AEE INTEC

gigaTES
www.gigates.at

Giga-Scale Thermal Energy Storage for Renewable Districts

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General

- Development of sophisticated concepts for giga-scale seasonal Thermal Energy Storages (TES) applicable in Austria and Central Europe

Source: Arcon-Sumark

Until now: ~200,000 m³ (Vojens, DK)

x10

Concepts up to 2,000,000 m³

- Austrian Flagship Project

Industry

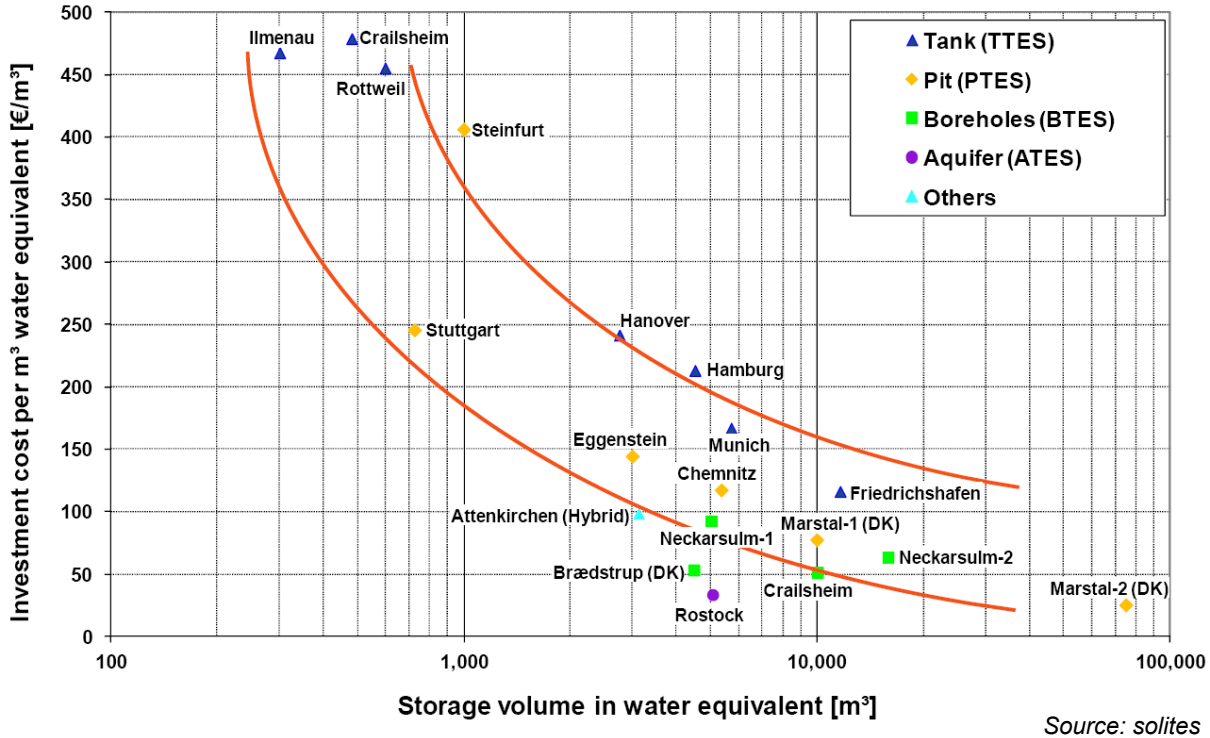
Research

Foreign expertise

Motivation

- Motivation:
  - High share of heat supply through District Heating
  - Mismatch between energy from RES (e.g. Solar Thermal) and Demand

- Why giga-scale TES?
  - A storage must be cheap: Economy of Scales. The specific costs decrease with increasing size.
  - A long-term storage must show low losses: The specific thermal losses decrease with increasing size, due to decreasing Surface-to-Volume ratio.



Source: solites

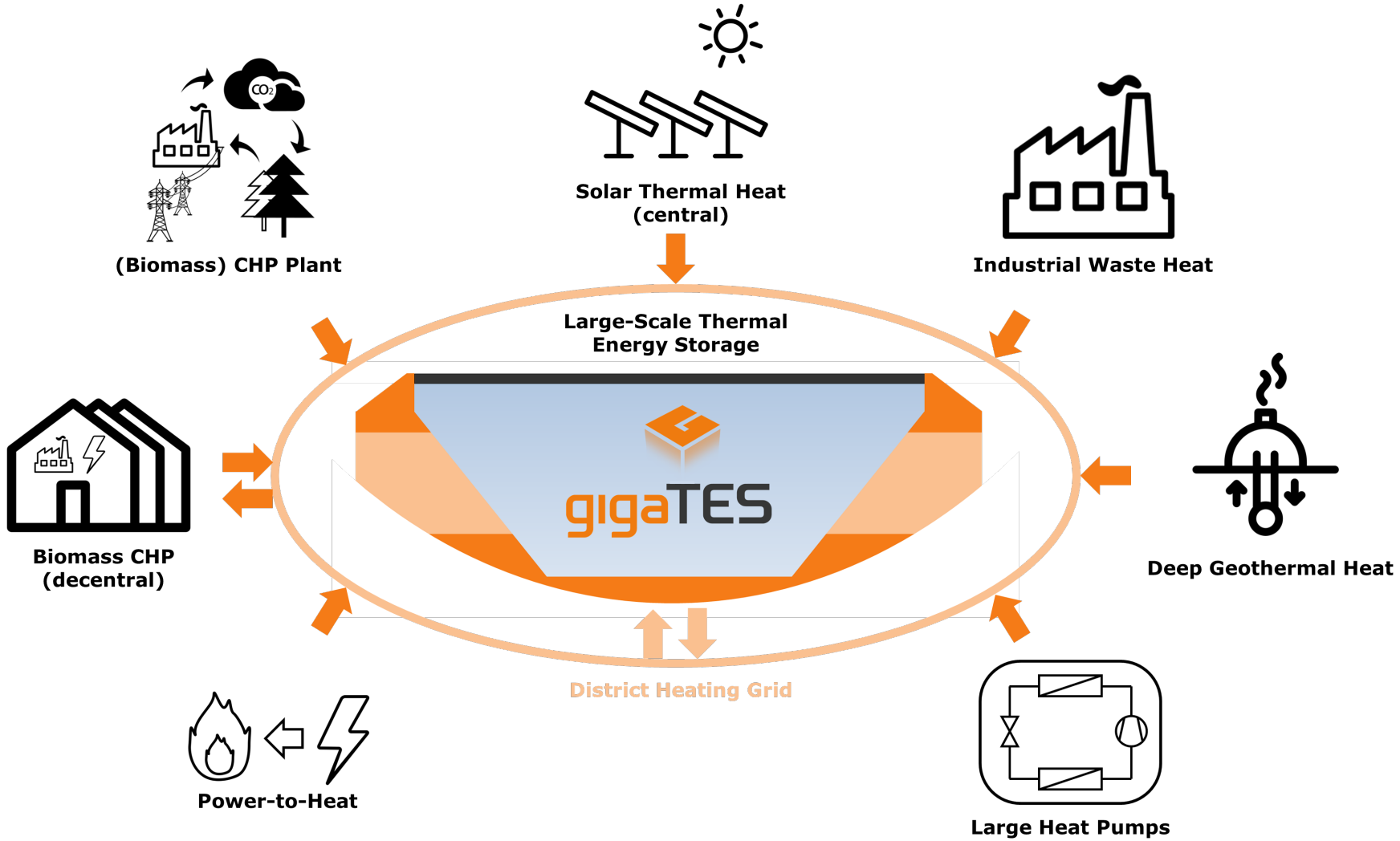
Objectives

- General objectives:
  - Increase the share of RES in DH grids
  - More Flexibility of DH grids

- Project specific objectives:
  - Higher storage capacity
  - Energetically more efficient
  - More cost-efficient
  - Better integrated in DH grids
  - Longer lifetime

… than State-of-the-Art solutions.

Giga-scale TES as a central element of DH grids



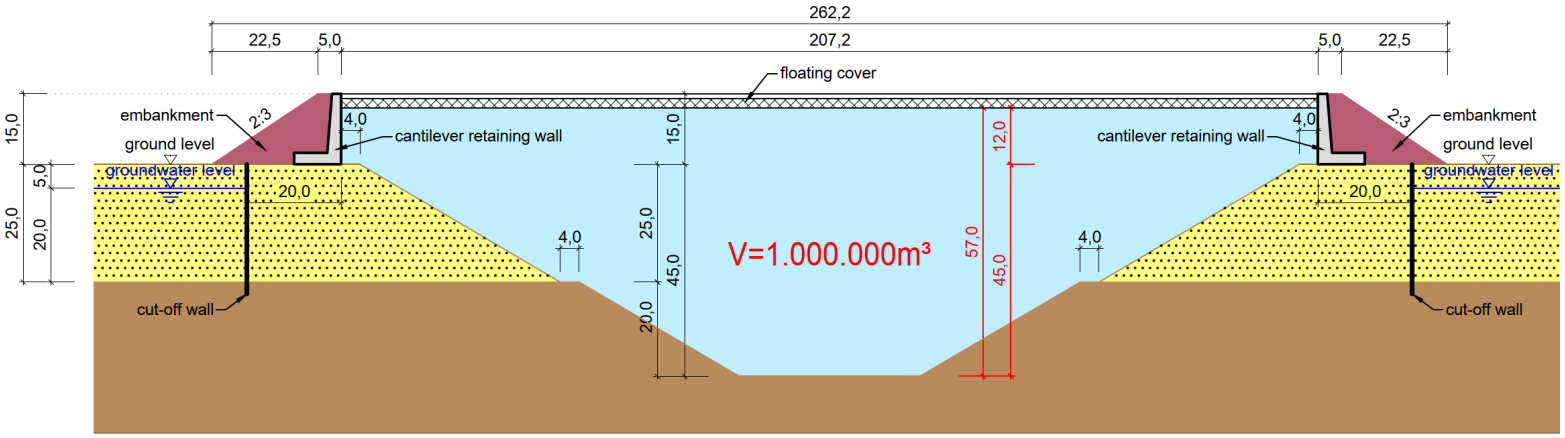
Sources:
Inspired by Maaß, Christian, Matthias Sandrock, und Roland Schaeffer. „Fernwärme 3.0 - Strategien für eine zukunftsorientierte Fernwärmepolitik“. Hamburg, 26. Jänner 2015.
Icons made by Icongeek26 and Freepik from www.flaticon.com & AEE INTEC

Challenges in Austria compared to State-of-the-Art solutions

Challenges AT vs SOA		Possible solutions and objectives within giga_TES
▪ Higher Storage Volume/Capacity (2,000,000 m³ vs 200,000 m³)	⇨	▪ Deeper constructions needed
▪ High land prices in urban areas	⇨	▪ Usable floating covers needed
▪ High DH grid temperatures (flow temperatures: ~130°C vs ~80°C)	⇨	▪ Higher storage temperatures (~97°C) needed
▪ Tough geological and hydro-geological boundary conditions (e.g. higher ground water levels: < 6m)	⇨	▪ Sealing and insulation against ground water needed

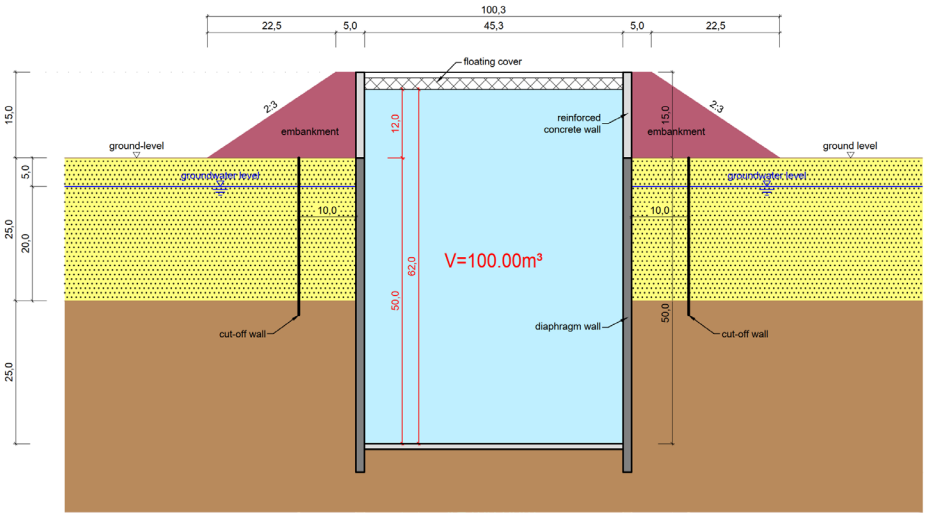
Developments within giga_TES

- Development of concepts for ground engineering and concepts for constructions of walls, bottoms and covers



Source: ste.p ZT GmbH

Pit-like concept with sloped walls: preferable for larger volumes



Source: ste.p ZT GmbH

Shaft-like concept: preferable for smaller volumes

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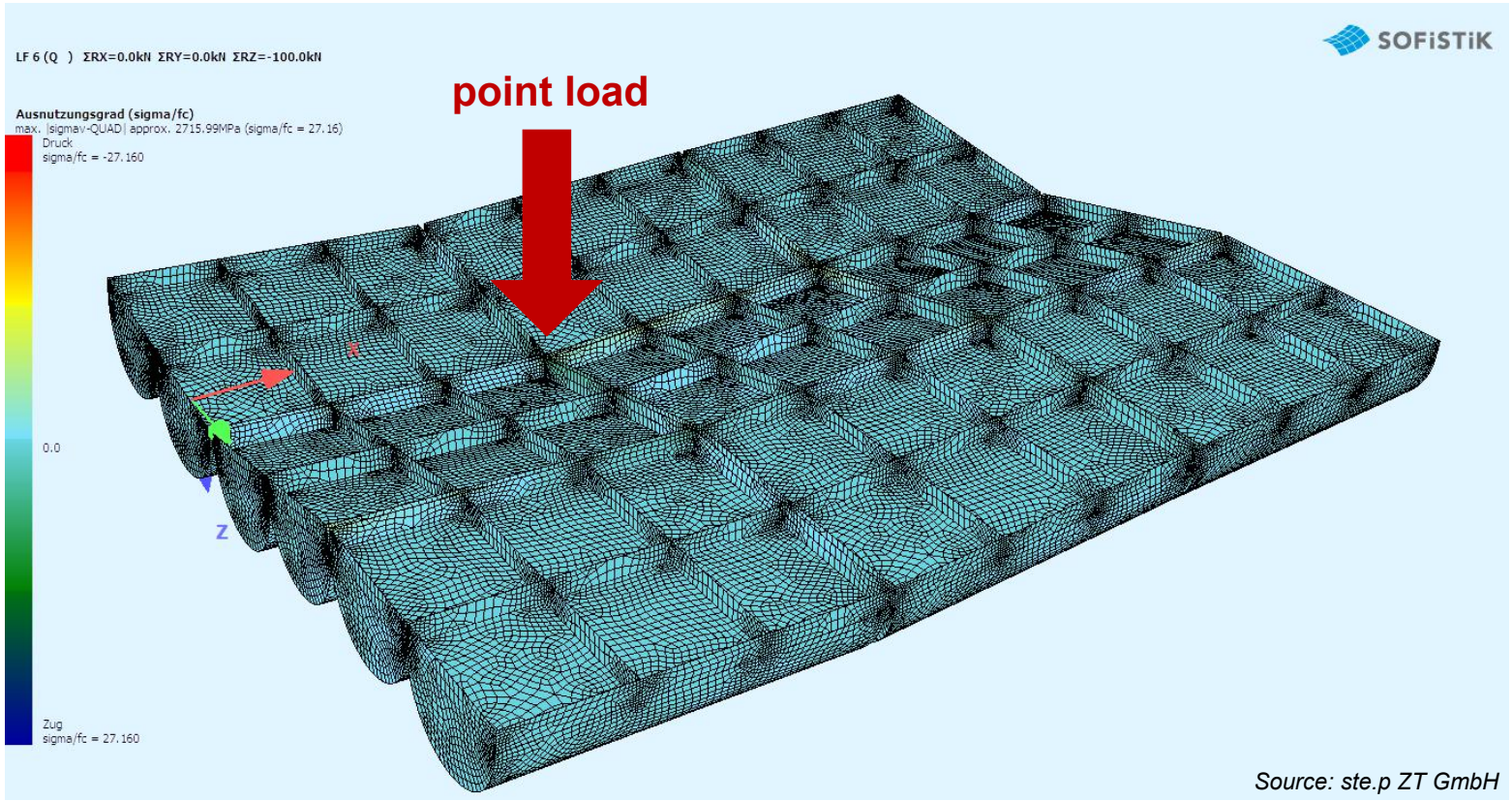
Developments within giga_TES



Source: ste.p ZT GmbH

FEM analyses of a possible cover construction with floating pontoons stressed with a point load

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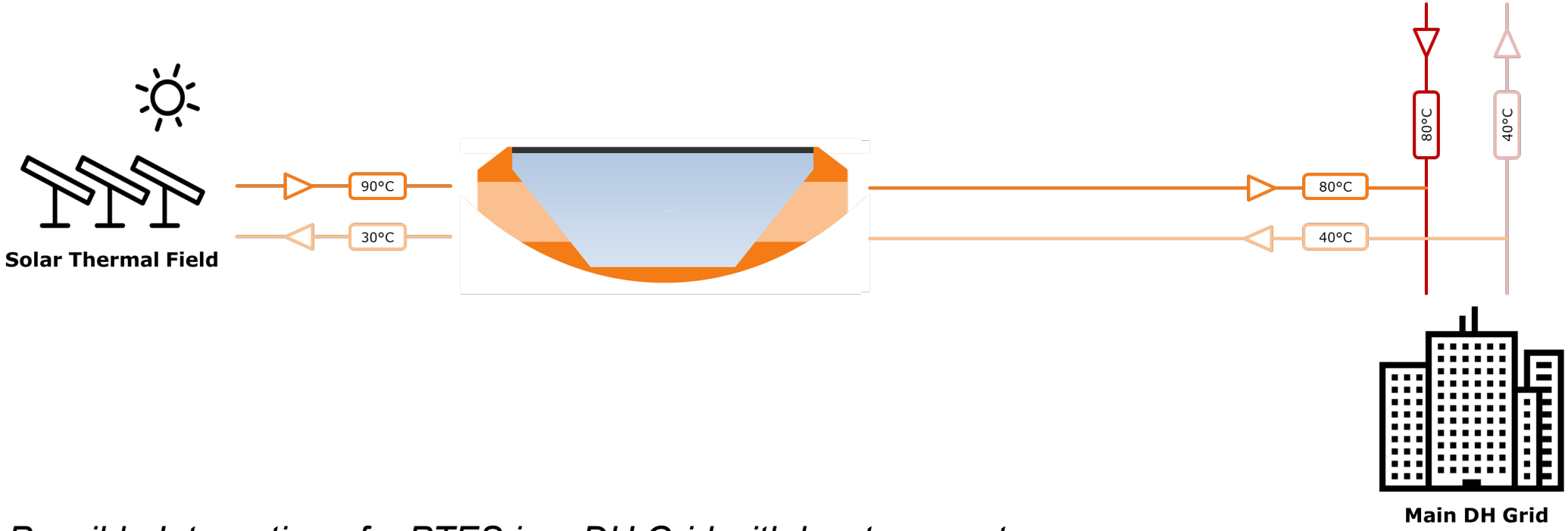
Developments within giga_TES

- Development and testing of novel materials (e.g. liner and concrete materials)

Developments within giga_TES

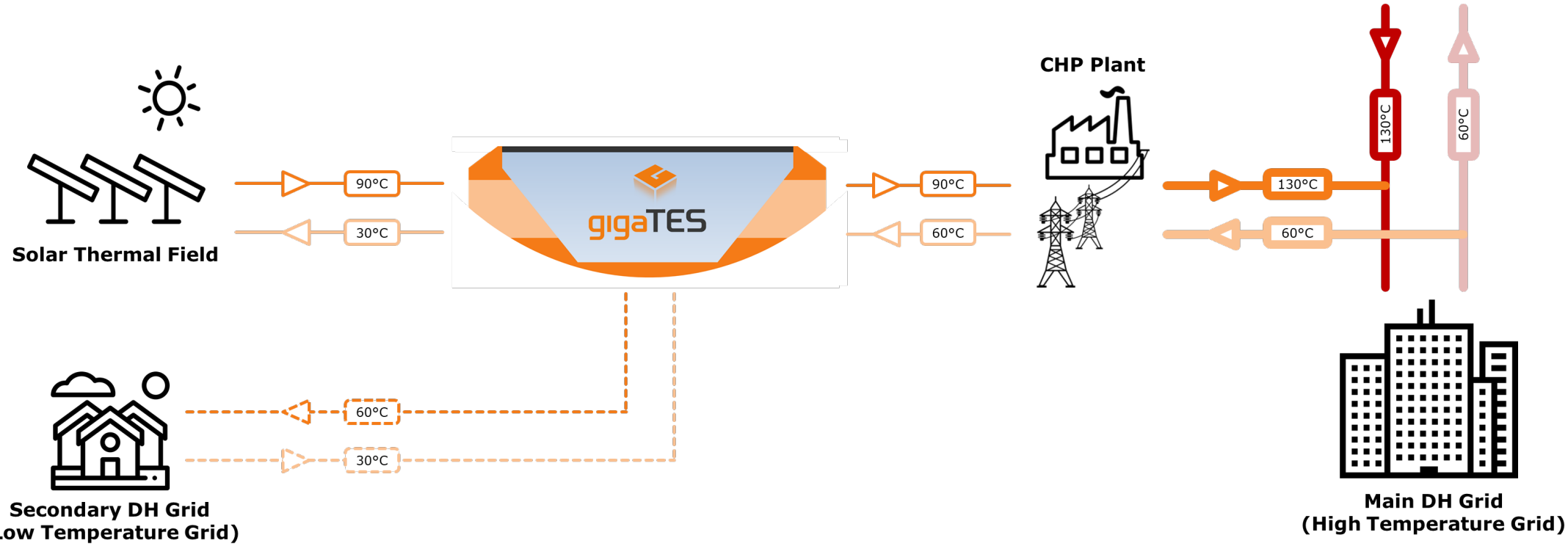


Possible Integration of a PTES in a DH Grid with low temperatures

Sources: Icons made by Pause08 and Freepik from www.flaticon.com & AEE INTEC

Developments within giga_TES

- Numerical system simulations of pre-defined scenarios for certain locations in Austria



Possible Integration of a giga_TES in a DH grid with high temperatures

Sources: Icons made by Pause08 and Freepik from www.flaticon.com & AEE INTEC

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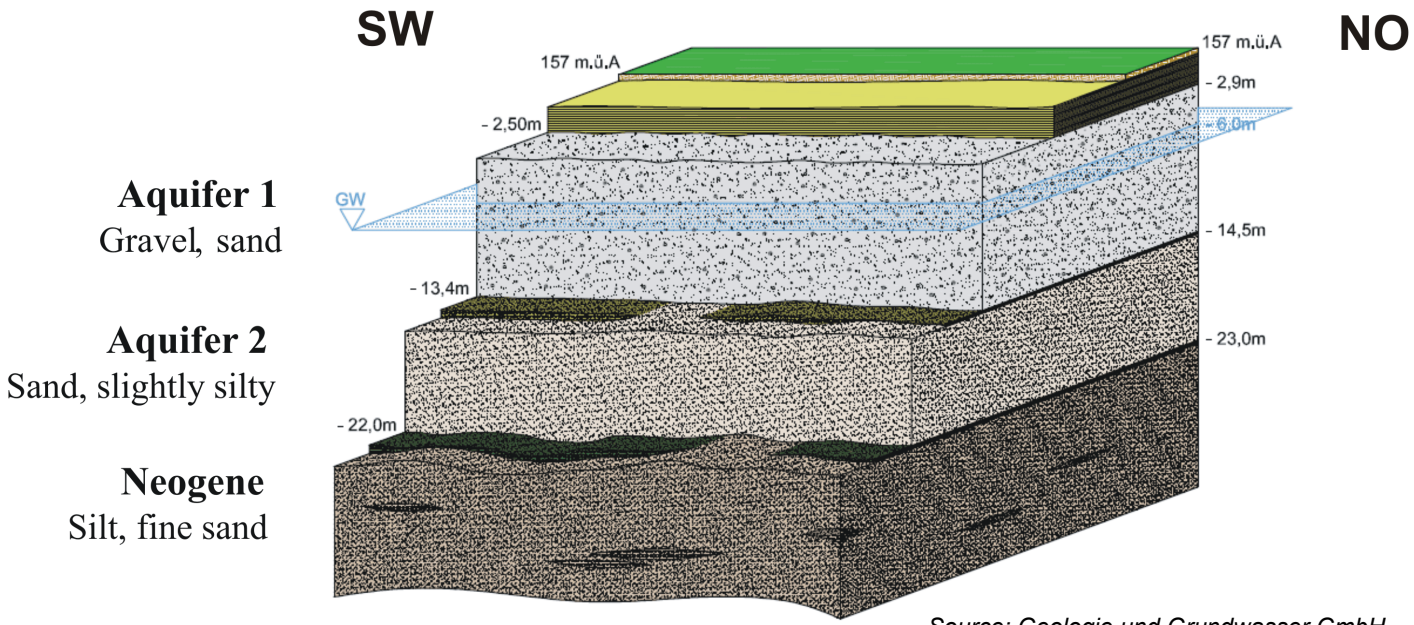
Developments within giga_TES

- Determination of ground conditions for pre-defined locations

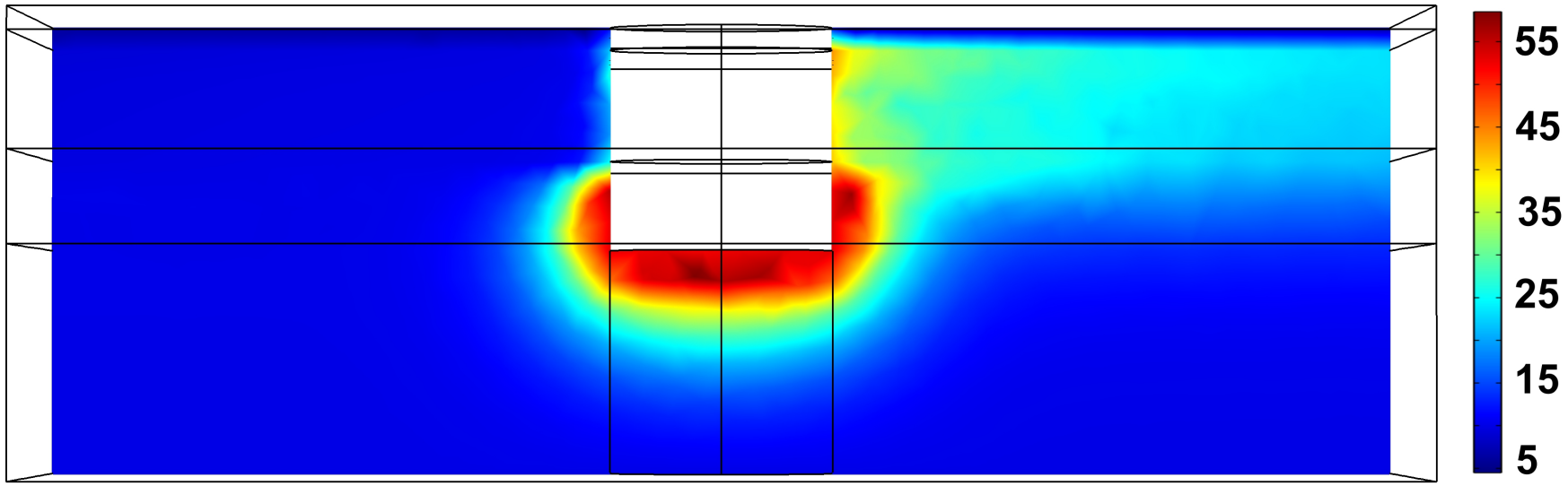


Source: Geologie und Grundwasser GmbH

Model of the structure of the subsurface and the depth of groundwater for a pre-defined location

Developments within giga_TES

- Detailed numerical component simulations (e.g. CFD-simulations)



Source: University of Innsbruck

2D simulated temperature field (in °C) of the surrounding subsurface of a storage with groundwater flow

Summary and Outlook

- Summary:
  - Development of concepts, materials and guidelines…
  - Development of novel materials…
  - Numerical simulations…
  - Case studies of certain scenarios at certain locations…

….for giga-scale TES applicable in Austria and Central Europe.

- Outlook:
  - ~1.5 years (of 3 project years) remaining
  - Further development and testing of materials, further numerical simulations and currently mock-ups are being developed and built
  - Webinars and external workshops with the results of the project in future

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IDEA TO ACTION

Thank you for your Attention!

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