Improve Power Usage Effectiveness (PUE) at Our Data Centers

Our Approach

With the spread of cloud computing, energy use by data centers is on an upward trend and society is showing more concern over the environmental performance of data centers. Data centers comprised 24% of FY 2015 CO_2 emissions in the Fujitsu Group, with emission rates increasing 6.5% over the three years from FY 2012–15 at our 18 main data centers in Japan. Furthermore, our data center CO_2 emissions are expected to continue to rise as our cloud business grows, making environmentally conscious data centers a social responsibility for the Group, as well as a critical theme to address in strengthening our business foundation over the long term.

In the Fujitsu Group, we are targeting*1 approximately 80% of our data centers (based on server room floor space) and we are working to boost environmental performance.

*1 **Activity targets:** Global data centers 1,000 m² or larger, in principle, or specific data centers requested by data center business units.

Summary of FY 2016 Achievements

Targets under the Fujitsu Group Environmental Action Plan (Stage VIII) (toward FY 2018)	Improve PUE of our major data centers by 8% or more. (Compared to FY 2013)
FY 2016 Targets	PUE 1.62 Improvement rate 4.8% (Compared to FY 2013)
FY 2016 Key Performance	PUE 1.61 Improvement rate 5.5% (Compared to FY 2013)

FY 2016 Performance and Results

Promoting Activities to Achieve the Targets

Continuing from Environmental Action Plan (Stage VII), Fujitsu is moving forward with the improvement of PUE*2 at its data centers inside and outside Japan. Primary initiatives include improving the cooling efficiency of air-conditioning systems, expanding the hours when external ventilation is used, and maximizing utilization of free cooling options. This has led to an average yearly improvement of 2% or more.

Environmental Action Plan (Stage VIII), which started in fiscal 2016, will require further effort in the future to achieve improvements. In addition to continuing and expanding operational improvements that have been made up to this point, we will also reduce the power used for facilities and ICT by making energy more efficient through introduction of innovative technologies. Further, we will strive to increase the use of renewable energy, aiming for a carbon-free society as stipulated in the Paris Agreement*3.

*2 **PUE (Power Usage Effectiveness):** an indicator showing the energy saving performance of data centers. PUE is obtained by dividing the energy usage of an entire data center by the energy usage of its servers and other ICT equipment. A PUE closer to 1.0 indicates better energy efficiency.

*3 **Paris Agreement:** A new framework for measures against global warming to reduce greenhouse gases through international cooperation, with more than 190 countries from the developed and developing world participating. It came into force in November 2016.

PUE Values and PUE Calculation Method

PUE values	PUE calculation method, etc.
Range: 1.32–2.21 Applicable DCs: 34 centers	- The Green Grid's method used - Implementation of improvement initiatives using the organization's DCMM

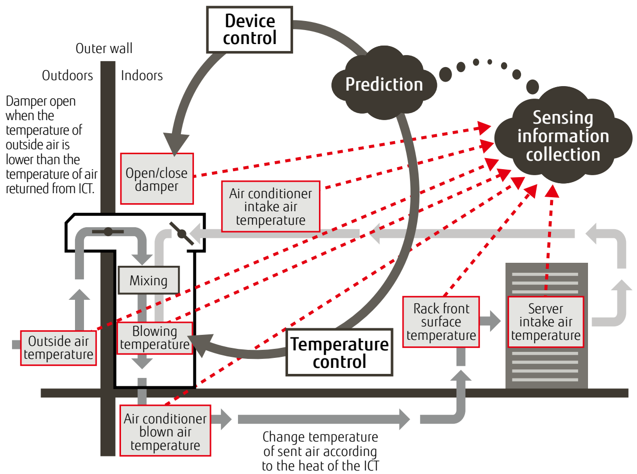
Air-conditioning Equipment Control through AI

Continuing from fiscal 2015, we improved air-conditioning energy efficiency inside and outside Japan, reaching the yearly target. We are improving efficiency through new technologies to achieve Environmental Action Plan (Stage VIII) targets.

For example, we are verifying Fujitsu's innovative just-in-time modeling air-conditioning controls, predicting temperatures and humidity an hour ahead from temperature, humidity, and power data for outside air environment and inside servers, then controlling outside air cooling and air-conditioning equipment air temperature.

Verification of AI-driven learning control technology is also currently underway. We are improving power efficiency with an AI learning wind volume, processing heat, outside air temperature, ICT device load, etc., and automatically model air conditioning properties. We will confirm effectiveness and implement measures at data centers in fiscal 2017.

JIT modeling air-conditioning control



Improve Power Usage Effectiveness (PUE) at Our Data Centers

Main Activities of FY 2016

Data Center Goal of "Extreme Energy Conservation: Working Toward PUE 1.0"

Expansion of high-performance computing (high-performance, high-heat-generating servers used for big data and AI) increases energy used to cool data centers. Accordingly, Fujitsu participated in the Ministry of the Environment's FY 2016 Low Carbon Technology Research, Development and Demonstration Program, and is working on fundamental reduction of CO_2 at data centers.

We are focusing on cooling methods suited to ICT device heating levels, working particularly on high-heat-generating servers. Using a liquid-immersion cooling method in which ICT devices are submerged in fluorinated inert liquid (Fluorinert) with high thermal transport efficiency and insulating properties, we are challenging the "PUE 1.00 wall" with Fujitsu's new proprietary natural convection technology for Fluorinert circulation. AI-driven improvement of cooling efficiency is also being verified.

Liquid-immersion cooling technology to cool servers by submerging them in Fluorinert

Establishment of a Laboratory for Low-carbon Next-generation Cloud Infrastructure

In April 2017, Osaka University, Fujitsu Limited, and Fujitsu Laboratories Ltd. established the "Next Generation Cloud Research Alliance Laboratories" in Osaka University's Cybermedia Center.

The Laboratory will be used for research on energy-saving technology and security technology toward development of a next-generation cloud infrastructure that will be compatible with the future low-carbon society. In addition, it will be used to train the next generation of technicians, mainly for Osaka University students. In the future, the three organizations will conduct proof-of-concept testing based on research findings, at the Laboratory and on test beds (verification platform) built internally and externally by consortiums in which the Laboratory participates. Further, the developed energy-saving technologies will be utilized in an effort to make the next-generation cloud infrastructure and next-generation AI infrastructure more energy-conserving and low-carbon. Fujitsu will strive to apply the results of development in its AI technology "Zinrai."

Cold Storage Geo Replication Technology

Currently, coordination between data centers is conducted via two methods: low-delay short-range synchronous communication and long-range asynchronous communication backup. With the former, it is highly possible that multiple data centers would suffer damage in a large-scale disaster, and with the latter, there is increased data delay, so it was only possible to use a standby redundant connection.

On the other hand, "cold data," mainly images and video, which is rarely updated, constitutes the majority of data. This means that there is an increasing need to accumulate new data and share data between multiple sites. However, issues hindering data center coordination between multiple sites include synchronization between data centers and increasing data reading response speed.

In that context, we have been working since November 2016 to conduct joint verification testing on intercontinental data center coordination, focusing on cold data storage, between a data center inside Osaka University and a data center of Paris-based AntemetA. We have built a long-range coordination storage infrastructure, which, in addition to improving throughput and disaster resilience, excels at lowering costs by eliminating redundancy within individual data centers, and are verifying the effects.

Cold Storage Geo Replication