Implementation of Large Ground-based Heat Storage Systems: Findings from European Demonstration Projects

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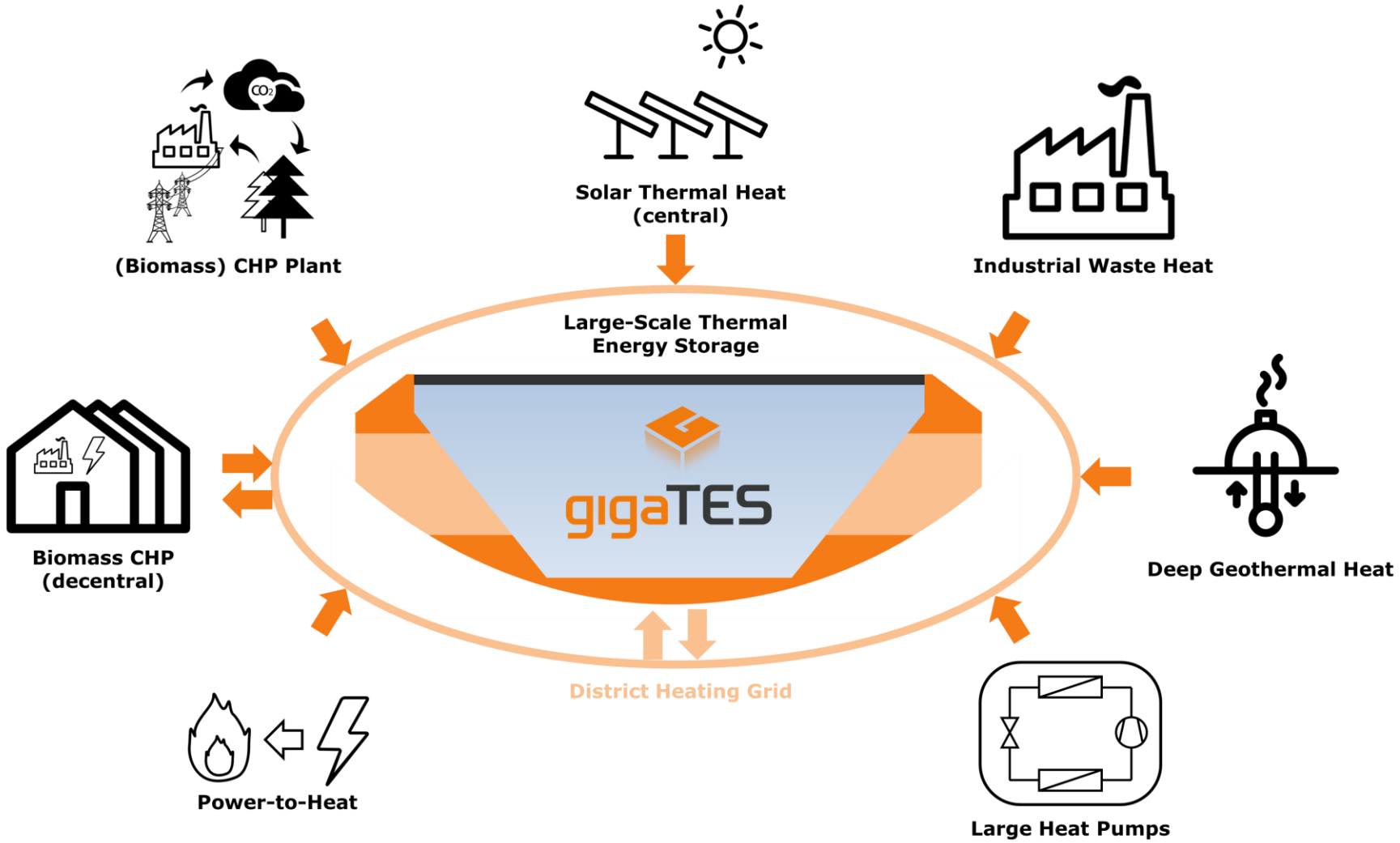
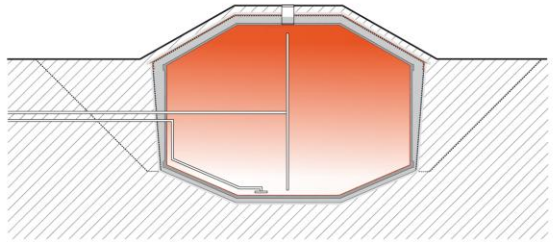
LTES as flexible element in future district heating systems and in industrial heat systems



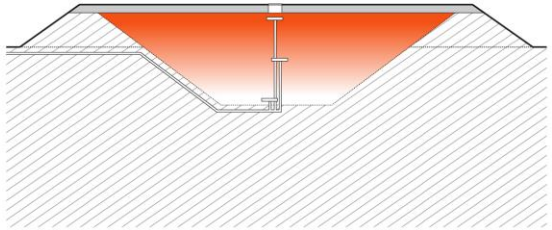
6 Large Ground-Based TES Technologies

Abbreviation	LTES technology
ATES	Aquifer TES, using water bearing layers in the subsoil
BTES	Borehole TES, vertical heat exchangers in the ground
CTES	Cavern TES, natural or artificial caverns in rock
MTES	Mine TES, using the water in old coal mines
PTES	Pit TES, water pits covered with an insulating lid
TTES	Tank TES, steel above-ground tanks

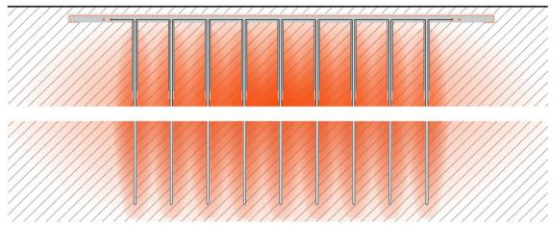
Tank thermal energy storage (TTES)



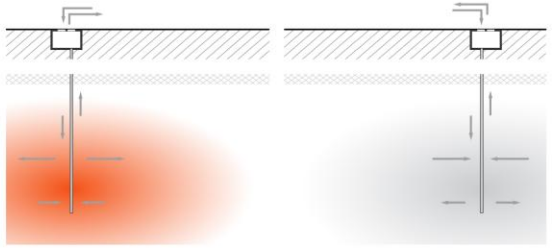
Pit thermal energy storage (PTES)

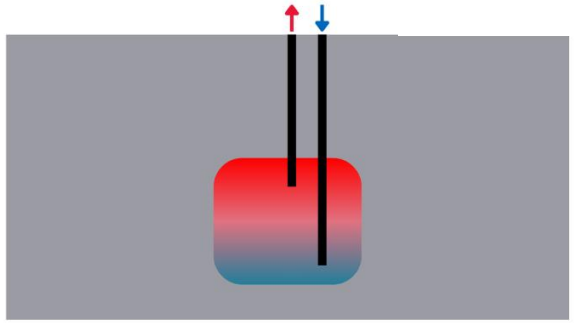


Borehole thermal energy storage (BTES)

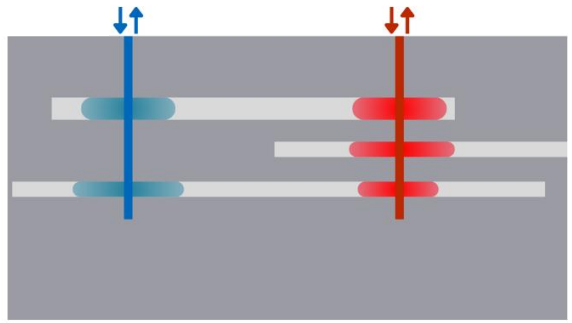


Aquifer thermal energy storage (ATES)





(c) Cavern TES



(d) Mine TES

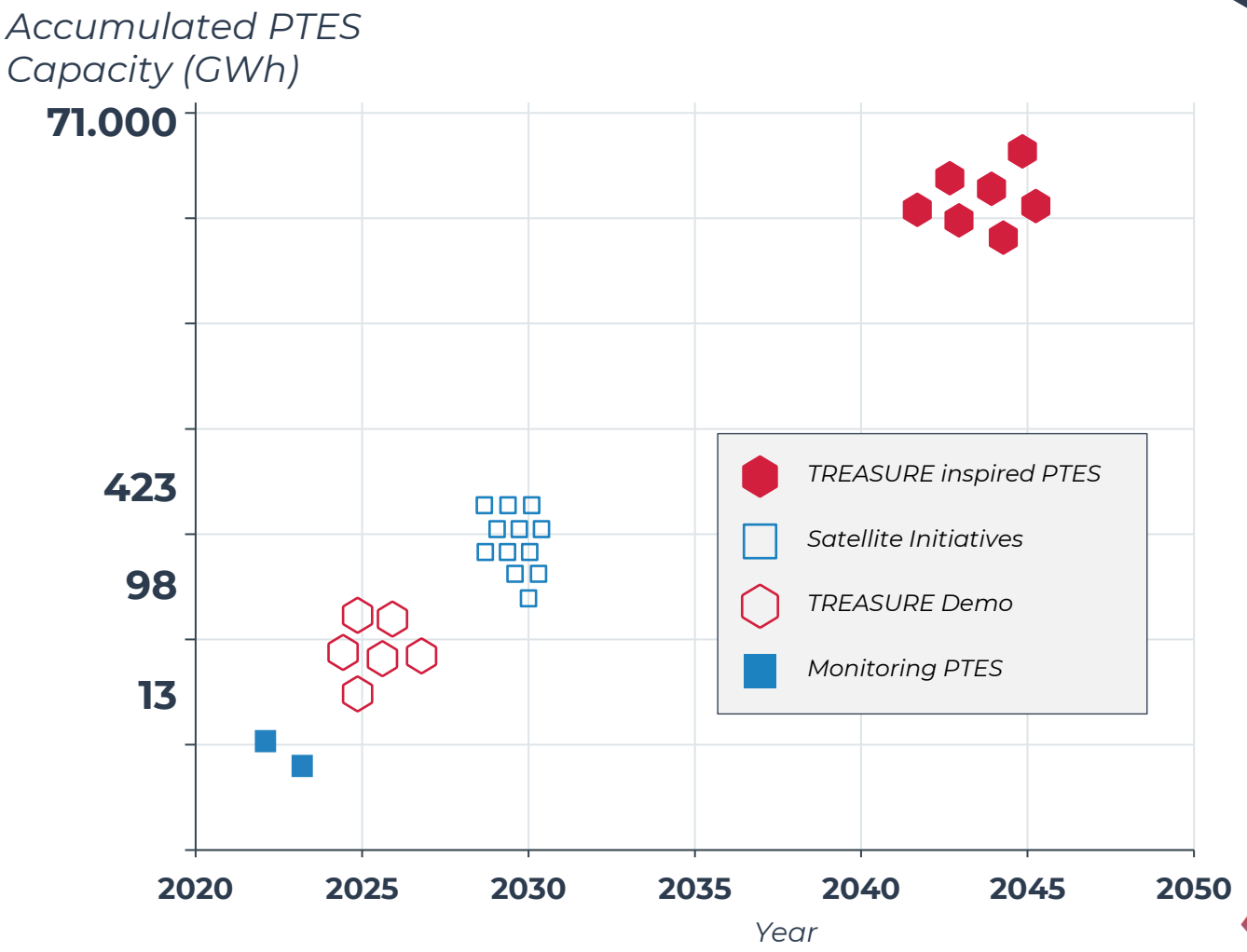
POTENTIAL OF PIT THERMAL ENERGY STORAGE FOR DISTRICT HEATING IN EUROPE

1784 TWh
DH final energy consumption (2050)

10 %
of annual heat sales to be stored

40 %
LTES for DH is PTES

71.000 GWh
PTES capacity for DH needed (2050)



How to realise 5000 LTES systems in Europe until 2050?

Measures to accelerate the uptake of LTES

Raising awareness

- Information about technologies, processes, permits, procedures, …
- Active dissemination to and participation of stakeholders

Reduce uncertainties

- Awareness on permitting; uniformity of procedures
- Work on standardisation; key performance indicators

Shorten the realisation time

- Uniform communication and protocolling; experience exchange

Decrease costs

- Component and process developments; experience exchange

Demonstrating: doing, showing, learning, improving

- One of the mechanisms to achieve acceleration is demonstration
- 3 EU-funded projects started in 2024 to demonstrate LTES:
  - Interstores (Cavern TES and re-use of infrastructure for LTES)
  - USES4HEAT (Aquifer TES and Borehole TES)
  - TREASURE (Pit TES)
- A multiple of these in national or regional LTES demo projects

- Next: a few examples, and early lessons learned

Demo: Medium-Temperature Aquifer demo in USES4HEAT

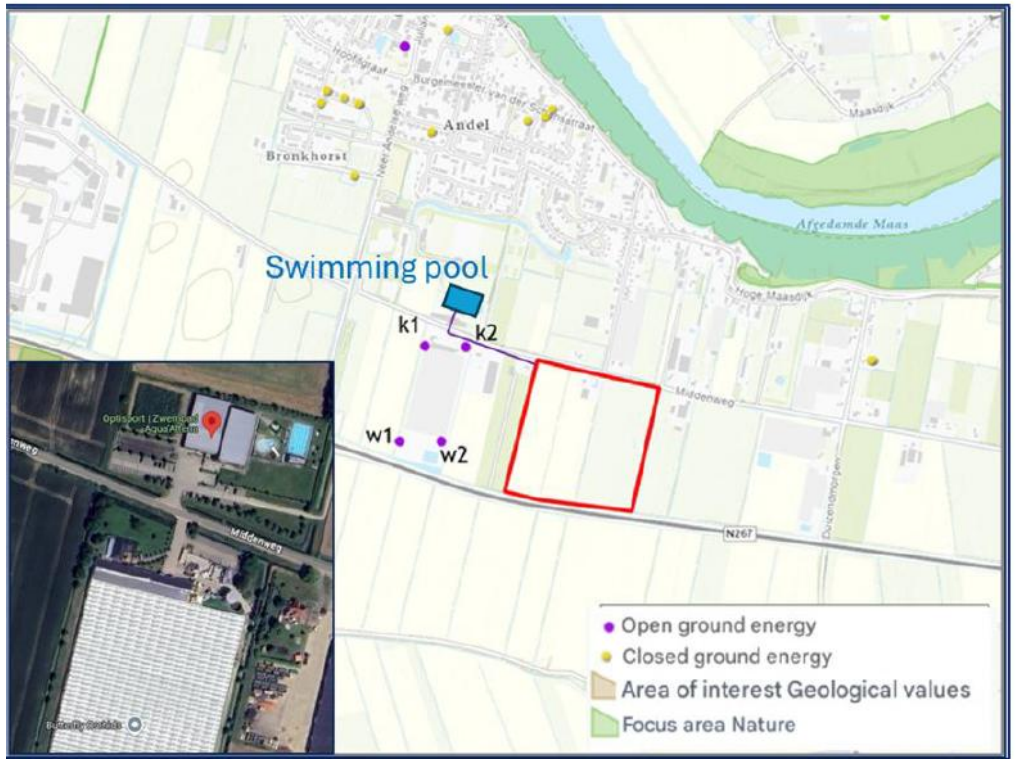
AEE INTEC

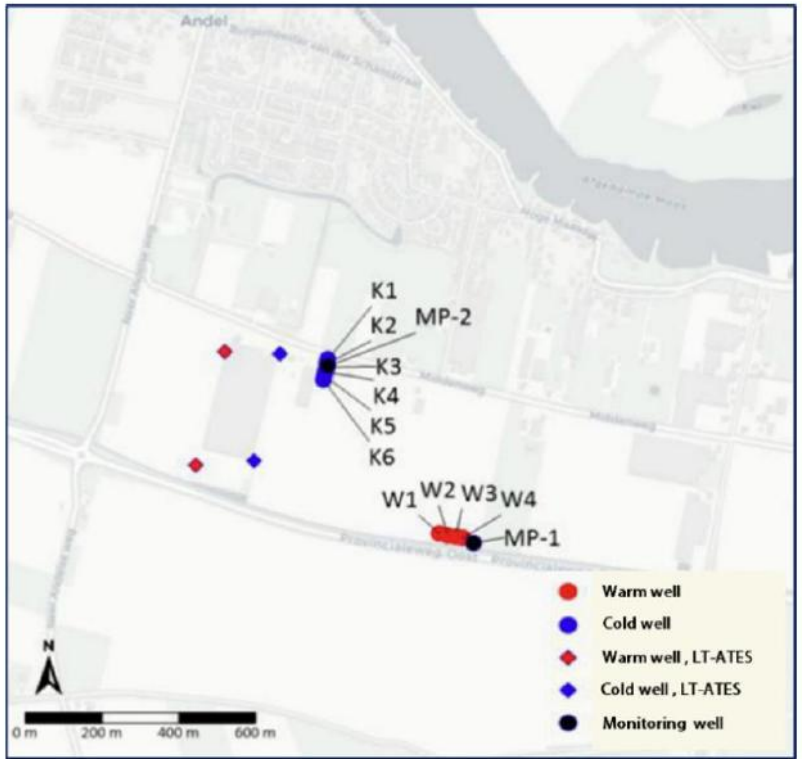
USES4HEAT

Funded by the European Union

- 12-hectare greenhouse
- 55 C max T
- 12,000 MWh stored heat
- For permit, permitting body must deviate from rules

Andel demo – situation





energy storage
IEA Technology Collaboration Programme

TREASURE

Demonstrating large pit thermal energy storages and improving their components, processes, and procedures for an accelerated realisation of 100% sustainable district heating networks in Europe.

START January 2024 END December 2027

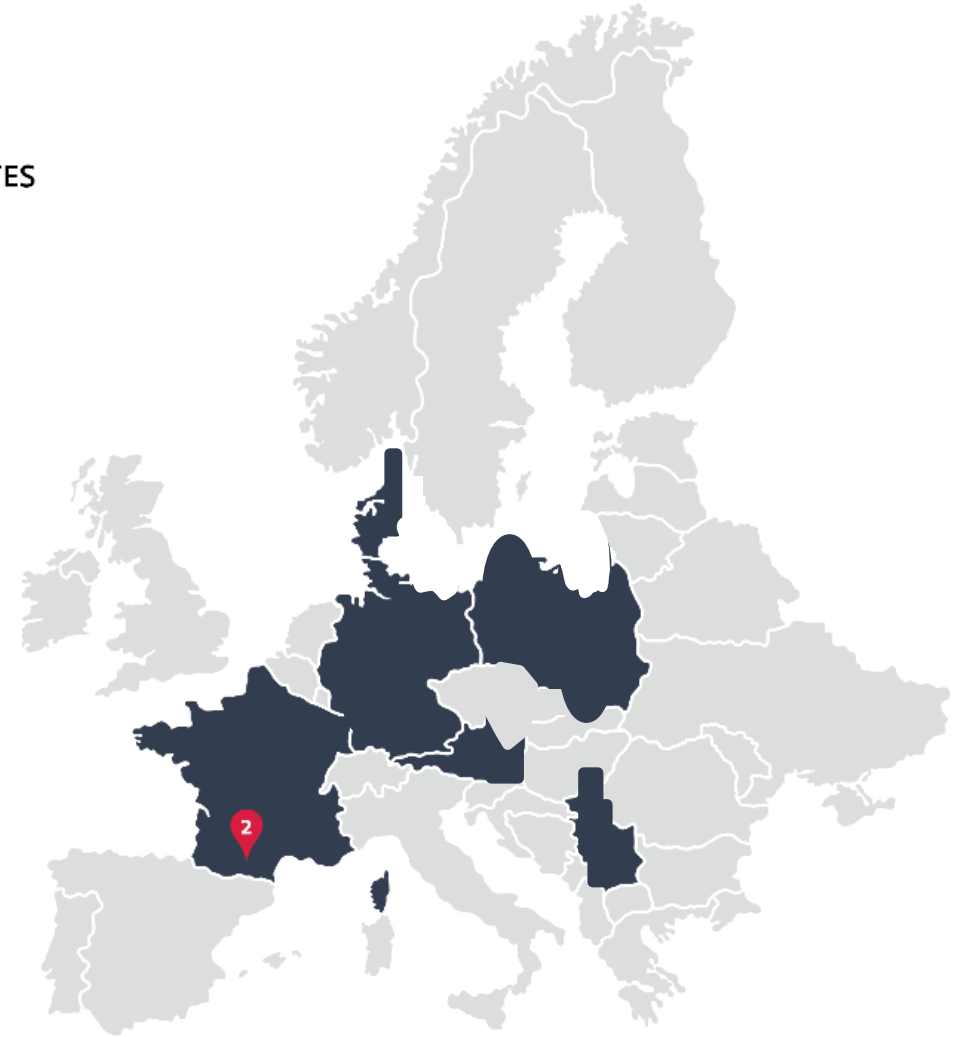
7 Demonstrators in 5 EU countries
Different locations, soil conditions
Different system integrations

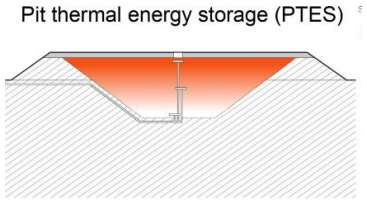
Funded by
the European Union

Demonstrator: Pau

Demonstrators

Location	Volume of PTES
2 Pau	340.000





Pau

PTES
Volume: up to 340.000 m^3
Operation planned: 2026-2027

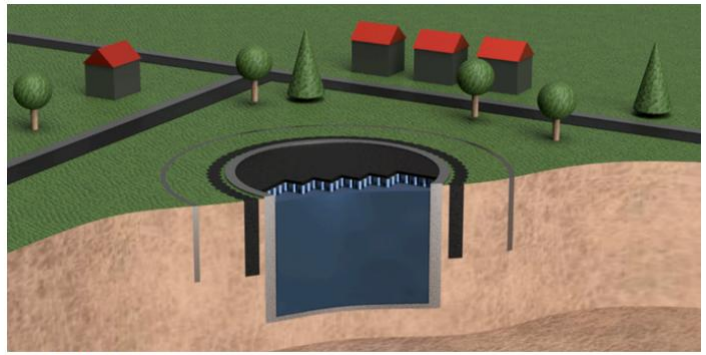
Demo in the city of Pau (FR) with ca. 77.000 inhabitants;

Heat sources are waste incineration heat, biomass and gas boiler (will be changed)

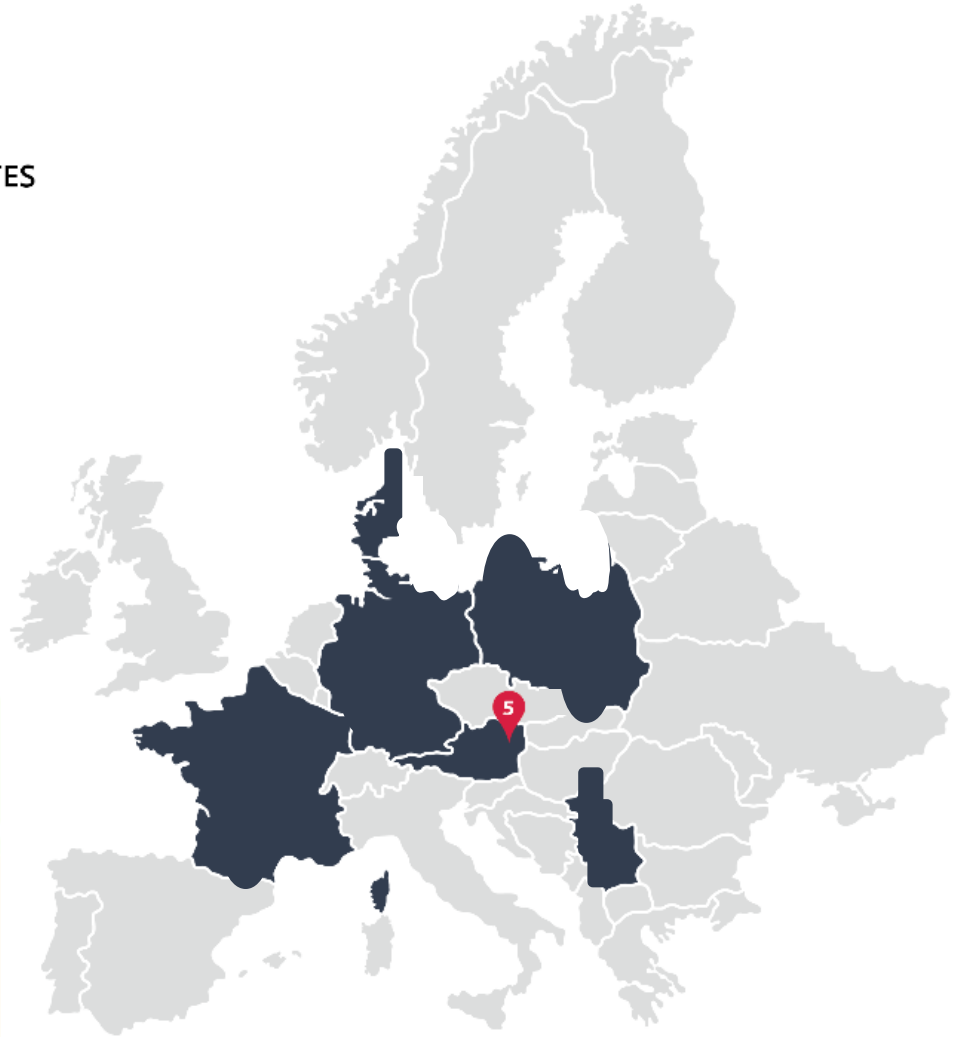
Demonstrator: Vienna

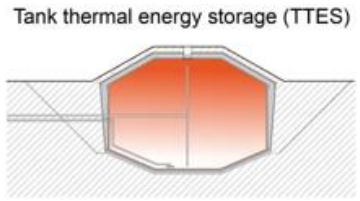
Demonstrators

Location	Volume of PTES
5 Wien	40.000



Quelle: Wien Energie



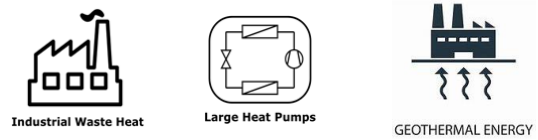


Wien

TTES
Volume: 40.000 m^3
Planned in operation: 2028-2029

Pilot storage for Vienna, Austria; ca. 2 million inhabitants

Heat sources are geothermal, waste heat and heat pumps



First Lessons Learned

- **Demo timelines are very dependent on external mechanisms**
  - Already in first 2 years, 1 demo in USES4HEAT and 2 in TREASURE could not be realised and had to be replaced
- **There are multiple sources for delay of the demos**
  - Rising costs due to inflation and crises
  - Lack of experience: every demo is a first, all has to be found out/invented
- **Exchange of experience and knowledge is crucial**
  - Exchange helps to develop common language/methods
  - Formation of a larger knowledge community and a stronger LTES ecosystem
  - Exchange within project, between projects and with other initiatives (e.g. satellite initiatives in TREASURE) is effective

What more is needed?

- Open monitoring to shorten the learning cycle
- Targeted development of specialised equipment (as with offshore wind)
- Development of standards, test methods and adoption of common rules/methods by all countries
- Well-rigged financial framework
- … and more

Source: https://www.vanoord.com/nl/materieel/offshore-wind-installatieschip/

- And, of course, you spreading the message and join the community!

Links:

Leaflets and further Documentation on the Task39 Website:

https://iea-es.org/task-39/

Giga_TES final report: https://gigates.at/index.php/en/publications/reports

TREASURE: https://www.treasure-project.eu

InterStores: https://interstores.eu/

USES4HEAT: https://www.uses4heat.eu/

Task45: https://iea-es.org/task-45/

All information material on the T39 website

Guide/overview of IEA-ES Task 39 deliverables

Subtask A Deliverables

Leaflet – Task brochure – Introduction

Leaflet – Task brochure – Use Cases

Report – Method to carry out an LTES project – Important questions and KPIs – Synthesis

Report – LTES project development case studies

Feasibility study – Analysis of LTES application for public/military communities lacated in different climate zones

Main report (STA) – Method to carry out an LTES project – Main stages, case studies and KPIs

Database – List of LTES projects

Subtask B Deliverables

Main report (STB) – Components and materials database

Annex 1 (STB) – Requirements for water quality in pit thermal energy storages

Subtask C Deliverables

Report – Numerical models list – Overview and collection of model fact sheets

Report – Modelling guidelines – Round robin test case description

Template – Modelling guidelines – Stage 1 load profiles for test cases

Template – Modelling guidelines – Stage 1 result template for test cases

Filled templates – Results of stage 1 round robin test case simulations – Result files

- Results from test case **ATES-1**
- Results from test case **BTES-1**
- Results from test case **PTES-1-C**
- Results from test case **PTES-1-P**
- Results from test case **TTES-1-AG**
- Results from test case **TTES-1-UG**

Subtask D Deliverables

Policy workshop – Are LTES a key element of the future energy system?

Website – LTES live and historical monitoring data

WEBSITE

www.treasure-project.eu

PRESENTER

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Thank you for your attention!

Contact us if you have any questions.

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