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

## Dennis Martin
## President, Demartek

**Tuesday, September 16, 2014**

**Demartek**®

# Agenda

- ☐ **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**

2

# SNIA SDC Session Evaluations

- Be sure to complete the session evaluations that will be emailed to you.

- The SNIA staff reads these and I also get a copy of the results for this session.

- SNIA is offering *a $100 American Express gift card* to a randomly selected individual who completes the evaluations.

# Demartek Video



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

## Demartek YouTube Channel:

## http://www.youtube.com/user/Demartek/videos

# About Demartek

- 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

- Demartek is an EPA-recognized test lab for *ENERGY STAR Data Center Storage* testing

- Website: www.demartek.com

5

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

# Is this your man-cave?

# Home vs. Data Center
## ►Electric Power Usage Comparison

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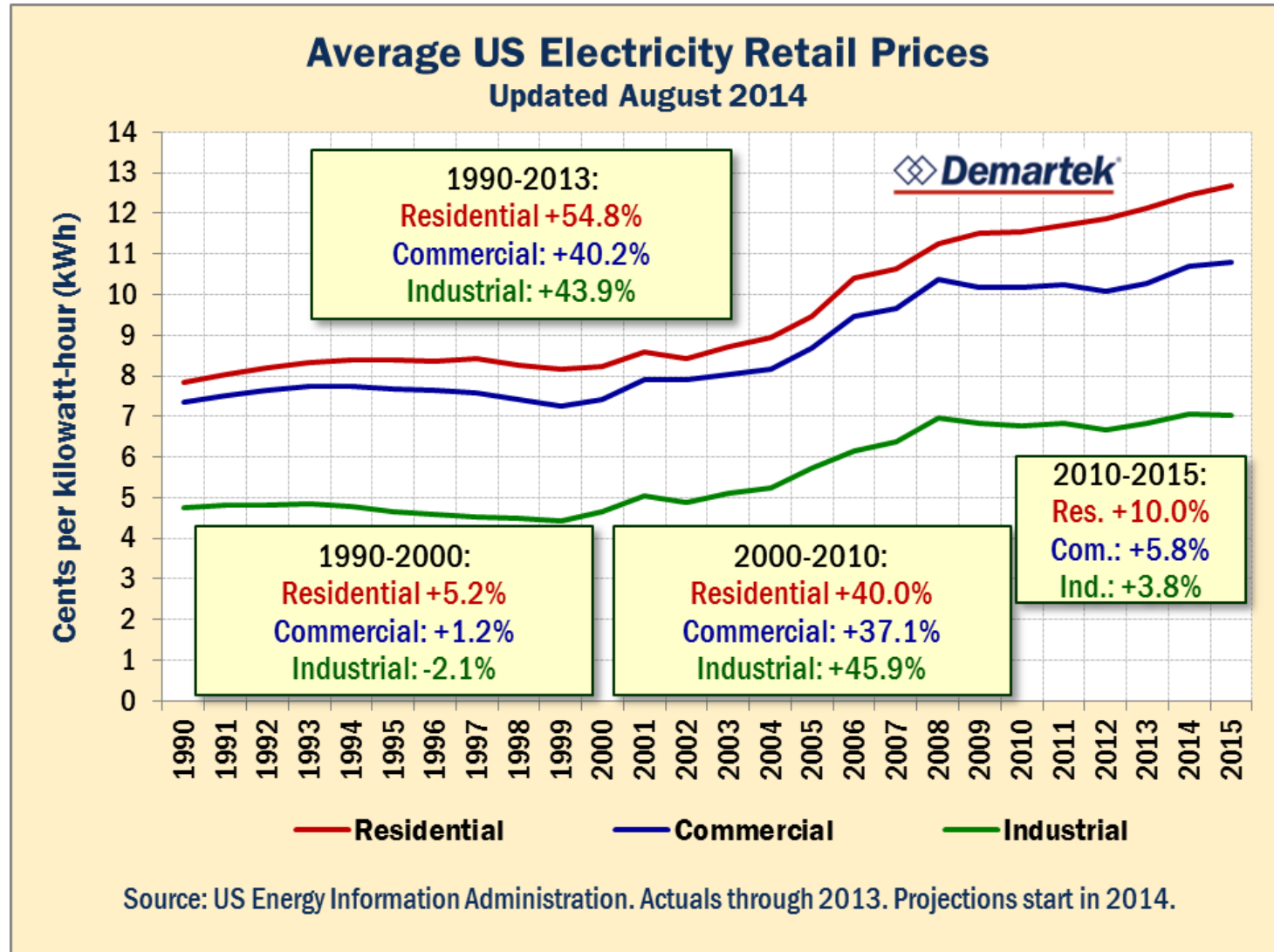
- ☐ Install more power-efficient devices
- ☐ Devices usually have one power supply
- ☐ Some devices always on
- ☐ Turn off devices when not in use

☐ **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**

7

SDC 14

# Electricity Price Trends



**Average US Electricity Retail Prices**
**Updated August 2014**

1990-2013:
Residential +54.8%
Commercial: +40.2%
Industrial: +43.9%

1990-2000:
Residential +5.2%
Commercial: +1.2%
Industrial: -2.1%

2000-2010:
Residential +40.0%
Commercial: +37.1%
Industrial: +45.9%

2010-2015:
Res. +10.0%
Com.: +5.8%
Ind.: +3.8%

◇ Demartek

— Residential  — Commercial  — Industrial

Source: US Energy Information Administration. Actuals through 2013. Projections start in 2014.

Yearly average increase, 1990-2013:
Res. 1.9%
Com. 1.5%
Ind. 1.6%

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

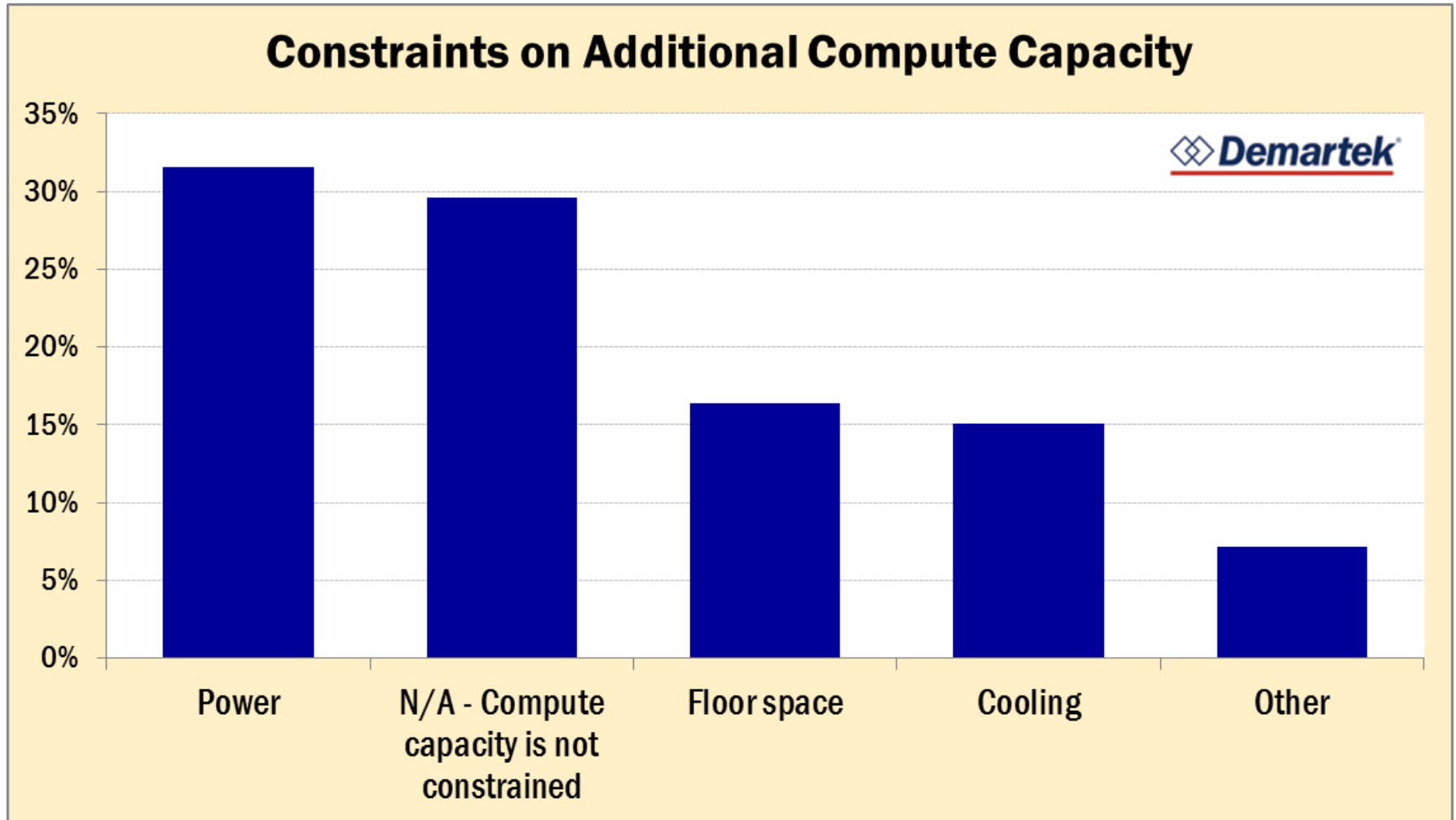Prices can fluctuate during different times of day.

8

# Data Center Trends

- **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

- **Data center power consumption grew +6.8% in North America during 2013**
  - Source: DCD Industry Census 2013

- **Increases in density of equipment in racks have implications for cooling, noise, arrangement of equipment and relationship to the power company.**

# Data Center Manager's Facility Concerns



**What Are Your Top 3 Facility Concerns?**
(Select 3 Items)
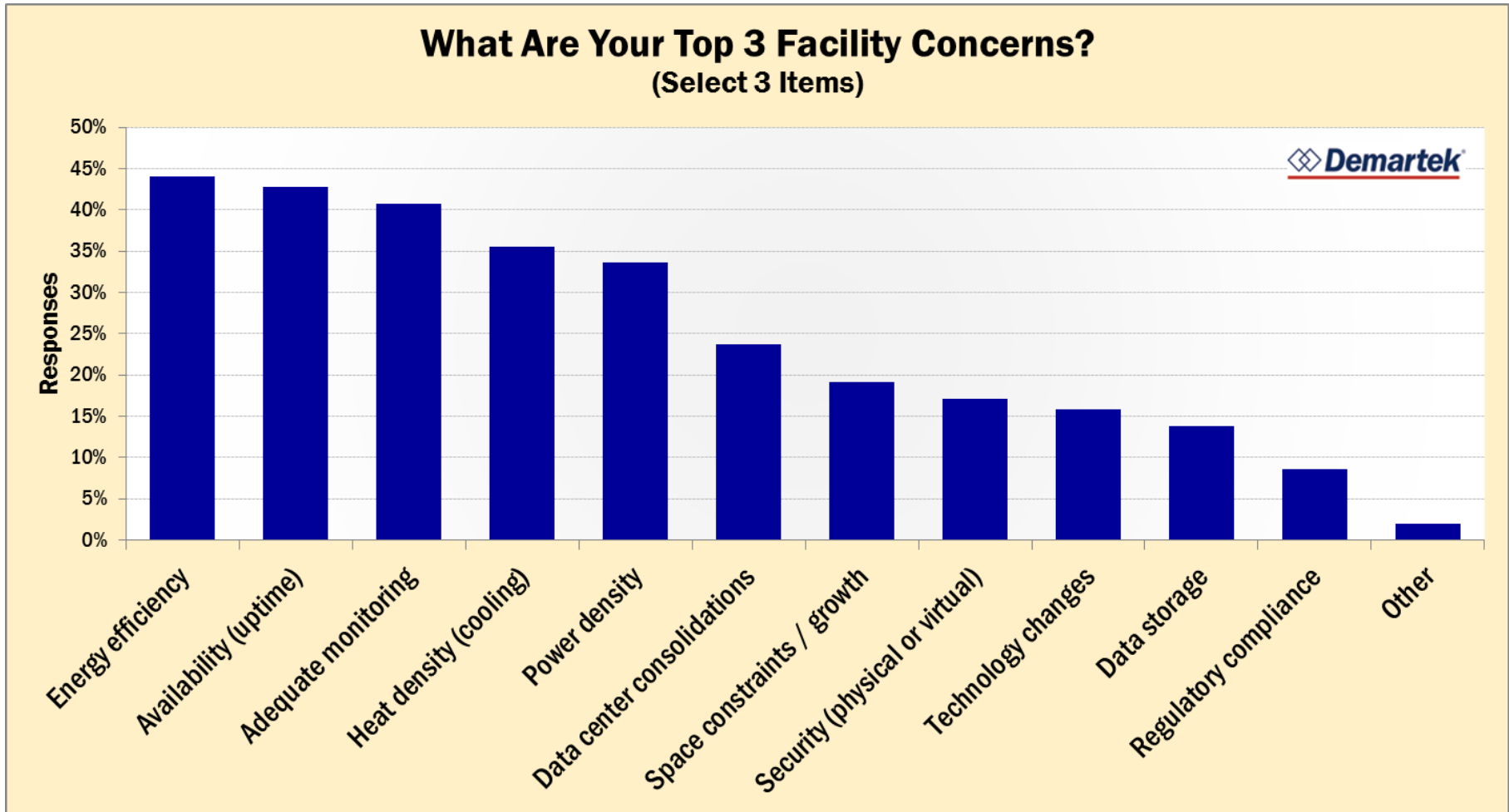
**Source: DCUG Survey, October 2013**

# Constraints on Compute Growth



## Constraints on Additional Compute Capacity

# Growth of Average Power Density per Rack



**Average Power Density per Rack 2013**

- 24+ kW, 1%
- Unsure, 5%
- 20 - 24 kW, 3%
- 16 - 20 kW, 2%
- 12 - 16 kW, 2%
- <= 2 kW, 5%
- 2 - 4 kW, 32%
- 8 - 12 kW, 14%
- 4 - 8 kW, 37%
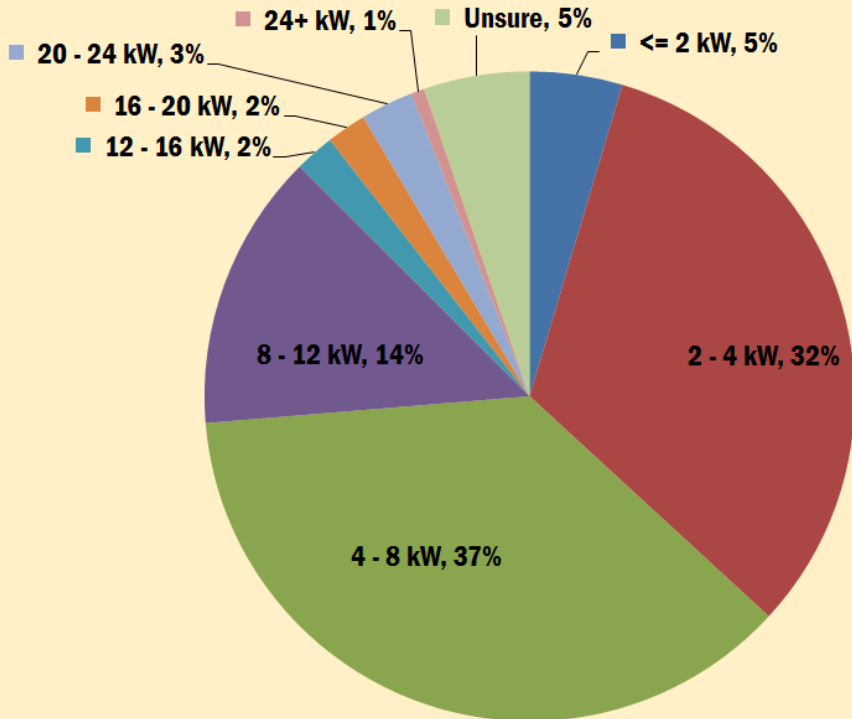
Source: DCUG Survey, October 2013

**Average Power Density per Rack 2015, projected**

- 24+ kW, 2%
- 20 - 24 kW, 5%
- 16 - 20 kW, 7%
- Unsure, 9%
- <= 2 kW, 3%
- 2 - 4 kW, 11%
- 12 - 16 kW, 12%
- 4 - 8 kW, 30%
- 8 - 12 kW, 22%

Strongest growth in these three avg. power density ranges:

8-12 kW
12-16 kW
16-20 kW

◇◇ Demartek
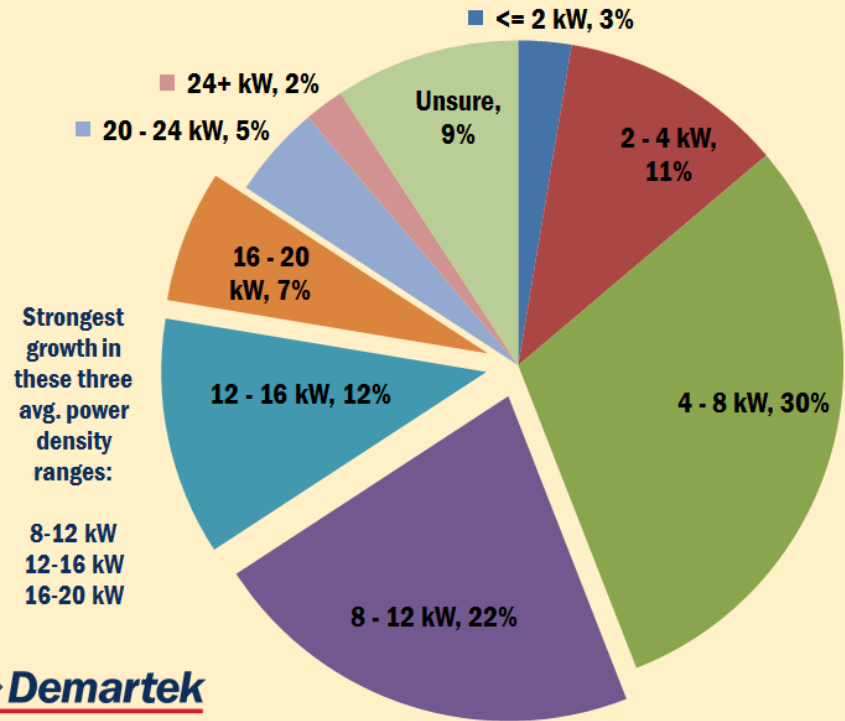
# Growth of Maximum Power Density per Rack



**Maximum Power Density per Rack 2013**
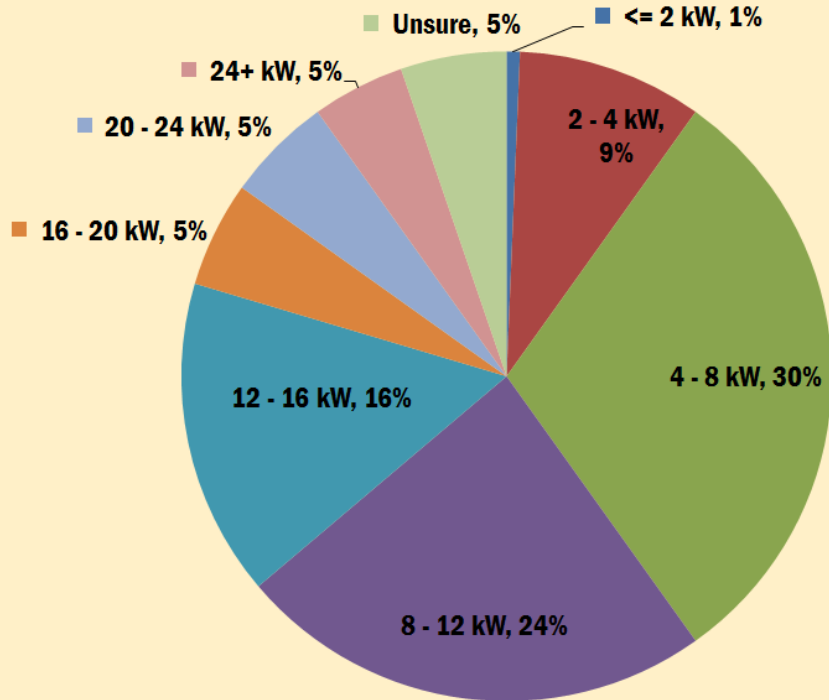
- Unsure, 5%
- <= 2 kW, 1%
- 2 - 4 kW, 9%
- 4 - 8 kW, 30%
- 8 - 12 kW, 24%
- 12 - 16 kW, 16%
- 16 - 20 kW, 5%
- 20 - 24 kW, 5%
- 24+ kW, 5%

Source: DCUG Survey, October 2013

Strongest growth in these two max. power density ranges:

12-16 kW
16-20 kW

**Maximum Power Density per Rack 2015, projected**

- <= 2 kW, 0%
- 2 - 4 kW, 6%
- 4 - 8 kW, 15%
- 8 - 12 kW, 24%
- 12 - 16 kW, 13%
- 16 - 20 kW, 14%
- 20 - 24 kW, 10%
- 24+ kW, 7%
- Unsure, 12%

◆ **Demartek**

SDC 14
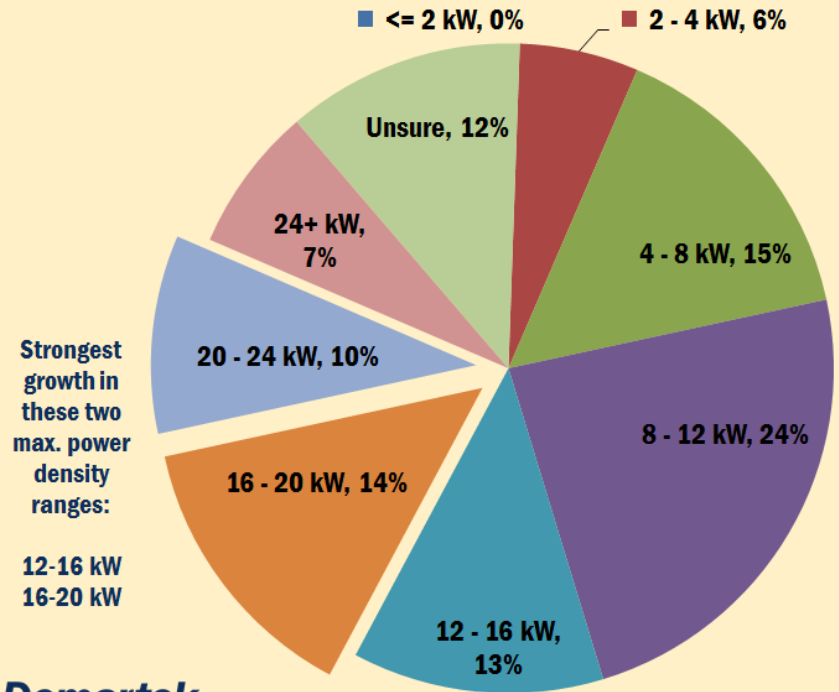
# Data Center Power: PUE and DCiE
## ►Developed by the Green Grid

- PUE = Power Usage Effectiveness

- DCiE = Data Center infrastructure Effectiveness

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

- 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

- 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

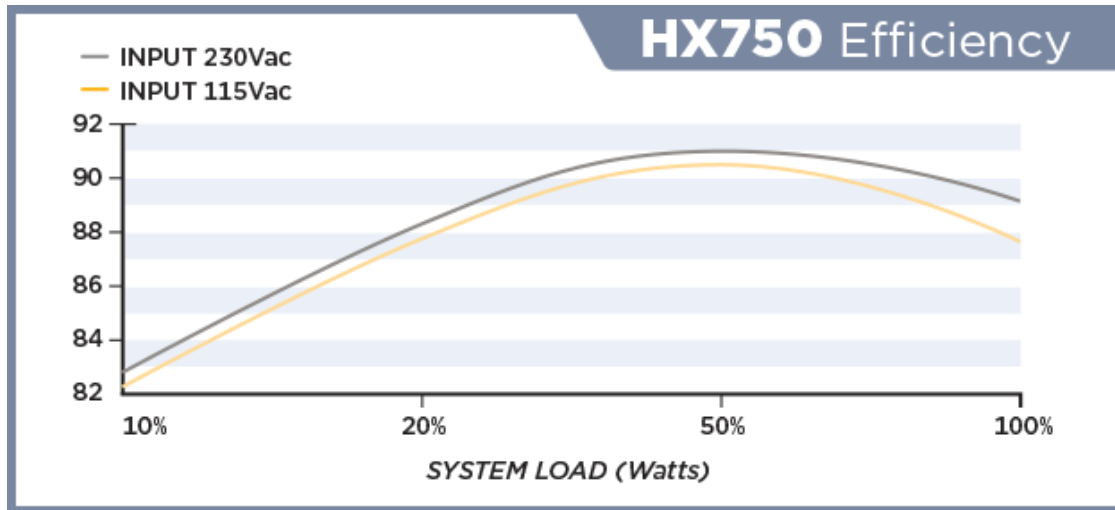- Measured at 115v and 230v

# 80 PLUS History
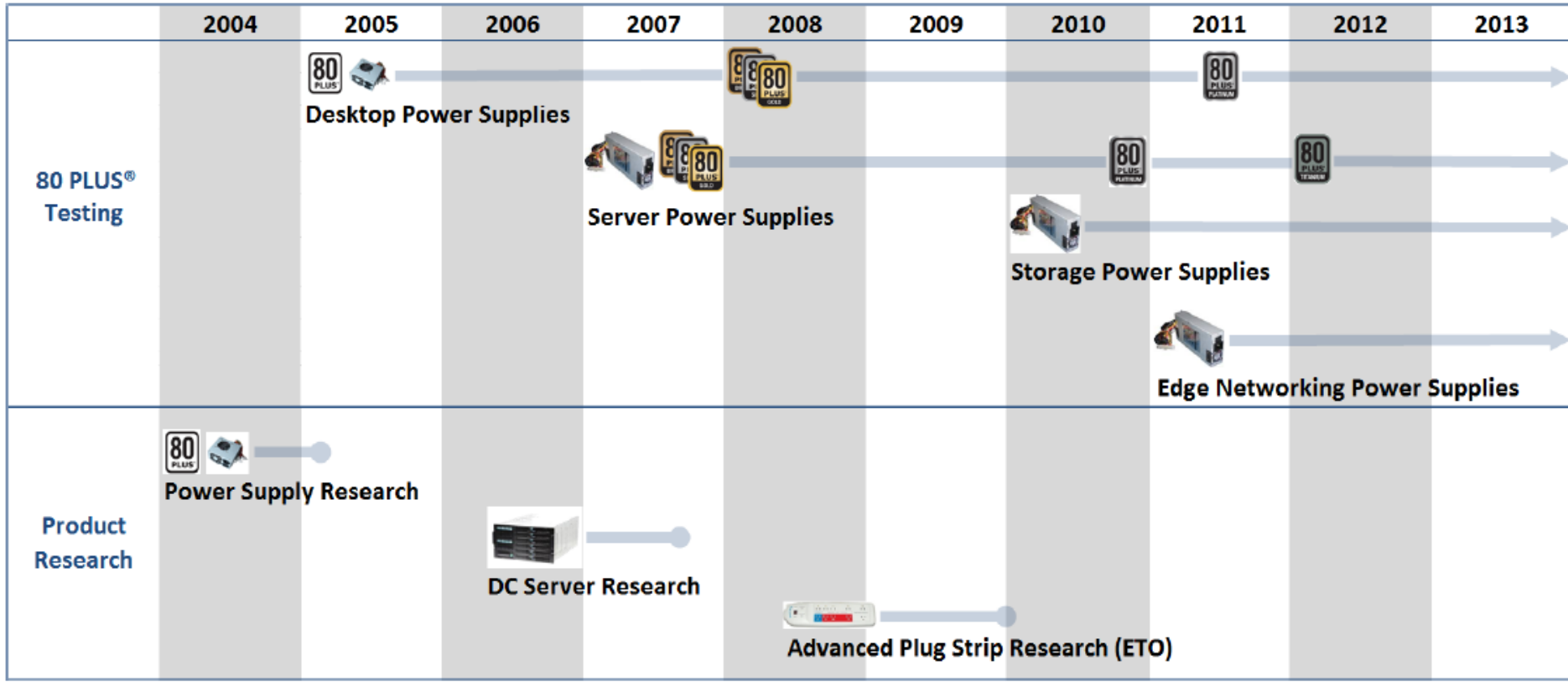


Source: Ecova

# 80 PLUS Ratings

| | 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



**HX750** Efficiency

— INPUT 230Vac
— INPUT 115Vac

SYSTEM LOAD (Watts)

**RM750** Efficiency

— INPUT 230Vac
— INPUT 115Vac
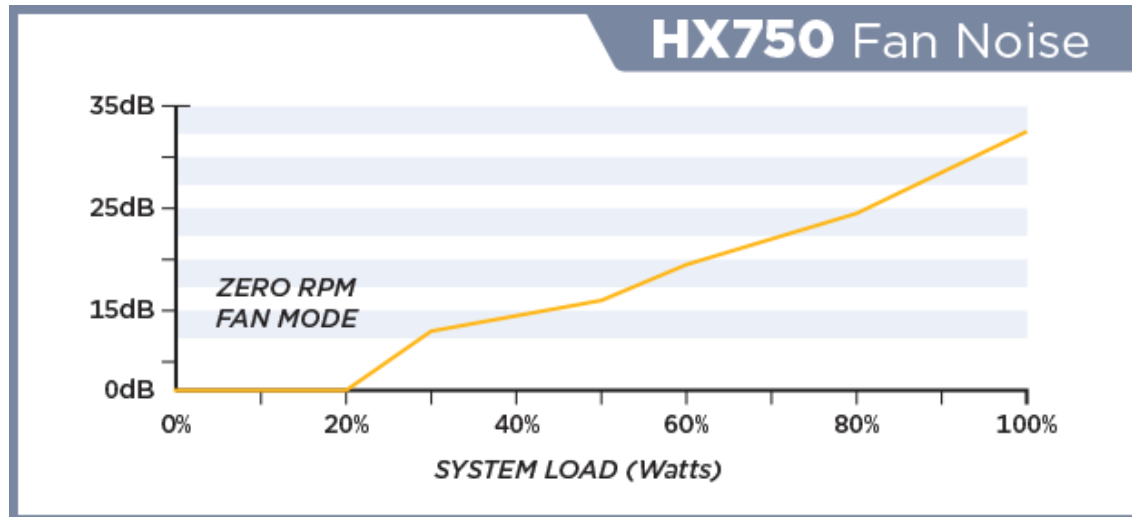
SYSTEM LOAD (Watts)
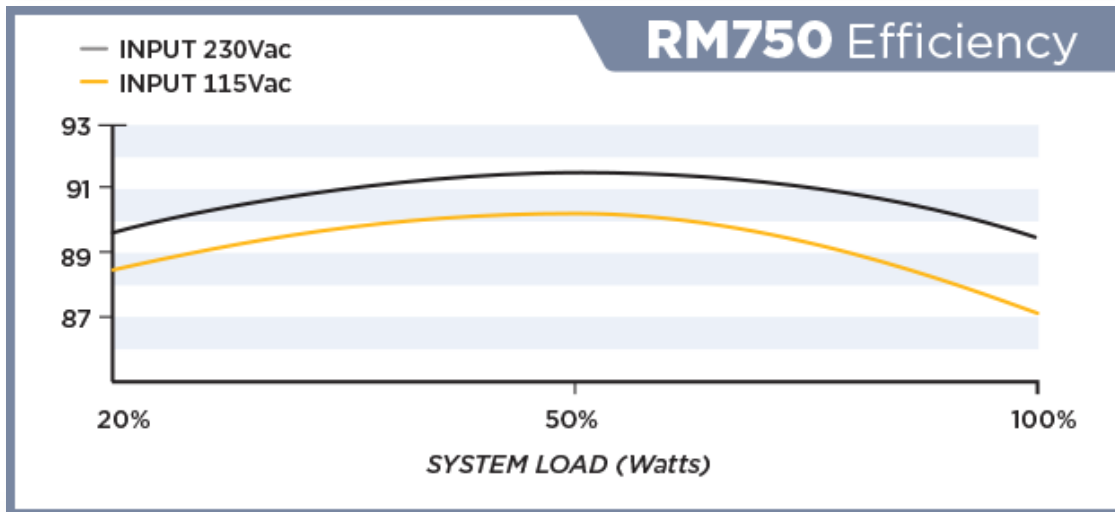
**Both are rated 80 PLUS Gold.**

**80 PLUS® GOLD**

**Which one is more efficient for a typical desktop computer?**

19

# Power Supply Noise Variations
► Two different models of 750 watt supplies, same vendor
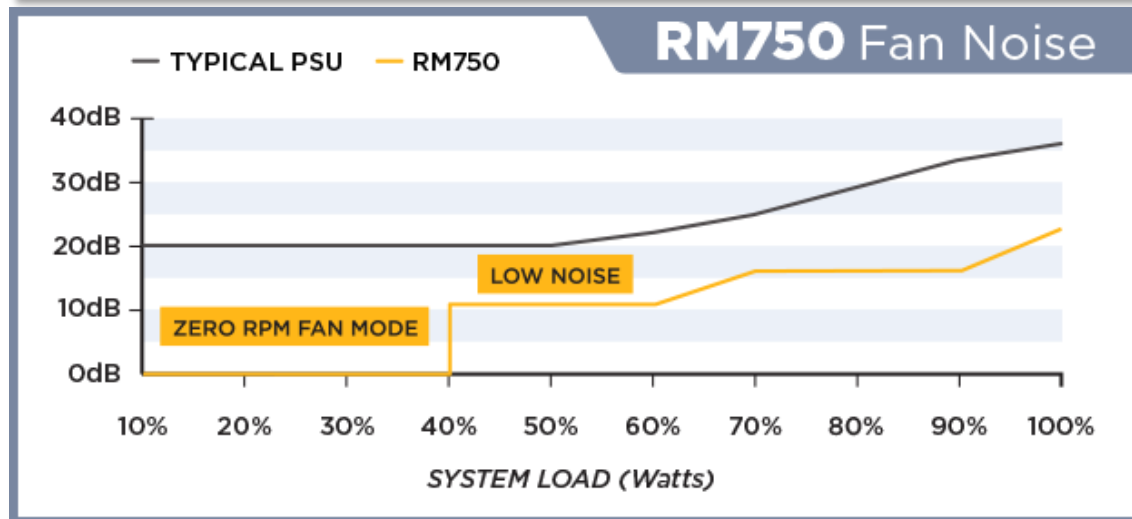


Both are rated
80 PLUS Gold.

Which one would
you rather have
next to your desk?

# Efficient Voltages

- **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.**

# SNIA Emerald™

- **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**

22

# SNIA Emerald™ Taxonomy

| | Online | Near Online | Removable Media Library | Virtual Media Library |
|---|---|---|---|---|
| **Consumer / Component** | Online 1* | Near Online 1* | Removable 1 | Virtual 1 |
| **Low-end** | Online 2 | Near Online 2 | Removable 2 | Virtual 2 |
| **Mid-range** | Online 3 | Near Online 3 | Removable 3 | Virtual 3 |
| | Online 4 | — | — | — |
| **High-end** | Online 5 | Near Online 5 | Removable 5 | Virtual 5 |
| **Mainframe** | 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.

# SNIA Emerald™ Taxonomy

- **<u>Online</u>**: storage systems that can consistently retrieve the first data of a data block within 80ms (milliseconds), generally disk-based.

- **<u>Near Online</u>**: not as fast as online but can support random and sequential I/O.

- **<u>Removable Media</u>**: tape libraries and optical juke boxes.

- **<u>Virtual Media Library</u>**: can meet the 80ms time to first data. Generally disk-based for sequential I/O.

# SNIA Emerald™ Tests

□ **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.**

25

# 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™ RTP

- □ **SNIA is developing 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*

# EPA ENERGY STAR

□ **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



energy ★
LEARN MORE AT
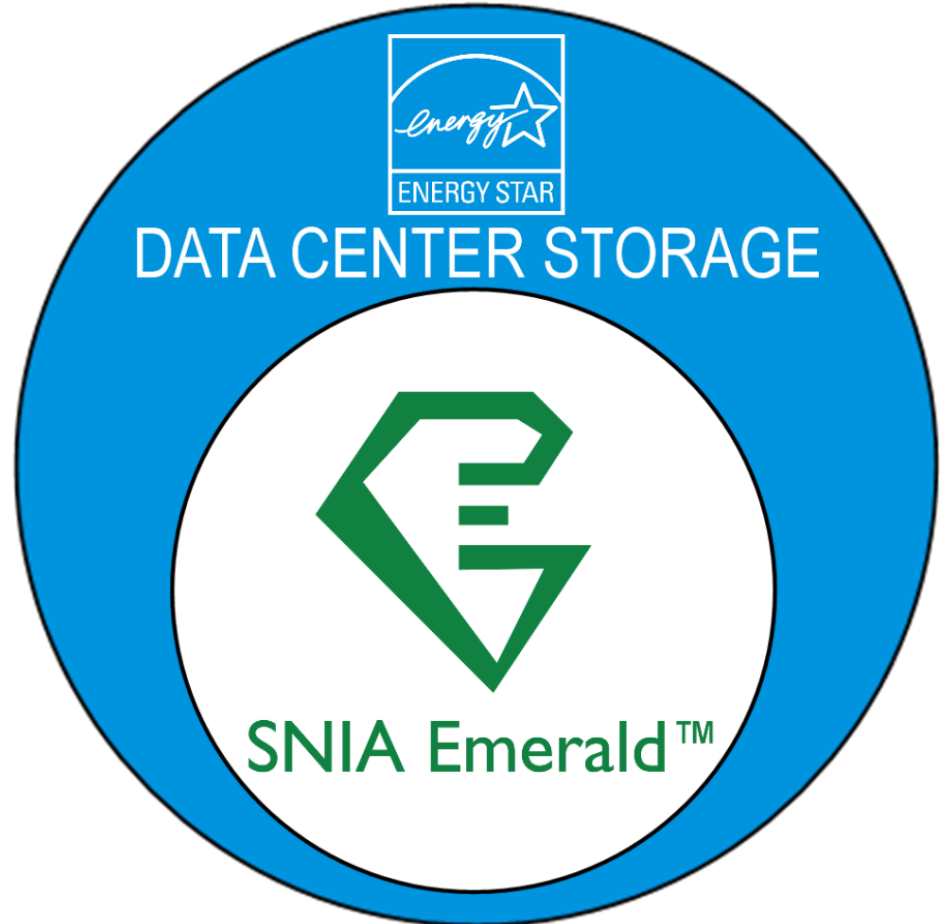energystar.gov

# EPA ENERGY STAR Data Center Storage
## ►Program Information

- The most recent new **EPA ENERGY STAR** program is for Data Center Storage.

- Storage systems that pass the tests can get listed on the EPA's Data Center Storage product list and have the ENERGY STAR label.
  - US federal government agencies are required to purchase ENERGY STAR products if available.

- First storage systems were listed in March 2014.

# 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
►Testing

- 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 <u>equivalent</u> 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.

SDC 14

# Demartek Emerald / EPA Testing

- 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 were the test lab for one of the storage vendors and their many submissions on EPA's website.

- We ran multiple configurations in parallel and completed 24 test configurations in one month.

- 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

# Additional Demartek Presentation

- 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

# EPA ENERGY STAR Data Center Storage
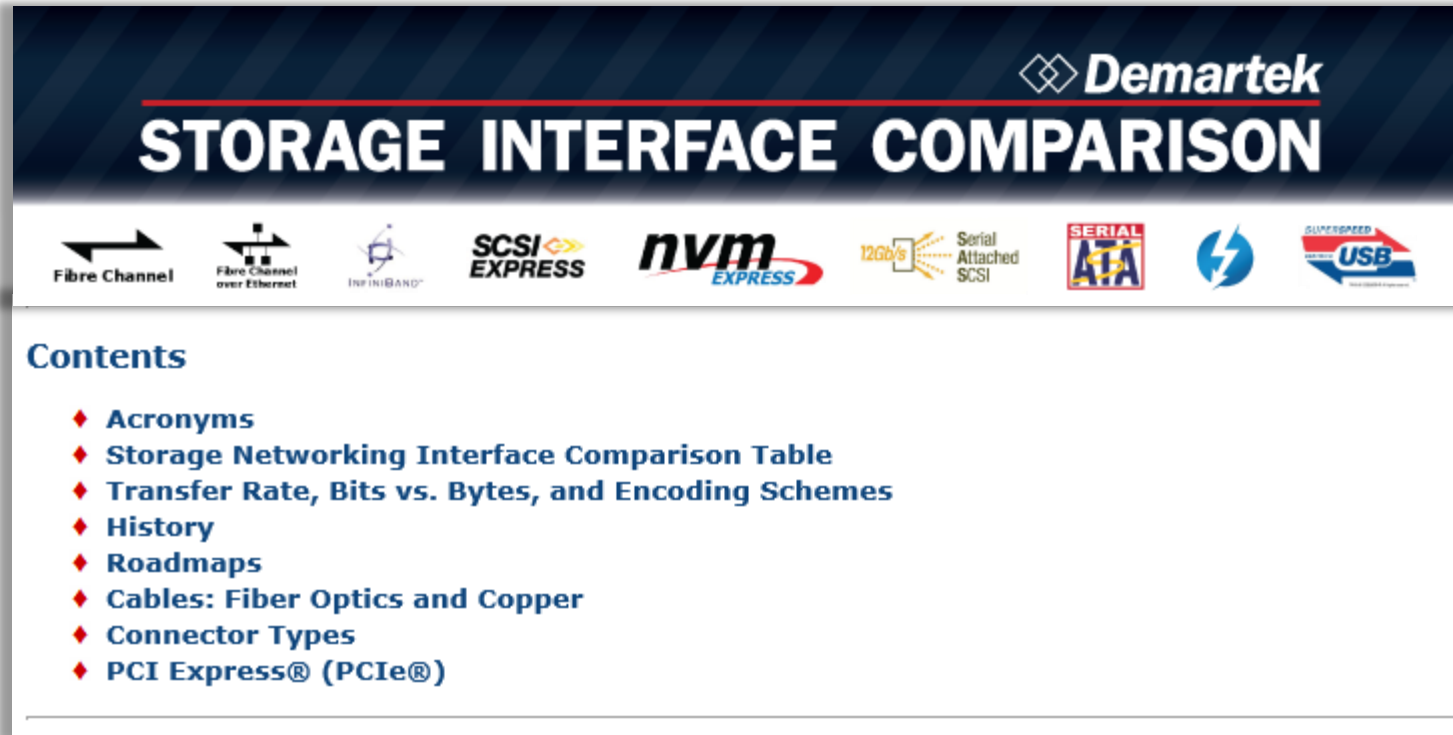
☐ *EPA ENERGY STAR Data Center Storage*
certified products:
https://data.energystar.gov/Government/ENERGY-STAR-Certified-Data-Center-Storage/gqtf-hp7x

# Demartek Free Resources

- **Demartek Commentary on the Flash Memory Summit 2014**
  www.demartek.com/Demartek_Flash_Memory_Summit_2014_Commentary.html

- **Demartek SSD Deployment Guide**
  www.demartek.com/Demartek_SSD_Deployment_Guide.html

- **Demartek Video Library**
  http://www.demartek.com/Demartek_Video_Library.html

- **Demartek FC Zone**
  www.demartek.com/FC

- **Demartek iSCSI Zone**
  www.demartek.com/iSCSI

- **Demartek SSD Zone**
  www.demartek.com/SSD

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

36

# Storage Interface Comparison



☐ **Downloadable interactive PDF version now available**

☐ **Search engine: "storage interface comparison"**

☐ **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

# SNIA SDC Session Evaluations

□ Be sure to complete the session evaluations that will be emailed to you.

□ The SNIA staff reads these and I also get a copy of the results for this session.

□ SNIA is offering *a $100 American Express gift card* to a randomly selected individual who completes the evaluations.

39

# Thank You!

**Dennis Martin, President**
dennis@demartek.com
www.linkedin.com/in/dennismartin



(303) 940-7575
www.demartek.com
http://twitter.com/Demartek
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.**



REAL-WORLD
HANDS-ON
RESEARCH
& ANALYSIS

*also on the back of Dennis' business card

Powered by: 

40