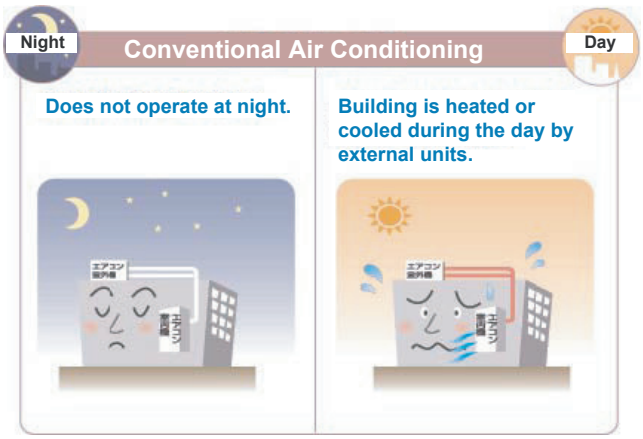
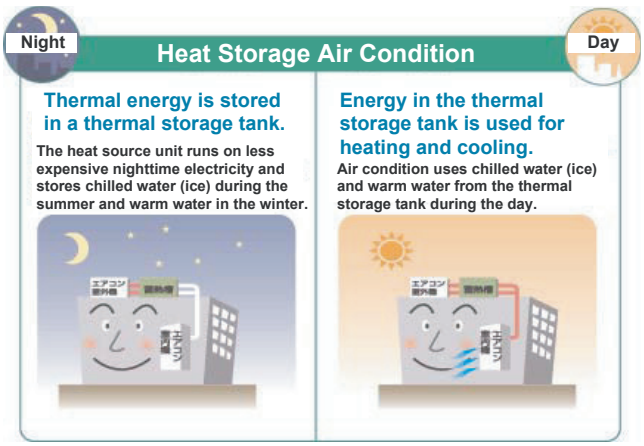
Thermal Storage Air Conditioning System

Features

- The thermal storage air conditioning system activates heat pumps during the night when energy demand is low, in addition to daytime hours when the building is supplied with conditioned air, to store thermal energy in the form of chilled water, ice and hot water so that they can be used during the day.
- An extremely efficient system can be built by combining thermal storage with high-efficiency heat pumps.
- With conventional air conditioning systems that do not use thermal storage, equipment is shut down completely during the night and the heat pump is activated during the day to supply hot and cool air. On the other hand, with thermal storage air conditioning, heat pumps are activated during the night when energy demand is low to store thermal energy in thermal storage tanks. Chilled water and ice are stored in the tanks for cooling purposes, and hot water for either heating or hot water supply. During daytime of the next day when demand is high, thermal energy is drawn from the thermal storage tank for cooling, heating or to supply hot water.



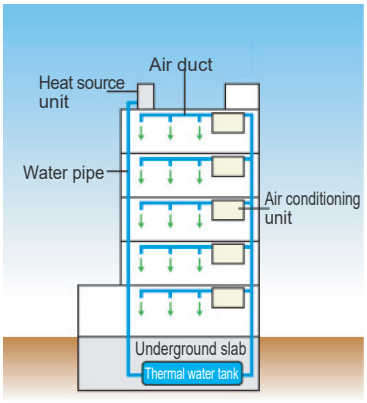


Basic Concept or Summary

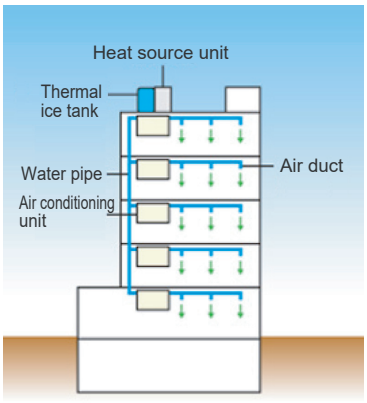
The most appropriate type of thermal storage air conditioning system such as water-type or ice-type system can be selected depending on the scale and size of the installation space.

- Water thermal storage system
  Underground space which is usually left unused (underground pit) is used as the thermal storage tank. The water in the thermal storage tank can be used for extinguishing fires or for domestic use during disasters or emergencies.
- Ice thermal storage system
  Ice is made in the thermal storage tank to store cold energy.
  The tank size can be kept smaller than with water thermal storage tanks.

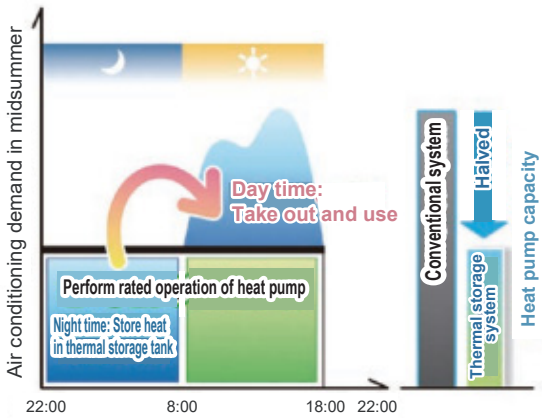
The thermal storage air conditioning system responds to peaks in cooling loads during the day by combining cold energy stored during the night with that produced during daytime. Consequently, the size of the installation capacity can be kept to almost half that of systems that do not utilize thermal storage.



Water thermal storage system

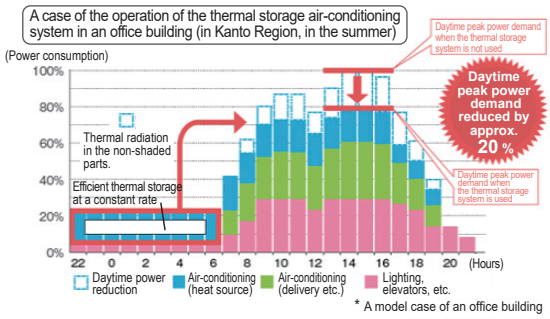


Ice thermal storage system (unit type)

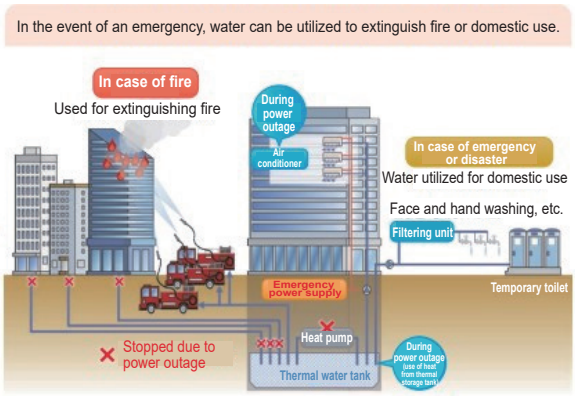


Effects or Remarks

- Reduction in the daytime peak power demand (power load leveling)
  The leveling of power load can be achieved as the system can transfer the power used during the peak hours in the daytime to the nighttime.
  Introduction of the heat pump/thermal storage system makes approx. 20 % reduction in the daytime peak power demand by supplying half the cold thermal energy required for the air-conditioning during the daytime from the thermal storage system.
- Utilization for demand response
  Demands can be suppressed and created when a demand response directive is issued, by regulating the amount of heat stored in the thermal storage tank and the amount of heat drawn from the thermal storage tank.
- Energy conservation and environmental friendliness
  The use of thermal storage tanks makes it possible to operate heat pumps efficiently at a constant rate without being affected by ever-changing air-conditioning load.
  The use of the cool outside air in the night for the generation of cold thermal energy when cooling is required leads to further improvement in the efficiency of the heat pumps.
  (The operational efficiency of the heat pump at 25 degrees is approx. 20% better than at 35 degrees.)
- Cost saving
  As this system allows the reduction in the capacity of the heat source unit, the contract demand can be reduced. The reduction in the contract demand means the reduction in the electricity charge.
  This system allows the use of lower-priced nighttime power.
- As a measure of BCP (Business Continuity Plan)
  The water in the thermal storage tanks can be used as domestic water or for firefighting at the time of emergency and disaster.
  There were cases where water in thermal storage tanks was used as domestic water in the relief effort after the Great East Japan Earthquake.



An example of the operation of the system in an office building

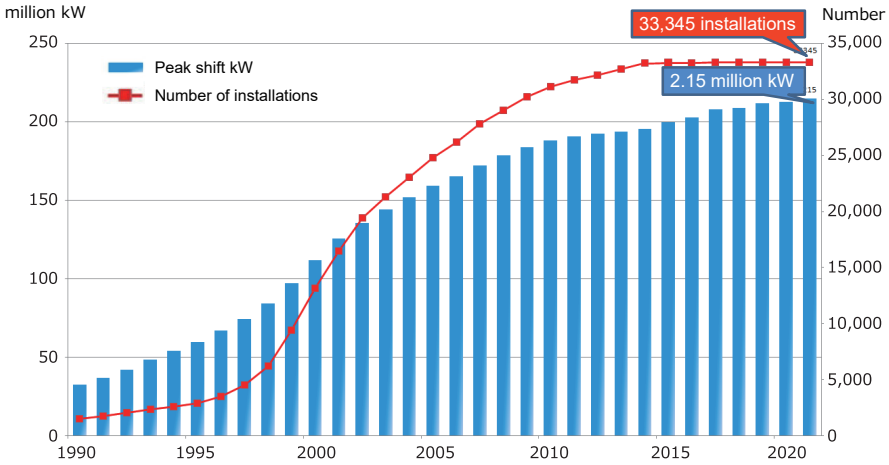


Use of the system at the time of disaster

Installation in Practice or Schedule

Domestic Number of installations: 33,345 (as of the end of FY 2021 estimate)
Peak shift effect in domestic power demand from thermal storage air conditioning system installation: 2.15 million kW (FY 2020 estimate)

◆ Number of Heat Storage Air Conditioning Systems Installed



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