



Understanding Data Storage Efficiencies: MAID (Massive Array of Idle Disks)

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COPAN Systems

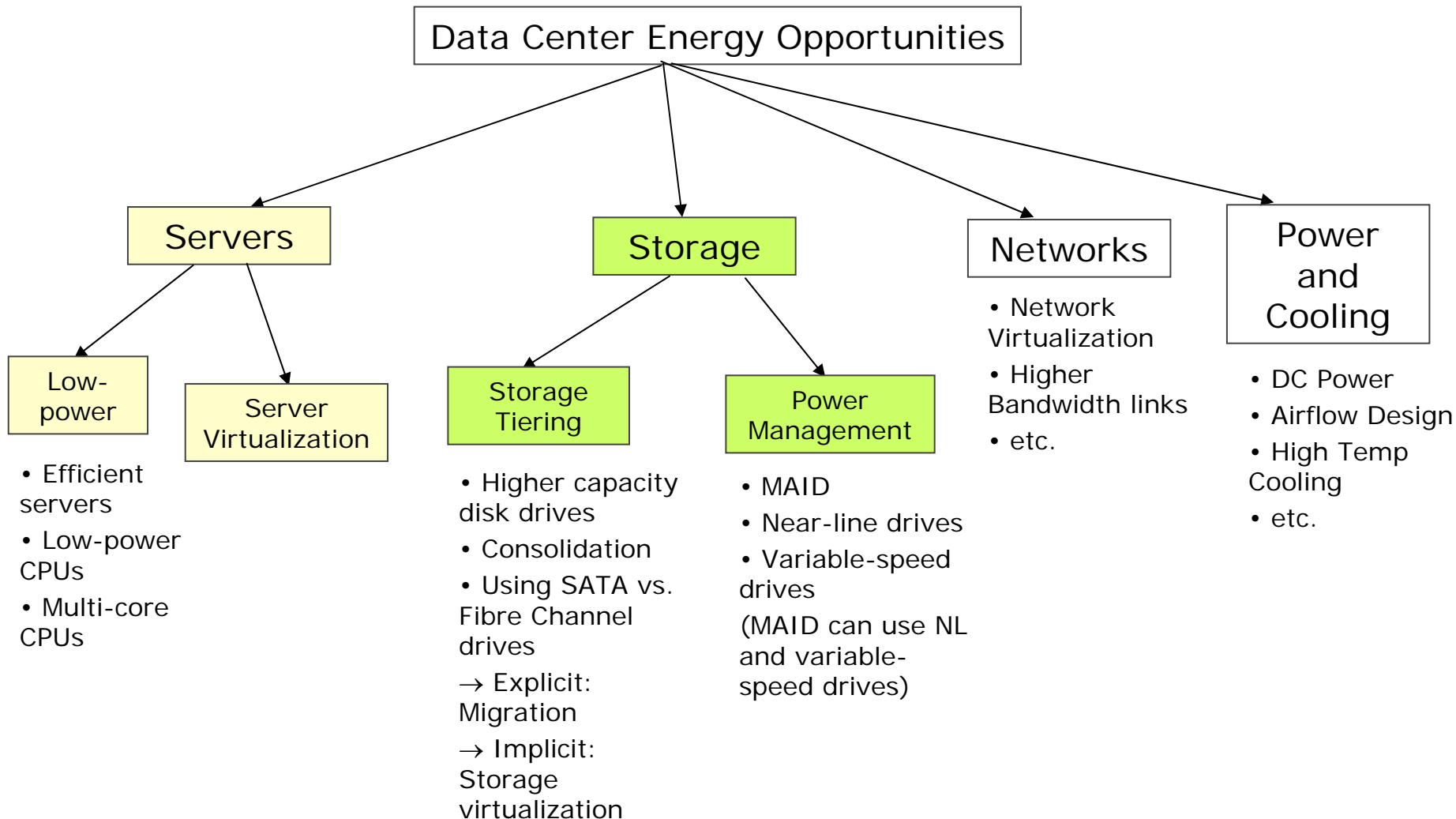
September 26, 2007

CEE Fourth Annual Industry Partners Meeting
Data Centers and Servers Track



- **Data Center Energy Savings Opportunities**
- **The Growth of Data and Storage**
- **Storage Energy Savings Options**
- **MAID Storage and Benefits**
- **Real-World Results**
- **Recommendations**

Energy Saving Opportunities: Servers and Storage



▪ Servers

- ◆ Currently largest consumer of energy
- ◆ Use server virtualization and efficient servers
- ◆ Energy savings depends on level of virtualization – depends on workload that is not deterministic

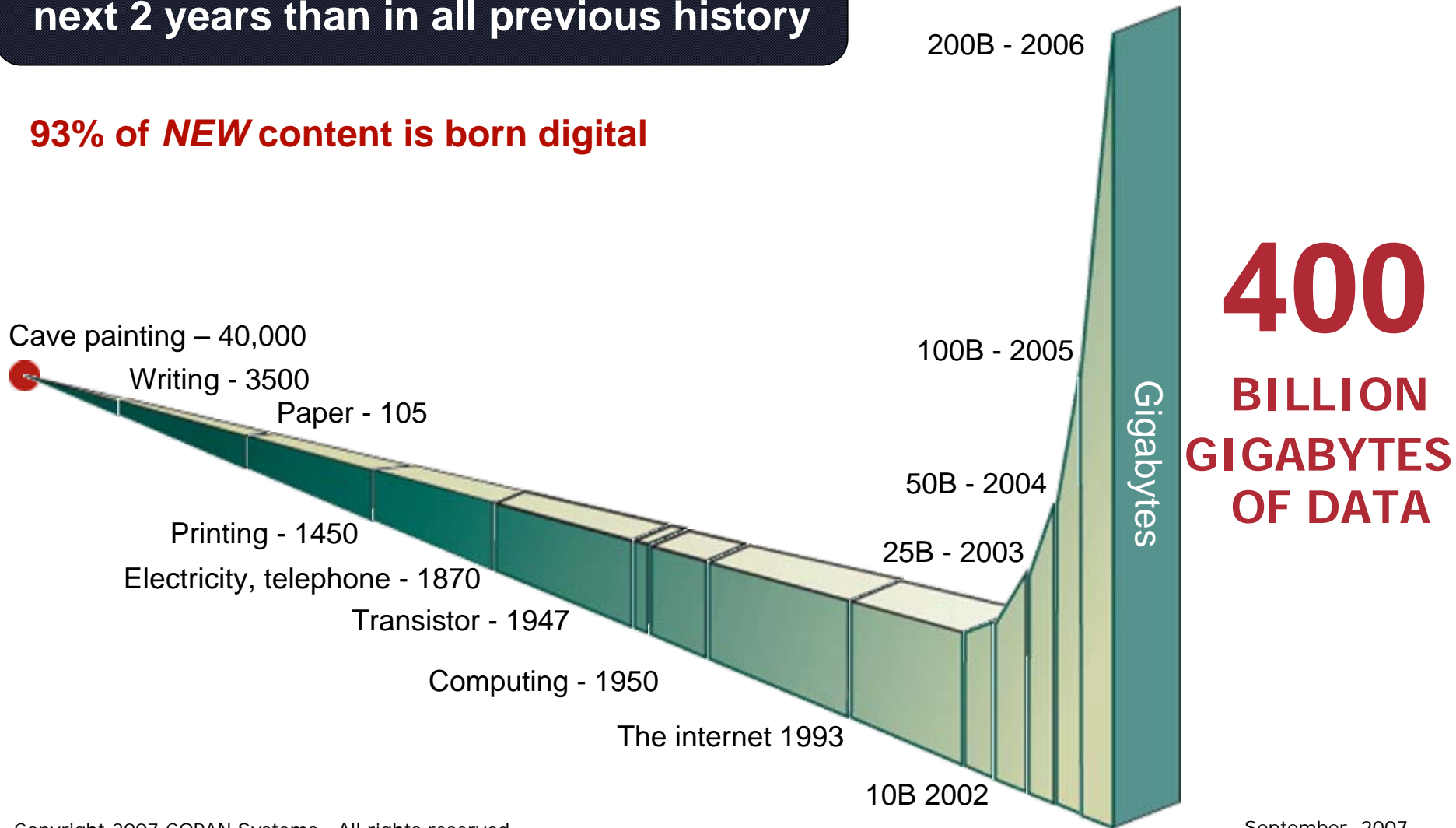
▪ Storage

- ◆ Currently second largest consumer of energy: highest CAGR of any asset in data center
- ◆ Use Storage Tiering, MAID and Power Management
- ◆ Energy savings more deterministic: persistent data is static, more predictable, 75%-90% of data center data
- ◆ Far better quantifiable ROI on energy savings investments

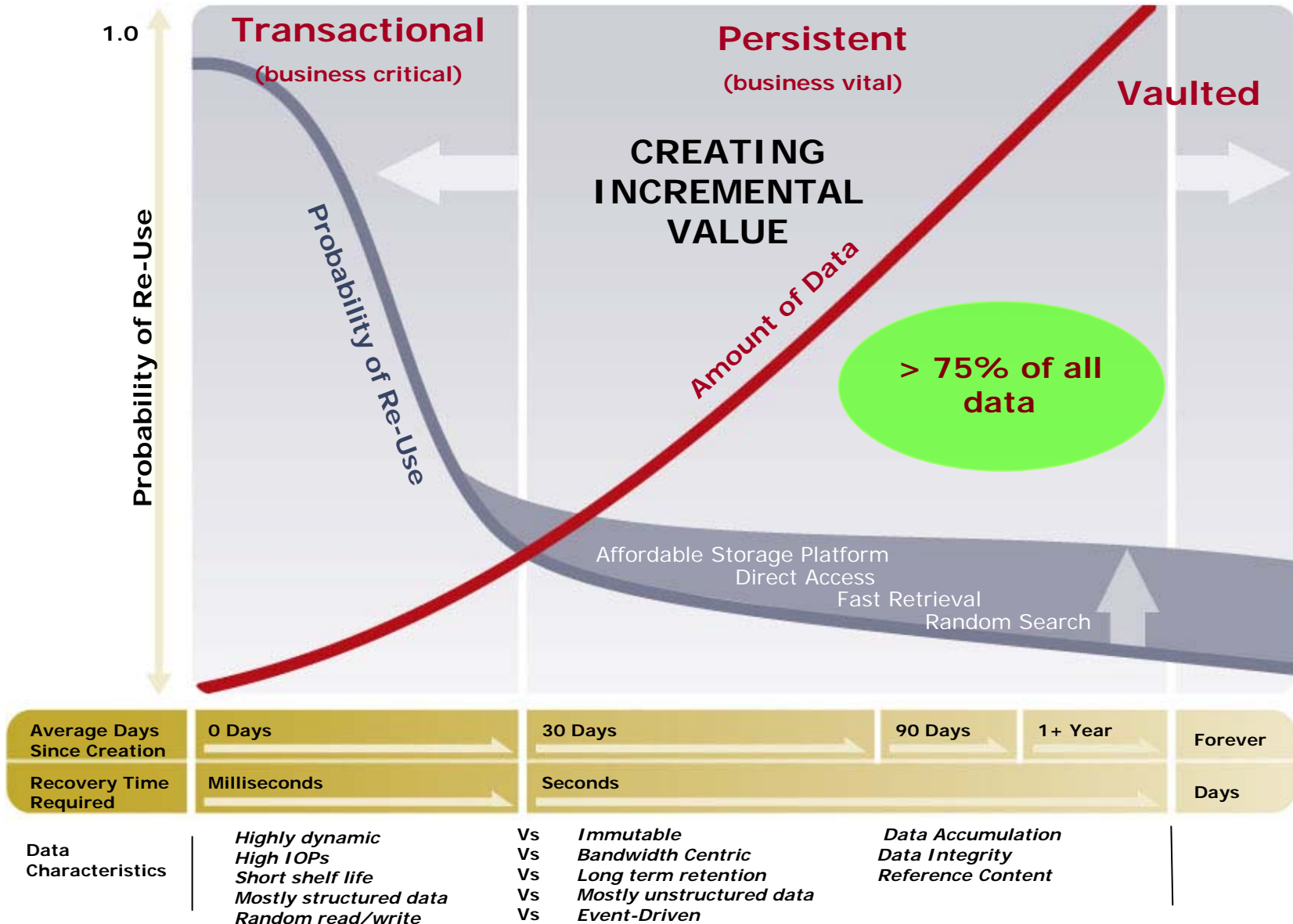
The Data Challenge!

More new information created over the next 2 years than in all previous history

93% of **NEW** content is born digital



Different Data—Different Needs



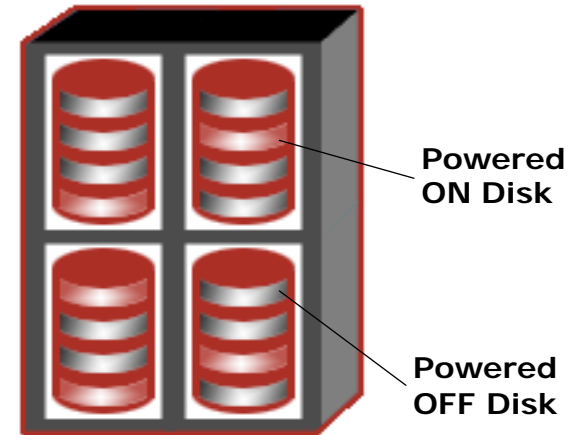
MAID: Power-Managed Disks

MAID

- ◆ Large number of power-managed disks
- ◆ More than 50% of drives powered off
- ◆ Power cycling by policy
- ◆ Lower management and environmental costs, and longer drive life

Enhanced MAID: Enterprise Focus

- ◆ Drives fully powered off when not needed
- ◆ RAID protection*
- ◆ Significant Power Savings
- ◆ Higher Drive Reliability*
- ◆ Data Reliability and Integrity*









SNIA Definition

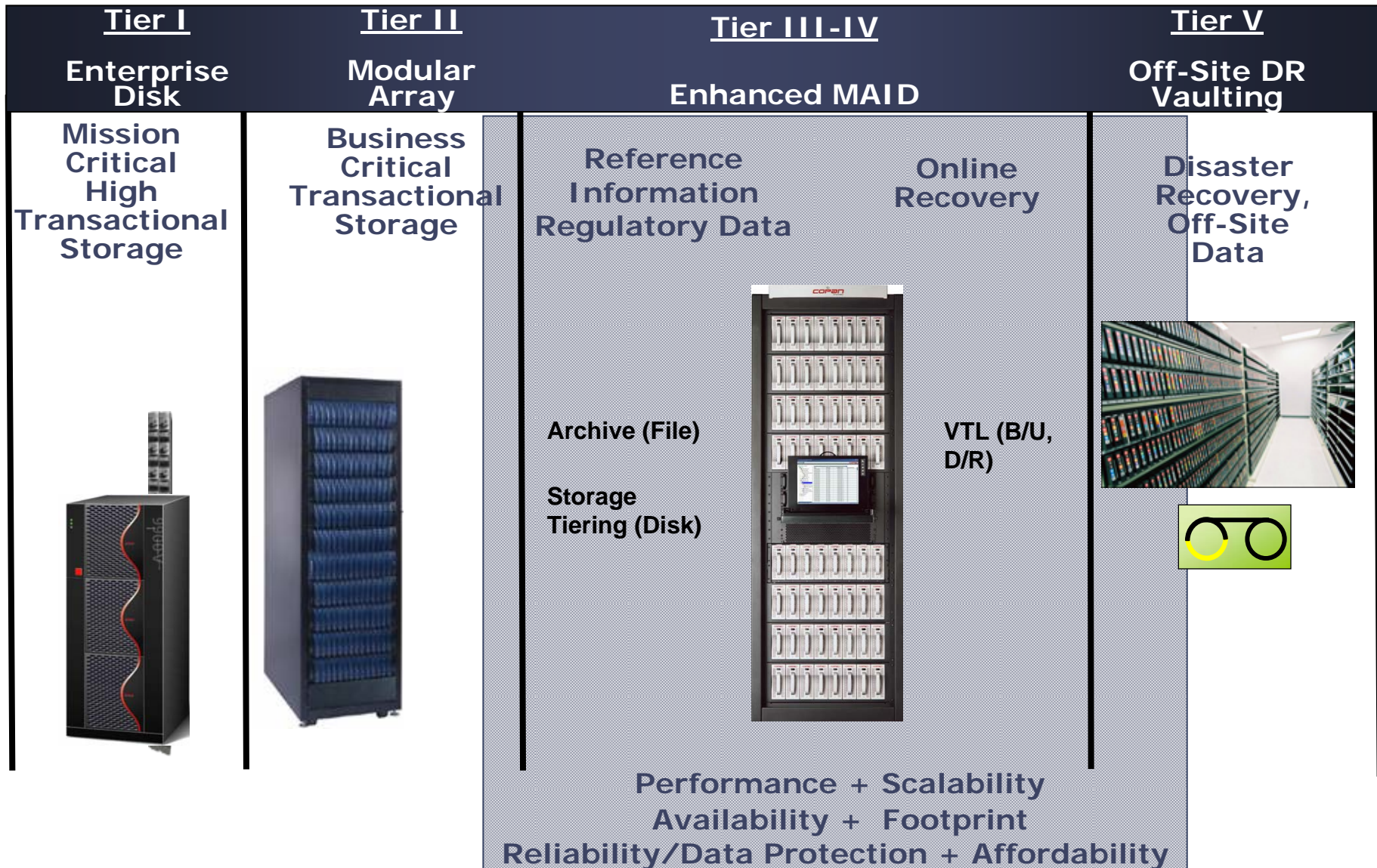
"A storage system comprising an array of disk drives that are powered down individually or in groups when not required. MAID storage systems reduce the power consumed by a storage array."

**Use of specialized software for monitoring and improving disk and data reliability*

Current Tiered Storage Concept

<p><u>Tier I</u></p> <p>Enterprise Disk</p>	<p><u>Tier II</u></p> <p>Modular Array</p>	<p><u>Tier III</u></p> <p>Object-Based File</p>	<p><u>Tier IV</u></p> <p>Backup/Recovery</p>	<p><u>Tier V</u></p> <p>Off-Site DR Vaulting</p>
<p>Mission Critical High Transactional Storage</p> 	<p>Business Critical Transactional Storage</p> 	<p>Low Cost SATA</p> 	<p>Online Recovery</p> 	<p>Disaster Recovery, Off-Site Data</p>  
<p>Performance</p> <p>Availability</p>	<p>Data Protection</p>	<p>Reliability</p>	<p>Scalability</p> <p>Footprint</p>	<p>Affordability</p>

New Storage Tiers



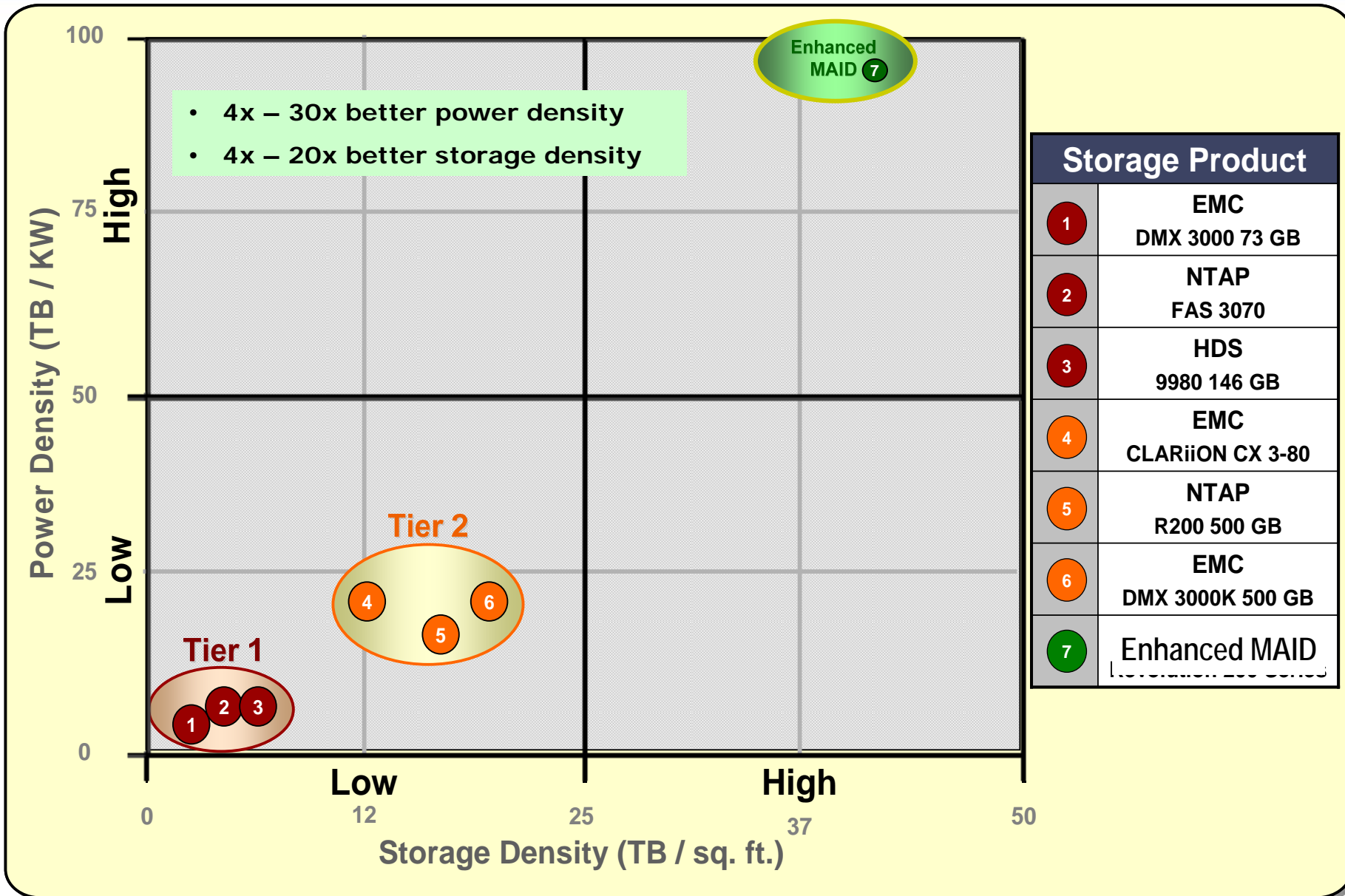
MAID* Benefits: Comparison



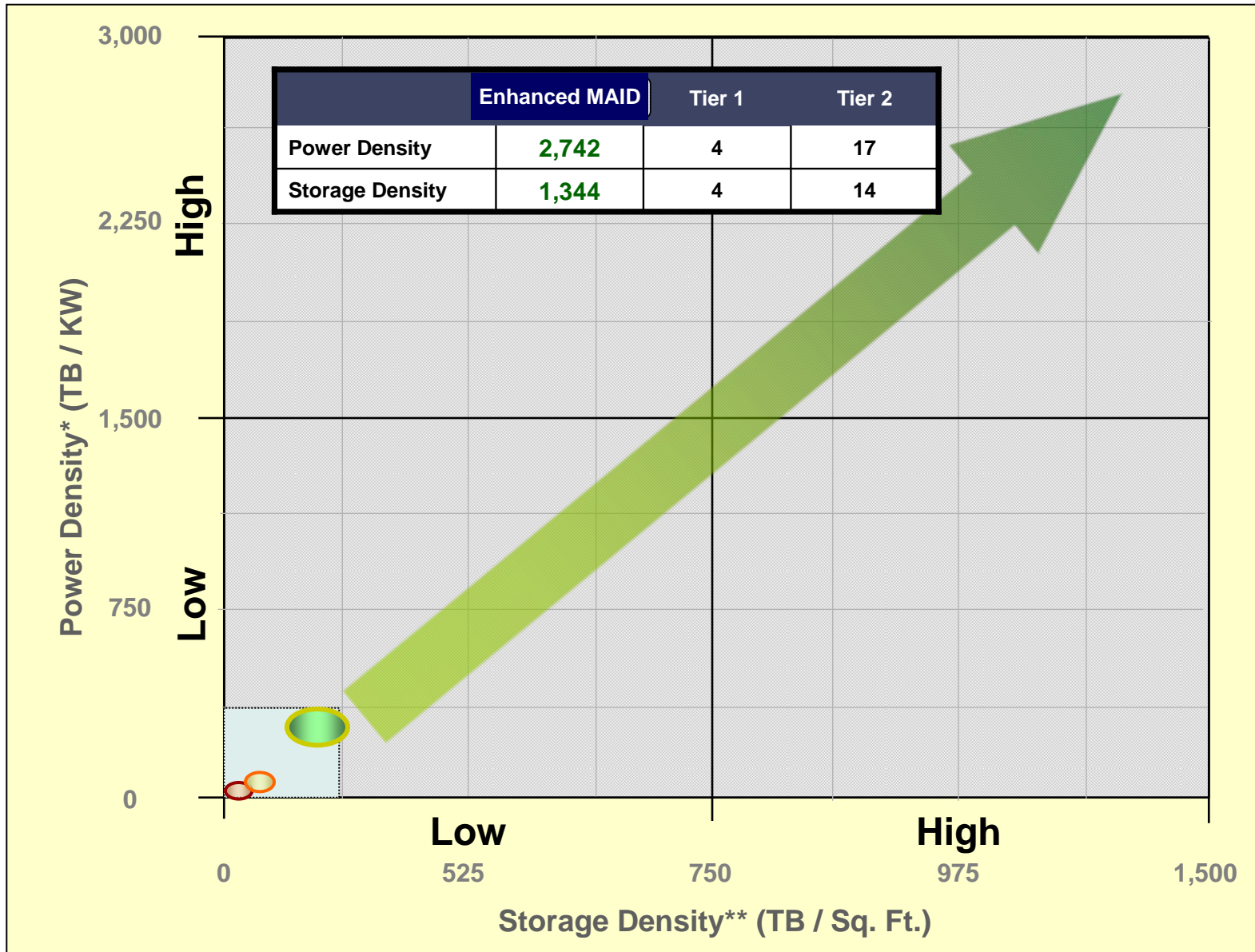
Versus Disk	Versus Tape
6x Better Drive Reliability	20x Faster Data Access
6x Higher Capacity in a single footprint	55% Reduction in Backup Times
32x Better Data Protection than Standard RAID	40% Increase in Recoverability from Backup Jobs <small>(from 60% before to 100% after)</small>
Unmatched Reliability & Self Healing	No Data Loss Due to Media Degradation
At Least 85% Better Power & Cooling	At Least 42% Better Power & Cooling
Product Life of 7+ Years	Product Life of 7+ Years
Assured Drive Health and Data Integrity	Assured Data Integrity

* Defined as Enhanced MAID systems where drives are fully powered down

Power Efficiency Quadrant



Power Efficiency Quadrant De-duplicated Capacity



MAID vs. Tier 1 FC and Tier 2 SATA Disk Storage

	Enhanced MAID	Tier 1	Tier 2	Percentage Improvement
Power Density (TB / KW)	91.40	4.08	17.44	2140% / 424%
Storage Density (TB / sq. ft.)	44.80	3.62	13.68	1138% / 228%

- The power consumption advantage of enhanced MAID systems is in its power density and can be measured in terms of capacity per unit of power, or TB/KW.
- Comparison based on actual data sheets of all storage classes.

Ref.: A. Guha, Solving the Energy Crisis in the Data Center Using COPAN Systems' Enhanced MAID Storage, COPAN Systems White Paper, November 2006.

Real World Measurements

- Tested MAID against 4 Tier 1 and 4 Tier 2 disk arrays
- Measurements exceeded energy savings estimates

Storage Tier	Projected				Measured*			
	Drive Size (GB)	Power Density (TB/KW)	Watts / TB	Energy Savings with MAID (%)	Drive Size (GB)	Power Density (TB/KW)	Watts/ TB	Energy Savings with MAID (%)
Fibre Channel	73/146	4.1	244	96%	146/300	3.5	286	97%
SATA	500	17.4	57	81%	500	5.4	185	95%
Enhanced MAID	500	91.4	11		500	107.6	9	

**Measurements from actual power consumption measurements conducted over a three week period, by an independent, large data center. Multiple vendor products besides COPAN Enterprise MAID were tested.*

An Average Fortune 1000 Enterprise

The Avg. F1000 Company Has...

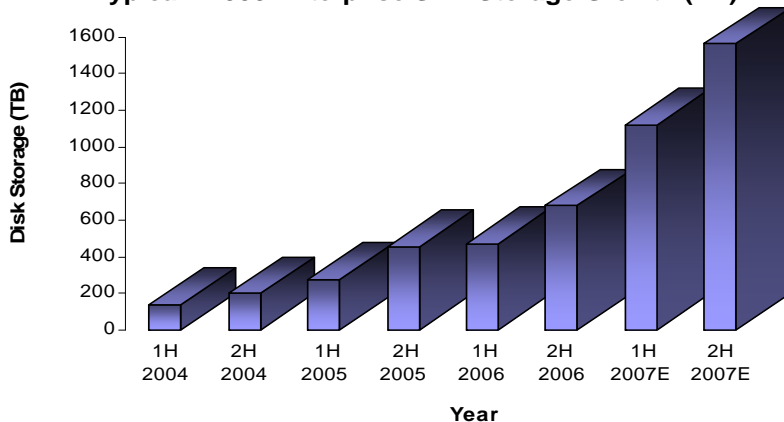
680 TB of data stored on disk

- 60% Fibre Channel
- 40% SATA

Avg. F1000 disk storage growth:

- Data is **doubling** every 10 months
- At this rate - **680 TB in 2006 will grow to over 8 PB by 2009**

Typical F1000 Enterprise SAN Storage Growth (TB)



Average F1000 data stored on disk
(Source: *The InfoPro, Storage Survey Wave 8, 10/06*)

Persistent Data Migration to Enhanced MAID ...

50% Migration

- First year = \$470,000
- Fourth year = **\$5,700,000**
- Cumulative 4 years savings over **\$10,000,000**

75% Migration

- First year = \$640,000
- Fourth year = **\$7,800,000**
- Cumulative 4 years savings over **\$13,000,000**

Source: *The InfoPro Storage* Wave 3 (Spring 2004) to Storage Wave 8 (Fall 2006)

All applicants must submit a Customized ENERGY EFFICIENCY/DEMAND RESPONSE INCENTIVE APPLICATION and at least one of the following project forms:

Non-Residential Projects

- NEW CONSTRUCTION/ADDITION – Attach NRNC Form
- Design Team – Attach NRNC-DT Form if applicable
- RENOVATION/RETROFIT – Attach NRR-DR Form

Residential Projects

- NEW CONSTRUCTION
- Performance Method – Attach RNC-ES Form if applicable
- Prescriptive Method – Attach RNC-PC Form if applicable

HOW TO APPLY

1. READ TERMS AND CONDITIONS ON:

- The back page of the Application
- The Project Form(s) that apply to your project(s)

2. COMPLETE:

- Applicant Information and Project Type on the Application
- (If applicable) Payment Section on the Application, if payment is to be paid to a party other than the Applicant
- Project Information and any calculations required by the Project Form(s)

3. SIGN:

- The Agreement on the Application
- (If applicable) The Payment Release Authorization on the Application, if incentive is to be paid to a party other than the Applicant
- The Agreement(s) on your choice of Project Form(s)

4. SUBMIT:

- The Application
- Your choice of Project Form(s)
- All required documentation pertaining to your project

FOR YOUR INFORMATION AND ASSISTANCE

You must contact a PG&E representative prior to submitting applications and other required documentation in order to participate in PG&E's Customized Energy Efficiency/Demand Response Incentive.

Non Residential Projects:

Contact Business Customer Center at 1-800-468-4743.
Email: energymgmtprograms@pge.com

*Customized Energy
Efficiency/Demand Response*

I•N•C•E•N•T•I•V•E
Application Instructions



**Pacific Gas and
Electric Company®**

Power and Cooling Calculator



Calculator Output

ENERGY SAVINGS CALCULATOR

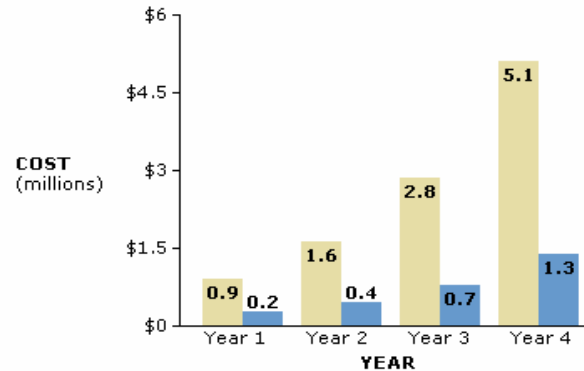
[Request a detailed Power and Cooling analysis!](#)

STEP 3 of 3

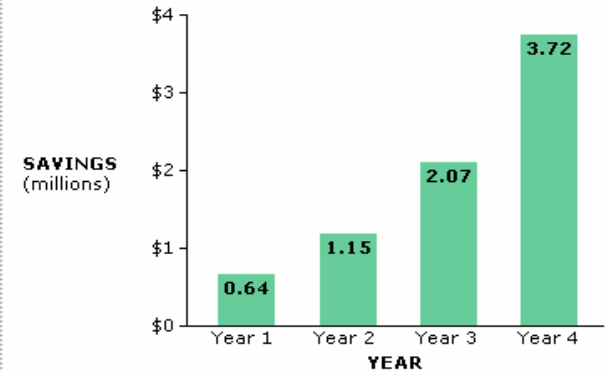
RECOMMENDED MIGRATION

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**Power and Cooling Cost Comparison
(Current Environment vs. Recommended Migration)**



Annual Power and Cooling Savings



Recommended Migration to Enhanced MAID = 75%

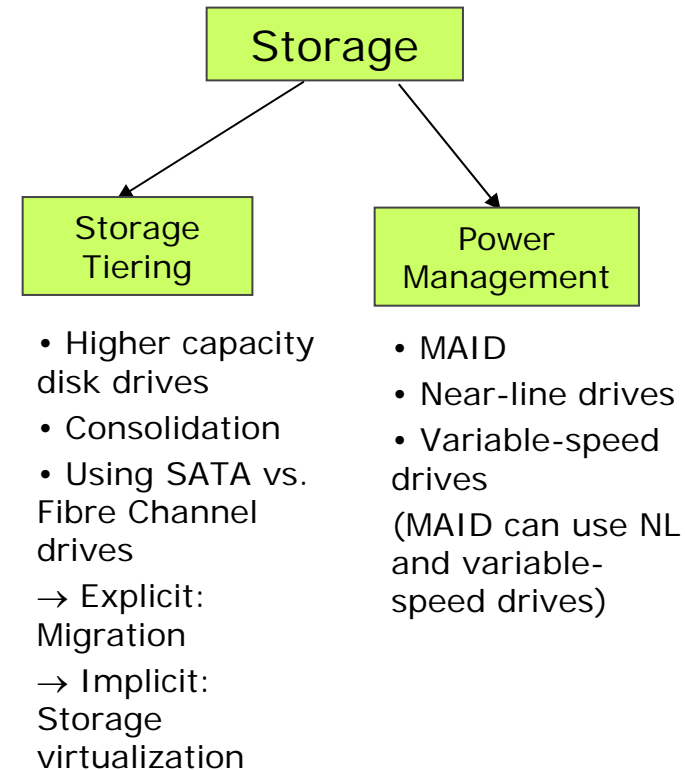
	Year 1	Year 2	Year 3	Year 4
Current Costs	\$867,521	\$1,561,537	\$2,810,767	\$5,059,380
Cost After Migration to MAID	\$229,996	\$413,993	\$745,186	\$1,341,336
Total Annual Savings	\$637,525	\$1,147,544	\$2,065,581	\$3,718,044

CUMULATIVE 4 YEAR SAVINGS **\$7,568,694**

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Steps to Save Storage Energy Consumption

- **Tier Your Data**
 - ◆ Recognize most data is persistent, not transactional
- **Move Persistent Data to MAID**
 - ◆ Data Protection: Backup/DR
 - ◆ Archive
 - ◆ Application Tiered Storage
- **Consolidate persistent storage**
 - ◆ Higher efficiency, better economics
 - ◆ Higher capacity drives
- **Deleted unwanted data**



- **Educate your data center users about storage energy savings options**
- **Set up an Incentive Programs for encouraging adoption of MAID**
- **Leverage work already done by other utilities who have set up programs with data center customers**



Thank You