What is a heat supply project?

District heating and cooling is a system for supplying only a necessary amount of heat energy required for the entire town (district) in gross. It is called areal utilization of energy.

It is a system to generate, in a plant, cold water, hot water, and steam to be used in air-heating and cooling and hot water supply by the entire town (district), and to supply the water and steam through a pipeline 24 hours a day, thereby achieving improved comfort and convenience.

Heating and cooling for individual buildings

It is a system to manage heating and cooling for individual buildings. Since heat source facilities are installed individually in every building, there may be some waste in the energy use.

As the district heating and cooling is designed to generate heat energy efficiently as a unit of the entire town, it not only has a higher energy conservation effect but also reduces CO₂ emissions, as compared to the heating and cooling for individual buildings.

Comparison of energy uses between the heating and cooling for individual buildings and district heating and cooling.

Table: Comparison of energy uses between the heating and cooling for individual buildings and district heating and cooling.

<table>
<thead>
<tr>
<th></th>
<th>District heating and cooling</th>
<th>Heating and cooling for individual buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy conservation</td>
<td>100%</td>
<td>50%</td>
</tr>
</tbody>
</table>

Reduction of carbon dioxide (CO₂) emissions by district heating and cooling

Reduction of carbon dioxide (CO₂) emissions (3,468,500 tons of CO₂ per year) (equivalent to the amount of CO₂ absorbed by 5,200 tall trees in a year, the number of trees being equivalent to 1,600 times the trees in Hibiya Park)

Usage: Agency for Natural Resources and Energy

Facilities for supplying heat energy

- District piping
- Chiller
- Heat pump
- Boiler
- Cogeneration
- Heat accumulator
- Water tank
- Central monitoring room
- Air conditioner

Mechanism of absorption chiller

1. Refrigerant is evaporated in an evaporator in a condition close to vacuum under a low temperature and pressure to obtain refrigeration in the evaporator.
2. The refrigerant is then compressed and then vaporized (expanded), thereby removing vaporization heat from the surrounding; and a method using an absorption chiller, in which cold water is produced using a chemical absorbing capacity (See the column “Mechanism of absorption chiller”).

Facility for monitoring the plant

Central monitoring room

Energy supply is controlled from the room 24 hours a day.

Facilities also helpful for disaster prevention

- Heat accumulator and water tank

The plant is a heat accumulator and a water tank. The water stored in these installations is used not only for air heating and cooling but also for fire-fighting water and living water in the event of a disaster.
Introduction of District Heat Supply System in Harumi Island District

TOKYO TOSHI SERVICE COMPANY
Location of Harumi Island Triton Square

- A relaying point for transportation located between the center of Tokyo and the Tokyo Waterfront City
- 3 km from Tokyo station
- 2 km from Ginza station
- In the waterfront area relatively close to the center of Tokyo
Development in multiple stages

Before launch of the redevelopment (before 1993)

At the end of 1st construction period (1997)

Upon completion of the redevelopment (2001)

Further development was started after residents were moved to the residence buildings completed in the first construction period.

Following the construction in multiple stages, the redevelopment was completed in 2001.
Harumi Island Triton Square

Office Tower Z
155 m

Office Tower X
195 m

Office Tower Y
175 m

Office Tower W
88 m

Maintenance shop
Commercial facilities
Hall

Unintended use and/or duplication is prohibited. (Tokyo Toshi Service Company)
Heat storage heat pump system
- good energy conservation performance -

- A daytime peak power demand is reduced by storing the heat generated during night hours with a lower electrical load and by retrieving the heat during daytime hours.
- A production efficiency is improved by operating the system during night hours with lower ambient temperatures.
- A reduced capacity required for heat source facilities (lower band of electricity contract)

High-efficiency operation through rated continuous operation

Heat storage system is effective for reduction of an initial cost, in addition to a low running cost.
Water supply system using large water temperature differences

Customer side (tower office building)

DHC plant

Heat accumulator

Cold water at 6°C/16°C
Hot water at 47°C/37°C

Air conditioners using large temperature differences

Installation, by customers, of air conditioners (ACs) applicable to a large temperature difference (10°C) system

Achievement of large temperature differences
(No need for a large flow rate)
Energy conservation and CO\textsubscript{2} reduction for the entire district

Energy conservation and CO\textsubscript{2} reduction effects in Harumi Triton Square (in comparison with a typical office building)

Largely contributed by energy conservation in air conditioning system, mainly by heat source equipment. (Approx. 80% of the reduction realized by the energy conservation in air conditioning systems.)

Utilization of a large capacity heat accumulator

Installation of facilities and equipment applicable to a large temperature difference system through the cooperation between those who supply heat and those who consume it

* Source: “Heat pump and thermal storage system - Town creation supporting the efforts to address the global warming in Harumi Island Triton Square” (Heat Pump & Thermal Storage Technology Center of Japan)

Comparison of annual energy consumption

<table>
<thead>
<tr>
<th></th>
<th>Typical Building</th>
<th>Harumi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevators, ventilation equipment, etc.</td>
<td>1,573 MJ/m\textsuperscript{2}\textsuperscript{year}</td>
<td>1,572 MJ/m\textsuperscript{2}\textsuperscript{year}</td>
</tr>
<tr>
<td>Outlets</td>
<td>2173 MJ/m\textsuperscript{2}\textsuperscript{year}</td>
<td>2173 MJ/m\textsuperscript{2}\textsuperscript{year}</td>
</tr>
<tr>
<td>Lighting fixtures</td>
<td>528 MJ/m\textsuperscript{2}\textsuperscript{year}</td>
<td>528 MJ/m\textsuperscript{2}\textsuperscript{year}</td>
</tr>
<tr>
<td>Air conditioners</td>
<td>430 MJ/m\textsuperscript{2}\textsuperscript{year}</td>
<td>430 MJ/m\textsuperscript{2}\textsuperscript{year}</td>
</tr>
<tr>
<td>Conveyance power</td>
<td>208 MJ/m\textsuperscript{2}\textsuperscript{year}</td>
<td>208 MJ/m\textsuperscript{2}\textsuperscript{year}</td>
</tr>
<tr>
<td>Heat sources</td>
<td>190 MJ/m\textsuperscript{2}\textsuperscript{year}</td>
<td>190 MJ/m\textsuperscript{2}\textsuperscript{year}</td>
</tr>
</tbody>
</table>

Reduction by 28% in the entire building

Comparison of annual CO\textsubscript{2} emissions

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<th>Typical Building</th>
<th>Harumi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevators, ventilation equipment, etc.</td>
<td>68.40 kg-CO\textsubscript{2}/m\textsuperscript{2}\textsuperscript{year}</td>
<td>60.46 kg-CO\textsubscript{2}/m\textsuperscript{2}\textsuperscript{year}</td>
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<tr>
<td>Outlets</td>
<td>88.40 kg-CO\textsubscript{2}/m\textsuperscript{2}\textsuperscript{year}</td>
<td>88.40 kg-CO\textsubscript{2}/m\textsuperscript{2}\textsuperscript{year}</td>
</tr>
<tr>
<td>Lighting fixtures</td>
<td>42.80 kg-CO\textsubscript{2}/m\textsuperscript{2}\textsuperscript{year}</td>
<td>42.80 kg-CO\textsubscript{2}/m\textsuperscript{2}\textsuperscript{year}</td>
</tr>
<tr>
<td>Air conditioners</td>
<td>21.40 kg-CO\textsubscript{2}/m\textsuperscript{2}\textsuperscript{year}</td>
<td>21.40 kg-CO\textsubscript{2}/m\textsuperscript{2}\textsuperscript{year}</td>
</tr>
<tr>
<td>Conveyance power</td>
<td>10.70 kg-CO\textsubscript{2}/m\textsuperscript{2}\textsuperscript{year}</td>
<td>10.70 kg-CO\textsubscript{2}/m\textsuperscript{2}\textsuperscript{year}</td>
</tr>
<tr>
<td>Heat sources</td>
<td>9.30 kg-CO\textsubscript{2}/m\textsuperscript{2}\textsuperscript{year}</td>
<td>9.30 kg-CO\textsubscript{2}/m\textsuperscript{2}\textsuperscript{year}</td>
</tr>
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Reduction by 32% in the entire building
Energy conservation performance in heat supply

Combined energy efficiency (= amount of heat energy sold / amount of primary energy used)

The Harumi Island district still maintains the efficiency at the highest level in Japan even today after over 10 years have passed since the completion of its construction.
CO₂ reduction performance in heat supply

CO₂ emissions per unit of heat

* Based on 2010 records - Carbon dioxide emission factor: calculated from 0.384 [kg-CO₂] for an entire day
Default factor based on the Act on Promotion of Global Warming Countermeasures: 57.00 [kg-CO₂/GJ]
Efforts and management system for town management (Integrated planning, designing, management, and operation of the entire town block)

◆ The general administrator (Harumi Corporation) remains to be a leader of activities even today, and all parties concerned continue to be involved in the “activities for reducing environmental impact”.

◆ As a part of the town management, continued “energy management” activities are in place.

◆ To inform the public of the efforts and activities in Triton Square, publications such as a performance report are issued (“visualization”).
Progress of combined energy efficiency

The Harumi Island district, which was launched in April, 2001, remains to deliver one of the highest performances in Japan through its continuous “energy management” activities.

Combined energy efficiency (amount of heat energy sold / amount of primary energy used)

Source: “Heat Supply Business Handbook” (2002 to 2014 version); the primary energy equivalent of electricity is based on the factor in the Tokyo Metropolitan Environmental Security Ordinance for each year.

- Large amount of reduction in pump power as a result of using a large temperature difference system with an agreement and cooperation by customers
- Achievement of energy conservation through continuous operational improvements
  - Proper operation of heat sources and modification of the number of pumps to be used, based on a study on actual load conditions
  - Optimization of the heat storage capacity based on an actual level of heat load
- Provision and publication of information, including the operation efficiency of the plant, to be fed into environmental information management activities

Amount of energy sold (TJ/year)
Adoption of large capacity heat accumulator
- Improvement of disaster prevention functions -

Use of the heat accumulator as a community tank

At normal times, heat source equipment is operated using the electricity in night hours, so that cold and hot water to be used in air conditioners used during daytime hours can be stored.

Sufficient water to provide for the entire working population (20,000) for 30 days (in the case of using the water as flushing water for toilets)

In the event of emergency such as a disaster, the water can be used to flush toilets in the building, or it can be utilized as living water such as for laundry and washing hands by installing filtering devices.

Heat accumulator with a capacity of approx. 20,000 m³

Sufficient water for 30 fire trucks to be engaged in fire fighting activities for approx. 10 hours.

In the event of a fire, the water can be used for fire fighting. (It is approved by Tokyo Fire Department to use a heat accumulator satisfying certain conditions as a tank for water also serving as fire fighting water.)
Fire hose training using the community tank

In the event of a fire, the water can be used for fire fighting. (It is approved by Tokyo Fire Department to use a heat accumulator satisfying certain conditions as a tank for water also serving as fire-fighting water.)
Thank you for your attention.

TOKYO TOSHI SERVICE COMPANY