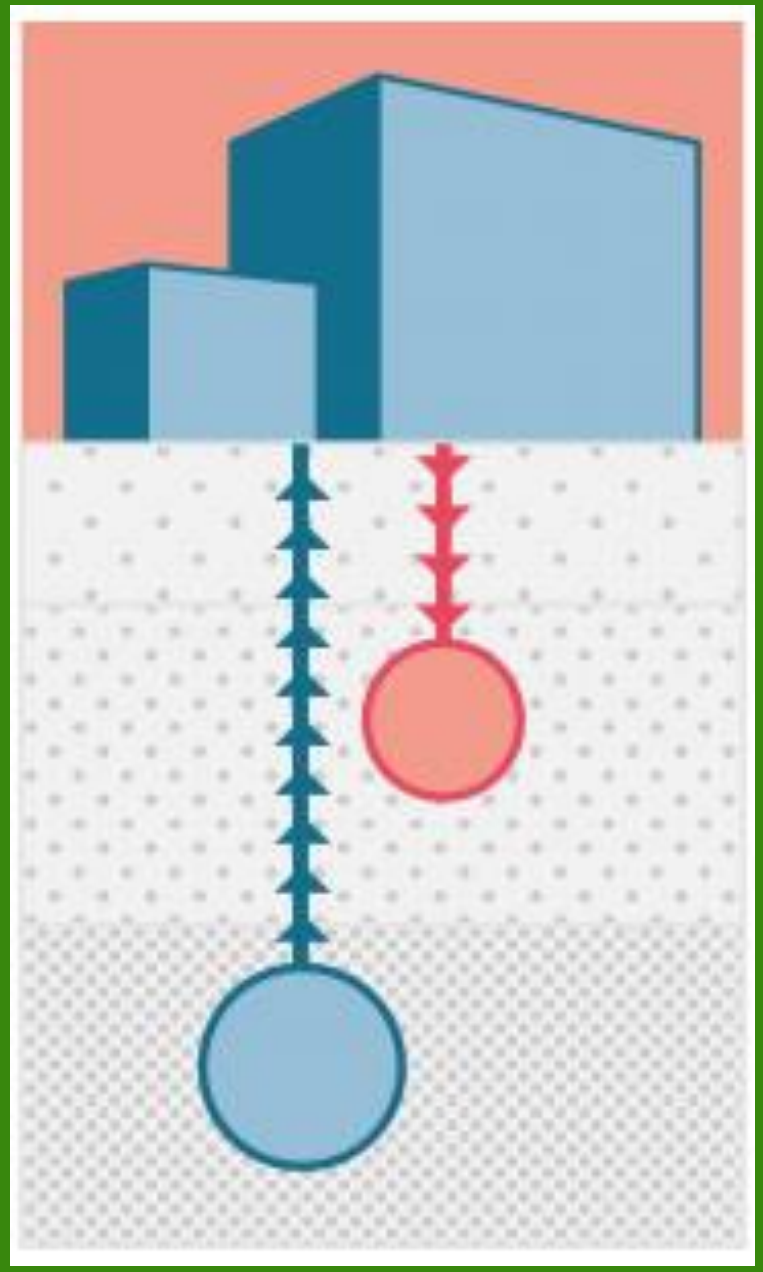


Netherlands Enterprise Agency

Renewable and efficient cooling with aquifer thermal energy storage (ATES) in NL

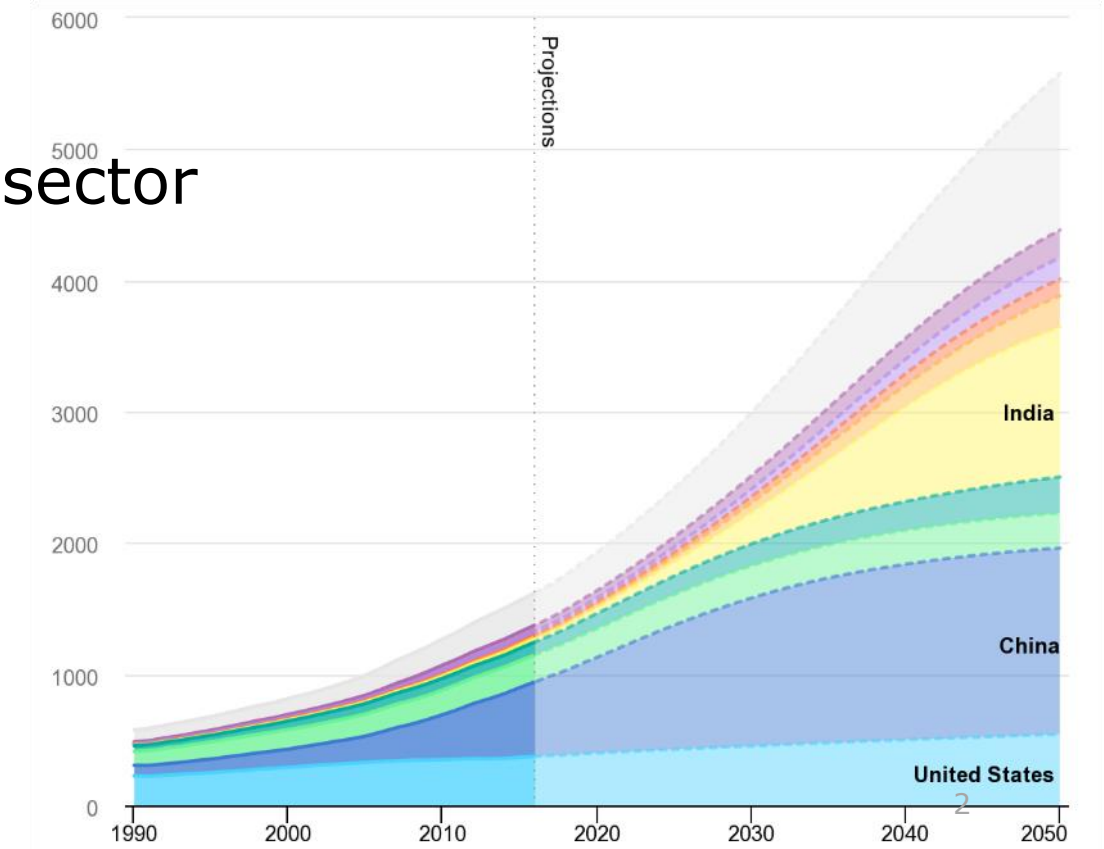
Status of ATES for cooling in the Netherlands

Lex Bosselaar

Ca-EED October 14th 2020

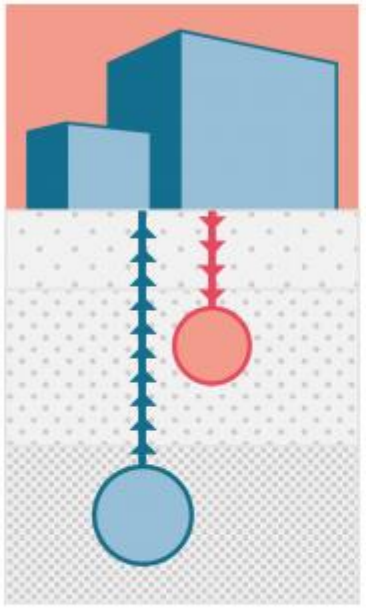
Status of cooling

- Growing demand for cooling
- Now 6% airco’s in houses in NL
- Airco is standard in offices and health sector
- Expected growth for cooling
- Efficient and renewable cooling is needed
- ATES is an option



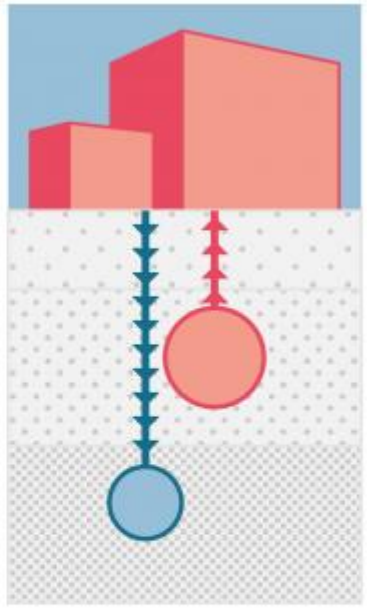
Principle of Aquifer Thermal Energy Storage (ATES)

Summer



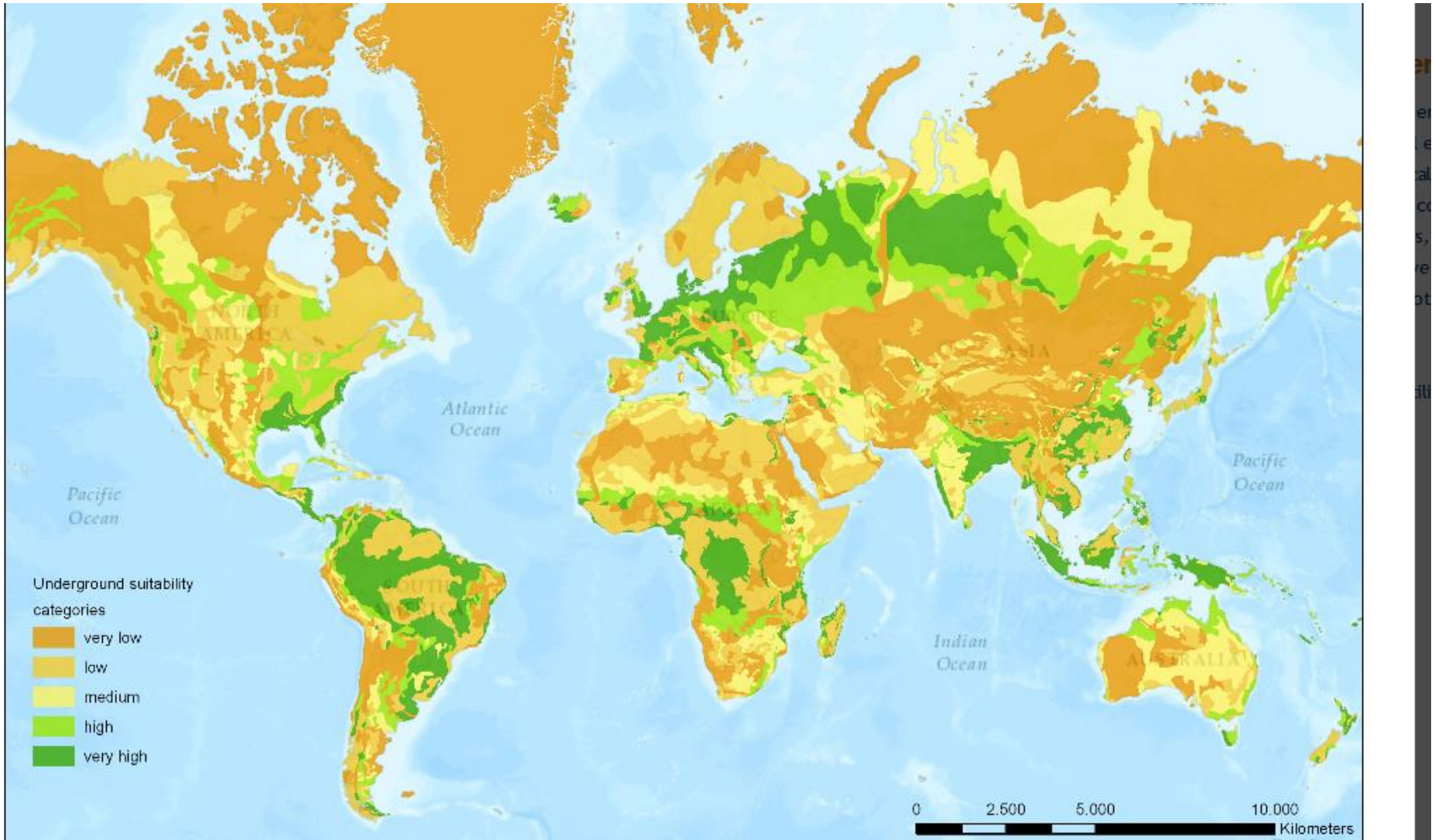
During summer cool groundwater is used to cool the buidling whilst extracted heat is stored in the aquifer for use in winter.

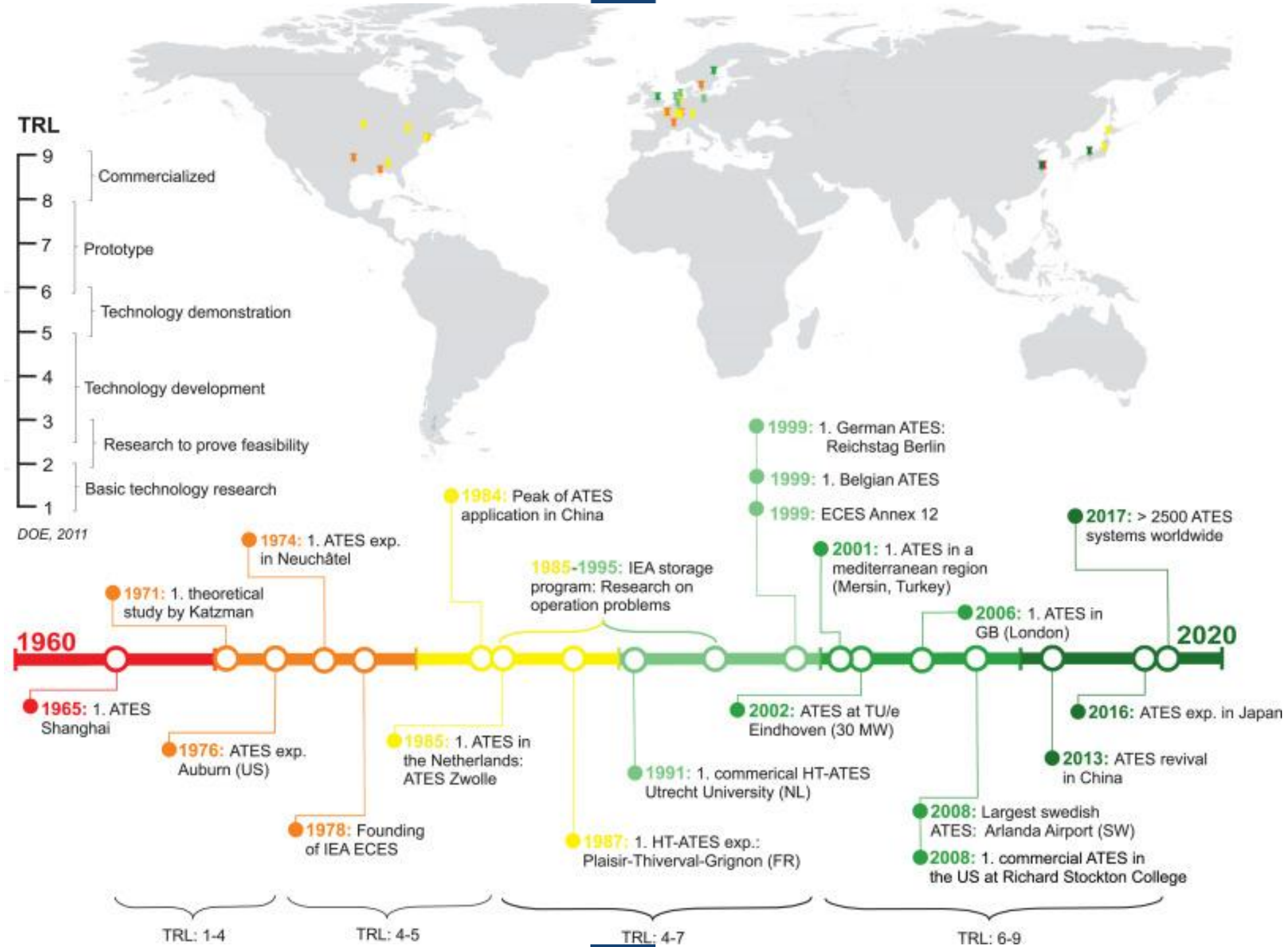
winter



During winter the warm groundwater from the aquifer can be used to warm the building whilst extracted cold is stored in the aquifer to be used in summer. Then the cycle can start again.

World wide potential for ATES




TRL
9
8
7
6
5
4
3
2
1
Commercialized
Prototype
Technology demonstration
Technology development
Research to prove feasibility
Basic technology research
DOE, 2011
1960
2020
1965: 1. ATES Shanghai
1971: 1. theoretical study by Katzman
1974: 1. ATES exp. in Neuchâtel
1976: ATES exp. Auburn (US)
1978: Founding of IEA ECES
1984: Peak of ATES application in China
1985: 1. ATES in the Netherlands: ATES Zwolle
1985-1995: IEA storage program: Research on operation problems
1987: 1. HT-ATES exp.: Plaisir-Thiverval-Grignon (FR)
1991: 1. commerical HT-ATES Utrecht University (NL)
1999: 1. German ATES: Reichstag Berlin
1999: 1. Belgian ATES
1999: ECES Annex 12
2001: 1. ATES in a mediterranean region (Mersin, Turkey)
2002: ATES at TU/e Eindhoven (30 MW)
2006: 1. ATES in GB (London)
2008: Largest swedish ATES: Arlanda Airport (SW)
2008: 1. commercial ATES in the US at Richard Stockton College
2013: ATES revival in China
2016: ATES exp. in Japan
2017: > 2500 ATES systems worldwide
TRL: 1-4
TRL: 4-5
TRL: 4-7
TRL: 6-9

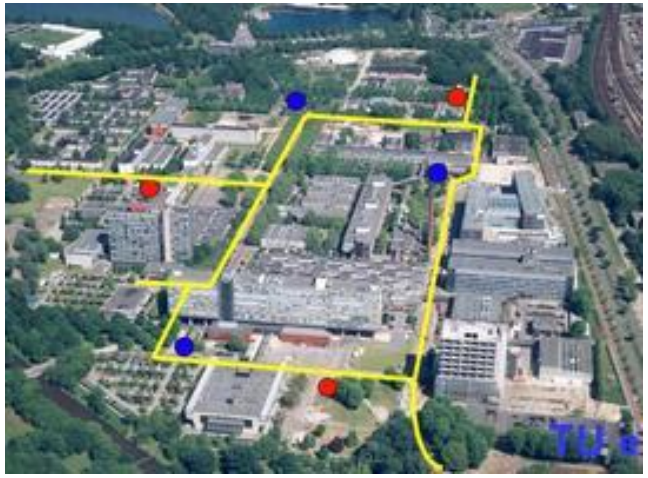
ATES Integrated Approach

Single Building	Between Buildings	Area development

Examples of large ATES systems

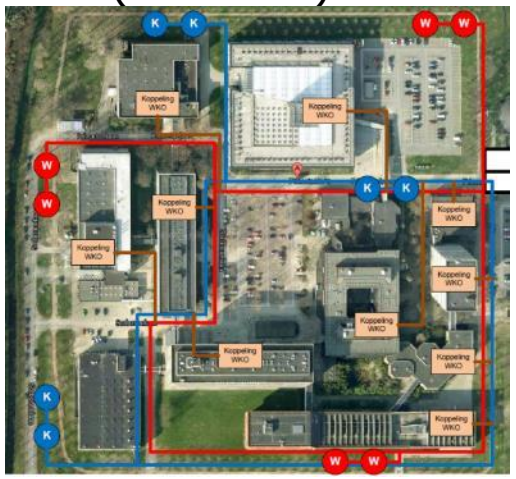
ATES with ring lines for multiple buildings on a site, energy can be exchanged between the buildings.

TU Eindhoven



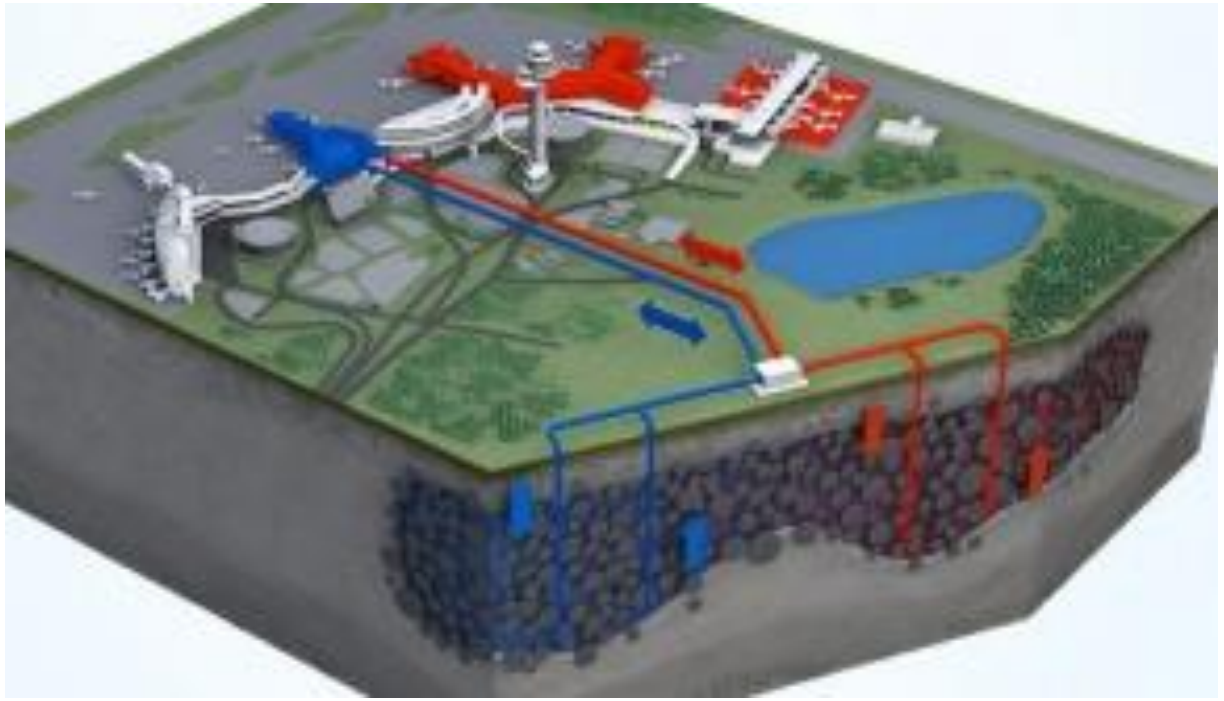
University of Utrecht

(NW area)



Airports around the world use ATES

- Amsterdam
- Stockholm
- Oslo
- Shanghai
- Christchurch
- Copenhagen



Current status in NL

- About 3000 systems in use
- Mainly in service sector
- Delivers 2 PJ of renewable cooling
- No contribution yet to RE target
- Cost effective for larger buildings (> 5000 m^2)
- Possible for apartments and houses
- No business case without cooling

Conclusions

- ATES is a mature technology
- Applicable a large parts of Europe
- Potential for large buildings with need for cooling
- Proven technology in the Netherlands

Questions?

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