6 M (2008, estimated)	Founded 1964. Based in Massachusetts. Produces audio and home theater products including headphones, computer speakers, home theater systems, and mini systems.	None
Panasonic *www.panasonic.com*		#3	#2	$91 B (2008)	Founded in 1918, based in Japan. Offers a wide range of electronics products for consumer, business, and industrial sectors.	Shelf systems Receivers
RCA (Rights to use RCA brand for select product categories, including home theater and audio systems, licensed to Alco Holdings Limited) *www.RCAav.com*		#9	#4	$628.6 M (Alco)	RCA founded in 1919. Brand name for audio products currently licensed to Alco, based in Hong Kong.	Receivers
Sharp Electronics *www.sharpusa.com*			#6	$34 B (2008)	Founded 1962. Based in Japan. Products include appliances, business electronics, notebook PCs, and solar products.	Shelf systems Component systems Receivers Amplifiers

Continued

COMPANY	BRAND RANK BY US$ SALES (2007)			REVENUE IN US$ (YEAR)	KEY FACTS	ENERGY STAR-QUALIFIED PRODUCTS
	AMPLIFIERS	HOME THEATER SYSTEMS	SHELF SYSTEMS			
Samsung *www.samsung.com/us*		#7		$573 M (2007)	Founded 1938. Based in Korea. Makes a wide variety of consumer and business electronics.	Shelf systems Receivers Amplifiers
Philips Electronics *www.philips.com*		#6	#5	$37.2 B (2008)	Founded 1891. Based in The Netherlands. Product categories include healthcare, consumer lifestyle, and lighting. Consumer products range from TVs to toothbrushes.	Shelf systems Receivers
GPX *www.gpx.com*			#7	$55.2 M (2008)	Founded 1974. Based in Missouri. Makes a range of audio products, iPod products, and digital picture frames.	None
Emerson *www.emerson.com*			#8	$24.8 B (2008)	Founded 1890. Based in Missouri. Global manufacturing and technology company offering products in a wide variety of areas.	None
iSymphony *www.myisymphony.com*			#9	Unknown	Founded 2006. Based in California. Privately held. Makes iPod-compatible audio products.	None
LG Electronics *www.lge.com*			#10	$24.7 B (2008)	Founded 1958. Based in Korea. Products include mobile phones, home entertainment devices, appliances, and computers.	Shelf systems Receivers

Sources: Brand rankings from: TWICE Staff. (July 2, 2007). 2007 Market Share Reports by Category, Part 1. TWICE. Retrieved from *http://www.twice.com/article/244040-2007_Market_Share_Reports_By_Category_Part_1.php?rssid=20328&q=2007+Market+Share+Reports+by+Category%2C+Part+1*. ENERGY STAR data from: ENERGY STAR. (May 1, 2009). Audio DVD Qualified Product List. Retrieved from *http://downloads.energystar.gov/bi/qplist/audio_dvd_prod_list.xls*. ENERGY STAR terminology differs slight from that used here. ENERGY STAR's "audio separates" category includes powered speakers, amplifiers, receivers and rack systems. The "mini systems" category includes compact audio or shelf systems as well as micro systems. The table lists only companies making ENERGY STAR-qualified receivers, amplifiers and shelf, component, and home theater systems. The companies listed may also make other ENERGY STAR-qualified audio products, including cassette decks, CD recorders, clock radios, CD players/changers, mini-disk players, speakers and tuners.

Product Development Process

The development timeline for home audio products is 6 to 18 months, depending on the complexity of the product. Manufacturers describe increasingly short product life cycles – both in terms of development time and shelf life.

Product Design

Manufacturers design and engineer their products in-house. These activities may occur in the U.S. or overseas. When product design takes place overseas, the manufacturer's U.S. office may perform its own market research or request specific product features.

Manufacturing

Most home audio products are manufactured in China or Japan, either in factories owned by the manufacturer or on a contract basis with a third-party manufacturer. Companies that outsource their manufacturing maintain tight control over the manufacturing process by delivering detailed product specifications to the manufacturer and/or tracking each component to ensure they are purchased and assembled as specified.

Distribution

Distribution channels for most home audio products are typical of consumer electronics in general and include:

- **Mass Market Retailers, Superstores, or Big Box Stores**
- **Regional Chains and Specialty Stores**
- **Online Retailers –** one manufacturer noted that it sells more of its home audio products online than is typical for the company as a whole because its brand is not as well known and it has difficulty getting shelf space at traditional retailers.

Whole home audio systems, which include receivers and/or amplifiers, differ in their distribution from other audio products. These complex systems typically require professional installation because key components like the receiver are in a central location, with built-in speakers distributed throughout the home. As a result, they are rarely sold through retail outlets or direct sales and are typically distributed through dealers/installers, who receive training and support from the manufacturer and provide installation for the end-user.

Industry Organizations and Events

The following organizations and events influence the home audio market.

- **Consumer Electronics Association:** The largest, most important industry organization. The annual *Consumer Electronics Show* is *the* event for announcing and demonstrating new products.
- **NPD Group:** A leading provider of point-of-sale data. NPD tracks sales of home audio products.
- **Custom Electronic Design & Installation Association (CEDIA):** An international trade association for companies that design and install home electronic systems, which include networking, home automation and communications, media and entertainment, lighting control, security, and HVAC. Activities organized by CEDIA include an annual conference, training, and certification exams.

Marketing

Manufacturers of audio receivers identified product packaging and print advertising in home theater and audio-specific magazines as two primary marketing strategies. Manufacturers may also place online advertisements, but this appears to be of secondary importance.

Manufacturers also work with retailers to market their products, providing in-store marketing collateral and responding to retailer requests for specific types of packaging.

Energy Efficiency

Manufacturer Attitudes towards Energy Efficiency

Of the four manufacturers interviewed, three make ENERGY STAR products. This is not representative of the larger population, in which fewer than half of top manufacturers make an ENERGY STAR-qualified product.

All three ENERGY STAR manufacturers considered it a high priority to increase the efficiency of their products and expand qualified product lines. Two of the manufacturers noted internal company goals to be at or near 100% compliant and both believed about 80% of their current product lines are ENERGY STAR-qualified. A third manufacturer has qualified about 20% of its products, with the intention to qualify all future tuner products and any others it deems feasible.

These manufacturers' focus on energy efficiency appears to be motivated by corporate environmental or sustainability goals, as well as the perception of a growing consumer demand for "green" or sustainable products.

The fourth manufacturer interviewed does not make any ENERGY STAR-qualified products and rated energy efficiency a moderate or low priority.

Efficiency Standards

ENERGY STAR is the most commonly cited standard for the U.S. market. The current specification (Version 1.0, Phase II) took effect in 2003 and includes only standby mode power consumption. Version 1.0 is available at: *http://www.energystar.gov/ia/partners/product_specs/eligibility/audio_dvd_elig.pdf.*

A new ENERGY STAR audio and video specification is in development and expected to take effect in May, 2010. Documents related to the development of Version 2.0 are available at: *http://www.energystar.gov/index.cfm?c=revisions.audio_video_spec*.

Other audio product specifications include:

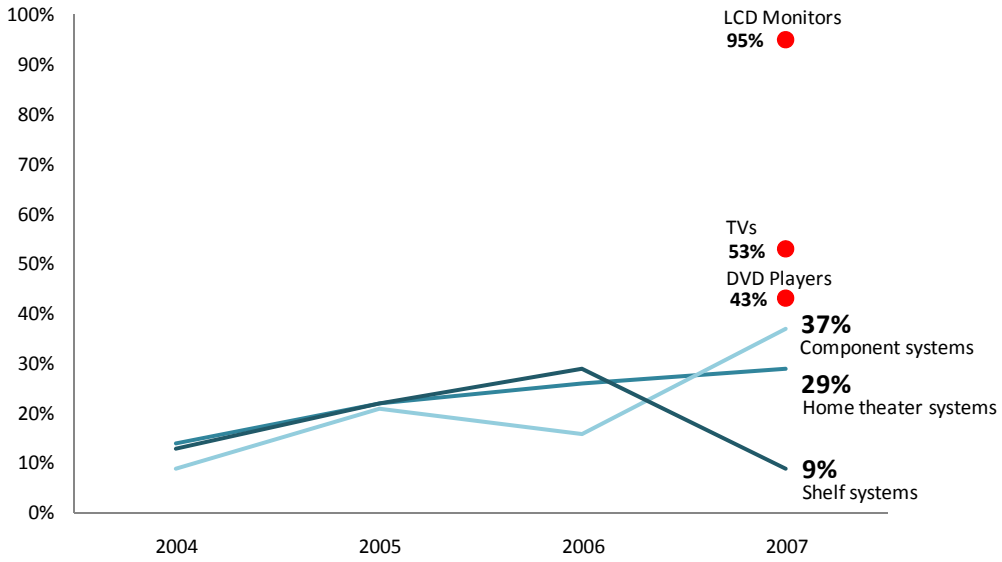
- **Commitment by the Consumer Electronics Industry on Reducing the Energy Consumption of Audio Products in Stand-by Mode (European Union) –** In 2000, European electronics manufacturers signed an agreement with the European Association of Consumer Electronics Manufacturers (EACEM) to limit standby power consumption of new products to 1 watt or less by 2007. Their agreement can be found at: *http://re.jrc.ec.europa.eu/energyefficiency/pdf/TR-036-r01_Audio_VA.pdf*
- **Minimum Energy Performance Standards (Australia)** – Home audio products will be covered by standby power requirements mandating products to use less than 1 watt standby power by 2012.
- **Nordic Swan (Norway, Sweden, Finland, Iceland and Denmark)** – Qualifying home audio equipment must meet *standby* and *on* mode power consumption limits of 2 watts and 40 watts respectively. The requirements are available at: *http://www.svanen.nu/Default.aspx?tabName=CriteriaDetailEng&menuItemID=7056&pgr=71*.
- **e-Standby Program (Korea)** – The program will require home audio products to use less than 1 watt of power in standby mode starting in 2010. Those that do not meet the requirement will have to carry a warning label.

ENERGY STAR Penetration

The penetration of ENERGY STAR home audio/DVD products was 36% in 2007, the lowest among all consumer electronics product categories. Even this figure is elevated because it includes DVD players, where penetration has been higher than home audio products.

Figure 3.6 compares itemized penetration rates for the three home audio products tracked by ENERGY STAR (shelf, component, and home theater systems) from 2004, when Version 1.0 went into effect, to 2007.

Figure 3.6: Penetration of ENERGY STAR Home Audio Products, 2004-2007



Data Source: U.S. EPA/ENERGY STAR. *Unit Shipment and Market Penetration Report*. Calendar year summaries for 2004, 2005, 2006, and 2007. Retrieved July 13, 2009 from *http://www.energystar.gov/index.cfm?c=partners.unit_shipment_data_archives*.

Three factors may be contributing to low penetration rates:

- **Only eight of the top 20 manufacturers make ENERGY STAR-qualified products**. As a result, if a consumer wants to purchase a particular brand, there may not be an ENERGY STAR model to choose from.
- **While many products have met ENERGY STAR standards, it is unclear how many of those products are actually available for purchase**. As of July 15, 2009, 222 receivers, 161 shelf systems, and 3 component systems had earned the ENERGY STAR label. However, the number of products available for purchase may be far lower. A spot-check of qualified products listed on the ENERGY STAR website found fewer than 50% were also listed on the manufacturer's website or available for purchase through online retailers.
- **Manufacturers rarely market energy efficiency as a product feature**. In product marketing, energy is, at best, secondary to other product features. This factor is discussed in more detail below.

Other factors to consider:

- **The cost of energy efficiency is likely a more important barrier to ENERGY STAR penetration among low-cost products designed to be sold at high volume than it is among higher-end products**. Manufacturers interviewed stated that cost was a significant consideration in their low-end products, with one manufacturer elaborating

that this price competition is driven by the relatively low barriers-to-entry in the consumer electronics industry. Manufacturers stated that these price concerns would take precedence over energy efficiency in their lowest-priced products, where they find it necessary to meet certain (low) price points in order to gain shelf space.

➡ **Among high-end consumer audio products, manufacturers interviewed stated that product features play a larger role in limiting the penetration of energy-efficient products than cost.** As one manufacturer emphasized, sound quality is generally proportional to energy use. Another manufacturer mentioned the incorporation of new, energy-using technologies as a factor limiting the potential to achieve energy efficiency in its newest product line.

➡ **Despite manufacturer concerns about price competition and sound quality, energy-efficient home audio products exist at all price points.** Studies leading to the formation of Australia's MEPS standards for home entertainment equipment found no correlation between the price of the equipment and its energy consumption. In fact, they discovered a great deal of variation in the power consumption of home audio products, at all price points.[97]

Marketing Energy-Efficient Products

Packaging and Point-of-Sale Materials

Manufacturers use packaging and other point-of-sale materials to highlight product features; Energy efficiency is not at the top of this list. Figure 3.7, below, shows packaging for three home audio products: an ENERGY STAR-qualified receiver, an ENERGY STAR-qualified shelf system, and a non-ENERGY STAR shelf system. Product packaging is similar in all three, with the product image primary, along with a short list of key features. The ENERGY STAR models feature the ENERGY STAR logo in a bottom corner, but it is not associated with any other product information. It is important to note that although the ENERGY STAR logo may be featured prominently on the products themselves, this would not influence the decision-making process of a potential purchaser.

[97] Equipment Energy Efficiency Programme (E3). (November, 2006). Proposed Minimum Energy Performance Standards for Home Entertainment Equipment. Prepared for the Ministerial Council on Energy by Energy Consult. Available at: *http://www.energyrating.gov.au/library/pubs/200613-meps-home-entertainment.pdf*

Figure 3.7: Packaging for Three Home Audio Products

ENERGY STAR-Qualified RCA Shelf System (Image: source available upon request.)

ENERGY STAR-Qualified Panasonic Shelf System (Image: *www.ebay.com*, accessed June 24, 2009.)

Non-ENERGY STAR Sony Shelf System (Image: *www.ebay.com*, accessed June 24, 2009.)

Online

As in other marketing mediums, manufacturers do not use energy efficiency to differentiate their products online, focusing instead on sound quality and other features. At most, they mention energy efficiency as one of many items in a list of features and some make no reference to a product's ENERGY STAR qualification.

For example, on web pages featuring ENERGY STAR-qualified home audio products:

- **Philips Electronics** does not include any energy information. A three-page downloadable brochure includes the ENERGY STAR logo on the bottom of the second page and, on the third page, one bullet point about the unit's 1-watt standby use appears in a long list of specifications and features.
- **Pioneer Electronics** places the ENERGY STAR logo at the bottom of some product pages, but not others, and makes no other reference to the product's energy efficiency on the webpage or the downloadable product brochure.
- **Sony** gives no indication that the product is ENERGY STAR-qualified. Although the unit's power consumption is listed on the *Specifications* tab, the ENERGY STAR logo does not appear and a consumer would not know that the 0.3 W standby power consumption makes this product best-in-class. See Figure 3.8.

Figure 3.8: Product Detail Page for an ENERGY STAR-Qualified Sony Receiver

(Image: *www.sony.com*, accessed May 12, 2009. Model number STR-DH700)

Print Advertising and Tradeshows

Manufacturers interviewed describe marketing ENERGY STAR products in magazine advertisements and at tradeshows, but emphasized that any reference to energy efficiency is typically limited to displaying the ENERGY STAR logo. One manufacturer noted he had never seen a full-page advertisement focused on energy use and believed the company had "under-marketed" this aspect of its products.

Barriers and Opportunities

Barriers

- **The current ENERGY STAR standard does not limit active mode power.** CEC Title 20 standards already limit standby power to 3 watts. Efficiency gains based on increased penetration of ENERGY STAR products in California can achieve, at most, 2 watts per unit.[98] However, this may be a temporary barrier, since the ENERGY STAR specification is under revision and is expected to include limits on *active* mode power when it takes effect in 2010. As of May 2009, ENERGY STAR was collecting test data from manufacturers, but had not yet released a draft.

- **For some products, particularly the high-volume/low-cost models, manufacturers must keep prices low to remain competitive and gain shelf space with retailers.** The manufacturers interviewed noted that retail price drives design choices for high-volume/ low-cost, products. These devices likely make up a large portion of the installed base and a correspondingly large share of many manufacturers' unit sales. As a result, efficiency is often sacrificed when it is not feasible to meet ENERGY STAR requirements, incorporate the necessary features, *and* hit the target price.

- **Many consumers are not aware of the energy consumption of home audio products and do not demand efficiency.** The manufacturers interviewed stated that their companies' product offerings are driven by consumer demand. They also believe that, while consumers are familiar with the ENERGY STAR brand and demand for efficient products is growing, consumers typically associate ENERGY STAR with appliances rather than home audio equipment.

- **While cost may be a primary barrier to efficiency in low-end products, energy required to produce high sound quality is likely a primary barrier to efficiency in high-end products.** Utility programs focused on home audio products may need to approach manufacturers differently to promote efficiency in products sold at different price points.

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98 Chase, Ramos and Pope. Consumer Electronics: Market Trends, Energy Consumption and Program Recommendations, 2005-2010.

Opportunities

- **Home audio equipment has high household penetration rates**. At least 40% of U.S. households are estimated to have at least one compact system and/or one component audio system. Penetration of home theater systems was low in 2006, at last measurement, (less than 20%) but thought to be increasing.

- **Penetration of ENERGY STAR-qualified products shows room for improvement**. Penetration of ENERGY STAR-qualified audio products is the lowest of all consumer electronics devices. Higher penetration rates in other consumer electronics product segments suggests opportunity in the home audio market.

- **Receivers have high *active* mode power use and total annual power use**. Ecos Consulting has measured the *active* mode power use of a typical receiver as between 40 and 50 watts. Studies vary, but receivers and systems with them use between 50 kWh and 150 kWh per year.[99] Estimates of savings potential for these products ranges from 3 to 50 kWh/year.[100]

- **The incremental cost of efficiency may be relatively low, on a per-unit basis**. Interviewees did not discuss the actual incremental costs of more efficient products. However, cost decisions in the home audio market, and among high-volume/low-cost products in particular, are more likely measured in cents than dollars. One manufacturer noted that even decisions with a cost impact of "pennies" merit high-level discussions and that component costs are measured in "fractions of cents."

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99 Annual unit energy consumption of receivers was estimated at 122 kWh (TIAX 2007), 133 kWh (Energy Solutions 2006), and 143 kWh (Ecos Consulting 2006). Shelf system unit energy consumption was estimated at 58 kWh (Ecos Consulting 2006), 76 kWh (Energy Solutions 2006), and 81 kWh (TIAX 2007). HTIB unit energy consumption was estimated at 89 kWh (TIAX) and 115 kWh (Energy Solutions 2006).

100 Chase, Ramos and Pope. Consumer Electronics: Market Trends, Energy Consumption and Program Recommendations, 2005-2010.; Roth et al. *Residential Miscellaneous Electric Loads: Energy Consumption Characterization and Energy Savings Potential.*

"SMART" POWER STRIPS & SURGE PROTECTORS

Power strips serve many functions in today's homes and offices. They provide additional electrical outlets and act as an extension cord. Surge protectors add the ability to protect devices from power surges. "Smart" products include all these features and also offer power management capabilities.

There are no published data on the number of power strips and surge protectors currently in use in the U.S. Individual manufacturer estimates range from 105 million (one for every household) to 250 million (two to three per household). Estimates of units sold in 2008 vary as well, from 8 to 26 million.[101]

The U.S. power strip and surge protector market is steady and some manufacturers estimate that it may be shrinking. Price competition is fierce and many manufacturers already use power management features to differentiate their products. Smart products currently represent less than 2% of the overall market and manufacturers see opportunity for growth in this area if the higher retail price of smart products can be overcome.

A power strip is an electrical unit that contains multiple outlets, allowing many devices to be plugged in to a single wall outlet. A master switch shuts off power to all devices plugged in to the strip.

"Smart" products use a variety of automated methods to turn off the master switch when devices are not in use, thus eliminating power that would have been consumed during idle or off modes.

(Image: *http://main.goecoreno.com/*)

Key Market Characteristics and Trends

➡ **The U.S. surge protector market is holding steady or shrinking.**[102] One manufacturer estimated the dollar value decline in the US market at 10% annually, from approximately $530 million in 2008.[103] This likely results from two factors: prices driven down by

[101] The lower figure (8 million) was estimated by a manufacturer based on the total unit sales of three major retailers and their market share. The higher figure (26 million) was estimated by a different manufacture based on total U.S. sales in dollars divided by average unit cost ($20). Marti Frank, Interviews with manufacturers, February-April 2009.

[102] Market data is available for surge protectors, but not power strips. When discussing market size, growth, and the market share of various manufacturers, this chapter refers only to the surge protector market.

[103] Brian Greenberg. (July, 2008). *2008 Power Protection Market Intelligence Program: Plug-In and Hard-Wired Powerline Surge Suppressors*. VDC Research Group. Retrieved from: *http://www.vdcresearch.com/PurchasedDownloadFile.asp?type=executivebrief&id=2221*; Frank interviews.

competition and private labels,[104] and a replacement cycle much longer than other consumer electronics products.

- **To capture market share, manufacturers must use creative product design, feature sets, or support of their end-users or channel partners to differentiate their products.** In recent years, the relative stability of the technology underlying power strips/surge protectors has led to declining prices and increasing similarity among products. As innovation in the underlying technology slowed, manufacturers have focused on product design and features to attract consumers and gain market share.
- **More smart products are coming to market.** Manufacturers view smart products as an *edge* – a way to gain market share and boost revenue in a very competitive environment. This perspective seems merited. Despite year-over-year sales that are largely stagnant for the industry as a whole, one manufacturer reported sales of smart products increased 150% from 2008 to 2009.

Supply Chain

There are two key players in the power strip/surge protector supply chain:

- **Manufacturers –** companies that design the product and manage its manufacture. Most manufacturers sell their product under their own brand. Some also make their product available for private labeling, in which case the product appears under another company's brand.
- **Retailers** – power strips/surge protectors reach customers through several types of retailers, from big box stores to online merchants. Retailers are discussed in detail in the *Distribution* section below.

Manufacturers

The power strip/surge protector market has seen considerable consolidation over last few years with some companies merging and others players dropping out of the market. Table 3.26 below lists the top five manufacturers in the American market in 2008. Table 3.27 lists other U.S. manufacturers.

[104] Private label products are manufactured by one company for sale under another company's brand. These products are often sold as store brands and seek to offer a lower price than major brand names. A prevalence of private labels puts downward pressure on prices across the market.

Table 3.26: Top Five U.S. Surge Protector Manufacturers, 2008

COMPANY	RANK (2008)	OVERALL COMPANY SALES IN US$ (YEAR)	KEY FACTS	SMART PRODUCT BRAND NAME AND DETAILS	ENERGY STAR-QUALIFIED PRODUCTS?
Belkin *www.belkin.com*	#1	$1 B (unknown)	Founded 1983. Based in California. Privately owned. Manufactures a variety of electronic accessories for MP3 devices, computers, networking, home theater.	*Conserve* ($35-60) Wireless one-touch remote. 8- and 10-outlet models. Two outlets "always on," remote turns off others.	N/A
Tripp Lite *www.tripplite.com*	#2	$215 M (2007)	Founded 1922. Based in Illinois. Privately owned. Manufactures 2,000 power protection and connectivity products. 16 million surge protectors in use.	*ECO Series* ($50-$90) Master/subordinate design. Also a UPS. 3 models released January 2009.	N/A
Philips Electronics *www.philips.com*	#3	$37.2 B (2008)	Based in The Netherlands. Product categories include healthcare, consumer lifestyle, and lighting. Wide range of consumer products, from TVs to toothbrushes, to earphones.	*Think Green* Also sold as the *Power Sentry Home Computer Advanced Power Surge Block* ($30-40) Master/subordinate design. 6 outlets: 1 master, 4 subordinate, 1 "always on."	N/A
Monster Cable *www.monstercable.com*	#4	$90.4 M (2007, estimated)	Founded 1979. Based in California. Manufactures high-performance cables for audio/video components, computers, and video games.	*Monster Digital Power w/Green Power* ($120-150) Master/subordinate design. 8- and 10-outlet models.	N/A
Prime *www.primewirecable.com*	#5	$5.4 M (2008)	Founded 1986. Based in California. Manufactures wire and cable products.	In development.	N/A

Sources: Company and smart product data from Hoovers.com, company websites, and manufacturer interviews. Manufacturer rankings from Greenberg. *2008 Power Protection Market Intelligence Program: Plug-In and Hard-Wired Powerline Surge Suppressors.* ENERGY STAR data is listed as not applicable because ENERGY STAR specifications do not cover power strips or surge protectors.

Table 3.27: Other Power Strip & Surge Protector Manufacturers Offering Products in the U.S. Market

COMPANY	OVERALL COMPANY SALES IN US$ (YEAR)	KEY FACTS	SMART PRODUCT BRAND NAME AND DETAILS	ENERGY STAR-QUALIFIED PRODUCTS?
American Power Conversion (APC) – owned by Schneider Electric SA *www.apc.com*	$25 B (2007 – Schneider Electric)	Founded 1981. Based in Rhode Island. Manufactures variety of power products. Parent company based in France.	*Power-Saving Essential SurgeArrest* ($25-30) Master/subordinate design. 7 outlets: 1 master, 3 subordinate, 3 "always on."	N/A
Leviton *www.leviton.com*	$800 M (2007)	Based in New York. Privately held. 25k + electrical products, including switches, plugs, networks, and lighting controls.	None	N/A
Acoustic Research – owned by Audiovox Corporation *www.araccessories.com*	$591 M (2008 – Audiovox)	Founded 1952. Manufactures consumer audio products.	None	N/A
CyberPower Systems, Inc. *www.cyberpowersystems.com*	$67.3 M (2008)	Founded 1997. Based in Minnesota. Manufactures primarily uninterruptible power supplies (UPSs).	In development	N/A
Micro Innovations (Acquired by Digital Innovations) *www.digitalinnovations.com*	Unknown	Founded 1997. Based in Arlington Heights, IL. Manufacturers keyboards, webcams, mice, speakers, and headsets.	*SP1000ESG SP2000ESG* ($90-$100) Master//subordinate design, 8 and 10 outlet models.	N/A
Panamax *www.panamax.com*	$13.2 M (2008)	Founded 1975. Based in California. Designs and manufactures electronic and electrical protection, filtration, and control products.	*M8/M10-HT-PRO* ($150-$170) Master/subordinate design, called "12-volt trigger" in company literature. 8 and 10 outlet models.	N/A
WattStopper *www.wattstopper.com*	$12.7 M (2007, estimated)	Founded 1984. Based in California. Company focused on energy-efficient products.	*Isole* ($90) Occupancy sensor. 8- outlet model has 2 outlets "always on," sensor controls others.	N/A

Continued

COMPANY	OVERALL COMPANY SALES IN US$ (YEAR)	KEY FACTS	SMART PRODUCT BRAND NAME AND DETAILS	ENERGY STAR-QUALIFIED PRODUCTS?
Bits Limited *www.bitsltd.net*	Unknown	Founded 1986. Based in New York. Company focused on energy-efficient products. SmartStrip is manufactured through a private label agreement with Coleman Cable Inc.	*SmartStrip* ($30-45) Master/subordinate design. 7- and 10-outlets models with 2 "always on" outlets.	N/A
Fellowes *www.fellowes.com/*	Unknown	Founded 1917. Based in Illinois. Manufactures and markets business machines, records storage equipment, and technology accessories.	*Smart Surge Power Strip ($30)* Master/subordinate design. 10-outlet model.	N/A
Globe *www.globe-electric.com*	Unknown	Founded 1932. Based in Canada. Manufactures light bulbs, lighting products, and other electrical products.	*8 Outlet Power Bar and Timer* ($19) Mechanical 24 hour timer allowing 48 on-off settings. 4 outlets controlled by timer.	N/A
Uninex International *www.uninex.com*	Unknown	Founded 1989. Based in California. Manufactures and imports consumer electronics, parts, and accessories.	*Power Managed Surge Protector* ($25-35) Master/subordinate design on 8-outlet model. Keychain remote on 6-outlet model.	N/A

Sources: Company and Smart product information from manufacturer websites. Revenue data from *http://www.hoovers.com*. ENERGY STAR data is listed as not applicable because ENERGY STAR specifications do not cover power strips or surge protectors.

Product Development Process

The development timeline for power strips/surge protectors is 12 to 18 months, depending on the complexity of the product. Certification and quality testing (performed by independent labs for a fee) consumes much of this time, with one manufacturer describing it as a "big roadblock."

Product Design

Manufacturers almost always design and engineer power strips/surge protectors in-house, using their own design and engineering staff. They may create entirely new products or modify

existing ones. Manufacturers may also introduce products into the U.S. market that are already available in other countries. Manufacturers conduct market research and use their marketing and sales staff to assess demand and determine feature sets. In some cases, a manufacturer may purchase a product from a (usually Asian) supplier and sell it under their own brand.

Manufacturing

Most, if not all, power strips and surge protectors are manufactured in China or Taiwan. None of the manufacturers interviewed own the facilities where their products are made. They outsource this work on a contract basis to a manufacturer who produces the product based on the manufacturer's design and specifications.

Distribution

When manufacturers sell the product under their own brand, they also manage its distribution. This occurs through multiple channels, and none of the manufacturers interviewed utilized precisely the same "bundle" of channels. Examples of these distribution bundles include:

- Superstores, mass market retailers, online retailers and the manufacturer's own website
- Superstores, mass market retailers, regional and specialty stores, and online retailers (but not the manufacturer's own website)
- Private label sales, direct sales to institutional customers, online retailers, and the manufacturer's own website

Bricks and Mortar Retailers

These traditional retailers move the largest volume of power strips/surge protectors, accounting for more than 50% of all shipments in 2007. The manufacturer's sales staff maintains relationships with retailers, which can be important for acquiring shelf space.[105]

While retailers can be categorized in multiple ways,[106] the manufacturers interviewed used the following terms to describe their retail partners.

- **Mass Market Retailers, Big Box Stores,** or **Superstores:** These national chain stores include supermarkets, home centers, drug stores, and discount stores. Big box or superstores are usually free-standing, one-level stores with floor space upwards of 50,000

[105] Greenberg. 2008 Power Protection Market Intelligence Program: Plug-In and Hard-Wired Powerline Surge Suppressors

[106] For example, the U.S. Bureau of the Census adopted a retail classification system in 1997, known as the North American Industrial Classification System (NAICS), which includes 176 classifications for the retail trade.

square feet. The top 10 mass market retailers are Wal-Mart, Kroger, Costco, Target, Walgreens, Sears, CVS/Caremark, Supervalu, Safeway and Loblaws (Canada).[107]

- **Regional Retailers:** These stores have multiple locations, but are limited to a particular geographic region (for example, Southeast electronics retailer HH Gregg).
- **Specialty Stores:** These retailers sell one type of merchandise and usually carry a selection of products that is narrow, but deep. Specialty stores may be mass-market retailers, regional retailers, or one-store independents (for example, True Value, Fry's Electronics, or Radio Shack).
- **Club or Warehouse Stores:** These retailers sell in bulk and require a membership fee (for example, Costco or Sam's Club).

Online Sales

Some manufacturers' online sales may account for as much 20% to 30% of total sales, making online sales a significant channel for the distribution of power strips/surge protectors, indicating online sales of surge protectors may play a larger role in their distribution than in U.S. retailing as a whole, where online sales made up only 3.4% of total retail sales in Q4 2008.[108]

Online sales channels for power supplies/surge protectors include retailers like Amazon.com and the manufacturer's own website. Some online retailers, like Gaiam.com, also mail paper catalogues.

Other Channels

- **Direct Sales:** One manufacturer reported selling directly to institutional customers, including universities and government agencies.
- **Private Label Sales:** One manufacturer sells its products wholesale to companies that brand and distribute it.
- **Electrical Distributors:** One manufacturer identified electrical distributors as an important sales channel, although this may be more common for installed hardware products wired into a home and usually installed during new construction or a major renovation.

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[107] Mass Market Retailers. Homepage. Retrieved April 22, 2009 from *http://www.massmarketretailers.com/*. There is much overlap among retailer categories. For example, Costco is both a mass market retailer and a club store.

[108] Census Bureau of the U.S. Department of Commerce. (February 17, 2009). Quarterly Retail e-Commerce Sales 4th Quarter 2008. Retrieved from *http://www.census.gov/mrts/www/data/html/08Q4.html*.

Marketing

Manufacturers manage all aspects of product marketing, from developing a marketing plan to designing product packaging and collateral materials (for example, brochures or in-store displays).

Although manufacturers engage in a variety of marketing activities, all identified product packaging as their most important marketing tool. According to one manufacturer, "The battle is at the shelf." Manufacturers describe purchasing behavior in which the purchase decision is often made in-store. In what manufacturers believe to be a typical example, a customer is already in the store to purchase another product, decides to purchase a power strip to gain additional outlets, then decides to upgrade from a power strip to a surge protector. As a result, product packaging or an in-store display becomes the customer's main source of product information.

Other manufacturer marketing activities include TV, print and online advertising, in-store promotions in collaboration with retail or distributor partners, and product displays at tradeshows.

Industry Organizations and Events

Three organizations influence and/or study the power strip/surge protector market:

- **Consumer Electronics Association –** the largest, most important industry organization whose annual Consumer Electronics Show is *the* event for announcing and demonstrating new products.
- **NPD Group –** a leading provider of point-of-sale data, NPD tracks sales of surge protectors.
- **Venture Development Corporation (VDC)** – a market research firm specializing in consumer electronics and accessories. Annual reports asses the global surge protector market and identify trends.

Energy Efficiency

A few key smart product trends are important for utility program implementers.

- **Manufacturers are increasingly turning to smart products as a way to differentiate their product and gain market share.** Twelve of the 15 manufacturers identified for this study currently sell or are developing a smart product.
- **The power used by smart products varies and may not be apparent to customers**. All smart products consume power to provide power management capabilities. Power use ranges from .25 to 3 watts, according to one manufacturer's unverified measurement. This information is rarely noted in product marketing materials and is not used to differentiate products.

➡ **Product recyclability and efficient use of materials are also top priorities for manufacturers**. Manufacturers describe efforts to reduce the materials and energy used to produce their products and are interested in complying with ROHS Regulations (an EU Directive banning certain hazardous materials like lead, cadmium, and mercury from electrical equipment).

Efficiency Standards

No energy efficiency standards apply to power strips or surge protectors. However, smart products reduce standby power use, which experts in the U.S. and abroad have identified as an area with high potential for energy savings.

Smart Products

The lack of a federal energy efficiency standard or labeling program for smart products makes tracking their penetration difficult. By one manufacturer's estimate, they represent less than 2% of the total surge protector market.

Manufacturer Data

Online product searches identified 16 power strip/surge protector manufacturers active in the U.S. market. Of those manufacturers:

➡ Three manufacturers do not make a smart product.

➡ Two manufacturers have a smart product in development.

➡ Eleven manufacturers make at least one smart product. Of these:

- Three manufacturers make only smart products
- Eight manufacturers make smart and regular power strips/surge protectors. These manufacturers' total number of strip/surge lines (including smart products) ranges from 3 to 16. Products in a line share features and branding, but may come with slightly different specifications, for example 8- and 10-outlet models.
- No manufacturers make more than one smart product line.

Four Types of Smart Products

Among the ten smart products currently on the market, four different power management strategies were identified. They are summarized in Table 3.28 below.

Table 3.28: Smart Product Power Management Strategies

SMART PRODUCT STRATEGY	DESCRIPTION	MANUFACTURERS EMPLOYING
Master/Subordinate or Master/Controlled Design	Large devices like a television or computer are plugged in to the "master" outlet(s), smaller items into the "subordinate" or "controlled" outlets. When the user turns the master device(s) off, the product automatically cuts power to the subordinate outlets.	APC Bits Limited Micro Innovations Monster Cable Panamax Philips Tripp Lite Uninex
Remote Control	The majority of outlets are controlled by a remote control, allowing the user to turn on or off power to the controlled devices. Some outlets are "always on" and are not controlled by the remote.	Belkin
Occupancy Sensor	The majority of outlets are controlled by an occupancy sensor, which turns them on when it detects occupancy, and off when no occupant is detected and after a preset delay. Some outlets are "always on" and are not controlled by the occupancy sensor.	WattStopper
Timer	A timer turns power on or off to controlled outlets, according to the user's settings.	Globe

Marketing Smart Products

Product packaging and the manufacturer's website are the two primary marketing tools for smart products, although manufacturers also list tradeshow demonstrations and utility bill inserts.

Manufacturers note that the marketing cycle for a new smart product may take longer because manufacturers need to develop messaging around the benefits of energy efficiency, but believe increasing public awareness of energy issues and smart products will reduce time-to-market in the future.

Packaging

Manufacturers use product packaging to differentiate smart products from regular power strips and surge protectors in several ways:

- Text and images tout the product's energy saving capabilities and explicitly connect energy and cost savings.
- Stand-by energy use is explained
- The color green is predominant

Figure 3.9, below, shows Belkin's packaging for the *Conserve* "smart" surge protector and its standard product.

Figure 3.9: Packaging of Two Belkin 8-Outlet Surge Protectors – A Smart Product (left) and Regular Product (right)

(Images: Source available upon request)

Website

The websites of most leading power strip/surge protector manufacturers do not call any more attention to their smart product than to any other offering. Three factors may explain this:

- Manufacturers appear to consider the website as secondary to product packaging as way to inform customers about product features.
- Manufacturers' websites display varying degrees of sophistication. Some manufacturers provide little more than a product number and a list of technical specifications for each product

- Some manufacturers make a wide range of products, from light bulbs to medical equipment. In these cases, surge protectors are just one of many products and do not receive top billing.

There are two notable exceptions, manufacturers that devote significant online resources to their smart product:

- **Belkin** displays its *Conserve* line in a separate section of the company's website, apart from other power strip and surge products. The *Conserve* section features a video demonstrating the product's energy-saving capabilities.
- **Bits Limited** has a narrower product range than other manufacturers and focuses its website primarily on the *SmartStrip*.

Utility Program Activity

NYSERDA is the only utility identified with an incentive program for smart products, which they describe as the "CFLs of power management." In fall 2008, a pilot with Bits Limited (makers of the *SmartStrip*) provided a 50/50 split incentive to retailers and manufacturers of $7 each, reducing the shelf price of the product from $42 to $28. The promotion sold about 1,200 products in one month.

NYSERDA began working with additional manufacturers in January 2009, including APC, Belkin, Ethereal, Globe, Monster Cable, Philips, and Uninex. NYSERDA is also working with other Northeast utilities and efficiency organizations to improve program effectiveness and gain economies of scale. Potential partners include Cape Light Compact (Cape Cod and Martha's Vineyard), Efficiency Vermont, National Grid, NSTAR (Massachusetts), and Western Massachusetts Electric Company. The program is expected to include mid- and upstream incentives to retailers and manufacturers, co-op marketing funds, point-of-sale materials, outreach events, and training.

Barriers and Opportunities

Barriers

- **Consumers are not aware of the benefits of smart products.** All manufacturers identify consumer awareness as a significant barrier to smart product adoption. They place high value on educating consumers about the phantom/vampire power drawn by consumer electronics, and the potential savings and economic benefits of power management.
- **The higher cost of smart products may deter adoption.** Manufacturers believe consumers are extremely price-sensitive. One manufacturer reported the need to sacrifice "green" features to keep their products' price competitive. The manufacturer did not

specify which features were cut, but noted a price difference of only a few dollars may affect a consumer's purchasing decision.

➡ **There is no nationally recognized standard for this product.** The lack of an ENERGY STAR specification or similar standard creates several gaps in the marketplace:

- Manufacturers do not have a standard to work towards and cannot take advantage of a branded label to raise awareness in product packaging and advertising.
- Consumers and utilities cannot be assured of the product's efficacy without a third-party verification process, and have no easy means to compare products.
- Awareness of the product category suffers because manufacturers cannot utilize the marketing apparatus and channels employed by other ENERGY STAR-qualified products, such as the ENERGY STAR website.

➡ **Manufacturers may be reluctant to launch new products in an uncertain economic climate.** Manufacturers noted they are less likely to launch new products now than they were last year (early 2008) because of reductions in consumer spending.

➡ **Anecdotal evidence suggests power strips and surge protectors are not replaced as often as other consumer and business electronics.** Consumer electronics are thought to have, at most, a five-year lifespan. While no data exists on replacement cycles for surge protectors, one manufacturer estimated consumers replace them every 10 to 15 years.

Opportunities

➡ **Manufacturers recognize the growth potential of smart products.** Manufacturers believe demand for smart products is growing and see value in developing new products.

➡ **Manufacturers are eager to work with utilities to promote smart products and raise consumer awareness**. All manufacturers interviewed were eager to open discussions with utilities to market smart products. They see value in utility partnerships, particularly around raising awareness and reducing the cost to consumers.

➡ **Manufacturers can be savvy in marketing smart products and developing effective messaging around energy efficiency**. Some manufacturers have shown an ability to develop sophisticated messaging and packaging design around the benefits of energy efficiency, which may be similar to that of utility program efforts.

➡ **Standby power is recognized worldwide as an area with high potential for energy savings. Smart products, if used correctly, can help reduce standby power**. Smart products eliminate standby power consumption from most of the devices plugged into them, without requiring users to replace existing equipment. However, their efficiency benefits are only realized if the product is used as intended.

UNINTERRUPTIBLE POWER SUPPLIES

Uninterruptible power supplies (UPSs) provide power to electrical devices during a utility outage, allowing the user to shut the device down safely. UPSs range from relatively small models designed to power one computer to much larger models for use with multiple servers or in data centers.

The total value of the North and South American UPS market was $2.8 billion in 2007. Large UPSs (>20 kVA[109]) are used primarily in data centers and constitute approximately 40% of the total market by dollar value.[110] The remaining 60% are smaller UPSs (<20 kVA) used for purposes as varied as home computers or workstations, small servers, point-of-sale machines, and medical equipment.

The <20 kVA UPS market was valued at approximately $1.7 billion in 2007 and is expected to grow at a rate of 8.1%, reaching $2.5 billion in 2012. Mid-sized UPSs (suitable for small servers or networks) constitute the largest portion, with shipments of just over $750 million.[111] The >20 kVA market was valued at approximately $1.1 billion and is expected to grow at a rate of 11.4%, reaching $1.9 billion in 2012.[112]

Uninterruptible power supplies (UPSs) provide emergency power to computers and other electronic devices in the case of a utility power outage, preventing damage and data loss. A battery or other source powers equipment for as little as a few minutes or as long as several hours, enough time for equipment to be shut down safely or for a backup generator to begin. Many UPSs also include surge protection and power management features.

UPSs range in size from less than 1 kVA (pictured above), suitable for a single computer or workstation, to over 1,000 kVA for large data centers.

(Image: *www.apc.com*)

Several factors drive growth in the UPS market, including an increase in the number of PCs and workstations, the use of UPSs to power accessories like external drives and printers, and the proliferation of home entertainment centers that require power conditioning and backup power. The direct installation of UPSs in homes by telecom service providers is also driving adoption.

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109 Kilovolt-amperes (kVA) are the standard measurement for the output power of UPSs.

110 Brian Greenberg. (October, 2008). *The 20.1 kVA and Over UPS Market: From VDC's 2008 Power Protection Market Intelligence Service Volumes 4-6*. VDC Research Group. Retrieved from *http://www.vdcresearch.com/PurchasedDownloadFile.asp?type=executivebrief&id=2217*.

111 Brian Greenberg. (August, 2008). *2008 Power Protection Global Market Demand Analysis Market Intelligence Program: Volume 1: UPS 20 KVA and Under, Americas*. VDC Research Group.

112 Greenberg. *The 20.1 kVA and Over UPS Market: From VDC's 2008 Power Protection Market Intelligence Service Volumes 4-6*.

UPSs are used to power fiber to the home (FTTH) systems during a utility outage to ensure users can contact emergency services.[113]

Several manufacturers market UPS products as energy-efficient in both the <20 kVA and >20 kVA categories. According to one manufacturer's marketing materials, a large UPS for use in a data center or large enterprise typically attains 94% efficiency. Other manufacturers claim their large UPSs achieve 96% efficiency or higher. Small UPS systems marketed as energy-efficient may achieve up to 99% efficiency.

Because of their size and lower average efficiency, the >20 kVA UPSs used primarily in data centers and enterprise applications may offer the greatest opportunity for energy efficiency gains. In addition, a growing interest in "green IT" is driving both manufacturers and consumers to buy more efficient products.

Key Market Characteristics and Trends

- **The residential market for UPSs is growing.** Several factors drive this growth: power requirements are increasing for computers and workstations; people are using UPSs with more devices, including printers, scanners, and external drives; high-end home entertainment systems are proliferating; and small and medium-sized data centers are becoming more common.
- **Increasing costs of electricity and growing reliance on computers and other electronic equipment are creating a cost-focused demand for energy efficiency in UPSs.** Organizations may spend as much as 10% of their IT budgets on cooling and 50% of IT budgets on running equipment.[114] Recognizing that their customers face these growing costs, UPS manufacturers see growth opportunities in increasing the energy efficiency of their products.
- **To differentiate their products and support diverse uses in residential and small office environments, UPS manufacturers must provide products in a variety of sizes, shapes, and combinations of features.** Residential customers may use UPSs with computers, home cinemas, and other entertainment equipment. To meet this need, manufacturers are offering UPSs with features like surge suppression and power conditioning, as well as lower-cost models for general use.

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[113] Conventional telephones require relatively little power to operate and the power needed is transmitted over the phone line by the service provider, who maintains the necessary backup power systems in a central location (including UPSs and generators). FTTH telecom services depend on power from the user's home and therefore require UPSs installed there to maintain service during power outages. UPSs installed by telecom service providers are typically around 0.4 kVA, enough power to maintain phone service for an industry standard eight hours.

[114] Greenberg. *2008 Power Protection Global Market Demand Analysis Market Intelligence Program: Volume 1: UPS 20 KVA and Under, Americas*.

- **Both businesses and individual consumers consider energy efficiency when buying a UPS.** A survey by industry analysts found that individual consumers rated energy efficiency as equally important to level of surge protection and less important only than battery life and reliability in their UPS purchasing decisions. Businesses rated energy efficiency as the fifth most important consideration in their UPS purchasing decisions, after reliability, battery life, level of surge protection, and backup time.[115]

- **The Internet is the most popular source of information for making UPS purchase decisions.** In a survey by industry analysts, two-thirds of consumers and more than half of business purchasers reported using the Internet to gather information on UPSs.[116]

- **UPS manufacturers are responding to demand for energy-efficient products resulting from their clients' "green IT" initiatives.** Industry analysts have identified "green IT" as one of the top strategic technologies and trends organizations face in 2008-2009. In response, UPS manufacturers have increased marketing of their products' energy efficiency and developed internal labels to identify "green" products.

- **As FTTH telecom service grows, telecom service providers will become an increasingly significant customer base for UPS manufacturers.** According to one UPS manufacturer, there are currently approximately 3.2 million UPSs installed in homes to support FTTH services, with 980,000 more expected to be installed in 2009. The Obama administration's broadband initiative is expected to accelerate the spread of FTTH services.

Product Categorization

This report considers two broad categories of UPSs, following distinctions made by industry analysts:

- **Small UPSs** (<20 kVA) range from units designed to power only a single workstation to units capable of powering IT and electrical engineering infrastructure, and, when multiple units are used, data centers.

- **Large UPSs** (>20 kVA) are installed only in large institutional settings powering infrastructure and large data centers.

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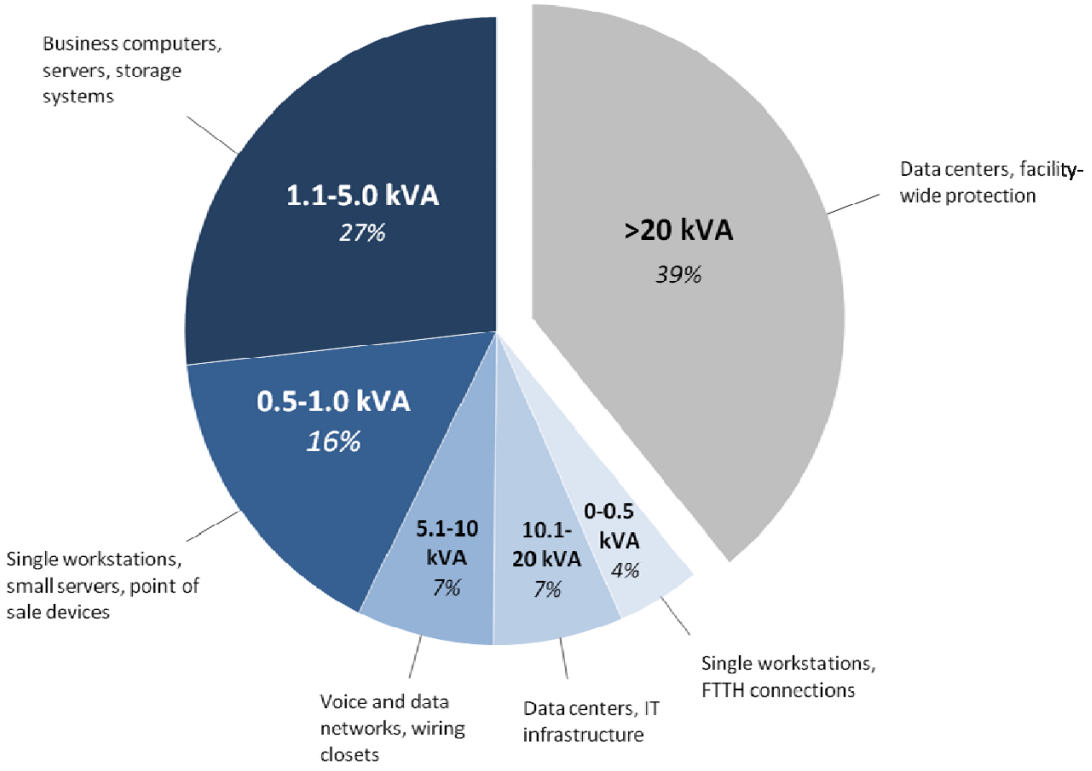
115 Greenberg. *2008 Power Protection Global Market Demand Analysis Market Intelligence Program: Volume 1: UPS 20 KVA and Under, Americas*.

116 Greenberg. *2008 Power Protection Global Market Demand Analysis Market Intelligence Program: Volume 1: UPS 20 KVA and Under, Americas*.

Figure 3.10 shows the proportion of shipments to the North and South American markets of UPSs of various sizes.

Figure 3.10: Percent of UPS Shipments in North and South America by Dollar Value, 2007



Sources: Greenberg. *2008 Power Protection Global Market Demand Analysis Market Intelligence Program: Volume 1: UPS 20 KVA and Under, Americas;* Greenberg. *The 20.1 kVA and Over UPS Market: From VDC's 2008 Power Protection Market Intelligence Service Volumes 4-6*.

Table 3.29 provides additional details about each size UPS, including the dollar value of 2007 shipments and projected annual growth rate through 2012.

Table 3.29: UPS Size and Usage

UPS POWER OUTPUT (KVA)	COMMON USES	VALUE OF 2007 SHIPMENTS TO NORTH & SOUTH AMERICAN MARKETS (US$)	PROJECTED ANNUAL GROWTH: 2008-2012
0-0.5	Single home and business workstations, and home networking equipment	$121.7 M	7.3%
0.5-1.0	Single home and business workstations, small servers, and point-of-sale devices	$448.9 M	8.0%
1.1-5.0	Business computers, servers, voice and data networks, and storage systems	$751.8 M	7.9%
5.1-10	Wiring closets, servers, voice and data networks, telecom equipment, and medical equipment	$199.5 M	7.9%
10.1-20	IT and electrical engineering infrastructure, data centers, and networks	$189.2 M	9.3%
>20	Data centers, and facility-wide protection	$1.1 B	11.4%

Source: Greenberg. *2008 Power Protection Global Market Demand Analysis Market Intelligence Program: Volume 1: UPS 20 KVA and Under, Americas;* Greenberg. *The 20.1 kVA and Over UPS Market: From VDC's 2008 Power Protection Market Intelligence Service Volumes 4-6*. Usage data gathered from manufacturer websites and interviews.

Supply Chain

There are four key players in the supply chain for uninterruptible power supplies:

- **Manufacturers** – design and manage the manufacture of UPSs.
- **Component Suppliers** – sell components like transformers, cables, and plastic to manufacturers.
- **Manufacturers' Representatives** – work with general contractors to sell large UPSs that are often customized to meet customers' needs.
- **Retailers and General Contractors** – sell UPSs to consumers, with retailers typically focused on smaller models and contractors typically focused on larger models.

Manufacturers

Analysts report that the structure of the UPS market did not change significantly between 2005 and 2007. Table 3.30 lists the top ten manufacturers of UPSs <5 kVA and <20 kVA in the North American and South American markets.

Table 3.30: Top Ten North & South American UPS Manufacturers, 2007

COMPANY	MARKET SHARE <20 KVA (RANK)	MARKET SHARE <5 KVA (RANK)	COMPANY SALES IN US$ (YEAR)	KEY FACTS	EFFICIENT PRODUCT INFORMATION		ENERGY STAR-QUALIFIED PRODUCTS?
					BRAND NAME AND DETAILS	PERCENT EFFICIENCY (CLAIMED BY MANUFACT.)	
American Power Conversion (APC) – Owned by Schneider Electric *www.apc.com*	44.2% #1	48.5% #1	$25.5 B (2007 – Schneider Electric)	Founded 1981. Based in Rhode Island. Manufactures variety of power products.	*"Green" UPS* (0.55 kVA, 0.65 kVA, 0.75 kVA, $50-110) High-efficiency charger, recycled packaging, 0.75 kVA model incorporates outlets with master/ subordinate design to eliminate standby power use by peripherals.	98%	N/A
Eaton *powerquality.eaton.com/USA*	11.3% #2	10.7 % #2	$15.3 B (2008)	Founded 1911. Based in Ohio. Produces a wide range of power management products, as well as other electrical, hydraulic, aerospace, truck and automotive products.	*Eaton 9395 UPS 225* (225 kVA) and *BladeUPS Power System* (12-60 kVA) Two models, both designed for business use. Manufacturer claims 9395 UPS operates at 94% efficiency and includes an "Energy Saver Mode" which enables 99% efficiency. Blade UPS system claims 97% efficiency.	94% - 99%	N/A
Emerson *www.emerson.com*	7% #3	4% #5	$24.8 B (2008)	Founded 1890. Based in Missouri. Global manufacturing and technology company, offers products in a wide variety of areas.	*Liebert NX* (40-120 kVA) Double conversion, three phase system designed for business or industrial use.	97%	N/A

Continued

COMPANY	MARKET SHARE <20 KVA (RANK)	MARKET SHARE <5 KVA (RANK)	COMPANY SALES IN US$ (YEAR)	KEY FACTS	EFFICIENT PRODUCT INFORMATION		ENERGY STAR-QUALIFIED PRODUCTS?
					BRAND NAME AND DETAILS	PERCENT EFFICIENCY (CLAIMED BY MANUFACT.)	
Tripp Lite *www.tripplite.com*	4.3% #4	4.7% #4	$215 M (2007)	Founded 1922. Based in Illinois. Privately owned. Manufactures 2,000 power protection and connectivity products.	*ECO Series UPS* (0.35-0.75 kVA, $49-$89), *SU40K* (40 kVA) Two product lines available: the line for home or small business use claims to be 99% energy-efficient. Models also use master/ subordinate design to cut standby power use. 3-phase system for business/ industrial use claims 96% efficiency.	96% - 99%	N/A
Toshiba *www.toshiba.com/tai*	4% #5	3.1% #6	$77.2 B (2008)	Founded 1875. Based in Japan. Manufactures a wide variety of electronics products.	*G9000 Series* (80-225 kVA) 3-phase system for business or industrial use.	96.5%	N/A
CyberPower Systems, Inc. *www.cyberpowersystems.com*	3.9% #6	5% #3	$67.3 M (2008)	Founded 1997. Based in Minnesota. Manufactures primarily small UPSs.	*Green Power UPS* (0.685-3 kVA) 28 models in 7 product lines use what the company calls Green Power Technology. Company claims efficient products have potential to cut UPS power use by 75%.	Unknown	N/A

Continued

COMPANY	MARKET SHARE <20 KVA (RANK)	MARKET SHARE <5 KVA (RANK)	COMPANY SALES IN US$ (YEAR)	KEY FACTS	EFFICIENT PRODUCT INFORMATION		ENERGY STAR-QUALIFIED PRODUCTS?
					BRAND NAME AND DETAILS	PERCENT EFFICIENCY (CLAIMED BY MANUFACT.)	
SMS Tecnologia *www.sms.com.br*	2.7% #7	2.7% #7	Unknown	Founded 1982. Based in Brazil. Manufactures a variety of energy management products.	*Gran Triphases* (60-300 kVA) Uses a special cooling system to reduce equipment size and conserve energy.	Unknown	N/A
Belkin *www.belkin.com*	1.9% #8	2.4% #8	$1 B (unknown)	Founded 1983. Based in California. Privately owned. Manufactures electronic accessories for MP3 devices, computers, networking, and home theater.	None found		N/A
Mitsubishi Electric Power Products, Inc. *www.meppi.com*	1.5% #9	0.5% #16	$17.7 M (2008)	Subsidiary of Mitsubishi Electric Corporation of Japan, founded 1921. Based in Pennsylvania. Manufactures a variety of electrical products directed to power systems, metal production, rail transportation, and water treatment.	*9900A Series* (80-225 kVA) 3-phase system for business or industrial use.	96.5%	N/A
PowerVar *www.powervar.com*	1.5% #10	1.5% #9	$8.0 M (2008)	Founded 1986. Based in Wisconsin. Products include power conditioners, UPSs, and custom engineered products.	None found		N/A

Source: Market share data from Greenberg. *2008 Power Protection Global Market Demand Analysis Market Intelligence Program: Volume 1: UPS 20 KVA and Under, Americas*. Sales data and product information from manufacturer websites and Hoovers.com. ENERGY STAR data is listed as not applicable because ENERGY STAR specifications do not cover UPSs.

Product Development Process

The product development timeline for UPSs varies greatly, depending on the size and complexity of the device, and the extent to which it incorporates new designs or technology. Small UPSs may be brought to market in as little as 90 days. Larger UPSs take considerably longer. A relatively simple product redesign that employs previously used technologies can take 8 to 12 months. A completely new design for a large UPS may take as much as three years.

According to one UPS manufacturer, the most time-consuming aspects of the product development process are product-qualification testing and gaining approvals from agencies like Underwriters Laboratories (UL). In the case of new designs, manufacturers may also seek input from customers and sales partners, further lengthening the development process.

Product Design

Manufacturers design and engineer their products in-house. This may occur in the U.S., overseas, or both. When the company designs a product to be sold under its own brand, it maintains full control over product design. The company identifies market needs, develops a product description and design requirements, and then turns these over to an engineering team that produces CAD drawings and further specifications. However, when the manufacturer designs a private label product (to be sold under a retailer or other company's brand), the purchaser may play a key role in setting product specifications, including features, materials, and packaging.

Manufacturing

UPSs are manufactured in locations worldwide, including China, India, Mexico, Scandinavia, and the U.S. Both manufacturers interviewed own their manufacturing facilities.

Distribution

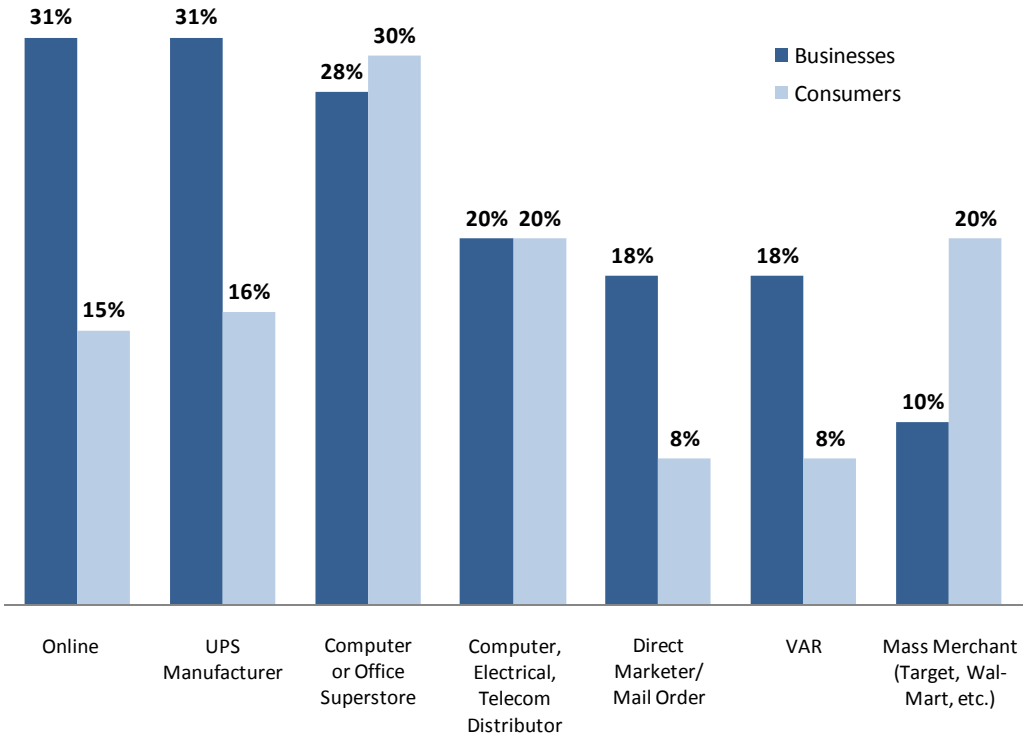
- **IT Distributors** obtain UPSs and other computer equipment at low cost from the manufacturer through volume rebates and discounts and sell them to VARs.
- **Manufacturer's Representatives** work for the companies whose products they sell. They typically work with contractors to specify large UPSs for data center and enterprise applications, but may also compete with VARs to install medium-sized UPS equipment.
- **Online Sales** retailers carry small UPSs, from general purpose sites like Amazon.com to more specialized technology sites like Newegg.com and Tigerdirect.com.
- **Private Label Products** are made by a manufacturer, but sold under a different brand, often that of the telecom service provider that installs them, the retailer where they are sold, or a computer manufacturer. For example, CyberPower manufactures UPSs sold under Best Buy's *Geek Squad* brand.
- **Retailers,** including office and computer superstores, sell small UPSs.

- **Telecom Direct-Installation** is done by FTTH service providers, who install UPSs in the range of 0.4 kVA in their customers' homes to provide telephone service in the case of a utility outage.
- **Value Added Resellers (VARs)** supply UPSs to customers along with other hardware, software, or services. VARs typically supply medium-sized UPS systems and provide customers with engineering resources and expertise in selecting a system that meets the customer's requirements.

Small UPSs

A leading market research report suggests consumers and businesses get their small UPSs through similar channels: online, from the manufacturer or at a retail store. This is not surprising, considering most <20 kVA units are designed for individual workstations or small to medium-sized business applications and do not require much customization or expertise to set up. Figure 3.11 shows the top places of purchase for small UPSs among both businesses and consumers.

Figure 3.11: Top UPS Places of Purchase for Businesses and Consumers



Source: Greenberg. *2008 Power Protection Global Market Demand Analysis Market Intelligence Program: Volume 1: UPS 20 KVA and Under, Americas.* Percentages do not add to 100% because respondents could select more than one place of purchase.

Large UPSs

Large UPSs require technical expertise to specify and install. As a result, they are rarely sold through retailers. Typical distribution channels include direct sales through the manufacturer's representatives or private label agreements with computer and server manufacturers. VARs may also play a role in the distribution of large UPSs, but manufacturers generally supply customers with the largest UPSs (>500 kVA) directly.

Marketing

Marketing activities for consumer and small business UPSs are similar to those for other electronics: online and magazine advertisements, as well as product packaging.

Marketing activities for large UPSs take place primarily through manufacturer outreach and education at conferences and industry tradeshows, joint marketing promotions with channel partners, on the manufacturer's website, and through direct mail.

Marketing Energy-Efficient Products

In the small UPS category, marketing for efficient products includes promoting the products' energy efficiency features in online advertisements, print advertisements, and on packaging. Some manufacturers have created logos to differentiate products that meet their internal standards for energy efficiency and reduction of other environmental impacts. For example, CyberPower offers a variety of products using what the company calls *GreenPower UPS* technology. To differentiate these products, CyberPower created a green leaf logo (Figure 3.12) that it displays on product packaging and on the product itself.

Figure 3.12: Example of a Manufacturer-Created Logo to Differentiate Energy Efficient UPSs

(Images: *www.cyberpowersystems.com*)

In the case of large UPSs, one manufacturer reported the cost savings associated with energy efficiency were a central part of the marketing messages surrounding energy-efficient products. These products are marketed as having a lower total cost of ownership than their competition and as providing cost savings on a yearly basis. For example, on the second page of a six-page product brochure for its 9900A series UPS (80-225 kVA), Mitsubishi

provides cost savings calculations showing its product could save $13,140 over five years compared to a competitor's UPS.[117]

Product Packaging

CyberPower, a manufacturer of several energy-efficient UPSs, uses product packaging to differentiate these products from standard offerings in several ways:

- Featuring manufacturer-created logos to signify green products
- Prominently displaying projected cost savings resulting from the product's energy efficiency
- Providing explanations of technological innovations that result in energy efficiency

Product Brochures

Many UPS manufacturers make product brochures available for download on their websites. These brochures detail a product's energy benefits by:

- Explaining energy-efficient technologies and comparing energy performance with standard UPS products
- Providing estimates of annual cost savings that result from energy-efficient products
- Using the color green in backgrounds and text

Manufacturer Websites

The leading UPS manufacturers appear to have embraced energy efficiency as a way to differentiate and market their products online. They tout both their corporate sustainability efforts and the efficiency of their products on their websites by:

- Prominently featuring energy efficiency information in product descriptions and explaining how energy-efficient technology works
- Highlighting energy-efficient features in green text
- Displaying logos to distinguish products that use particularly energy-efficient technologies or that meet internal standards for energy efficiency
- Calling attention to the cost savings and environmental benefits associated with energy efficiency

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[117] Mitsubishi Electric. 9900A UPS Uninterruptible Power Supplies. Product brochure. Retrieved June 25, 2009 from *http://www.meppi.com/Products/UninterruptiblePowerSupplies/Products/9900/Brochure.pdf*.

- Promoting energy-efficient products on the website's homepage.

Industry Organizations and Events

Web searches and conversations with manufacturers identified relatively few industry organizations or events that specifically target the UPS industry. One notable exception is Venture Development Corporation (VDC), a market research firm specializing in consumer electronics and accessories that provides annual reports assessing the global UPS market and identifying trends. And, like all consumer electronics manufacturers, makers of UPSs maintain a presence at the Consumer Electronics Association's annual *Consumer Electronics Show*.

Energy Efficiency

Efficiency Standards

There are no energy efficiency standards for UPSs in the United States. European countries, however, have established energy efficiency standards for UPSs. They include:

- **The European Commission Code of Conduct** – specifies energy efficiency standards for large UPSs (delivering 3-phase uninterruptible power above 10 kVA). The current standards (Version 1.0) went into effect on January 22, 2008. The Code of Conduct specifies minimum energy efficiency requirements by UPS size and percentage of nominal transformer power.[118] For 2008-2009, these standards range from 96% to 98% efficiency at 100% of nominal transformer power. These specifications are available at: *re.jrc.ec.europa.eu/energyefficiency/pdf/CoC%20UPS%20efficiency-v1-0a-22012008.pdf.*

- **The Swiss Federal Office of Energy** – conducted a study in 2007 that proposed a labeling system to call attention to the energy efficiency performance of UPSs. The study is available at: *www.bfe.admin.ch/dokumentation/energieforschung/index.html?lang=en&project=101928.*

- **The Canadian Standards Association** – specified a test method for measuring the energy efficiency of uninterruptible power supplies in 2001; however the standard did not specify a minimum acceptable level of efficiency. In 2008, the CSA published energy efficiency standards for battery charging systems that apply to UPSs up to 0.5 kVA. The test procedure established in 2001 is available at: *http://www.shopcsa.ca/onlinestore/GetCatalogItemDetails.asp?mat=2414728&Parent=2730*. The specification related to

[118] Nominal transformer power is the percentage of a UPSs total available power used by the devices to which it is connected (i.e., power drawn by devices divided by the UPSs maximum power output). For example, if devices connected to a UPS with an output power capacity of 500 W are drawing 300 W, the nominal transformer power is 60%. UPSs are generally least efficient when nominal transformer power is low.

battery charging systems is available at: *http://www.shopcsa.ca/onlinestore/GetCatalogItemDetails.asp?mat=2419514&Parent=4888.*

Penetration of Energy-Efficient Products

The lack of a federal energy efficiency standard or labeling program for efficient products makes tracking their penetration difficult. Eight of the top 10 manufacturers of UPSs <20 kVA make at least one product they market as energy-efficient. Of these:

- One manufacturer markets energy-efficient products only for home and small business use (<1 kVA).
- Two manufacturers market energy-efficient products for home and small business use, and for data centers or large enterprises.
- Five manufacturers market energy-efficient UPSs only for data center and large enterprise use. Interviews with manufacturers suggest that energy efficiency is indeed a high priority in this segment.
- Four manufacturers claim their efficient large UPSs achieve 96-97% efficiency.

Utility Program Activity

There is no known utility program activity focused on UPSs.

Barriers and Opportunities

Barriers

- **Small UPSs have become increasingly commoditized and consumers are price-sensitive.** Both manufacturers interviewed identified cost as a significant factor influencing purchasing decisions for small UPSs and believe consumers may be unwilling to pay extra for energy-efficient features.
- **Manufacturers believe best-in-class small UPS technology has achieved the maximum efficiency possible**. Both interviewees noted the efficiency of small UPSs improved markedly over the last few years, with one noting a 40% increase and the other stating their products are 96% to 98% efficient. Both believed home and workstation systems (typically <1 kVA) do not consume much electricity because they spend the majority of time in standby mode. No independent tests have been conducted to verify these claims or measure small UPS energy consumption.
- **There is no nationally recognized energy efficiency standard for this product.** The lack of a standardized testing and reporting methodology makes it difficult to assess and compare manufacturers' claims about product efficiency. As in other consumer

electronics product categories, like power strips, the absence of an ENERGY STAR specification creates several additional gaps in the marketplace. Manufacturers do not have a standard to work towards, and cannot take advantage of a branded label to raise awareness in product packaging and advertising. Awareness of the product category also suffers because manufacturers cannot utilize the marketing apparatus and channels employed by other ENERGY STAR-qualified products, for example, the ENERGY STAR website.

Opportunities

- **Manufacturers are willing to work with utilities to market energy-efficient products.** Both interviewees suggested ways in which they could imagine working with utilities. These included using the utility logo and a testimonial in their advertising, as well as marketing utility incentives to their customers through existing distribution channels.

- **Retailers likely have direct input into the design of private label products, which may make up as much as 25% of total consumer electronics sales, and is growing.** The market for private label electronics was estimated at approximately 20% of the total consumer electronics market in 2000 and is thought to have grown since.[119] While none of the 40-plus interviewees surveyed for this study identified retailers as having direct input into the typical product design process, one UPS manufacturer noted that when it comes to the design of private label products, the purchaser exerts a strong influence over the design of the product and is "very involved" in the process.

- **The incremental cost to the manufacturer of the most efficient small UPSs over less efficient, lower-end models is small.** One interviewee noted that the incremental cost of its most efficient small UPS over the least expensive (but most popular) product is about $2.85. However, this is an extremely significant amount to the manufacturer, as it represents about half their profit on the product. As the interviewee explained: the typical retail price of the product is $40, of which the retailer takes $15 to $16 (38% to 40%) and the manufacturer's cost is $18 to $19 (46% to 48%), leaving the manufacturer with a profit margin of 12% to 14% or $5 to $6 on a $40 product. This interviewee noted there is a "lock" on the $40 price point for the lowest-end UPSs and that all competitors feel bound to deliver a product at this price.

- **Small UPSs are increasingly being installed in private homes by telecom service providers to provide phone service during a utility outage**. If it can be determined that the UPSs being installed by telecom providers are not best-in-class, there may be an opportunity for utilities to work directly with these companies to improve efficiency.

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[119] Bill Roberts. (January 29, 2007). A peek at private label consumer electronics trends. *Electronic News*. Retrieved from *http://www.allbusiness.com/company-activities-management/product-management/6303488-1.html*.

These UPSs are manufactured by leading companies under private-label contracts with the telecoms.

- **There is a strong business case for increasing the energy efficiency of large UPSs.** Energy use for powering and cooling IT equipment constitutes a significant portion of many organizations' IT budgets, making these organizations receptive to the potential for cost savings related to energy efficiency.
- **As a "green IT" initiative, energy-efficient UPSs offer the potential for energy savings without requiring behavior change on the part of end-users, especially in datacenters.** Unlike other IT efficiency measures (for example, power management or virtualization), replacing an inefficient UPS with a more efficient model does not require long-term behavior changes on the part of the IT manager or end-users.
- **Manufacturers see a growing demand for "green" products.** Interviewees note that although energy efficiency and sustainability have been discussed in their industry for some time, it is only in the last year that it has risen to become a higher priority.
- **Consumer awareness of and demand for efficient products drives product design**. Interviewees noted in the market for both small and large UPSs, they design products to meet what they perceive to be customer demands.

EXTERNAL POWER SUPPLIES

External power supplies are the ubiquitous *chargers* or *adapters* that power hundreds of small electronic devices like cell phones, iPods, routers, and cameras. ENERGY STAR estimates there were 1.5 billion chargers in the U.S. in 2008, or five for every person. Mobile phone chargers account for about half of these.

The amount of electricity passed through external power supplies in the U.S. is equally large. ENERGY STAR estimates it at 300 billion kWh per year, or 11% of the national electric bill. These devices are often inefficient as well. EPA research suggests many chargers may be only 50 to 70% efficient.[120] The large number of external power supplies in use, combined with their often inefficient power conversion, makes them an important product to watch.

External power supplies are either AC-AC (convert AC input to a lower voltage) or AC-DC (convert AC input to DC output). They are physically separate from the device they power and connect to it with a cable.

(Image: *www.lakewoodconferences.com*)

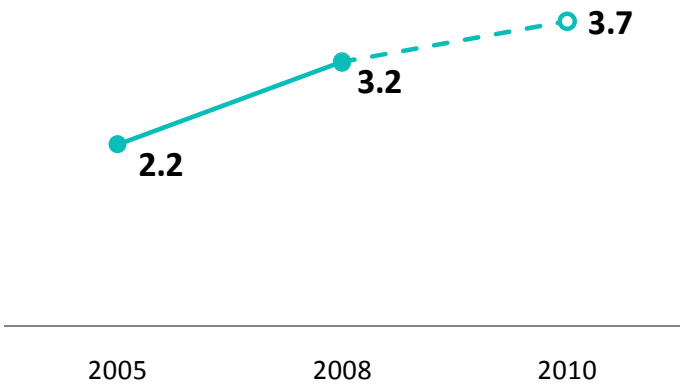
Key Market Characteristics and Trends

➡ **The number of external power supplies is growing**. It is estimated the industry shipped 3.2 billion of these devices worldwide in 2008. Shipments are projected to grow nearly 40% between 2005 and 2010 (see Figure 3.13). Mobile phones are a key driver of this growth.[121]

[120] U.S. EPA/ENERGY STAR. External Power Supplies. Retrieved July 14, 2009, from *http://www.energystar.gov/index.cfm?c=archives.power_supplies*.

[121] Alliance for Universal Power Supplies. (June 13, 2008). *The Facts and Market Drivers*. PowerPoint Presentation. Retrieved from *http://www.allianceforuniversalpower.org/presentations/2_market_aups-jun08.ppt*.

Figure 3.13: Actual and Projected Worldwide Shipments of External Power Supplies (in Billions), 2005-2010



Source: Alliance for Universal Power Supplies. The Facts and Market Drivers.

➡ **Turnover is high, as millions of external power supplies are "retired" every year.** The current 1-to-1 relationship between device and power supply means the latter becomes useless when the device it's sold with is no longer used. More than 400 million portable devices are "retired" every year in the U.S., and at least as many power supplies.[122]

➡ **New products will feature faster charging, smaller size, and/or the ability to communicate more intelligently with the device it powers.** The first two trends, faster charging and smaller size, are not necessarily compatible and present a challenge for manufacturers.

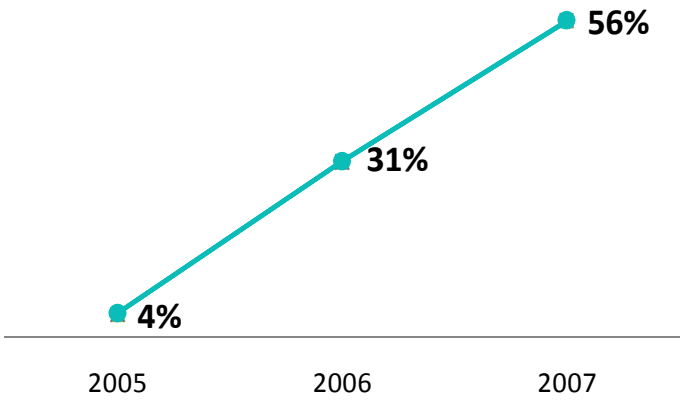
➡ **The industry is taking first steps towards standardization and/or universal chargers**. Two groups have announced their intention to develop standards so power supplies can be used with multiple devices. They are:

- **GSMA –** in February 2009, this European association of mobile phone manufacturers announced that by 2012, all new cell phones produced by 17 leading mobile phone manufacturers would support a universal charging solution using a Micro-USB interface, and that the majority of chargers would meet high efficiency targets.
- **Alliance for Universal Power Supplies –** a U.S.-based, industry-driven organization, is working to develop and promote standards for re-usable, efficient multi-port products.

[122] Alliance for Universal Power Supplies. *The Facts and Market Drivers*.

➡ **Penetration of ENERGY STAR-qualified products is increasing**. Since the first specification took effect in 2005, penetration of ENERGY STAR-compliant power supplies increased exponentially (See Figure 3.14).

Figure 3.14: ENERGY STAR-Qualified External Power Supplies (As A Percent Of Total Shipments), 2005-2007



Data Source: U.S. EPA/ENERGY STAR. *Unit Shipment and Market Penetration Report*. Calendar year summaries for 2004, 2005, 2006, and 2007. Retrieved July 13, 2009 from *http://www.energystar.gov/index.cfm?c=partners.unit_shipment_data_archives*.

➡ **OEM demand for efficient products is growing**. All manufacturers noted a rise in their customers' attention to, and interest in meeting or exceeding, efficiency standards. Manufacturers note that big customers require ENERGY STAR-qualified products, while smaller companies do not want to pay the associated cost premium.

➡ **Standby power will decrease**. Manufacturers note that extremely low standby power use is an important goal for future products.

Supply Chain

There are three primary players in the external power supply market: power supply manufacturers, component suppliers, and original equipment manufacturers (OEMs). See *Appendix L* for a detailed supply chain diagram.

➡ **Manufacturers** – design and build external power supplies.

➡ **Component suppliers** – sell components, like integrated circuits, to external power supply manufacturers.

➡ **OEMs –** buy external power supplies from manufacturers and sell them, bundled with the device they power, to the end-user.

In the majority of cases, OEMs specify design requirements for external power supplies to manufacturers. OEMs may convey these requirements through an RFP or competitive bid situation, or in one-on-one negotiations, which is more common when the OEM and manufacturer have an existing relationship. Less frequently, manufacturers design products to their own specifications and without a specific customer in mind.

Research and design activities for external power supplies may take place in the U.S., Europe, or in other locations throughout the world. They are primarily manufactured in China, but also in Brazil, India, and Thailand. Manufacturers purchase components from suppliers and assemble the product in plants they own or in plants owned by third-parties. In some cases, for example integrated circuits, manufacturers may work with suppliers to cooperatively develop the component.

It takes six months to one year from product design to distribution, depending on the complexity of the product and the extent to which its design builds on that of existing products.

Manufacturers

Manufacturers of external power supplies are in the middle of the supply chain. They obtain components from suppliers, assemble the product, and sell it to an OEM. Typically, end-users do not purchase external power supplies individually.

ENERGY STAR estimates there are more than 3,000 manufacturers of external power supplies, with the top 50 to 60 companies supplying at least half the world market. It is likely that smaller manufacturers, predominantly in Asia, supply only their own domestic markets. Precise market share information could not be identified, but nine major manufacturers are listed in Table 3.31, below.

Table 3.31: Selected Major External Power Supply Manufacturers

COMPANY	REVENUE IN US$ (YEAR)	KEY FACTS	MAJOR PRODUCTS AND/OR SELECTED CUSTOMERS	ENERGY STAR-QUALIFIED EPS	
				AC-AC	AC-DC
Delta Electronics *www.deltaww.com*	$4.8 B (2007)	Founded 1971. Based in Taiwan. World's largest provider of switching power supplies and brushless fans.	Major manufacturer of power management solutions, visual displays, industrial automation, networking products, and renewable energy solutions.	No	Yes
Emerson Network Power (a business segment of Emerson) *www.emerson.com*	$13.5 B (2008)	Founded 1890. Based in the U.S.	Diversified business segments including process management, industrial automation, network power, climate technologies, appliances, and tools.	No	Yes
Friwo (CEAG Group) *www.friwo.com*	$460 M (2007)	Founded 1967. Based in Germany.	Held a 22% share of mobile phone power supply business until sold to Vista Point Technologies/Flextronics in 2008. Now focused on IT/communications, household appliances, and power tools.	No	Yes
FSP Group *www.fsp-group.com*	$553 M (2008)	Founded 1993. Based in Taiwan.	The 6th largest power supply manufacturer in the world. Products include PC, industrial, TV, and adapters.	No	Yes
Leader Electronics, Inc. *www.lei.com.tw/main.htm*	$198 M (2008)	Founded 1970. Based in Taiwan. 5,800 employees.	Adapters, switching power supplies, transformers. Delta, Flextronics, GE, LG, Motorola, NEC, Nokia, Panasonic, Philips, RadioShack, Ricoh, Samsung, Sanyo, Sony, Toshiba, Yamaha	Yes	Yes
Lite-On Technology *www.liteon.com*	$400 M (2002)	Founded 1975. Based in Taiwan. 35,000 employees. 37 factories. World's largest notebook adapter manufacturer with 60% market share.	LEDs, semiconductors, computer chassis, monitors, motherboards, and other CE products.	No	Yes

Continued

COMPANY	REVENUE IN US$ (YEAR)	KEY FACTS	MAJOR PRODUCTS AND/OR SELECTED CUSTOMERS	ENERGY STAR-QUALIFIED EPS	
				AC-AC	AC-DC
Phihong Enterprise Co., Ltd. *www.phihong.com*	$450 M (2006)	Founded 1972. Based in Taiwan. One of top ten global power supply manufacturers.	Adapters and power supplies for telecom, datacom, CE, and industrial markets, including: Motorola, Cisco, Panasonic, Sony, Acer, HP, Sanyo, Toshiba.	No	Yes
Salcomp *www.salcomp.com*	$375 M (2008)	Founded 1975. Based in Finland. 7,000 employees. 2007 market share about 23%. Market leader in mobile phone market, top five in all charger types.	Mobile phone and other hand-held device chargers.	No	Yes
Sino-American Electronic Co., Ltd. (SAC) *www.sac.com*	N/A	Founded 1968. Based in Taiwan.	Manufacturer of adapters, inverters, open frame power supplies, and transformers.	No	Yes
Vista Point Technologies (a business of Flextronics International) *www.vptech.com*	$30 B (Flextronics revenue, 2007)	Based in California.	Power supplies for mobile phones, computing, networking/servers, telecom, and printers.	No	Yes-listed as Flextronics Sales and Marketing

Sources: Revenue data from *http://www.hoovers.com*. Key Facts, Major Products, and Selected Customers from manufacturer websites and interview data. ENERGY STAR data from U.S. EPA/ENERGY STAR. (July 1, 2009). *ENERGY STAR External Power Supplies.* Product lists for AC-AC, AC-DC, EPS Families, and Switch Selectable EPS. Retrieved from *http://www.energystar.gov/index.cfm?c=ext_power_supplies.power_supplies_consumers*.

Component Suppliers

There are likely thousands of component suppliers in the external power supply market. Manufacturers likely buy from "tens" of component suppliers. The integrated circuit (IC) used in power conversion is an example of a more complex component of particular interest to this study because it affects energy efficiency. Table 3.32 lists five suppliers of integrated circuits for external power supplies.

Table 3.32: Selected Integrated Circuit Suppliers

COMPANY	REVENUE IN US$ (YEAR)	KEY FACTS
Fairchild Semiconductor *www.fairchildsemi.com*	$1.5 B (2008)	Founded 1957. Based in Maine.
Infineon Technologies *www.infineon.com*	$6 B (2008)	Based in Germany.
National Semiconductor *www.national.com*	$1.9 B (2008)	Founded 1959. Based in California.
NXP *www.nxp.com*	$5.4 B (2008)	Founded 2006 (formerly a division of Phillips). Based in The Netherlands.
ON Semiconductor *www.onsemi.com*	$2.2 B (2007)	Founded 1999 as spinoff from Motorola. Based in Arizona.
Power Integrations *www.powerint.com*	$4.8 B (2007)	Founded 1988. Based in California.
STMicroelectronics *www.st.com*	$10 B (2007)	Based in Switzerland.
Texas Instruments *www.ti.com*	$12.5 B (2008)	Founded 1930. Based in Texas.

Sources: Revenue data from *http://www.hoovers.com/*. Key facts from component supplier websites.

OEMs

OEMs purchase external power supplies from manufacturers and bundle them with products they market, under their own brands, to end-users. Examples include Nokia cell phones or Dell laptop computers.

Industry Organizations and Events

The following organizations and events influence the external power supply market.

- **Power Sources Manufacturing Association (PSMA):** A non-profit membership organization for companies in the power supply industry. PSMA develops standards, prepares industry reports, organizes trainings and serves as a liaison with academia and government. Its members represent about 60% of power supplies on the world market. PSMA members also draft *Power Technology Roadmaps* that make five-year projections for the industry. Six roadmaps have been developed to date (1997, 2000, 2003, 2006, and 2008), with the goal of facilitating communication among suppliers, customers, universities, and manufacturers. The 2008 committee included more than 50 industry professionals.

- **Applied Power Electronics Conference (APEC):** The premier event for power supply designers, manufacturers, suppliers, and OEMs, held annually in February. The 2009 conference in Washington, D.C. had 2,100 registrants from 41 countries.
- **Institute of Electrical and Electronics Engineers (IEEE):** A non-profit professional organization for a wide range of technical fields from aerospace and computers to electrical power and consumer electronics, with more than 375,000 members in 160 countries.
- **GSMA:** A mobile communications industry trade association. Members include more than 750 mobile operators and 200 companies making handsets, software, equipment and other media products.
- **Darnell Group:** The leading source for market research on the power source industry, including annual and forecast reports, a manufacturer directory and news. Product types covered include power converters, energy storage, and semiconductors.
- **Micro-Tech Consultants:** A one-person consulting company, highly regarded by industry professionals, it focused on the power supply industry. Annual reports are available for purchase, as well as a monthly newsletter.

Energy Efficiency

The leading manufacturers of external power supplies appear to have embraced energy efficiency as a way to differentiate and market their products. They tout both their corporate sustainability efforts and the efficiency of their products on their websites by:

- Displaying the ENERGY STAR logo
- Listing awards received related to environmental stewardship, sustainability, or energy efficiency
- Identifying products that meet various efficiency standards or regulations

All companies interviewed for this study (three leading power supply manufacturers and one supplier of ICs) reported discussing the energy-efficient or "green" features of their products with OEMs and marketing efficiency as a benefit. Some manufacturers report advising OEMs on new energy efficiency technologies and strategies for complying with regulations or standards.

However, cost is the key concern for all players and margins are slim. As one interviewee commented, "This is a market that will kill for two cents." Multiple interviewees noted that when OEMs demand a low price point, efficiency suffers.

Efficiency Standards

ENERGY STAR is the most commonly cited standard for the U.S. market. The current Version 2.0 took effect November 1, 2008, replacing Version 1.0, which took effect January 1, 2005. This specification is available at: *http://www.energystar.gov/ia/partners/prod_development/downloads/power_supplies/Final_EPS_Specs_Notes.pdf*.

Several other countries and regions have their own voluntary standards or mandatory requirements.

- **European Commission Code of Conduct:** The current Version 3 took effect January 1, 2009. This specification is available at: *http://www.powerint.com/green-room/regulations-agency/eu-code-conduct*.
- **MEPS (Australia and New Zealand):** External power supply standards took effect December 1, 2008, in Australia and April 1, 2009, in New Zealand. These requirements are available at: *http://www.energyrating.gov.au/eps2.html*.
- **e-Standby Program (Korea):** Standards for power supplies target standby power reduction.
- **Canadian Standards Association:** External power supply and battery charging standards were published November 2008. Standards utilized the ENERGY STAR test method and are expected to be revised in 2009. The standards are available at: *http://www.shopcsa.ca/onlinestore/GetCatalogDrillDown.asp?Parent=4887*.

ENERGY STAR Penetration

U.S. Data

Penetration of ENERGY STAR-qualified products increased exponentially since the first standard took effect in 2005: from 4% of units shipped to 56% of units shipped in 2007, or over 312 million units (see Figure 3.14).

Other AC-AC and AC-DC external power supply penetration data (as of April 2009) published by ENERGY STAR include:

- 98 companies manufacture at least one ENERGY STAR-qualified external power supply
- 2,013 products earned the ENERGY STAR label
- 369 end-use products are sold with ENERGY STAR-qualified external power supplies

Manufacturer Data

Among the three manufacturers interviewed for this study, two believed at least 90% of their models were ENERGY STAR-compliant and the third estimated compliance at 20%. The first

two both expect to reach 100% compliance moving forward, as older products go out of production and all new products will be designed to meet the ENERGY STAR standard. The latter manufacturer expected to increase their ENERGY STAR-qualified models from 20% to 40% in the next five years due to customer demand.

Barriers and Opportunities

Barriers

- **Efficient products may cost more.** OEMs are perceived as extremely price sensitive and thus power supply manufacturers are too. But if an OEM is willing to pay more for an efficient product, the manufacturer will produce it. Manufacturers noted that where there is no cost penalty for making a more efficient product, they abide by higher standards, even if it has not been specified.
- **Sourcing an efficient power supply may require an OEM to change suppliers, which they may perceive as a risk.** Anecdotal discussions with efficiency professionals suggest OEMs may resist changing to a new power supply manufacturer.
- **The power supply is secondary to the primary product and may not be influenced by consumer demand**. End-users make purchase decisions based on products, not power supplies – the power supply is just one of the components they receive with their new camera, MP3 player, or laptop. OEMs put their effort into designing the product and the power supply is, in one interviewee's words, a "necessary evil."

Opportunities

- **Efficiency standards like ENERGY STAR drive change in this market.** Consumer demand is not typically a factor in the design of external power supplies. As a result, standards like ENERGY STAR are currently motivating higher efficiency among manufacturers and may be a tool for utility programs to employ.
- **Market leaders are embracing energy efficiency and participating in ENERGY STAR**. It appears many leading external power supply manufacturers both acknowledge the importance of energy efficiency and the ENERGY STAR standards. Some have made sustainability an internal company goal.
- **The PSMA Power Technology Roadmap Committee is well-established with a history of making accurate forecasts**. Utilities and standards-setting organizations need to understand industry trends and forecasts. Technology roadmaps are useful for this purpose and the power supply industry, led by the PSMA, has been developing them since 1994. The roadmaps have been accurate in predicting future performance.

4 RECOMMENDATIONS FOR FURTHER RESEARCH

Energy efficiency programs are only beginning to take interest in the electronics market, thus there are many opportunities and needs for further research. Perhaps the most important gap is the lack of on-going assessment of the types of electronic devices in U.S. homes and commercial buildings (the "installed base") – their usage patterns, power modes, and energy use. The rapid evolution of products requires a study of the type conducted by Ecos Consulting in 2006, to be completed every two years, at most. Although this gap has been partly filled by the NRDC, for example, in its November 2008 report on the energy use of game consoles, the energy efficiency industry and utility programs need a more comprehensive approach that will allow for the establishment of market penetration and baseline figures.

APPENDICES

A LIST OF ACRONYMS

BCE	Business and consumer electronics
CA	Conditional access
CE	Consumer electronics
CEA	Consumer Electronics Association
CRT	Cathode ray tube
DVR	Digital video recorder
EMS	Equipment manufacturing supplier
EPS	External power supply
HD	High definition
HTIB	Home theater in a box
IC	Integrated circuit
IEA	International Energy Agency
IPTV	Internet protocol television
IT	Information technology
kVA	Kilovolt-ampere
LCD	Liquid crystal display
MEPS	Minimum energy performance standards
MFD	Multi-function device
MPS	Managed print services
ODM	Original design manufacturer
OEM	Original equipment manufacturer
ROHS	Regulation of Hazardous Substances
STB	Set-top box

TEC	Total energy consumption
UPS	Uninterruptible power supply
VAR	Value added reseller

B METHODOLOGY

Data for this study came from a wide-ranging literature review and in-depth interviews with energy efficiency program staff, manufacturers, and industry trade organizations.

LITERATURE REVIEW

Three studies proved fundamental for this work. They are:

- Suzanne Foster Porter, Laura Moorefield, and Peter May-Ostendorp. (2006). *Final Field Research Report*. Prepared for California Energy Commission by Ecos Consulting.
- Alex Chase, Ryan Ramos, and Ted Pope. (2006). *Consumer Electronics: Market Trends, Energy Consumption and Program Recommendations, 2005-2010*. Prepared for PG&E by Energy Solutions.
- K. Roth, K. McKenney, R. Ponoum, and C. Paetsch. (2007). *Residential Miscellaneous Electric Loads: Energy Consumption Characterization and Energy Savings Potential*. Prepared for U.S. DOE by TIAX LLC.

Other sources consulted include: energy use research studies; publicly available information from market research firms like IDC, Gartner, and NPD; newspapers like *The Wall Street Journal*; industry-specific websites and blogs; and company websites. No market research reports were purchased for this study.

PRODUCT SELECTION

In selecting the subjects of this study, SCE wanted to start from an assessment of all electronic products that make up the electronics plug load, rather than just those being targeted in their 2009-2011 Business and Consumer Electronics program – TVs, PCs, and monitors. These products were being studied by another utility, so they were excluded from this study, except to provide a summary of other research.

The eight electronics products we focused on were selected because of their high per-unit energy use, contribution to total residential and/or commercial electricity use, and potential for inclusion in an SCE electronics program.

Table B.1 shows the average annual energy use for the home entertainment and IT products measured for the *Final Field Research Report*. **Highlighted** products had already been selected for likely inclusion in the BCE program.

Table B.1: Home Entertainment Product Types and Energy Use

PRODUCT	AVERAGE ANNUAL ENERGY USE (KWH)
Plasma TV (<40")	441
Personal Video Recorder (PVR)	363
Desktop Computer	255
Digital Cable Set-Top Box (STB)	239
Digital Cable STB with PVR	376
Satellite Cable STB with PVR	236
Receiver	143
Satellite Cable STB	124
CRT TV (<40")	123
Laptop Computer	83
CRT Monitor	82
LCD Monitor	70
LCD TV (<40")	77
Speaker	66
Sub-woofer	60
Multi-Function Printer/Scanner/Copier	55
Modem	50
Audio Mini-System	58
DVR	52
Wireless Router	48
VCR	34
Fax	26
Computer Speakers	20
USB Hub	18
Portable Stereo	18
Radio	18
Video Game Console	16
Printer	15
DVD	13
Amplifier	13
CD Player	12

Source: Foster Porter, Moorefield, and May-Ostendorp. *Final Field Research Report* .

Eight electronics products were chosen for this study.

- **Audio Receivers** – were chosen because of their high annual energy use relative to other home entertainment and IT products, which together make up 91% of residential plug load energy use.[123]
- **External Power Supplies** – were selected for inclusion based on ENERGY STAR data on the quantity of devices in use and the amount of electricity that passes through them annually. The ENERGY STAR website noted that about 1.5 billion are currently in use (about five for every person) and that about 11% of the national electric bill, or 300 billion kWh, passes through them annually.[124]
- **Game Consoles** – were selected based on a recommendation from ENERGY STAR program staff and NRDC's *Lowering the Cost of Play* (2008), which reported on high console penetration rates and energy consumption, estimated at 11 billion kilowatts annually.
- **Imaging Equipment** – was included because ENERGY STAR identified it as among the most energy-intensive commercial products, in part, because they often remain in "active" mode for many hours every day.
- **Servers** – were selected based on findings from Lawrence Berkeley National Laboratory's *Estimating Total Power Consumption by Servers in the U.S. and the World* (2007), which showed that electricity use by servers could increase 40% to 76% between 2005 and 2010. In addition, ENERGY STAR launched its first server specification during the course of this study, which was expected to catalyze interest.
- **Set-Top Boxes** – were requested by SCE as an area of focus because of existing interest on the part of program managers.
- **"Smart" Power Strips** – were selected because they have residential and commercial applications, and are a relatively new product.
- **Uninterruptible Power Supplies** – were selected based on the fact that UPSs are found in a variety of locations (homes, small offices, data centers) and that efficiency losses account for 5% to 12% of all energy used in data centers.[125] In addition, an undated utility

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123 Foster Porter, Moorefield and May-Ostendorp. *Final Field Research Report.*

124 EPA/ENERGY STAR. External power adapters. Retrieved July 17, 2009 from *http://www.energystar.gov/index.cfm?c=ext_power_supplies.power_supplies_consumers*.

125 M. Ton and B. Fortenbury. (2005). *High Performance Buildings: Data Centers Uninterruptible Power Supplies (UPS)*. Retrieved November 18, 2008, from: *http://hightech.lbl.gov*.

study estimated that UPS inefficiencies "can total hundreds of thousands of wasted kilowatt hours per year."[126]

INTERVIEWS

The primary method for data collection on selected products was interviews with energy efficiency program staff, manufacturers, and industry representatives.

Energy Efficiency Program Staff

We conducted a total of 14 interviews with energy efficiency program staff. Interviewees were identified in consultation with SCE, based on a review of organizations pursuing research or program activity in the selected product areas. Table B.2 lists the organizations we consulted and their area(s) of expertise. Interview questions for program staff are in Appendix C.

Table B.2: Program Lead/Program Manager Interviewees

ORGANIZATION	AREA(S) OF EXPERTISE
ACEEE	Set-top boxes
BC Hydro	Set-top boxes
Consortium for Energy Efficiency	External power supplies Set-top boxes TVs
Ecos / 80 PLUS Program	Internal power supplies
EPA / ENERGY STAR	External power supplies Game consoles Home audio receivers Imaging equipment Servers Set-top boxes
Natural Resources Defense Council	External power supplies Game consoles Set-top boxes
Northeast Energy Efficiency Partnership	Set-top boxes "Smart" power strips TVs
NYSERDA	"Smart" power strips

[126] Pacific Gas & Electric. (n.d.). *Data Center Design Guidelines Summary*. Retrieved November 19, 2008, from *http://www.pge.com*.

Manufacturers and Industry Trade Organizations

We conducted a total of 40 interviews with manufacturers and representatives of industry trade organizations. These in-depth interviews lasted from 30 to 90 minutes; follow-up exchanges were conducted via email. Interview questions for manufacturers and trade organizations can be found in *Appendix D*.

A list of the manufacturers of each product was developed from several sources: rankings of manufacturer market share; membership in industry organizations; retailer websites; articles in industry publications; and participation in energy efficiency efforts. Sample sizes for the number of manufactures to be interviewed for each product were determined based on the size of the manufacturer population and the project budget.

Interviewees were selected at random or based on the manufacturer's market share. It was a goal of the project to interview the manufacturers with the largest market share of each product, as well as smaller manufacturers with a significant share of the energy-efficient product market. Representatives of industry trade organizations were also interviewed. At least five attempts were made to reach each interviewee via email or telephone. When an interviewee refused to participate or the attempts were exhausted, a new interviewee was selected from the list. Table B.3 summarizes manufacturer and trade industry interviewees by product type. For reasons of confidentiality, interviewee names and affiliations are not included.

Table B.3: Number of Manufacturer and Industry Trade Group Interviewees by Product Type

PRODUCT	COMPLETED INTERVIEWS	PROPOSED SAMPLE SIZE	ESTIMATED POPULATION
Set-Top Boxes	7	9	
Manufacturers	6	6	>5
Cable Service Providers	0	2	>15
Satellite Service Providers	1	1	2
Servers	6	3	>10
Game Consoles	1	2	3
Imaging Equipment	5	3	>30
Home Audio Receivers	4	4	>20
"Smart" Power Strips	4	4	>5
Uninterruptible Power Supplies	2	2	>50
External Power Supplies	6	4	>50
Internal Power Supplies	5	4	>100
TOTAL	**40**	**35**	

The number of completed interviews met or exceeded the proposed sample size for all but two products. In the set-top box category, none of the seven cable service providers contacted resulted in an interview. Two contacts refused to participate and five failed to respond to repeated requests for an interview. In the game console category, two of the three manufacturers refused to participate.

C INTERVIEW GUIDE – ENERGY EFFICIENCY PROGRAM STAFF

Interviews were open-ended and did not follow a rigid structure, but an attempt was made to include all questions in each interview.

1. What do you see as the key barriers preventing more energy-efficient [product] from reaching consumers?

2. What role do you think consumer demand plays in driving efficiency improvements in [product]?

3. What changes in market structure or incentives do you think are necessary to increase the share of efficient products?

4. What (if any) changes do you expect to see regarding the market share of efficient products produced in the next one, three, and five years?

5. How does your organization work with the market players?

6. What have you found to be the most effective ways to communicate information about efficiency to the [product] distribution chain?

7. What other organizations or governments do you think have the most influence today on improving the efficiency of products, and why do you think they've been successful?

8. Are there any others success stories you think are important, or other lessons learned?

9. Are there any common influences on the timing of the purchase of [product] that you've identified?

10. *Prompt:* an example about air conditioners purchased in May and ordered 9 months prior.

11. Are there any common influences on the timing of the purchase of [product] that you've identified?

12. When you think about this market, is there any one thing that particularly comes to mind that makes the market either particularly easy, or difficult, to think of changing to provide more energy-efficient products?

D INTERVIEW GUIDE – MANUFACTURERS AND TRADE ORGANIZATIONS

Interviews were open-ended and did not follow a rigid structure, but an attempt was made to include all questions in each interview.

1. How do you develop and distribute your [products]?

2. What does your company do to market and promote sales of its [products]?

3. What are the top features you use to currently promote your [products]?

4. What important new features, or improvements to existing features, are being built into the next wave of [products] that will be launched in the next year or two?

5. Compared to other features being improved or developed for new [products], how would you rate the priority of improved energy efficiency [EE] or qualifying for ENERGY STAR [ES]? Would you say it's a high, medium, or low priority, or not a priority at all?

6. Why do you say [priority]? What factors influence how high a priority it is to develop [EE/ES products]?

7. Of these factors, which one or two are most important in making [EE/ES] products a [priority]?

8. What percent of your products are currently [EE/ES]? How do you think this compares to your industry as a whole?

9. Does developing an [EE/ES product] change the development process in any way?

10. What about marketing - do you do anything additional or different to market [EE/ES products]?

11. Is there any difference in distribution channels for your [EE/ES-qualified products]?

12. How do you expect the percent of [EE/ES products] to change over time – say the next one, three, and five years?

13. What changes do you expect to see in your industry as a whole?

14. Is there anything that discourages your company from making [products] that are even more efficient?

15. What would encourage your company to develop more [EE/ES products]? Are there things that would prompt you to exceed ENERGY STAR specifications?

16. What can utilities like SCE do to get your company to increase its emphasis on marketing [EE/ES products]?

17. What do you think would induce consumers to buy more [EE/ES products]?

18. Could you estimate your company's market share for [products] in the U.S.? In California?

19. If you were working with SCE to promote and sell a larger percent of more efficient [products], what type of consumer or sales data might you be willing to share with SCE, assuming it would be kept confidential?

E FOUR ENERGY USE STUDIES

Four studies, all conducted in 2006-2007, report the energy use of consumer and business electronics in U.S. homes. The relevant data from each study is included in the appendices that follow.

- Suzanne Foster Porter, Laura Moorefield and Peter May-Ostendorp. (2006). *Final Field Research Report*. Prepared for California Energy Commission by Ecos Consulting (noted as *Ecos*).
- Alex Chase, Ryan Ramos and Ted Pope. (2006). *Consumer Electronics: Market Trends, Energy Consumption and Program Recommendations, 2005-2010*. Prepared for PG&E by Energy Solutions (noted as *Energy Solutions*).
- K. Roth, K. McKenney, R. Ponoum, and C. Paetsch. (2007). *Residential Miscellaneous Electric Loads: Energy Consumption Characterization and Energy Savings Potential*. Prepared for U.S. DOE by TIAX LLC (noted as *TIAX 2007*).
- K. Roth, K. McKenney, R. Ponoum, and F. Goldstein. (2006). *U.S. Residential Information Technology Energy Consumption in 2005 and 2010*. Final Report. Prepared for U.S. DOE by TIAX LLC (noted as *TIAX 2006*).

Data sources for each study differ and are noted below. The Ecos study is the only one to have conducted primary research and the others cite it often. In general:

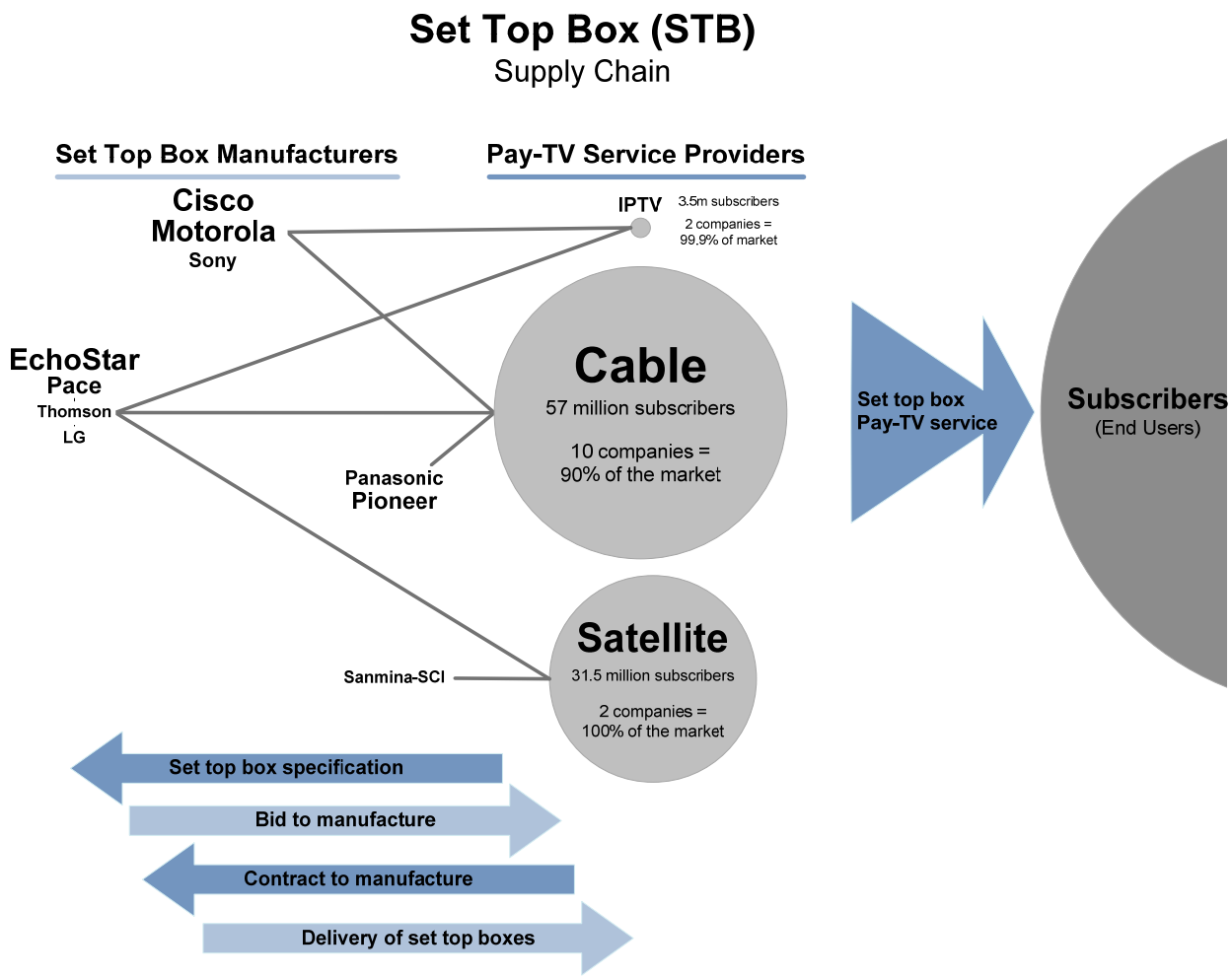
- Ecos study data were derived from time-series measurements taken in 50 homes over a one-week period.
- Energy Solutions study data were derived from secondary sources, including:
  - ADL (2002). *Energy Consumption by Office and Telecommunications Equipment in Commercial Buildings: Volume I: Energy Consumption Baseline*. Kurt W. Roth, Fred Goldstein, and Jonathan Kleinman. Arthur D. Little Reference No. 72895-00.
  - Cremer et al. (2003). *Energy Consumption of Information and Communication Technology (ICT) in Germany up to 2010*. Project No. 28/01.
  - The ENERGY STAR website (2006)
  - The Ecos Study
  - The TIAX IT Study

➡ TIAX data in both studies were derived from secondary sources, including:

- M. McWhinney et al. (2004). *Field Power Measurements of Imaging Equipment.* Lawrence Berkeley National Laboratory Report, LBNL-54202.
- B. Nordman and A. Meier. (2004). Energy Consumption of Home Information Technology. Lawrence Berkeley National Laboratory Report, LBNL-5350.
- The Ecos Study
- The ENERGY STAR website (*www.energystar.gov*)

F SET-TOP BOXES

SUPPLY CHAIN



GLOSSARY

- **High Definition (HD) TV:** ENERGY STAR defines high definition video output as signals with resolutions greater than 480i/p.[127]
- **Digital Video Recorder (DVR):** A device that records and stores video in digital formats on an internal hard drive.
- **CableCARD:** A small card-like device contining user information and conditional access codes that can be plugged into another device, including an STB, a compatible digital television, or any other device that allows an end-user to view digital cable content. Cable CARDs were developed in response to the FCC's requirement that cable providers separate the user information and conditional access codes from STB hardware. Cable service providers have been required to use CableCARD technology since 2007.
- **Firmware:** Software that controlls a device's basic functions and is installed on the device before it ships to the end-user.
- **Head End:** The technology that service providers use to transmit signals to end-users.
- **Middleware:** Software that connects various software components or applications and allows devices to interact across a network.
- **Multi-System Operator (MSO):** Cable providers who serve multiple communities. All of the top ten U.S. cable service providers can be considered MSOs.
- **System on a Chip:** A single integrated circuit that includes a microprocessor and other components of a computer.
- **Tru2Way:** A technology currently in development that brings interactive cable content to viewers, who will be able to use either STBs or compatible digital televisions with CableCARDs to decode the signals.

ENERGY USE DATA

Three studies have examined STB energy use.

[127] U.S. EPA/ENERGY STAR. *ENERGY STAR Program Requirements for Set-top boxes Version 2.0*. Retrieved July 14, 2009, from *http://www.energystar.gov/ia/partners/product_specs/program_reqs/set_top_boxes_prog_req.pdf*.

TIAX (2007)

Table F.1: STB Installed Base, by Type (2006)

STB TYPE	INSTALLED BASE (MILLIONS)
Digital Satellite	61
Digital Cable	42
Analog Cable	28
Digital Satellite with DVR	6
Digital Cable with DVR	4
Stand Alone DVR	1.5
HD Digital Satellite	1.4
HD Digital Satellite With DVR	1.4
HD Digital Cable	1.0
HD Digital Cable With DVR	1.0

Source: Roth et al. *Residential Miscellaneous Electric Loads*. Table 4-81.

Table F.2: STB Usage by Mode

STB TYPE	USAGE BY MODE (HRS/YR)	
	ACTIVE	OFF
Cable	2,730	6,030
Satellite	3,420	5,520
Stand Alone DVR	2,080	6,680

Source: Roth et al. *Residential Miscellaneous Electric Loads*. Table 4-83.

Table F.3: STB Electricity Use

STB TYPE	POWER DRAW (W)		UNIT ELECTRICITY CONSUMPTION (KWH/YEAR)			NATIONAL ENERGY CONSUMPTION (TWH/YR)
	ACTIVE	OFF	ACTIVE	OFF	TOTAL	
Analog Cable	16	16	44	93	138	4
Digital Cable	14	14	38	84	123	5
HD Cable	22	21	59	124	182	0
Cable with DVR	26	21	71	127	198	1
HD Cable with DVR	29	24	79	145	224	0
Digital Satellite	13	13	43	70	113	7
HD Satellite	21	18	69	100	169	0
Satellite with DVR	25	25	82	139	222	1
HD Satellite with DVR	42	40	137	223	360	1
Stand-Alone DVR	27	27	56	180	237	0.4

Source: Roth et al. *Residential Miscellaneous Electric Loads*. Power draw data from Table 4-82. Unit energy consumption data from table 4-84. National energy consumption data from Table 4-85.

Table F.4: STB Best in Class Energy Use

STB TYPE	BEST IN CLASS POWER DRAW (W)		BEST IN CLASS UNIT ELECTRICITY CONSUMPTION (KWH/YEAR)			BEST IN CLASS NATIONAL ENERGY CONSUMPTION (TWH/YR)
	ACTIVE	OFF	ACTIVE	OFF	TOTAL	
Analog Cable	10	10	27	60	88	2
Digital Cable	12	12	33	72	105	4
HD Cable	13	13	35	78	114	0
Cable with DVR	26	21	71	127	198	1
HD Cable with DVR	21	20	57	121	178	0
Digital Satellite	8	8	26	44	70	4
HD Satellite	21	15	69	83	152	0
Satellite with DVR	17	16	55	88	143	1
HD Satellite with DVR	37	37	120	204	324	0
Stand-Alone DVR	21	2	44	13	57	0

Source: Roth et al. *Residential Miscellaneous Electric Loads.* Power draw data from Table 4-86. Unit energy consumption data from Table 4-87. National energy consumption data from table 4-88.

Ecos

Table F.5: Average STB Power Use

STB TYPE	AVERAGE POWER USE BY MODE (W)				AVERAGE ANNUAL ENERGY USE BY MODE (KWH)			
	STANDBY	LOW POWER	ACTIVE	INDETER-MINATE	STANDBY	LOW POWER	ACTIVE	TOTAL
Analog Cable	—	—	—	10.2	—	—	—	89.4
Digital Cable	—	—	—	26.4	—	—	—	239.3
Digital Cable with DVR	—	—	—	43.0	—	—	—	376.4
Satellite	12.3	11.1	16.0	17.2	49.3	24.7	49.6	123.7
Satellite with DVR	24.8	—	27.6	33.6	48.9	—	187.2	236.1
DVR	—	—	—	36.7	—	—	—	362.6

Sources: Foster Porter, Moorefield and May-Ostendorp. *Final Field Research Report.* Average power use by mode data from Table 7. Average annual energy use data from Table 8. Because power use for some STBs varied little across operating modes, the report considered these devices to operate in only one mode, which it labeled 'indeterminate.'

Energy Solutions

Table F.6: STB Energy Consumption by Device Type and Mode

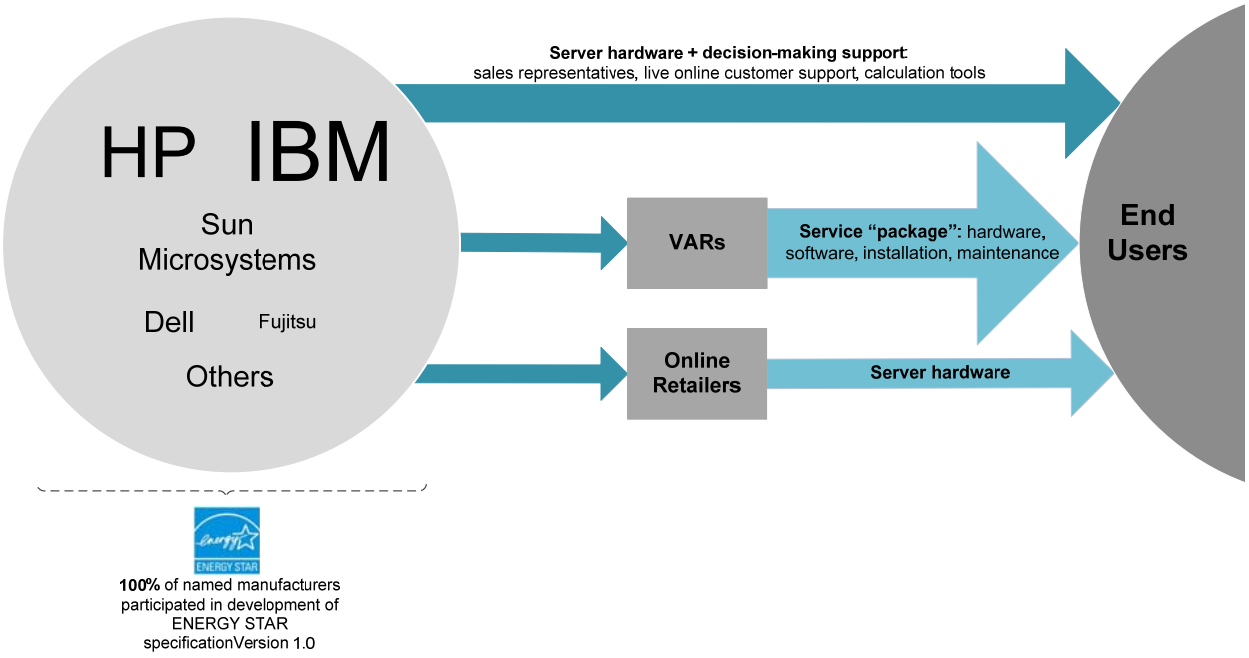
STB TYPE	BASELINE MEAN POWER USE (W)		UNIT ANNUAL ELECTRICITY CONSUMPTION (KWH/YR)		
	ACTIVE MODE	STANDBY MODE	ACTIVE MODE	STANDBY MODE	TOTAL
Analog Cable	12	11	—	—	—
Digital Cable	19	18	31	128	159
Digital Satellite	16	14	26	98	125
Digital TV Adapter	17	8	—	—	—
DVR	31	30	51	213	264
IPTV	15	14	25	100	124

Source: Chase, Ramos and Pope. *Consumer Electronics.* Baseline mean energy consumption from table 4.3-6. Annual electricity consumption from table 4.3-7.

G SERVERS

SUPPLY CHAIN

Server
Supply Chain



GLOSSARY

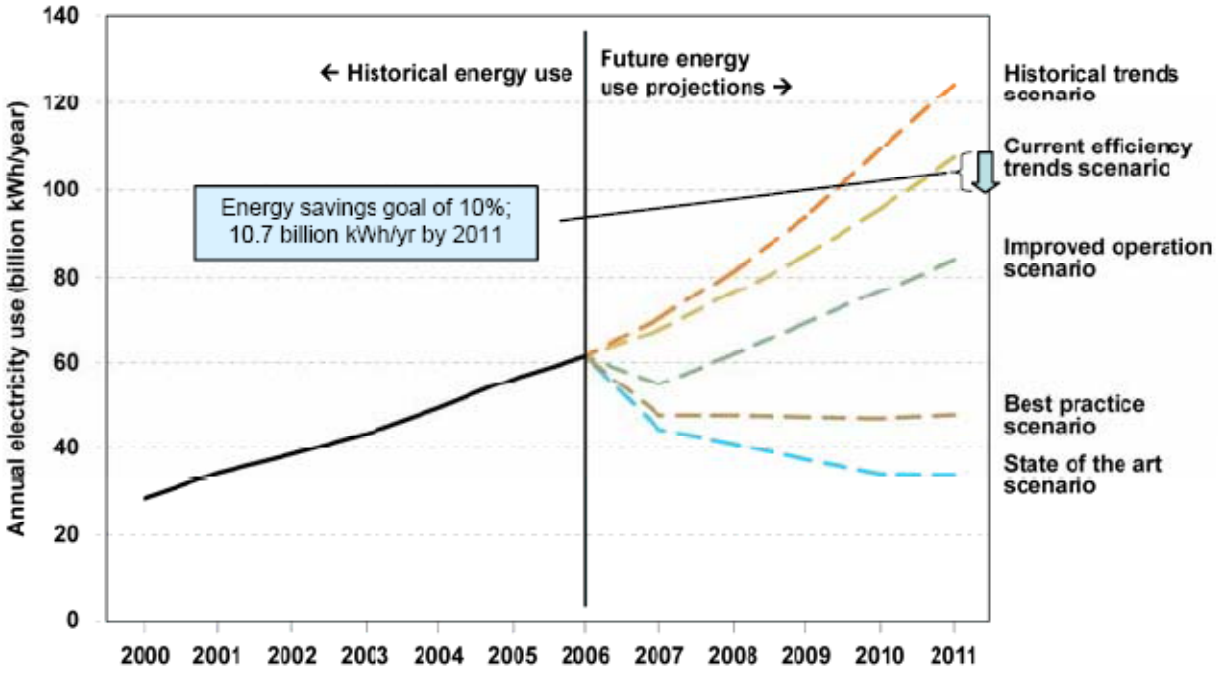
- **Blade Server**: A self-contained server designed for high-density use in a separate rack/ enclosure; a server with many components removed to save space, while still retaining all functional components needed to be considered a computer.
- **Chassis:** The piece of equipment that holds the components or blades needed for a server configuration. Chassis can be pedestal or rack form and can hold various amounts of processors or other equipment.

- **Cloud Computing**: A method of computing where scalable resources are provided over the Internet to provide a remote technology infrastructure. Resources are often virtualized and host common business software on the server to provide easy use, with maximum efficiency, for the person or business using the "cloud."
- **Data Center**: A facility used to house the computer systems, cooling systems, backup power supplies, and telecommunications equipment needed for data management. Data centers are sometimes referred to as "server farms."
- **Desktop-Derived Server:** A server which provides file or printer networking and is constructed in a pedestal or tower similar to a desktop computer. These servers are distinct from desktop computers in that they may contain server processors, large power supplies, and larger data storage capabilities.
- **Enterprise Server:** A large-scale server used for businesses with extensive computing needs. For example, large Internet companies like Google or a financial institution like Citibank require servers on this scale.
- **Processor or CPU:** The "brain" of the computer. A processor prioritizes and commands tasks for the computer. Different processors run at different speeds, measured in Megahertz (MHz). The two most common processor brands are Intel and AMD.
- **Sockets:** Sockets provide the physical support for the processor in a server. Servers may have one or many sockets, which determine how many processing units they can hold.
- **Value Added Reseller (VAR)**: A company that adds features, software, or services to an existing product and then sells it to the end-user. Professional services provided by a VAR can include training, technical support, consulting, or bundling software with the purchased product. Ingram Micro was identified by a manufacturer as a key VAR (*www.ingrammicro.com/*).
- **Virtualization**: The abstraction or separation of computer resources from their original context. Virtualization can happen in varying degrees (partial virtualization) and means that the software a person is using is a virtual simulation of the actual software. Virtualization allows a user to have fewer physical servers. This process can help share a computer system among multiple users and saves energy and cooling costs, application testing time, antivirus software costs, and licensing costs.

SCENARIOS FOR SERVER AND DATA CENTER ENERGY CONSUMPTION

The following chart, from the 2007 EPA/ENERGY STAR *Report to Congress on Server and Data Center Energy Efficiency*, shows five scenarios for server and data center energy consumption to 2011.

Figure G.1: Comparison of Projected Electricity Use, 2007-2011

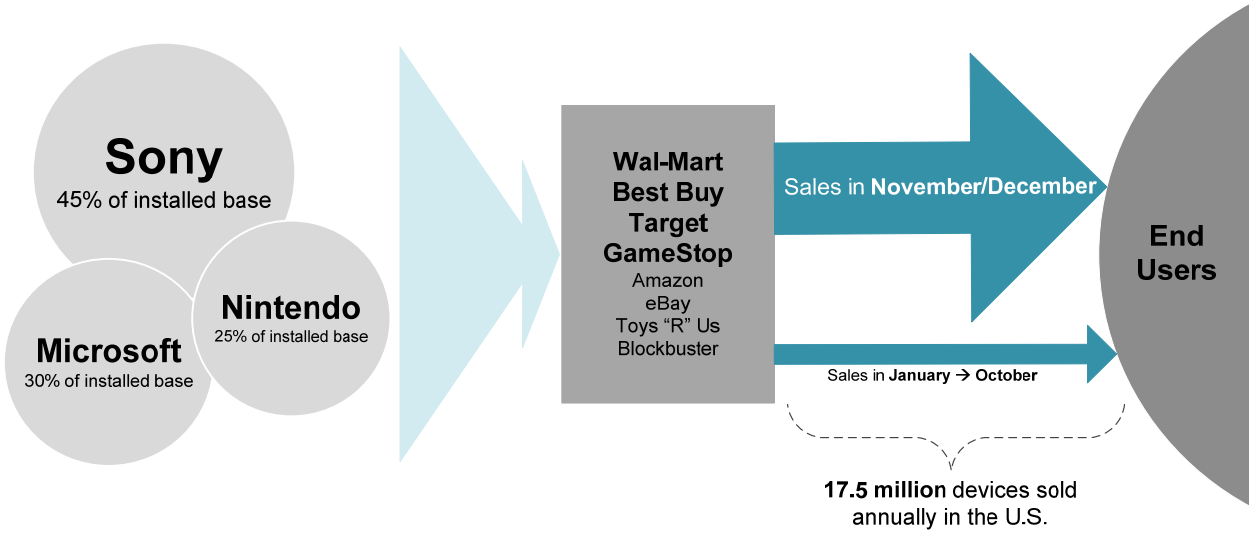


Source: EPA/ENERGY STAR. (August 2, 2007). *Report to Congress on Server and Data Center Energy Efficiency*. Public Law 109-431, U.S.

H VIDEO GAME CONSOLES

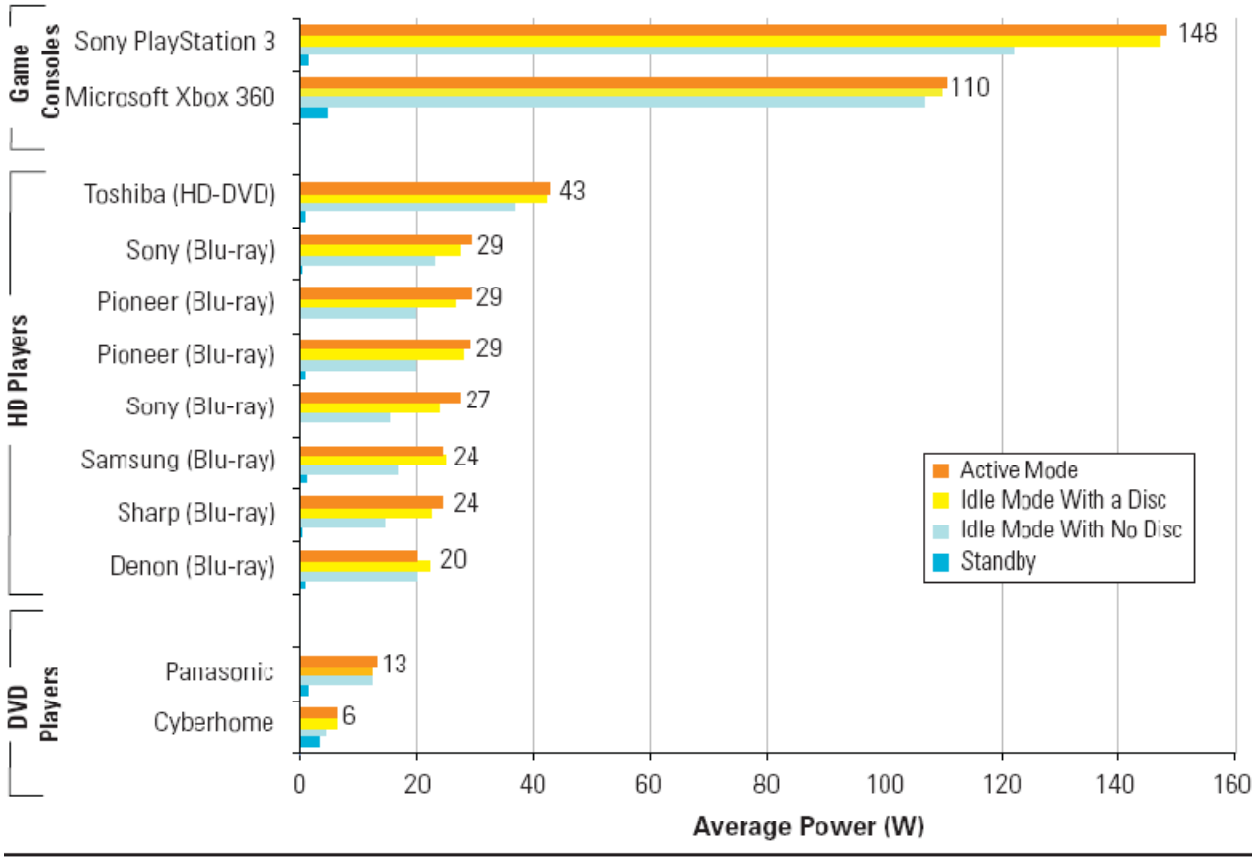
SUPPLY CHAIN

Game Console
Supply Chain



POWER CONSUMPTION

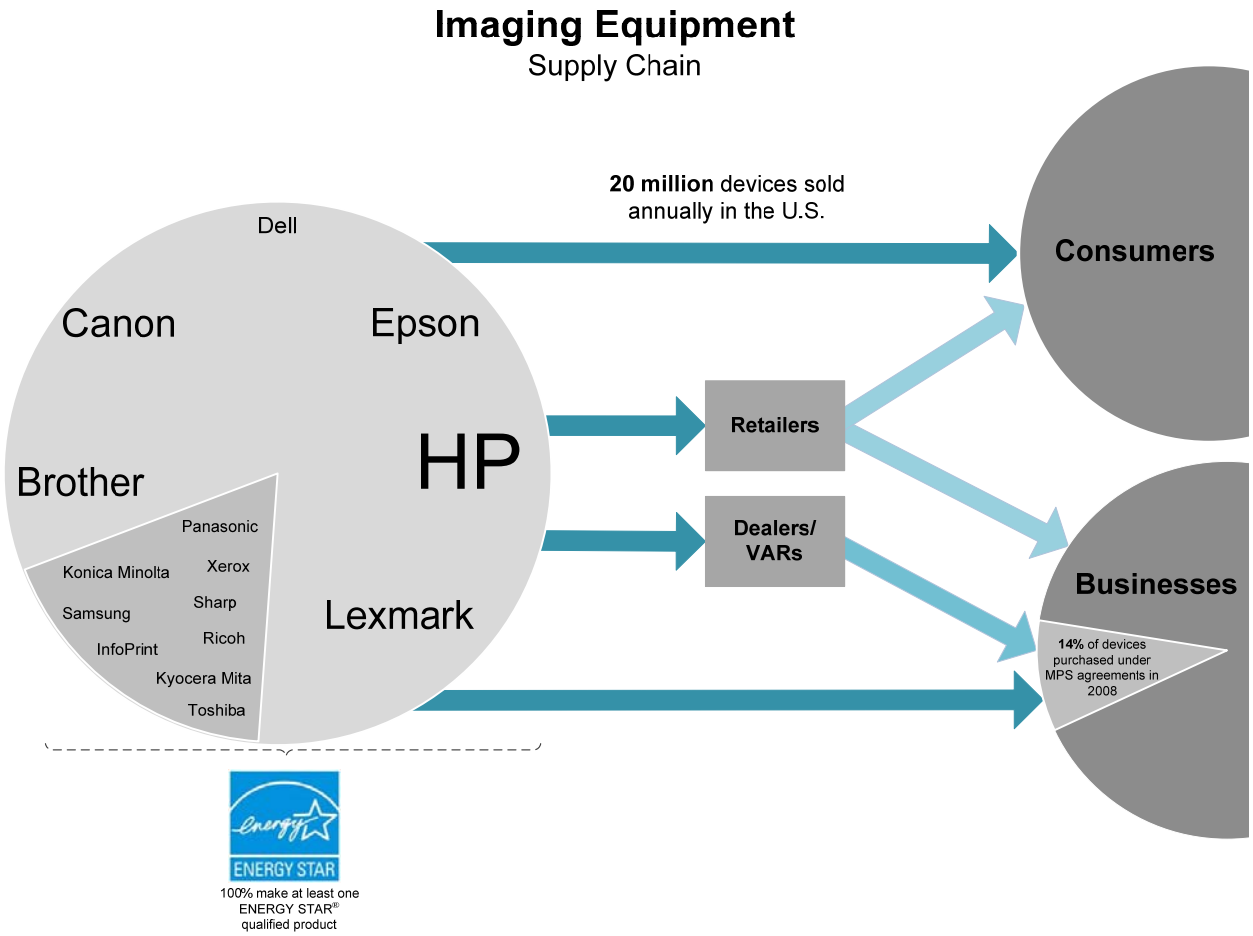
Figure H.1: Power Measurements of Standalone DVD Players Compared with Video Game Consoles



Source: Horowitz. *Lowering the Cost of Play*.

I IMAGING EQUIPMENT

SUPPLY CHAIN



ENERGY USE DATA

The relevant data from each study is summarized below. The first section compares data across studies; the following sections report data for each study individually.

The number of hours devices spend in various states (active, sleep, etc.), power consumption in each state, and annual electricity use vary across the four studies, as shown by the tables below.

Comparison Across all Studies

Table I.1: Copier Data Comparison

MODE	ECOS	ENERGY SOLUTIONS	TIAX
TIME BY MODE (%)			
Active	—	0.06%	None provided
Standby	100%	0.3%	
Sleep	—	49%	
Off	—	49%	
POWER CONSUMPTION BY MODE (W)			
Active	18.4	300	None provided
Standby	1.2	63	
Sleep	—	11	
Off	—	—	
ANNUAL ELECTRICITY CONSUMPTION BY MODE (KWH/YR)			
TOTAL	**11.3**	**51**	—

Sources: **Ecos** data from in-home measurement of one copier. **Energy Solutions** data from Cremer et al. (2003).

Table I.2: Multifunction Device Comparison

MODE	ECOS		ENERGY SOLUTIONS	TIAX[II]
	INKJET	LASER	UNDEFINED	INKJET
TIME BY MODE (%)				
Active	3%	2%	1.6%	0.6%
Low Power	7%	—	—	—
Standby / Ready	83%	48%	15%	18%
Sleep	—	—	33%	81%
Off / No Power	7%	50%	50%	—

Continued

MODE	ECOS		ENERGY SOLUTIONS	TIAX[II]
	INKJET	LASER	UNDEFINED	INKJET
POWER CONSUMPTION BY MODE (W)				
Active	15.2	—	19	19
Low Power	9.1	—	—	—
Standby / Ready	6.2	5.2	11	11
Sleep	—	—	7	7
Off / No Power	—	—	7	—
Indeterminate	5.3	—	—	—
ANNUAL ELECTRICITY CONSUMPTION BY MODE (KWH/YR)				
TOTAL	**54.7**	**23.0**	**68**	**59 / 68[i]**

Sources: **Ecos** data from in-home measurement of 13 inkjet MFDs and two laser MFDs. **Energy Solutions** data from ENERGY STAR website (2006) and figures as reported in TIAX 2007 and TIAX 2006 studies respectively. **TIAX** data from McWhinney et al. (2004) and Nordman and Meier (2004).

Table I.3: Printer Comparison

MODE	LASER			INKJET		
	ECOS	ENERGY SOLUTIONS	TIAX	ECOS	ENERGY SOLUTIONS	TIAX
TIME BY MODE (PERCENT)						
Active	1%	0.4%	None provided	1%	0.5%	1%
Low Power	2%	—		—	—	—
Standby / Ready	97%	8%		99%	13%	—
Sleep	—	92%		—	—	—
Off / No Power	—	—		—	87%	99%
POWER CONSUMPTION BY MODE (W)						
Active	39.0	161	None provided	8.9	13	8.9
Low Power	9.6	—		3.2	—	—
Standby / Ready	1.3	54		1.7	5	3.2
Sleep	—	7		—	—	—
Indeterminate	4.3	—		1.9	2	—
Off	—	—		—	—	1.7
ANNUAL ELECTRICITY CONSUMPTION BY MODE (KWH/YR)						
TOTAL	**14.9**	**97**	—	**15.1**	**21**	**16**

Sources: **Ecos** data from in-home measurement of 18 inkjet MFDs and four laser MFDs. **Energy Solutions** data from ADL (2002), Cremer (2003), ENERGY STAR website (2006), and TIAX IT study. **TIAX** data from Ecos study.

Ecos

Table I.4: Copier Summary

CHARACTERISTIC	STANDBY	ACTIVE	INDETER-MINATE	TOTAL
Percent of Time by Mode	100%	—	—	—
Average Power Use by Mode (W)	1.2	18.4	—	—
Average Annual Energy Use by Mode (kWh)	10.9	0.5	—	**11.3**

Source: Table 2 on p. 29, Table 7 on p. 62, and Table 8 on p. 63.

Table I.5: Inkjet Multifunction Device Summary

CHARACTERISTIC	NO POWER	STANDBY	LOW POWER	ACTIVE	INDETER-MINATE	TOTAL
Percent of Time by Mode	7%	83%	7%	3%	—	—
Average Power Use by Mode (W)	—	6.2	9.1	15.2	5.3	—
Average Annual Energy Use by Mode (kWh)	—	46	5.3	3.4	—	**54.7**

Source: from Table 2 on p. 29, Table 7 on p. 62, and Table 8 on p. 63.

Table I.6: Laser Multifunction Device Summary

CHARACTERISTIC	NO POWER	STANDBY	LOW POWER	ACTIVE	TOTAL
Percent of Time by Mode	50%	48%	—	2%	—
Average Power Use by Mode (W)	—	5.2	—	—	—
Average Annual Energy Use by Mode (kWh)	—	21.8	—	1.2	**23.0**

Source: Table 2 on p. 29, Table 7 on p. 62, and Table 8 on p. 63.

Table I.7: Inkjet Printer Summary

CHARACTERISTIC	STANDBY	LOW POWER	ACTIVE	INDETER-MINATE	TOTAL
Percent of Time by Mode	99%	—	1%	—	—
Average Power Use by Mode (W)	1.7	3.2	8.9	1.9	—
Average Annual Energy Use by Mode (kWh)	14.6	0.1	0.5	—	**15.1**

Source: Table 2 on p. 29, Table 7 on p. 62, and Table 8 on p. 63.

Table I.8: Laser Printer Summary

CHARACTERISTIC	STANDBY	LOW POWER	ACTIVE	INDETER-MINATE	TOTAL
Percent of Time by Mode	97%	2%	1%	—	—
Average Power Use by Mode (W)	1.3	9.6	39.0	4.3	—
Average Annual Energy Use by Mode (kWh)	11.6	1.4	2.0	—	**14.9**

Source: Table 2 on p. 29, Table 7 on p. 62, and Table 8 on p. 63.

Energy Solutions

Table I.9: Copier Summary

CHARACTERISTIC	ACTIVE	STANDBY	SLEEP	OFF	TOTAL
Annual Hours per Mode	5	25	4,364	4,366	—
Baseline Power Consumption per Unit (W)	300	63	11	—	—
Annual Electricity Consumption Estimate per Unit (kWh/Yr)	2	2	48	0	**51**
"Improved Case" Annual Electricity Consumption per Unit (kWh/Yr)	—	—	—	—	**25**
"Improved Case" Annual Electricity Savings per Unit (kWh/Yr)	—	—	—	—	**26**

Source: Table 4.4-1 on p. 18, Table 4.1-7 on p. 21, Table 4.1-8 on p. 22, and Table 4.1-12 on p. 26.

Table I.10: Multifunction Device Summary

CHARACTERISTIC	ACTIVE	STANDBY	SLEEP	OFF	TOTAL
Annual Hours per Mode	139	1,326	2,915	4,380	—
Baseline Power Consumption per Unit (W)	19	11	7	7	—
Annual Electricity Consumption Estimate per Unit (kWh/Yr)	3	15	20	31	**68**
"Improved Case" Annual Electricity Consumption per Unit (kWh/Yr)	—	—	—	—	**19**
"Improved Case" Annual Electricity Savings per Unit (kWh/Yr)	—	—	—	—	**49**

Source: Table 4.4-1 on p. 18, Table 4.1-7 on p. 21, Table 4.1-8 on p. 22, and Table 4.1-12 on p. 26.

Table I.11: Inkjet Printer Summary

CHARACTERISTIC	ACTIVE	STANDBY	SLEEP	OFF	TOTAL
Annual Hours per Mode	44	1,102	—	7,615	—
Baseline Power Consumption per Unit (W)	13	5	—	2	—
Annual Electricity Consumption Estimate per Unit (kWh/Yr)	1	6	—	15	**21**
"Improved Case" Annual Electricity Consumption per Unit (kWh/Yr)	—	—	—	—	**12**
"Improved Case" Annual Electricity Savings per Unit (kWh/Yr)	—	—	—	—	**9**

Source: Table 4.4-1 on p. 18, Table 4.1-7 on p. 21, Table 4.1-8 on p. 22, and Table 4.1-12 on p. 26.

Table I.12: Laser Printer Summary

CHARACTERISTIC	ACTIVE	STANDBY	SLEEP	OFF	TOTAL
Annual Hours per Mode	35	698	8,027	—	—
Baseline Power Consumption per Unit (W)	161	54	7	1	—
Annual Electricity Consumption Estimate per Unit (kWh/Yr)	6	38	54	—	**97**
"Improved Case" Annual Electricity Consumption per Unit (kWh/Yr)	—	—	—	—	**78**
"Improved Case" Annual Electricity Savings per Unit (kWh/Yr)	—	—	—	—	**19**

Source: Table 4.4-1 on p. 18, Table 4.1-7 on p. 21, Table 4.1-8 on p. 22, and Table 4.1-12 on p. 26.

TIAX (2007)

Table I.13: Inkjet Multifunction Summary

CHARACTERISTIC	RESULT	COMMENTS
Installed Base (Millions)	225.25	Approximate based on total installed base of MFDs and inkjet printers of 101 million, with MFDs making up 25%
Market Penetration (Percent of Households)	68%	
Unit Electricity Consumption (UEC) (kWh/Year)	57	
Best In Class - UEC (kWh/Year)	7.5	Based on ENERGY STAR (2006)
Best In Class – UEC Savings (kWh/Year)	50	
Best In Class – UEC Savings as a Percent of Total Original UEC	88%	
Annual Electricity Consumption (AEC) (TWh/Year)	1.5	Based on total AEC of MFDs and inkjet printers of 2.6 TWh/year, with MFDs making up 55%

Source: Section 4.9, p. 4-49. This study reported data for inkjet devices only (not laser MFDs) and reported data for printers and MFDs together. Only MFD data has been included here.

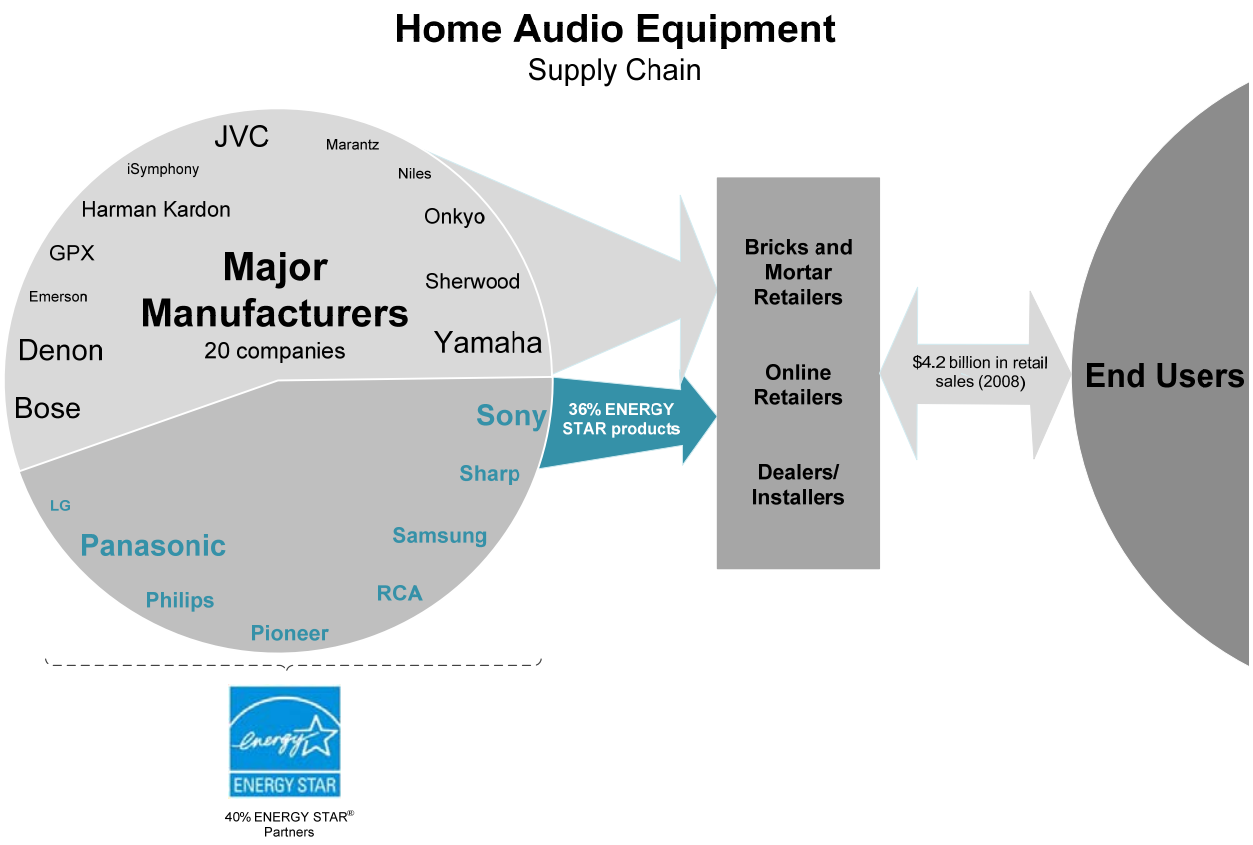
Table I.14: Inkjet Printer Summary

CHARACTERISTIC	RESULT	COMMENTS
Installed Base (Millions)	75.75	Approximate based on total installed base of MFDs and inkjet printers of 101 million, with printers making up 75%
Market Penetration (Percent of Households)	68%	
Unit Electricity Consumption (UEC) (kWh/Year)	16	
Best In Class - UEC (kWh/Year)	1.6	Based on ENERGY STAR (2006)
Best In Class – UEC Savings (kWh/Year)	14	
Best In Class – UEC Savings as a Percent of Total Original UEC	13%	
Annual Electricity Consumption (AEC) (TWh/Year)	1.2	Based on total AEC of MFDs and inkjet printers of 2.6 TWh/year, with printers making up 45%

Source: Section 4.9, p. 4-49. This study reported data for inkjet devices only (not laser printers) and reported data for printers and MFDs together. Only printer data has been included here.

J HOME AUDIO EQUIPMENT

SUPPLY CHAIN



ENERGY USE DATA

Energy Solutions

Table J.1: Shelf Systems

CHARACTERISTIC	PLAY	ACTIVE STANDBY	PASSIVE STANDBY	OFF	TOTAL
Annual Hours per Mode	964	1,664	6,132	NA	—
Baseline Power Consumption per Unit (W)	22	17	4	NA	—
Annual Electricity Consumption Estimate per Unit (kWh/Yr)	21	29	25	NA	**76**
"Improved Case" Annual Electricity Consumption per Unit (kWh/Yr)	—	—	—	—	**40**
"Improved Case" Annual Electricity Savings per Unit (kWh/Yr)	—	—	—	—	**36**

Source: Table 4.4-5 on p. 67, Tables 4.4-8 and 4.4-9 on p. 69, and Table 4.4-13 on p. 72. The study refers to shelf systems as "Compact Stereo." Language has been changed to maintain consistency in this report.

Table J.2: Component Systems

CHARACTERISTIC	PLAY	ACTIVE STANDBY	PASSIVE STANDBY	OFF	TOTAL
Annual Hours per Mode	1,664	1,402	5,694	NA	—
Baseline Power Consumption per Unit (W)	41	39	2	1.6	—
Annual Electricity Consumption Estimate per Unit (kWh/Yr)	68	55	10	NA	**133**
"Improved Case" Annual Electricity Consumption per Unit (kWh/Yr)	—	—	—	—	**86**
"Improved Case" Annual Electricity Savings per Unit (kWh/Yr)	—	—	—	—	**47**

Note: Energy Solutions 2006 refers to component systems as "Component Stereo." Language has been changed to maintain consistency in this report.

Table J.3: HTIBs

CHARACTERISTIC	PLAY	ACTIVE STANDBY	PASSIVE STANDBY	OFF	TOTAL
Annual Hours per Mode	730	2,008	5,621	402	—
Baseline Power Consumption per Unit (W)	38	36	3	0.1	—
Annual Electricity Consumption Estimate per Unit (kWh/Yr)	28	73	14	0.0	**115**
"Improved Case" Annual Electricity Consumption per Unit (kWh/Yr)	—	—	—	—	**82**
"Improved Case" Annual Electricity Savings per Unit (kWh/Yr)	—	—	—	—	**33**

Note: Energy Solutions 2006 refers to HTIB as "Home Theaters." Language has been changed to maintain consistency in this report.

Table J.4: Baseline Power Consumption per Unit (W)

CHARACTERISTIC	PLAY	ACTIVE STANDBY	PASSIVE STANDBY	OFF
Shelf Systems	22	17	4	NA
Component Systems	41	39	2	1.6
HTIB	16	14	2	NA

Source: Table 4.4-8 on p. 69.

Ecos

Table J.5: Receiver Energy Use Summary

CHARACTERISTIC	STANDBY	ACTIVE	INDETER-MINATE	TOTAL
Percent of Time by Mode	75%	25%	—	—
Average Power Use by Mode (W)	3.3	50.1	—	—
Average Annual Energy Use by Mode (kWh)	23.9	119.0	—	**142.9**

Source: Table 1 on p. 23, Table 7 on p. 62, and Table 8 on p. 63.

Table J.6: Shelf System Energy Use Summary

CHARACTERISTIC	STANDBY	ACTIVE	INDETER-MINATE	TOTAL
Percent of Time by Mode	—	—	—	—
Average Power Use by Mode (W)	6.2	13.6	16.3	—
Average Annual Energy Use by Mode (kWh)	48.2	9.4	—	**57.6**

Source: Table 7 on p. 62 and Table 8 on p. 63. The report refers to shelf systems as "Mini Systems." Language has been changed to maintain consistency in this report.

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Table J.7: Home Audio Summary Table

CHARACTERISTIC	SHELF SYSTEM	COMPONENT SYSTEM	HTIB
Installed Base (Millions)	76	50	25
Market Penetration (Percent of Households)	44%	40%	17%
Unit Electricity Consumption (UEC) (kWh/Year)	81	122	89
Best In Class - UEC (kWh/Year)	31	103	86
Best In Class – UEC Savings (kWh/Year)	50	19	3
Best In Class – UEC Saving as a Percent of Total Original UEC	61%	15%	3%
Best In Class - Off Mode Power (W)	0.1	0.1	0.1
Annual Electricity Consumption (AEC) (TWh/Year)	6.2	6.1	2.2
Percent of Total AEC	35%	35%	13%
Best In Class – AEC Savings (TWh/Yr)	3.8	0.9	0.0
Peak Demand Impact	Low		
Variability Usage	High		

Source: Section 4.2, p. 4-4, 4-11 and 4-12. The report refers to shelf systems as "Compact Audio" or "Compact Stereo Systems" and component systems as "Component Audio" or "Component Stereo Systems." Language has been changed to maintain consistency in this report.

Table J.8: Unit Electric Consumption, Shelf System

CHARACTERISTIC	ACTIVE	IDLE	OFF	TOTAL
Power (W)	23	16	7	—
Usage (hr/yr)	840	730	7,190	8,760
Unit Electricity Consumption (kWh/year)	19	12	50	81
Percent of Total Unit Electricity Consumption	23%	15%	62%	—

Source: Data from Section 4.2, p. 4-8.

Table J.9: Unit Electric Consumption, Component System

CHARACTERISTIC	ACTIVE	IDLE	OFF	TOTAL
Power (W)	45	43	3	—
Usage (hr/yr)	1,580	730	6,450	**8,760**
Unit Electricity Consumption (kWh/year)	71	31	19	**122**
Percent of Total Unit Electricity Consumption	58%	25%	16%	—

Source: Section 4.2, p. 4-9.

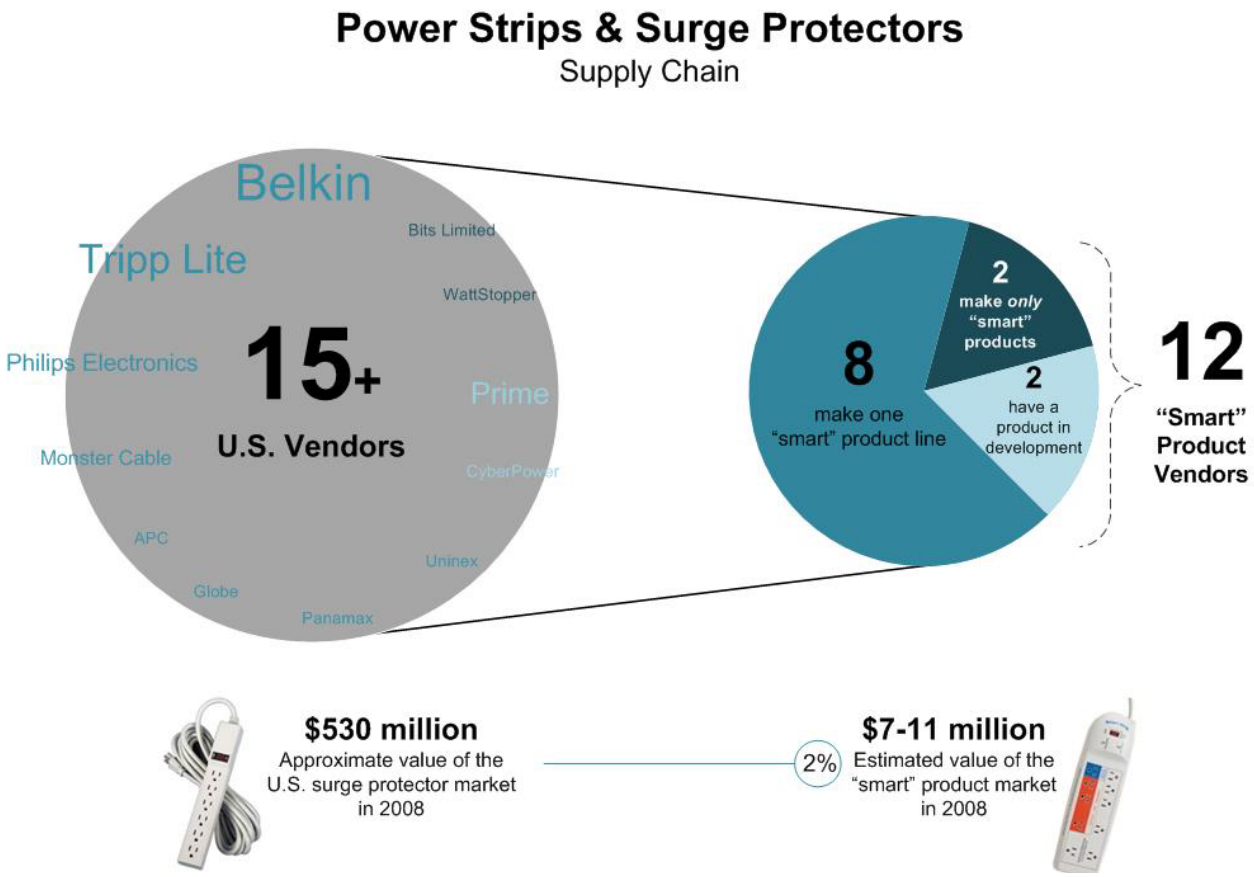
Table J.10: Unit Electric Consumption, HTIB

CHARACTERISTIC	ACTIVE	IDLE	OFF	TOTAL
Power (W)	38	34	0.6	—
Usage (hr/yr)	1,580	730	6,450	**8,760**
Unit Electricity Consumption (kWh/year)	60	25	4	**89**
Percent of Total Unit Electricity Consumption	67%	28%	4%	—

Source: Section 4.2, p. 4-10.

K "SMART" POWER STRIPS AND SURGE PROTECTORS

SUPPLY CHAIN



POTENTIAL ENERGY SAVINGS FROM USE OF SMART POWER STRIPS

Navigant Consulting has produced a working paper for SDG&E examining the potential energy savings related to "smart" power strips.[128] The paper draws primarily on three sources (cited

[128] Erin Palermo. (March 31, 2009). *Smart Strip Portfolio of the Future*. Prepared by Navigant Consulting Inc., for San Diego Gas & Electric.

below) to determine the standby energy consumption of home office and home entertainment peripherals that "smart" power strips could eliminate. The tables below summarize the relevant data.

Table K.1: Standby Energy Consumption of Computers and TVs

CONTROLLING DEVICE	TIME NOT IN USE (HRS/YEAR)	PERCENTAGE OF TIME NOT IN USE	PERCENTAGE OF HOMES THAT DO NOT CONNECT POWER STRIPS TO DEVICE, OR DO NOT TURN THEM OFF WHEN NOT IN USE
Computer	7,474.40	85.6%	88.2%
TV	6,784.31	77.7%	93.8%

Table K.2: Average Savings per Home Office for Peripherals

PERIPHERAL	TOTAL ENERGY CONSUMPTION RATE WHEN COMPUTER IS OFF (KWH)	TIME PC IS NOT IN USE (HRS/YEAR)	PERCENT OF PERIPHERALS NEVER USED WITHOUT PC	PERCENT OF HOUSEHOLDS WITH PERIPHERAL	AVERAGE SAVINGS PER HOME FOR PERIPHERAL (KWH)
Flat Panel Monitor	1.29	7,474	100%	69.3%	6.70
CRT Monitor	0.72	7,474	100%	25.1%	1.36
Printer	2.32	7,474	80%	43.1%	5.97
Multifunction Printer, no Fax	7.81	7,474	66.7%	4.0%	1.55
Multifunction Printer with Fax	7.57	7,474	57.3%	8.3%	2.70
Speakers, subwoofers, bass	4.76	7,474	100%	0.6%	0.20
Scanner	1.42	7,474	95.5%	7.4%	0.76
Copier	0.32	7,474	58.1%	4.8%	0.07
Modem	6.46	7,474	90.4%	8.1%	3.53
Router	5.07	7,474	93.3%	9.9%	3.49
External Hard Drive	1.13	7,474	100%	0.3%	0.03
				Total Average Savings Per Home Office:	**26.34**

Sources: Energy use data from: Lawrence Berkeley National Laboratory (LBNL). (September 2004). Developing and Testing Low Power Mode Measurement Methods. Prepared for California Energy Commission's Public Interest Energy Research (PIER) Program. Additional energy use data from Ecos Consulting (October 31, 2006). Final Field Research Report. Prepared for California Energy Commission's PIER Program. Usage data from: Hiner and Partners. (October 2008). Statewide Home Electronics Assessment Survey.

Table K.3: Average Savings per Home Entertainment Center for Peripherals

PERIPHERAL	TOTAL ENERGY CONSUMPTION RATE WHEN TV IS OFF (WATTS)	TIME TV IS NOT IN USE (HRS/YEAR)	PERCENT OF PERIPHERALS NEVER USED WITHOUT TV	PERCENT OF HOUSEHOLDS WITH PERIPHERAL	AVERAGE SAVINGS PER HOME FOR PERIPHERAL (KWH)
DVD Player	2.12	6,784	93.3%	53.3%	7.16
VCR	5.92	6,784	97.9%	21.3%	8.37
Stereo	4.07	6,784	50.7%	30.9%	4.33
Speakers, Subwoofers	11.07	6,784	86.2%	2.1%	1.36
Video Game Consoles	0.57	6,784	98.0%	5.3%	0.20
Computer Only Used for Video	17.77	6,784	66.7%	0.3%	0.27
Total Average Savings Per Home Entertainment Center:					**21.69**

Sources: Energy use data from: Lawrence Berkeley National Laboratory (LBNL). (September 2004). Developing and Testing Low Power Mode Measurement Methods. Prepared for California Energy Commission's Public Interest Energy Research (PIER) Program. Additional energy use data from Ecos Consulting (October 31, 2006). Final Field Research Report. Prepared for California Energy Commission's PIER Program. Usage data from: Hiner and Partners. (October 2008). Statewide Home Electronics Assessment Survey.

L EXTERNAL POWER SUPPLIES

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