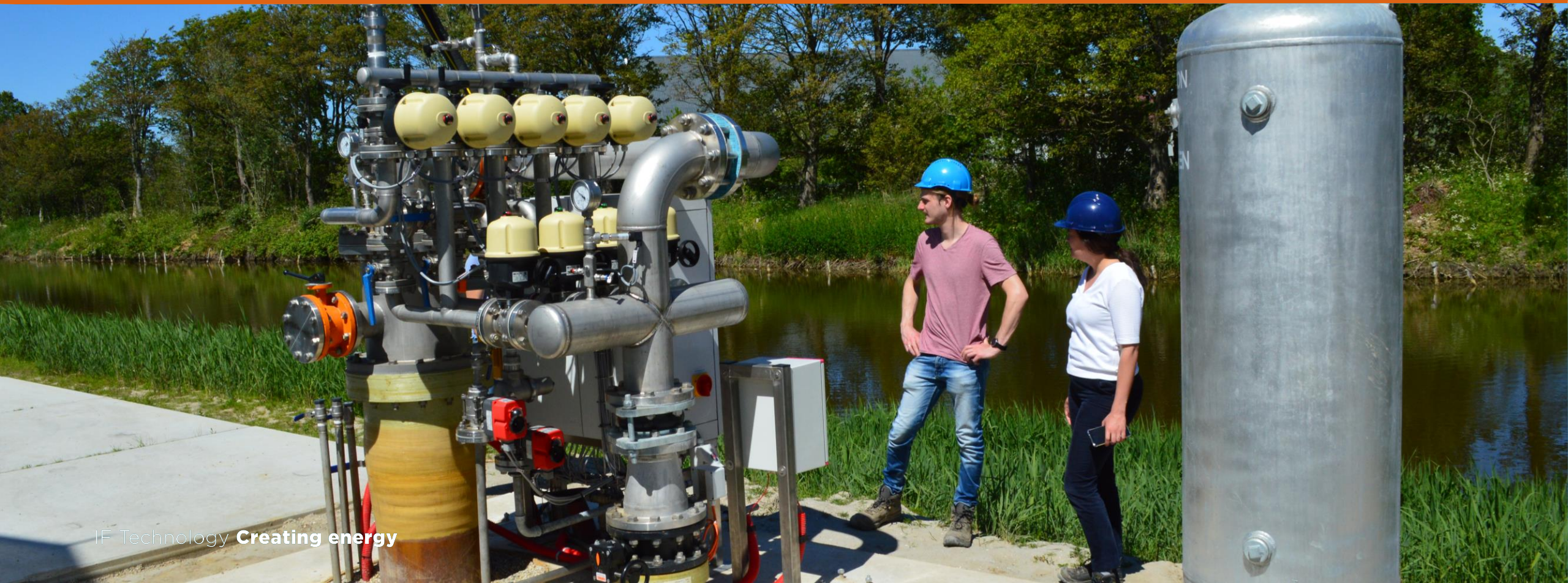


Webinar series heat storage

HT-ATES: Heat storage in underground aquifers



Contents

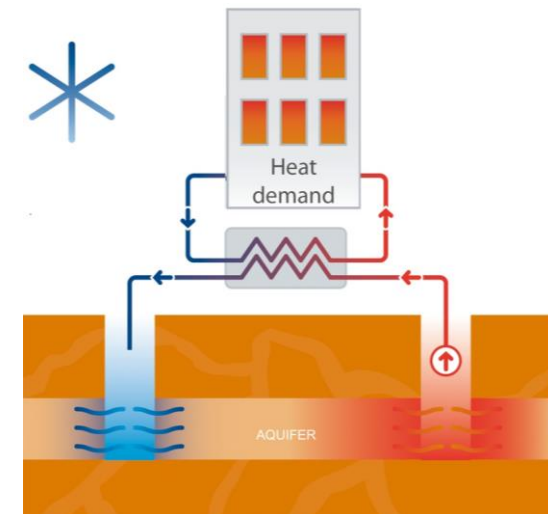
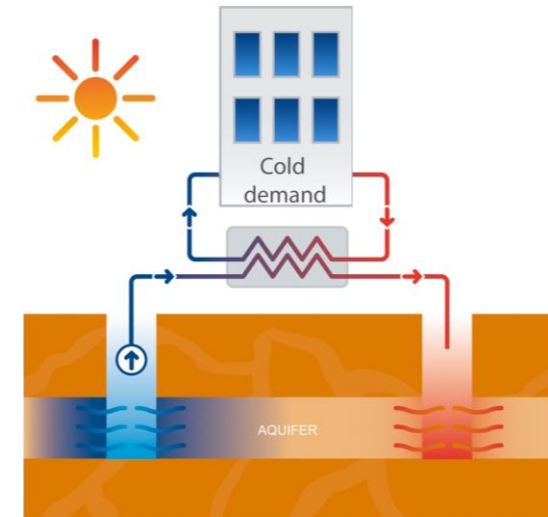
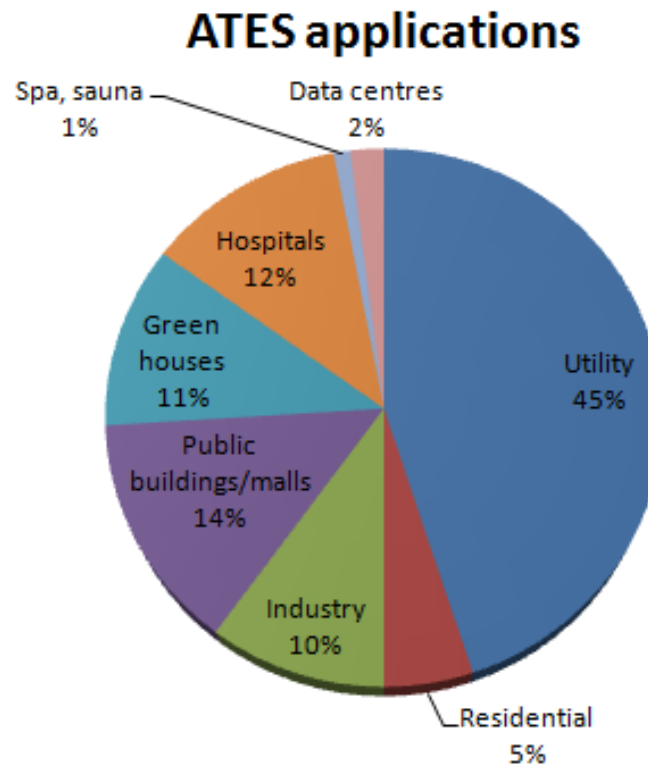
- Why large heat storage?
- What is ATES and HT-ATES?
- When can HT-ATES be applied?
- Steps necessary to make a successful ATES system

Why large heat storage?

- Space and water heating account for almost half of global energy use in buildings
- Nearly two thirds of heating energy use still rely on fossil fuels
- Storage improves business case for sustainable heating technologies
- Price of heat storage per kWh much lower than for electrical storage
- Impact to environment much lower than electrical storage

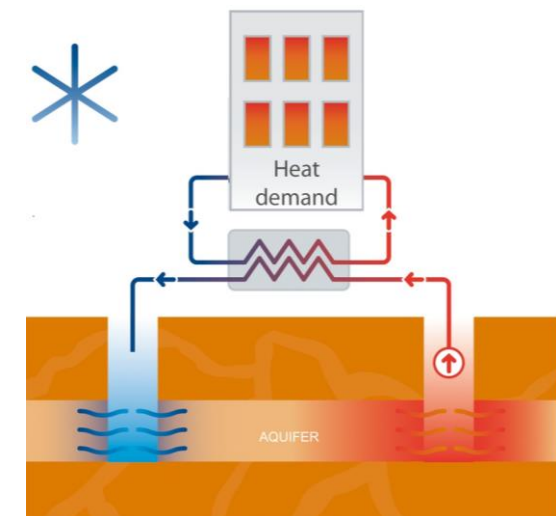
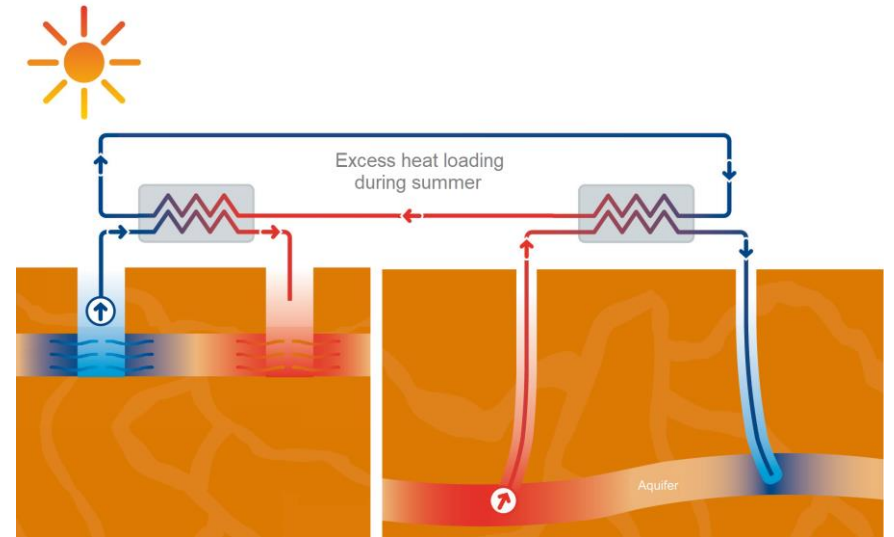
Aquifer Thermal Energy Storage (ATES)

- Regular ATES:
 - Seasonal heat and cold storage
 - 5°C to 30°C
 - Mature technology: over 4000 systems
- MT-ATES:
 - Seasonal heat storage (cold optional)
 - 30°C to 60°C
 - Multiple working systems
- HT-ATES:
 - Seasonal heat storage
 - 60°C to 90°C
 - Currently one large working system



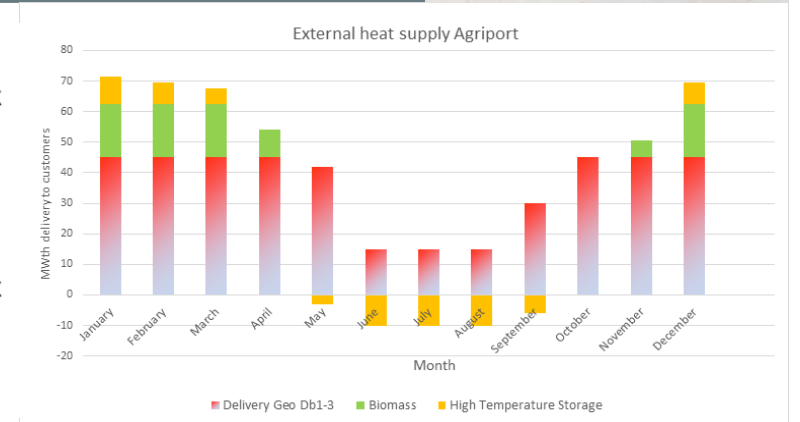
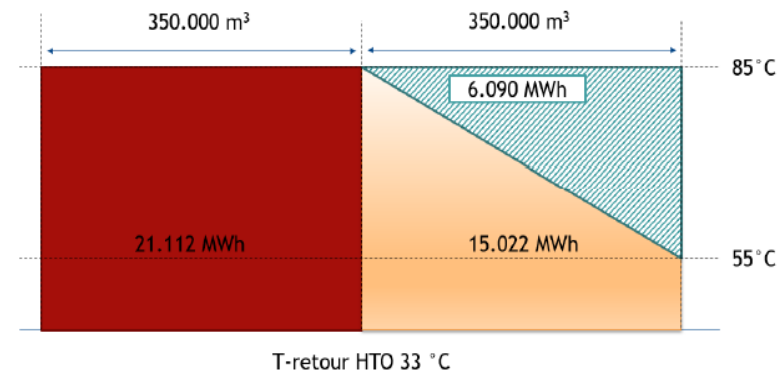
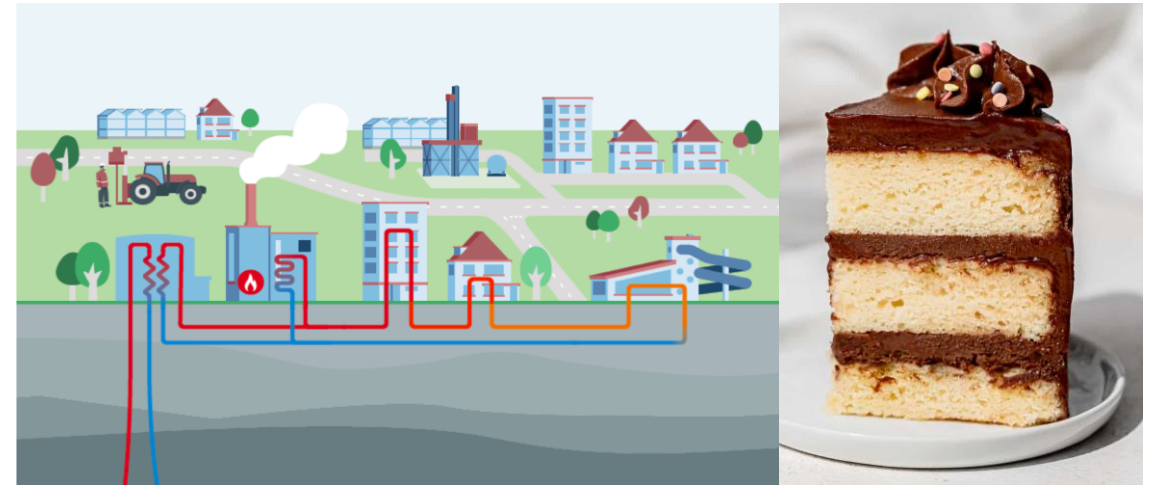
Middle and High Temperature ATES

- Main purpose
 - Making more systems more useful
- Main uses
 - Greenhouses
 - District heating systems
- Heat sources
 - Solar thermal
 - Geothermal
 - Hydrogen production
 - Waste heat (industry, data centers, powerplants, etc.)
 - Power to heat → balancing e-grid



Middle and High Temperature ATES

- Integration in heating networks
 - Direct heating of lower temperature network
 - Direct pre-heating high temperature network
 - Efficient heating with (high temperature) heat pumps
- Main challenges HT-ATES
 - Matching supply and demand
 - Temperatures
 - Power outputs
 - Total energy
 - Finding suitable underground layers



Technical details and estimated costs HT-ATES

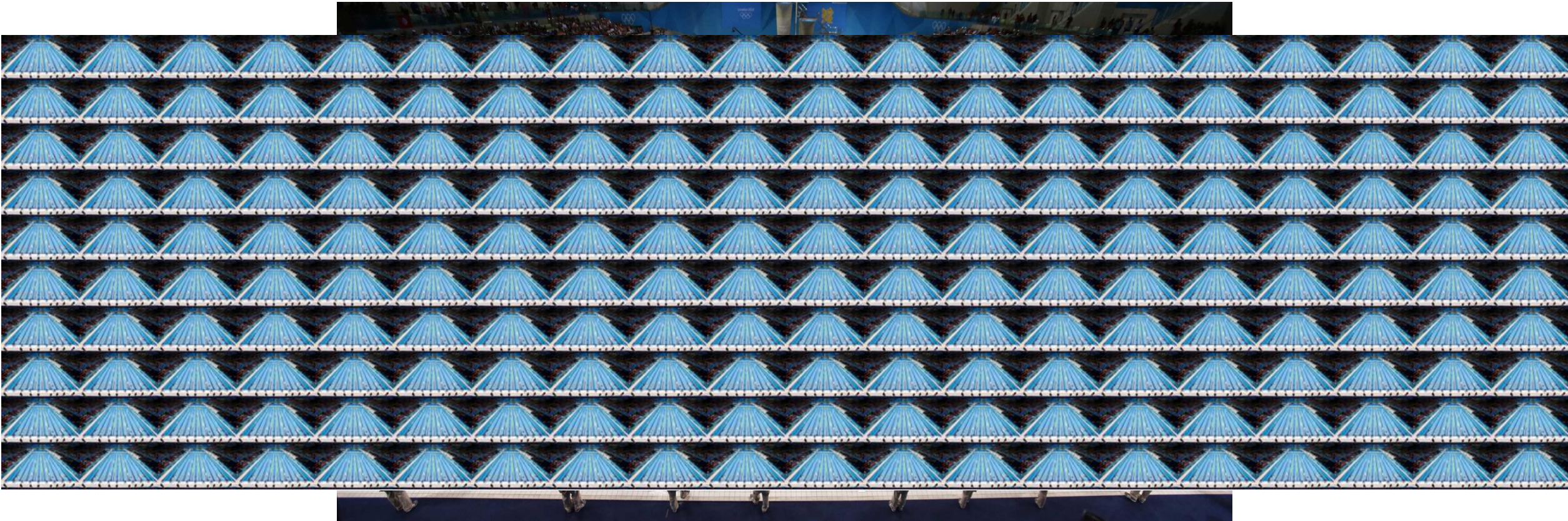
- How flexible is it?
 - Controllability: From 20% power to 100% in 5 minutes
 - Scale: From 600 MWh heat per season to 38 GWh per season
 - Below 60° C: high frequency flow reversal possible
 - Between 60° C and 90° C: Limited flow reversal. Higher frequency in development
- Time scales
 - Storage duration: full season
 - From idea to working product: ± 4 years
 - Achieving full efficiency: ± 5 years
 - Expected lifetime: >30 years
- Estimated costs
 - Between € 2,5 and 4 mln per system with 2 wells

How large is HT-ATES?

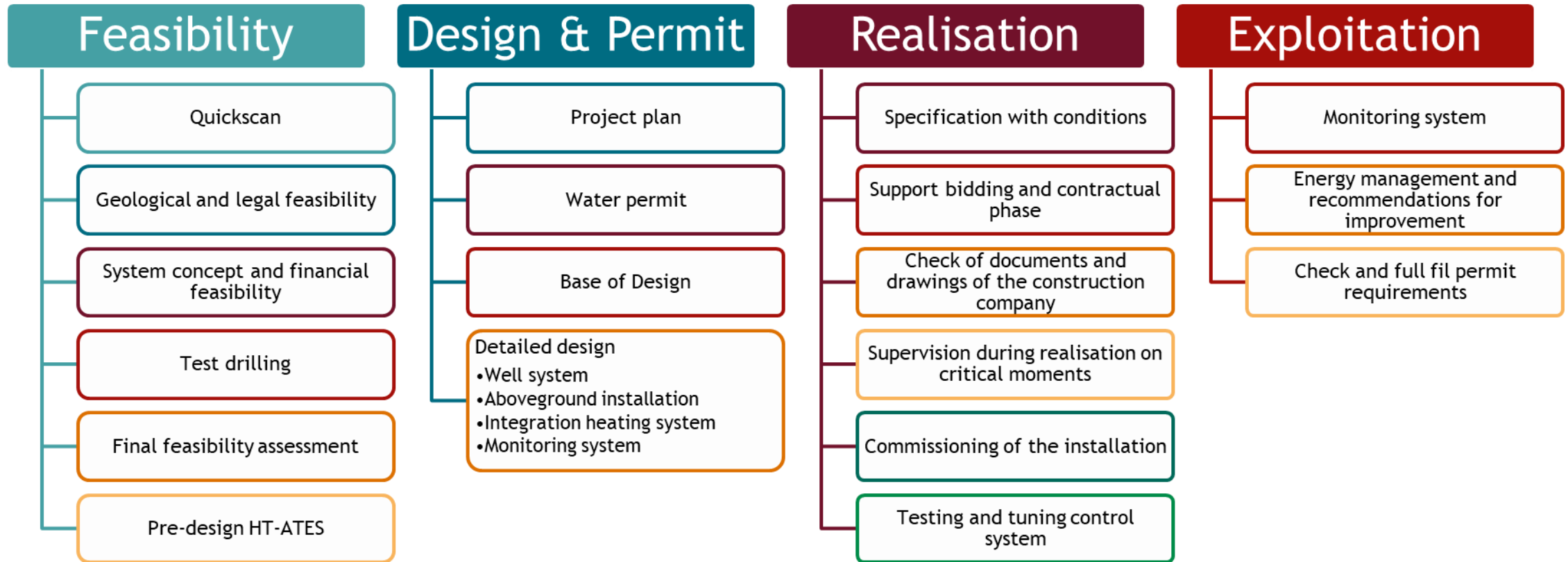
- Surface area technical room: 120 m²
- Water treatment: 40 m² (separate space)
- Length x width x height well: 3x2x3 m
- Surface area well: 5x3 m (incl. N₂-tank)
- What you don't see: 600.000 m³ water



What you don't see

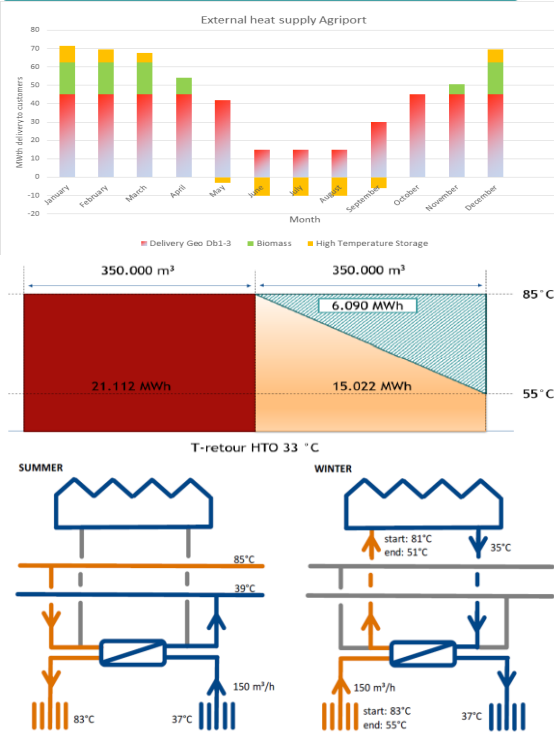


Workflow of the development of HT-ATES

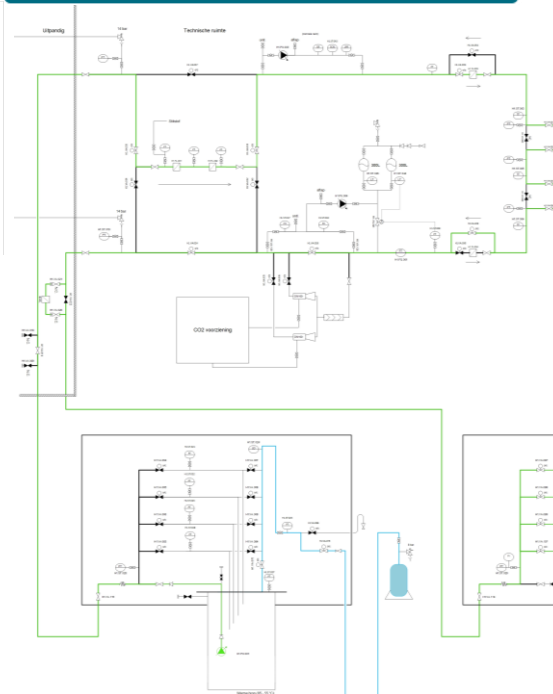


Workflow of the development of HT-ATES

Feasibility



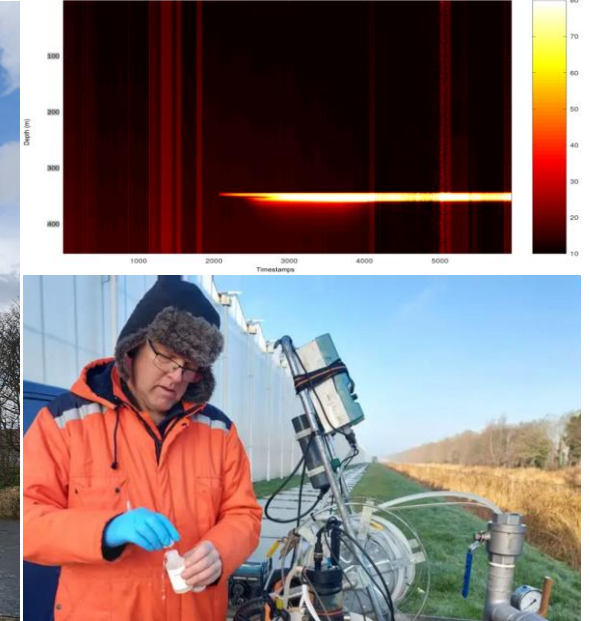
Design & Permit



Realisation

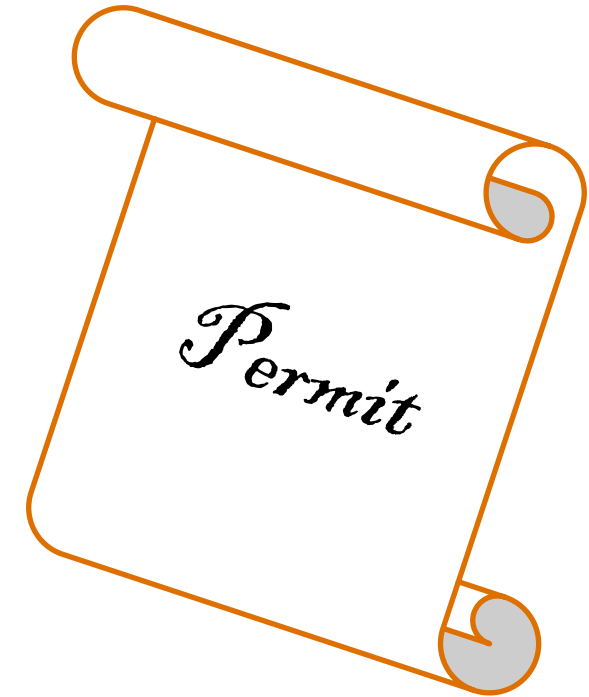


Exploitation



Legal aspects developing HT-ATES

- Always conduct complete research on environmental influences
- Different limitations will apply in every country
 - Permit available up to 500 meters depth in the Netherlands
- Communication with local residents very important!
 - Avoid lawsuits
 - Limited technical risks, high rewards





IF Technology **Creating energy**