Technical White Paper

How ETERNUS DX contributes to energy efficiency, cost savings and a human-centric intelligent society

Energy efficiency was never more important than in our times of rising energy costs. Fujitsu ETERNUS DX disk storage systems provide good answers to this challenge. They are equipped with many eco-conscious features, which save you money and contribute to society.

Content

Why energy-efficient IT systems have become a focus topic

As energy costs have been rising, companies' electricity bills have become a major topic. IT departments are a big contributor to that bill, as well as to the company's overall carbon footprint. They run power-hungry equipment, which is over-provisioned in many cases in order to avoid system outages.

In the race to satisfy increasing demand for computing power, many organizations have equipped their data centers with power-hungry servers. The harder these machines work, the hotter they become, so equally power-hungry cooling systems are required in order to prevent them from crashing. This in turn brings about another challenge: adding further servers requires more floor space; the storage environment can also be improved.

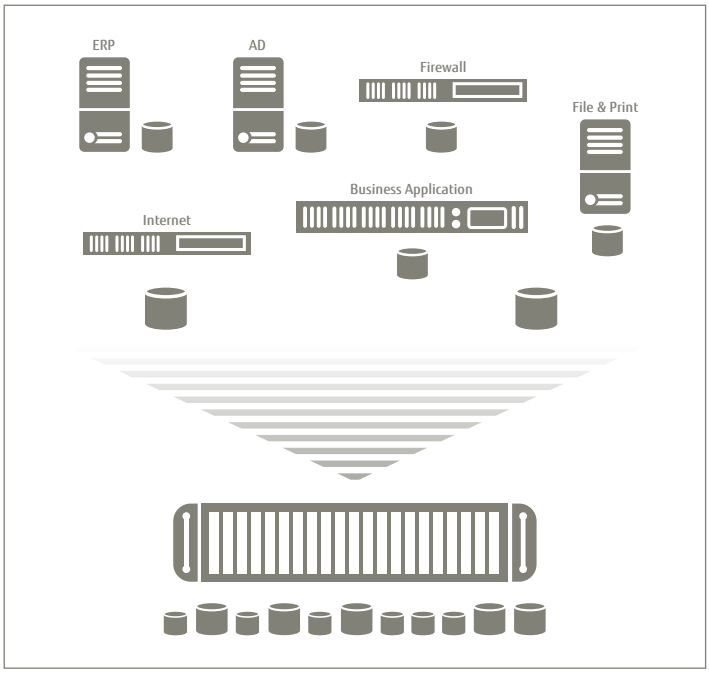
Fujitsu in general and ETERNUS DX disk storage systems in particular, provide reasonable answers to these challenges, whilst also being eco-friendly.

> "Optimization leads to reduced expenses and this is a fundamental step towards companies becoming more competitive, more profitable, and better able to weather the ups and downs in the economy. Simply put, companies that embrace environmental efficiency are simply better-run than those that do not."
>
> **Vernon Turner,** Senior Vice President of Enterprise Infrastructure, Consumer, Network, Telecom and Sustainability Research at IDC

More efficiency through consolidation and virtualization

One of companies' top priorities is consolidating the data center. IT infrastructures that have evolved historically are not only energy-consuming, they are also expensive to operate. Implementing an external storage system and consolidating data, which was formerly distributed across several servers, can improve performance, backup processes, the usage of energy and – in the end – it decreases costs enormously. As consolidation means having all your eggs in one basket, it requires performance and reliability, which ETERNUS DX can deliver.

> "Thanks to virtualization and Fujitsu's stable storage systems, our IT runs securely and smoothly – and the performance is exceptional. We felt that we were in good hands during the consulting process."
>
> **Frank Rabe,** Acting National Chief Executive, DLRG

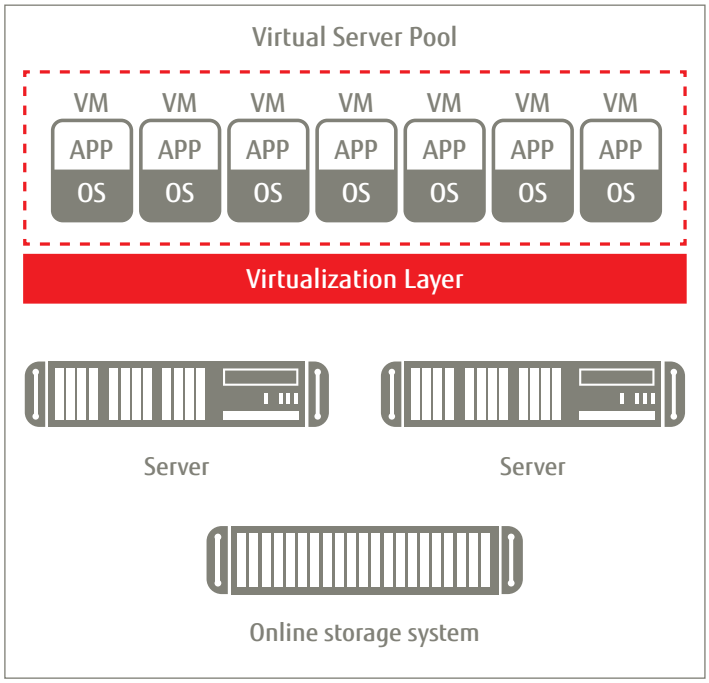


Consolidating data on a central storage system

When going for virtualization, a consolidated environment is the perfect basis to start with. This kind of infrastructure makes it easier to implement virtualization, which helps drastically reduce hardware, save energy and therefore lower costs.

But as virtual machines are only files on a storage system, a reliable, high-performance storage system like ETERNUS DX is a must, because if the storage system is down, so too are the virtual servers.

So consolidation and virtualization are important milestones when saving energy costs. But that is not enough.



Implementing virtualization

How to save energy and costs with ETERNUS DX

Increasing energy costs in data centers are also making storage decision makers more conscious about energy efficiency. Many companies and IT organizations have experienced massive data growth which needs more storage. They have been used to meeting those demands by adding additional servers or storage systems. At the same time, they are also required to increase power, space, and cooling systems which create other challenges for the data center. Therefore, ETERNUS DX disk storage systems have been designed in a way to support energy savings through high density packaging technologies and a whole set of energy saving functionalities.

ETERNUS DX systems improved performance while lowering costs.

Energy efficiency by design

An eco-friendly and cost-effective family concept

The ETERNUS DX system family offers a unique family concept using the same hardware and software functionalities within the whole product range. This not only ensures investment protection, it is also very eco-friendly as it allows customers to reuse the existing components when upgrading to a bigger system in case the current system cannot cope with the needed capacity, performance or functionality anymore.

Cooling technology

In hardware devices, the highest amount of power is used for cooling, which is why Fujitsu has made significant technology developments in this area.

Straight cooling is the technology used for almost all products. Fujitsu raises efficiency by arranging heat-generating components in a straight line, which naturally removes obstacles to air flow and allows collective cooling of every heat center.

During active maintenance, components are connected and disconnected on a per-unit basis. This process can allow air to escape the system, thereby disrupting internal cooling. In order to maximize cooling the effect cannot be ignored. In large units, Fujitsu installs flaps that keep gaps closed and maintain steady cooling even during maintenance.

Saving power and space

Fujitsu has a high-density mounting design and significantly reduced parts in the ETERNUS DX S2 models, reducing end-product size by about half that of earlier models. The ETERNUS DX60 S2, for instance, uses 56 percent fewer parts than its predecessor thanks to advancements such as the integration of several functions onto a single CPU.

Moreover, power consumption was halved by using a highly effective power supply module and 2.5-inch SAS drives as well as SSDs (Solid State Drives).

All this was made possible without sacrificing reliability and throughput – we even enhanced reliability and throughput in using SSDs.

SSDs use semiconductor memories for data storage. Since they have no motors or other moving parts, SSDs make it possible to achieve high-speed data access and power savings.

Compared with a 15,000 rpm HDD, an SSD with semiconductor memory offers overwhelmingly higher random I/O performance. This promises considerable effectiveness when used for databases and other applications requiring strong random performance.

The lack of moving parts also makes SSDs considerably more reliable than hard disk drives (HDDs). With ETERNUS DX systems, data stored on HDDs can be shifted to SSDs for improved performance and major power reduction.

Example:

How much rack space and energy is needed to store 50 TB of data?

Disk type	No. of needed disks for 50 TB capacity	Average power consumption [W]	Energy costs per year [US$]*
3.5", 7k, 3 TB	17 (2 shelves)	123	307,19
3.5", 15k, 600 GB	84 (7 shelves)	1168	2919,79
2.5", 7k, 1 TB	50 (3 shelves)	256	640,63
2.5", 15k, 300 GB	167 (7 shelves)	1013	2531,25
SSDs, 800 GB	63 (3-6 shelves)	322	805,47

Findings

1. When comparing 3.5" 7k disks with 2.5" 7k disks, 2.5" disks consume double the power. You also need three times more disks if you choose a 2.5" form factor, but one shelf fits up to 24 2.5" disks as opposed to only 12 3.5" disks.
2. SSDs consume only one third of the power of the fastest 2.5" disks (15k), are available with higher capacities, which saves rack space, and are also faster than 2.5" disks.

Conclusion

A comprehensive storage strategy should include several disk types, which are combined in a smart way. For huge amounts of data without high availability requirements, high capacity 3.5" disk drives with lower performance, and thus a low power consumption, should be used.

Databases and business-critical applications usually demand high performance. For these applications it is worthwhile to save the data on fast SSDs. With regards to power consumption, SSDs are much more cost effective than using fast disk drives. In the above example, by storing 50 TB of data on SSDs you could save about 2000 US$ energy costs per year!

Tiered Storage / Automated Storage Tiering

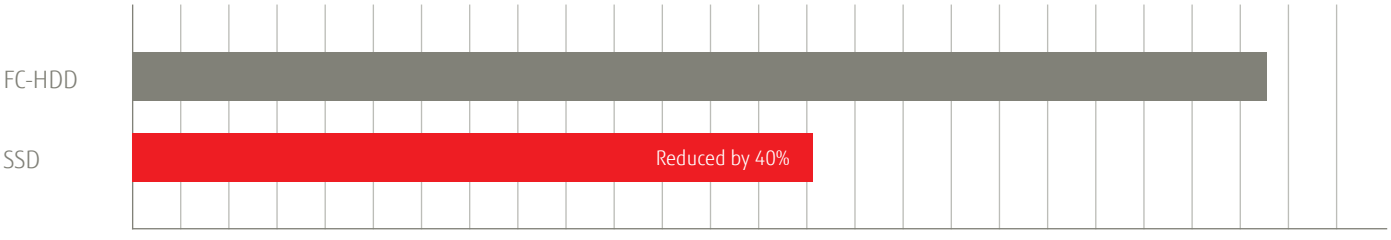
As requirements for storage differ according to the type of data and the frequency of its usage, various types of disk drives need to be supported in order to allocate the right disks for each type of data.

Storing infrequently accessed data on high-performance storage devices generates unnecessary costs. To meet the growing demand for cost-effective storage of less frequently accessed data, Fujitsu provides high-capacity, highly reliable, yet cost-optimized Nearline disk drives in its ETERNUS DX disk storage systems. A smaller number of Nearline SAS disks with high capacity reduce floor space – and also energy consumption and cooling costs.

In addition to manual tiering of data into the appropriate type of disk drives, the ETERNUS DX product family supports Automated Storage Tiering (AST). On the basis of defined rules, AST selects optimal drives and allocates data to suit the value and importance of the data. This means that less important or less used data can be stored on high capacity Nearline SAS drives. Ultimately, it reduces space and power consumption as a result of having less drives.

Power consumption

Fujitsu comparison between SSD and Fibre Channel disk drives (15,000 rpm) in operation.



ETERNUS DX400 series and DX8000 series comparison of power consumption

* Calculating with 2.5 US$ per Watt (Average European price).

Thin Provisioning

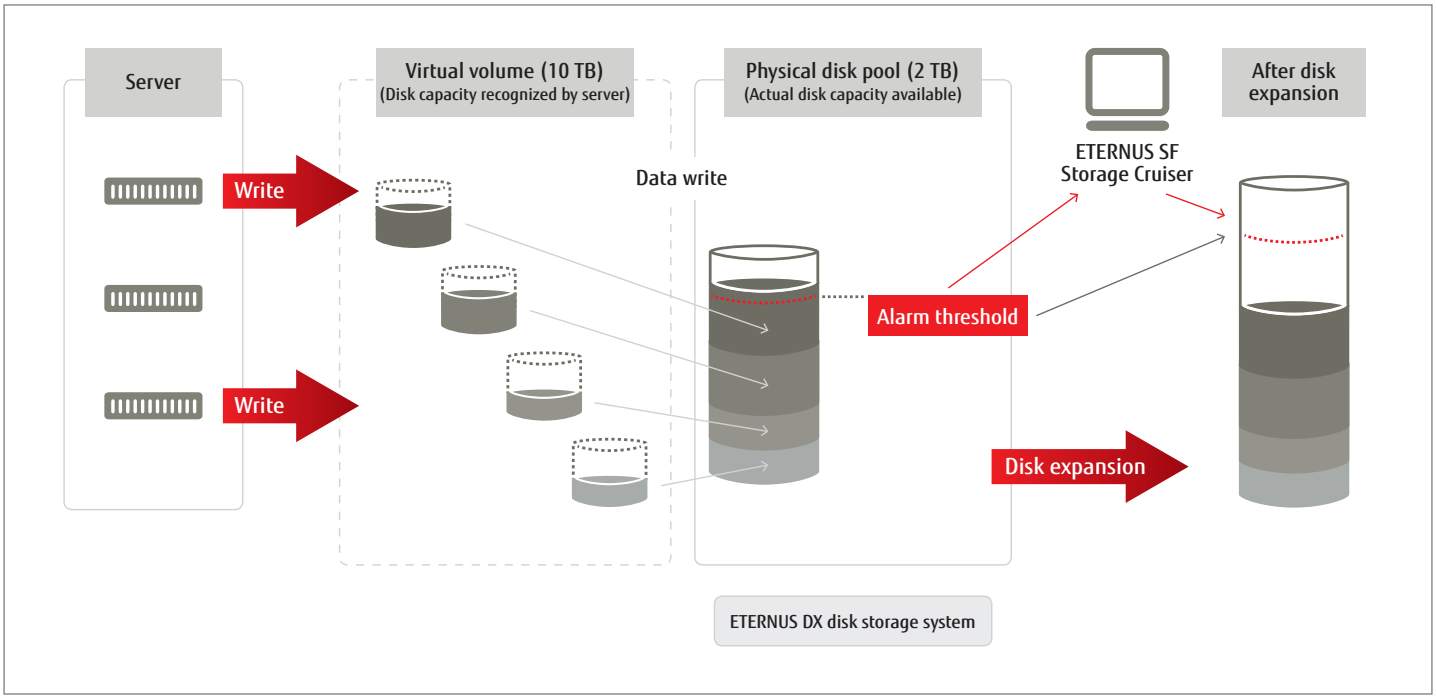
Data growth continues year on year. Due to concerns about having sufficient storage capacity, users tend to deploy more physical storage than they actually need – "just to be on the safe side." However, in practice the allocated capacity is often underutilized. Industry research organizations have even stated that in some cases only 20 percent to 30 percent of deployed capacity is actually used.

Thin Provisioning technology has been developed to enable effective use of available storage capacity for better investment utilization. It reduces physical storage deployment through the use of virtual storage technologies that maximize available capacities.

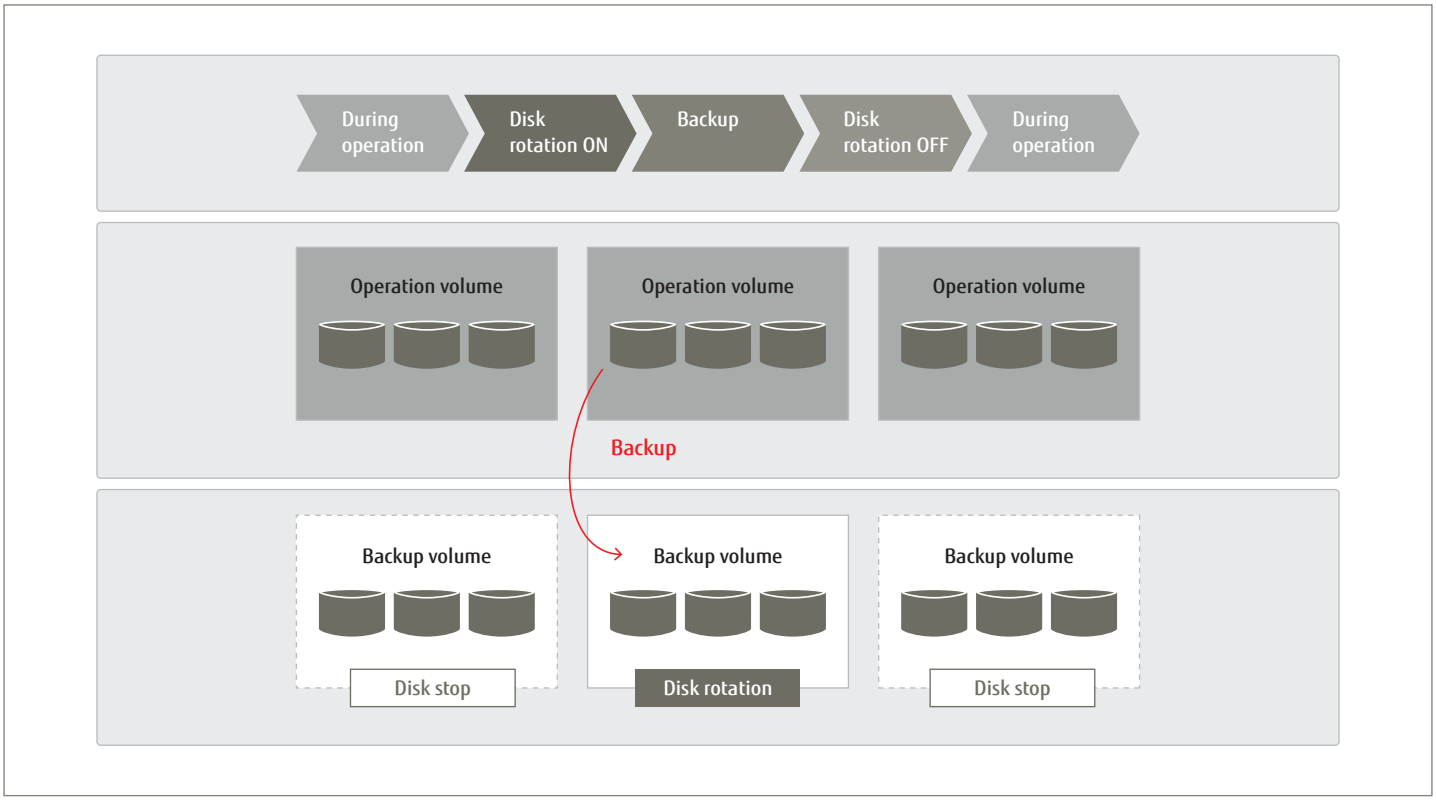
With Thin Provisioning, the total overall user capacity is only allocated as virtual storage. The actual physical disk capacity is allocated as and when it is needed. All physical disks are managed as a single disk pool and allocated according to the amount of data written to the virtual volumes. This reduces the amount of unused physical disk capacity and supports much more effective storage operations. In addition, pre-defined thresholds avoid storage capacity shortages by warning when additional physical disks need to be added.

Example:

A user requests 10 TB of resource allocation from the server administrator. While 10 TB of physical storage capacity may eventually be needed, current usage suggests that 2 TB of storage is sufficient. The system administrator therefore prepares 2 TB of physical storage, but allocates a 10 TB virtual volume to the server. This means that the server can start using the existing physical disk pool which is only around 1/5 of the virtual volume. This "start small" approach enables more effective use of storage capacity. As more physical capacity is required to support the virtual volume, existing physical volume capacity is consumed. In order to avoid capacity shortage, the physical disk pool is monitored using a predefined usage threshold. For example, by defining 80% of the entire disk pool as the threshold, an alarm tells the administrator to expand the number of physical disks when that amount is reached. This means that the new drives can be added without stopping the system, ensuring continuous system operation.



The effect ot Thin Provisioning



Eco-mode process

Eco-mode reduces power consumption

To achieve low power consumption for storage, ETERNUS DX systems are equipped with Eco-mode functions. Using MAID (Massive Array of Idle Disks) technology, ETERNUS DX disk drives have Eco-mode support to manage the on/off state of the disk drive's spindle motor. Eco-mode stops disk rotation at specified times based on customer's usage patterns. It can ideally be used for backup-to-disk.

There are two variants: "storage device Eco-mode" and "RAID Group Eco-mode". Each Eco-mode can be set ON or OFF separately, so it is possible to achieve high energy savings.

When Eco-mode is activated, ETERNUS SF storage management software monitors the activity between servers and storage devices to get a full picture of server and disk storage system requirements. Energy efficiency and system temperature can be displayed and checked or written to file. By turning off unused disks, energy consumption can be reduced. Data monitoring also enables optimized use of electricity and air conditioning.

Backup with reduced power consumption

In conjunction with ETERNUS SF, the time-controlled Eco-mode is used to reduce energy consumption by only powering the backup drives during the backup window. Such scheduled use of specific disks can be set up for individual RAID groups and backup operations. Power usage is reduced outside specified backup windows by stopping the rotation of the backup disks. Rotation stops if the disks are not accessed within specified time periods. When a data access command is received, rotation starts again. Full rotation is restored in about one minute.

For example using Eco-mode within the ETERNUS DX400 S2 series with backup volumes (50 disk drives) running only 4 hours per day achieves annual reductions of some 4,720 kWh in power consumption and 1,830 kg in CO2 emissions. This is a 15 percent overall power reduction.

Measurable efficiency gains

Tools to monitor power consumption

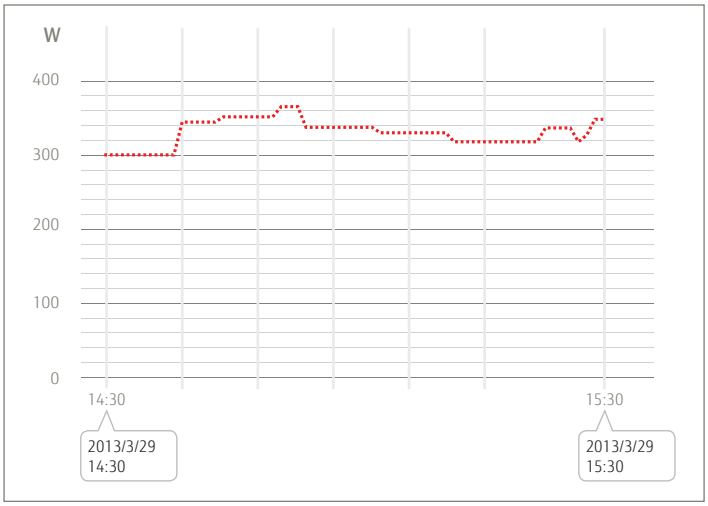
Visualization of power consumption and temperature with ETERNUS SF Storage management software

Being able to visualize power consumption makes it easier to introduce more energy-efficient operations and reduce OPEX by, for example, reducing the power used by the air-conditioning equipment. With Fujitsu storage products, all system states are monitored. The results are visualized and gathered as statistics in chronological sequence according to factors such as energy consumption and temperature. Scheduled operations and virtualization make it possible to use only the equipment needed at any given time, leading to significant energy savings across the board.

Power consumption varies widely depending on the type, rotation and number of hard disk drives installed. The ETERNUS power consumption calculation tool can be used before any changes are made to confirm the effectiveness of power reduction compared to existing devices. Calculating power usage of a new configuration before making a purchase allows major power savings. Once a system has been purchased, the power consumption can be set to optimize the status monitoring and operating conditions of each device.

The Graphical User Interface (GUI) allows you to check usage of the drives and shift of electricity consumption and temperature data easily on a graphic file as statistic information of each operation.

ETERNUS SF lets customers monitor device operating environments by displaying current power consumption and temperature readings. Furthermore, it provides consumption data by day, week and year. Using the data visualized by this software, specific measures can be devised for different operating conditions, making it possible to see energy-saving and carbon dioxide reduction effects for storage arrays in total.



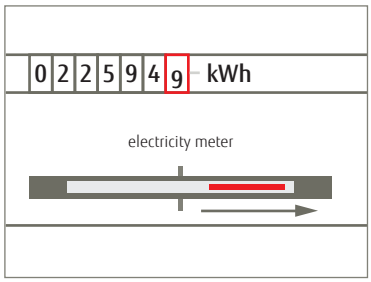
Power measurement with ETERNUS SF storage management software

Identify energy guzzlers in your data center

So, ETERNUS DX systems provide power consumption monitoring, but not all hardware products offer this possibility. Energy consumption is a topic which should be looked at from an overall level as energy costs provide huge savings potential and as each single watt of IT energy consumption will generate energy costs from 1,3 US$ up to 4 US$ per year**.

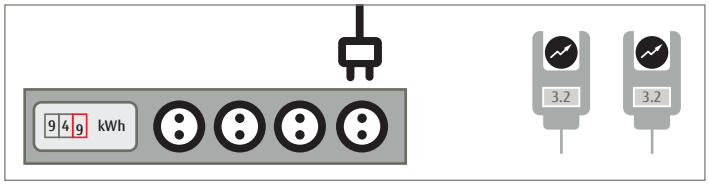
More than 70 percent of the data centers are still equipped with energy-inefficient IT equipment. Fujitsu provides a solution to identify energy guzzlers in the data center. Our monitoring solutions identify them, evaluate the savings potential and open up ways to replace those systems with energy-efficient IT infrastructure products such as ETERNUS DX.

Energy optimization requires energy monitoring as an initial step.



What and how to measure?

- Fujitsu's new server and storage power supply units deliver power consumption values
- Intelligent PDUs (power distribution unit) are able to provide power values via SNMP
- The SNMP power clamp is a compact device used to monitor up to 2 power strips without downtime. It can be used to measure the power consumption per power cord



The energy data from the measured systems will be provided in a clearly arranged report. The reports will provide a list with the storage power consumption and a list with a Green IT KPI for storage, which is calculated as follows:

Usable Storage Capacity (TB) / Electric Power (Watt)

This allows you to replace energy-inefficient systems with more efficient and therefore more cost-effective systems.

** based on European prices.

Fujitsu's Green IT initiatives and activities

Since its founding in 1935, Fujitsu's basic principle of environmental management has been set "manufacturing in harmony with nature".

Green policy

Fujitsu Green Policy Innovation is our worldwide project for reducing burdens on the environment.

Green Policy Innovation

Fujitsu's ICT sustainability strategy drives business performance while minimizing environmental impact and shaping a prosperous low carbon society. Green Policy 21 is the long-term environmental concept bonded by the slogan "we make every activity green". Green Policy 2020 is the medium-term environmental vision. The three key themes are: benefiting our customers and society, pursuing internal reforms, and conserving biodiversity. The Environmental Protection Program is the immediate action plan consisting of individual 3-year-cycles with underlying key performance indicators

Global top 500 Green companies

In acknowledgement of its world leading green program , Fujitsu is also highly ranked by Gartner & WWF on "Global Low-Carbon and Environmental Leadership, 2010" and was included in the inaugural 2011 Newsweek Green Global 500 Ranking coming in 13th position. The Newsweek Green Ranking places the largest international companies based on their actual environmental footprint, management of that footprint and sustainability communications.

Fujitsu also has been awarded the first place on the Top 12 Green-IT Vendors list by IDG (International Data Group)'s Computerworld in both 2010 and 2011, where Fujitsu was chosen as a company working on implementing smart, efficient strategies to achieve "Green-IT".

The companies were judged especially on their IT departments' efforts to reduce energy consumption, and to use technology to conserve energy and lower carbon emissions.

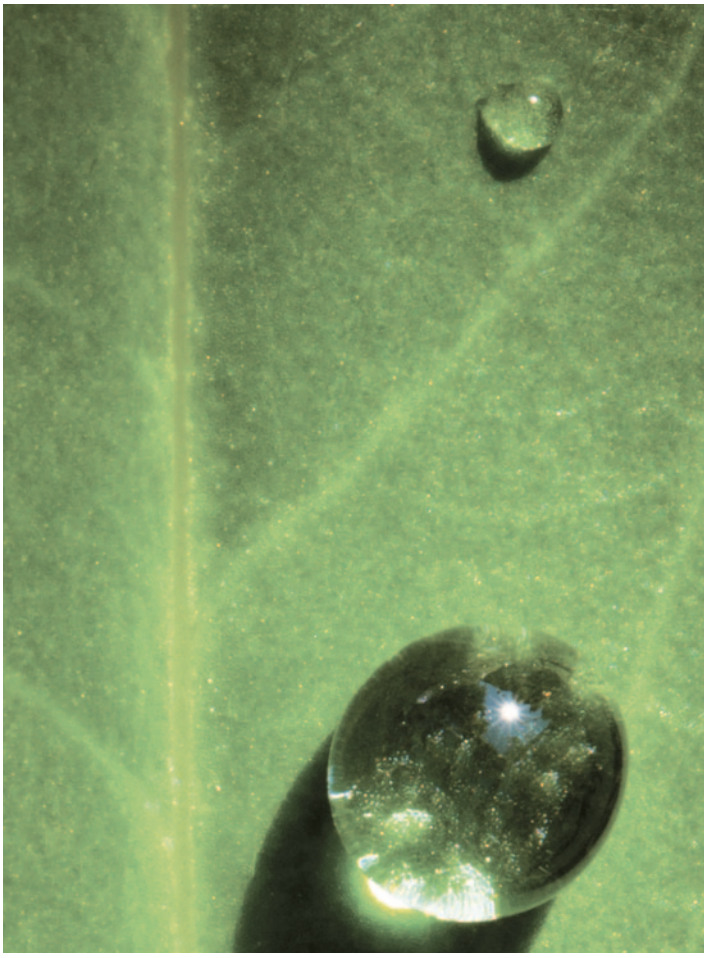
Fujitsu is also a member of the SNIA Green Storage Initiative (GSI), which is dedicated to advancing energy efficiency and conservation in all networked storage technologies and minimizing the environmental impact of data storage operations.

Green IT label

Fujitsu has been pioneering environmentally conscious products and processes since long before legal obligations were an issue.

Fujitsu's Green IT label covers three categories to further specify an extensive product portfolio.

Every product is rated at the beginning of its lifecycle. The specifications which our products fulfil to qualify are ahead of legal requirements. The Green IT label reflects the holistic environmental approach of Fujitsu including material, energy consumption and recycling.



Saving and recycling resources

At the heart of environmental care is the attitude that environmentally conscious product development begins at the initial design phase. Fujitsu focuses on recycled and bio-based plastics, as well as on exhaustive environmental assessments. Leading-edge facilities and tools ensure optimal development efficiency. In manufacturing, Fujitsu works to reduce not only electricity usage, but also gas and crude oil consumption. Lessening chemicals and waste materials, and promoting recycling with organic materials have contributed to zero emissions.

Limited resources should be used effectively and just in the needed amounts. For this reason, Fujitsu applies a wide range of proven resource-saving techniques. These start with reducing parts and cables, improving performance and lessening space requirements, and also include making manuals and other documents digital.

Another example is using longer-life system capacity units instead of batteries during power outages, so that no component exchanges are required during the lifetime of the storage device. This achieves reductions in industrial waste. ETERNUS DX systems include long-life and lead-free batteries and there is no need to replace BBUs during the products' lifetime.

From the initial design stage, Fujitsu designs parts for easy recycling. Fujitsu is also improving its recycling capabilities to advance the collection and reuse of resources in its products.

Fujitsu is committed to delivering Green IT at all stages of the design, manufacture, use and recycle lifecycle. The 'use' and 'reuse' stages are where existing equipment is brought back to a standard that enables it to fulfill a second or even third productive lifecycle. Extending the lifespans of products makes a valuable contribution to sustainability. With many raw materials being in finite supply, we need to ensure we are unlocking their full value. Additionally, bringing an older product back into use will ultimately consume far less energy and resources and emit far less CO2 than manufacturing a brand-new product.

Remarketing from Fujitsu

Remarketing was established to add value for its customers by delivering competitive commercial solutions and acting as a responsible contributor to raw materials' sustainability.

Remarketing provides a wide portfolio of customer solutions and services around used and rental equipment. Based in Germany, Remarketing has its own combined refurbishment and recycling plant and a central multi-lingual sales center, where used electrical and electronic devices from private households can be returned free of charge. Remarketing is also responsible for the resale of returned goods and the disposal of assets.

Increasing cost efficiency and contributing to society

Power consumption is one of the biggest contributors to the OPEX of every company. In addition, it creates a heavy burden on the environment.

For many years, Fujitsu has been striving to create a low carbon society through green infrastructure and green IT solutions. This can be seen in the development of energy-efficient and environmentally-friendly products and solutions as well as in the green initiatives of Fujitsu.

Fujitsu products are designed to reduce the environmental burdens on companies and society. Continuous innovation in ecologically beneficial technologies and power-saving system operation are passed on in support of the environmental efforts of businesses.

And thanks to its unique family concept the ETERNUS DX series is especially eco-friendly, because it uses the same components over the whole system family. That allows customers to reuse the existing components when upgrading to a bigger system in case the current system cannot cope with the needed capacity, performance or functionality.

Combining this concept with all sustainable features included in ETERNUS DX systems makes them one of the most energy-efficient and thus cost-saving disk storage systems.

> "At Fujitsu, we are committed to working in an ethical and sustainable way in order to ensure that we can make a positive contribution with innovative ICT that helps address and solve the issues of today and address the challenges of tomorrow."
>
> **Rod Vawdrey,** Corporate SVP & President Intl. Business and CEO CEMEA&I

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