IEA Technology Collaboration Programme

1st webinar by IEA-ES Task 45:

Planning, Regulatory, Societal, and Financial Dimensions of Large-Scale Thermal Energy Storage Implementation

Tuesday, 10 June 2025

9:00 – 12:00 (CET)

Learn more at https://iea-es.org/task-45/

Workshop Program

Planning, Regulatory, Societal, and Financial Dimensions of Large-Scale Thermal Energy Storage Implementation

9:00 - 9:20	• Welcome, introduction and brief technical overview of Large Thermal Energy Storage technologies, based on IEA-ES Task 39. *Romain Sucche, PlanEnergi*
9:20 - 9:40	• Planning, Integration & Regulatory Framework, applied on a Aquifer Thermal Energy Storage case study. *Bas Godschalk, DTESS BV*
9:40 – 10:02	• Planning, Integration & Regulatory Framework, applied on a Borehole Thermal Energy Storage case study. *Lukas Seib, Technische Universität Darmstadt*
10:02 - 10:12	• Break
10:12 - 10:30	• Stakeholder engagement and public perception in an Large Thermal Energy Storage project. *Michal Klauda, Fenix TNT*
10:30 – 10:55	• Planning, Integration & Regulatory Framework, applied on a Pit Thermal Energy Storage case study. *Per Alex Sørensen, PlanEnergi*
10:55 - 11:15	• The European Framework for Large Thermal Energy Storage project. *Johanna Schickling, Hamburg Institut*
11:15 – 11:25	• Break
11:25 - 11:45	• Large Thermal Energy Storage financing methods. *Geoffroy Gauthier, PlanEnergi*
11:45 - 12:00	• Wrap-Up & Open Discussion. *Geoffroy Gauthier & Romain Sucche, PlanEnergi*

Submit your questions !

Submit your questions by filling up this form → https://forms.office.com/e/3826HwsSUw

Questions will be considered:

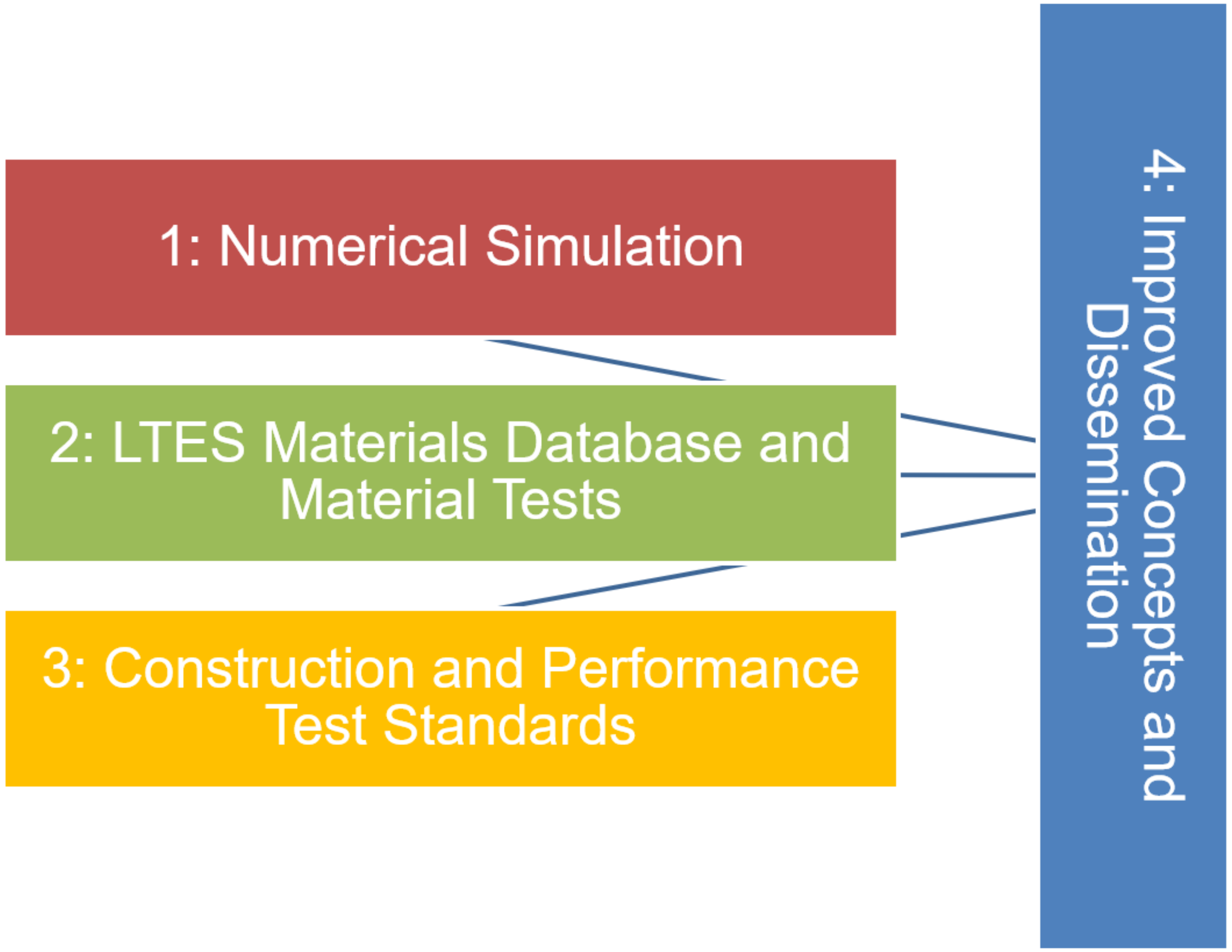
- At the end of each webinar (if time permits)
- Or during the planned Q&A sessions

Introduction to IEA-ES Task 45

Goal of IEA-ES-Task 45

"Accelerating the uptake of Large Thermal Energy Storages”

Task subtasks



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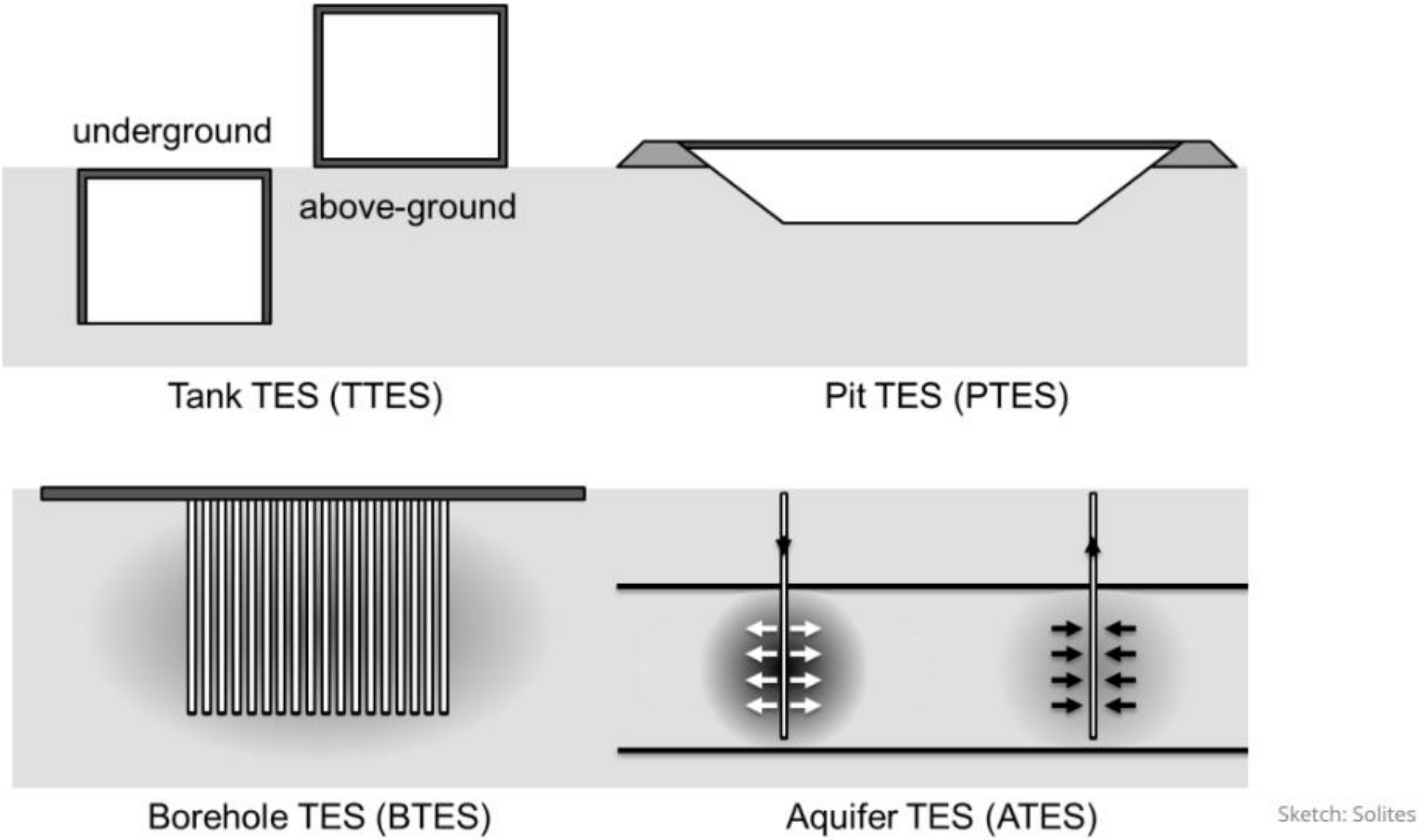
Task scope : Investigation of the 4 main LTES technologies and improved concepts



- Yearly stored energy > 1 GWh
- Typical storage temperatures 100 °C – 120 °C
- Daily, weekly and seasonal storage
- DH or industries

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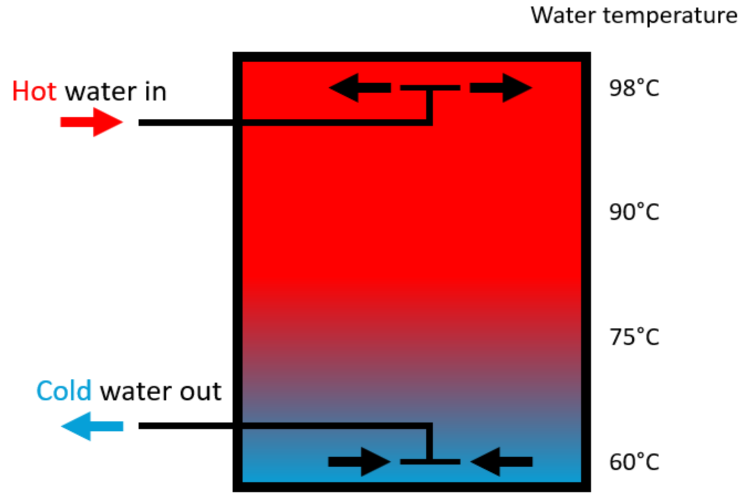
Tank Thermal Energy Storage (TTES)

- Large tank filled with water, usually in a cylindric shape, insulated at the top and to the sides
- Storage medium is water
- Most of the time placed above ground, although it can also be (fully or partially) underground



Sketch of a TTES while charging Planenergi

Technical Characteristics, TTES	
Size range, 1 tank [m^3 water equivalent volume]	1’000 - 60’000
Max thermal power [MW_{th}]	1 – 1’000
Usage	Daily/weekly storage
Maturity	
Number of implemented full-scale projects by 2022	> 100
TRL	9

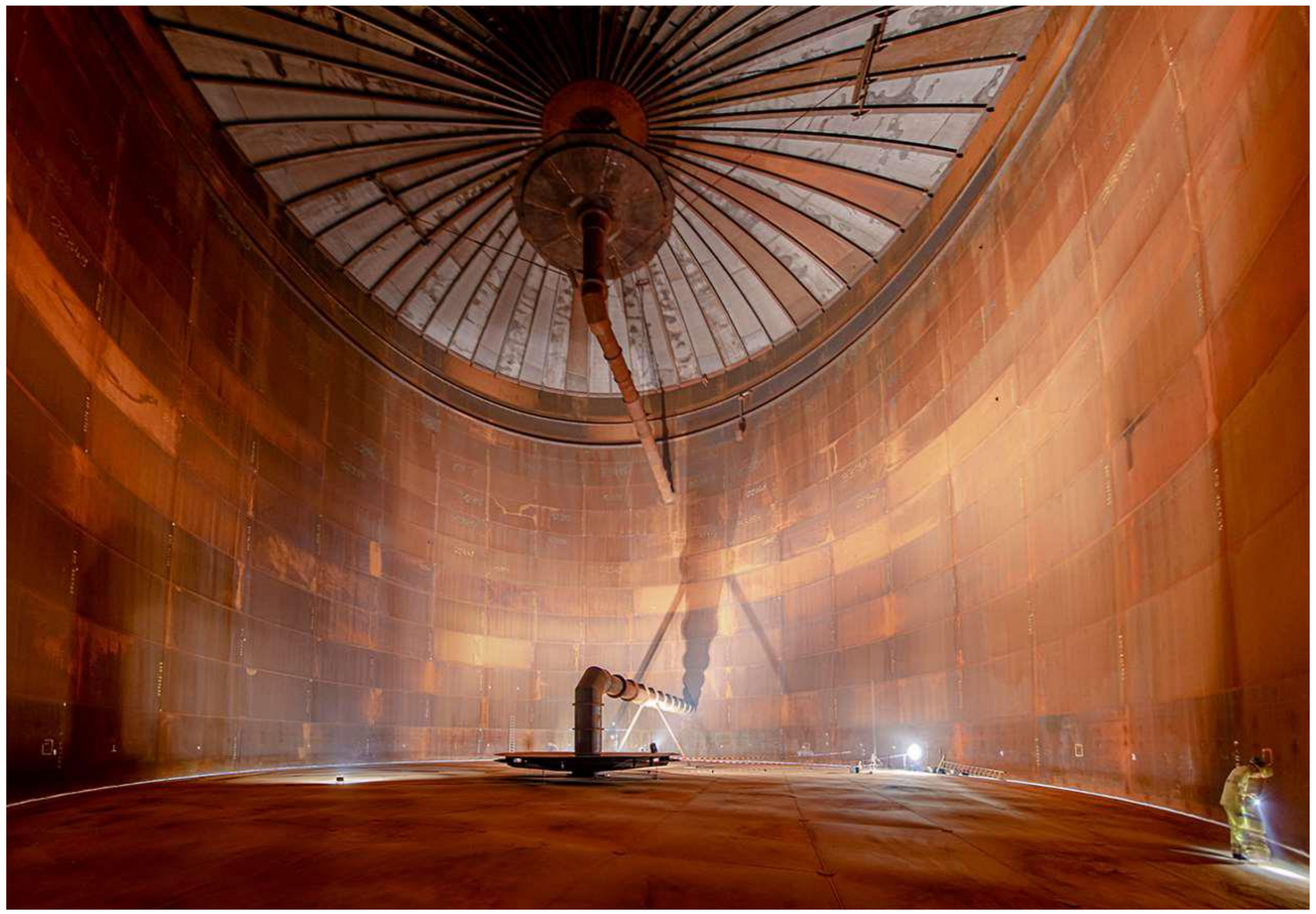


Photo: Vattenfall

Example: TTES in Berlin (DE) by Vattenfall

- Commissioned in 2023
- Water volume of 56’000 m^3
- Ø 43 m x h 45 m
- 2’750 MWh storage capacity
- Charge-discharge capacity: up to 200 MW_{th}
- ~70-120 cycles of charge/discharge per year
- Max operational temperature: 98°C (atmospheric)

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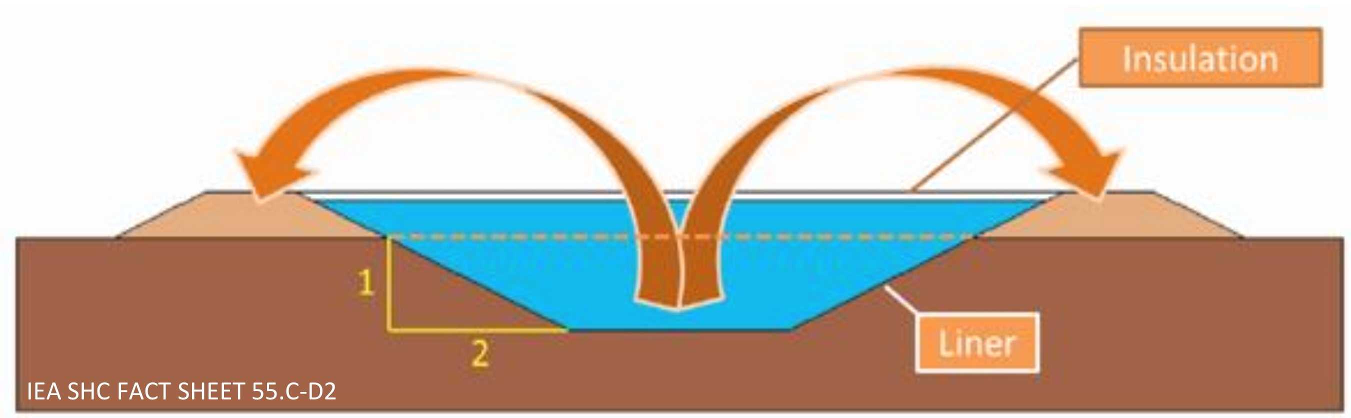
Pit Thermal Energy Storage (PTES)

- Pits dug in the ground, and thermally insulated at the top and sometimes on the sides as well
- Storage medium is usually water
- Reuse of the soil to build up the sides of the pit is important to minimize the costs of soil handling



Technical Characteristics, PTES	
Size range, 1 pit [m^3 water equivalent volume]	20'000 – 1'000'000
Max thermal power [MW_{th}]	10 – 1'000
Usage	Daily/weekly or seasonal storage
Maturity	
Number of implemented full-scale projects by 2022	7
TRL	8-9

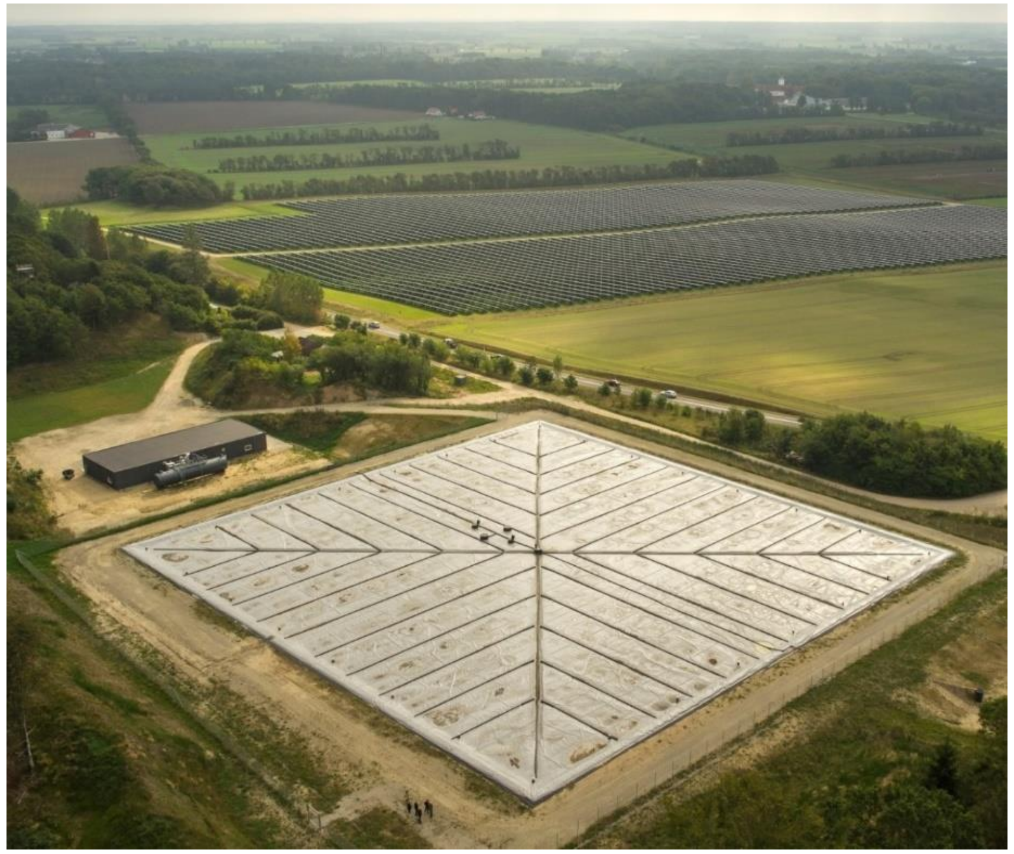


Photo: PlanEnergi

Example: PTES in Dronninglund (DK)

- Commissioned in 2014
- Water volume of 60'000 m^3
- Lid dimension: 91 m x 91 m
- Storage capacity: 5'000-5'500 MWh
- Charge-discharge capacity: 27 MW_{th}
- 2-2.5 cycles of charge/discharge per year
- Max operational temperature: 85-90°C (only summer)

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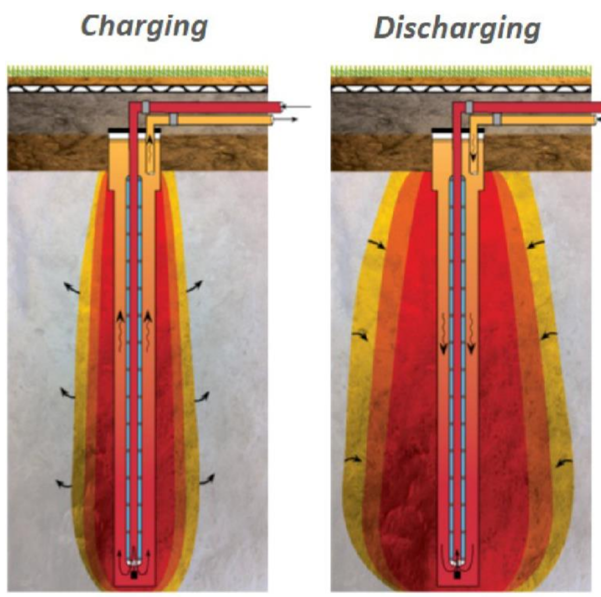
Borehole Thermal Energy Storage (BTES)

- Thermal Energy Storage where the heat is stored directly in the ground
- Storage medium is soil or rock
- It is a series of boreholes where heat exchangers are inserted in order to transfer heat to the surrounding soil
- The BTES lid is usually covered with soil after implementation



Source: Andersson, O.; Håkansson, N.; Rydell, L. Heat Pumps Rescued Xylem's Heat Storage Facility in Emmaboda, Sweden.

Technical Characteristics, BTES	
Size range [m^3 water equivalent volume]	20'000 – 1'000'000
Max thermal power [MW_{th}]	2 - 50
Usage	Seasonnal storage
Maturity	
Number of implemented full-scale projects by 2022	4
TRL	8

Picture showing the piping and manifolds of some sections of the BTES in Emmaboda during installation in 2010

Example: BTES in Emmaboda (SE)

- Commissioned in 2010
- Boreholes configurations: 140 boreholes in a rectangular area to a depth of 150 m
- Underground volume: 336'000 m^3
- Storage capacity: 3'800 MWh (for ΔT of 20°C)
- Storage temperature: 60-40°C (design), 40-20°C (actual)

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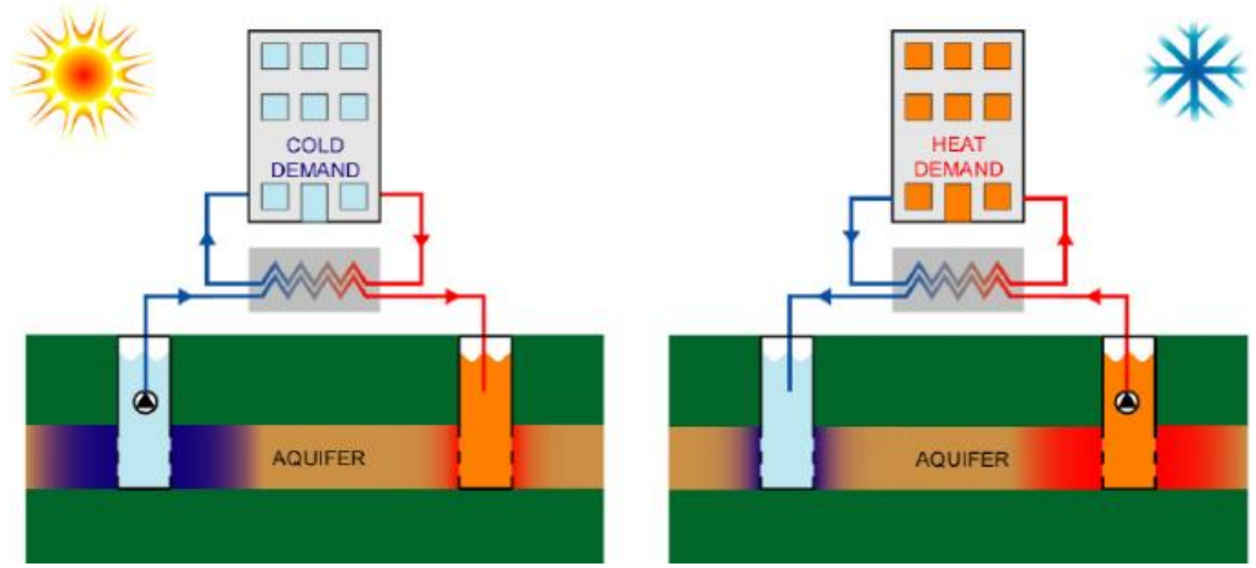
Aquifer Thermal Energy Storage (ATES)

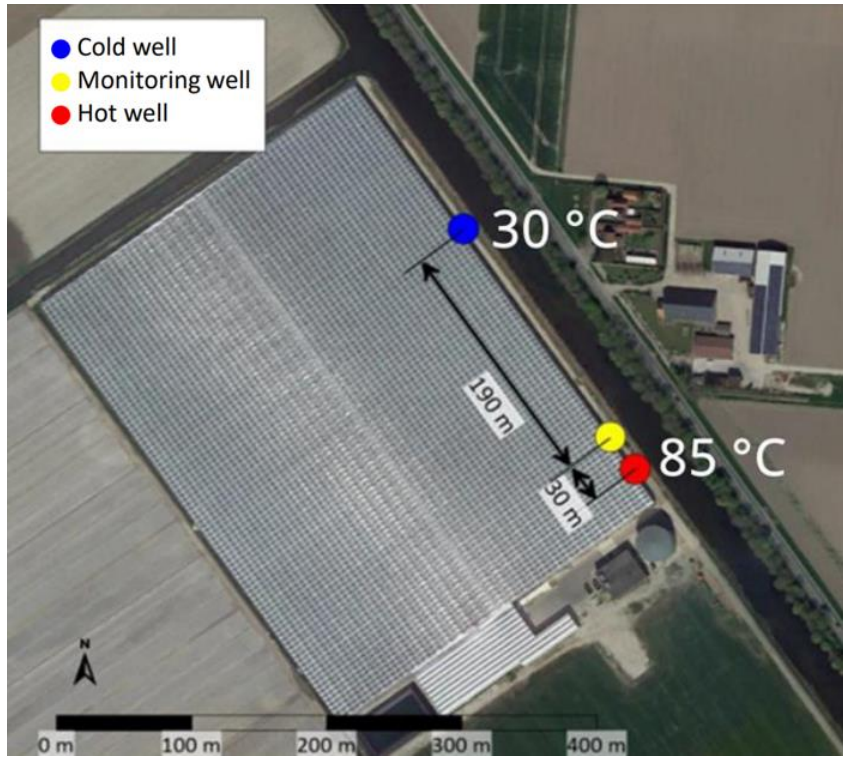
- Thermal Energy Storage where the heat is stored directly in an aquifer
- The storage medium is groundwater and soil/ground
- The basic system consist of a medium temperature well for “cold” water abstraction and a hot well for the injection of the charging heat



“Groundwater as a heat source for geothermal heat pumps” Benno Drijver (IF Technology, Arnhem, The Netherlands) & Guus Willemsen

Technical Characteristics, HT-ATES	
Size range, 1 pair of wells [m^3 yearly pumped water vol.]	250’000 - 800’000
Max thermal power [MW_{th}]	5 - 20
Usage	Seasonnal storage
Maturity	
Number of implemented full-scale projects* by 2022	4
TRL	8

*1 of the HT-ATES projects is now decommissioned, and another is used as a geothermal heat source



Top view presenting the location of the wells of the HT-ATES

Example: HT-ATES in Middenmeer (NL)

- Commissioned in 2021
- Main heat source: geothermal heat of 90 °C from 2’400 m
- Water volume of 440’000 m3
- Storage capacity of 28 GWh
- Charge-discharge capacity: 12-10 MWth
- 1 cycle of charge/discharge per year
- Max operational temperature: 90°C (infiltration temperature); 85-50 °C abstraction temperature

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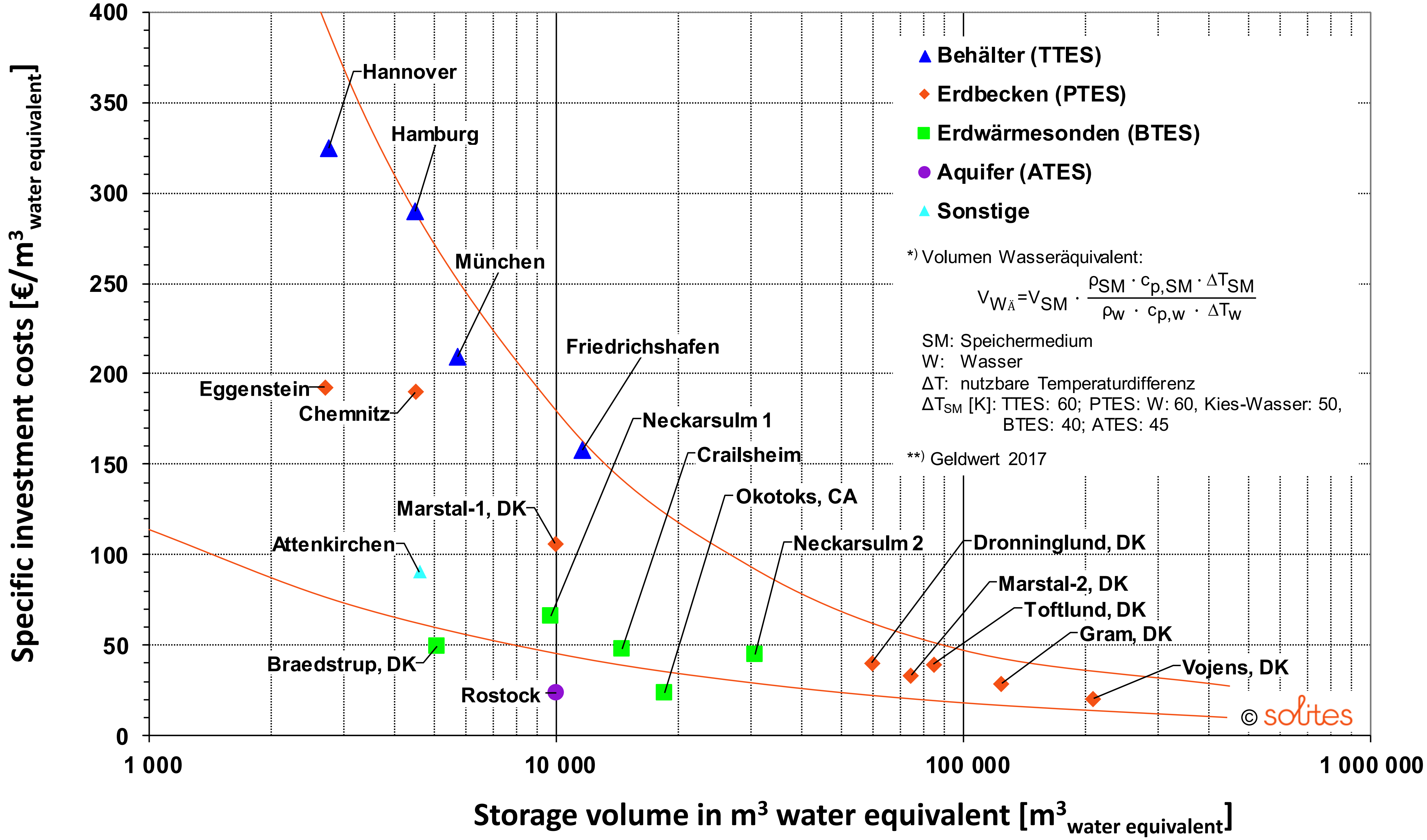
LTES benefit from economies of scale

- Lower cost per unit: Fixed and material costs spread over more energy stored
- Better thermal efficiency: Less heat loss due to lower surface area-to-volume ratio



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Source: Epp, Bärbel. „Seasonal pit heat storage: Cost benchmark of 30 EUR/m³ Solarthermalworld.org“ May 17th, 2019. https://www.solarthermalworld.org/news/seasonal-pit-heat-storage-cost-benchmark-30-eurm3

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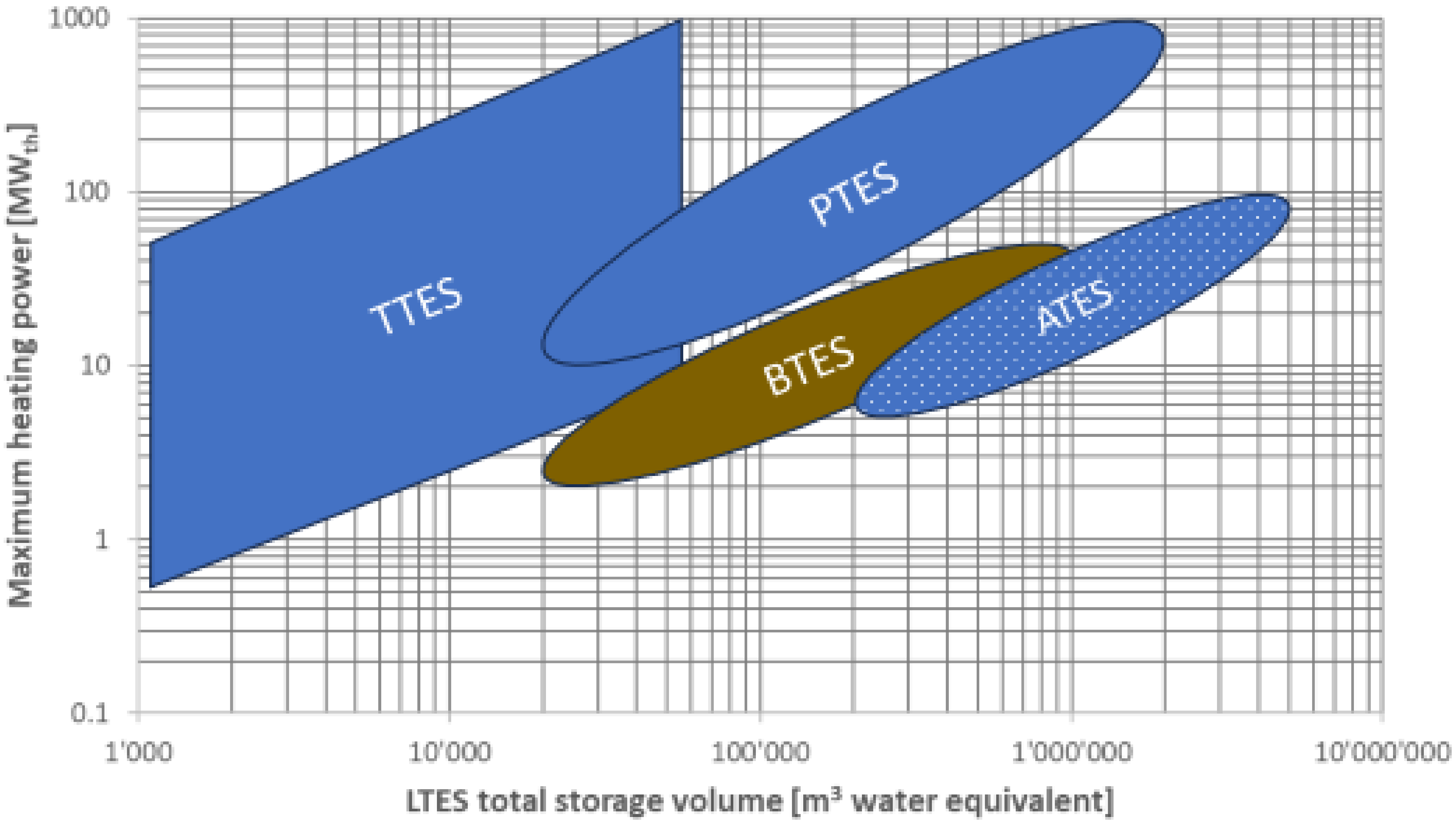
LTES can be used to cover a wide range of application

- TTES offers a wide range of heating power but is limited in storage volume
- PTES provides both high power and large capacity for large-scale use
- BTES has moderate power but is highly scalable in volume
- ATES supports very high storage capacities but with lower heating power compared to PTES



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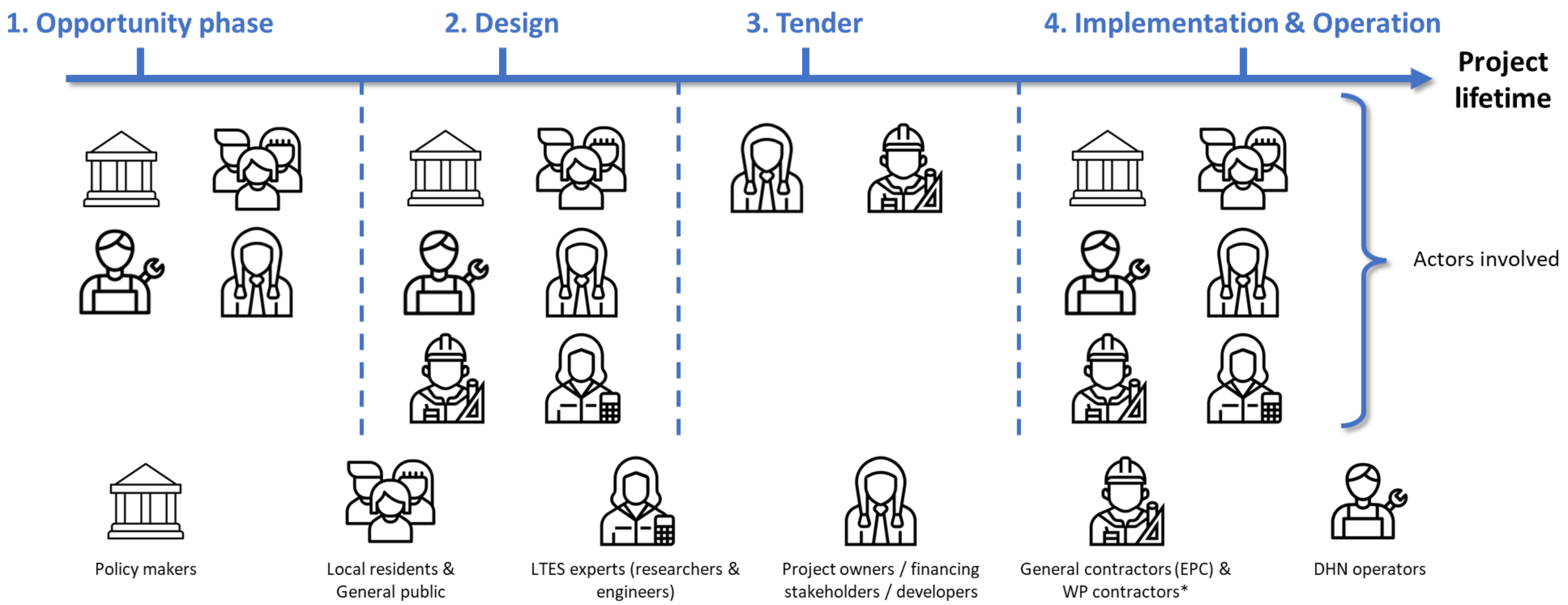
LTES implementation takes place in 4 main phases

Phase	Opportunity	Design	Tender	Implementation
Key activities	Assess potential, involve stakeholders, pre-select LTES type	Analyze DHN data, run feasibility studies, define size and specs	Prepare technical specs, initiate tender, sign contracts	Build, operate, and maintain LTES under regulatory oversight



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Thanks for your attention !

Romain Sucche

rsu@planenergi.dk

Learn more at https://iea-es.org/task-39/ & https://iea-es.org/task-45/

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Break until 11:25

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