Aquifer Thermal Energy Storage (ATES) systems - current global practical experience

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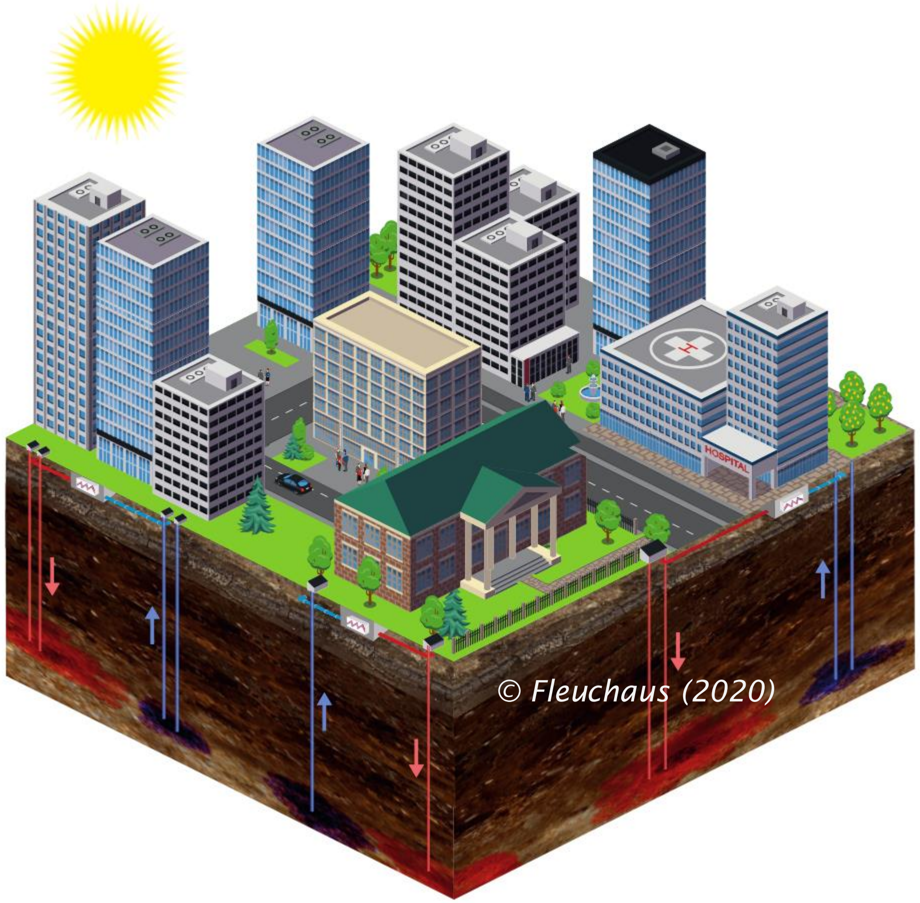
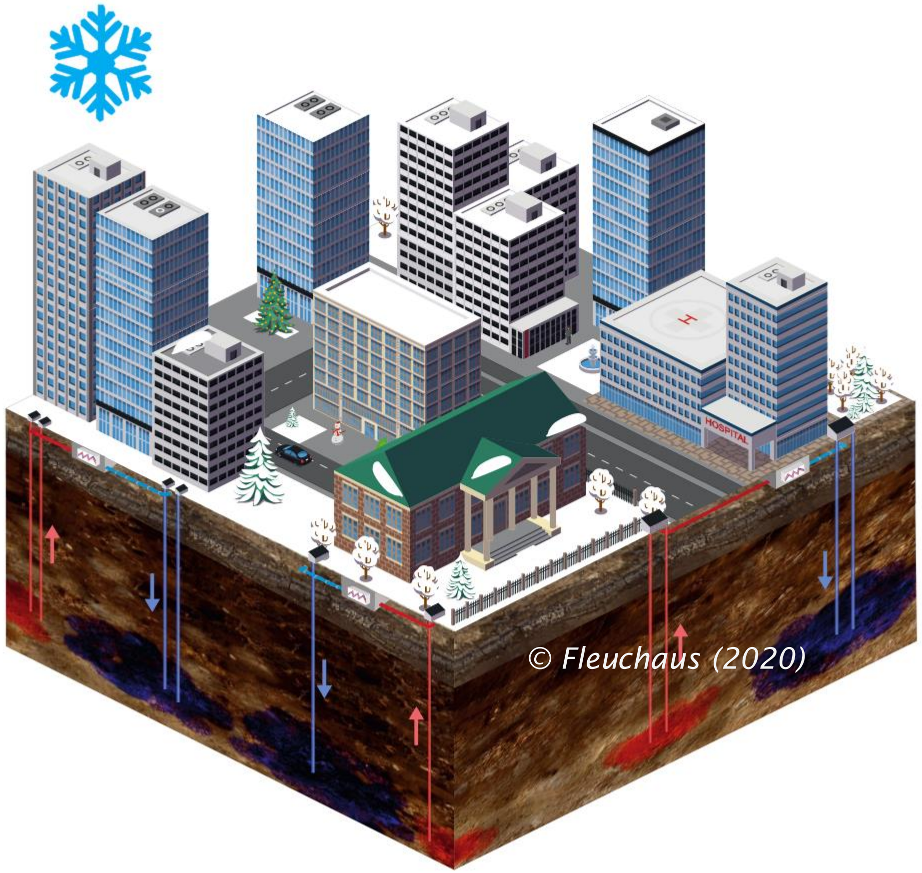
Less an energy, but more a storage problem

Basic principle of an Aquifer Thermal Energy Storage (ATES)

Summer

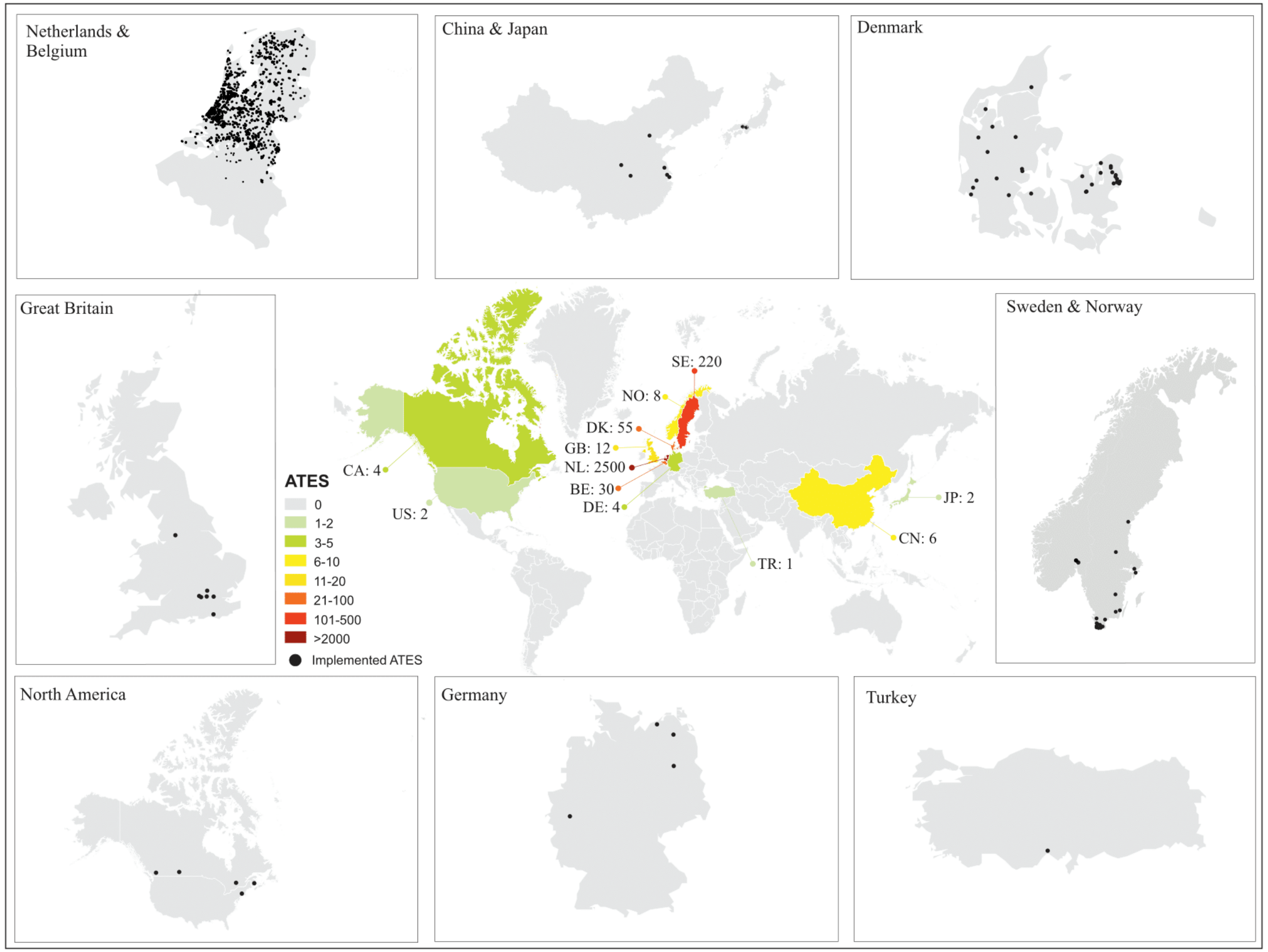


Winter



More than 2,800 ATES systems currently in operation worldwide

Global distribution of Aquifer Thermal Energy Storage (ATES)



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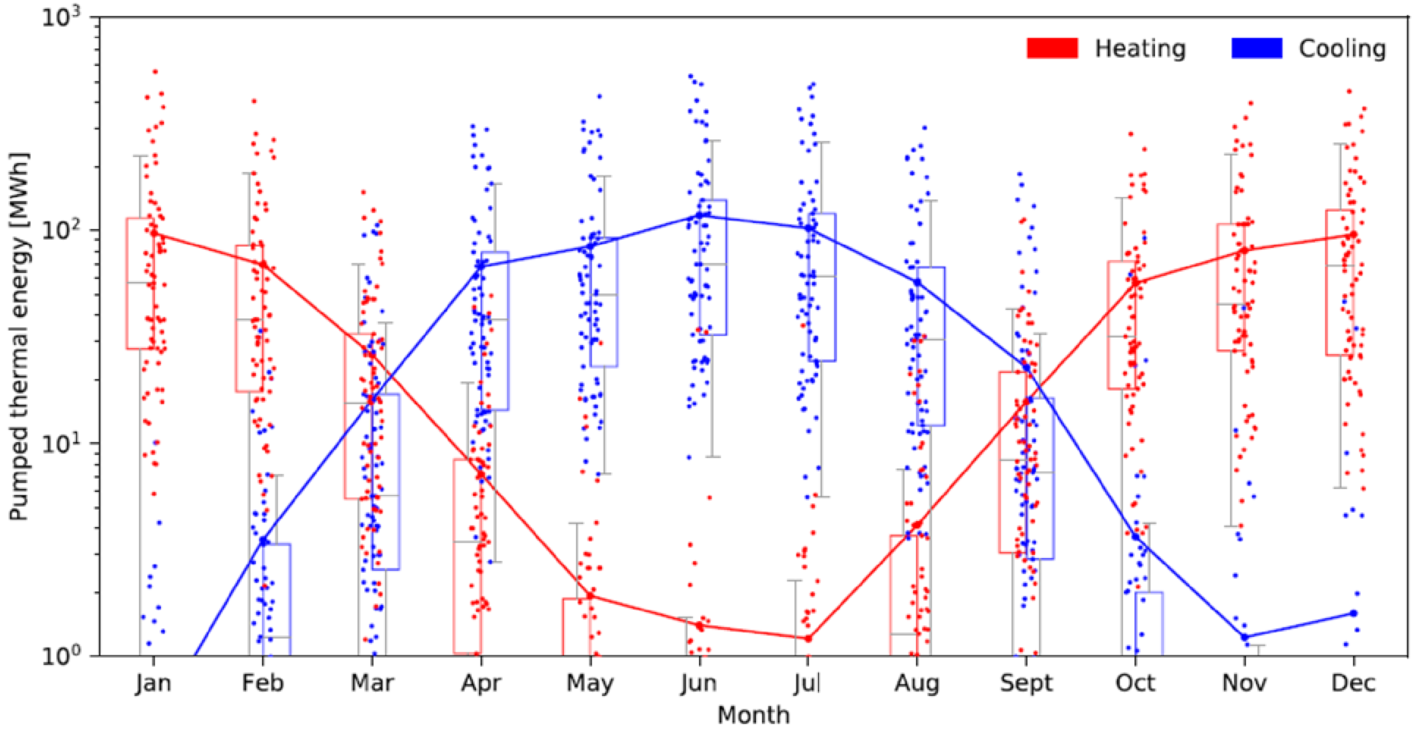
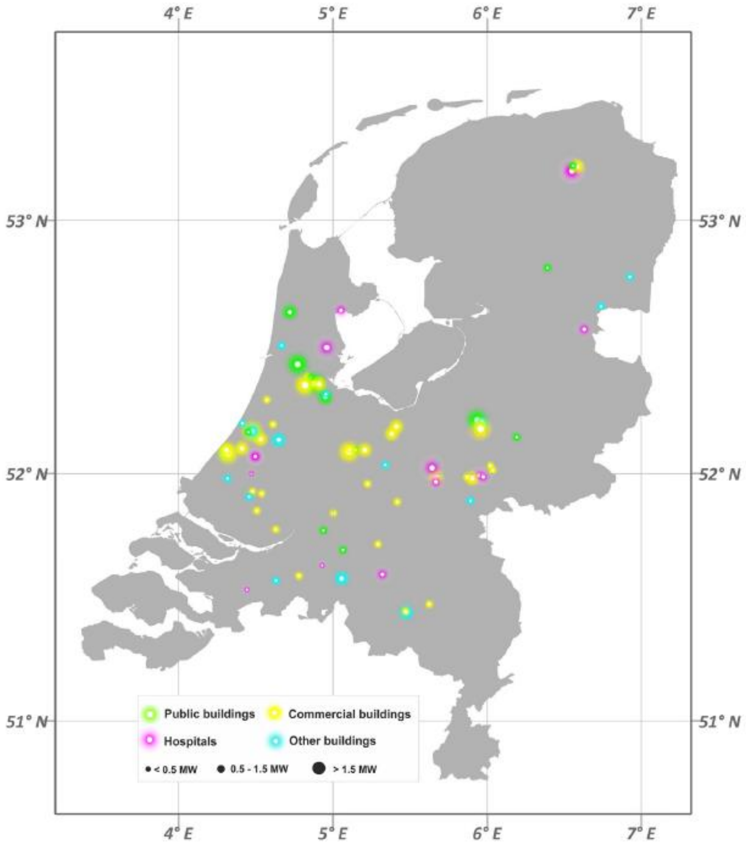
2 TWh of abstracted energy in the Netherlands

Monitoring data of 73 ATES systems





- 1 GWh of abstracted thermal energy for heating and cooling of buildings on average
- 380 mio m³ of abstracted groundwater.
- Approximately 2 % of heating and cooling demand (127 TWh) are supplied by ATES systems.

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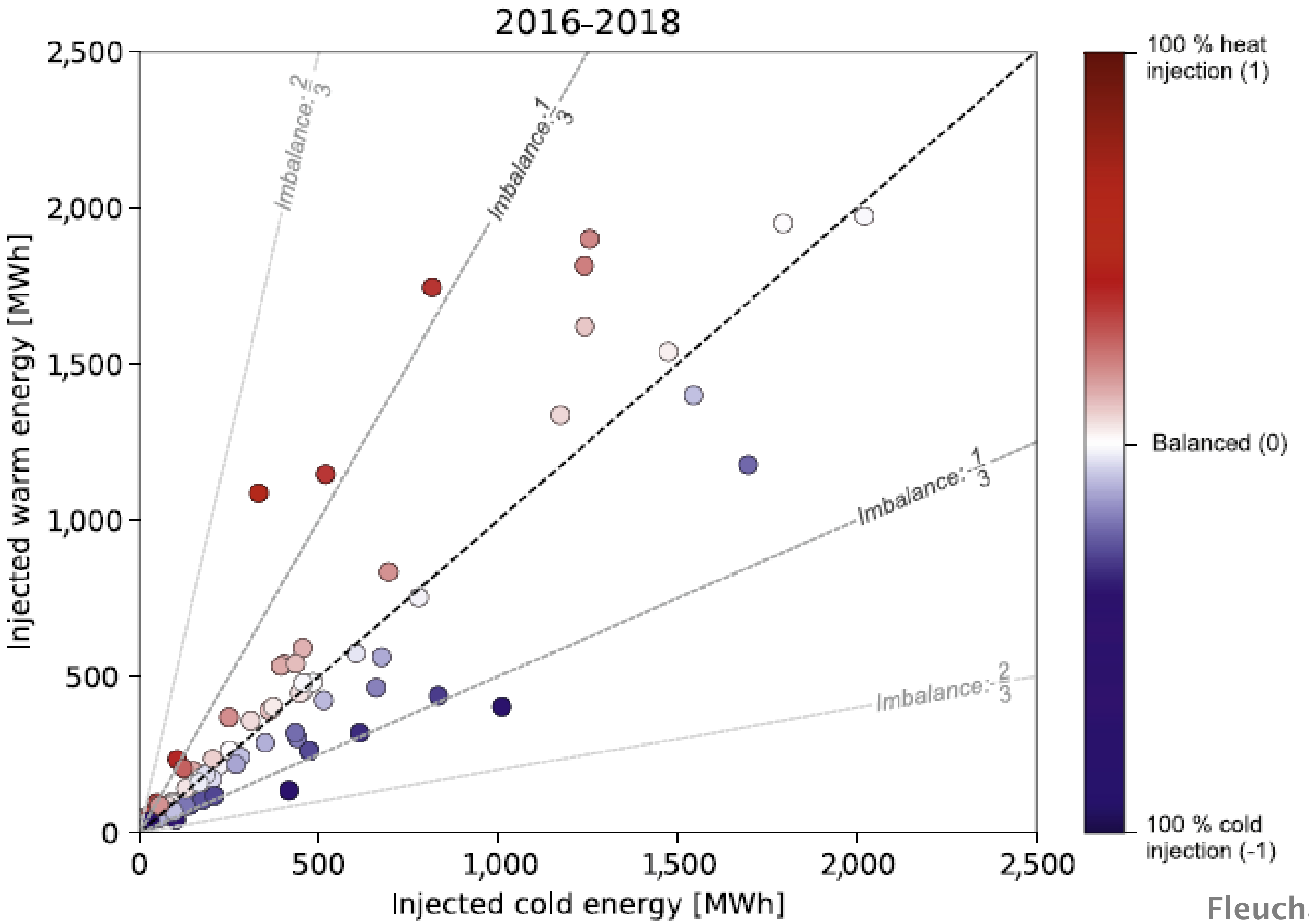
Balanced operation is required

Comparison of heat and cold storage



- Authorities request a balance operation over a period of 3 years.
- Synergies through combined supply of buildings with large cooling demand (e.g. data centres) and large heating demand (e.g. hotels).
- Average imbalance amounts to approximately 3 %

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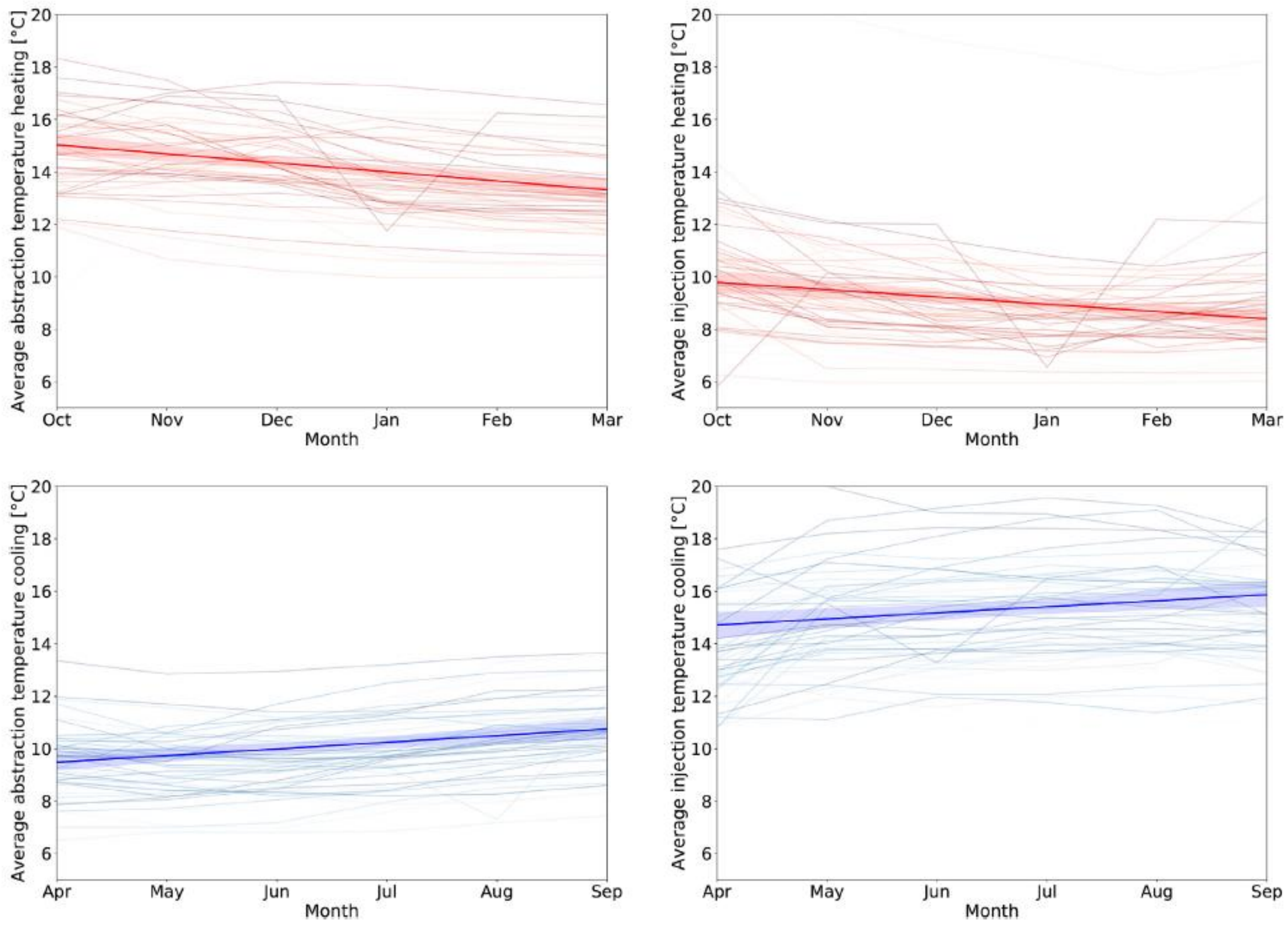
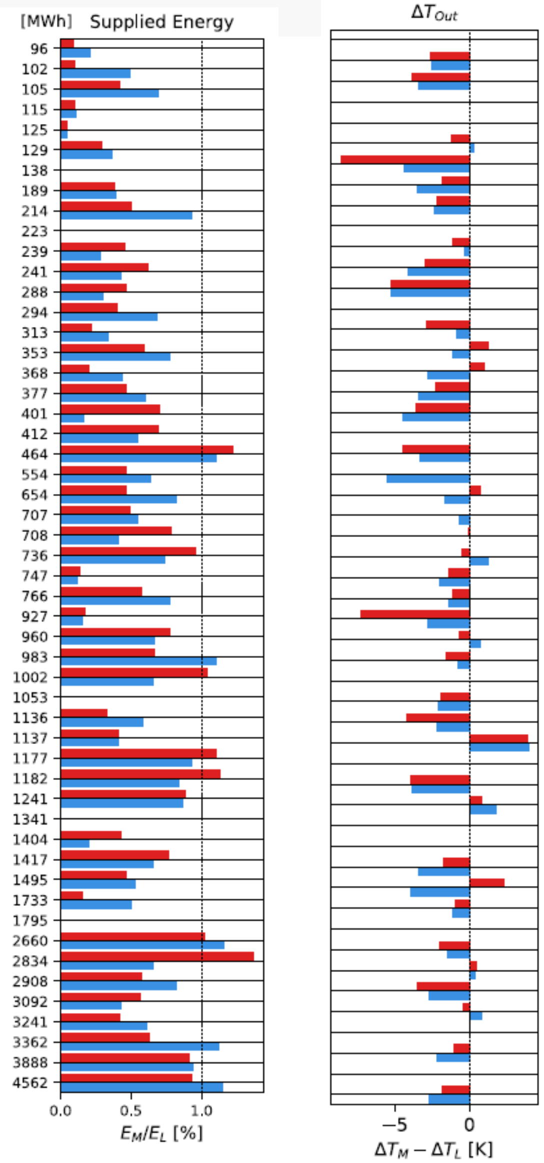
Average ΔT of 5 K

Injection and reinjection temperature levels





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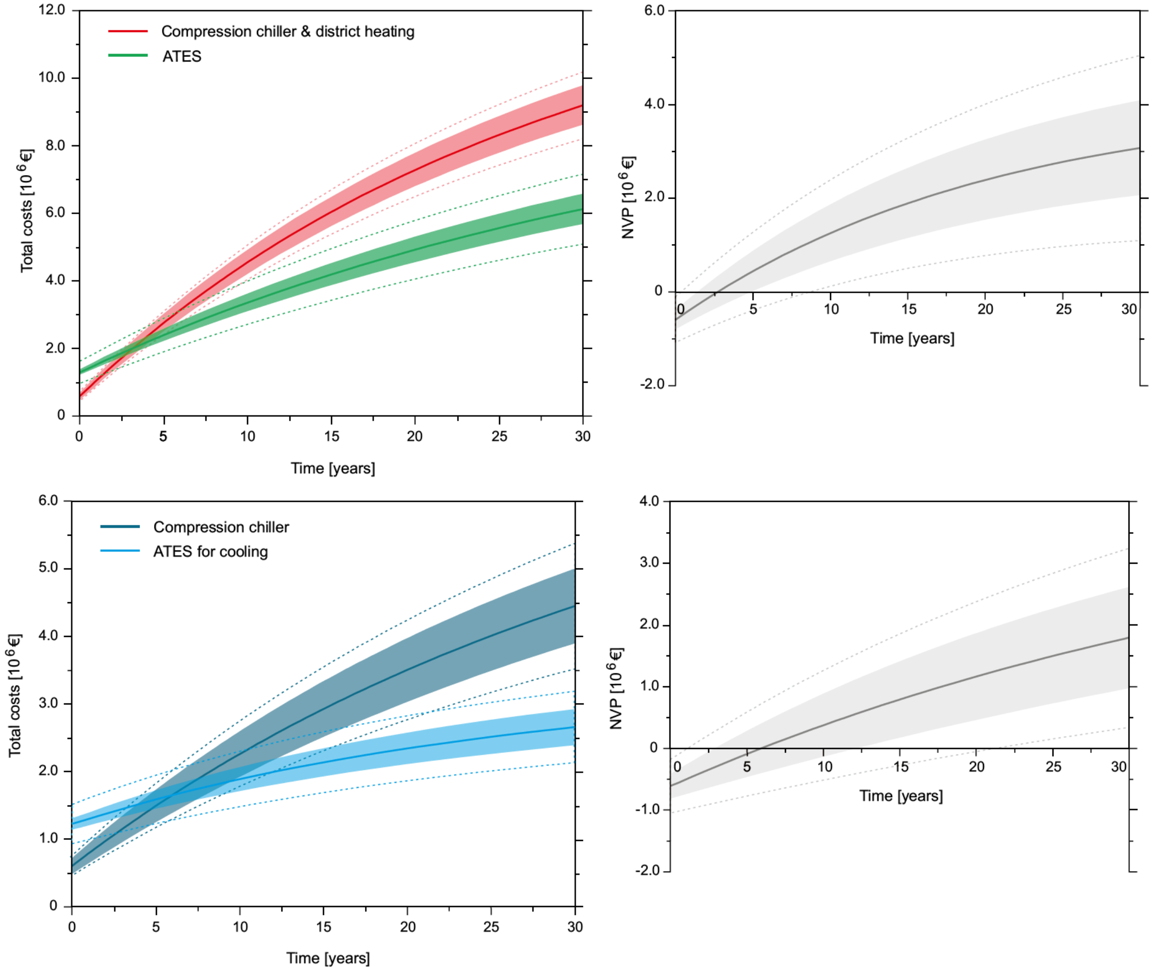
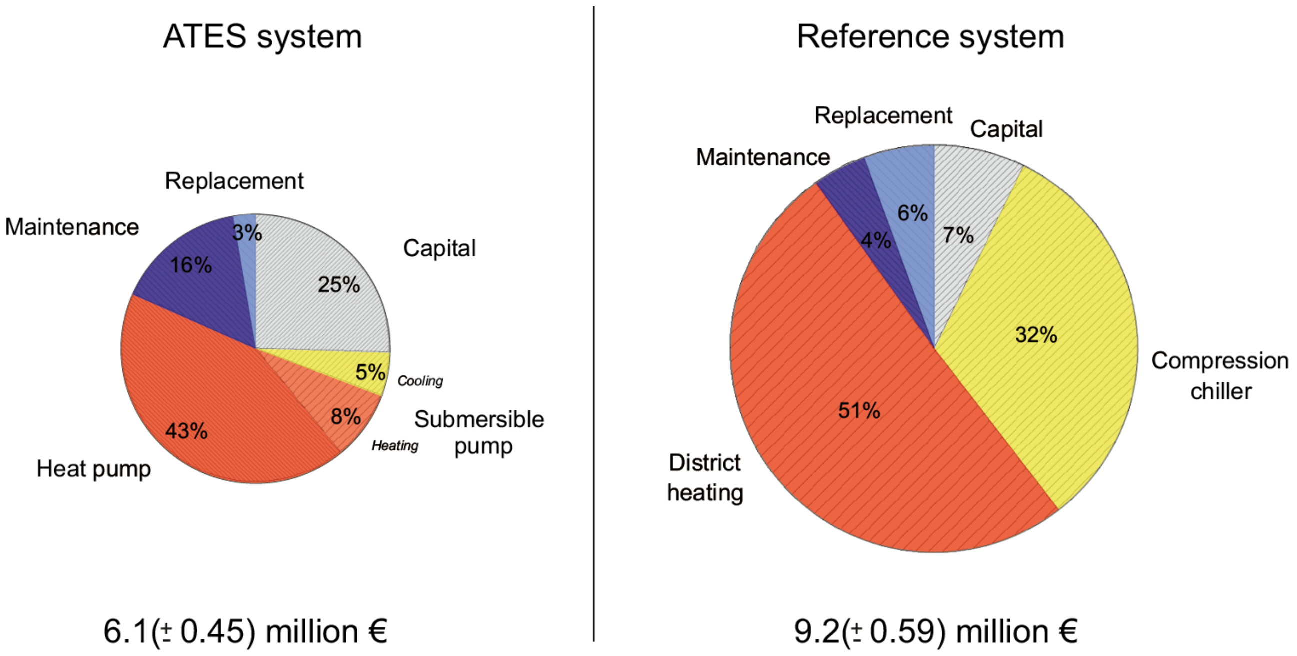
Payback time of ATES after 3 years

Economic comparison of ATES with common supply technologies





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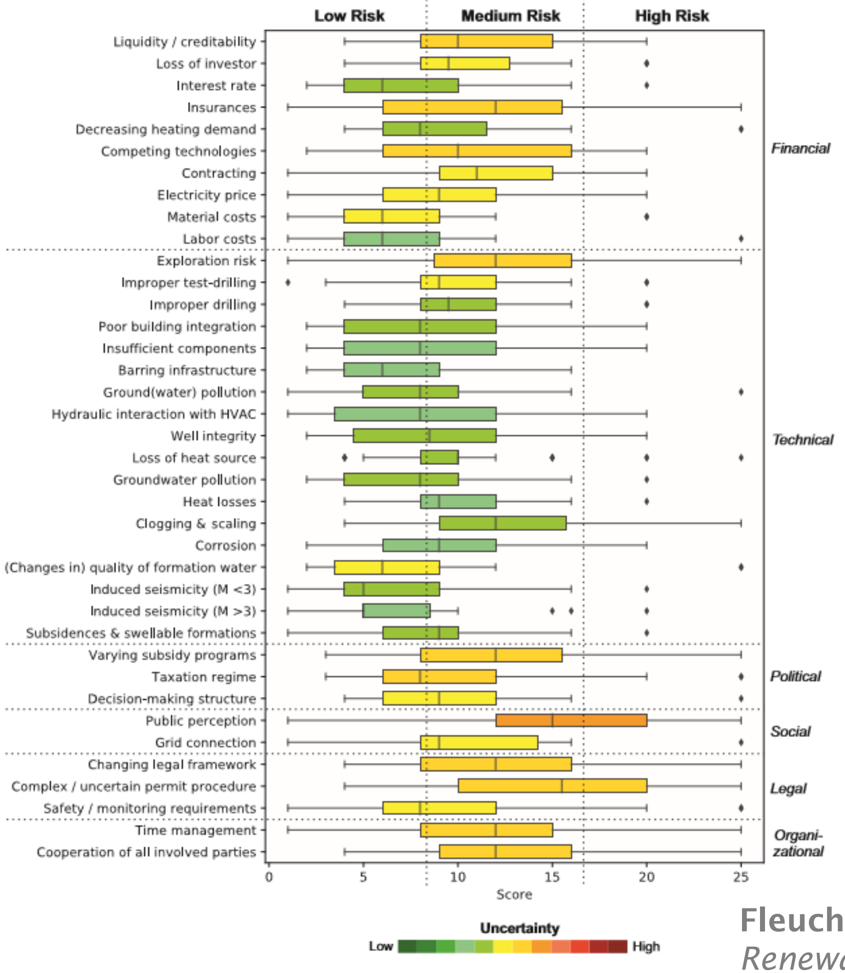
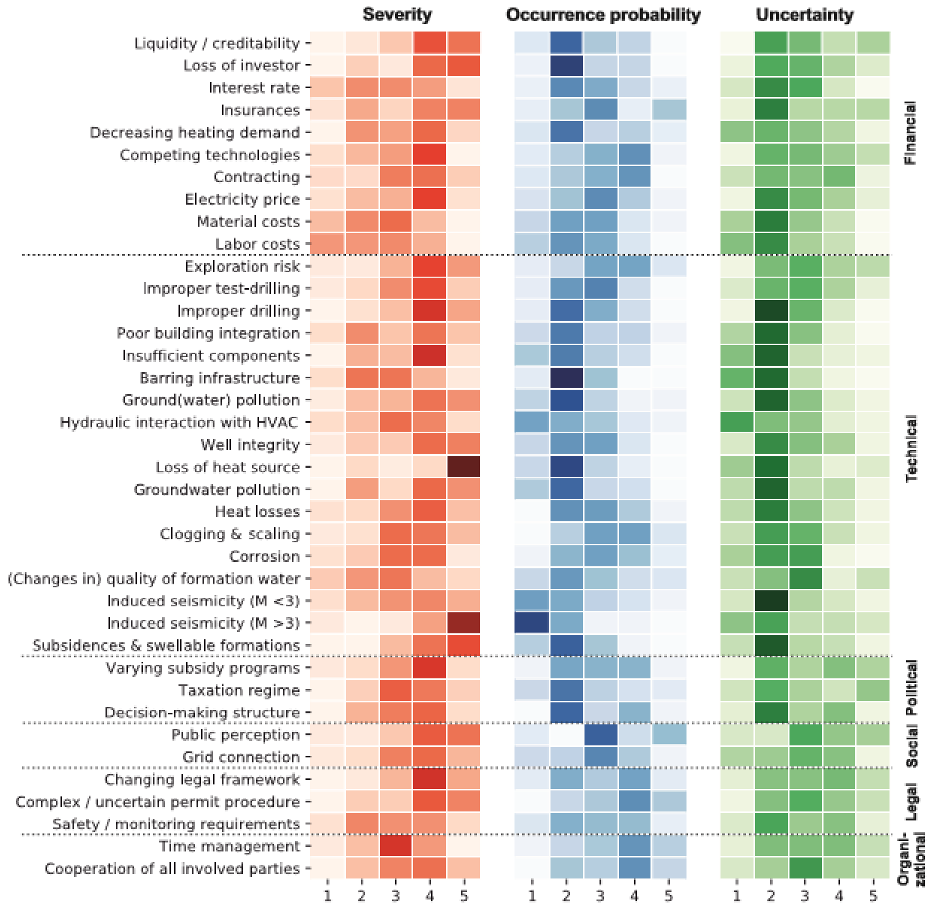
Expert survey

Qualitative risk analysis of high temperature ATES (HT-ATES)





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Conclusion

- Interaction between subsurface and heating and cooling systems needs to be optimized.
- Large discrepancy between licensed and actual extraction of thermal energy leads to an inefficient utilization of the subsurface space.
- Large economic potential compared to common supply technologies such as compression chillers.
- Implementation of monitored demonstration sites and pilot projects facilitates market entry.
- Project specific risk assessment is highly recommend in particular for HT-ATES.

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