PRACTICAL APPLICATION OF SNOW MELTING SYSTEM USING NATURAL RESOURCES IN JAPAN

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MAJOR ACTIVITIES

■ Development of Snow Melting System

Research/Design/Construction/Fabrication and Maintenance

■ Development of Natural Resources

Hot Spring Development/Geothermal/Ground Source

■ Environmental Protection

Soil & Groundwater Remediation

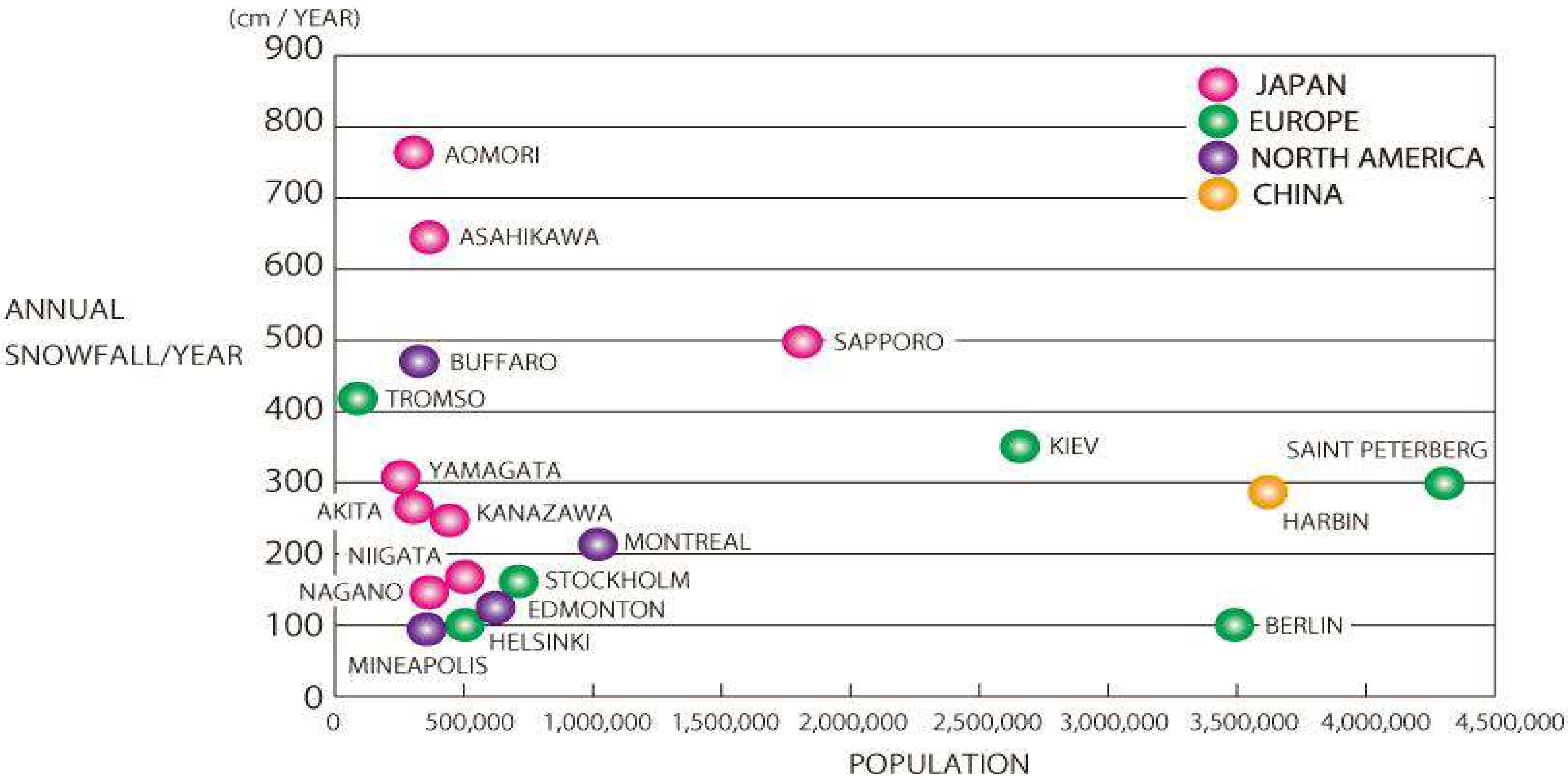
Artificial Recharge of Groundwater

Development of Ground Source Heat Pump System

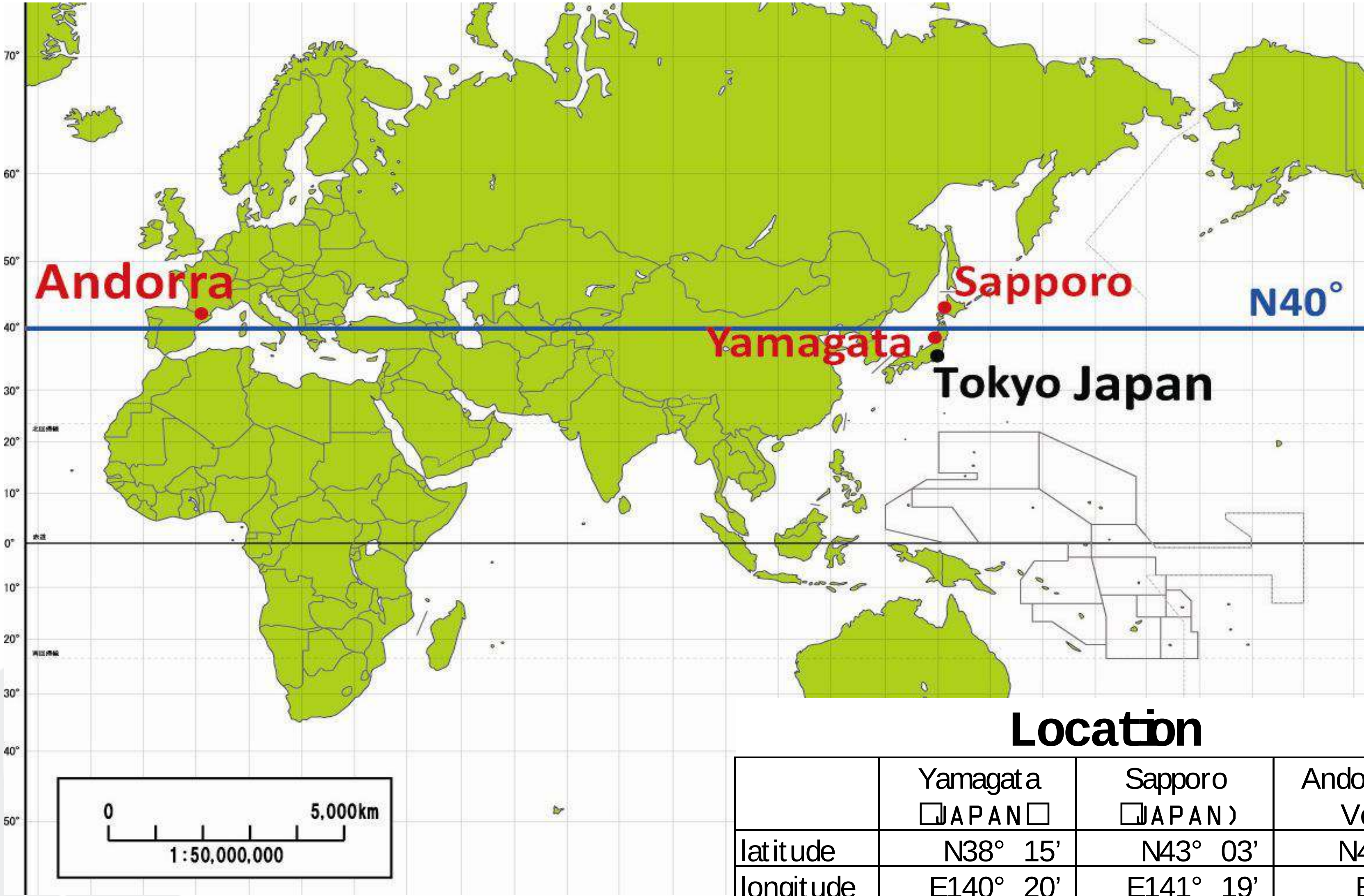
Development of Aquifer Thermal Energy Storage System

COMPARISON OF SNOWY CITIES IN THE WORLD

Source : Snow Research Center, Japan



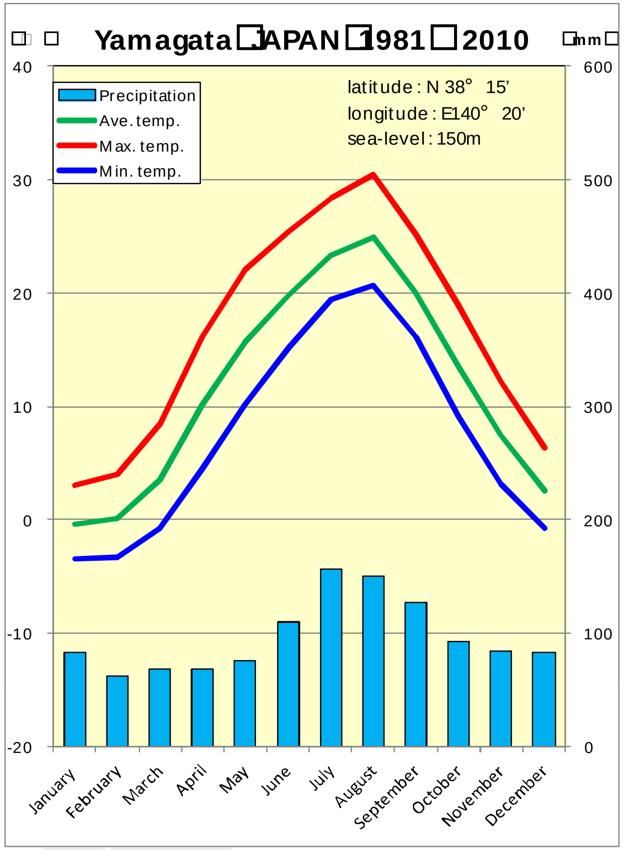
LOCATION



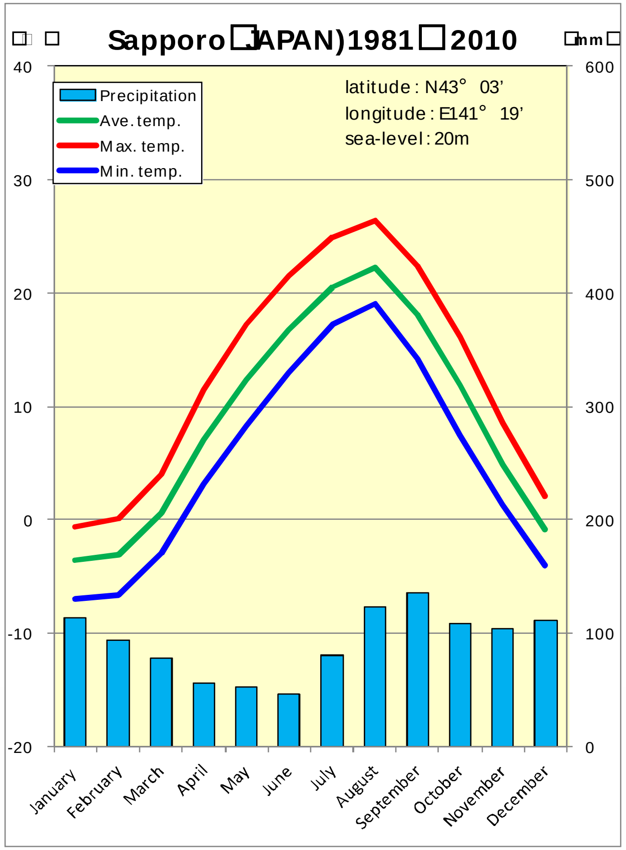
Location

	Yamagata (JAPAN)	Sapporo (JAPAN)	Andorra La Vella
latitude	N38° 15'	N43° 03'	N42° 30'
longitude	E140° 20'	E141° 19'	E1° 31'
sea-level	150m	20m	1100m

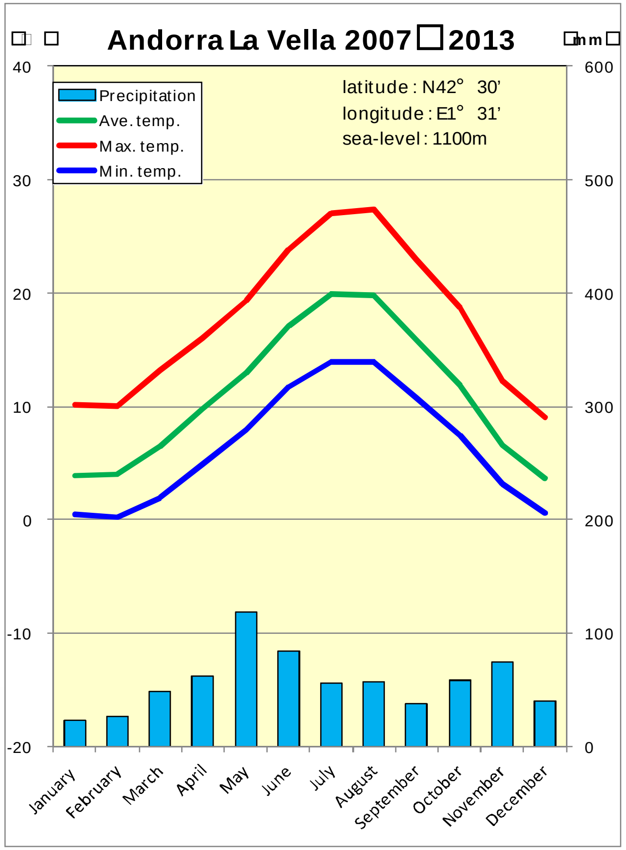
COPM ARISON OF WEATHER CONDITION



Annual Ave. temp. : 11.7℃
Annual Max. temp. : 16.7℃
Annual Min. temp. : 7.5℃
Annual Precipitation : 1163.0mm

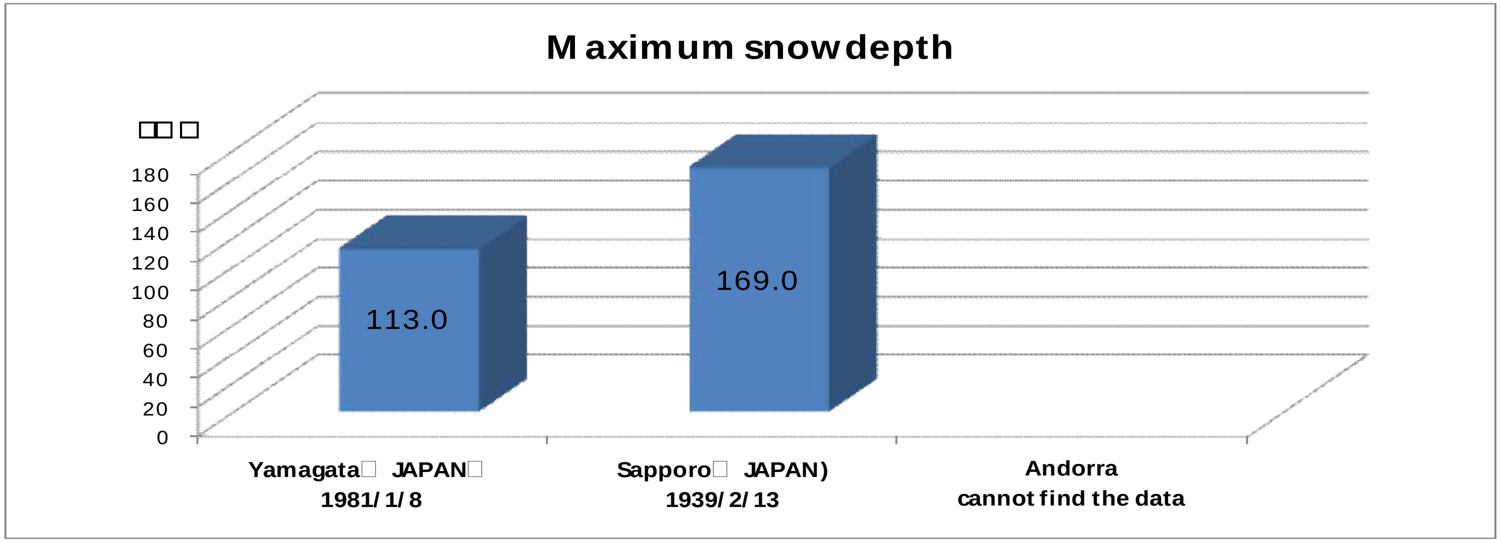


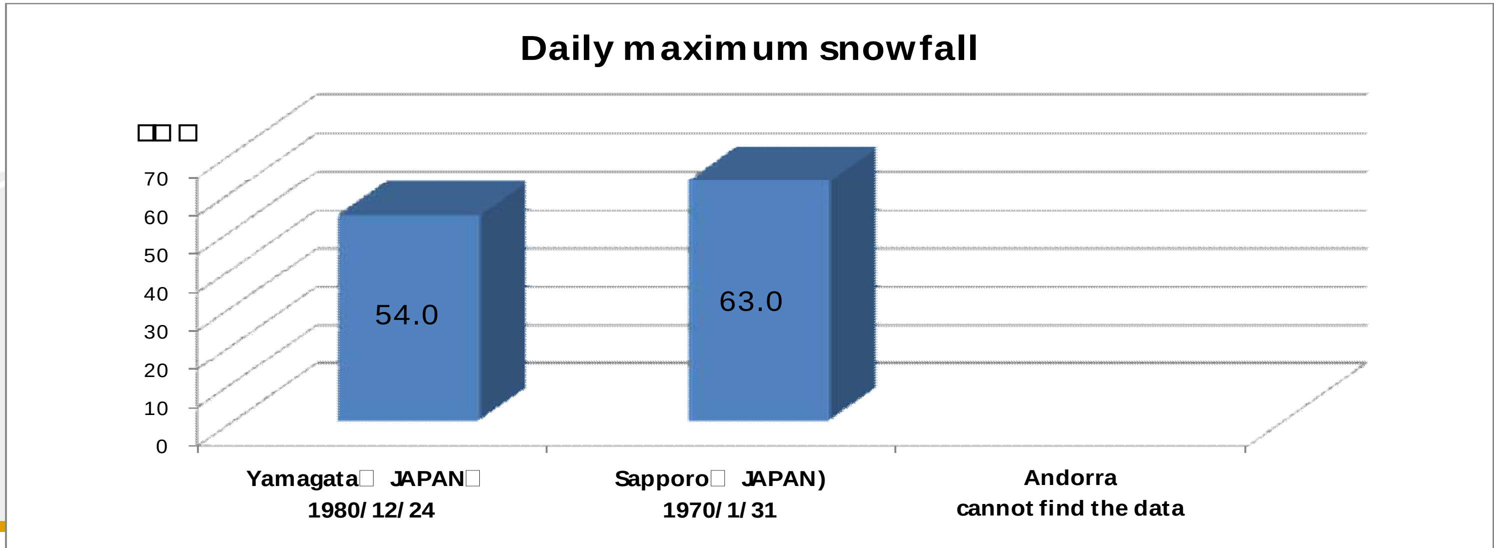
Annual Ave. temp. : 8.9℃
Annual Max. temp. : 12.9℃
Annual Min. temp. : 5.3℃
Annual Precipitation : 1106.5mm



Annual Ave. temp. : 11.0℃
Annual Max. temp. : 17.5℃
Annual Min. temp. : 6.4℃
Annual Precipitation : 687.1mm

SNOW DEPTH & SNOW FALL





IN FRONT OF MY HOUSE: Feb, 2013

Snow is beautiful.
But snow disturbs the
Life of snowy regions.

In Japan, several
Hundred thousand
residents, or even
more than million
residents living in
snowy regions

TURNING POINT OF SNOWY AND COLD AREA WORK IN JAPAN

1957 The Act on Special Measures concerning Maintenance of Road Traffic in Specified Snow Coverage and Cold Districts was introduced.

1990 Studded Tires Regulation Law was introduced because of pollution of the fine particle.

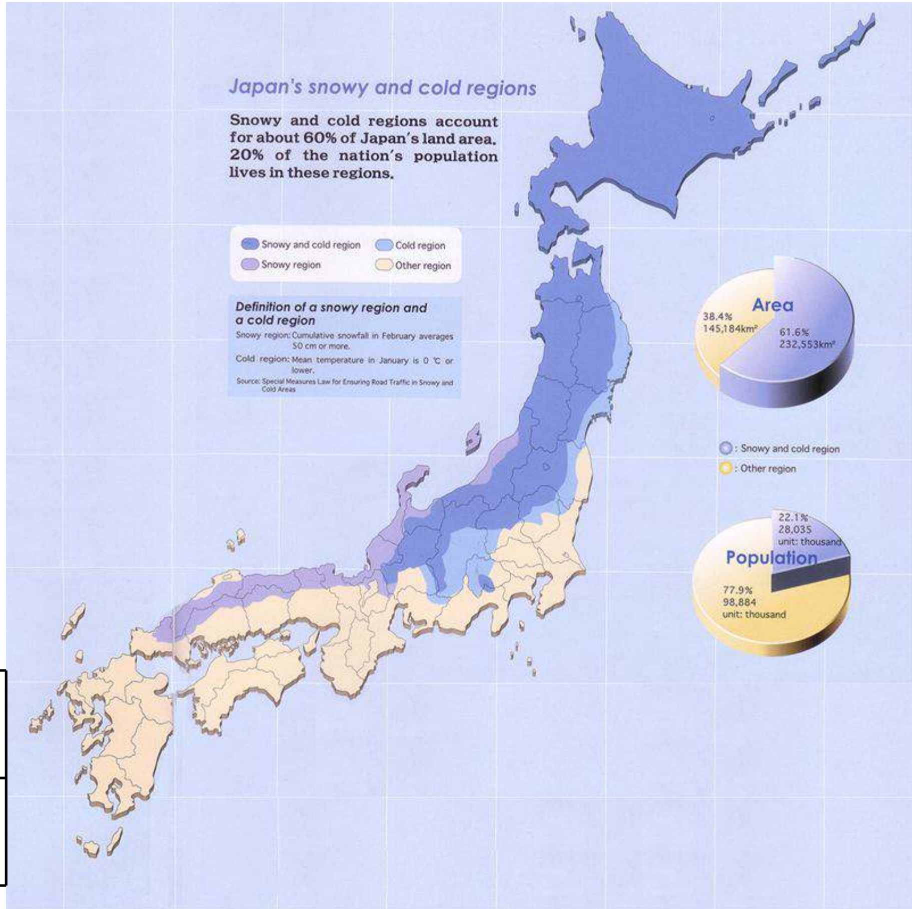
SPECIFIED SNOW COVERAGE AND COLD DISTRICTS IN JAPAN

■*Snow Coverage Area*

Maximum depth of the snow in every 5 years is above 50cm average.

■*Cold District Area*

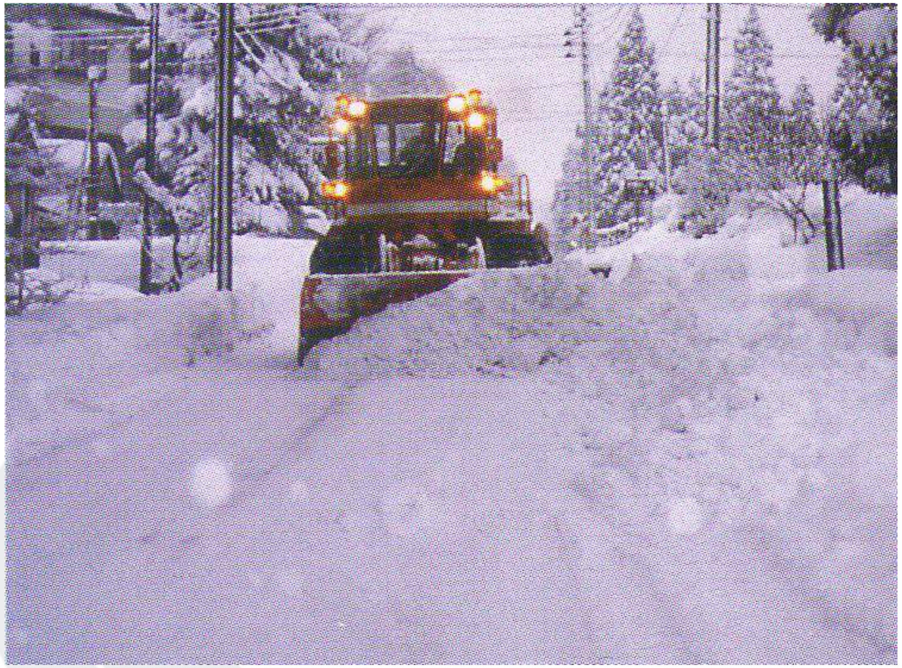
Average temperature in January in every 5 years is less than 0 ℃.



60% of the area	22% of the population
232,200㎡	28 million people

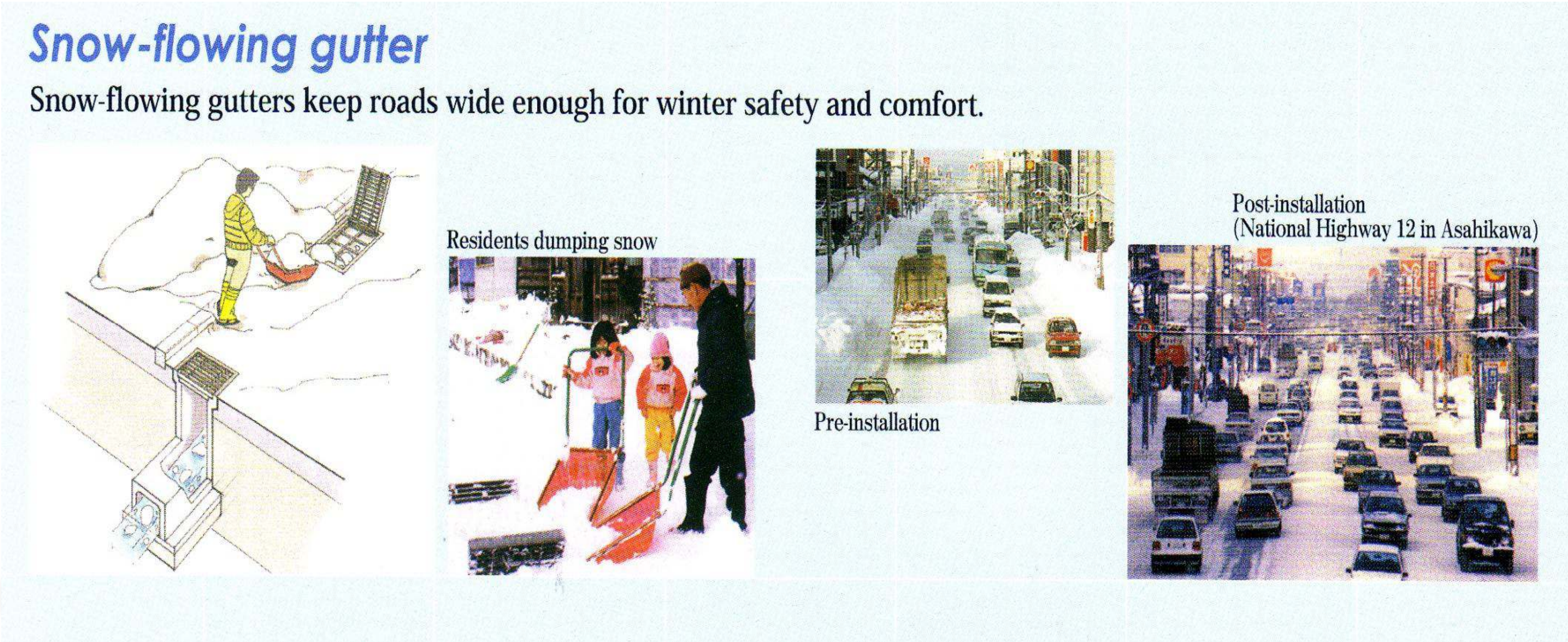
HOW TO CONTROL SNOW PROBLEM ON THE ROAD IN JAPAN

Snow Removal in the snowy city



Spreading anti-freezing agents

HOW TO CONTROL SNOW PROBLEM ON THE ROAD IN JAPAN



SMS WITH SPRINKLED GROUNDWATER

1961, Snow Melting System used groundwater sprinkled from pipes installed on the road was produced in Nagaoka-city, Niigata pref.

PROBLEM OF SMS WITH SPRINKLED GW

The use of excessive amounts of groundwater resulted lowered groundwater level.

→ *Led to land subsidence.*

⇩

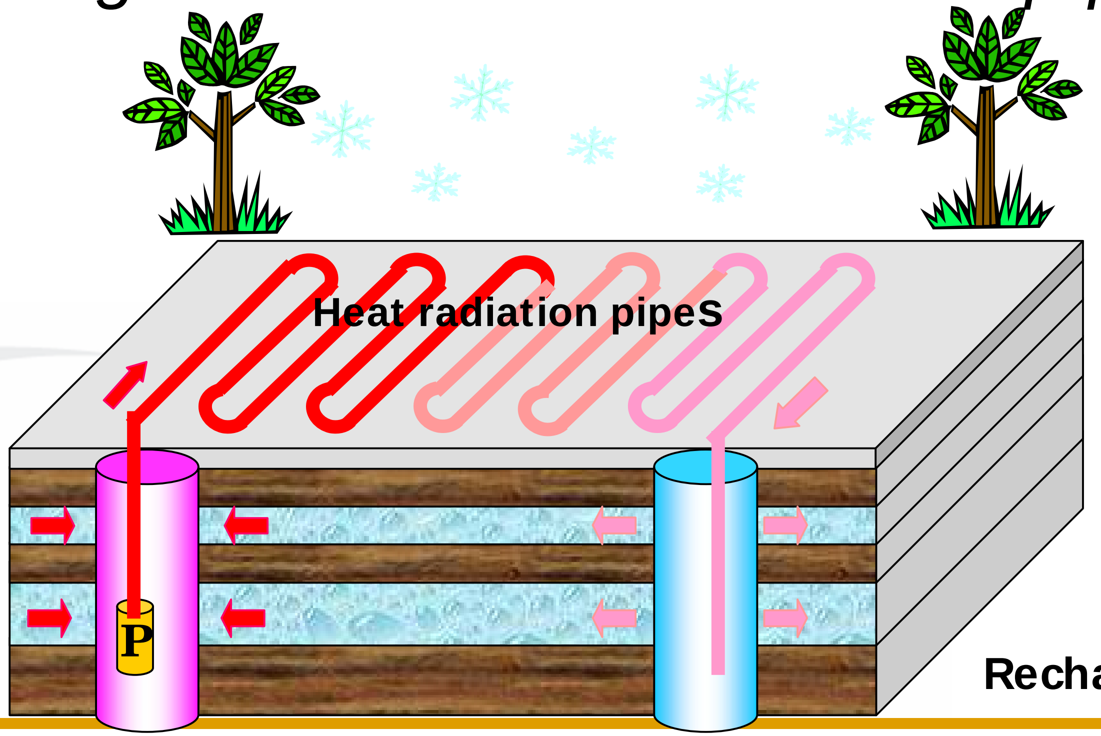
New, better solution was required.

→ *SMS without Sprinkling GW was produced by JGD in 1982.*

SMS WITHOUT SPRINKLING GW

SYSTEM

This system consists of pumping well, recharge well and heat radiation pipes.

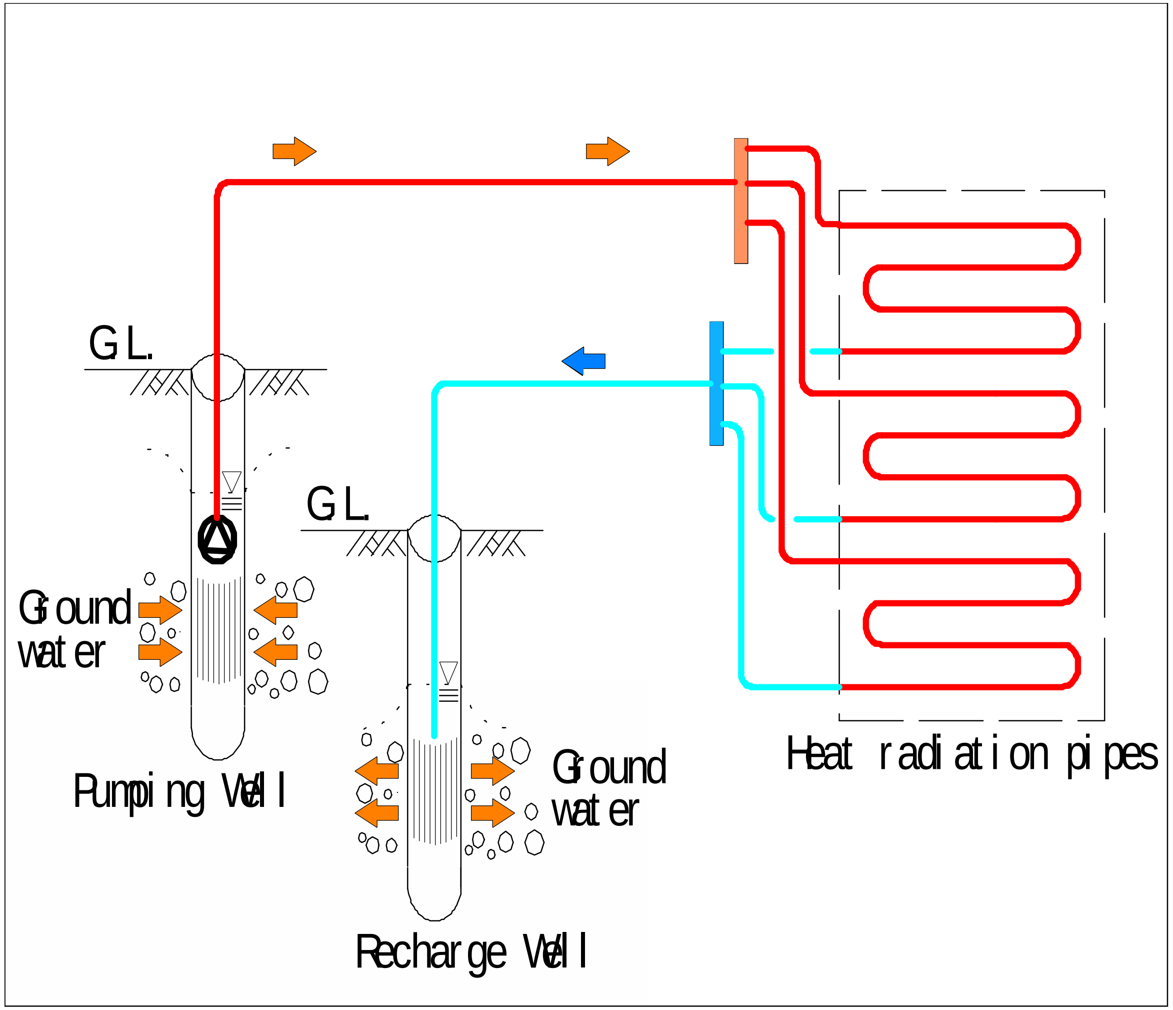


FLOW

SMS WITHOUT SPRNKLING GROUNDWATER

Pumped groundwater is led to the embedded heat radiation pipes and radiates its heat energy to warm the pavement.

And the it is recharge again.



ADVANTAGES

SMS WITHOUT SPRINKLING GROUNDWATER

☆*Energy Saving and low running costs because of heat energy of groundwater.*

☆*Convenient for pedestrians because of no water sprinkled and no splashed.*

☆*No land subsidence because it does not waste groundwater.*

DESIGN OF THE SYSTEM

Climatic Conditions

☆*Ambient temperature*

☆*Strength of Snowfall*

☆*Temperature of Snow*

☆*Wind Velocity*

Above data for more than 5 years are analyzed.

Heat Required

☆*How much heat is required for snow melting?*

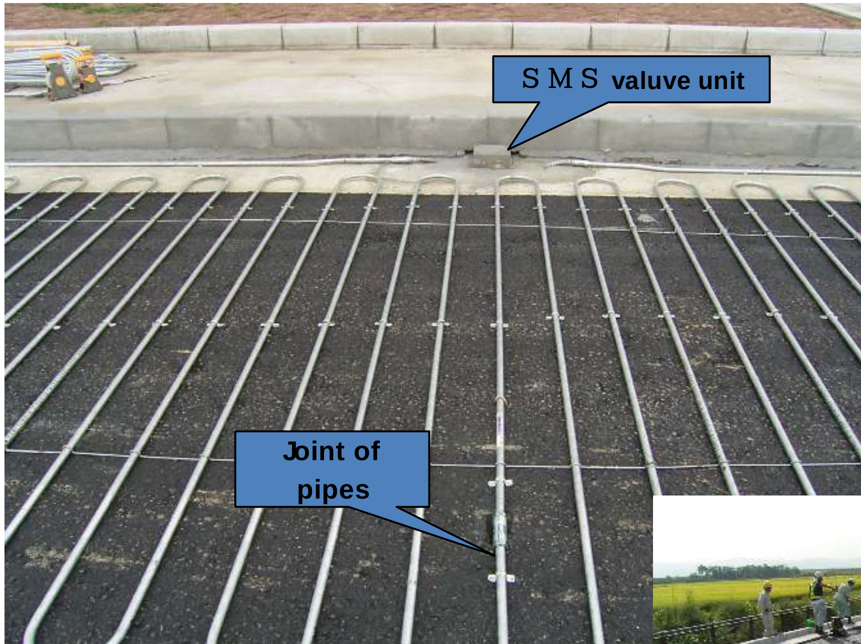
☆*How much heat is required for deicing?*

Designed value is whichever larger between two.

DESIGN OF THE SYSTEM

Design of heat radiation pipes

Depth and pitch of heat radiation pipes are designed according to how much heat required, groundwater temperature and pavement materials.



RECORDS OF CONSTRUCTION IN JAPAN

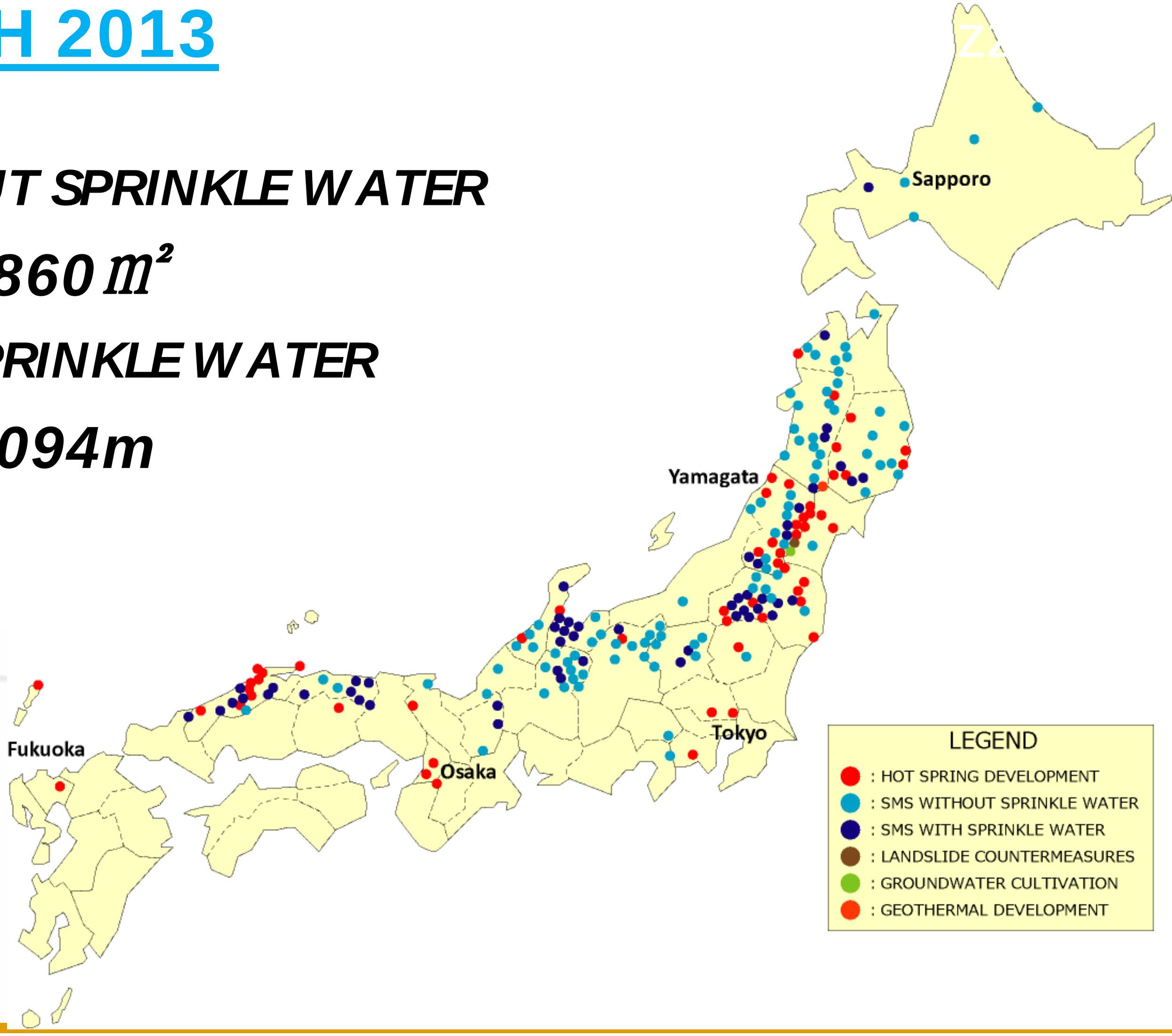
MARCH 2013

1. SMS WITHOUT SPRINKLE WATER

1,439,860 m^2

2. SMS WITH SPRINKLE WATER

1,021,094m



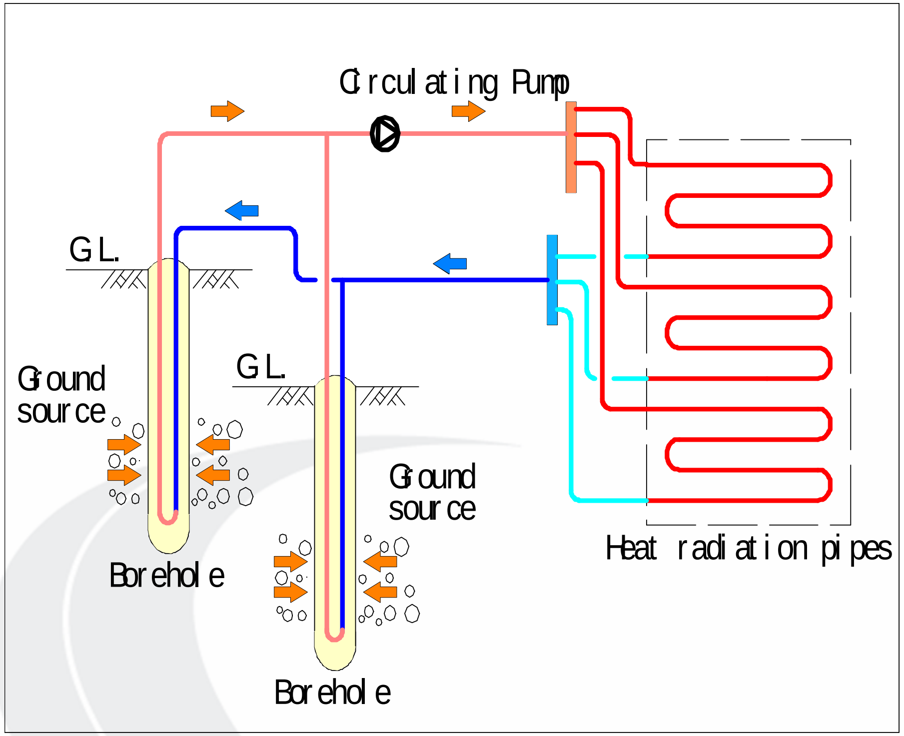
ANOTHER SNOW MELTING SYSTEMS

- SMS using ground source (Shallow geo thermal)
- SMS using biomass
- SMS using air heat
- SMS using ocean heat
- SMS using hot water boiler

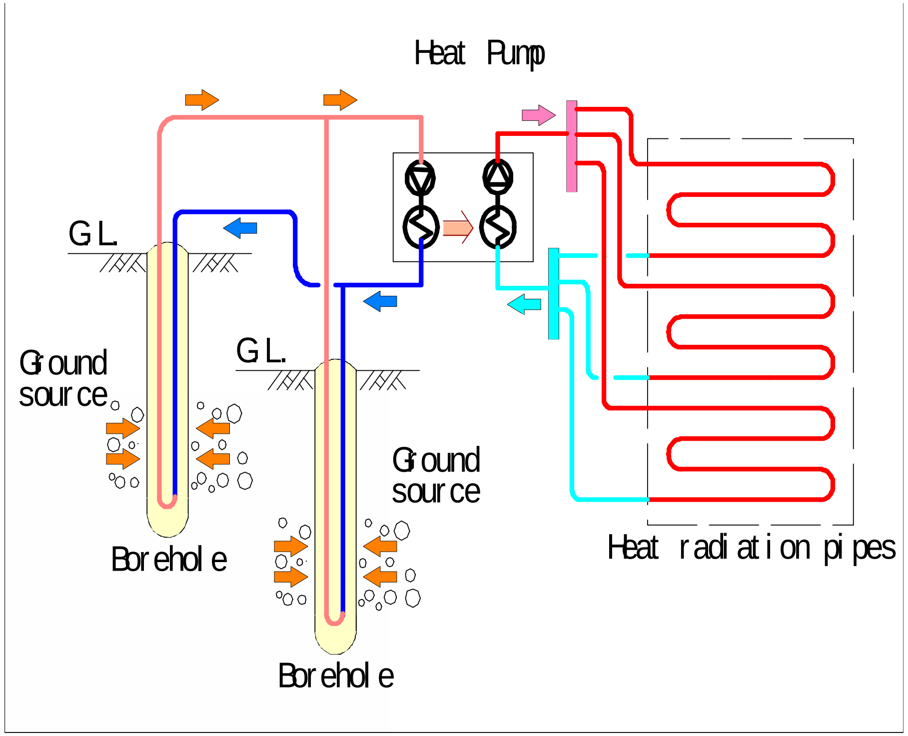
etc.

SMS USING GROUND SOURCE

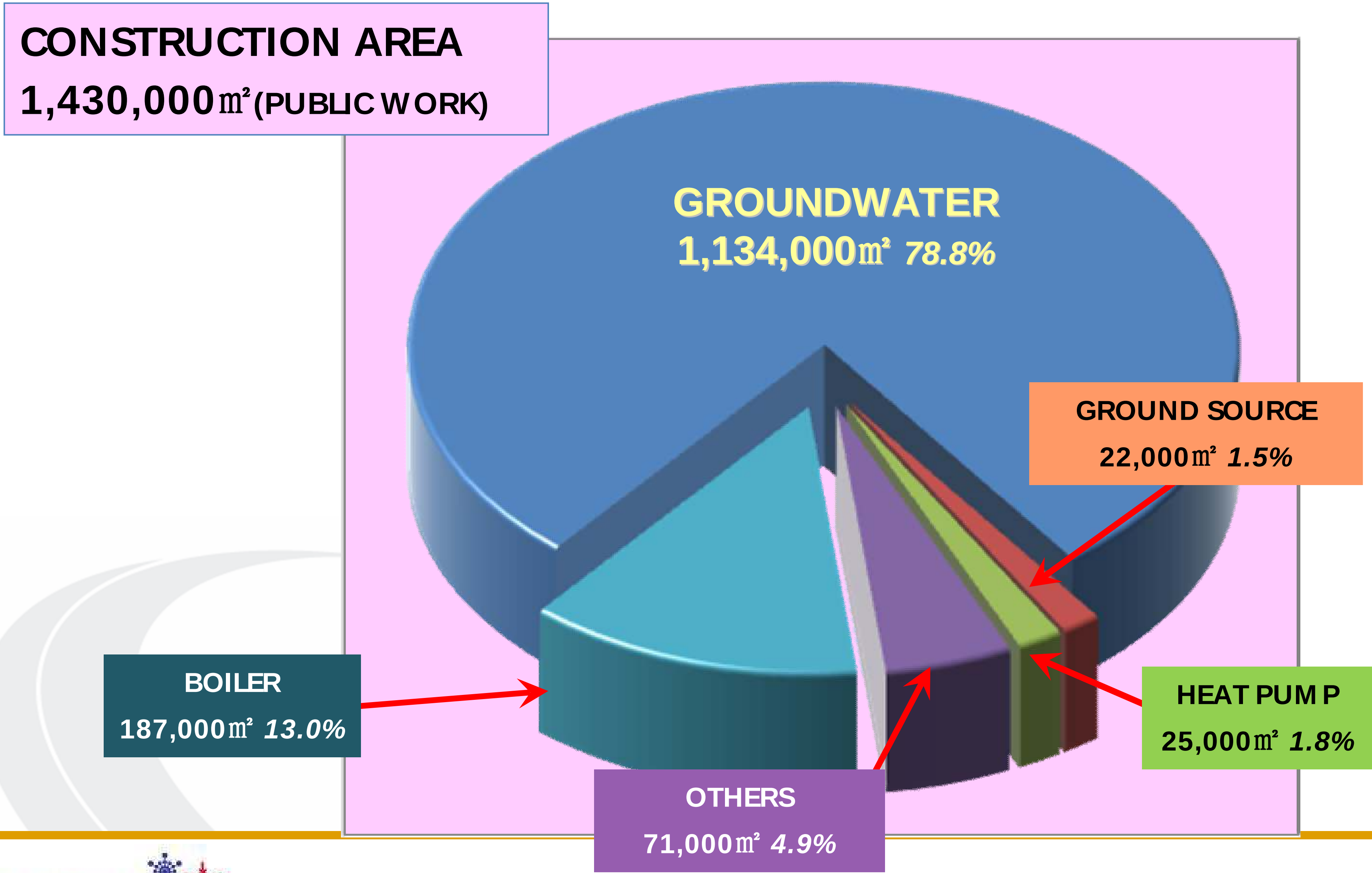
Bacic Component of the SMS using Ground Source



Basic component of the SMS using Ground Source Heat Pump



LIST OF HEAT SOURCES



TYPICAL INSTALLATIONS OF THIS SYSTEM

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Andorra 2014 AIPCR - PIARC

SMS FOR RESIDNCIAL USE CALLED "JOSANE"

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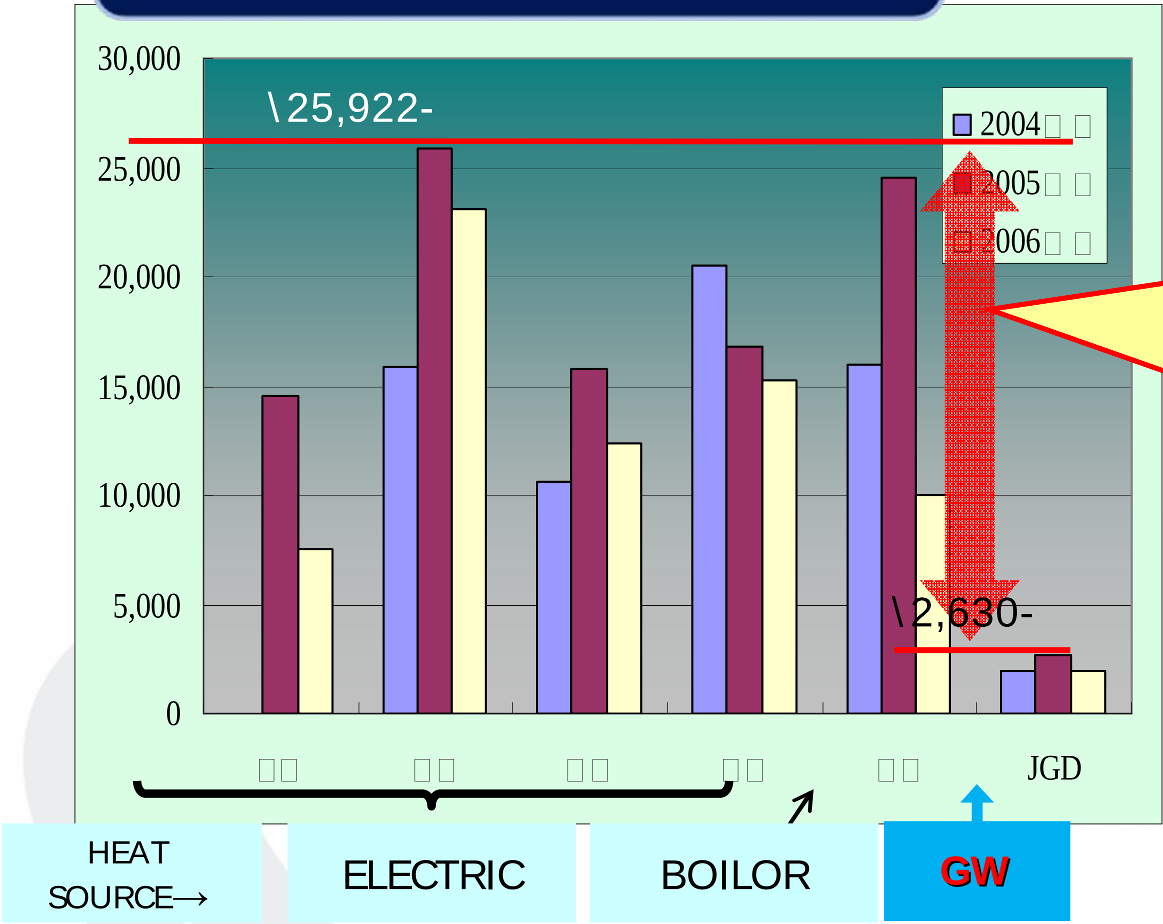
COST COMPARISON WITH ALTERNATE HEAT SOURCE



If being of the groundwater use, the running cost is about 1/10 of the electric heat snow melting.

COMPARISON OF CO_2 EMMISION

SMS USING GW, KEROSENE AND ELECTRICITY

SMS	HEAT CAPACITY (W/㎡)	SNOW MELTING AREA (㎡)	OPERATIONAL TIME (H)	POWER CONSUMPTION (kWh)	FUEL CONSUMPTION (L)	CO2 EMMISION / YEAR(kg)	RATIO
USING GW	135	1,500	1,000	15,000	—	7,020	1.00
USING KEROSENE	135	1,500	700	9,450	20,300	54,970	7.83
USING ELECTRICITY	135	1,500	700	178,500	—	83,538	11.90

【 Condition of the reviewing for the CO_2 emission calculation】

■Planning Area : Walkway ＝1,500㎡（L=300m, W=2.5m, Both side）

■Heat Capacity to melt snow　qt＝135W/㎡

■Snow Depth/hour ＝h=1.6cm/h, Temperature=-3.1℃

■CO_2 emission-factor of KEROSENCE is used by data from Global Warming Act.

■CO_2 emission-factor of ELECTRICITY is used by data from Tohoku EPCO's 2009

ANOTHER POSSIBILITY TO USE GROUNDWATER

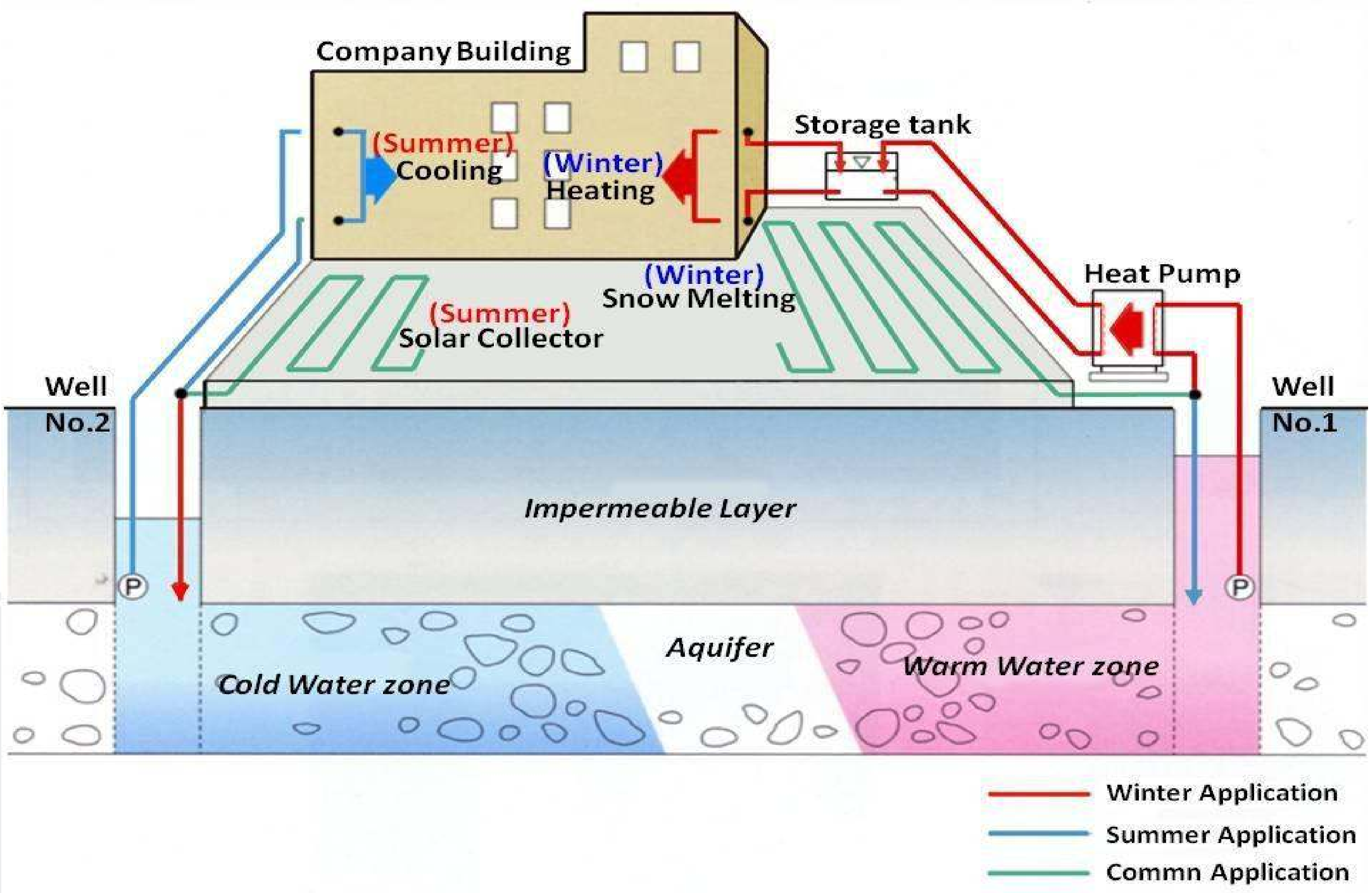
ATES SYSTEM = 【Aquifer Thermal Energy Storage】

This system effectively utilize the heat energy of groundwater.

It cuts carbon dioxide emissions and reduce the heat island effect by limiting the release of waste heat from air conditioners to the atmosphere.

Technical improvements are expected to further reduce costs and enhance the system's performance , and to make the system popular in Japan.

HEAT PUMP AIR-CONDITIONING SYSTEM USING ATES （1984 to 2011）



DEMONSTRATION OF MEASURES TO COPE WITH GLOBAL WARMING, 2011

BY MINISTRY OF ENVIRONMENT

■*Mitigation of influence of ATES on the underground environment.* (2011 to 2013)

Promoted by

●Professor. Hikari FUJII, Akita University

●Ph.D. Yohei UCHIDA・Mayumi YOSHIOKA, AIST

●JGD

ENERGY TREND IN JAPAN

BY THE HEAT FOR THE HEAT FOR THE SUSTAINALBE LIFE

After the Tohoku earthquake and Tsunami 2011,
the discussion is proceeded with about the use of the renewable energy.
But almost all discussions talked about how to make electricity.
We have to think about how to save energy and how to use the natural heat energy which is sleeping underground.

THANK YOU

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