

GROUND-SOURCE HEAT PIPE SNOW-MELTING SYSTEMS IN JAPAN

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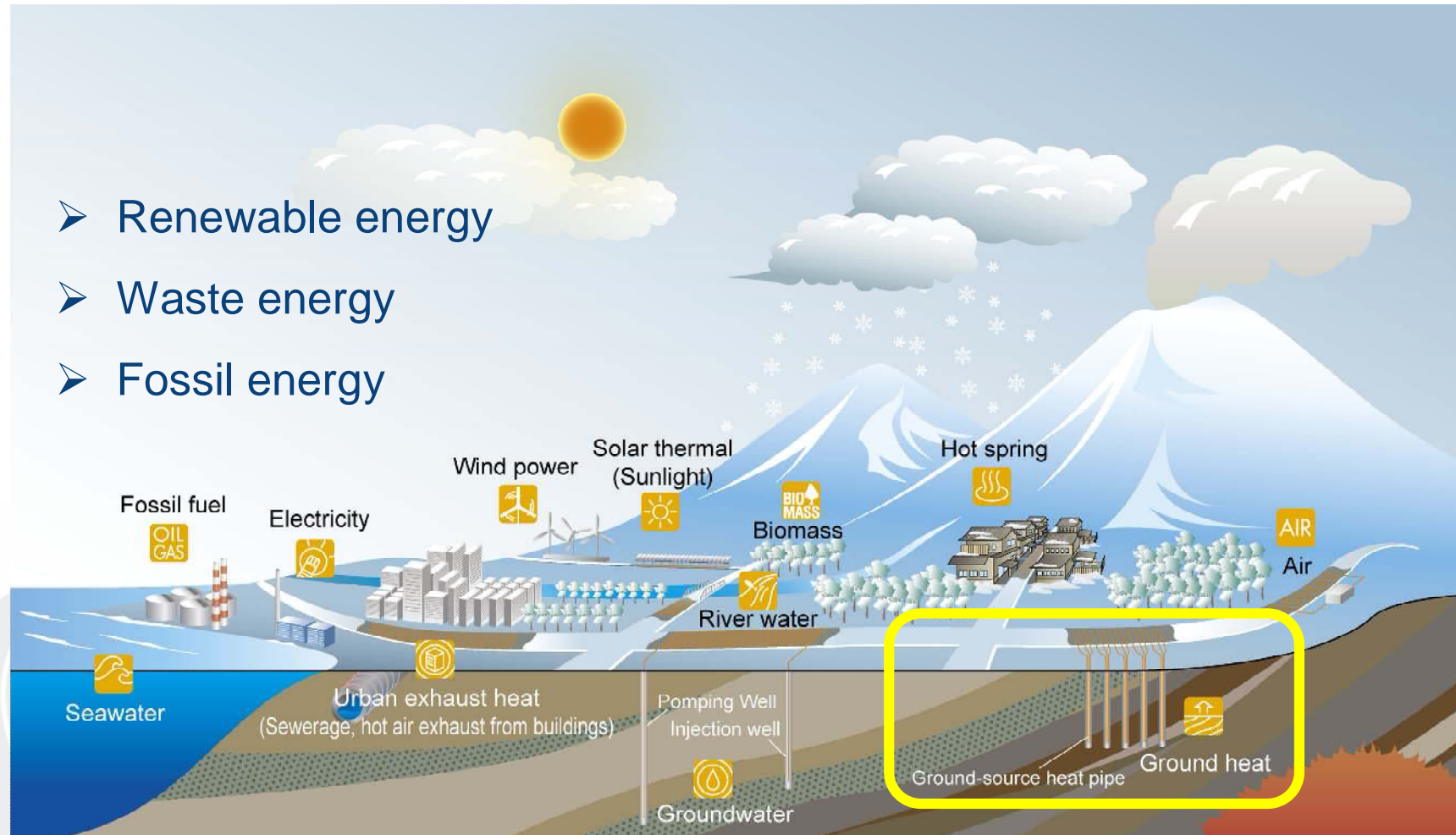
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1. INTRODUCTION

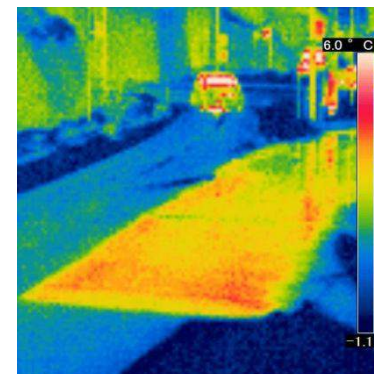
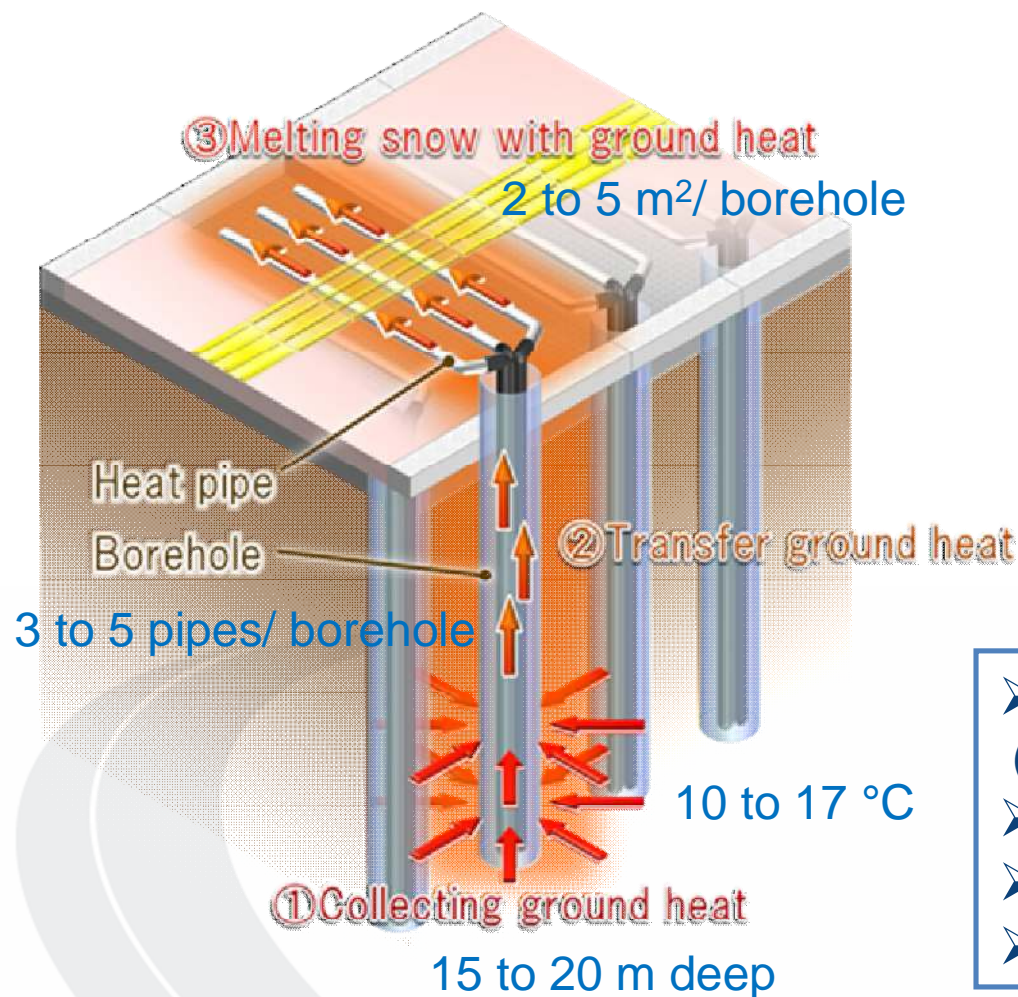
Types of thermal energy used for snow-melting systems in Japan

- Renewable energy
- Waste energy
- Fossil energy



2. SYSTEM CONFIGURATION

System configuration and advantages



Heat pipe

- Heat flux : 100 to 180 W/m²
(Snow-melting capacity: 1 to 3 cm/hour)
- Automatically controlled
- No electricity or petroleum
- No operating costs

2. SYSTEM CONFIGURATION

Installation procedures



1) Drilling



2) Heat pipe installation



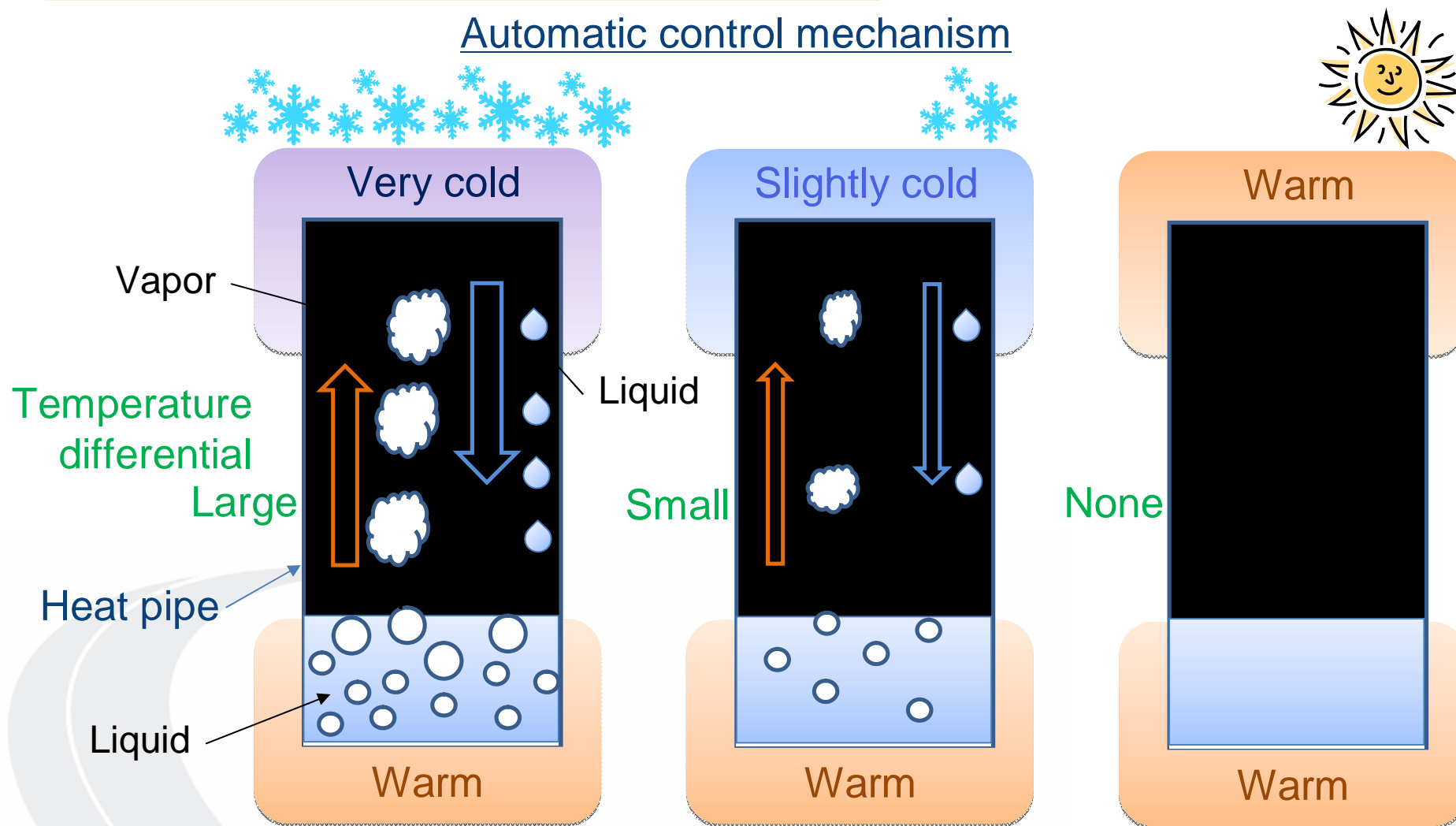
3) Heat pipe anchoring and paving



4) Completed for snow melting

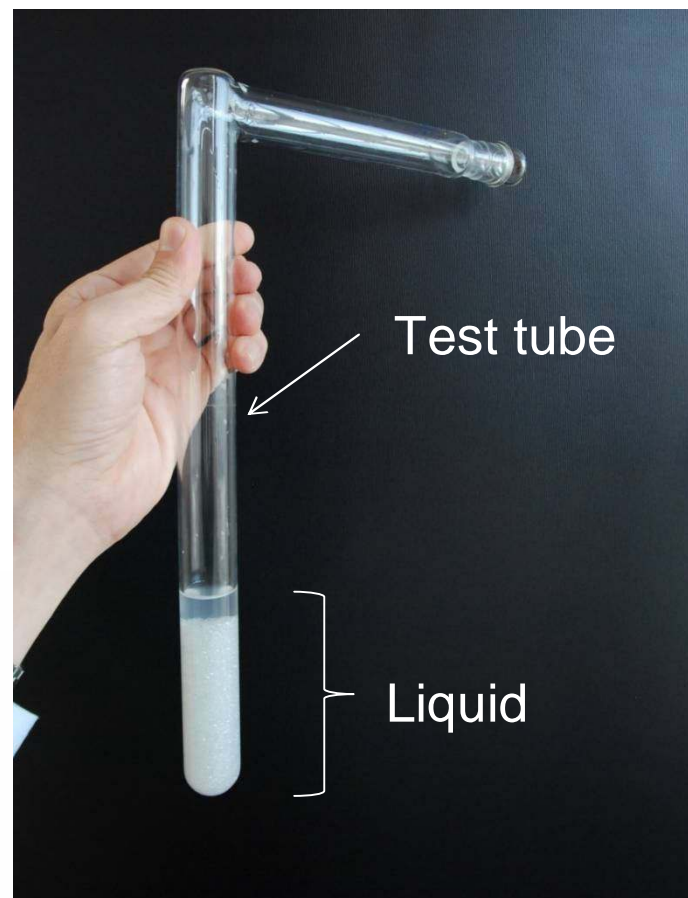
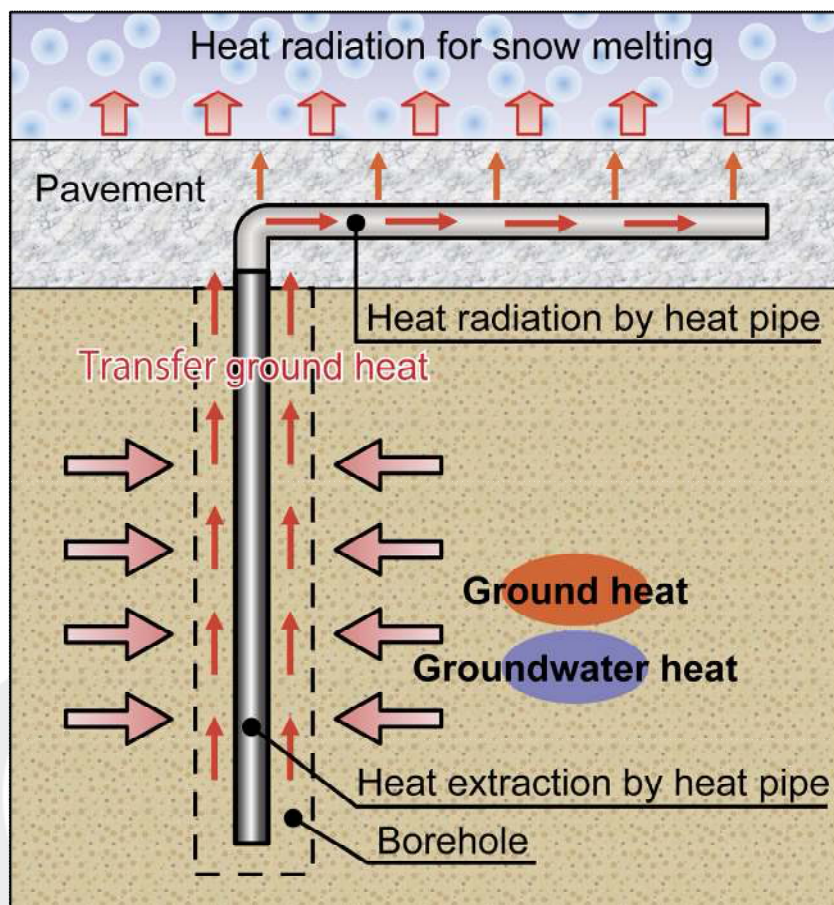
3. SNOW MELTING MECHANISM

Automatic control mechanism



3. SNOW MELTING MECHANISM

A glass heat pipe for demonstration



Glass heat pipe

3. SNOW MELTING MECHANISM

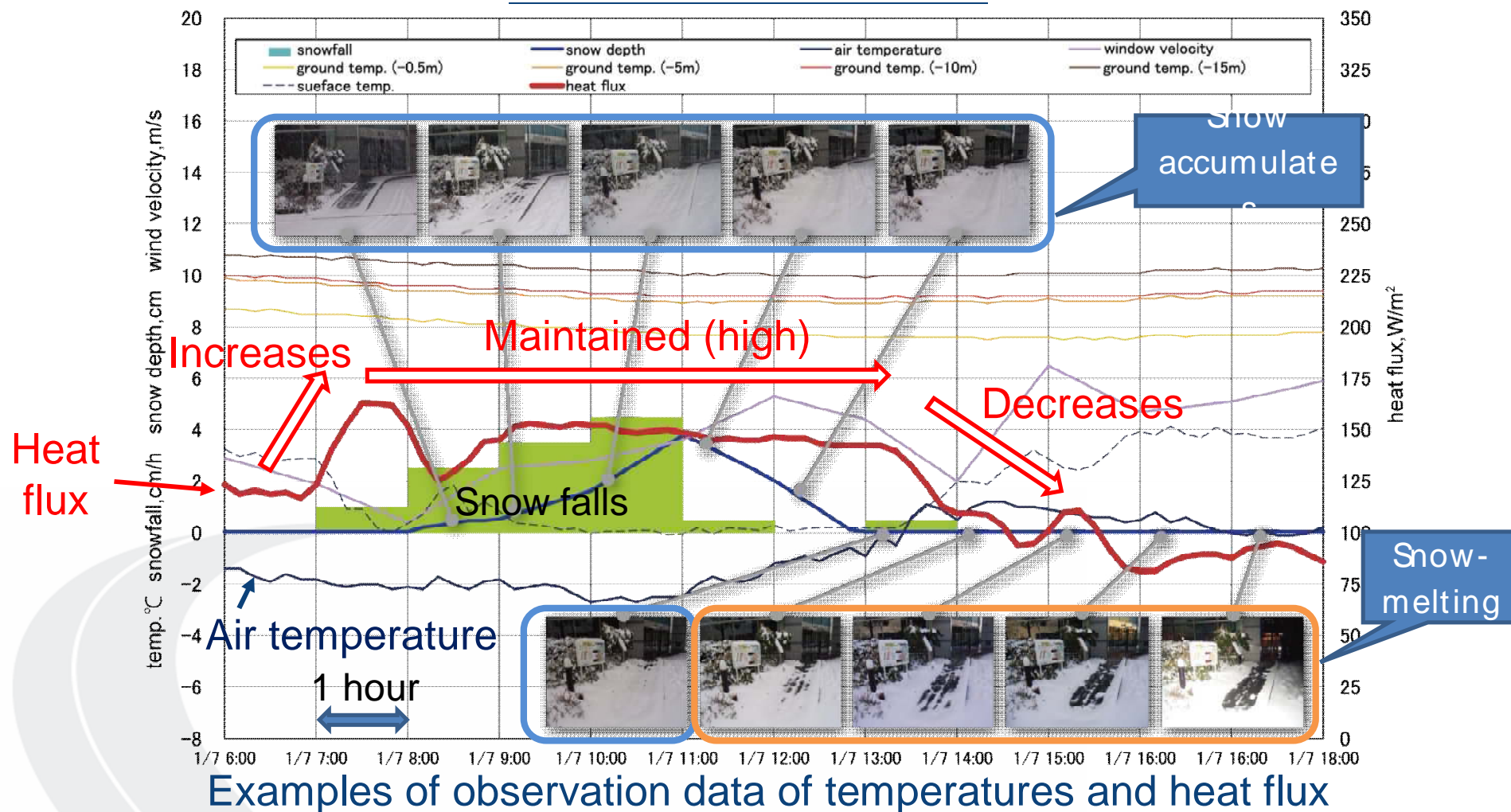
A glass heat pipe for demonstration

The medium vaporizes when snow and ice are put on the condensation section.



3. SNOW MELTING MECHANISM

Heat flux when snow falls



Examples of observation data of temperatures and heat flux

4. INSTALLATION CONDITIONS

Installation examples

Sidewalk



(Station square)

Road



(Interchange ramp/curve)

Parking lot/ Path



(Residence)



(Bus stop)



(Steep slope/curve)

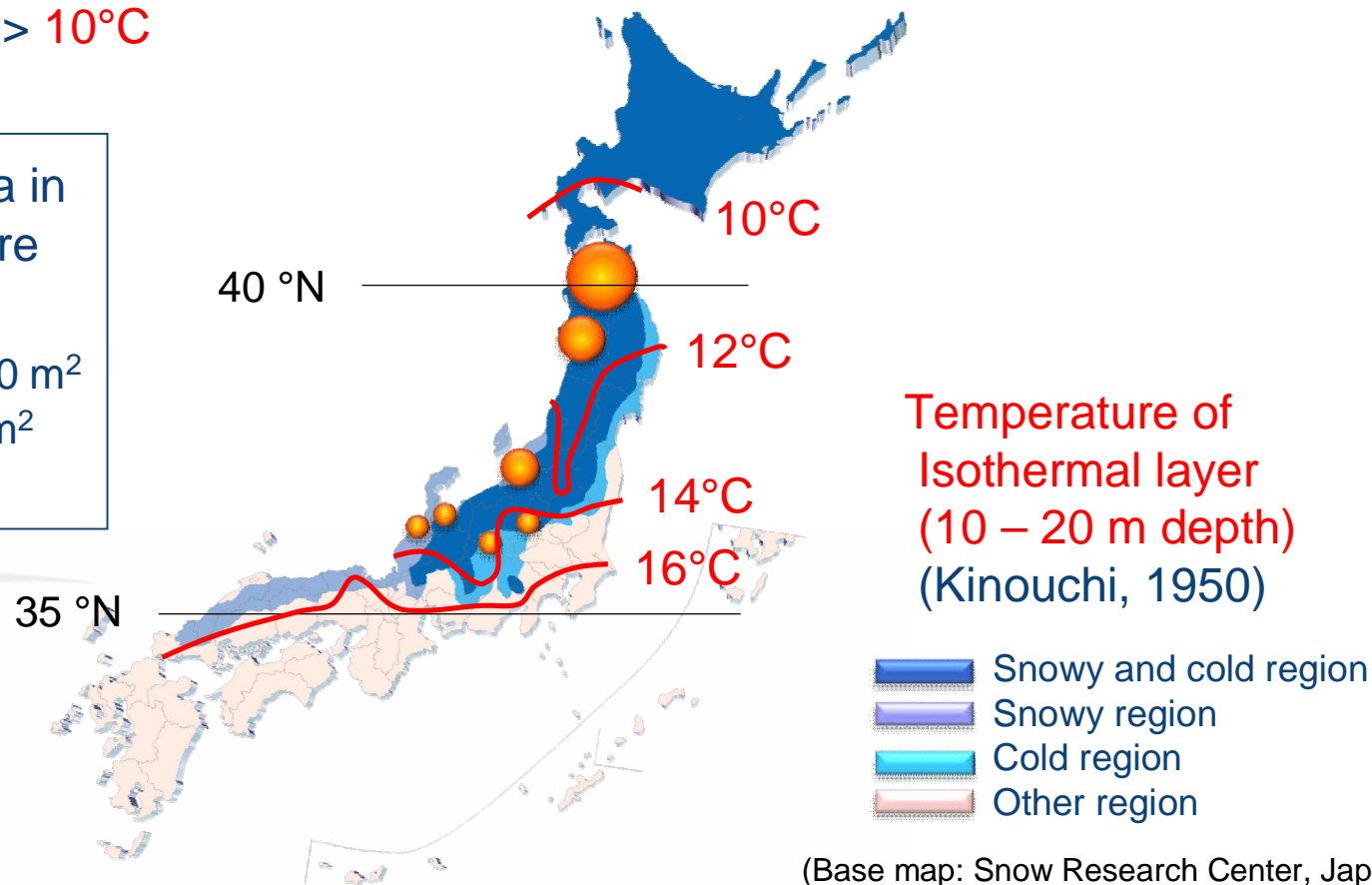
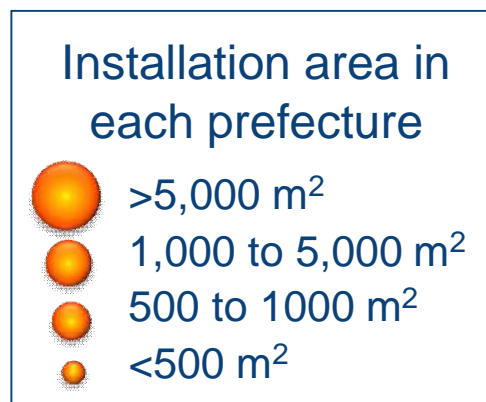


(Office building)

4. INSTALLATION CONDITIONS

Installation regions and ground temperature

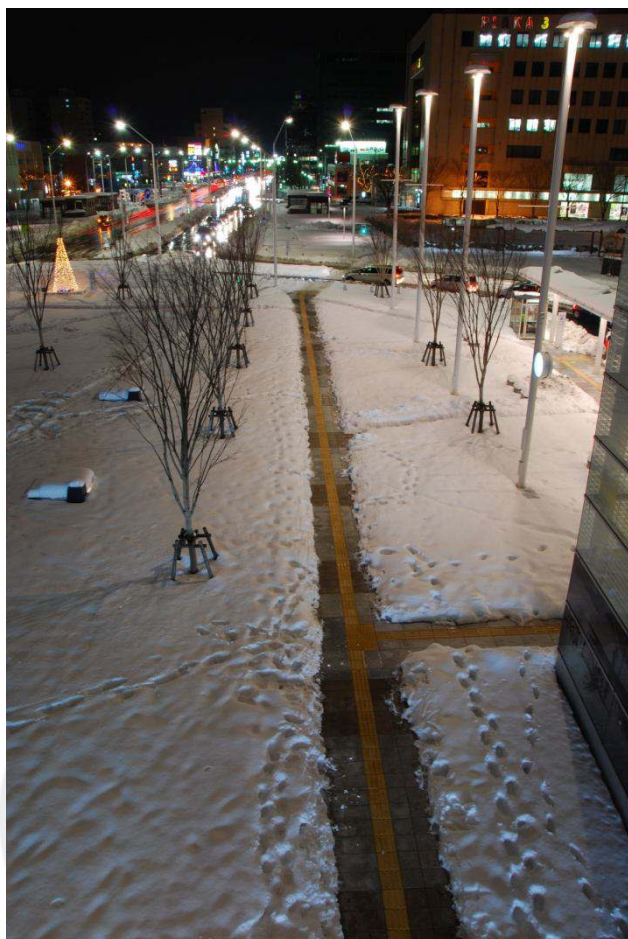
- Ground temp. > 10°C



(Base map: Snow Research Center, Japan)
(Climate date: Japan meteorological agency)

5. CONCLUSION

Ground-source heat pipe snow-melting system



Advantages

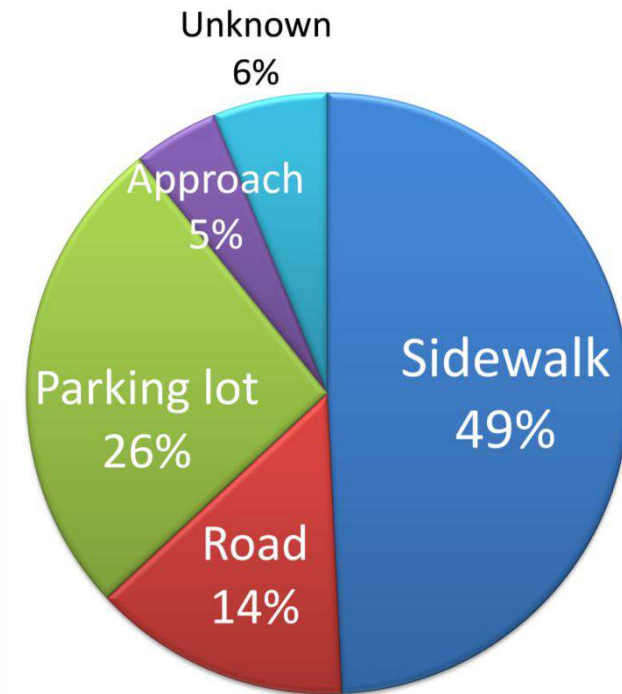
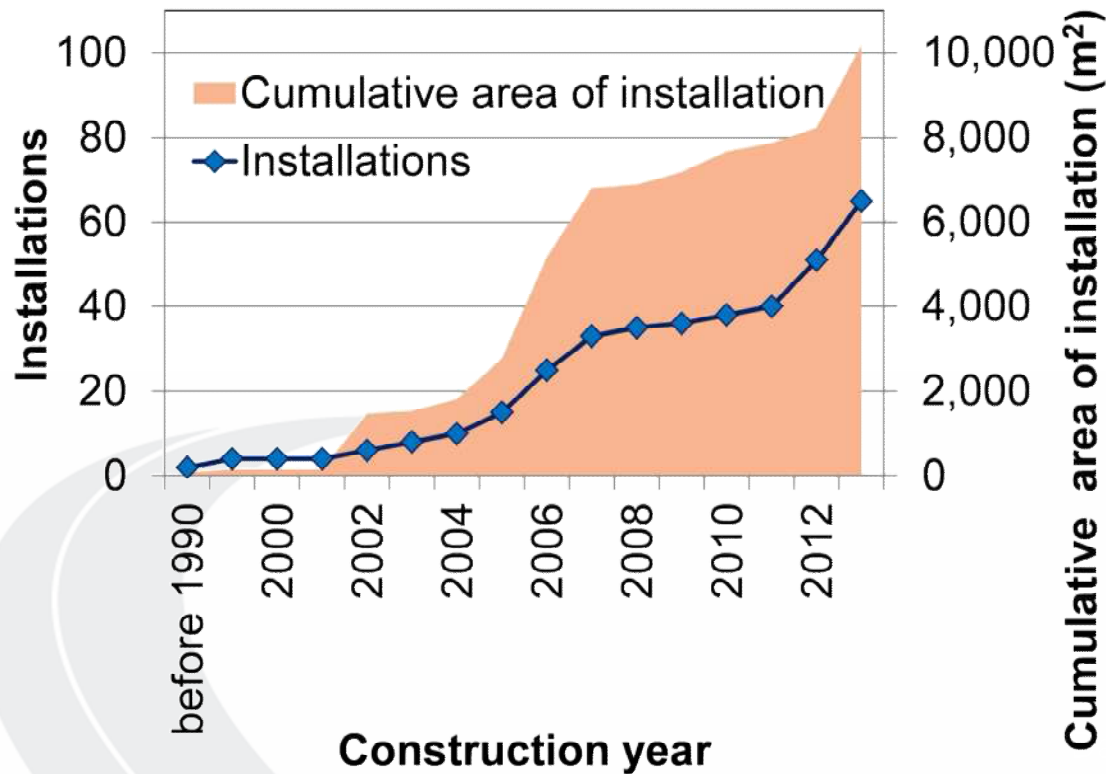
- *The simplicity of only inserting heat pipes into boreholes*
- *Automatic control*
- *No electricity or petroleum (no CO₂ emissions)*
- *No operating costs*

Issues

- *Need to reduce drilling costs*

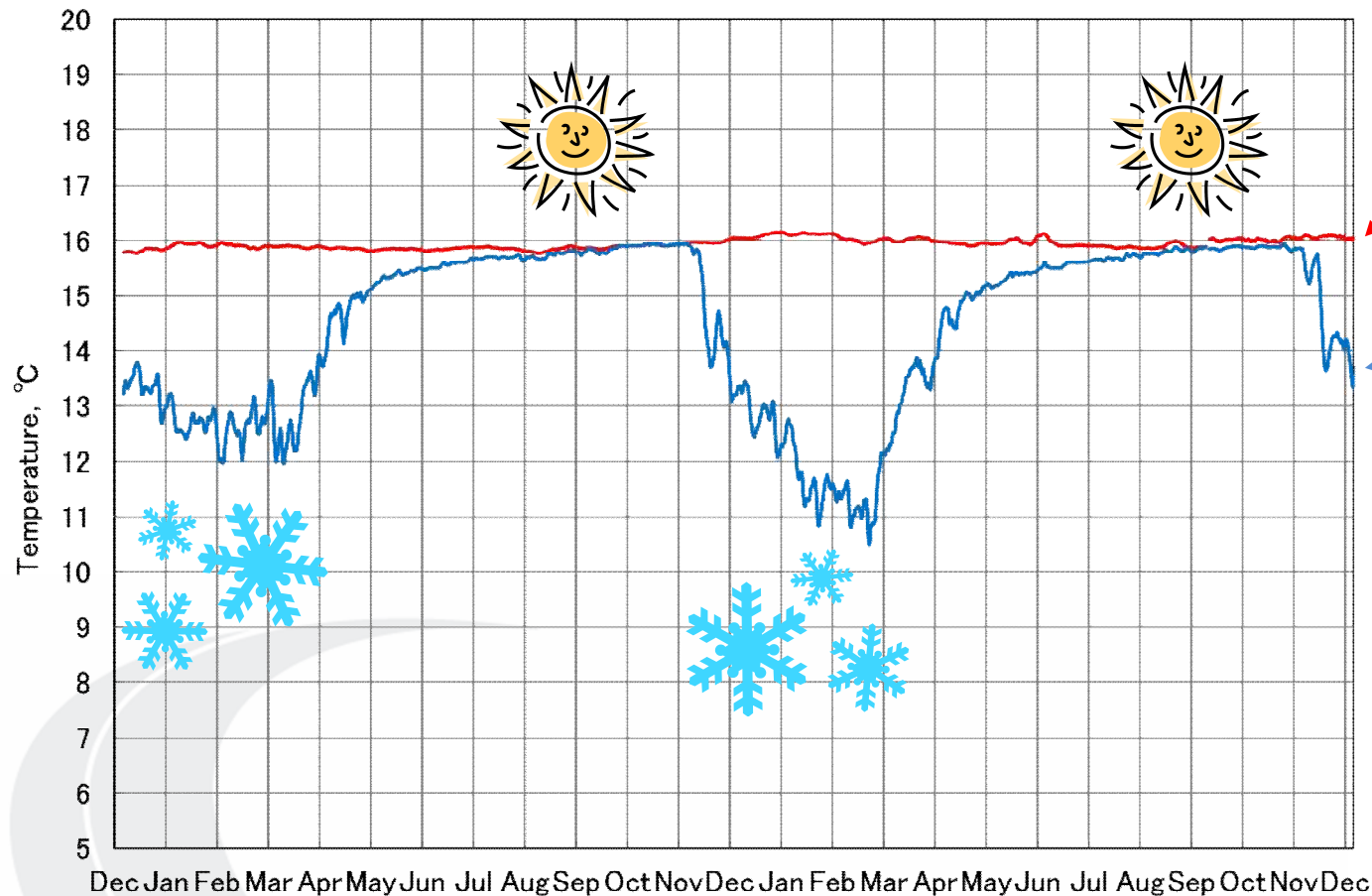
Installation conditions

- 1980: First installed (Association for Heat Pipes, Japan (2001))
- 2013: Cumulative installation area of more than 10,000 m²



Number of installations

Recovery of ground temperature



Ground temp. at -15m w.o. heat pipe (no installation)

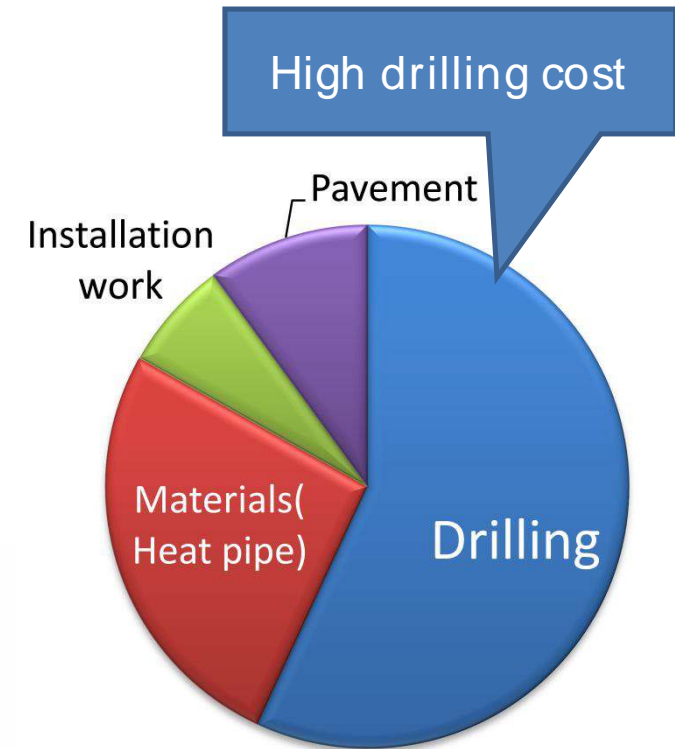
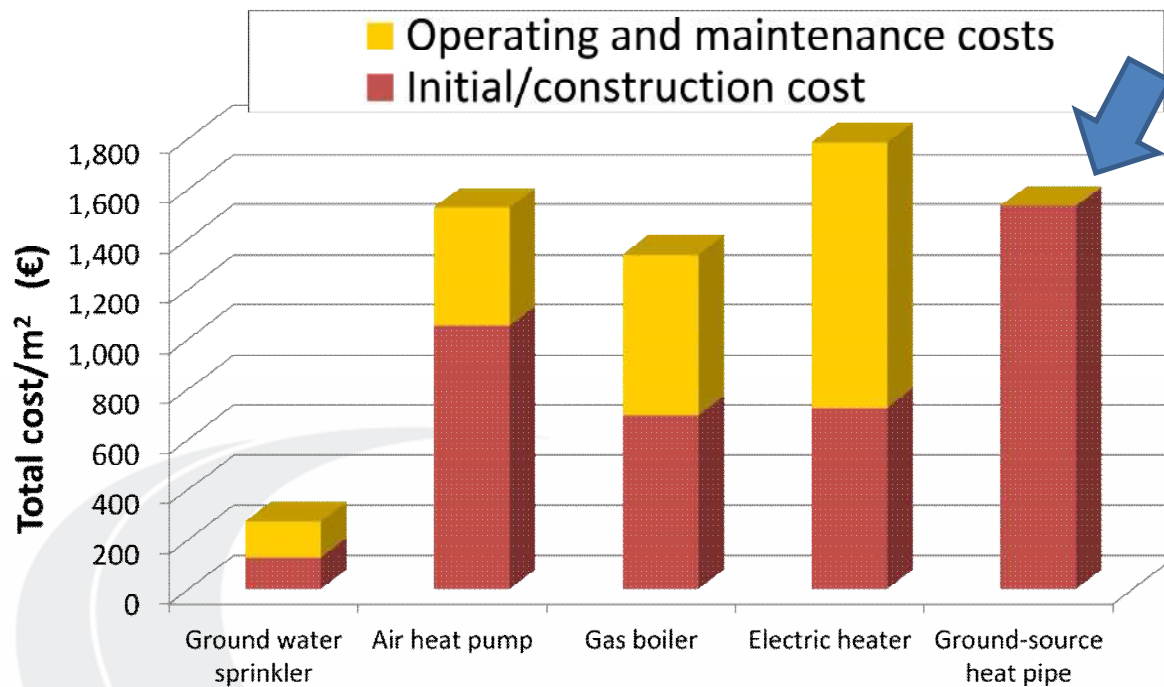
Ground temp. at heat pipe



Examples of observation data of ground temperatures (15-m depth)

Cost competition

- Construction /initial cost: about 1,600 €/ m²
- Operating and maintenance costs: 0



Assumptions: 1) 2,400-m² installation area, 2) 30-year lifetime

Cost reduction

➤ Improved drilling works



Short strokes / Low power

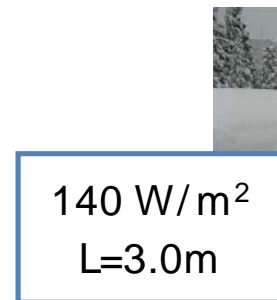


Longer strokes



Higher power

➤ Reduced boreholes



Restrain the heat flux



Partial installation

Cost reduction

- Restrain the heat flux

