Challenges for the Development of Zero Energy Buildings

The Ministry of Economy, Trade and Industry has formulated a vision in which zero energy building (ZEB*) technology will be used in the construction of all new public facilities by 2020 and for all new facilities (including private facilities) by 2030. Field experiments are also being conducted in various areas across Japan for the development of smart communities designed to generate and use energy efficiently and comfortably. Taisei Corporation is working to facilitate the development of ZEB technology with the aim of optimizing the use of energy in buildings in smart communities.

* ZEBs are designed to reduce the consumption of primary energy, such as oil and natural gas, to zero by making full use of energy conservation and generation technologies to supply energy required for air conditioning and lighting.

Towards the Development of ZEB Technology

Taisei Corporation has succeeded in reducing energy consumption by half (energy consumption reduced by 52% in 2010) in the Taisei Sapporo Building completed in 2006 before all other competitors. In order to further promote the development of ZEB technology, Taisei plans to build a ZEB demonstration facility on the grounds of the Taisei Technology Center. Our initial plan was to complete the development of ZEB technology by 2020. However, in view of the recent energy conditions, including power supply shortages as well as the ongoing global warming, we are striving to complete the development by 2014.

Roadmap for the development of ZEB technology

- **Technologies newly developed or introduced**
  - Thermal storage/radiation air-conditioning system
  - Free cooling
  - Sunlight system, T-Soleil
  - Floor supply displacement air-conditioning system

- **Technologies to be developed**
  - Building-integrated solar power generation
  - Omnidirectional natural sunlight system
  - High heat-insulation, heat-shield facade
  - Super high-efficiency air-conditioning and lighting system
Challenges for the Development of Urban-style ZEB Technology

Based on the recognition that ZEBs are most often required in urban areas, Taisei is working to develop ZEB technology for urban architecture. The ZEB demonstration facility, which is being planned to be built within the Taisei Technology Center, is designed as a building that allows the maximum use of natural energy, including sunlight and natural ventilation, with the support of various advanced technologies. We also apply cutting-edge technologies for saving energy and using renewable energy and propose new work styles in order to create an attractive working environment that does not require “enduring” energy saving.

Taisei Corporation’s urban-style ZEB demonstration facility (image)

The new value of ZEB technology is to change the way of thinking about how to use energy.

The development of zero energy building (ZEB) technology for urban areas requires more advanced, higher-level integration of architecture and facility technologies. ZEB technology not only reduces energy consumption to zero, but also enables people living in buildings to understand how their behavior affects the environment, thereby helping them think about how to use energy and urging them to change their lifestyles. ZEB construction projects are currently being implemented in various countries around the world, including the United States, Singapore and South Korea. In order to play the leading role in the world, it is therefore essential that we establish our own ZEB style as soon as possible.

Takaharu Kawase: Specializing in architecture and urban science, Prof. Kawase teaches the Environmental Design course in Chiba University’s Human Environment Design and Science Program. After serving as general facility manager at Nikken Sekkei Ltd., he has been teaching at Chiba University since 2003. Prof. Kawase has designed various buildings, including Saitama Super Arena, and is a member of the Architectural Institute of Japan and the Society of Heating, Air-conditioning and Sanitary Engineers of Japan and other academic associations. He also serves as Taisei Corporation’s ZEB Advisor.
Participating in the Yokohama Smart City Project in order to optimize energy use in cities

In order to optimize the energy use of entire local communities and to be able to provide energy during a disaster, projects are being undertaken to create smart communities equipped with comprehensive energy management systems, including a power infrastructure that uses renewable energy and a transportation infrastructure (electric vehicles). Taisei Corporation participates in smart community demonstration projects and contributes to optimizing energy use by commercializing building energy management systems (BEMS) based on the knowledge obtained through such projects.

Overview of the YSCP system

Source: Yokohama City’s materials, with revisions added

Abbreviated terms
*1 Storage battery SCADA: storage battery supervisory control and data acquisition system
*2 CEMS: community energy management system
*3 BEMS: building energy management system
*4 HEMS: home energy management system
*5 FEMS: factory energy management system
*6 EV: electric vehicle
In order to further reduce power consumption and prepare for power cuts during peak hours, we provide T-Green BEMS technology.

With a view to optimizing the use of building energy, Taisei Corporation has commercialized its original T-Green BEMS technology in order to make proposals for customers. An ordinary BEMS requires that building administrators analyze massive energy consumption data by themselves in order to improve the management of facility systems. Taisei’s T-Green BEMS not only visualizes energy consumption, but also thinks by itself to support building administrators’ decision making, thereby making it possible to use energy wisely in preparation for power consumption reductions and power cuts during peak hours.

Optimizing the use of building energy with next-generation BEMS

Contributing to the optimization of local energy use

Taisei Corporation has created a next-generation BEMS within the Taisei Technology Center by installing cutting-edge facility systems for the YSCP along with next-generation heat and electricity storage systems. The BEMS is designed to provide comfort and to make optimum use of energy at the same time through the optimized control of three elements: energy generation (heat and electricity generation), energy storage (heat and electricity storage) and energy use (facility management). In addition, by supporting demand response* through regional collaboration using CEMS, the BEMS makes it possible to optimize the energy use of entire local communities (this demonstration experiment is a joint project with Toshiba Corporation).

Demonstration experiment system at the Taisei Technology Center

* Mechanism for adjusting power consumption in response to demand in a power supply network
Using Energy Wisely

In addition to constructing buildings designed to make efficient use of air, underground heat and sunlight, Taisei Corporation has also been working to develop various original technologies, including systems that provide optimum control of lighting and air conditioning. We are contributing to optimizing energy use through making positive proposals for customers.

Outdoor air-cooling system that uses cool natural air for air conditioning

The Ishikari Datacenter, located in Hokkaido, has installed an outdoor air-cooling system that benefits from the area’s cool climate, thereby achieving a substantial reduction in energy consumption. Taisei’s outdoor air-cooling system mixes waste heat from servers with outside air and provides server rooms with cooled air maintained at appropriate temperature and humidity levels, thereby eliminating almost all costs required for air conditioning throughout the year. The system contributes to reducing IT costs in Japan to the global level by drastically minimizing air-conditioning costs.

Geothermal air-conditioning system that uses underground energy for air conditioning with cast-in-place building piles

The underground temperature remains relatively stable throughout the year. For this reason, heat pumps that exchange heat underground, where it is cooler than outside air in the summer and warmer in the winter, are effective in reducing energy consumption and CO₂ emissions as well as mitigating heat island effects. However, it has been difficult to promote the use of geothermal air-conditioning systems due to their large installation costs.

Taisei Corporation focused its attention on cast-in-place concrete piles used in construction and achieved a cost reduction by attaching underground heat exchange pipes to the piles in advance. We will make proactive proposals to customers in order to promote the use of this heat exchange system.
T-Zone Saver, an environmental control technology that provides air conditioning and lighting only where there are people

Taisei’s T-Zone Saver detects the surface temperature of the human body and recognizes the presence or absence of people in real time using next-generation sensors. These sensors can distinguish between changes in temperature caused by heat generated by PCs or sunlight and changes caused by human bodies, making it possible to provide optimal control of air conditioning and lighting. Installed in a general office setting, Taisei’s T-Zone Saver is capable of reducing energy consumption by approximately 35% without compromising comfort. Following the 2010 Environment Minister’s Award for Global Warming Prevention in the Technological Development and Commercialization category, the T-Zone Saver also received the 2011 Power Saving Award, which is the 8th Ecoproducts Award Council Special Award, for its outstanding performance in reducing energy and power consumption.

T-Soleil, a lighting system that uses sunlight for office lighting

Taisei’s T-Soleil is a lighting system that uses sunlight instead of artificial light. T-Soleil conducts light into a building by using an automatic sun-tracking mirror installed in the skylight in combination with multiple layers of mirrors inside the building, thereby creating a bright and comfortable lighting environment. The use of natural light is said to have various advantages in addition to reducing energy consumption, including heightening individuals’ sensibilities and even increasing their intellectual productivity. T-Soleil was used for the first time in the Taisei Sapporo Building built in June 2006. T-Soleil 100, designed specifically for high-rise buildings, was used for the first time in the Minato Mirai Center Building, which was completed in 2010.