The society founded 100th anniversary publication

Air/Water/Energy for Environment

[SHASE]
The Society of Heating,
Air-Conditioning and
Sanitary Engineers of Japan

About Our Society

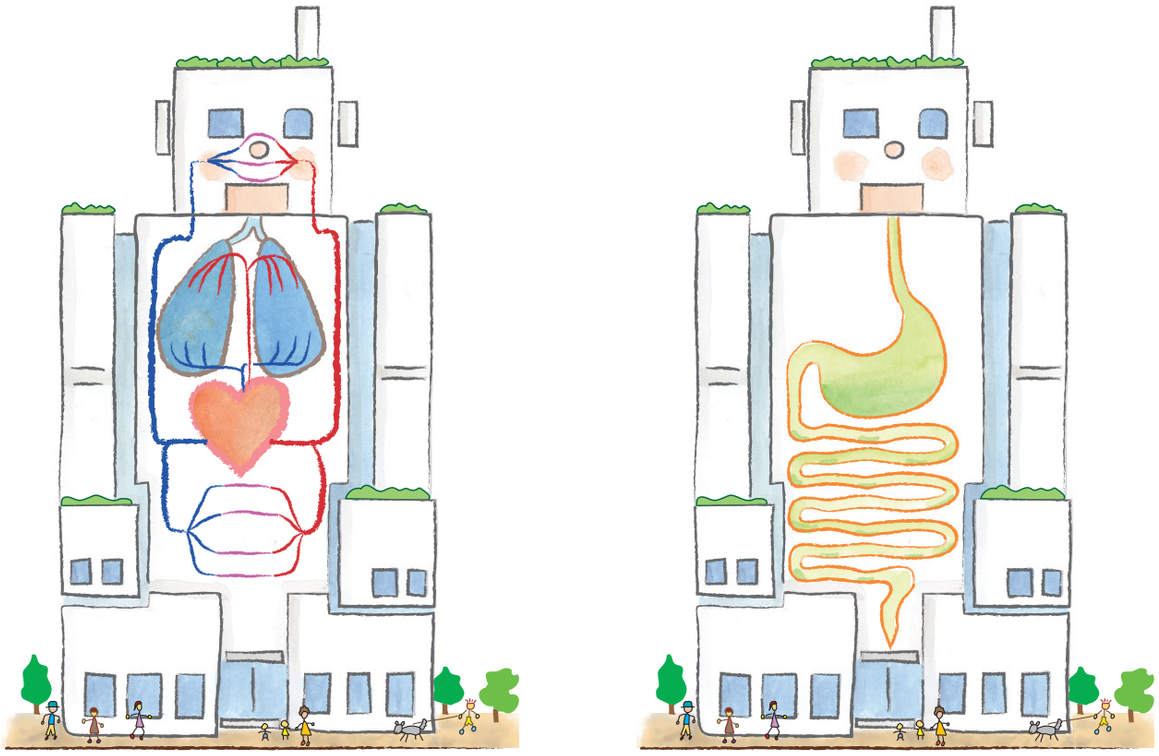
The Society of Heating, Air Conditioning and Sanitary Engineers of Japan (SHASE) is a scientific organization specializing in heating, cooling, ventilation, water supply/drainage, and sanitary facilities that are used all around us, as well as their mechanisms and operating principles.
SHASE conducts various activities relating to them with the aim of contributing to the maintenance and improvement of safety, health, and comfort in buildings.
Our society also diligently addresses the issues of energy conservation, preserving the global environment, and resilience to disasters, which have been gaining importance in recent years.

What are Building Services?

The term, "building services" may not be mentioned frequently in a daily life. Building services are essential for providing comfortable and pleasant indoor environments (residences, hotels, etc.) and human-friendly workplaces (office buildings, hospitals, stores, etc.). To create excellent buildings, the integration of architectural design, structural engineering and building services engineering is required. Building services in a building are often compared to the organs inside the human body.

What is Our Role and Mission?

Building services engineers design the diverse and complicated systems necessary for the proper functioning of buildings. They are also responsible for creating such systems and ensuring their proper operation.
The construction of a building consumes large amounts of resources. Considerable amounts of energy and water are consumed in the operational phase. Then, when a building reaches the end of its service life, a huge amount of waste is generated.
To respond to global environmental issues and to achieve a sustainable society, we need to give serious thought to the conservation of energy and water during the operational phase of buildings. This is, especially important in the early design phase.
As people need to manage their health, buildings also require daily maintenance and regular commissioning/renewal for proper functioning and long service life. Building services engineers play an important role in this regard.



Building Facilities Are Like Internal Organs

Our Roles and New Mission

Creation of People- and Earth-Friendly Environment

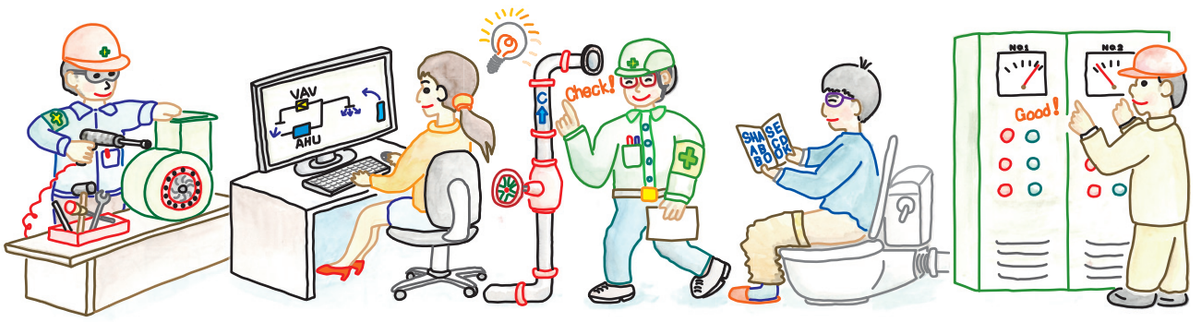
The assurance of the safety, health, and comfort for building users, residents, and others is a primary function of building services. At the same time, we must contribute to the realization of a sustainable society.
In the field of building services, the conservation of energy and water is a high priority.

Air Conditioning and Sanitary Engineering

"Air conditioning" refers to the adjustment of indoor temperature, humidity, and air quality for improving comfort and good health. Various activities are conducted not only for air conditioning for people but also for the creation of ultra-clean manufacturing environments, for example. Buildings are equipped with water supply systems and sanitation facilities for hygiene and comfort. Gas supply facilities and fire control systems are also provided in buildings.

Our New Initiatives

Efforts are continually made to improve buildings' basic performance for saving energy and resources and providing safe, healthy, and comfortable indoor environments. For that purpose, we utilize and incorporate eco design, eco work style, high-efficiency facilities, and natural energy. In addition, comprehensive and integrated initiatives including electrical systems are becoming increasingly important. Furthermore, new needs are emerging, such as wide-area water recycling and renewable energy use, interchange of energy among buildings and resilience to disasters.
SHASE will respond flexibly to those needs in collaboration with other associations and organizations in related fields.



Develop and Manufacture High-Efficiency Equipment | Consider a Good Design and Make a Drawing | Construct and Supervise High Quality System | Use Comfortably and Meditate Silently | Operate, Manage, Verify and Tune according to Usage

People Involved in Building Services

The Long Journey of a Drop of Water

People used to fetch water from wells and boil it in kettles before it could be drunk, and toilets used to be insanitary. Today, hot and cold water is readily available, and toilets are hygienic. People take these benefits for granted, but various mechanisms and technologies are at work behind the scenes.
Many areas of Japan are endowed with ample water resources, but, from a global perspective, water is scarce and a very valuable resource. In recent years, even in Japan, there have been water-related problems, such as water shortages due to abnormal weather and reduced water-holding capacities resulting from reckless deforestation. Also, drainage water is causing the abnormal growth of algae in lakes and seas and resulting in nutrient pollution.
It is important to remember how people used to use water carefully and sparingly.

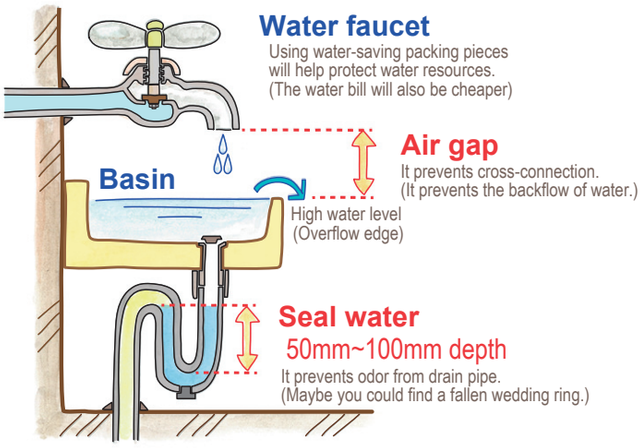
People- and Earth-Friendly Sanitary Engineering

Life with Water

Sanitary facilities are indispensable for a safe, healthy, and comfortable living.
They must be designed for easy and safe use for everyone.
We need to re-think how we can reduce environmental pollution and live Earth-friendly lifestyles.

Safe and Healthy Environment

The availability of safe drinking water is one of the most important requirements. There are only a few countries in the world where tap water can be safely consumed by humans without any processing. This is made possible in Japan by stringent water quality standards and advanced technologies. Proper design and construction of sanitary facilities is also crucial.
The measures shown in the image on the right prevent cross connection and the entry of odors and insects. For the operation and maintenance of buildings, such measures are taken for a safe and healthy environment.



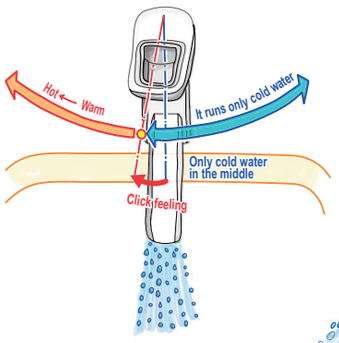
Hidden Ingenuity for a Safe and Comfortable Life

Water Saving

Conservation of water contributes to the protection of water resources. At the same time, it reduces the energy used for the purification and transportation of water, wastewater treatment and discharge into the sea.

Strategies at Home

Using less hot water reduces the energy used for heating water. About 30% of energy consumed by households is used for heating water. To achieve Japan's target set in the Paris Agreement, it is necessary to reduce CO_2 emissions in the household sector by about 39% (from the level in 2013). This is equivalent to a reduction of about 620 kg-CO_2 by every person in Japan in a year. Getting out of the shower one minute sooner reduces about 29 kg-CO_2 annually. Such small but continuous energy-saving efforts are very important.

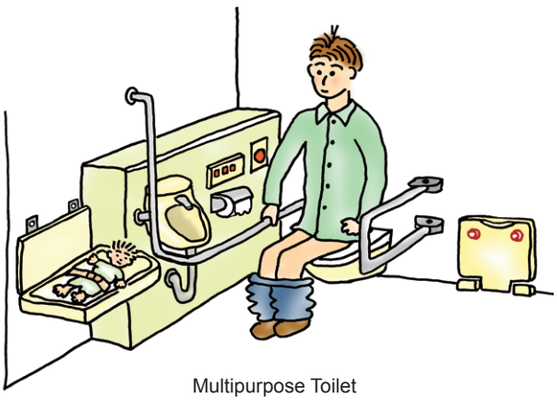


Single Lever Faucet for Saving Hot Water

Water-Saving Shower

Human Friendly

The creation of communities that are friendly, not only to the Earth but also, to all people including older people, children, and physically impaired people is being promoted. For houses, it is also important to make the provision of nursing care easier.
The universal design concept can be represented by keywords such as "simple," "easy to understand," "safe," and "for everyone." Universal design must also be implemented in the field of sanitary facilities since they are closely related to comfort in our everyday life.



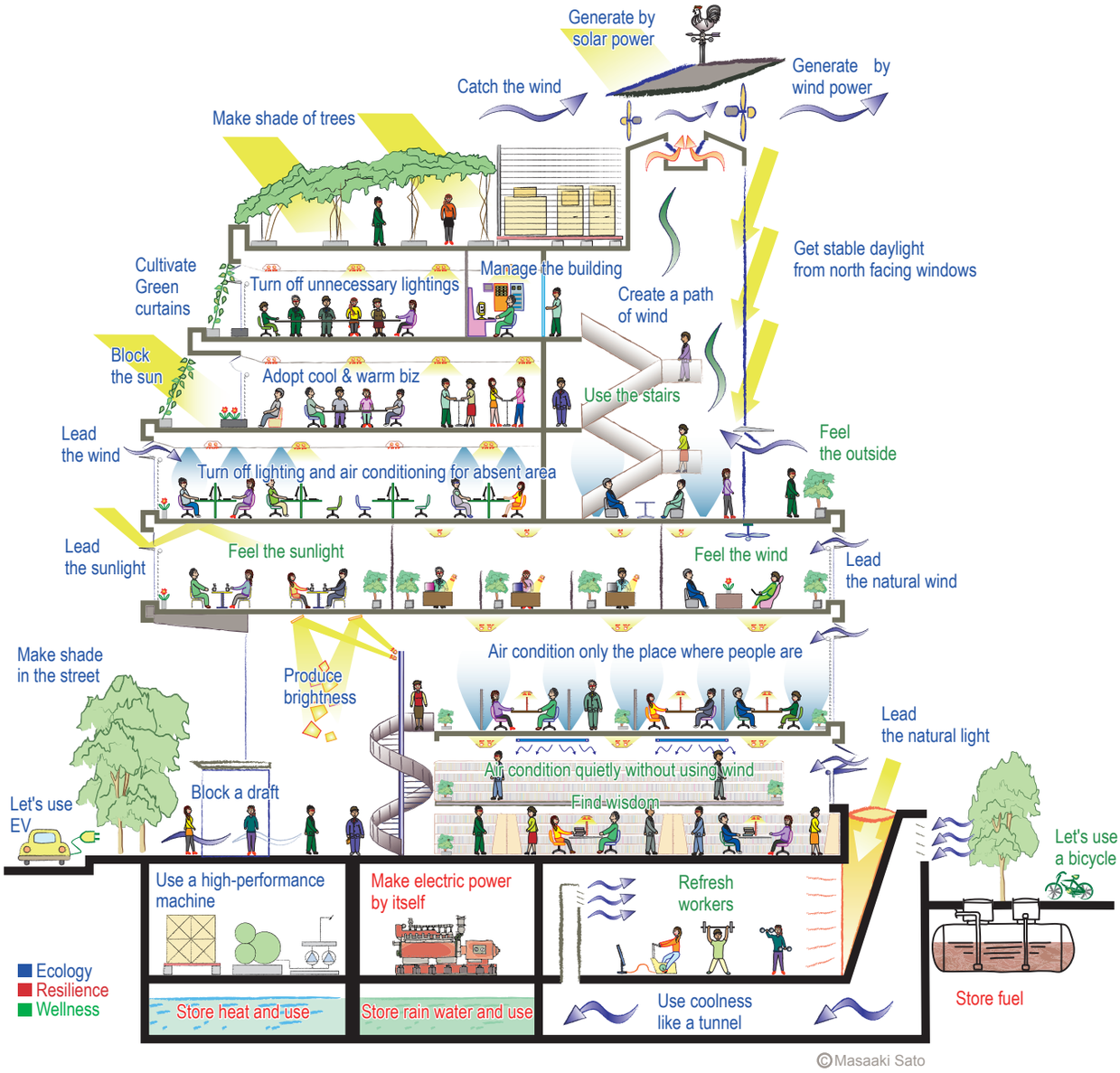
Multipurpose Toilet

Smart and Comfortable with Low Energy

Energy saving and CO_2 emissions reduction are important social issues. Also, we started to realize that enabling building users to conduct activities in safe, healthy, and comfortable surroundings (wellness), and offering environments with high functionality and productivity (smartness) are important performance factors of buildings.

Safety, Healthy and Comfortable, with Low Energy

To achieve this goal, not only high-performance energy-saving systems but also utilization of the blessings of nature and improvements of work styles (eco work styles) are important.
In some production facilities, the temperature, humidity, and air cleanness must be kept constant throughout the year. In residences and workplaces, however, people need to feel seasonal changes and daily fluctuations.
Preparation for emergency situations (disaster resilience) is also becoming increasingly important for ensuring safe and secure living.



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Building where Energy Conservation and Health/Safety/Comfort Are Compatible

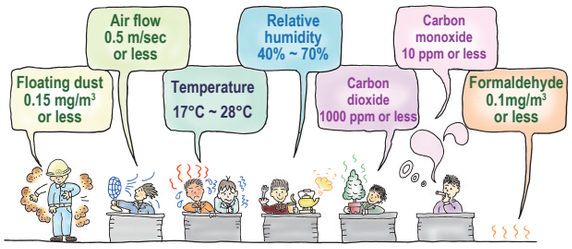
People- and Earth-Friendly Air Conditioning Engineering

Comfortable and Eco-friendly

The adjustment of the air and temperature conditions in a building is called air conditioning. The elements to be controlled are temperature, humidity, air flow, and air quality. Buildings are equipped with various types of equipment and devices for the control of these elements.
Building facilities must be carefully designed to provide comfortable work environments and save energy at the same time.
We need to work toward the realization of Zero Energy Buildings (ZEB) and Zero Energy Houses (ZEH) to achieve the ultimate energy-saving performance.

Indoor Environment Quality

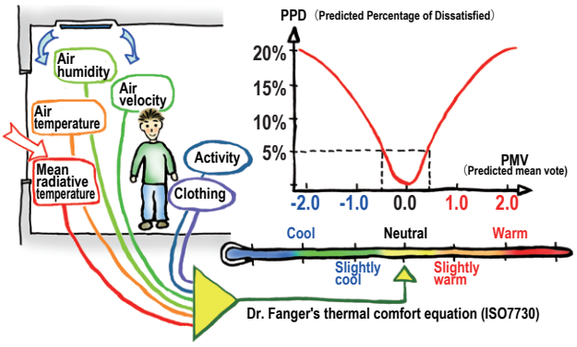
The Act on Maintenance of Sanitation in Buildings stipulates indoor environmental standards and requires that buildings larger than a certain size meet the seven criteria shown in the image at the right. Those values are not set for the purpose of providing comfort, but are minimum standards.
Operation of facilities with increased attention to the balance between energy saving and comfort will gain greater importance in the future.



Indoor Environmental Standards Based on the Act on Maintenance of Sanitation in Buildings

Thermal Comfort

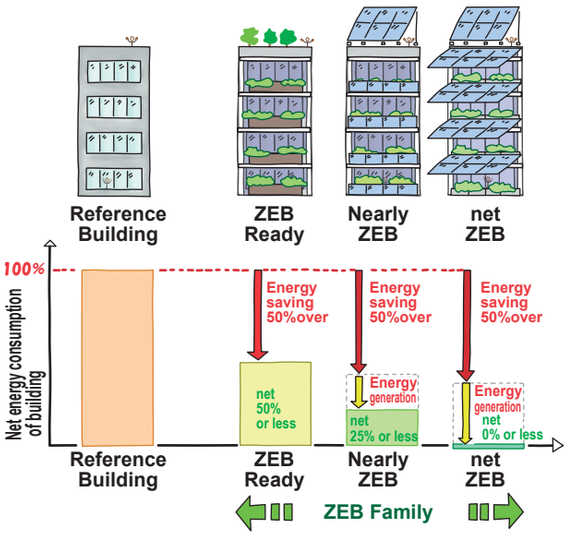
The level of comfort provided by air conditioning varies depending on the combination of factors such as air temperature, air humidity, and air velocity as well as radiative temperature, clothing, and the activities of occupants.
It is possible to predict the average thermal comfort and estimate the percentage of dissatisfied people based on the data of these six parameters. In order to achieve both energy saving and comfort, it is necessary to adjust them properly.



Prediction of Thermal Comfort by Six Parameters

Toward the ZEB

The Paris Agreement was adopted at the Paris Climate Change Conference (COP21). To achieve the target, it is imperative to attain significant reductions of CO_2 emissions in the building operational phase. From 2017, Japan requires mandatory compliance with building energy efficiency standards, and the regulations are expected to become even stricter in the future.
ZEB is the concept of buildings with ultimate energy-saving performance. We will strive to promote "net ZEB," and, at the same time, we consider it important to promote "ZEB Ready" to minimize the financial burden.



Super Low Energy Aiming at Net Zero Energy Consumption

Mechanism of Hot and Cold Water Supply

Water Supply Facility

Water from the service main is supplied to the kitchen, washroom, etc.

Hot Water Supply Facility

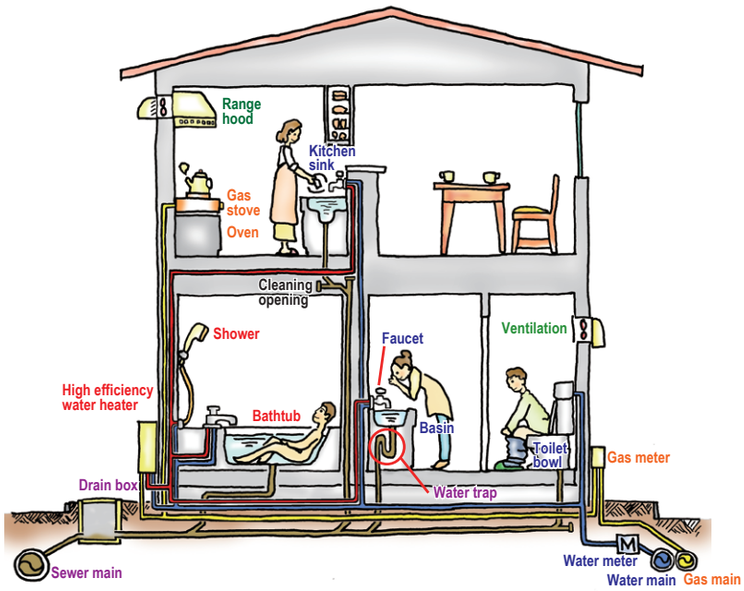
Hot water from the boiler/water heater is distributed to the bathroom, kitchen, etc.

Drainage Facility

Waste cold/hot water is discharged through the drainage pipes to the outside of the house and into the sewer main.

Gas Supply Facility

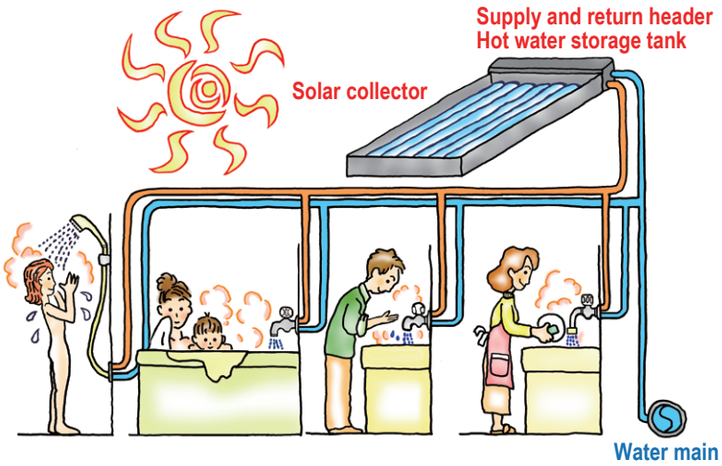
Gas from the gas mains is supplied to the kitchen and other places and used by the gas stove, gas range, hot water heater, and other appliances in the house.Their proper functioning ensures a sanitary and comfortable living environment.



Mechanism of Hot and Cold Water

High Efficiency Hot Water Supply System

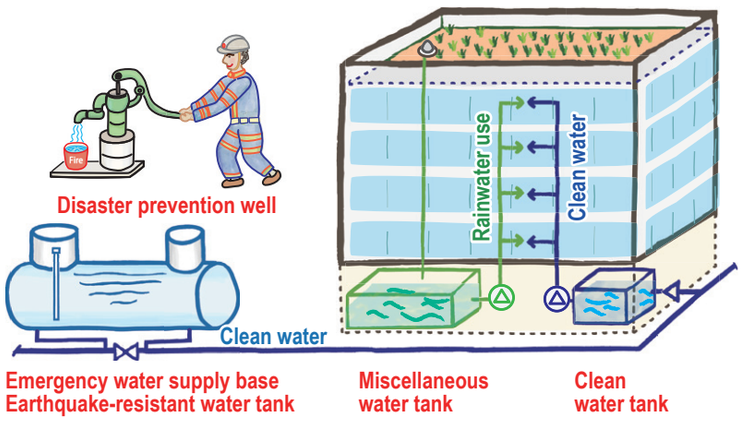
Approximately 30 % of energy consumed in a house is used for heating water. High efficiency heat-pump water heaters, latent heat recovery water heaters, and the like are commonly used to save energy. Hot water supply systems using solar energy are also effective for saving energy.



Hot Water Supply System Using Solar Heat

Preparation for Emergencies

To prepare for possible power failure and water supply suspension in the event of a major earthquake, it is recommended to store sufficient drinking water and food for three days and keep other essential commodities.
It is also necessary to keep a sufficient amount of non-potable water. Initiatives have been launched to establish regional disaster prevention wells and install earthquake-resistant water tanks.



Securing Water in an Emergency

Principle of Ventilation and Heating

Ventilation

Ventilation systems take fresh air into the room and remove the combustion gases produced by cooking ranges and other gas-using appliances to keep the indoor air clean. They also eliminate odors from toilet rooms. Ventilating the bathroom removes moisture, thus helping prevent mold growth on tiles and walls. Ventilating the attic removes excess heat and moisture and improves the indoor environment.

Cooling

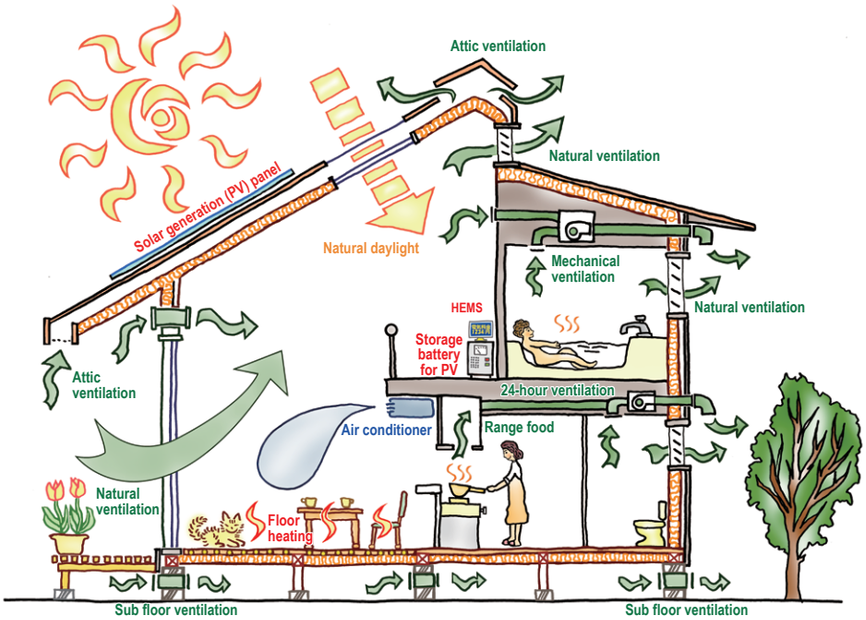
Most houses are installed with split type air conditioners. Home air conditioners utilize the phenomenon that when a compressed liquid expands and evaporates, it provides a cooling effect. We should, however, occasionally open the windows and enjoy incoming fresh air.

Heating

For domestic heating, heat-pump air conditioners and floor heating are now widely used instead of conventional open-type burning heaters. Select and use a heating method suitable for your lifestyle, but remember to take energy saving, comfort, and safety into consideration.

Zero Energy Houses (ZEH)

ZEH can be realized by measures such as thermal insulation, airtightness, control of sunlight and natural ventilation, high-efficiency housing equipment, solar power generation, and utilizing Home Energy Management Systems (HEMS), which achieve comprehensive optimization of equipment.



Principle of Ventilation and Heating

Prevention of Heat Shock

Heat shock due to sudden ambient temperature change can be very hazardous to the health of older people and people with high blood pressure. There is the problem that toilets and bathrooms are colder than other rooms in old houses. In recently constructed super-insulated, super-airtight houses, measures are taken to solve the problem of heat shock.

Prevention of Heat Shock

Principle of Water Supply and Sanitation

The water supply and sanitation facilities in a building are often compared to the organs inside the human body. Their integrated functions hidden behind maintain good hygiene and a comfortable environment.

Sanitary Equipment

Toilets in bathrooms and washbasins in washrooms are called sanitary equipment. They use water, and wastewater is drained from them. Water-saving sanitary equipment is widely used today.

Water Supply Facility

In high-rise buildings, water is usually stored in the water receiving tank, and then pumped up to the high tank installed on the rooftop. Water is then distributed stably to water outlets located throughout the building by utilizing the force of gravity. Some low-rise buildings use other systems for distributing water internally.

Drainage Facility

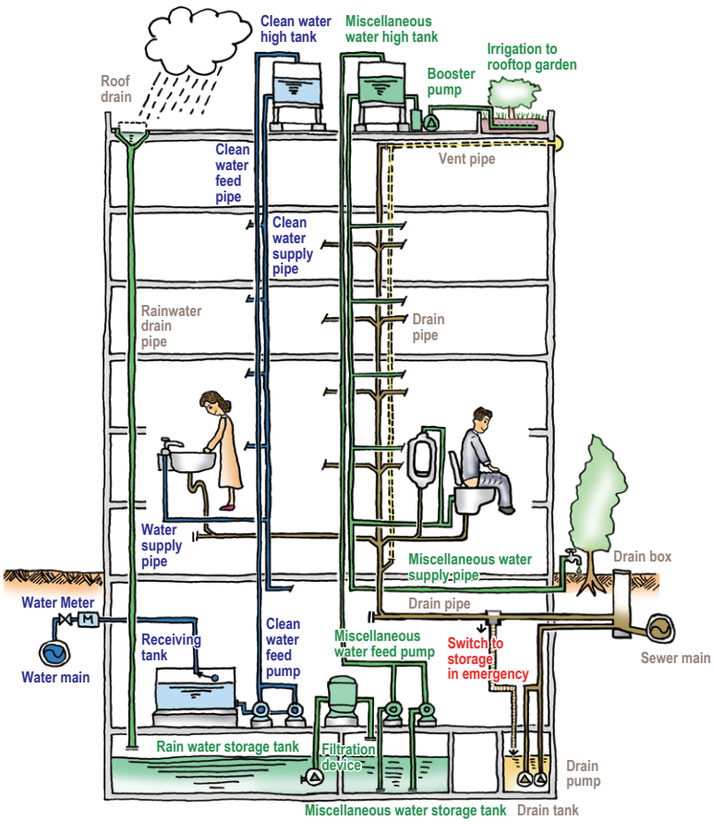
Water used on floors above ground is drained naturally, but water used on underground floors is stored temporarily in a drain tank and then pumped up for discharge from the building. Vent pipes are installed in buildings. They serve to adjust the internal pressure of drainage pipes and ensure the proper functioning of traps for the prevention of odor leakage.

Rain Water Utilization

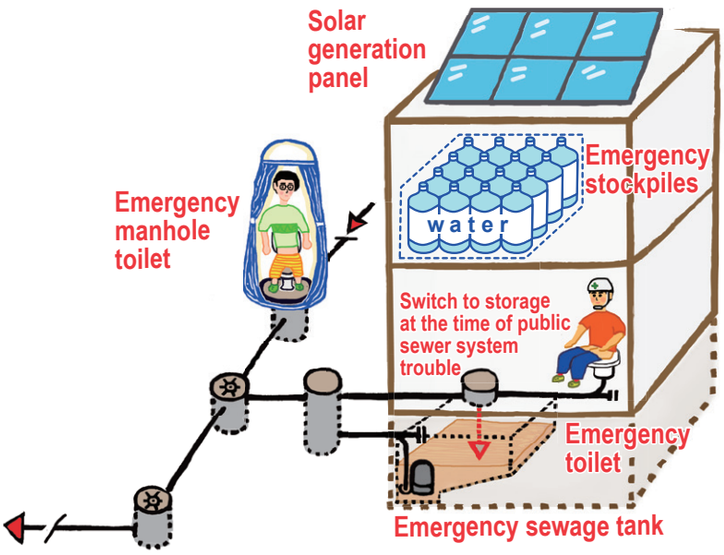
Rainwater that falls on the rooftop can be stored temporarily and filtered and then utilized for miscellaneous use.
Use of rainwater contributes to the conservation of water resources. Since the temporary storage of rainwater during heavy rain helps secure miscellaneous water for emergency use in the event of an earthquake, this system is actively promoted.

Resilience and Emergency Planning

A business continuity plan (BCP) against earthquake disasters is important, particularly for highly functional buildings.
In such a plan, sufficient reserves of drinking water, miscellaneous water, fuel and private power generation system are required. Even in general buildings, we need to consider countermeasures to disasters from the usual time. Securement of drinking water, basic toilet functions, and power supply and communication means should also be examined and planned in advance.



Principle of Water Supply and Sanitation



Preparation for Emergencies

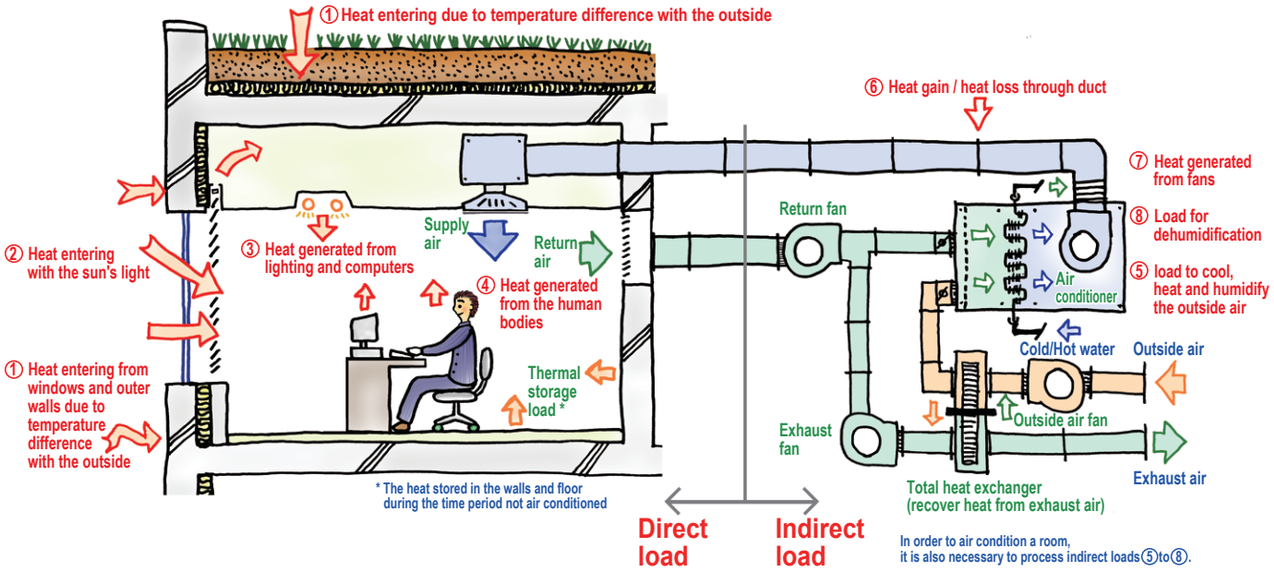
Principle of Air Conditioning

The operating principle of air conditioning systems for buildings is the same as that of cooling and heating systems for homes. However, air conditioning systems for buildings are more complex than residential products. Air conditioning systems introduce fresh outside air into buildings even when the windows are closed. They provide cool/warm air, humidify/dehumidify, and remove airborne dust.

Huge Energy is Consumed for Cooling in Buildings

Air conditioners are operated for cooling for a variety of reasons. Among them, the four factors (① to ④) shown in the image below occur near the rooms and cause direct thermal loads. In addition to these, there are indirect loads (⑤ to ⑧). As a first step to reduce energy consumed by the air conditioning system, the causes that necessitate cooling should be alleviated.

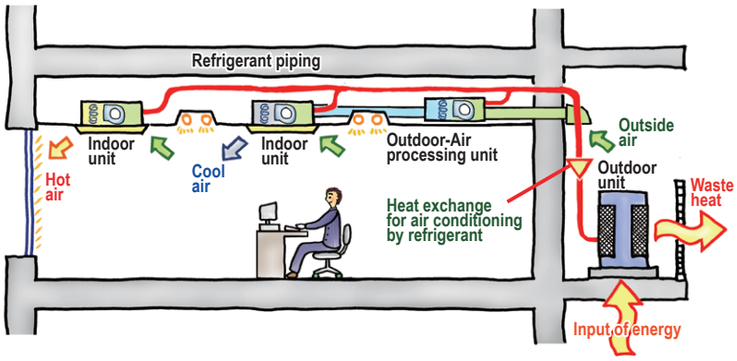
In new buildings, less heat is generated because of the use of high-efficiency LED lighting systems and notebook PCs. Since such reduction of heat generation decreases the required design specific capacity of air conditioning systems, it is possible to use smaller systems, thus saving energy.



Principle of Air Conditioning

System for Small-Sized Building

In small-/medium-sized buildings multi-type split air conditioners (VRV) are often installed. These systems operate on the same basic principle as that of residential air conditioners, but each outdoor unit is connected to multiple indoor units. Some systems respond to complex user needs, such as heating for areas near windows and cooling for areas where computers are operated at the same time.



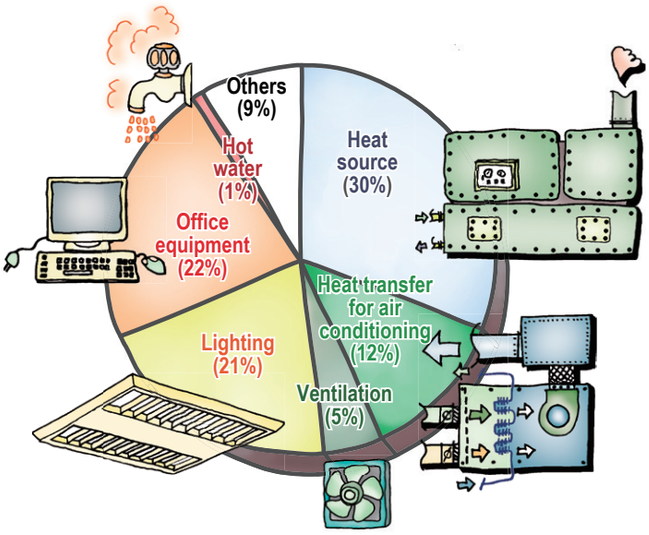
Multi-type Split Air Conditioner (VRV)

Consume Energy Carefully

Buildings need lighting systems, computers, water supplies, hot water supplies, air conditioning, etc. in order to provide functional and productive environments. These functions consume large amounts of energy. The consumption of energy not only leads to the depletion of fossil fuels but also increases global warming. Furthermore, the released heat from buildings to the atmosphere causes urban heat islands.

Energy Consumption of Building

In an office building the energy consumed directly by lighting systems, computers, hot water heaters, and the like accounts for about half (left side of the circle graph) of the total amount of energy used in the building. The consumption of this energy generates heat in the building. Then, energy (right side of the circle graph) is consumed to process the generated heat and the heat entering from the outside.



Energy Consumption in a Typical Office Building

Generation of cold/hot water

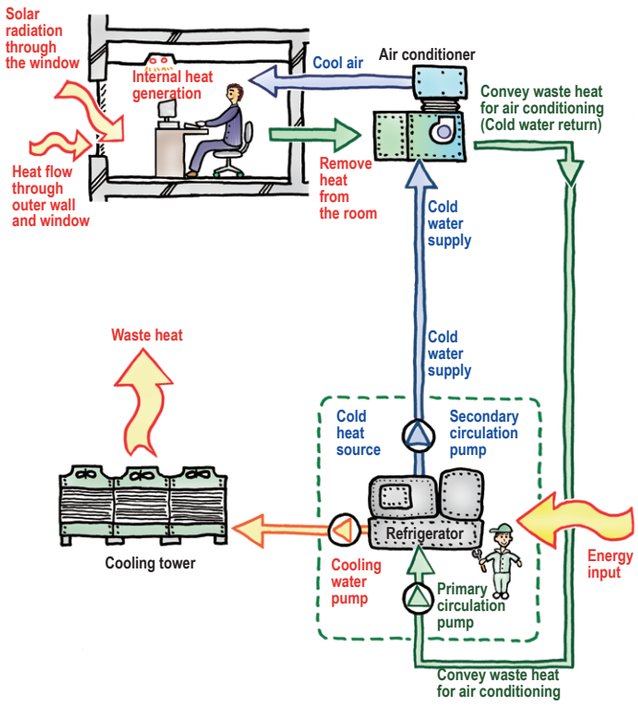
Large buildings are usually installed with equipment that produces the cold/hot water necessary for air conditioning. In the case of cooling, the heat generated in rooms is transported to the refrigerator where it is cooled and waste heat is discharged from the cooling tower.

Transfer of the cold/hot water

A cooling system uses pumps to send cold water produced by the refrigerator to air conditioner units installed at various locations inside the building. Air conditioners cool the air using chilled water inside the units, and then supply the cool air to the rooms.

Smart Use of Energy

High-efficiency equipment and systems for cooling/heating have been developed. Since building facilities consume large amounts of energy, it is necessary to select products smartly according to the characteristics of the building in which they are to be installed. Not only the initial cost and running cost but also various other factors such as safety, supply stability, and the effects on global warming, air pollution, and ozone layer depletion should be considered when selecting equipment and systems.

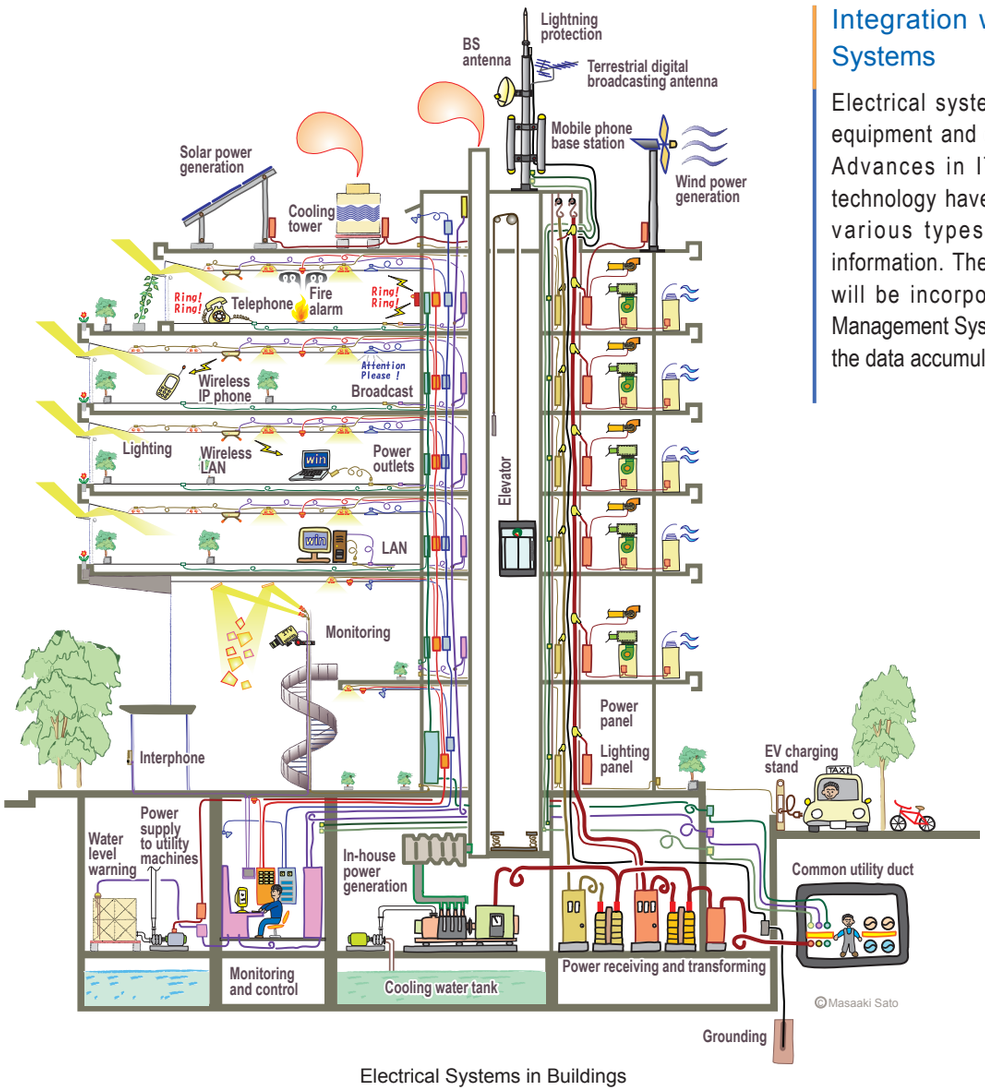


Air Conditioning a Room during the Cooling Season

Energy Saving

Smart Energy Solution

Air conditioning and sanitary systems play an indispensable role in ensuring safe, healthy, and comfortable environments for people. To further improve indoor environmental control, energy-saving performance, and workplace productivity, integrated system design including electrical systems is required.



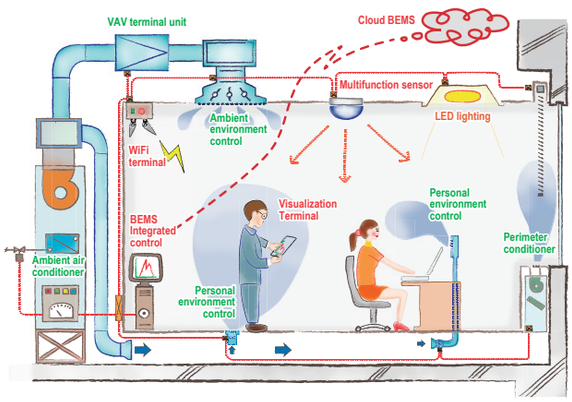
Electrical Systems in Buildings

Integration with Various Electrical Systems

Electrical systems encompass the various equipment and devices shown in the image. Advances in IT technology and sensing technology have enabled us to easily obtain various types of indoor environmental information. These cutting-edge technologies will be incorporated into Building Energy Management Systems (BEMS), and will enhance the data accumulation and control functions.

What will Change with the Internet of Things?

The Internet of Things (IoT), in which almost all physical objects around us are connected via the Internet, is about to become a reality. Sensing technologies for radiative temperature, thermal comfort, luminance, and brightness are now available. Personal recognition system technology is also advancing. These technologies can be used to achieve optimal control and visualization to promote environmentally friendly activities.



Integration of Building System

Extend Our Horizons

Utilization of Water Resources and Resilience to Disasters

Water is one of the most important resources in the world, and Japan is relatively well-endowed with water resources.
However, in cities with concentrated populations, it is important to implement and promote multi-faceted initiatives and activities for water resources in order to support healthy and comfortable living environment. This includes the conservation of water, effective use of water, recycling of water, utilization of heat contained in water, creation of comfortable environments through the use of water, prevention of urban flooding, and resilience to disasters.

Utilization of Water Resources and Resilience in Urban Areas

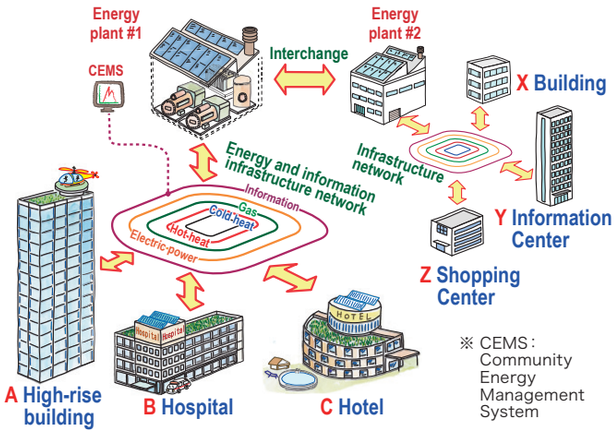
Smart Use of Renewable Energy

Renewable energy, which exists locally in abundance, is low in density and difficult to utilize. However, it is inexhaustible. We need to develop a method that allows individual buildings, regions, and cities to effectively utilize renewable energy. Utilization of renewable energy and interchange of energy among buildings are important for the promotion of effective use of energy in cities and the improvement of resilience to disasters.

Regional Renewable Energy

Effective Energy Use in Urban Areas

Various buildings and other structures are built closely to each other in cities, and this limits the use of solar power generation, which is a commonly used renewable energy source. More effective use of energy can be attained by the integrated control and interchange of energy among various buildings in which the electricity and heat usage characteristics differ. This requires the examination of various systems, such as heat-pump systems that use urban heat sources and heatsinks, CHP systems, and thermal storage systems, for leveling energy demand.



Effective Energy Use in Urban Areas

1. About Us

The Society of Heating, Air-Conditioning and Sanitary Engineers of Japan (SHASE) is a major organization for heating, air-conditioning, and sanitary engineering in Japan. Our society celebrates its 100th anniversary in 2017.

1917	The organization was established as the Heating and Refrigeration Association.
1927	The organization was renamed as the Society of Domestic and Sanitary Engineering.
1962	The organization was renamed as the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan (SHASE).
2012	SHASE became a public interest incorporated association.
2017	100th anniversary

2. MISSION

The mission of SHASE is to develop the science of mechanical service systems for buildings and environmental engineering, including heating, ventilation, air-conditioning, and sanitary engineering, through the following activities:

1	Education	Organizing symposiums, technical seminars, training courses, and technical tours
2	Publication	Journals, technical papers, research reports, handbooks, and others
3	Research	Conducting, supporting, and promoting research and investigations
4	Collaboration	Cooperating and collaborating with international societies
5	Standards	Updates through SHASE-S (Standard), -M (Manual), -G (Guideline), -R (Technical Report)
6	Professional Certification	Establishing the qualifications for "Building Service Engineers" in Japan
7	Awards	Recognizing contributions to the field by awarding prizes

3. MEMBER

as of September 2016

Individual						Company	Total
Regular	Honored	Special	Life	Student	Subtotal		
14 550	30	34	0	431	15 045	492	15 537

4. CONTACT

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