

Less Energy. More Reliability.  
More Performance.



# Green SSD

2009. October

Semiconductor Business  
**SAMSUNG** Electronics

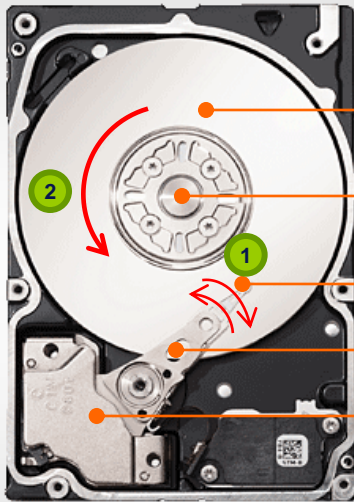


# Why SSD performance is faster than HDD?



- **HDD has long latency & late seek time due to mechanical operation**
  - SSD does not have both latency and seek time

## 15K RPM 2.5" SAS HDD



Platter

Spindle

Head

Arm

Actuator

① Seek time : ~ 3.1msec

② Latency : ~ 2.0msec

## Advantage and disadvantages of High RPM HDD

### Advantage

- Low latency & seek time → High performance

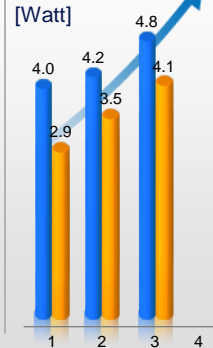
● Seek time  
● Avg. Latency



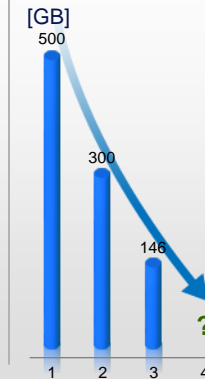
### Disadvantages

- More Power consumption
- Downsize Max. Capacity to reduce air drag
- More Noise
- Worse Shock condition (70Gs@7.2K → 60Gs @15K)

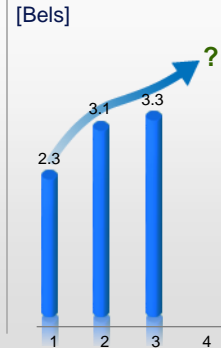
● Active  
● Idle



● Max. Capacity GB



● Acoustics

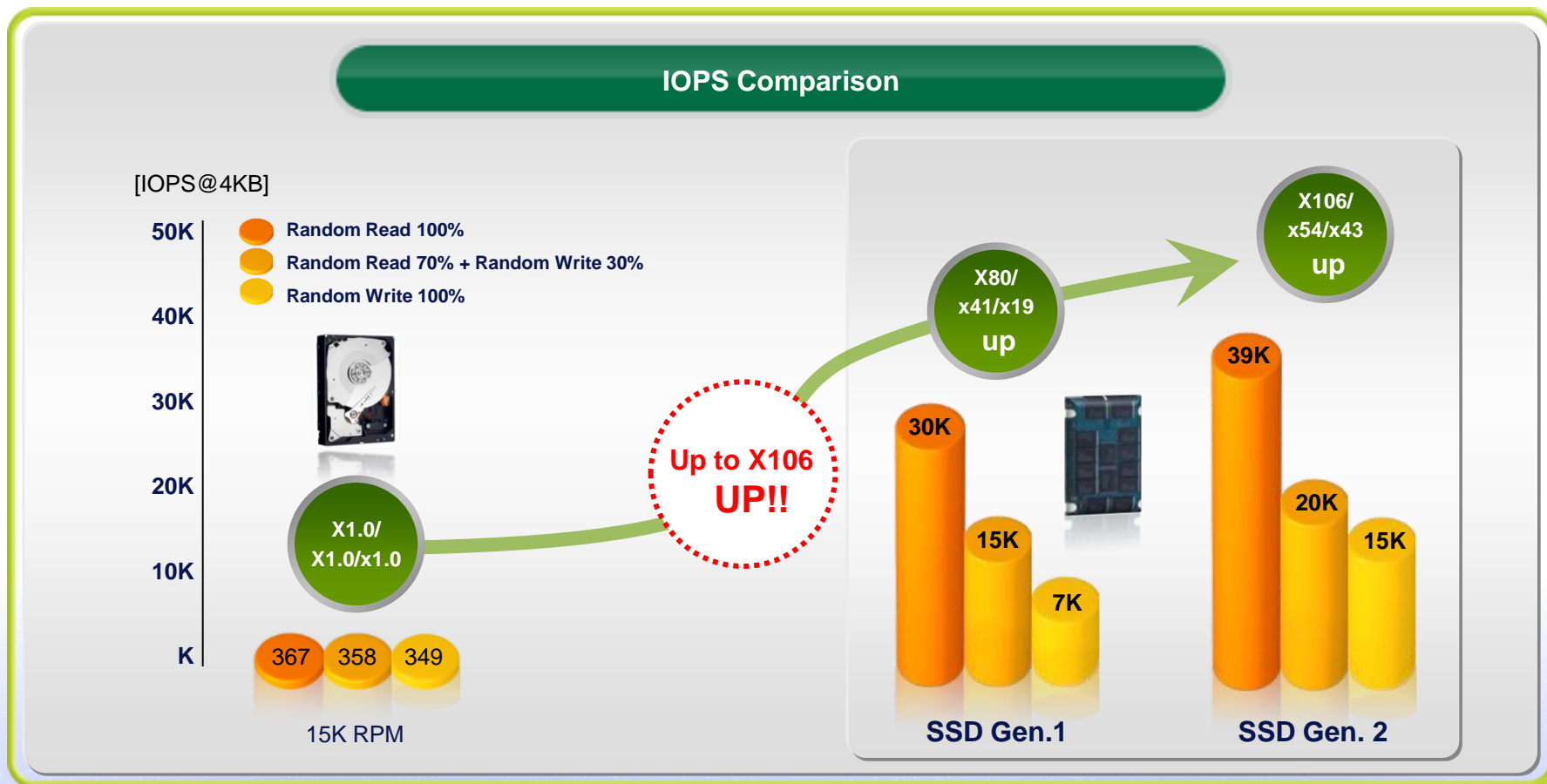


\* All HDD values are based on available datasheets. It can be varied under different test circumstances and preconditions.  
(1)7.2K RPM HDD (2)10K RPM HDD (3)15K RPM HDD (4) >15K RPM HDD

# SSD vs HDD IOPS Performance comparison



- **Samsung SSD outperforms 15K RPM HDD in performance**
  - Samsung SSD is up to x106 faster than HDD in IOPS performance



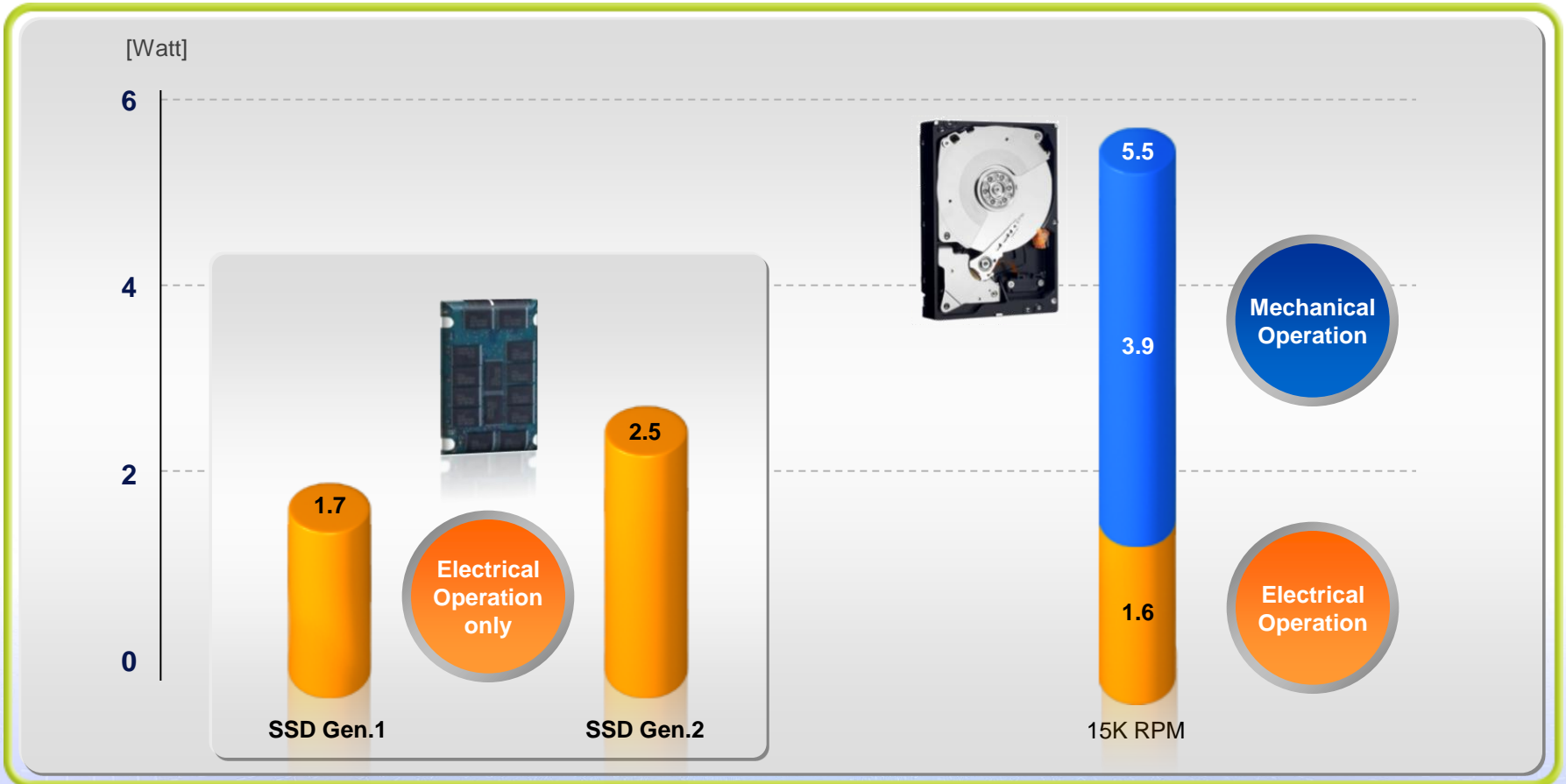
\* SSD performance is based on SEC test result and 15K RPM SAS HDD performance is based on available spec.

\* All test result can be varied under different test circumstances and preconditions.

# Why SSD power consumption is lower than HDD?



- **HDD has mechanical parts, Spindle & Arm motor to operate**
  - Without mechanical parts, SSD saves power to operate



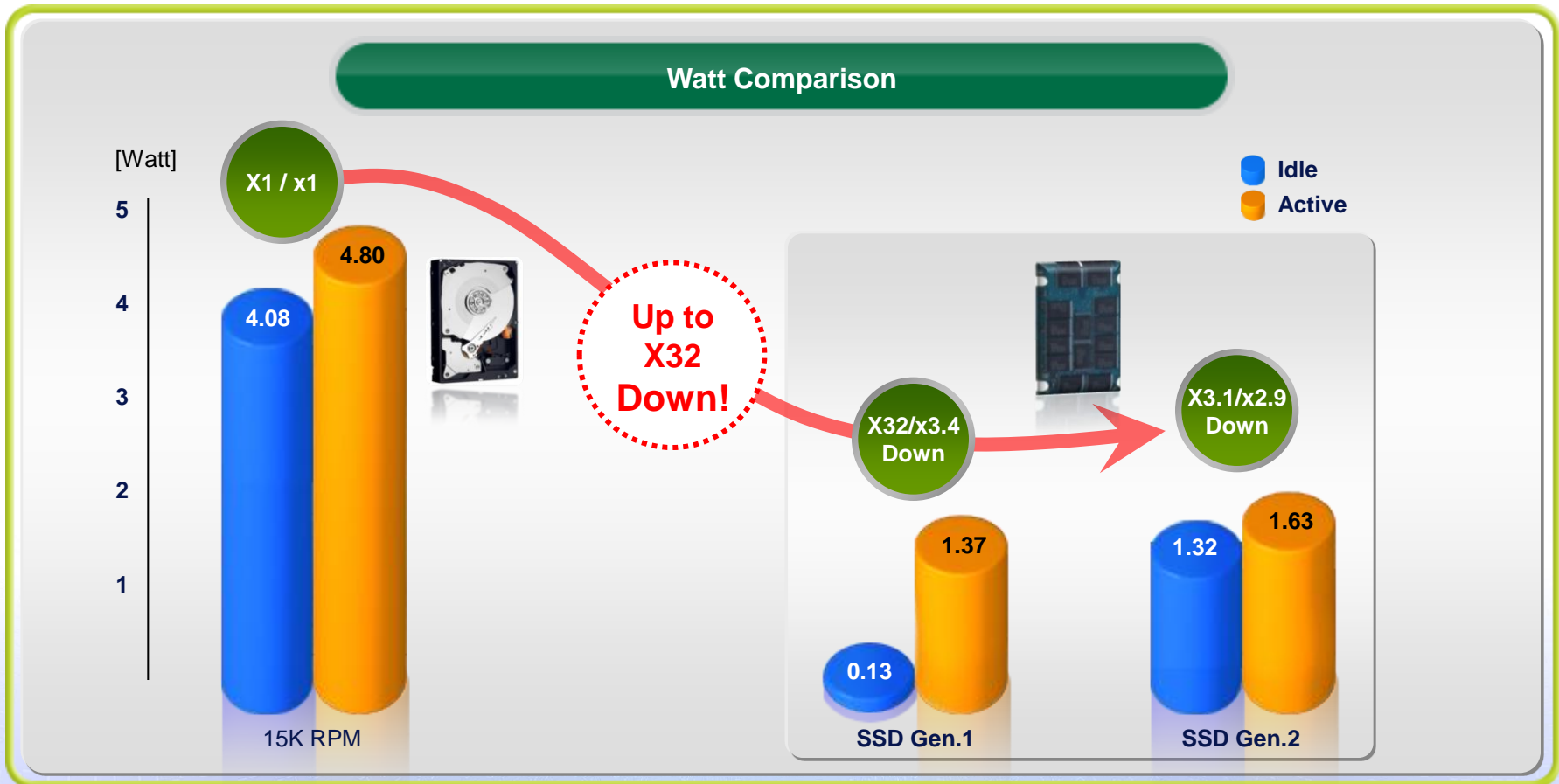
\* SSD and 15K RPM HDD power consumption is based on SEC test measurement.

\* All test results can be varied under different test circumstances and preconditions. SSD Gen.1 is 2.5" and Gen.2 is 3.5" form factor.

# SSD vs HDD power consumption comparison



- **Samsung SSD vs 15K RPM HDD power consumption**
  - Samsung SSD can save up to x32 power consumption than 15K HDD



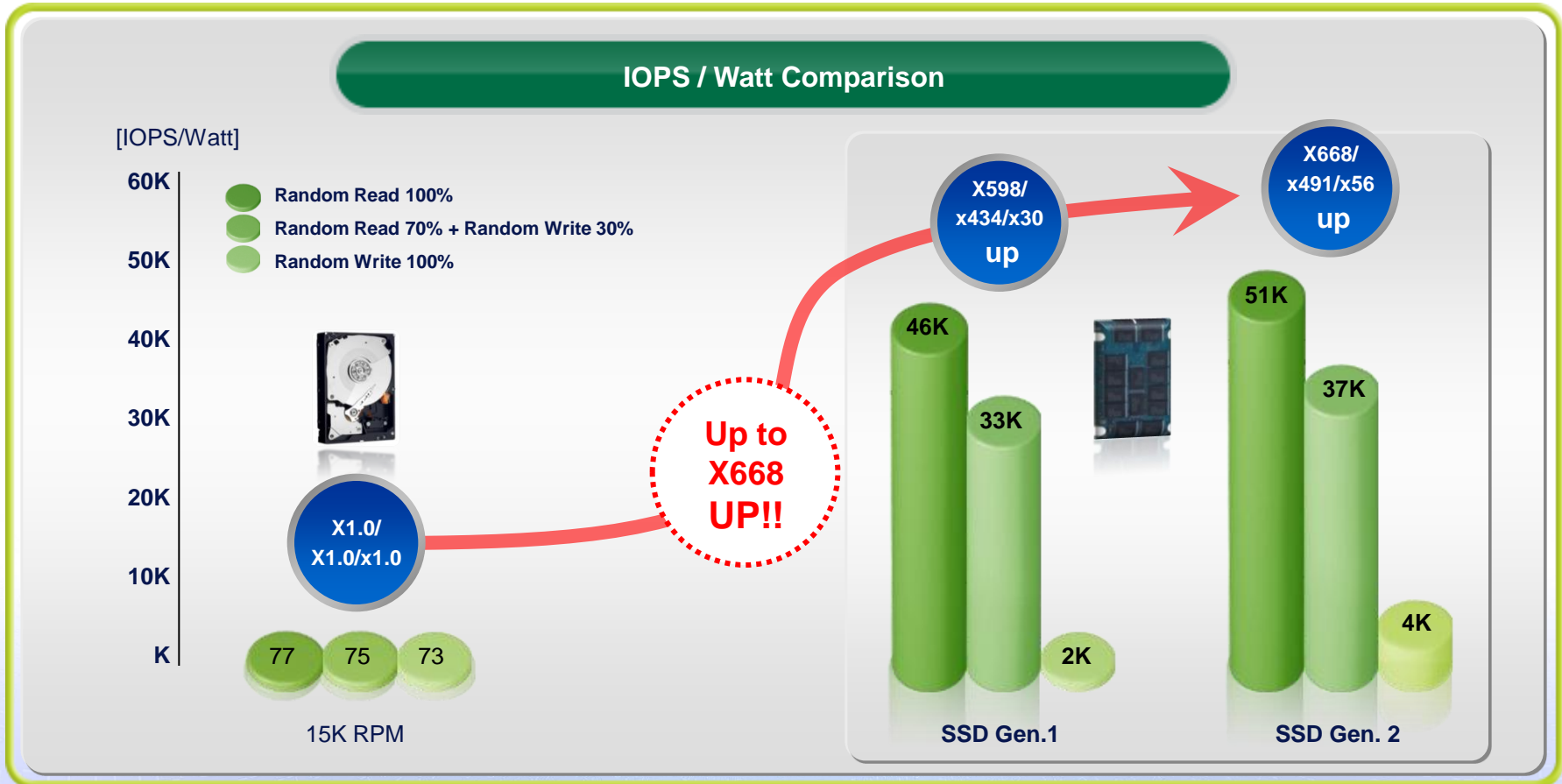
\* SSD Power consumption is based on SEC test result and 15K RPM SAS HDD power consumption is based on available spec.

\* All test result can be varied under different test circumstance and preconditions.

# SSD vs HDD – IOPS/Watt comparison



- **IOPS/Watt makes bigger gap in Samsung SSD vs 15K RPM**
  - SSD IOPS/Watt is up to x668 higher than 15K RPM



\* All SSD test result is based on SEC measurement. Performance result can be varied under different test condition and FW change.

\* 15K RPM HDD power consumption is based on available spec.

\* Configuration : CPU - 1.86Ghz Quad Core / HBA- PERC6.2 / RAM- DDR2 FBDIMM 4GB  
OS - Windows 2003 Server / Test Program- IOMETER / Q-depth 32

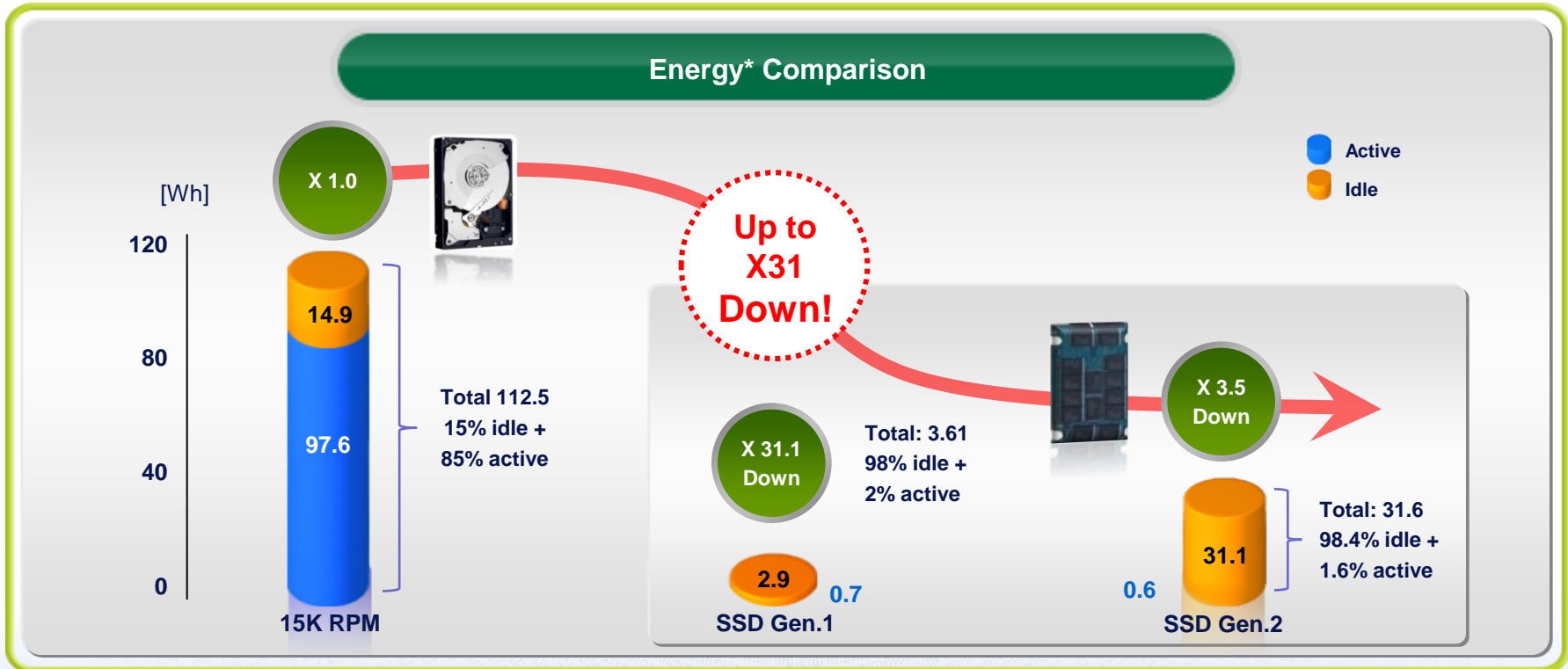
SAMSUNG

Higher performance with less power, Green **SSD!**

# SSD vs HDD – Energy Cost Comparison



- For example, let's assume there is same 10GB workload (4KB Ran. R 70% / 4KB Ran. W 30%) and operate SSD and HDD in 24hours



\* All SSD test result is based on SEC measurement. Performance result can be varied under different test conditions and FW change.

\* 15K RPM HDD power consumption is based on available spec.

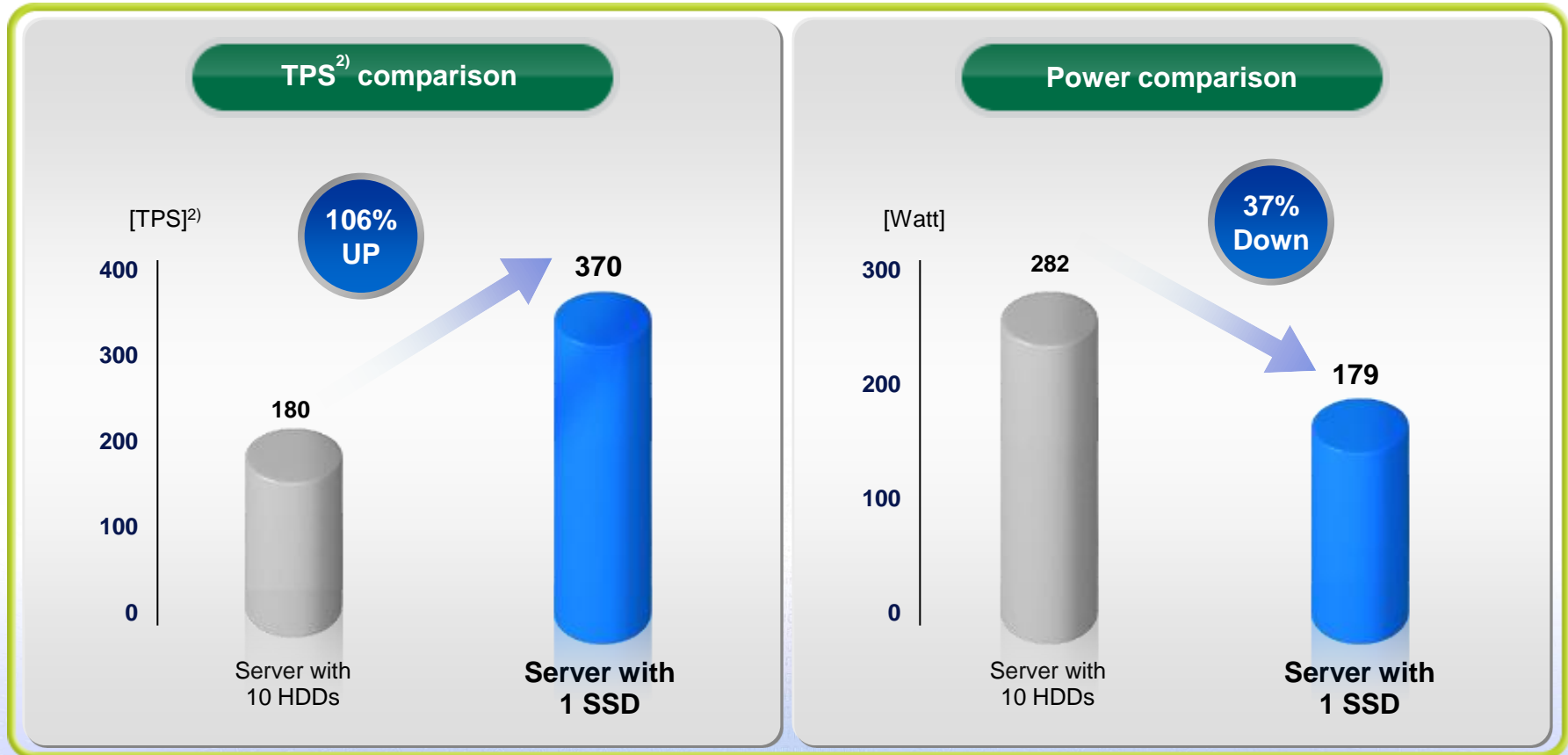
\* Configuration: CPU- 1.86Ghz Quad Core / HBA- PERC6.2 / RAM- DDR2 FBDIMM 4GB  
OS - Windows 2003 Server / Test Program- IOMETER / Q-depth 32

- SSD finishes the workload much faster and goes to idle, but HDD spends time mostly in active mode and have less idle**

# Case Study 1 : Server in OLTP application



- **One Samsung SSD can beat 10 Enterprise HDDs in OLTP<sup>1)</sup>**
  - Increasing I/O transactions (106% improvement)
  - Saving Power (37% power reduction)



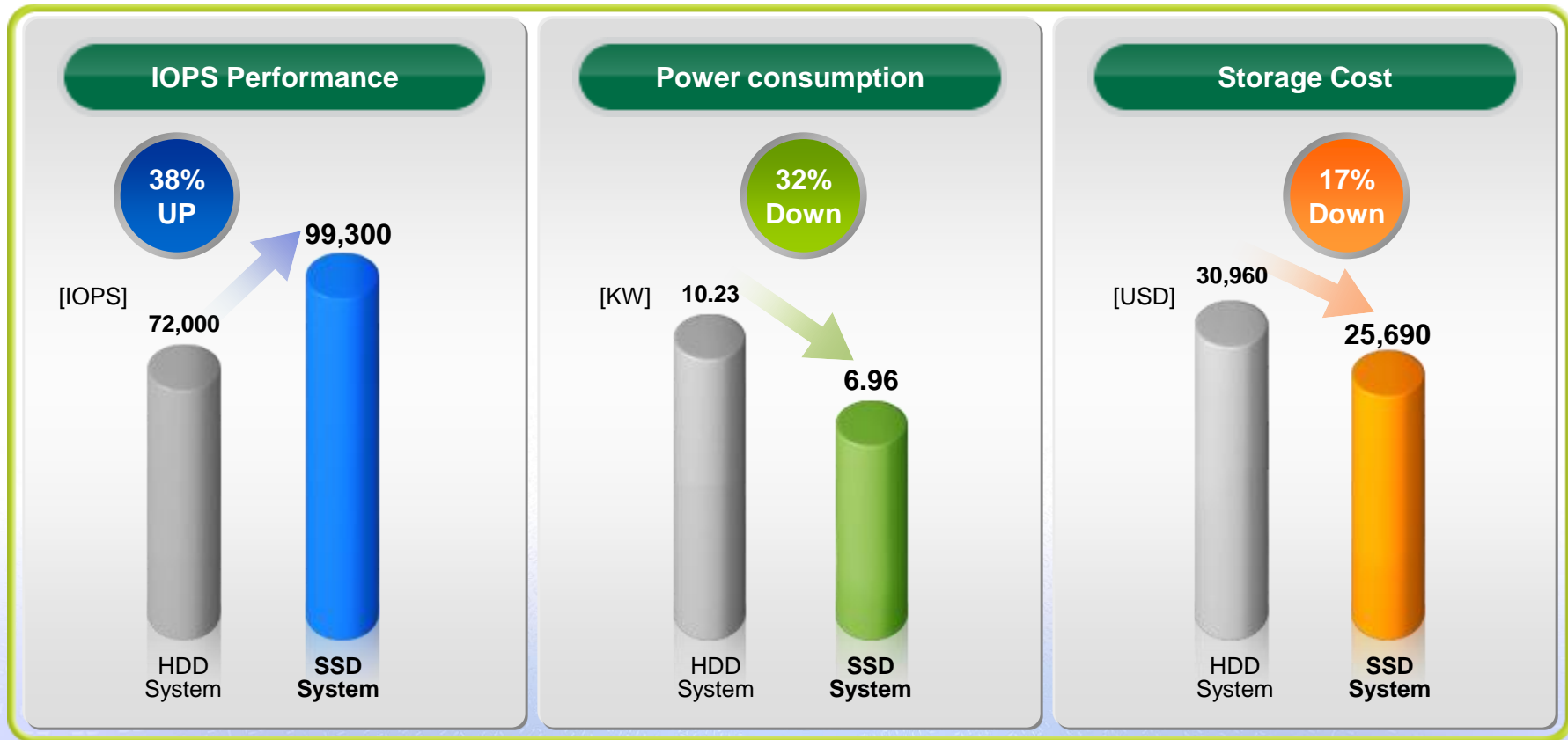
\* OS : Oracle Enterprise Linux 5.1  
\* DBMS : Oracle Database 10g R2(10.2.0.1.0) for Linux x86  
\* TPC-C Benchmark Software: BMFactory  
\* Source : SKKU VLDB lab.

1) OLTP : Online Transaction Processing  
2) TPS : Transaction Per Second

# Case Study 2 : Enterprise Storage system



- **Samsung SSD values in enterprise storage system**
  - Higher IOPS performance : 38% improvement
  - Lower Storage Cost : 17% Savings
  - Less Power Consumption : 32% Reduction



\* HDD System : 240 x 300GB 15K FC Disks

\* SSD System : 8 x 200GB SSD + 120 x 400GB 10K FC Disks + 24 x 1TB SATA

\* Source : Samsung & EMC

SAMSUNG

Higher performance with less power, Green SSD!

# Best Storage Configuration Practice



- Experience how Samsung SSD could save \$/IOPS, Watt/IOPS
- Visit the website :
  - SSD : [www.samsung.com/ssd](http://www.samsung.com/ssd)
  - Calculator : [www.samsung.com/global/business/semiconductor/products/flash/ssd/2008/calculator/calculator.html](http://www.samsung.com/global/business/semiconductor/products/flash/ssd/2008/calculator/calculator.html)

**Green Savings Calculator**

01. How many TB do you require in your storage system?

160TB

5TB 300TB

02. Compose your storage system choosing between SSD, 15Krpm HDD and/or 7200rpm HDD storage capacity with SSD or HDD should equal to 100% (Select each storage density first, then adjust percentages)

Enterprise SSD 100%

100 GB

15Krpm FC HDD 0%

300 GB

7200rpm SATA HDD 0%

100 GB

03. Results

3X Savings

574.9X Savings

\$/IOPS Watt/IOPS

Reference 100% filled with 146GB 15Krpm FC HDD.

	\$/IOPS	Watt/IOPS
Configuration	0.153846	574.912
Reference	0.457142	0.04714

IOPS Input/Output Operations Per Second

Assumption: IOPS based on 70:30-Read: Write workload scenario, Power number comes from datasheet, Price is based on Garbar 2009  
Notice: Samsung does not make any representations regarding the use, validity, accuracy of reliability of the calculator. The results of the use of this tool are for illustrative purposes only.

GREEN DDR3 | Semiconductor Home | Legal | Contact us

Copyright© 1995-2008 SAMSUNG. All rights reserved.



# SSD Roadmap



E/S C/S M/P

4Q, 2009

Year Model	F/F	Density (GB)	2009		2010				2011		
			Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	
SS805	2.5"	100/50	5xnm, 8Gb SLC								
SS1605	2.5"	200/100	4xnm, 8Gb SLC								
SS1625*	2.5"	400/200	3xnm, 16Gb SLC								

Less Energy. More Reliability.  
More Performance.



Thank you

