Activities of Energy and Environment Technologies Committee to Improve Energy Efficiency

Yuji Uenishi, Jiro Nakamura, and Keiichi Saito

Abstract

The NTT Group is facing many challenges in the areas of energy and the environment, from the rapidly increasing cost of electrical power to various global environmental concerns. This article introduces some initiatives of the NTT Information Network Laboratory Group's Energy and Environment Technologies Committee to realize a sustainable infrastructure that is able to continue providing safe and secure connectivity while adapting to future increases in traffic and power consumption.

Keywords: energy environment, energy saving, sustainable infrastructure

1. Introduction

For the NTT Group, global environmental issues such as global warming, depletion of natural resources, and threats to biodiversity are unavoidable issues to be managed as part of the Group's corporate social responsibility. At the same time, the rising cost of electricity year-on-year is becoming an even more urgent issue for NTT as a heavy user of electrical power for information and communications technology (ICT) equipment such as routers and servers, as well as the machinery necessary to cool the ICT equipment.

In fiscal year (FY) 2012, the total amount of electricity used by the NTT Group was approximately 8600 gigawatt-hours (GWh), representing approximately 1% of the total commercial power consumed in Japan. From another perspective, this electrical power consumption is the source of 93% of the total carbon dioxide (CO_2) emissions by the NTT Group (**Fig. 1**). Currently, the NTT Group is almost 100% reliant on commercial power for this electrical energy, and because the cost of power in Japan is currently based on imported fossil fuels, the unit price for power is rising yearly (**Fig. 2**). This is a situation that the NTT Group cannot ignore, even regarding its short-term revenues. Furthermore, with the rapid expansion of high-volume content services such as video and new smartphone services, traffic is continuing to increase, ICT equipment must then be

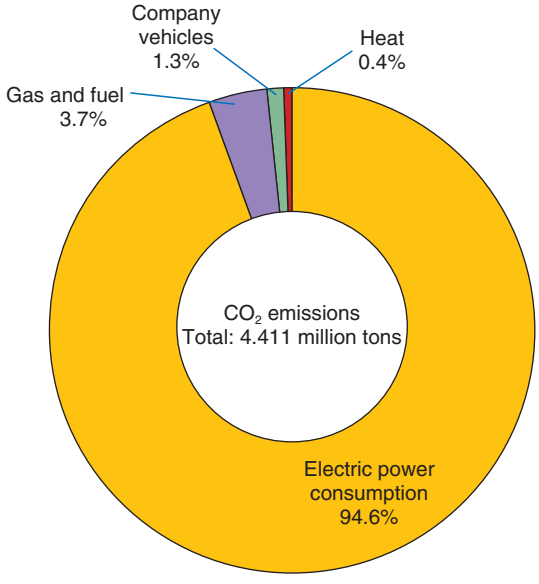

Fig. 1. Sources of CO_2 emissions of the NTT Group in FY2012.

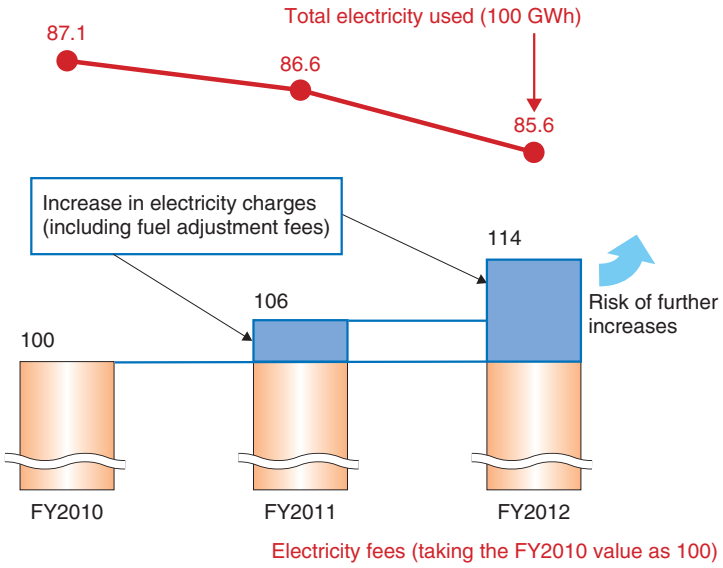

Fig. 2. NTT Group trends in total electricity consumed and electricity fees.

upgraded to increase capacity, and the power required to provide these services also increases.

As part of planning for future networks, the NTT Information Network Laboratory Group has established the Energy and Environment Technologies Committee as a strategic coordinating organization spanning all of the laboratories within the Laboratory Group. The committee is working to resolve both global environmental issues in the future as well as the urgent issue of energy costs. Its objectives are to draft a research and development (R&D) strategy and promote development of technologies that contribute to a sustainable society by providing stable ICT services and by reducing the power consumption of ICT services, reducing the accompanying CO_2 emissions, and reducing the use of resources.

2. Energy and Environment Technologies Committee's network infrastructure vision

The committee takes the position that a sustainable infrastructure providing continuous connectivity 24 hours a day, 365 days a year must be implemented using resource-conserving technologies that reduce the total power consumption of network systems, advance energy management, increase energy self-sufficiency by integrating renewable energy and other energy-generation and energy-storage technologies, and adapt to resource risks, as well as using environmental energy technologies such as technology to mitigate environmental interference in communications equipment.

The set of technologies that must be addressed in order to implement a sustainable infrastructure is shown in **Fig. 3**. These technologies are divided into six technology groups, which are: (1) Power source related technologies that will provide power and increase the energy self-sufficiency of future networks; (2) Air conditioning related technologies that will increase the energy efficiency of communications buildings; (3) Technology that links network equipment with power and air conditioning equipment; (4) Energy-saving technology in network architecture and equipment contributing to energy-saving ICT; (5) Resource conservation technologies for green ICT; and (6) Technologies for dealing with interference from the external environment such as electromagnetic radiation or lightning. The committee is promoting R&D on technologies in each of these areas.

When promoting specific R&D, the committee establishes practical working groups to carry out feasibility testing of the technologies developed in each laboratory. These groups promote the development of the technologies by performing evaluations in real environments, either at the Musashino R&D center or an external office building. Each technology is connected as required—which may involve installing it in an office or using it to supply power to communications equipment—or is tested from an environmental

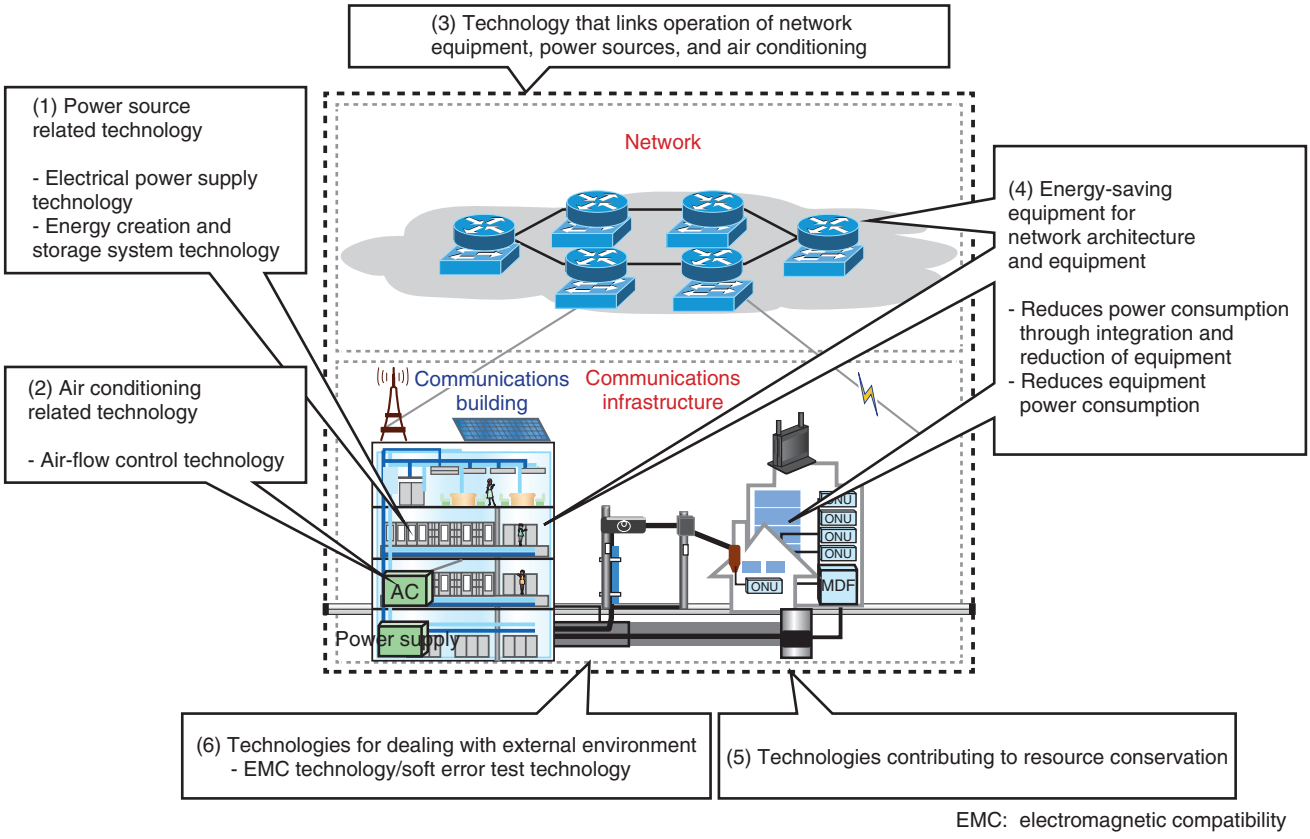

Fig. 3. Six technology groups related to environmental energy.

energy perspective, and the groups cooperate with the developing laboratory by selecting issues to be addressed in areas such as usability or deployment in a business [1].

3. Overview of the six technologies

(1) Power source related technology

The speed and capacity of ICT equipment continues to increase along with the ever increasing amounts of network traffic, and the power consumption is expected to increase accordingly. The NTT Group has developed direct-current (DC) power supply technology to supply DC power efficiently to ICT equipment within communications buildings and datacenters. NTT must also reduce its power costs, improve resistance to power outages, and provide more stable power for its businesses. To do so, it will be necessary, in the medium and long terms, to consider energy creation systems using renewable energy or fuel cells, energy storage systems that are used all of the time and not just for backup, and other new energy systems that increase energy self-sufficiency or provide distributed power. Accordingly, the committee is promoting R&D on initiatives to achieve a stable power supply from power generation to provision [2].

(2) Air conditioning related technology

Hotspots often occur in machine rooms where network equipment is installed. Hotspots are areas where the local temperature is higher than the surrounding area. The use of air conditioning to cool these areas can increase power consumption. We have developed technology that increases the cooling efficiency of air conditioning by placing a flow control panel called a diffuser at the equipment exhaust port or the cool air intake port. We are also developing other ways to improve energy efficiency within communications buildings. One example for improving air conditioning efficiency involves rearranging network equipment in a machine room according to the air conditioning conditions [2], [3].

(3) Technology linking control of network, power supply, and air conditioning equipment

As the use of server and network virtualization technology expands, the electrical load of ICT devices and the accompanying quantity of exhaust heat are expected to fluctuate with the amount of traffic. Consequently, it is essential to improve the efficiency of power supply and air conditioning technology so that the power supply and air conditioning can be controlled according to fluctuations in traffic flow and processing load. The committee is advancing R&D on technology to link control of power and air conditioning equipment with ICT equipment in order to resolve these issues [2].

(4) Energy-saving technology for network architecture and equipment

To create a future convergence network, with the goal of establishing a shared network infrastructure applicable for different services and domains, the committee is promoting a simplified network architecture composed of fewer network nodes and servers. This will reduce overall power consumption and the power consumption of individual network devices. It is also conducting R&D on other energy-saving technologies such as network terminals that have a sleep function, and the optical network unit, an optical communication device used in end-user households [4].

(5) Technologies contributing to resource conservation

As the service life of ICT equipment, telephone poles, cables, and other equipment used to provide information and communications services expires, some equipment must be disposed of. This is also necessary when equipment must be updated to provide new services. Such disposal amounts to approximately 800,000 tons of waste per year. The NTT Group has achieved zero emissions with such material by promoting reuse and recycling. To achieve further conservation of resources, the committee is focusing on technical initiatives to lengthen and extend the life of current equipment, to conserve resources when updating equipment, and to carry out recycling with high added value.

(6) Technologies for dealing with the external environment

As new technologies are introduced to implement a sustainable infrastructure, it is essential to increase reliability by controlling—as much as possible—how certain external environmental factors such as lightning, electromagnetic radiation, and cosmic rays affect the infrastructure. It is also important to avoid generating new electromagnetic noise. In particular, the introduction of smart meters in homes, the expansion of wireless sensor networks for visualizing power use and other data, and the use of distributed power sources with new energy creation and storage systems mean that sources of electromagnetic radiation are increasing, and the electromagnetic environment for ICT equipment is therefore expected to get worse. Manufacturing processes for circuit boards are expected to become finer still, and the risk of software errors occurring will continue to rise. To deal with these circumstances, the committee is promoting the development of EMC (electromagnetic compatibility) testing and mediation technology for new equipment and services as well as design and operations technologies to reduce software errors [5].

4. Future prospects

With the Energy and Environment Technologies Committee as its core, NTT Energy and Environment Systems Laboratories is advancing plans for a future vision and technical validation in collaboration with other NTT laboratories, with the goal of reducing management risk related to energy and resources. We will continue to promote technical development to further increase energy and resource efficiency in the overall business activities of the NTT Group by rapidly reflecting external trends and the needs of the workplace.

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