

Current status of ATES utilization in Korea

Yoonho SONG and Tae Jong LEE

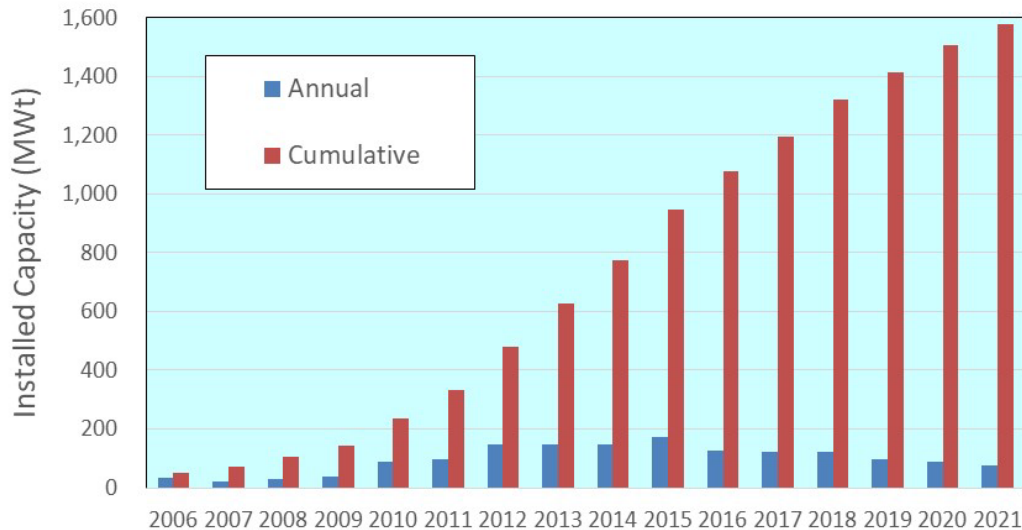
Korea Institute of Geoscience and Mineral Resources (KIGAM)

Overview of geothermal heating & cooling

- Rapid increase of ground-source heat pump (GSHP) installation
 - Not only for heating but also for cooling in most of application
 - Total Installed capacity approached 1,600 MWt in 2021
 - ⇒ Heating (3,822.7 TJ) and cooling (2,297.1 TJ) productions in 2021
 - ⇒ Geothermal became important player in renewable heating & cooling
- Other geothermal heating is from hot spring water utilization
 - Installed capacity of 43.6 MWt has been stagnant since 2008
 - No further survey has been made
- Systematic monitoring of performance along with better statistics is yet to be resolved
 - Official statistics do neither separate heating and cooling application nor reflect load characteristics

Increase of Geothermal Heat Pump Installation

Installed Capacity (MWt)



More than 100 MWt annual installations for 2012~2018; and slightly decreasing since 2019

- Large installations for office and public buildings, universities
- Typical GHP unit capacity: 10-150 kW
- No. units > 10,000
- COP: 3.0-4.5
- ~75% of installations vertical BHE
- Increasing installations for residential houses and greenhouses

- Data from Korea Energy Agency (KEA; formerly KEMCO)
- Estimates for 2021 based on the subsidies and reports to “Mandatory Act”

ATES in Korea

- A proof-of-concept research program (2007-2010) has been performed
 - A capacity of 70 kWt was installed for an industry building
 - Not in operation at the moment
 - A paper in the journal 'Energy' in 2010*
- ATES is not considered as separate technology but as a type of groundwater-source heat pump
 - There may be more installations but no detailed official information is available
- There is a recent installation for greenhouse heating & cooling
 - Completed at the end of 2022
 - Monitoring is underway

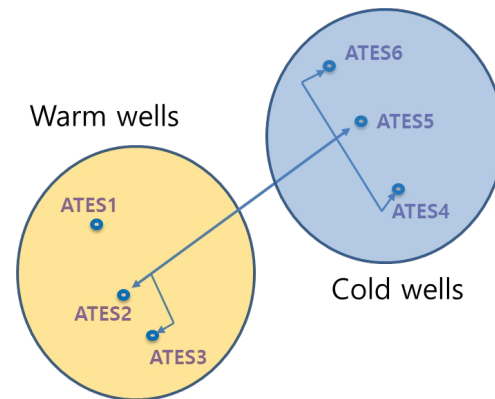
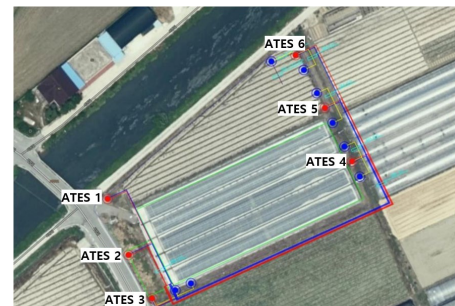
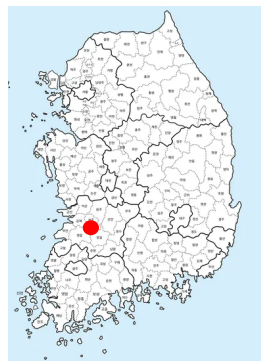
* Kim et al, 2010, Numerical modeling of aquifer thermal energy storage system, *Energy*, **35**, 4955-4965.

ATES Project for Greenhouse Heating & Cooling by KIGAM for 2020-2022



0.3 ha size *Freesia* Greenhouse in Wanju-Gun

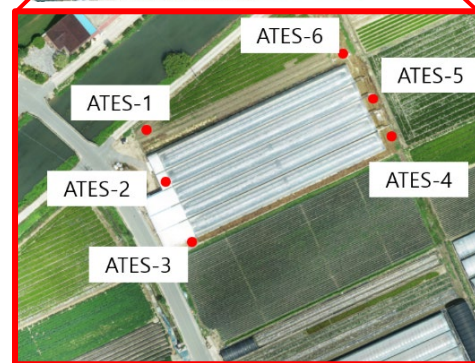
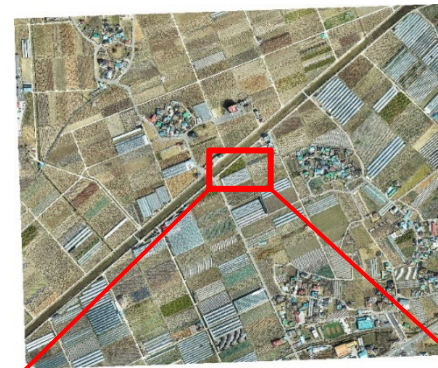
ATES well depth: 100 m
Alluvium aquifer thickness: 3 - 5 m
Capacity: ~350 kW



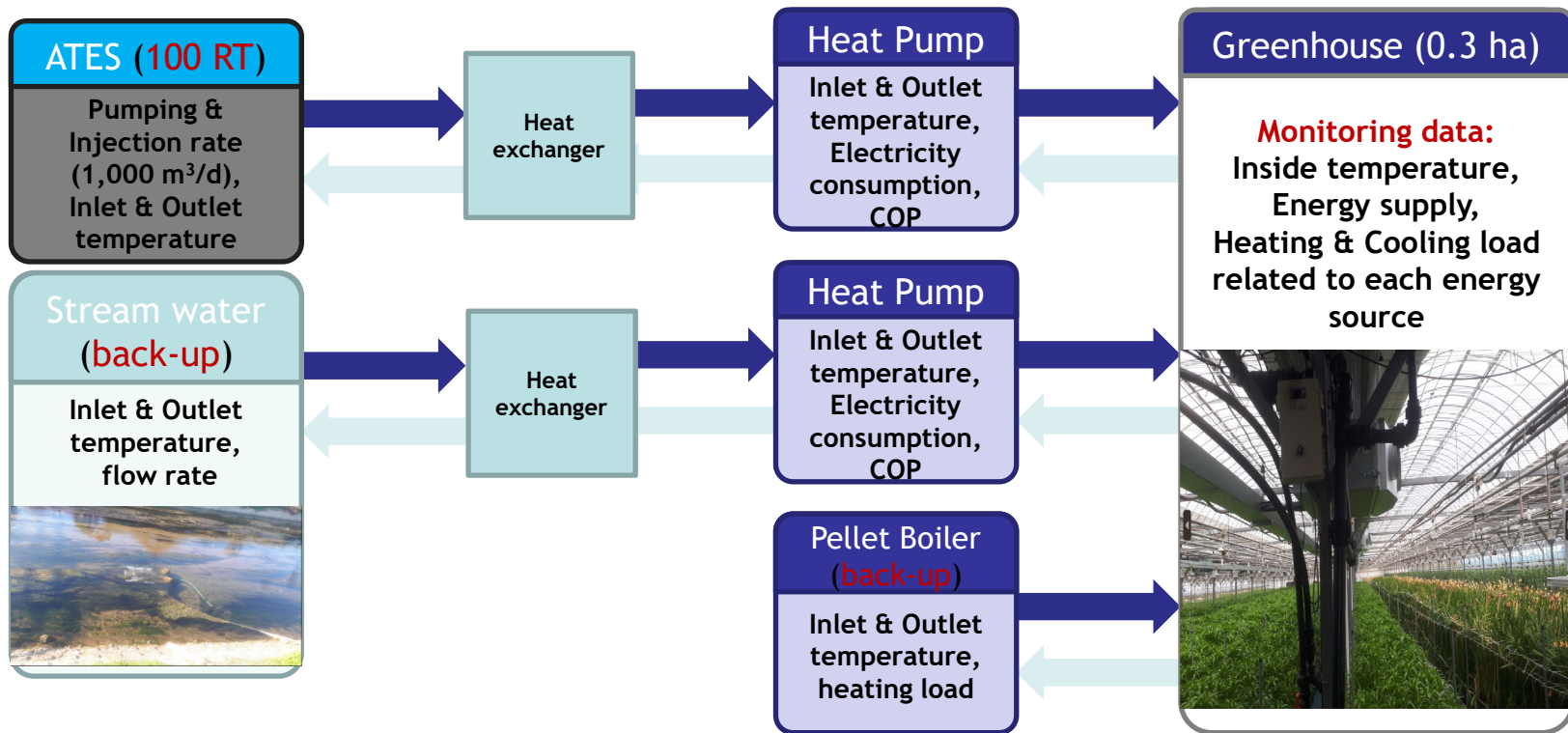
Contact: Byoung Ohan Shim (boshim@kigam.re.kr)

Project Title: Convergence energy (ATES, Bio-facility, Water-source heat pump) production, management, and demonstration model construction (funded by the Ministry of Agriculture, Food and Rural Affairs).

Participants: KIGAM, KIER, GSN Engineering, Sendori Co.LTD., Sookmyung Women's Univ., Jeonbook Agriculture Research & Extension Service



Energy flow and monitoring data diagram



Ongoing tasks

- Nation-wide survey, monitoring and statistics are needed
 - There may be more than a few ATES
 - A mine water (abandoned coal mine) utilization for a resort facility (> 3 MWt) is in operation
- Enhancing performance and extending to other facilities
 - There are lots of existing facilities equipped with groundwater-source heat pump systems which can be upgraded to low-temperature ATES
 - Possible collaboration with international community
 - A research team in KIGAM (Dr. Byoung Ohan Shim) is ready for collaboration

Thank you for attention!

Government building complex in Sejong City

- GSHP installed capacity > 20 MWt (zones 1, 2 and 3)
- Covers more than 38% of heating and cooling of building area of 607,555 m²
- 70% from BHE (1,190 boreholes * 200 m = 238 km); 30% from ground water well (SCW; 69 wells of ~400 m)
- Started operation in 2012 (zone 1); 2013 (zone 2); 2014 (zone 3)

