



Feature *Achieving a carbon-free society requires energy-efficient offices and buildings*

Contributing to the Realization of Net Zero Energy Buildings through Optimally Controlled Air Conditioning Systems

DAIKIN'S APPROACH

Net Zero Energy Buildings (ZEBs) Dramatically Reduce Energy Consumption

Efforts are accelerating on a global scale towards the realization of net zero energy buildings (ZEBs), which dramatically reduce energy consumption while maintaining comfort for occupants.

Amidst efforts to reduce carbon emissions under the Paris Agreement, buildings account for approximately one-third of the world's energy consumption, and if no measures are taken, it is estimated that the energy consumed by buildings will approximately double by around 2050. Making buildings ZEBs is an effective and necessary means of reducing energy consumption. The Japanese government has announced a target of having all new public buildings be constructed as ZEBs by 2020.

Air conditioners, which account for more than 40% of building energy consumption, must be more

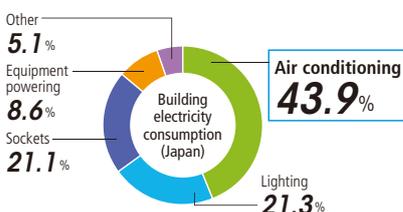
energy efficient to make buildings ZEBs. Daikin is making it a key task to use its proprietary technologies to achieve greater energy efficiency of buildings. In 2015, we began conducting ZEB demonstration testing at our Technology and Innovation Center (TIC), which we opened with the goal of creating new value for society.

DAIKIN'S PERFORMANCE

ZEB Demonstration Testing at TIC Achieves 82% Reduction in Energy Consumption

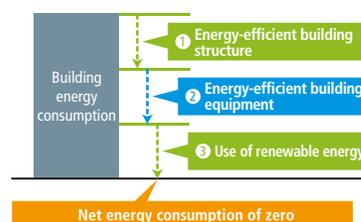
At the TIC, we collaborated with an architectural firm in exhaustive testing aimed at reducing energy consumption. For example, we reduced the amount of air conditioning and artificial lighting needed by using structures that maximize natural light and wind, and we incorporated highly energy-efficient equipment and management systems for operating this equipment.

Building Electricity Consumption and Net Zero Energy Buildings (ZEBs)



Source: Energy Conservation Center, Japan (ECCI)

ZEB Definition



How buildings are being made into ZEBs

Highly efficient insulation, wind and solar power, blocking of solar radiation, natural ventilation, others

More efficient equipment, more efficient systems, energy-efficient operation, others

Solar power, wind power, storage batteries, heat storage tanks, others

Daikin's strength

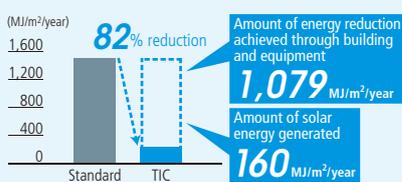
Energy management

TIC's ZEB Technologies

With sensors throughout the entire floor and the ability to control all air conditioners, energy consumption can be controlled so that both room comfort and energy efficiency are achieved. In addition, solar power and other renewable energy sources are utilized. Energy-efficiency also goes beyond air conditioning to include equipment such as LED lighting.



TIC's energy consumption



1 Energy-efficient building structure

- **Use of natural light and ventilation**
- **Use of thermal energy**
A system was introduced to effectively use geothermal heat.
- **Improve performance of building's outer layer**
The easy-to-install ZEFFLE infrared reflective coating was applied to effectively reflect sunlight and keep indoor temperatures down.

2 Energy-efficient building equipment

- **Ultra-high-efficiency air conditioning**
The VRV series of multi-split type air conditioners for commercial buildings adjusts temperature, and the DESICA HOME AIR uses outdoor air to control humidity. These two are combined in a system for separation of latent heat that allows efficient energy usage.

3 Use of renewable energy

- **Use of solar power**
A 300-kW solar power generation system uses tracking solar panels to achieve maximum power generation.

Energy management

- **Optimal control**
Optimal air conditioning is achieved by adjusting to outdoor air temperature.
- **On-screen information about energy efficiency**
Digital signage in the TIC offices shows the amount of electricity currently being consumed.

As a result, in fiscal 2016 we succeeded in reducing overall building energy consumption by 72% compared to standard values. When solar power generation was added to the equation, we achieved an 82% reduction.

In July 2016, the TIC received the highest rank of Platinum Certification in the LEED for New Construction (LEED-NC). LEED is the world's most widely adopted system for the evaluation of environmentally responsible buildings.



Energy Management Balancing Comfort and Energy Efficiency

Building energy management systems (BEMSs) ensure optimal operation of air conditioning according to the specific usage conditions of each building and thus hold the key to achieving air conditioning that offers both energy efficiency and comfort. Daikin is already putting to practical use the technologies it has acquired through demonstration testing. For example, we have conducted real-time analysis at the TIC to test whether energy management systems are continuously maintaining comfortable room environments, and systems adopting the fruits of this testing have been incorporated in new buildings aiming to achieve net zero energy usage.

One such building in Tokyo uses the system to achieve the most energy efficient means of air conditioning according to continuously changing conditions. For example, the system employs a vast array of sensors for real-time measurement of factors necessary to maintaining a comfortable room environment, such as temperature, humidity, illumination, CO₂ concentration, outdoor wind speed, and precipitation. When room comfort can be achieved with only the cold air from outside, the system automatically switches to outdoor air cooling mode. An evaluation of the building shows that it is now twice as efficient as standard buildings.

Stakeholder's Comment

I'm Counting On Daikin Innovations to Help Realize a Zero-carbon Society

With the Paris Agreement going into effect and debate on long-term targets for the reduction of greenhouse gases, the prevailing opinion is that the private sector must for the most part achieve zero carbon emissions by the latter half of this century. Daikin's challenge to make the TIC a ZEB is a successful case study of an energy system that achieves good overall balance throughout an entire building. It would be great to see this experience give rise to more such successes in the future.



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NEXT CHALLENGE

Build Up Scientific Proof of Energy Efficiency and Help Spread the Construction of ZEBs

Daikin holds regular discussions with groups around the world that are promoting the move to ZEB and other green buildings. To achieve optimal control of air conditioning, it is crucial to take into consideration the climate, types of buildings, and air conditioner usage conditions that are peculiar to each country and region. In Japan and other industrialized Western countries, as well as in newly emerging countries that hope to achieve both economic growth and environmental protection, we are using our energy-efficient air conditioners and energy management know-how to hasten the move to ZEB and to contribute to energy efficiency that spans towns, cities, and entire regions.