Miercom

Lab Testing Summary Report

June 2010
Report 100104B

Key findings and conclusions:

- **HP A5820-24XG switch saves up to 44% in annual energy costs when compared to Industry Average**

- **A5800 Series Switches are up to 15 % more energy efficient than comparable switching products**

- **Line rate Layer 3 switching with no additional energy consumption (~0.2 watts) for both L2 v L3 traffic**

- **Management interface enables energy saving features with port operation scheduling and speed throttling**

- **Support for Intelligent Management Center (IMC) allows efficient and effective network administration**

Product Category:

Energy Efficient Switches

Vendor Tested:

hp

Products Tested:

**HP A5820-24XG
HP A5800-24G-PoE
HP A5800-48G
HP A5800-48G-PoE**

Miercom CERTIFIED GREEN™

Hewlett-Packard* A5800 Series and A5820 Switches were evaluated by Miercom under the Certified Green Program for power consumption and energy efficiency. We analyzed the overall environmental impact and business enabling green benefits that this series of switches offers to its customers.

In hands-on testing and analysis of the HP A5800-24G-PoE, A5800-48G, A5800-48G-PoE and A5820-24XG, the switches proved to afford customers a highly economical, manageable and energy efficient Layer 2 and Layer 3 switching solution. Utilizing the latest silicon technology and energy efficient design, the HP A5800 Series Switches leverages its green feature to promote environmentally sound network products.

Models A5800-24G-PoE and A5800-48G-PoE are IEEE standard 802.3at-2009 (PoE+) Type 2 Power Sourcing Equipment (PSE) switches which have an advantage of supplying
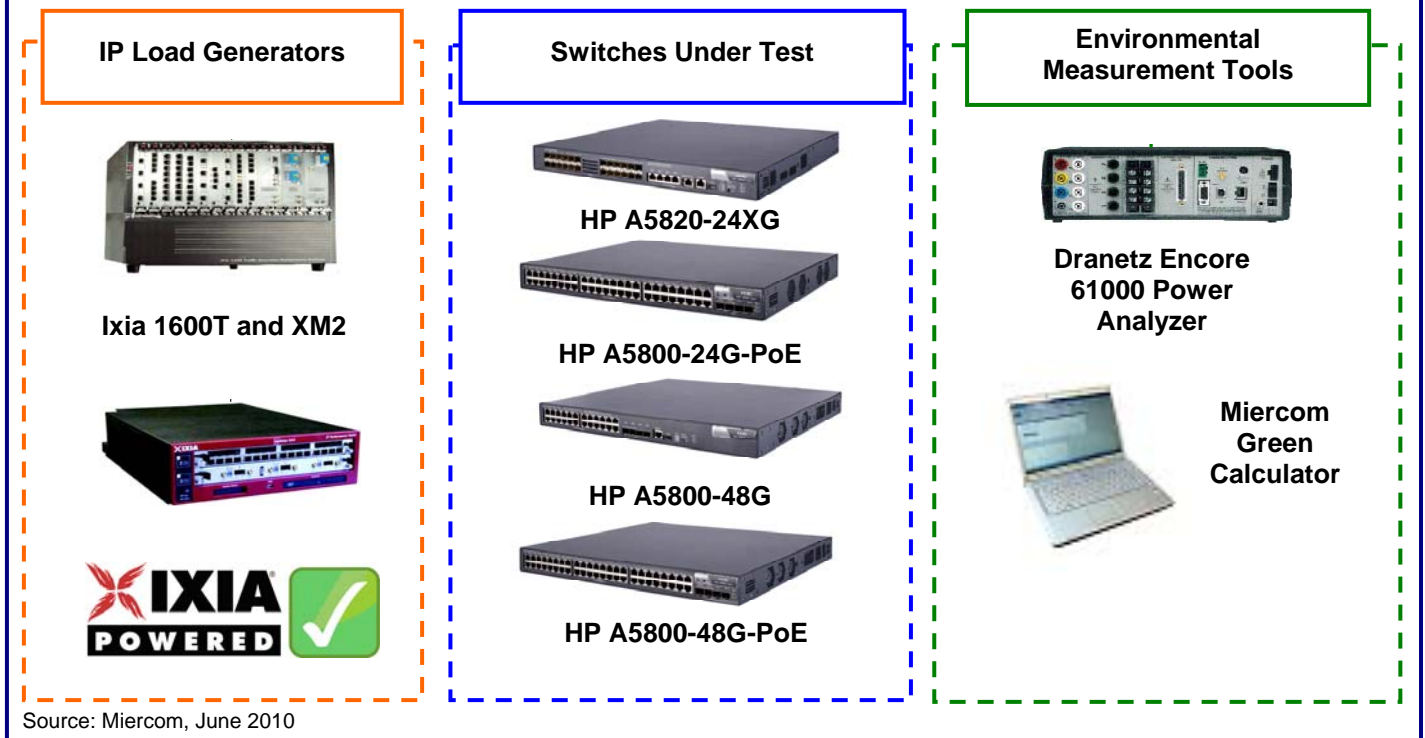

Figure 1: HP A5800 Series Switches Annual Energy Cost
All ports loaded, IMIX pattern, typical load
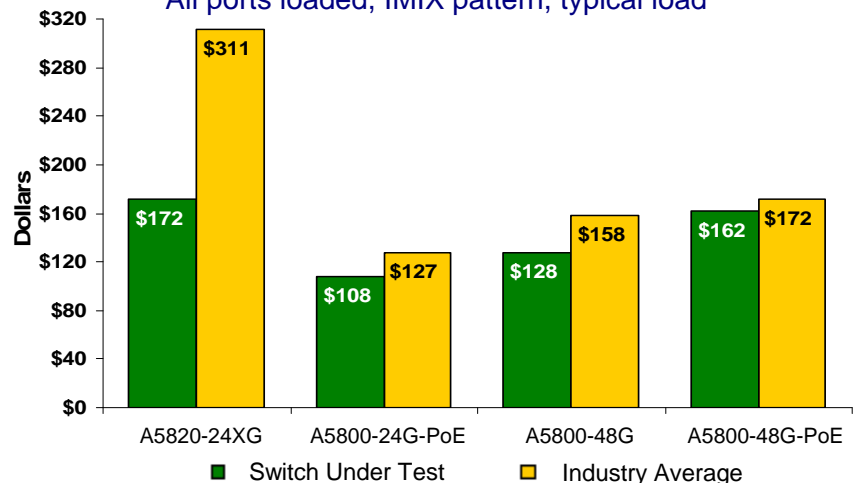
Source: Miercom, June 2010

Projected annual energy costs for HP A5800 Series and A5820-24XG show better efficiency than the Industry Average for switching products within a comparable product class. See the Business Case section on page 7 for additional details and calculations.

Test Bed Diagram

IP Load Generators	Switches Under Test	Environmental Measurement Tools

IP Load Generators

Ixia 1600T and XM2

Switches Under Test

HP A5820-24XG

HP A5800-24G-PoE

HP A5800-48G

HP A5800-48G-PoE

Environmental Measurement Tools

Dranetz Encore 61000 Power Analyzer

Miercom Green Calculator

Source: Miercom, June 2010

How We Did It

The HP A5800-24G-PoE, A5800-48G, A5800-48G-PoE, A5820-24XG switches were evaluated for environmental impact by looking at the individual components as well as features and capabilities. Layer 2 and Layer 3 power consumption was measured by configuring 48 1Gbps ports and four 10Gbps SFP+ ports for both HP A5800-48G and -48G-PoE switches. The measurements were taken with and without PoE. 24 1Gbps ports and four 10Gbps SFP+ ports were used for the HP A5800-24G-PoE tests with and without PoE. Layer 2 testing was performed using 24 10Gbps SFP+ ports and four 1Gbps ports for the HP A5820-24XG switch.

Audit results were verified with site survey assessments. Tests included measuring changes in power consumption by scheduling the independent ports for power down and configuring them for rate changes via GUI. Power consumption was measured at idle link with no traffic, 70% and 100% loads.

Power Consumption Measurement: The power consumption of HP A5800 Series and A5820-24GX switch ports were measured at varying network and link loads that the switch would typically experience in a real world deployment. Power consumption was measured using a Dranetz Encore 61000 Power Analyzer from New Jersey based, Dranetz-BMI (www.dranetz-bmi.com). The SUT was loaded with traffic at various rates and packet sizes in accordance with RFC 2544 Benchmarking Methodology for Network Interconnect Development.

Power consumption measurements were taken during system boot-up, idle in link-up and link-down mode, and with 70% and 100% load. Power consumption was measured, while running Layer 2 traffic with an XM2 and 1600T traffic generators from Ixia (www.ixiacom.com). Traffic was applied to each of the 1 Gbps ports while stressing the product with supported features. All power measurements were taken at 110 volts and 60 Hz frequency. Frequency was also regulated at 50Hz and 60Hz to test actual power provided in other countries. In addition to it, power measurements were also taken for varying frame size from small to jumbo size to analyze the change in power consumption.

Miercom recognizes Ixia as an industry leader in energy efficiency testing of networking equipment. Ixia's unique approach utilizes coordination of energy measurements with network traffic load – allowing energy consumption to be graphed against network traffic volume. Real-world traffic is generated by Ixia's test platform and test applications, principally IxNetwork for layer 2-3 routing and switching traffic and IxLoad for layer 4-7 application traffic.

Environmental Analysis: Miercom's environmental review of the HP A5800-24G-PoE, A5800-48G, A5800-48G-PoE, A5820-24XG switches also included an examination of the company-wide and product-specific environmental impact reduction efforts. Analysis also includes comparisons to Industry Average for similar competitive products.

up to 25.5W to a PoE Powered Device (PD). These switches have 24 and 48 1-GbE ports and four additional 10-GbE SFP+ ports respectively. A5800-56C does not support PoE. HP A5820-24XG has 24 10-GbE SFP+ ports and four 1-GbE ports. See switch details in *Figure 2* below.

The annual cost of running the HP A5800 and A5820 Series Switches was compared to an Industry Average of similar switches and is shown in *Figure 1* on page 1.

The A5820-24XG switch costs $172 per year to operate 24 10GbE SFP+ ports, a savings of $139. Other HP A5800 Series Switches offer cost saving from $10 to $30 per model. An explanation of the cost is described on page 7, under "Business Case."

The HP A5800 and A5820 Series provide 1-GbE and 10-GbE port density with a high availability architecture that handles Layer 2 and Layer 3 traffic at line rate, and supports IPv4 and as well as IPv6.

Figure 2: Hewlett-Packard Switches

Product	A5820-24XG	A5800-24G-PoE	A5800-48G	A5800-48G-PoE
Form/design	Rack	Rack	Rack	Rack
Internal Power	1	1	1	1
Redundant Power	1	1	1	1
Fan/module	3	6	4	6
Hot Swap fans	yes	no	no	no
PoE Power	NA	30W	NA	30W
Switch Ports	24-10G SFP+; 4 - 1G	24 -1G PoE; 4-10G SFP+	48 -1G; 4-10G SFP+	48 -1G PoE; 4 - 10G SFP+
Operating Temp	0-45º C	0-45º C	0-45º C	0-45º C
Watts - Idle with links up	157.8	98.91	116.64	147.47
Annual cost*	$172	$108	$128	$162

* Annual running cost is based on 12.5¢ kWh; for 12 hours daily with varying CPU utilizations. See Business Case on page 7 for details.

The switches use Intelligent Resilient Framework (IRF) to enable the creation of a resilient virtual switching fabric. IRF delivers geographic independence, distributed high availability and resiliency by extending the control plane across multiple active switches. IRF convergence technology includes Spanning Tree Protocols (STP) and Virtual Router Redundancy Protocol (VRRP). IRF allows an enterprise to collapse their network architectures from three- to two-tiers and eliminates the additional network layers, thereby reducing end-to-end latency.

Power Consumption

The power consumption of the HP A5800-24G-PoE, A5800-48G, A5800-48G-PoE and A5820-24XG switches was measured at idle with link-up, 70% and 100% network utilization with Layer 2 and Layer 3 traffic.

To verify the accuracy of the power consumption, measurements were recorded with various loads and frame sizes from 64 to 9216 bytes. Power measurements were recorded from off through standby modes, idle in link-up and link-down mode. Power measurements were made at typical 70% load and maximum 100% load at a voltage of both 110V and 220V for Layer 2 and Layer 3 traffic.

A5820-24XG

This switch has 24 SFP+ 10-GbE ports and four 10/100/1000BASE-T ports creating a total switch capacity of 488 Gbps. Power consumption for this switch ranged from 157.80 at idle to 161.37 with 512 byte frames and 100% utilization *(see Figure 3 on page 4).*

A comparison of power consumption at Layer 2 and Layer 3 to the Industry Average (IA) shows the switch consumes 127 watts less than the IA of 287.55 watts *(see Figure 4 on page 4).*

A5800-24G-PoE

HP A5800-24G-PoE has 24 10/100/1000 Base-T PoE ports and an expansion slot that can take a range of modules up to a capacity of four 10-GbE SFP+ ports providing a switching capacity of 208 Gbps. We measured the power consumption for the switch at 70% and 100% load for different frame sizes at Layer 2 and Layer 3. There was no PoE power consumption during this measurement.

At idle, 98.91 watts was recorded which increased by a maximum of 1.65 watts using 512-byte Layer 3 traffic at 100% load. As expected, when the frame size was increased power consumption decreased for both Layer 2 and Layer 3 traffic. The power consumption for the switch was 17 watts less than Industry Average recorded at 117.6 watts *(see Figure 4 on page 5)*.

A5800-48G

This switch has 48 10/100/1000 Base-T and an expansion slot that can take a range of modules up to a capacity of four 10-GbE SFP+ ports providing a total switching capacity of 256 Gbps. We measured the power consumption for the switch at 70% and 100 % load for different frame size with Layer 2 and Layer 3 traffic. At idle status with all links up, 116.64 watts were used and then increased to 119.60 watts for Layer 3 with 512 byte frames at 100% network utilization (*see Figure 3 on page 4).*

As we increased the frame size, the power consumption decreased for both Layer 2 and Layer 3 at 70% and 100% load. The switch consumed 28 watts less than IA of 147.67 watts as shown in *Figure 4 on page 5.*

A5800-48G-PoE

This switch has 48 1-GbE (10/100/1000 Base-T) PoE ports and an expansion slot that can take a range of modules up to a capacity of four 10-GbE SFP+ ports providing a switching capacity of 256 Gbps. We measured the power consumption for the switch at 70% and 100% load with different frame sizes at Layers 2 and 3.

At idle with links up, 147.47 watts were used. A total of 149.88 watts was used with 512-byte Layer 3 traffic at 100% load. An increase in the frame size decreased the watts used in all cases. The power consumption for the switch was 149.7 watts compared to the IA of 160 watts *(see Figure 4 on page 5)*.

Each switch in the A5800 Series used less energy than Industry Average since they use the latest silicon to allow ports to be powered down if not connected, and lower power usage for cables that are not at the maximum length.

Product Efficiency

The HP A5800 series family has 3 switch models: -24G-PoE, -48G and -48G-PoE. Each switch has the ability to pass and route IPv4 and IPv6 traffic at line rate. As a dual stack platform, the switches are IPv4 and IPv6 ready, and support Layer 3 routing and multicast protocols.

The A5800 Series has 1RU and 2RU platforms with 10-GbE and 1-GbE copper and/or fiber connectors. There is one internal non-replaceable power supply in the A5800-48G, -24G-PoE and -48G-PoE switches. They each support one external redundant power supply. Non-PoE devices have four internal non-replaceable fans, while the PoE devices have six internal non-replaceable fans.

The A5820-24XG, also 1RU, is ideal for server-to-server backup and has a hot swappable fan tray which can be replaced without restarting the equipment, which increases the network uptime and facilitates the maintenance. The A5800 Series supplies power through PoE and data over

Figure 3: HP A5800 Series Switches Power Consumption Relative to Load
All ports loaded, 512 byte frames, specific loads

	Idle	70% Load		100% Load	
		Layer 2	Layer 3	Layer 2	Layer 3
Model:	Watts				
A5820-24XG	157.80	159.72	160.50	160.65	161.37
A5800-24G-PoE	98.91	99.89	100.02	100.43	100.56
A5800-48G	116.64	118.35	118.54	119.40	119.60
A5800-48G-PoE	147.47	148.87	149.14	149.71	149.88

Comparison of power consumption for both Layer 2 and Layer 3 traffic with 512 byte frames and at 70% and 100% network utilization. There was Minimal power consumption difference observed between Layer 2 and Layer 3 traffic. PoE devices were not attached during testing.

a single cable, lowering network wiring and management expenses, and facilitating deployment of network attached devices where separate power cabling would be physically inefficient and cost prohibitive.

A5800-24G-PoE and -48G-PoE switches supply 30 watts for PoE devices. Built-in support for AC and DC powered operations allows the enterprise to leverage existing power schemes and cost effectively extend power to the edge of network. Using Intelligent Resilient Framework (IRF) technology and Rapid Ring Protection Protocol (RRPP), local or geographically distributed A5820X series can be interconnected to deliver higher resiliency and performance to ensure business connectivity and effective disaster recovery.
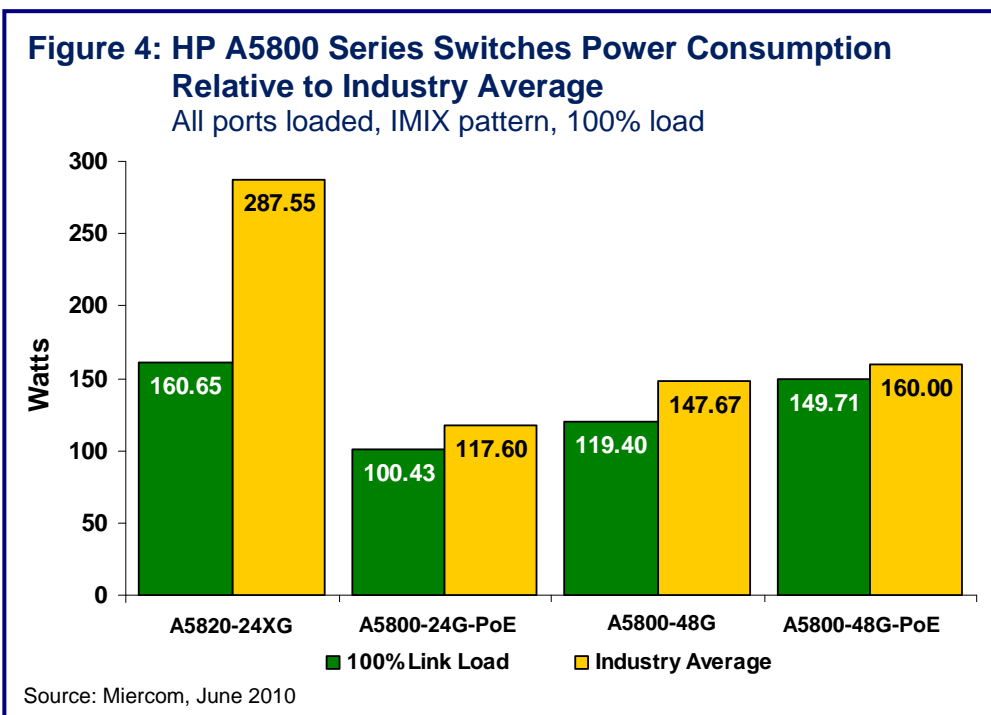
We observed that the switches supporting PoE had a management GUI allowing PoE power to be disabled according to schedule, and allow port selection for PoE. *Figure 5 on page 7* is a screenshot of the switch GUI showing the Energy Saving feature. Administrators can schedule to disable, enable, throttle speed and shutdown the ports anytime. This feature provides additional power savings since ports can be shut-off or speed reduced.

The A5800 Series and A5820 switch operate between 0-45º C (113 ºF) *(see Figure 2 on page 3).* Since these switches can operate at higher temperatures, cooling requirements for the data center are reduced. This is an additional operational energy savings.

HP uses an Intelligent Management Center (IMC) to manage, monitor and control Enterprise class networks. The IMC included administrative control, resource management, performance and event management, reporting, VLAN management, ACL management and Network traffic analysis. The system administrator controls which users are allowed to manage devices and groups of devices, and can restrict the user operations that users can perform. We saw that there was access to a full audit trail that had details of all network changes with identification. Power consumption was analyzed with this tool and it can accommodate any power saving device from any interoperable vendor.

Other product efficient characteristics include an automatic power down option that is activated by the port when the port is not active; forced port speed negotiation where port speed is limited to a specific value; fan speed auto adjustment with temperature sensor that allows fan speed to be controlled and run at a slower mode; and a time based power saving feature of a timer setting where both the port and PoE power can be enabled or disabled. A low power SPF+ design enables the switches to use less energy since this design avoids the high-energy needs of XFP and X2 requirements.

Figure 4: HP A5800 Series Switches Power Consumption Relative to Industry Average
All ports loaded, IMIX pattern, 100% load

Switch	100% Link Load	Industry Average
A5820-24XG	160.65	287.55
A5800-24G-PoE	100.43	117.60
A5800-48G	119.40	147.67
A5800-48G-PoE	149.71	160.00

(Y-axis: Watts, 0 to 300)

Source: Miercom, June 2010

Based on 512 byte frames and 100% network link utilization, this chart displays the power consumption for the switches under test compared to the Industry Average (IA). As shown, HP A5820-24XG consumes 44% less, A5800-24G-PoE 14.6% less, A5800-48G 19.1% less, and A5800-48G-PoE 6.4% less than the Industry Average.

Business Processes

IMC provides network management and administration through a single console interface. This enables end-to-end business administration by combining traditionally separate management tools, policy management, and 3rd party device management for more effective and efficient network administration.

Green Innovation

Hewlett-Packard implements the newest ASICs which enable switch products with the latest advances in silicon technology to deliver critical data center features and performance, while providing reductions in power usage. Temperature management is included on each I/O module to allow dynamic control of the speed of the cooling fans per module.

The switches use IRF, a technology which provides distributed high availability and resiliency by extending the control plane of multiple active switches in different geographic locations. IRF eliminates the need for complex redundancy technologies, such as Spanning Tree Protocol (STP) or Virtual Router Redundancy Protocol (VRRP). Enterprises can collapse their network architecture from 3 to 2 tiers, eliminating the associated power costs, and reducing network latency while improving performance.

Affiliations and Standards

Hewlett-Packard is an active member of Energy Efficient Ethernet and drives the standards for more energy efficient design and development. Hewlett-Packard is the founding sponsor and member of Green Grid. Hewlett-Packard is a strong proponent of standards based design, utilizing standards based Link Layer Discovery Protocol (LLDP), supporting dynamic power allocation, resulting in increased energy efficiency.

Hewlett-Packard products are compliant with RoHS and exceed the international standards. The affiliations mentioned help Hewlett-Packard to innovate based on "standards based design" and point to the credibility Hewlett-Packard products and solutions have in the industry.

Business Case

An annual power savings for up to 45% is calculated for the A5800 Series Switches tested. The annual usage of the switch is based on being deployed 12 hours per work day each week. During 60 working hours, 10 hours will be running at 100% load and 50 hours at 70% load. Weekends and the remaining 12 hours per day are idle/ready for a total of 108 hours per week. Annual cost is calculated by multiplying kilowatts by total hours; and then by 12.5 cents per kWh.

Figure 5: HP A5800/A5820-24XG Series Power Efficiency Relative to Performance Throughput
All ports loaded, jumbo frames (9208 bytes), 100% load
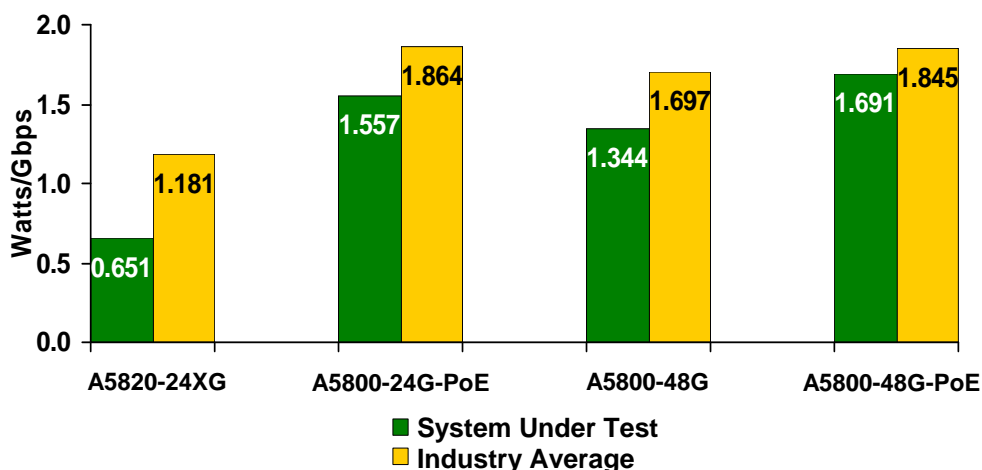
This chart illustrates the power consumption relative to performance throughput for the switches under test compared to the Industry Average (IA). As shown, A5820-24XG consumes 57% less, A5800-24G-PoE 28.2% less, A5800-48G 47% less, and A5800-48G-PoE 6% less than the Industry Average for power consumption relative to throughput for switches in this class.

Source: Miercom, June 2010

Miercom Certified Green

The energy-saving attributes of Hewlett-Packard's Switch Models A5820-24XG, A5800-24G-PoE, A5800-48G and A5800-48G-PoE were evaluated by Miercom in accordance with the Certified Green Testing Methodology. The products achieved sufficient scores in each of the rated criteria to achieve the Miercom Certified Green Award.

Based on our hands-on testing and the verified representations made by HP, Miercom confirms that Hewlett-Packard's Switch Models A5820-24XG, A5800-24G-PoE, A5800-48G and A5800-48G-PoE are designed to provide enterprise customers effective and environmentally friendly solutions.

HP A5820-24XG

HP A5800-48G

HP A5800-24G-PoE

HP A5800-48G-PoE

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