Game Consoles

Response to California Energy Commission
2013 Pre-Rulemaking Appliance Efficiency
Invitation to Participate

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Summary

The information below provides direct response to the California Energy Commission's (CEC) Invitation to Participate (ITP) for the 2013 Appliance Efficiency Pre-Rulemaking, regarding Game Consoles, including reference to several primary sources, some of which are attached separately (see References for more details). This document includes all of the questions asked in the ITP, even for those with no response.

In summary, CEC has an excellent opportunity to explore energy efficiency opportunities for game consoles. The EPA has recently released voluntary standards for game consoles, but no mandatory state or federal standards exist. The game console market has grown dramatically over the past ten years and is poised for further expansion with several new products expected to be released in 2013. Game consoles increasingly provide features that overlap with those provided by other consumer electronics, such as video streaming, but typically at a much higher energy cost. These trends underscore the importance of pursuing game console energy efficiency opportunities that save Californians money and reduce pollution without interfering with the gaming experience.

There are several sources of game console data for consideration. Documents prepared by the United States Environmental Protection Agency for the voluntary Recognition Program for Game Consoles provide information on general scope and definition as well as test procedures and potential standard levels. U.S. game console sales information is available online from VGChartz. Modal power data and information of default power management settings and language are available from testing performed by NRDC, Ecova, and Energy Solutions. The Consumer Electronics Association has collected information on game console usage patterns that reflect its duty cycle.

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1 Basic Information

1.1 Product Definition and Scope

Game consoles are defined as electronic devices enable users to play games by interacting with video displays that meet the following conditions (adapted from EPA Recognition Program for Game Consoles Performance Requirements 1.0 [EPA 2013]):

- are intended for stationary home use;
- consist of computer-like hardware components such as central processors, system memory, graphics processors, video memory, and storage drives; and
- rely primarily on televisions and specialized hand held controllers for signal output and input, respectively.

Game consoles have been sold in the United States since 1972, when Magnavox's Odyssey was released. Over the past four decades, the industry has undergone massive technological changes and significant market upheavals. The launches of these major game consoles have been informally categorized into overlapping generations of approximately six years each. We are currently in the middle of a transition from Generation 7, which began in 2005, to Generation 8, which was initiated with announcement of Nintendo's Wii U console in 2011. The Wii U went on sale in late 2012 (see Figure 1) and Sony and Microsoft are expected to follow suit in 2013 with PlayStation 4 and Xbox 720, respectively.

Figure 1 Current Generation Game Consoles (cw from upper left: Sony PlayStation 3 [current], Microsoft Xbox 360 [current], Nintendo Wii [replaced by Wii U in November 2012], Nintendo Wii U [current as of November 2012])

Several new consoles are expected to challenge the market in 2013, including Ouya, which is funded through Kickstarter; and Piston from modular PC maker Xi3. The large number of new entrants into the game console market in 2013 underscores the importance of exploring game console energy efficiency opportunities that save Californians money and reduce pollution without interfering with the gaming experience.

The basic hardware specifications for consoles currently available in the North American market are shown in Table 1 (note that there are nuances to these specifications that are not detailed; the table is meant to provide a broad overview only). At any given time, the same console platform is typically sold in 1-3 different hardware configurations. Currently, all three major manufacturers produce two different models of their most current platforms for the North American market, each with a different storage option. As detailed in Table 2, these configurations can be thought of as "entry-level" and "high-end" configurations.

Table 1. Game console hardware specifications for products available in North America.

Hardware	Wii	Wii U	Xbox 360 S	PlayStation 3
RAM	88 MB	2 GB	512 MB	512 MB
Removable Media Player Storage	none	none	DVD, CD	BDD, DVD, CD
Solid State (flash)	512 MB	8 GB, 32 GB	4 GB	none
Hard Disk Drive	none	none	250 GB	250 GB, 500 GB

Table 2. Game console storage configurations available in North America.

Configuration	Wii U	Xbox 360 S	PlayStation 3
Entry Level	8 GB Flash	4 GB Flash	250 GB
High End	32 GB Flash	250 GB HD	500 GB

Typically, game consoles are sold with at least the following components:

1. console
2. power supply (internal on PS3)
3. RCA video cable
4. controller

For marketing purposes, game consoles may also be bundled with additional game titles, motion control accessories, other accessories, and/or with different case colors. For example, Sony created a limited run of the PlayStation 3 500 GB console in garnet red, and packaged it with a red wireless controller and six game titles.

1.2 Existing Test Procedures

The Environmental Protection Agency

The Environmental Protection Agency (EPA) Recognition Program for Game Consoles has developed a test method for evaluating compliance with auto power down requirements as well as modal power limits (EPA, 2013). This test method can be used for testing compliance with all requirements of the proposed standard except the requirement to report active game play power level and the internal power supply efficiency requirement.

Natural Resources Defense Council

Natural Resources Defense Council (NRDC) has developed a draft test method for evaluating power levels during active game play (NRDC, 2013). This draft test method addresses the challenges presented by variability in power use depending on player skill, game title, and game position. It provides results that are sufficiently repeatable and representative for a Test and List requirement, if not for a mandatory power limit.

The Electric Power Research/Ecova

The Electric Power Research Institute (EPRI) and Ecova have developed a test method for evaluating the performance of internal power supply units: Generalized Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc and Dc-Dc Power Supplies (EPRI 2012). This test method can be used to evaluate game console internal power supply efficiency.

1.3 Sources of Test Data

Game Consoles – Nintendo, Microsoft, and Sony products

- Duty Cycle: [CEA] Consumer Electronics Association. 2010. "Consumer Electronics Association Gaming and Energy Study." Arlington, VA. September 2010.
- Power Use: Testing by NRDC, Ecova, and Energy Solutions. Results of these tests are summarized in Tables 2.2-2.4 below.
- Duty Cycle and Power Use: Hittinger, E., K. Mullins & I. Azevedo. 2012. "Electricity Consumption and Energy Savings Potential of Video Game Consoles in the United States." Energy Efficiency 1-15. Digital Object Identifier: 10.1007/s12053-012-9152-z. Date of Publication: March 31, 2012.

Game Consoles – New Products Expected in 2013

- Ouya

  Stevens, T. 2013. "Ouya Review (founding backer edition)." Accessed online April 29, 2013 at http://www.engadget.com/2013/04/03/ouya-review-founding-backer-edition/.

- Piston

  Leadbetter, R. 2013. "What's inside the Piston Steam Box Prototype?" Accessed online April 29, 2013 at http://www.eurogamer.net/articles/df-hardware-what-is-inside-piston.

DVD and Blu Ray Disc Players (for comparison of media playback energy consumption)

- [EPA] United States Environmental Protection Agency. 2013b. U.S. Environmental Protection Agency (EPA) ENERGY STAR Qualified AV Products. Available online at http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=DP

Apple TV (for comparison of streaming media energy consumption)

- Shimpi, A. 2013. Apple TV 2013 (A1469) Short Review: Analysis of New A5.Accessed online April 29, 2013 at http://www.anandtech.com/show/6834/apple-tv-2013-a1469-short-review-analysis-of-a-new-a5

1.4 Existing Standards and Standards under Development

No mandatory standards currently exist for game console energy efficiency. The EPA, with support from the Department of Energy (DOE), has developed a voluntary standard through the EPA Game Console Recognition Program. The EPA standards include modal limits for streaming media, navigation and standby. The European Commission is also in the process of considering game console energy efficiency standards (Ecodesign ENTR Lot 3; EC 2012), and is very close to adopting a horizontal modal power limit for networked standby (Eurodesign Lot 26; EC 2013). The Ecodesign Lot 26 networked standby standard is meant to be applicable to a variety of consumer electronics, including game consoles. The draft Ecodesign Lot 26 standard establishes a 6 W limit for networked standby effective 2017 and 3 W limit effective in 2018 (EC 2013).

Game consoles use either internal (Sony PlayStation) or external power supplies (Microsoft Xbox and Nintendo Wii and Wii U) to convert alternating current to direct current for use by electronic components. Nintendo's power supplies are Class A external power supplies (single-voltage with a rated output of less than or equal to 250 watts), and are subject to federal efficiency standards established by the DOE. The federal Class A external power supply standards are listed in Section 301 of the Energy Independence and Security Act of 2007, effective July 1, 2008. The Microsoft Xbox 360 power supply is multi-voltage. While not currently subject to energy efficiency standards, non-class A external power supplies are anticipated to be covered in the upcoming DOE BCEPS rule, initially proposed in March 2012. This proposed rule would pre-empt California's standards as of the anticipated effective date of 2015.

Single-voltage external power supplies for certain consumer electronics, including laptop computers, mobile phones, printers, print servers, scanners, personal digital assistants (PDAs), and digital cameras are regulated by Federal standards which require that regulated external power supplies with a nameplate output of more than 51 watts in active mode achieve an efficiency of at least 85%.

No mandatory federal or California state standards exist for internal power supplies. A private-sector company (Ecova) administers a voluntary certification for internal power supplies called "80 PLUS." 80 PLUS includes several tiers of requirements. The "Standard" tier requires multi-output power supplies in computers and servers to be 80% or greater energy efficient at 20%, 50%, and 100% of rated load with a true power factor of 0.9 or greater. The test method used for 80 PLUS certification is the same test method used for the ENERGY STAR® standards for computers and servers.

1.5 Product Lifetime

Historically, game consoles tended to be sold on the market for approximately four to eight years before being replaced with a new generation of console (Hittinger, 2012). The product

development and replacement cycle is longer than might be expected for a computer-like product as a result of the need to provide a stable platform for software development, which represents the primary source of revenue for manufacturers (Hittinger, 2012).

1.6 Product Development Trends

1.6.1 Redesign Cycle

Game console manufacturers do make some changes to products within a generation, periodically releasing new models of the same platform. Typically, new models of the same console platform replace previous versions and include features such as altered form factor, increased internal storage capacity, or improved network capabilities. Manufacturers also leverage improvements in semiconductor fabrication processes to decrease motherboard energy consumption and accompanying space and cooling requirements. Microsoft's release of the Xbox 360 S (or "slim") in 2010 is an example, featuring a slimmer form factor, more hard drive storage, built-in networking, and a new, more efficient processor architecture (Shimpi 2010).

2 Operations, Functions, and Modes

2.1 What are the operating modes of game consoles? Game Play, Media Play, Navigation, Networked Standby, and Standby/Off?

Many consumer electronics have similar operational modes, though modal definitions used in codes and standards around the world can vary both by product category and/or government entity. To facilitate comparisons, Table 3 presents the functions that would be available to game consoles in each of four potential operational modes, as inferred from existing language in European and U.S. EPA standards for consumer electronics and game consoles.

In its Recognition Program for Game Consoles, the U.S. EPA recognizes only two modes: Standby and Active. It should be noted that the EPA does not deny the existence of additional modes in game consoles (such as networked standby), but does not test or issue recognition based on performance in other modes. EPA does establish modal power limits for two of the functions available in Active mode, denoted by an asterisk below:

1. Navigation Menu Functions (EPA voluntary power limit 50 watts)
2. Game Functions
3. Streaming Media Functions (EPA voluntary power limit 40 watts)
4. System Maintenance and Download Functions

Because of the unique power requirements associated with providing each of the major functions available in Active mode, it is reasonable to regulate them individually, regardless of whether they are defined as “modes” or “functions as the EPA has done. By definition, game consoles’ primary purpose is to allow users to play video games. Therefore, it is reasonable not to place limits on the amount of power that consoles can draw to perform “game functions” since there is no way to anticipate the power that may be required by future innovations in the gaming industry. On the other hand, devices already exist for streaming media, providing a benchmark for regulating “streaming media functions” in game consoles.

As a result of these considerations, we suggest close consideration of the following modes, which are defined in this document as "modes" for convenience:

1. Standby
2. Networked Standby
3. Navigation
4. Streaming Media
5. Game Play

Table 3 Functions Permitted in Game Console Operational Modes Implied by Existing European Commission and U.S. EPA Standards

	Permitted Functions						
Mode	Ensuring Electromagnetic Compatibility	Charging	Device-Activated Maintenance and Downloads	Mode Indication	Information or Status Display	Remote Reactivation	Network Reactivation
Off	Yes	Yes	Yes	Yes	No	No	No
Standby	Yes	Yes	Yes	Yes	Yes	Yes	No
Networked Standby	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Active (includes Game Play, Media, Navigation, and other Applications)	Yes	Yes	Yes	Yes	Yes	NA	NA

Sources: Derived from European Commission Lot 26 Draft Regulation on Network Standby (EC 2013), European Commission Lot 6 Regulation of Standby and Off Mode (EC 2008); U.S. EPA Recognition Program for Game Consoles (EPA 2013).

2.2 How much power is used in each mode for each model currently in the market?

The power draw of game consoles in each mode are shown in Table 4. The unit energy consumption of game consoles in each mode is detailed in Table 5. The power draw of selected accessories is presented in Table 6.

Table 4 Game Consoles Power Draw by Mode

	Power Draw (watts)			
Mode	Wii	Wii U	Xbox 360 S	PlayStation 3
Game Play	14	35	78	71
Media	14	29	63	63
Navigation	12	32	65	68
Standby	1.3	0.5	0.4	0.3
Networked Standby	6	11	none	11

Source: Testing by NRDC, Ecova, and Energy Solutions in 2010 (Wii) November 2012 (Wii U) and April 2013 (Xbox 360 S, PlayStation 3).

Table 5 Game Consoles Sales- and Duty-Cycle Weighted Modal Energy Use

	Energy Use (kWh/year)	
Mode	Overall Average	Playstation 3 and Xbox 360 Only
Game Play	37.4	46
Media	21.2	26
Navigation	25.0	30
Standby	3.0	2.6
Networked Standby	5.1	2
Total	91.6	106.1

Source: Power from testing by NRDC, Ecova, and Energy Solutions (Table 2.2); Duty Cycle from CEA 2012 (Table 2.6); Sales from VGChartz for U.S. market January 1, 2012-mid April 2013 (Table 5.1).

Table 6 Power Draw of Selected Game Console Accessories

	Power Draw (watts)	
Console	**Wii U**	**Xbox 360 S**
Accessory	GamePad	Kinect
Power (watts)	2	3-6

Source: Measurements by NRDC, Energy Solutions, and Ecova in November 2012 (Wii U) and April 2013 (Xbox and PS3).

2.3 How much time is spent in each operating mode?

The results of a survey commissioned by the Consumer Electronics Association in 2010 on how game consoles are used (CEA 2010) are shown binned by mode in Table 7. The total time and fraction of time game consoles spend in each mode are summarized in Table 8.

Table 7. Game Console Active Uses

Use	Daily Usage (h)	Weekly Usage (h)	% of Active Time	% of Total Time	Bin
Games	1.66	11.6	53.8%	6.9%	Game Play
DVDs	0.37	2.6	12.1%	1.5%	Media
Music	0.26	1.8	8.3%	1.1%	Media
Internet	0.19	1.3	6.0%	0.8%	Media
HD-DVD or Blu-Ray	0.13	0.9	4.2%	0.5%	Media
Streaming Movies-Internet	0.09	0.6	2.8%	0.4%	Media
Streaming Movies-Local	0.09	0.6	2.8%	0.4%	Media
Other Active Uses	0.31	2.2	10.0%	1.3%	Navigation
Total Active Uses	3.08	21.6	100.0%	12.8%	
Inactive, But On	0.95	6.7		4.0%	Navigation
Total On	4.03	28.2		16.8%	
Total Off	20.0	139.8		83.2%	

Source: Compiled and binned by Energy Solutions based on results of survey commissioned by the Consumer Electronics Association (CEA 2010).

Table 8 Game Console Duty Cycle

Mode	Time Spent in Mode (%)			
	Wii	Wii U	Xbox 360 S	PlayStation 3
Game Play	7%	7%	7%	7%
Media	5%	5%	5%	5%
Navigation	5%	5%	5%	5%
Standby	41.5%[1]	83%	83%	78%
Networked Standby	41.5%[1]	0%[2]	0%[3]	5%[4]

Source: Derived from data in survey by the Consumer Electronics Association (CEA 2010; see also Table 2.5).

[1] Available usage data does not disaggregate non-active time between time spent in standby and networked standby modes, so in the absence of more specific information we propose assuming an even division between the two modes for Wii.

[2] Wii U can automatically download software in standby mode and in the future may be capable of being remotely triggered to perform other functions as well, but in the absence of more specific information, we propose assuming no time in networked standby.

[3] To date, the Xbox 360 S does not appear have a networked standby mode.

[4] Information from Sony suggests the networked standby feature is little-used, so in the absence of more specific information we propose assuming 5% of non-active time in Networked Standby for PlayStation 3.

2.4 Has usage changed from the past to present? How is it anticipated to change in the future?

There are two major trends in game console evolution:

1. Game consoles have supported increasing realistic gaming experiences, including higher quality graphics and more sophisticated, naturalistic, motion-based control mechanisms.
2. Game consoles have broadened the range of functions they provide for users, such as playing removable media, streaming video, or storing photos.

Both of these trends are likely to continue in the future as game consoles compete with mobile gaming and other devices for their share of consumers' screen time.

2.5 What are the factory default display and console power management settings?

Game consoles power management functions do include explicit settings for controlling the display power. PlayStation 3 is the only console that provides separate power management setting options for different modes. An Xbox 360 S randomly selected in April 2013 from a retailer in the Bay Area had auto power disabled as a default. Microsoft claims that their consoles are shipped with auto power down turned on and that this observation was the result of a temporary and unintentional production glitch. The default power management settings for the three current consoles are shown in Table 9.

Table 9. Default Power Management (Auto Power Down) Settings

Mode	Wii U	Xbox 360 S	PlayStation 3
Streaming Media	1	Off [1]	4
All Others			2

[1] Microsoft claims that their consoles are shipped with auto power down turned on and that this observation was the result of a temporary and unintentional production glitch.

2.6 What are the other power management settings?

Xbox 360 S does not provide an additional power management settings. PlayStation 3 provides the option of setting an auto power down inactivity duration for controllers, which is set to "off" by default.

2.7 What storage size is required to hold operations in a sleep state?

No response.

2.8 How much does it cost to implement an automatic sleep function on a per-unit basis? Are these costs associated with hardware or software?

No response.

2.9 Are all game console models in the current market shipped with auto power down enabled by default in all modes?

An Xbox 360 S randomly selected in April 2013 from a retailer in the Bay Area had auto power disabled as a default. Microsoft claims that their consoles are shipped with auto power down turned on and that this observation was the result of a temporary and unintentional production glitch.

2.10 To what extent do game consoles save games prior to auto power down?

No response.

2.11 Which setting do consumers typically choose when overriding the factory default auto power down setting?

2.11.1 Is the option to disable auto power down available in the out- of-the-box initial set up menu?

No, but the Wii U does display strong warning language and guidance on how to disable auto power down during initial setup (see Table 10).

2.11.2 What is the language manufacturers use to offer users the option of disabling auto power down?

Providing unnecessarily strong warnings and facilitating the ability to disable auto power down may lead to lower use of this important energy-saving feature. The language that consoles display to describe power management settings, including the option of disabling auto power down, are shown in Tables 10 and 11. Table 10 shows the language displayed during critical events, like initial startup. Table 11 shows the language displayed as the user navigates to the power management settings.

Table 10 Power Management Language in Game Consoles – Critical Events

Providing unnecessarily strong warnings and facilitating the ability to disable auto off may lead to lower use of this important energy-saving feature.

	Power Management Language Displayed		
Context	Wii U	Xbox 360 S	PlayStation 3
Initial Setup	To conserve energy, the Wii U console has been set to power down automatically if left unused for a 1-hour period. Please be aware that if the console powers down during a game, any unsaved data will be lost.	None.	None.
When Enabling Auto Power Down	If the console is idle for X hour(s), it will automatically power down. If the console powers down during a game any unsaved data will be lost.	None.	None.
When Disabling Auto Power Down	None.	None.	None.
Prior to Auto Power Down	None.	Your console will shut down soon.	The system will turn off soon because the [System Auto-Off] setting is enabled. This setting can be adjusted under [Settings] > Power Save Settings.
Resuming after Auto Power Down	The console automatically powered down during the last session, as it had not been used for more than 1 hour(s). You can change the automatic power-down wait time in System Settings => Auto Power Down.		

Table 11 Power Management Language in Game Consoles – Menus

Providing unnecessarily strong warnings and facilitating the ability to disable auto off may lead to lower use of this important energy-saving feature.

Menu Level	Display Type	Power Management Language Displayed		
		Wii U	Xbox 360 S	PlayStation 3
Level 1	Menu Title	System Settings	Settings	Settings
Level 2	Menu Title	Auto Power-Down	System	Power Save Settings
	Message	Activate this feature to have your Wii U console turn itself off after it has been idle for a certain time. • You can set the time before the console turns itself off for 1-12 hours. • Please be aware that if the power is turned off during a game, any unsaved data will be lost.	None.	None.
Level 3	Menu Title	Auto Power-Down	Console Settings	System Auto-Off
	Message	Would you like the Wii U console to turn itself off automatically if it sits idle for a set amount of time?	Change your Xbox 360 settings, including display, audio, language, and remote control.	Sets whether or not to automatically turn off this system. If you do not operate the system for a set amount of time, the system will turn off automatically.
Level 4	Menu Title	None.	Startup and Shutdown	Video/TV/Music Photo (option) Game/Other Features (option)
	Message	Set how long the console will wait before automatically powering down.	Set how long the Xbox waits before shutting down when there's no activity	For each feature below, set the amount of time that this system will wait before automatically turning off when you do not operate the system.
Level 5	Menu Title		Auto-Off	
	Message		Set how the long the Xbox waits before shutting down when there's no activity	
Level 6	Menu Title		Disable (value)	
	Message		Turn your console off after a period of inactivity.	

2.12 What are the energy use and performance characteristics of the media playback function of a game console?

As shown in Table 2.2 above, PlayStation 3 and Xbox 360 S stream high definition (1080p) video using about 63 watts, whereas Wii U uses under 30 watts.

2.13 How does media playback energy use compare with that of a standalone media player (e.g. DVD players, Blu-Ray Players, etc.)?

Blu Ray High Definition Video

- Stand-alone Blu-Ray players qualifying for the U.S. EPA's ENERGY STAR label can play high-definition video using under 10 watts.
- Blu-Ray Player Energy Consumption Available from EPA ENERGY STAR: http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=DP (EPA 2013b)

Streaming Video

- Apple TV can stream high definition video using less than 1 watt.
- Tear-Down Analysis of Apple TV: http://www.anandtech.com/show/6834/apple-tv-2013-a1469-short-review-analysis-of-a-new-a5 (Shimpi 2013)

3 Energy Saving Technologies, Components, and Features

3.1 What energy saving technologies or features are currently included in game consoles?

The Wii U, currently on the market, draws 30-32 watts during menu navigation, and 30-35 watts during game play with high-definition video, or about half of what the Xbox 360 S and PlayStation 3 draw (see Table 2.2).

3.1.1 How much energy does each save?

Like PlayStation 3 and Xbox 360 S, the Wii is capable of displaying high-definition video (1080p). If PlayStation 3 and Xbox 360 S consoles sold in 2012 had been as efficient as the Wii U in each mode of use (see Table 2.2), California would have saved approximately 29 GWh of electricity that year (even including greater energy consumption in networked standby, per Table 2.2 and Table 2.6). Savings were calculated as product of the following terms:

- PS3 and Xbox consoles sold in 2012 from Table 5.1
- Modal power use from Table 2.2; and
- Duty cycle from Table 2.6.

3.1.2 How much does each cost the manufacturer to implement on a per-product basis?

No response.

3.1.3 How common are they?

No response.

3.2 Which energy saving technologies or features could potentially be incorporated in game consoles?

Ouya, the upcoming new entrant into the game console market, points the way toward what is possible for energy efficient game consoles. Initial tests indicate that it draws under 5 watts of power during active game play, or less than 1/6 of the most efficient console currently on the market.

Report on Ouya Energy Consumption:
http://www.engadget.com/2013/04/03/ouya-review-founding-backer-edition (Stevens 2013)

Stand-alone electronic devices provide benchmarks against which the performance of game consoles providing similar functions can be measures. Stand-alone Blu-Ray players can play high-definition video from removable media using under 10 watts. Apple TV can stream high-definition video using less than 1 watt.

- Blu-Ray Player Energy Consumption Available from EPA ENERGY STAR: http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=DP (EPA 2013b)
- Tear-Down Analysis of Apple TV: http://www.anandtech.com/show/6834/apple-tv-2013-a1469-short-review-analysis-of-a-new-a5 (Shimpi 2013)

3.2.1 How much energy does each save?

No response.

3.2.2 How much does each cost the manufacturer to implement on a per-product basis?

No response.

4 Hardware Technology

4.1 How efficient are the power supplies of game consoles currently in the market (e.g. power input versus output)?

The power supply efficiency of Xbox 360 S and PlayStation 3 at different loading rates are shown in Table 12. The Wii and Wii U external power supplies are class A and therefore currently pre-empted by federal regulations (see section 1.4 for discussion).

Table 12 Power Supply Efficiency of Xbox 360 S and PlayStation 3

	Power Supply Efficiency (Output as % of Input Watts)	
Load (% max)	Xbox 360S (external multi-voltage)	PlayStation 3 (internal)[1]
20%		74.82%
25%	81.61%	
50%	83.50%	81.58%
75%	81.20%	
100%	83.87%	80.98%

Source: Tested by Ecova, April 2013.

[1] Tested ex-situ, with cooling from a fan powered by a source other than the power supply unit.

4.2 How efficient are they during Game Play mode?

The efficiency of power supplies during game play is presented in Table 13, based on the testing data shown in Table 12. The efficiencies of the Xbox 360 S and PlayStation 3 consoles during active game play are estimated to be approximately 83.0% and 78.5%, respectively. The Wii and Wii U external power supplies are class A and therefore currently pre-empted by federal regulations (see section 1.4 for additional discussion).

Table 13 Game Console Power Supply Summary

	Wii & Wii U	**Xbox 360S**	**PlayStation 3**
Power Supply Location	External	External	Internal
Power Supply Type	Class A, Level V	Non-Class A	
Current Regulation	Federal	None[1]	None[2]
Game Play Power (watts)	Not measured	78	71
Game Play PS Load (% max)	Not measured	56%	37%
Game Play PS Efficiency (output watts as % of input watts)	Not measured	**83.0%**[3]	**78.5%**[3]

Source: Tested by Ecova, April 2013.

[1] Anticipated to be covered in the upcoming DOE BCEPS rule, initially proposed in March 2012, effective 2015.

[2] Voluntary certification (80 PLUS®) administered by Ecova [Ecova 2013]).

[3] Interpolated linearly from testing data using two nearest load points (Table 3.1)

4.3 Are there challenges involved with using more efficient power supplies for game consoles? If so, what are they?

No response.

4.4 To what extent do manufacturers take advantage of existing performance scaling capabilities in console processors?

No response.

4.5 Do manufacturers engineer processors to adjust operating speed and energy consumption in relation to computing demand?

No response.

5 Market Characteristics

5.1 How many game consoles were sold in California in 2006 through 2011 and projected for 2012 through 2015 by brand and model?

The estimated game console sales in California are presented in Table 14. The rapid growth in sales in the early 2000s has become more uneven in recent years, potentially due to consumer fatigue with the previous generation of consoles. As a new generation of consoles is released by Nintendo, Sony, and Microsoft and new manufacturers enter the market, we expect total sales to return to approximately the rate seen soon after the launch of the last generation (~2 million units/year).

Table 14 Estimated California Game Console Sales 2005-2015

Year	Wii	Wii U	Xbox 360	PS3	Total
2005			68,140		68,140
2006	130,083		463,651	80,779	674,513
2007	779,580		530,943	296,387	1,606,910
2008	1,188,712		590,548	420,711	2,199,971
2009	1,087,437		579,117	504,747	2,171,301
2010	894,997		846,763	573,088	2,314,847
2011	590,099		930,628	542,785	2,063,512
2012	247,028	112,881[1]	673,323	415,377	1,448,610
2013					2,000,000[2]
2014					2,000,000[2]
2015					2,000,000[2]

Source: http://www.vgchartz.com, "USA Hardware By Platform," accessed March 29, 2013. California sales estimated by multiple U.S. sales by fraction of U.S. population in California (12%).

[1] Wii U went on sale in November, so the total here captures less than two months.

[2] Proposed assumption for total console sales following the launch of new consoles from Nintendo, Sony, Microsoft, and other new manufacturers.

5.2 What is the current estimated number of units in existing California stock by brand and model?

Since all three of the major console manufacturers released new platforms around 2005, consoles released before that are largely no longer in use (Hittinger, 2012). Assuming that users tend not to replace consoles belonging to the same generation due to minimal changes in functionality (see Section 1.6 for discussion) and ignoring replacement due to breakage, theft, or other loss, the total stock is approximately the sum of the yearly sales between 2005 and 2012, shown in Table 5.2, or about 12 million units.

5.3 If California-specific figures are unavailable, please provide U.S. figures.

The California-specific estimates presented in Table 14 were calculated by multiplying U.S. sales data by the fraction of the U.S. population in California (12%). The U.S. totals are shown in Table 15.

Table 15 U.S. Game Console Hardware Sales 2005-2012

Year	Wii	Wii U	Xbox 360	PS3	Total
2005			563,282		563,282
2006	1,075,329		3,832,778	667,762	5,575,869
2007	6,444,409		4,389,044	2,450,089	13,283,542
2008	9,826,502		4,881,772	3,477,812	18,186,086
2009	8,989,309		4,787,281	4,172,494	17,949,084
2010	7,398,500		6,999,773	4,737,437	19,135,710
2011	4,878,060		7,693,050	4,486,935	17,058,045
2012	2,042,064	933,131	5,566,035	3,433,720	11,974,950
Total	**23,426,249**	**40,654,173**	**933,131**	**38,713,015**	**103,726,568**

Source: http://www.vgchartz.com, "USA Hardware By Platform," accessed April 26, 2013.

5.4 To what extent is the game console market uniform or different in the state, country, continent, and world?

No response.

5.5 How many small businesses are involved in the manufacture, sale, or installation of these products?

No response.

6 Market Competition for Efficient Products

6.1 What are the current market drivers initiating the improvement of game console efficiency?

No response.

6.2 How are consumers identifying the most and least efficient products on the market?

No response.

6.3 Which game console models currently meet the EPA Recognition Program 1.0 criteria (organized through ENERGY STAR)?

No response.

7 Any other information relevant to this proceeding

No response.

8 References

(References attached separately are highlighted in grey)

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