The Green University of Tokyo Project

The University of Tokyo is a workplace that emits one of the greatest amounts of carbon dioxide in Tokyo. To remedy this situation, the Green University of Tokyo Project has been launched with the aim of reducing CO_2 emissions using IT. The project leader, University of Tokyo Professor **Hiroshi Esaki**, explains the background to the project and its objectives.

The Green University of Tokyo Project is the Green IT campus project that started in June this year at Building No. 2 of the Faculty of Engineering. The slogans for the project are "environmental measures with intelligence and wisdom that utilize information" and "from coerced environmental measures to those spontaneously adopted."

The project comprises energy conservation and environmental measures that use computer networks, or Green IT. In Japan, energy conservation has been attempted separately in relation to each component, mainly with semiconductors, optical technologies and Internet data centers. However, advanced energy conservation capabilities cannot be used unless these measures work together in harmony. To give an example, a hybrid car that gets good mileage is not able to conserve energy if it is driven inappropriately.

One of the goals of the Green University of Tokyo Project is to achieve energy conservation that effectively makes optimum use of cutting-edge components, while using the information network at Building No. 2 of the Faculty of Engineering at the University of Tokyo. For this purpose, the air-conditioning, lighting and other facilities are made as open as possible and are coordinated so that the system can be designed as a whole.

The vision and mission of the project is encompassing not only Building No. 2 but also the entire campus of the University of Tokyo, the cities in Japan and Earth as a whole.

The Green University of Tokyo Project aims to be regarded as a technological central project of the Univer-

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The test bed: Building No. 2 of the Faculty of Engineering

sity of Tokyo's Todai Sustainable Campus Project (TSCP), which aims to reduce CO_2 by 15% by 2012 and by 50% by 2030 compared to the levels in 2006.

The annual CO_2 emissions of the University of Tokyo were about 136,000 tons in 2006, which is the highest among commercial and business entities in metropolitan Tokyo. In fact, it costs about six billion yen (60.6 million dollars) each year for the electricity alone. A reduction in electricity consumption leads not only to a reduction in CO_2 emissions but also in costs. It is one of the most influential universities in Japan, and the project undertaken in Tokyo with the large volumes of CO_2 emissions would have a significant ripple effect on other universities and cities.

Building No. 2 of the Faculty of Engineering, where demonstration tests are being conducted for the Green University of Tokyo Project, is a twelve-story building completed in 2005. This building houses a variety of functions including lecture rooms, offices, research areas and laboratories. This building, where a variety of users use a range of equipment can serve as a model for households, small and medium-sized businesses and tenant buildings where the idea of energy conservation has not taken hold. In other words, we plan to use Building No. 2 of the University of Tokyo as a test bed for disseminating environmental measures into society.

How the System Works

The main demonstration tests performed in Building No. 2 are as follows. First, the data on the operating statuses of the laboratory equipment, the lighting and other facilities, in addition to the data for the entire building structure, are collected and analyzed. The conventional control systems of buildings consist of subsystems for the air-conditioning, lighting, security, power sources and so forth that are based on the separate technical specifications of the respective suppliers. As such, it was very difficult to ensure data compatibility among these subsystems. For this reason, the project uses IPv6, the next-generation Internet platform protocol, for configuring the IP network that connects each of the facilities. And not only the air-conditioning and lighting systems, but also all other electrical devices, such as personal computers, refrigerators and TVs that are all equipped with measuring devices to collect the data on electricity consumption on a real-time basis. And the data are provided to the users through IPv6. In other words, the information on how much electricity is being consumed, when, and where, is made visible. The effects of this visualization process are then verified. Based on the data collected, we conduct studies on what kind of facility management and control should be provided. In other words, we try to clarify how the air-conditioning, lighting, security and other systems can be combined in order to configure effective and energy-conserving systems.

It is already possible to monitor how much electricity is being consumed by each of the research rooms and laboratories in Building No. 2. By the spring of next year, we plan to make the data available on the personal computers of each of the researchers engaged in study at Building No. 2. This is sure to reduce the electricity consumption. We also plan to install motion sensors in the research rooms and lecture rooms that will be coordinated with the air-conditioning and lighting systems. This will enable the air-conditioners and lights to be turned on and off automatically when people enter and leave the room.

It is relatively easy to introduce these systems in a new building, but rather more difficult in existing buildings. It is for this reason that the experiments at Building No. 2 can serve as a model when introducing these systems into other existing buildings.

If these initiatives were undertaken throughout Japan, the structure of facilities-related industries would change significantly. Today, an inefficient division of work has been established in the area of building construction, where each entity uses its own technologies. If the system was opened up, competition and the subsequent creation of new industries will likely take place.

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A joint research consortium has just been formed to implement the Green University of Tokyo Project. The consortium is led by the University of Tokyo, and consists of Nagoya University, Keio University, Tokyo Metropolitan government, IT-related NPOs and about thirty companies. The participating enterprises include building owners, developers, general contractors, architectural design offices and equipment vendors. By allowing diverse entities to participate, or by making the project open, it has been possible to clearly set the objective of developing technologies that society genuinely needs for the project.

As part of the project we will prepare technical specifications that enable the interconnection of diverse sensors and actuators, and prepare specifications for procuring energy-conserving facilities. By referring to these specifications, the costs for constructing energy-conserving buildings can be significantly reduced in the future.

Although currently there is no standard benchmark for the effect of energy-conservation, benchmark specifications will be established through the project. It would then be possible for anyone to obtain objective data related to energy conservation.

If certain energy conservation measures prove to be highly cost-effective and provide economic bene-

fits, entities would adopt the measures. Energy conservation methods that require restraint on the part of the people cannot be disseminated. One of the important goals of the project is to expand corporate and social activities and promote their functions with less energy through increased efficiency and innovation, instead of restraining corporate and social activities. For enterprises, this could enhance their international competence. We need to configure a model that provides businesses and other entities with benefits while also being kind to the global environment.

The project is led mainly by industry and academia, with no financial assistance provided by the government. The reason for this is that we need to remain independent from the government if we are to make it a genuinely sustainable project.

Extending the Network to the World

Prior to the Green University of Tokyo Project, some entities have already provided environmental measures that make use of the Internet and sensors in some projects. For example, the Tokyo Metropolitan government introduced IPv6 for the building management system in its main office. This enabled the centralized monitoring and control of lighting, electricity, disaster prevention and other systems from the central monitoring room of the main office building, resulting in energy conservation and a reduction in the personnel costs.

Panasonic Electric Works Co. configured a lighting control system that utilizes IPv6 for lighting fixtures in the Beijing Olympic Park where the main stadium is located. The system has efficiently controlled and monitored the 18,000 lights located in the vast area measuring 1.4 km by 2.4 km, from a remote location. The system aims to result in a 10% reduction in the use of energy.

In the project named Live E!, individuals, universities, enterprises, local governments and other participants have installed meteorological measuring devices connected to the Internet at more than 150 locations nationwide since 2005, through which meteorological data such as temperature, humidity, atmospheric pressure and rainfall are collected on a real-time basis and provided to all the participants. The participants have used the information for educational programs, public services and businesses. The city of Kurashiki in Okayama Prefecture in western Japan, which is an enthusiastic participant in the project, has installed the meteorological measurement unit mainly at twenty-seven schools in the city. The city government has used the units to collect the information necessary for issuing evacuation warnings in the case of local torrential rain. Live E! has spread overseas as well, to eighteen countries and regions mainly in Asia, including Thailand, Indonesia, China and India.

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A measuring device to collect the data on electricity consumption of electric devices on a real-time basis

Just as Live E! expanded overseas, the Green University of Tokyo Project also contributes to the configuration of a sensor network that will spread over the university campus, Tokyo and the rest of the world. Creating the space to share the digital information collected using the sensors can lead to the creation of new ways of using the data.

Inverting a well known saying, Junichi Rekimoto of Sony Computer Science Laboratories says, "invention is the mother of necessity." This means that an invention can be used in a way that is totally different from those assumed by the inventor. It is important to spot the seeds and use all your wisdom for utilizing them.

With the Green University of Tokyo Project also, new ways to use the system that go beyond energy conservation can be created by forming a space where information related to energy conservation is shared. An example is urban planning. Urban plans of the future need to facilitate efficient social activities by optimizing the energy flow. For that purpose, information related to energy needs to be collected and cities must be planned based on the information. This is a paradigm shift in urban planning. If this were to spread throughout the world, the global environment can be saved.

Speaking of "Think globally, act locally," the Green University of Tokyo Project is indeed an attempt to incorporate information into local systems, while retaining global sensitivity.

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