



# Storage Systems Can Now Get ENERGY STAR Labels and Why You Should Care

**Dennis Martin**  
**President, Demartek**



- **About Demartek**
- **Energy Efficiency in the Home and in Data Centers**
- **Power Supplies**
- **SNIA Emerald Specification**
- **EPA ENERGY STAR Data Center Storage**
- **Demartek Experience Running Emerald/EPA Tests**
- **Demartek Free Resources**



Click to view this one minute video  
(available in 720p and 1080p)

**Demartek YouTube Channel:**

**<http://www.youtube.com/user/Demartek/videos>**

**[http://www.demartek.com/Demartek\\_Video\\_Library.html](http://www.demartek.com/Demartek_Video_Library.html)**

- Industry Analysis and ISO 17025 accredited test lab
- Lab includes enterprise servers, networking & storage (DAS, NAS & SAN)
- We prefer to run real-world applications to test servers and storage solutions (databases, Hadoop, etc.)
- Demartek is an EPA-recognized test lab for *ENERGY STAR Data Center Storage* testing
- Website: [www.demartek.com/TestLab](http://www.demartek.com/TestLab)



Is this your  
man-cave?

“Tonight, an in-depth look at what each of us can do to help conserve electricity.”

# Home vs. Data Center

## ➤ Electric Power Usage Comparison

### ➤ Home

- ◆ Install more power-efficient devices
- ◆ Devices usually have one power supply
- ◆ Some devices always on
- ◆ Turn off devices when not in use

### ➤ Data Center

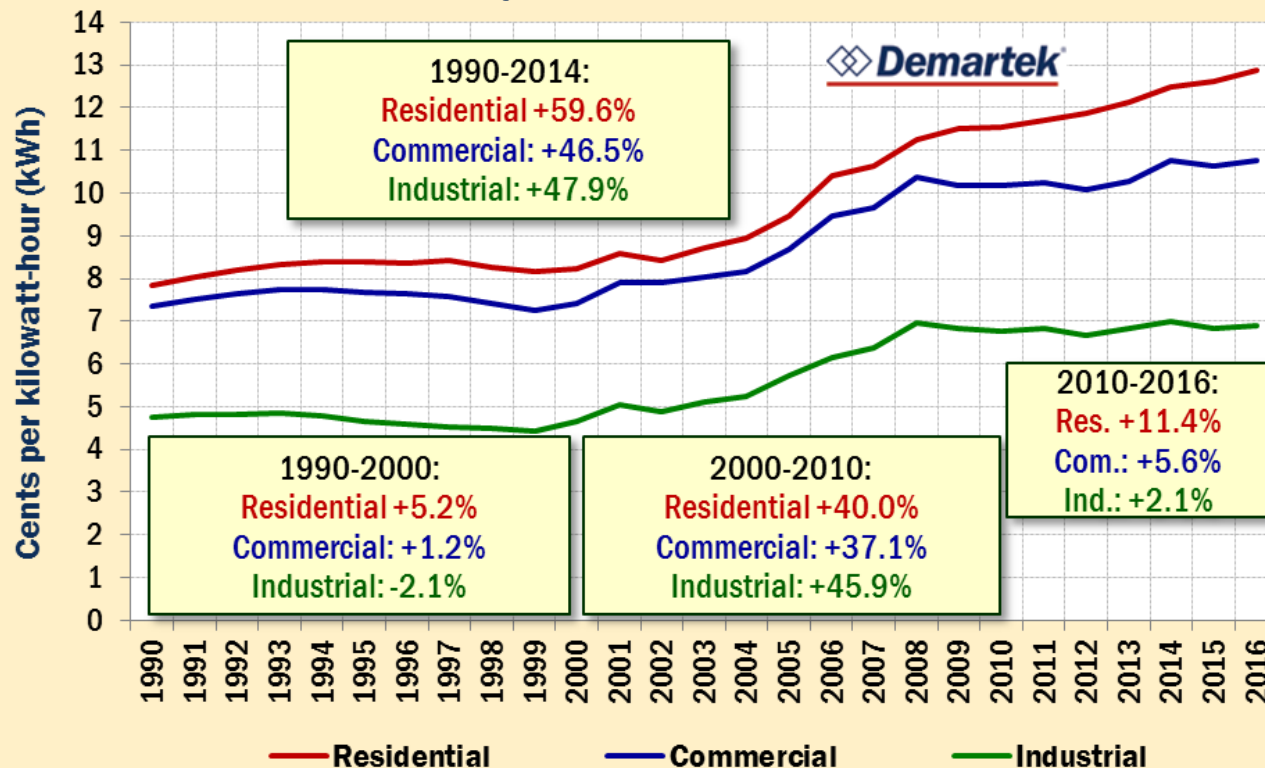
- ◆ Install more power-efficient devices
- ◆ Devices usually have redundant power supplies
- ◆ Most devices always on
- ◆ Achieve 99.999% uptime

**Home and Data Center have divergent requirements with respect to electric power consumption**

# Electricity Price Trends

## Average US Electricity Retail Prices

Updated March 2015



Yearly average increase,

**1990-2014:**

**Res. 1.97%**

**Com. 1.60%**

**Ind. 1.64%**

Prices tend to be above average in New England, the middle Atlantic States, California, Alaska and Hawaii.

Prices can fluctuate during different times of day.

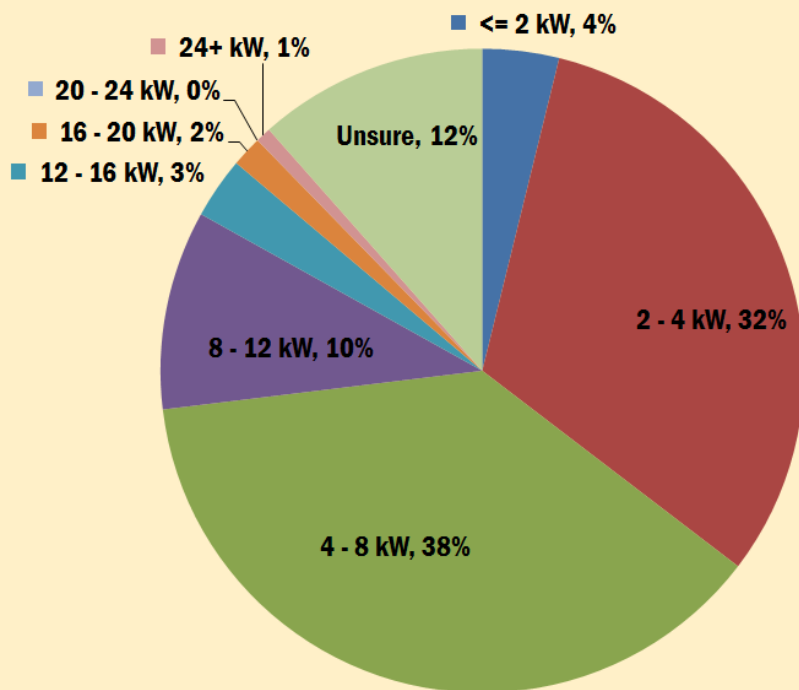
Source: US Energy Information Administration. Actuals through 2014. Projections start in 2015.

- **Nearly three million data centers in the USA today**
  - ◆ Source: National Resources Defense Council (NRDC)
- **Data center equipment is becoming more dense**
  - ◆ New server designs with more processors and memory per rack unit
  - ◆ Increasing use of 2.5-inch drives for storage
- **Increases in density of equipment in racks have implications for cooling, noise, arrangement of equipment and relationship to the power company.**



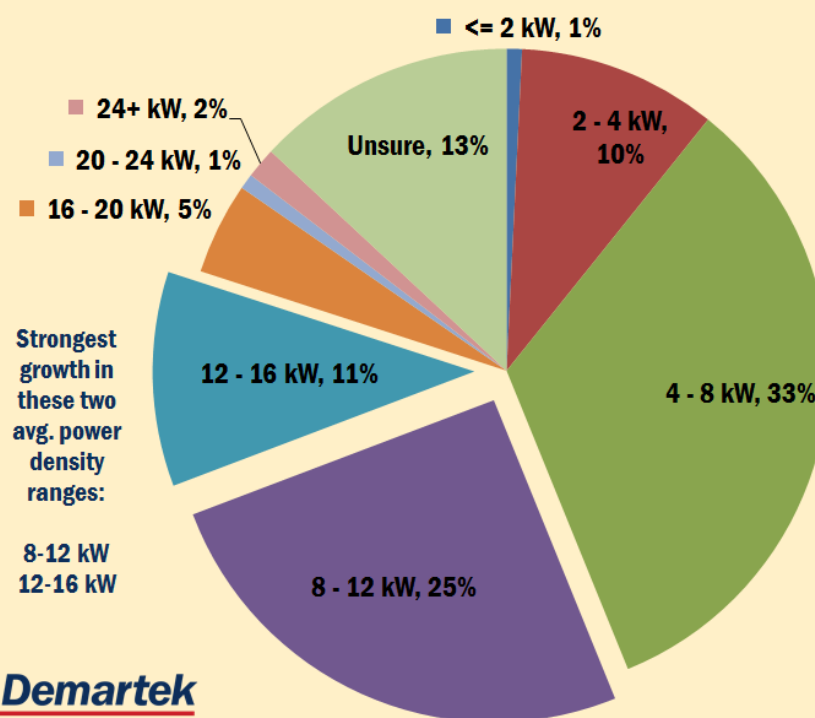
# Growth of Average Power Density Per Rack

## Average Power Density per Rack 2014



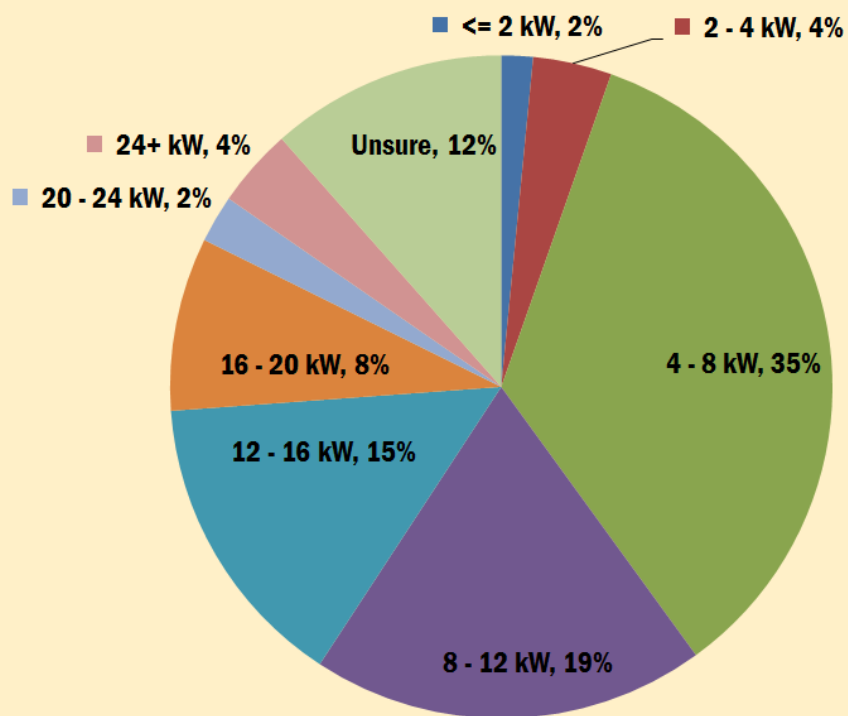
Source: DCUG Survey, October 2014

## Average Power Density per Rack 2016, projected

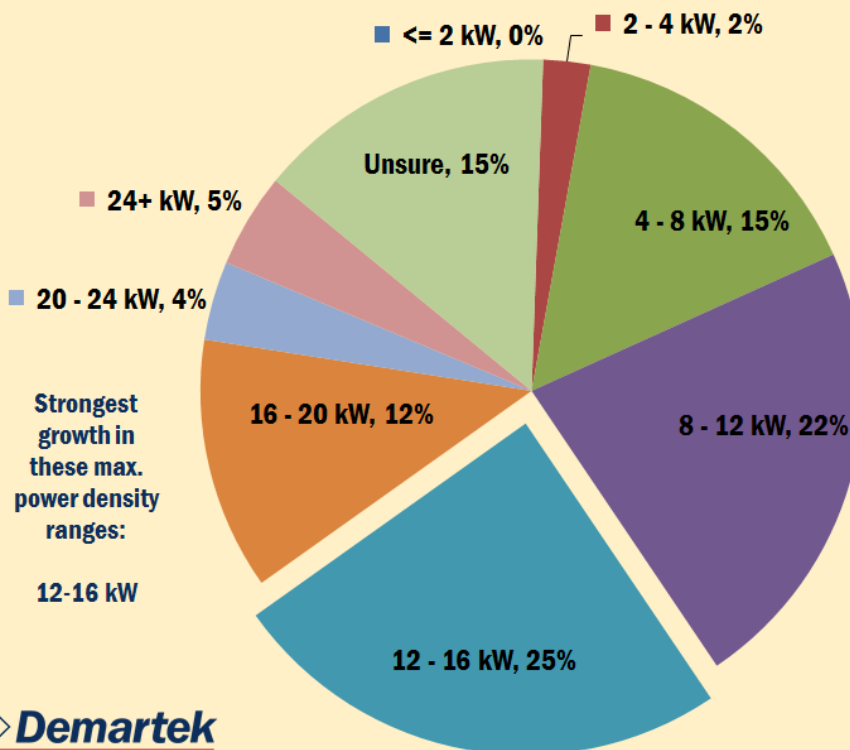


# Growth of Maximum Power Density Per Rack

## Maximum Power Density per Rack 2014



## Maximum Power Density per Rack 2016, projected



Source: DCUG Survey, October 2014



# Data Center Power: PUE and DCiE

➤ Developed by the Green Grid

➤ PUE = Power Usage Effectiveness

➤ DCiE = Data Center infrastructure Effectiveness

$$PUE = \frac{\text{Total Facility Energy}}{\text{IT Equipment Energy}} \qquad DCiE = \frac{1}{PUE}$$

➤ The ideal PUE is 1.0, but very difficult to achieve

- ◆ A PUE of 2.0 means that for every 2 watts of power delivered to the data center, 1 watt reaches the computing equipment
- ◆ Some large-scale datacenters have PUE as low as 1.06, 1.12, etc.

➤ PUE measures the entire data center as a whole

- ◆ PUE does not address efficiency of individual IT devices
- ◆ Individual IT devices could have low power efficiency

- **Power supply efficiency measures how efficiently power is delivered from the “wall power” to the components inside a computing device such as a server or storage system.**
  - ◆ A 60% efficient power supply will draw 1000 watts from the grid in order deliver 600 watts to the components inside the computer or storage system. The other 400 watts would be wasted as heat.
  - ◆ Higher efficiency power supplies waste less energy, are cooler and quieter, resulting in lower OPEX.
- **Reducing OPEX is increasingly important.**

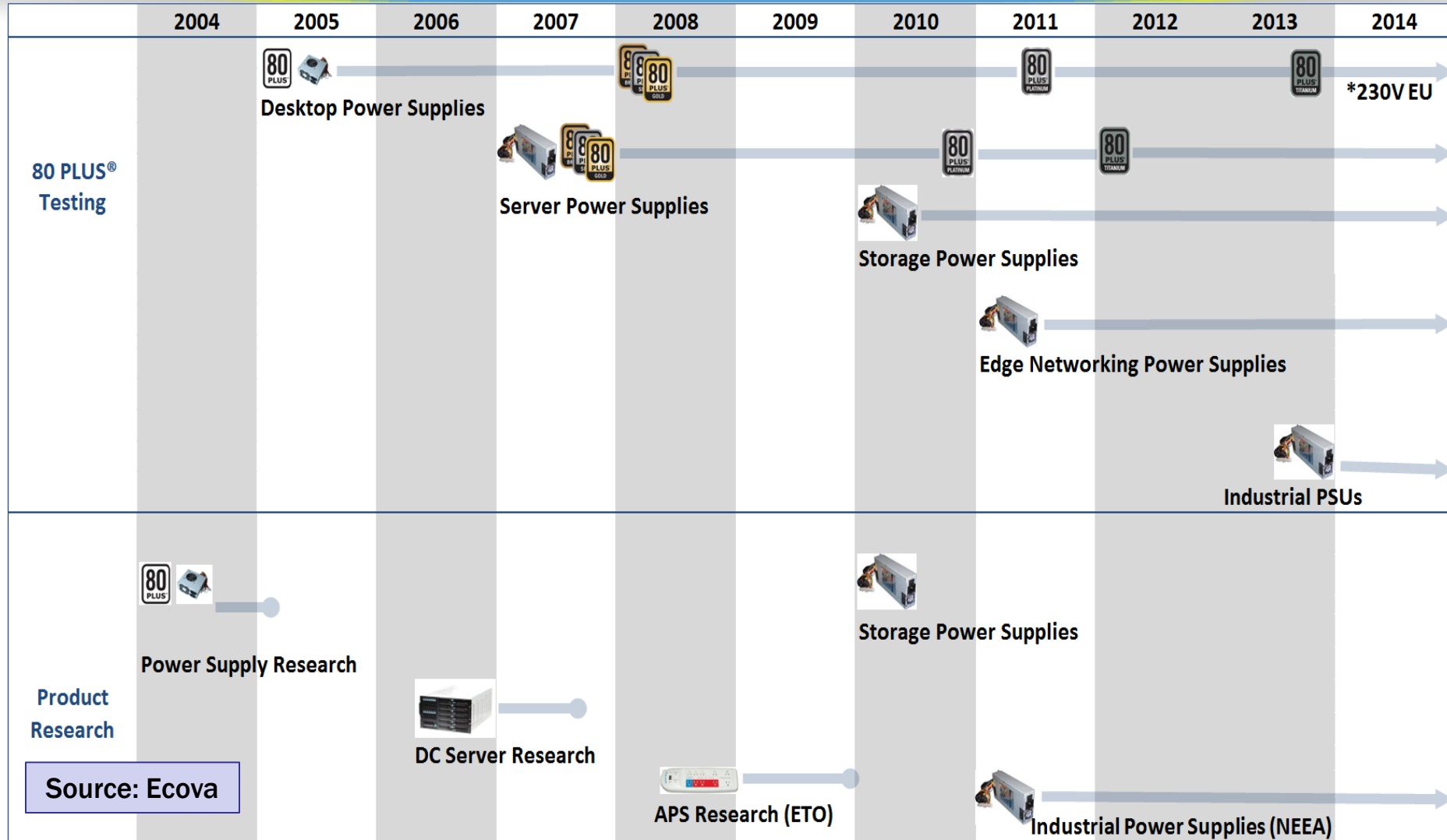
# 80 PLUS



- Started in 2004
- A voluntary certification program
- Certifies that power supplies are at least 80% efficient at 20%, 50% and 100% of rated load.
- Power factor of 0.9 or greater at 100% load
- Measured at 115v and 230v



# 80 Plus History



Source: Ecova

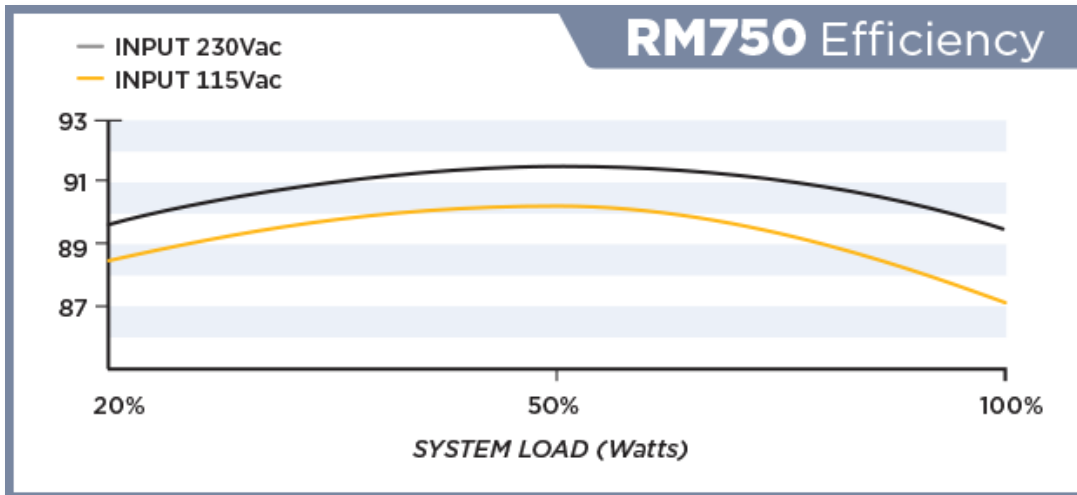
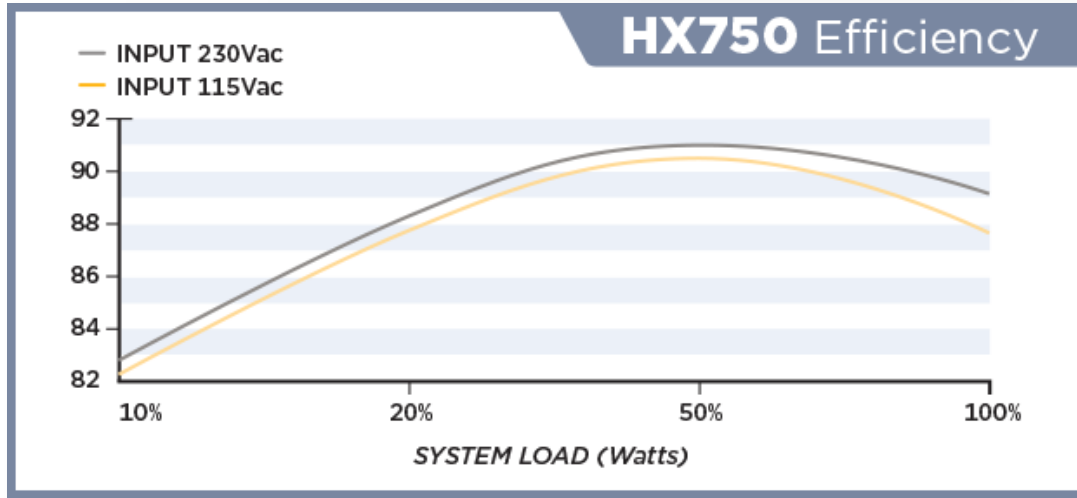
# 80 Plus Ratings



Demartek®	115v Internal Non-Redundant				230v Internal Redundant			
% of Rated Load	10%	20%	50%	100%	10%	20%	50%	100%
80 PLUS	—	80%	80%	80% PFC.90	—	—	—	—
80 PLUS Bronze	—	82%	85% PFC .90	82%	—	81%	85% PFC .90	81%
80 PLUS Silver	—	85%	88% PFC .90	85%	—	85%	89% PFC .90	85%
80 PLUS Gold	—	87%	90% PFC .90	87%	—	88%	92% PFC .90	88%
80 PLUS Platinum	—	90%	92% PFC .95	89%	—	90%	94% PFC .90	91%
80 PLUS Titanium	90%	92% PFC .95	94%	90%	90%	94% PFC .95	96%	91%

# Power Supply Efficiency Variations

➤ Two different models of 750 watt supplies, same vendor



Both are rated  
80 PLUS Gold.

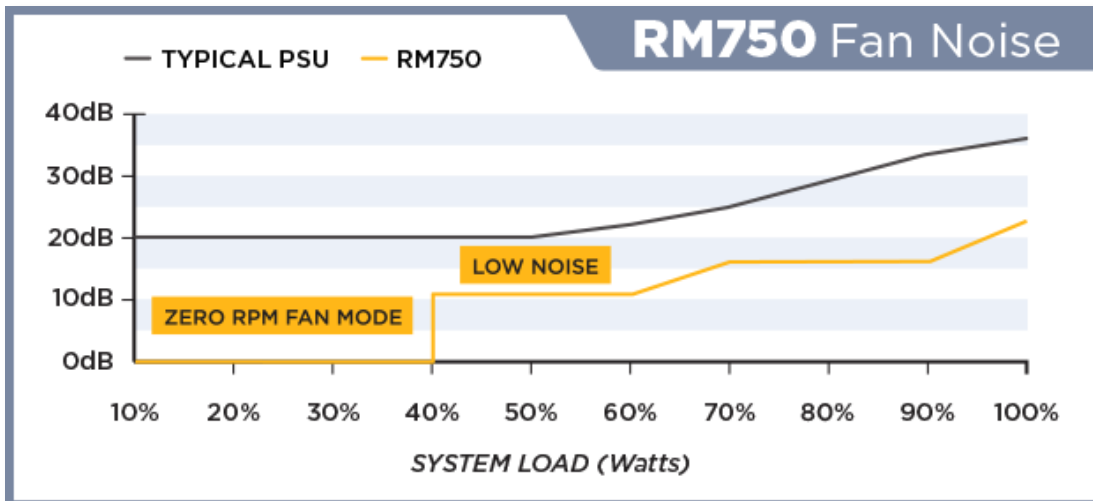
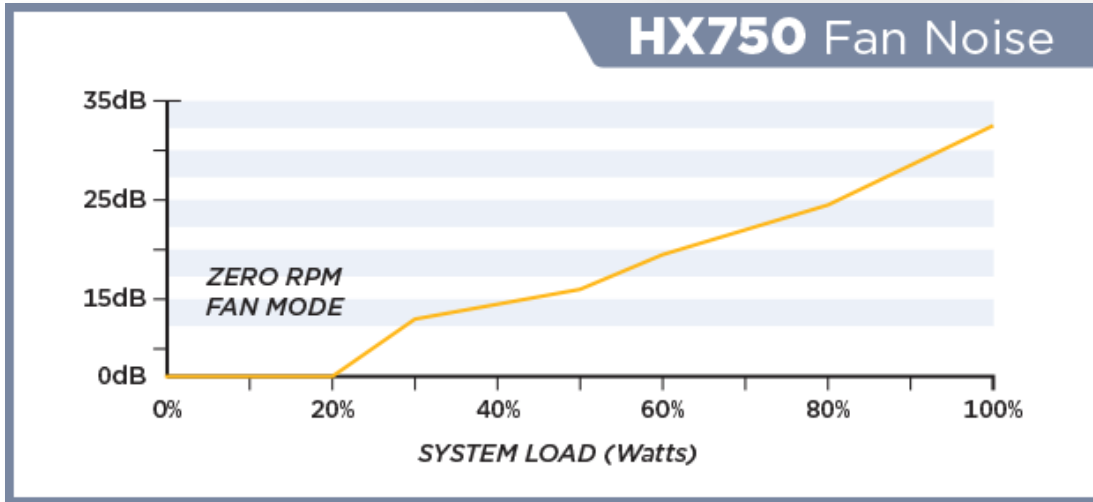


Which one is more  
efficient for a  
typical desktop  
computer?



# Power Supply Efficiency Variations

➤ Two different models of 750 watt supplies, same vendor



Both are rated  
**80 PLUS Gold.**



Which one would  
you rather have  
next to your desk?

- Many of today's power supplies are rated for a range of voltages, such as 100v – 240v or sometimes broader.
  - ◆ Applies to many consumer and enterprise devices and systems
- These power supplies are more efficient at 230v or 240v than they are at 115v or 120v.
- Demartek labs runs 80% of its racks at 230v/240v and 20% of its racks at 115v/120v.

- The SNIA Emerald program provides storage system power usage and efficiency information to the public.
  - ◆ Part of the **Green Storage Initiative** (GSI)
- It uses a well-defined test procedure to provide performance/watt and capacity/watt results for storage systems, known as the **SNIA Emerald Power Efficiency Measurement Specification**.
- Website: <http://snia.org/emerald>

# SNIA Emerald™ Taxonomy



	<b>Online</b>	<b>Near Online</b>	<b>Removable Media Library</b>	<b>Virtual Media Library</b>
<b>Consumer / Component</b>	Online 1*	Near Online 1*	Removable 1	Virtual 1
<b>Low-end</b>	Online 2	Near Online 2	Removable 2	Virtual 2
<b>Mid-range</b>	Online 3	Near Online 3	Removable 3	Virtual 3
	Online 4	—	—	—
<b>High-end</b>	Online 5	Near Online 5	Removable 5	Virtual 5
<b>Mainframe</b>	Online 6	Near Online 6	Removable 6	Virtual 6

\* Online 1 and Near Online 1 are not covered in the current version of the specification.

- **Online**: storage systems that can consistently retrieve the first data of a data block within 80ms (milliseconds), generally disk-based.
- **Near Online**: not as fast as online but can support random and sequential I/O.
- **Removable Media**: tape libraries and optical juke boxes.
- **Virtual Media Library**: can meet the 80ms time to first data. Generally disk-based for sequential I/O.



- **VDBENCH is used as the disk I/O workload generator. VDBENCH is maintained by Oracle Corp.**
- **The scripts for the workloads include:**
  - ◆ Pre-fill Test (phase)
  - ◆ SUT Conditioning Test (12 hours of run time)
  - ◆ Active Test
  - ◆ Ready Idle Test
  - ◆ Capacity Optimization Method (COM) Test
- **Power meters and temperature sensors are required.**
  - ◆ Power meter list taken from SPEC power benchmark

# SNIA Emerald™ Metrics



- Hot band workload – IOPS/watt
- Random Read workload – IOPS/watt
- Random Write workload – IOPS/watt
- Sequential Read workload – MBPS/watt
- Sequential Write workload – MBPS/watt
- Achieve the best performance/watt results while maintaining < 20ms latency
- Capacity/watt (idle)
- Pass the COM (capacity optimization) tests

# SNIA Emerald™ Output



Output is a multi-page spreadsheet that combines the technical performance data, power measurements, and information about the model under test.

Some data fields are mandatory and some are optional.

Must understand difference between GB and GiB.

SNIA Emerald Test Data Report version 2.0.2-03

## The SNIA Emerald Test Data Report

Disclosure for storage systems and products

**NOTICE:** This document is published and made accessible by SNIA for non-commercial use only and subject to restrictions stated in the Terms of Use contained herein.

### Product Description

Company	Binford Systems	
Address	123 Main Street	
(address line 2)		
(address line 3)		
Municipality	City, State, ZIP	Company logo here
Product Name	Binford 6100	
Taxonomy Category	Online 4	
Product Release Date	15-Jun-2014	
Description	The advanced "more power" storage system.	
Product Web Page	<a href="http://www.demartek.com">www.demartek.com</a>	
List Price (optional)	USD	
Raw capacity	160 TB	
Submission Date		Last status change
Document Status		SNIA tracking #
	Mandatory items per taxonomy	Optional items

Copyright 2011-2014 SNIA. All rights reserved.  
Use in competitive literature is prohibited: see the Terms of Use.

SNIA Emerald Test Data Report version 2.0.2-03

### Operational Power

<b>Idle power test</b>	
Average watts	1160.97 W
Raw capacity tested	160 TB
EP <sub>Kit</sub>	137.8 GB/W
Standard idle metric	GB per Watt

<b>Active power tests</b>					
EP <sub>RR</sub>	4.11	run length (minutes)	30	Average latency	17.53 ms
Small random reads	I/Os per second per Watt			RTA <sub>1000</sub> (1800) <=	20 ms
EP <sub>RW</sub>	9.39	run length (minutes)	30	Average latency	14.7 ms
Small random writes	I/Os per second per Watt			RTA <sub>1000</sub> (1800) <=	20 ms
EP <sub>SR</sub>	2.89	run length (minutes)	30		
Large sequential reads	MiB per second per Watt				
EP <sub>SW</sub>	2.93	run length (minutes)	30		
Large sequential writes	MiB per second per Watt				
EP <sub>HB</sub>	10.63	run length (minutes)	30	Average latency	7.3 ms
Hot band workload	I/Os per second per Watt			RTA <sub>1000</sub> (1800) <=	20 ms
Random + sequential workload w/ hot spots					

NOTE: power-related numbers are required to be reported to three significant digits

<b>Capacity Optimizations</b>	On during test?	Available in SUT?
Deduplication	no	yes
Compression	no	yes
Thin provisioning	no	yes
Parity RAID	yes	yes
Read-only delta snapshots	no	yes
Writeable delta snapshots	no	yes

**Other mandatory disclosures, per spec**  
Replaced standard drive LEDs with multi-colored LEDs

Copyright 2011-2014 SNIA. All rights reserved.  
Use in competitive literature is prohibited: see the Terms of Use.

2015 Data Storage Innovation Conference. © Demartek. All Rights Reserved.

24



- SNIA has developed the SNIA Emerald Recognized Tester Program (RTP)
- Organizations can become recognized testers by demonstrating knowledge of and proficiency with the SNIA Emerald test specification. An on-site audit is required.



**September 16, 2014: Demartek is the first official SNIA Emerald Recognized Test Lab**



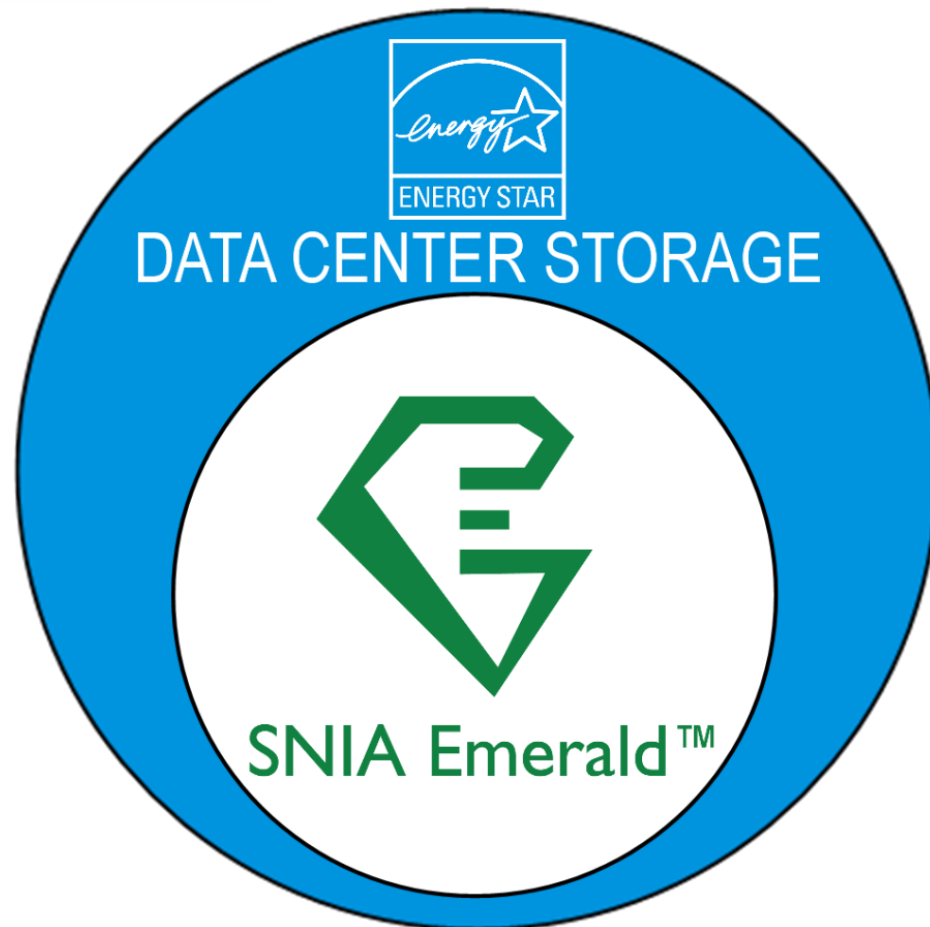
<http://www.snia.org/emerald/rtp-overview>

- The US Environmental Protection Agency (EPA) has defined the ENERGY STAR program to encourage energy efficiency with a wide variety of consumer and business products.
- Electronics and Office Equipment programs include:
  - ◆ Computers
  - ◆ Data Center Storage
  - ◆ Displays
  - ◆ Enterprise Servers
  - ◆ Small Network Equipment
  - ◆ Uninterruptible Power Supplies
- Future programs include
  - ◆ Large Network Equipment



# EPA ENERGY STAR Data Center Storage & SNIA Emerald

- EPA ENERGY STAR Data Center Storage Specification 1.0 uses the SNIA Emerald Power Efficiency Measurement Specification 2.0.2.





- **EPA ENERGY STAR Data Center Storage uses the SNIA Emerald test specification.**
  - ◆ EPA adds requirement for tight voltage variations and total harmonic distortion (THD) measurements.
  - ◆ EPA requires temperature and humidity measurements.
  - ◆ EPA requires 80PLUS Silver equivalent or better power supplies in the storage systems under test.
  - ◆ EPA has slightly different COMs requirements.
- **EPA-recognized testers must be ISO 17025 accredited test labs**
- **Submissions for EPA can be tested or modeled.**

- We have been deploying storage systems from many different vendors in our test lab for several years.
- We added A/C sources to meet EPA ENERGY STAR electrical requirements.
- We have submitted EPA ENERGY STAR Data Center Storage test results for more than one vendor and more than one product family.
- We can run multiple configurations in parallel.
- We have automated the process of collecting the performance data, power meter data and temperature sensor data to produce the SNIA Emerald TDR.
  - ◆ This data is used for the EPA ENERGY STAR submissions

- **Demartek has a separate presentation that provides the details of the EPA ENERGY STAR Data Center Storage specification.**
  - ◆ Information for product vendors to get started with EPA ENERGY STAR
  - ◆ Detailed comparison between SNIA Emerald & EPA ENERGY STAR Data Center Storage
- **Demartek also works with product vendors to complete the large amount of marketing product data required for the EPA submissions.**

# EPA ENERGY STAR Data Center Storage



## ➤ *EPA ENERGY STAR Data Center Storage*

certified products:

<https://data.energystar.gov/Government/ENERGY-STAR-Certified-Data-Center-Storage/gqtf-hp7x>

## ➤ EPA Product Shipment Data

- ◆ SNIA has been appointed as the Storage Shipment Data Aggregator by the EPA

[http://www.snia.org/emerald/EPA\\_Reporting](http://www.snia.org/emerald/EPA_Reporting)

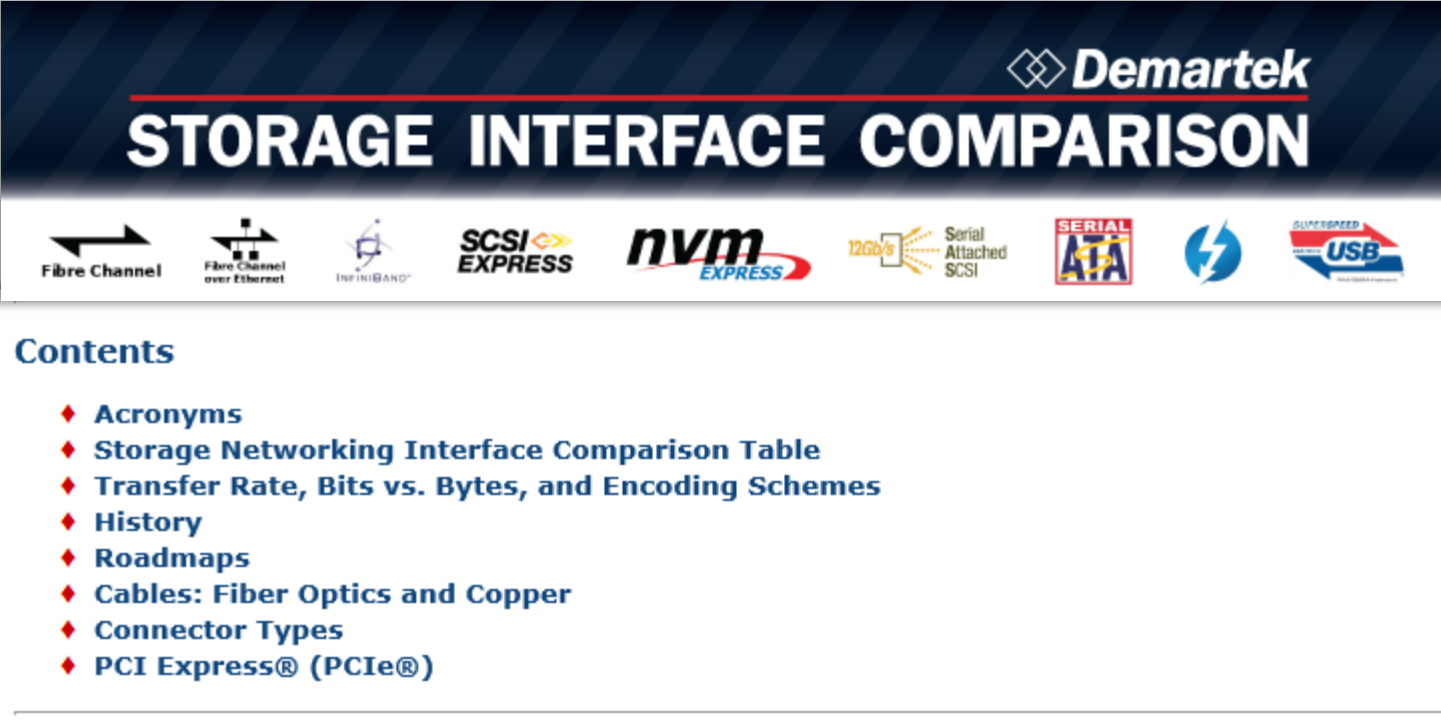
# Demartek Free Resources

- **Demartek Commentary on the Flash Memory Summit 2014**  
[www.demartek.com/Demartek\\_Flash\\_Memory\\_Summit\\_2014\\_Commentary.html](http://www.demartek.com/Demartek_Flash_Memory_Summit_2014_Commentary.html)
- **Demartek SSD Deployment Guide**  
[www.demartek.com/Demartek\\_SSD\\_Deployment\\_Guide.html](http://www.demartek.com/Demartek_SSD_Deployment_Guide.html)
- **Demartek Video Library**  
[www.demartek.com/Demartek\\_Video\\_Library.html](http://www.demartek.com/Demartek_Video_Library.html)
- **Demartek FC Zone**  
[www.demartek.com/FC](http://www.demartek.com/FC)
- **Demartek iSCSI Zone**  
[www.demartek.com/iSCSI](http://www.demartek.com/iSCSI)
- **Demartek SSD Zone**  
[www.demartek.com/SSD](http://www.demartek.com/SSD)

Performance reports,  
Deployment Guides and  
commentary available  
for free download.



# Storage Interface Comparison



The banner features the Demartek logo in the top right corner. Below it, the title "STORAGE INTERFACE COMPARISON" is displayed in large, bold, white letters on a dark blue background. A horizontal line separates the title from a row of storage interface logos: Fibre Channel, Fibre Channel over Ethernet, InfiniBand, SCSI EXPRESS, nvm EXPRESS, 12Gb/s Serial Attached SCSI, SERIAL ATA, and USB. Below the logos, the word "Contents" is written in blue. A list of topics follows, each preceded by a blue diamond symbol.

**Demartek**  
**STORAGE INTERFACE COMPARISON**

Fibre Channel   Fibre Channel over Ethernet   INFINIBAND™   SCSI EXPRESS   nvm EXPRESS   12Gb/s Serial Attached SCSI   SERIAL ATA   USB

**Contents**

- ◆ Acronyms
- ◆ Storage Networking Interface Comparison Table
- ◆ Transfer Rate, Bits vs. Bytes, and Encoding Schemes
- ◆ History
- ◆ Roadmaps
- ◆ Cables: Fiber Optics and Copper
- ◆ Connector Types
- ◆ PCI Express® (PCIe®)

- ◆ Downloadable interactive PDF version now available
- ◆ Search engine: “storage interface comparison”
- ◆ [www.demartek.com/Demartek\\_Interface\\_Comparison.html](http://www.demartek.com/Demartek_Interface_Comparison.html)

# Free Monthly Newsletter

Demartek publishes a free monthly newsletter, *Demartek Lab Notes*, highlighting recent reports, articles and commentary.



Look for the newsletter sign-up at:  
[www.demartek.com/Newsletter](http://www.demartek.com/Newsletter)

# Thank You!

**Dennis Martin, President**

[dennis@demartek.com](mailto:dennis@demartek.com)

[www.linkedin.com/in/dennismartin](http://www.linkedin.com/in/dennismartin)



(303) 940-7575

[www.demartek.com](http://www.demartek.com)

<http://twitter.com/Demartek>

[www.youtube.com/Demartek](http://www.youtube.com/Demartek)


Skype: Demartek

## To learn more about Demartek:

- ◆ Download the Aurasma App (Android/iPhone)
  - ◆ Search and follow “Demartek”
  - ◆ View image below with viewfinder.



\*also on the back of Dennis' business card

Powered by:   
AURASMA