TANK THERMAL ENERGY STORAGE

INTRODUCTION & USE CASES

Geoffroy Gauthier

Energy systems engineer

PlanEnergi

Leader of Subtask D in IEA-ES Task 39

Picture: Karup District Heating

energy storage

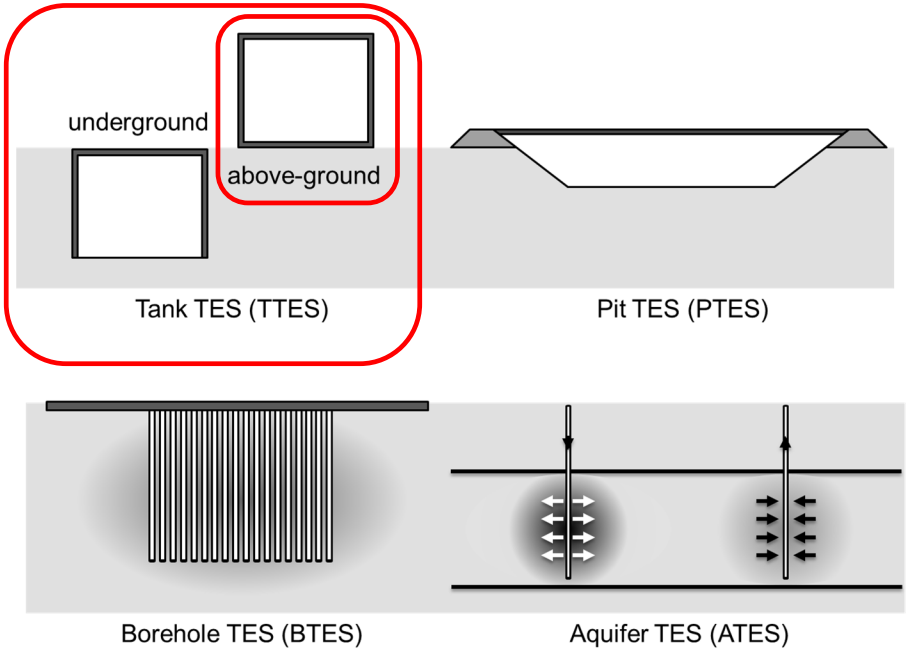
IEA Technology Collaboration Programme

With support from

EUDP

INTRODUCTION: WHAT IS A TANK THERMAL ENERGY STORAGE (TTES), WHAT IS IT USED FOR?

TTES IS ONE OF THE 4 LTES FROM TASK 39



Sketch: Solites

WHAT IS A TTES?

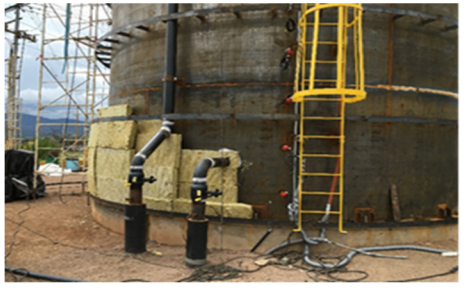
A TTES is a giant thermos, built in 5 main steps

1. Build the foundation of the tank

2. Build the roof of the tank*, then build from top to bottom, one level at a time

3. Build diffusors at each corresponding level while building up the tank

4. Install insulation around and on top of the tank once the tank is built up



Pictures from a project of F.W. Rørteknik of a 4'500 m³ TTES in Chile. See: https://www.fw.dk/references/4500-m3-heat-storage-tank-chile/ for more information

*** It is possible to do it the other way around, from bottom to top, with the roof last**

PlanEnergi

energy storage
IEA Technology Collaboration Programme

WHAT IS A TTES?

A TTES is a giant thermos, built in 5 main steps

5. Install cladding around the insulation to protect it from wind & rain, and decorate the tank

5'600 m³ TTES from Alperia Ecoplus, in Bolzano (IT)

Picture from a project of F.W. Rørteknik of a 4'500 m³ TTES in Chile. See: https://www.fw.dk/references/4500-m3-heat-storage-tank-chile/ for more information

PlanEnergi

energy storage
IEA Technology Collaboration Programme

IN DENMARK, TTES ARE EVERYWHERE

TTES are used coupled to biomass boilers, waste incinerators, CHP* plants

6.000 m³ TTES in Slagelse (SK Varme). Source: Steeltank A/S

***CHP = Combined Heat and Power**

IN DENMARK, TTES ARE EVERYWHERE

Solar District Heating (SDH) is a Danish specialty… and uses TTES

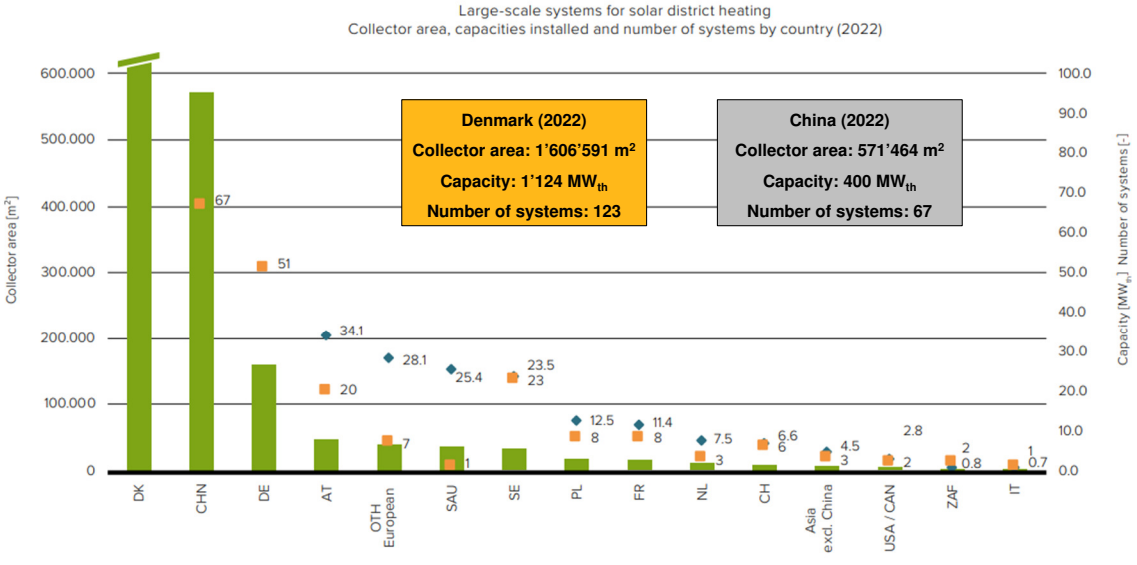


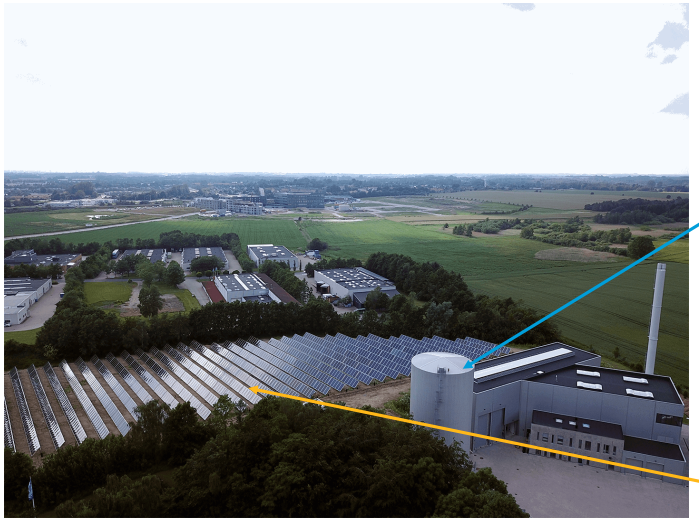
Figure 9: Large-scale systems for solar district heating – capacities and collector area installed and number of systems by the end of 2022

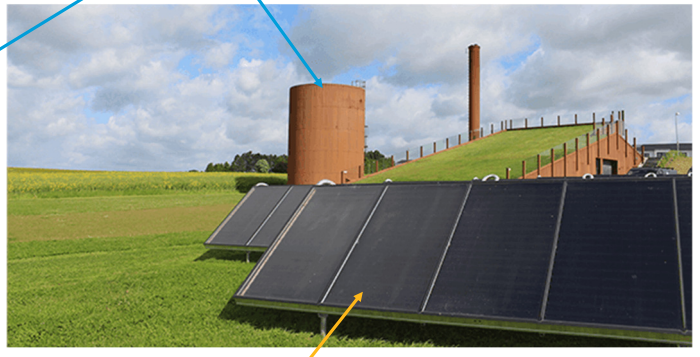
Data sources: Daniel Trier - PlanEnergi, DK, Jan-Olof Dalenbäck - Chalmers University of Technology, SE, Sabine Putz - IEA SHC Task 55, AT, Bärbel Epp - solrico.com, DE[9].

Source : https://www.iea-shc.org/Data/Sites/1/publications/Solar-Heat-Worldwide-2023.pdf

IN DENMARK, TTES ARE EVERYWHERE

Solar District Heating (SDH) is a Danish specialty… and uses TTES





Daily thermal storage

Solar thermal field

Pictures of the two SDH plant of Egedal Fjernvarme (DK): Stenløse Nord (left) and Stenløse Syd: https://www.egedalfjernvarme.dk/om-fjernvarme/om-fjernvarme/miljoe/

PlanEnergi

energy storage
IEA Technology Collaboration Programme

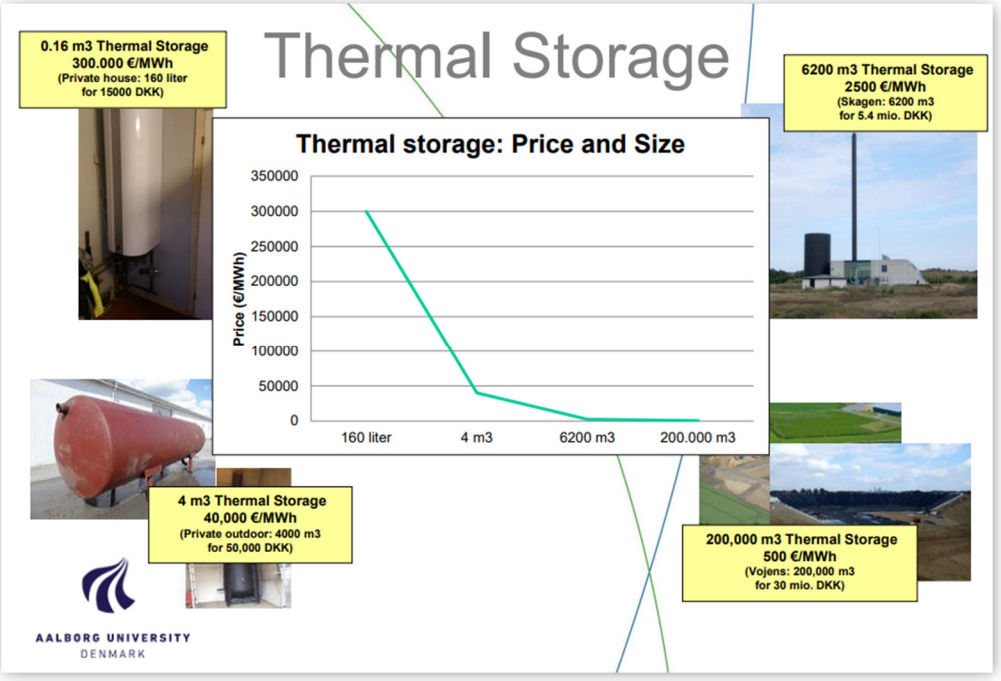
WHY LARGE THERMAL ENERGY STORAGES (LTES) FOR DISTRICT HEATING (DH)?

WHY? BECAUSE HEAT IS INEXPENSIVE TO STORE

- How inexpensive?

From* 10€/kWh to
less than 1€/kWh

(PHS**: 175€/kWh)

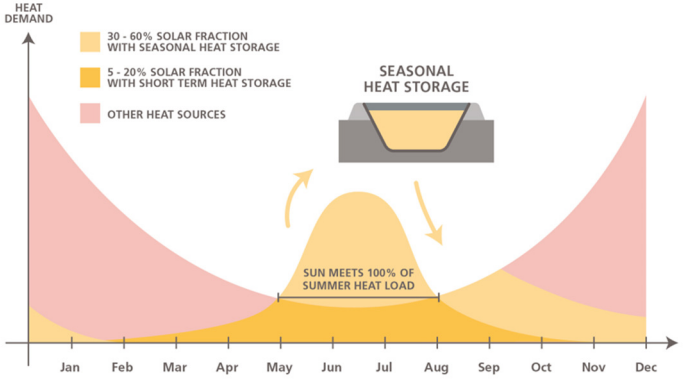


*at large scale

Source: The Status of 4th Generation District Heating: Research and Results. Presentation by Henrik Lund made at the 4th International Conference on Smart Energy Systems and 4thGeneration District Heating, 13-14 November 2018 in Aalborg, Denmark.

THERMAL STORAGE ENABLES RENEWABLES

- LTES provide:
  - More flexibility in DH Systems
  - Higher share of renewables and waste heat
  - Peak shaving, P2H* (sector coupling)
  - Large variation of operational conditions: short term, long term, middle to very large district heating systems



- Larger storages are needed:
  - To serve DH systems and other large-scale applications
  - To further reduce specific costs of renewables & primary energy use

PlanEnergi

*P2H = Power to Heat

energy storage
IEA Technology Collaboration Programme

WHY IS THERMAL STORAGE LESS KNOWN?

- Often coupled to DH/big infrastructure
- Local solution (unlike electricity storage)
- Less use cases
- Less “high-tech”

TTES in Detmold (Germany) – Stadtwerke Detmold, 1’850 m³

PlanEnergi

energy storage
IEA Technology Collaboration Programme

ADVANTAGES OF TTES

A TTES IS A VERY SIMPLE SOLUTION

Advantages

- High-temperatures (98°C, 103°C, 115 °C)
- Low maintenance
- Long lifetime
- Can be integrated to environment
- Very high charge-discharge capacitites (several 100 MW)
- Well known
- Little restrictions from the underground conditions

Disadvantages

- Higher specific price than other LTES
- Visual impact

TTES from Stadtwerke Heidelberg (DE) 19'980 m^3 of water (two-zoned storage)

PlanEnergi

energy storage
IEA Technology Collaboration Programme

DETAILS OF 2 USE CASES FOR TTES:

SOLAR DISTRICT HEATING IN AULUM
DISTRICT HEATING IN BERLIN

TANK THERMAL ENERGY STORAGE
USE CASE AULUM (DK)

- Year : 2015
- Solar collector area: 16’000 m^2
- 3’600 m^3 TTES
- 21% solar fraction
- Auxiliairy heat sources:
  - Gas CHP
  - Gas boiler
  - Electric boiler

Aerial view of the SDH plant in Aulum (DK) https://www.herningfolkeblad.dk/artikel/52ba4119-a03e-4537-84ee-d3f06b95758d/

PlanEnergi

energy storage
IEA Technology Collaboration Programme

TANK THERMAL ENERGY STORAGE
USE CASE BERLIN (DE)

About the TTES

Technology: TTES (Storage medium: water)
Type of usage: daily storage of heat
Year commissioned: 2023

Technical details

Water volume: 56'000 m^3
Dimensions: Ø 43 m x h 45 m
Storage capacity: 2'750 MWh
Charge-discharge capacity: up to 200 MW_{th}
~70-120 cycles of charge/discharge per year
Max operational temperature: 98°C (atmospheric)
Static pressure holding function possible

Auxiliary equipment

Power-to-heat: 120 MW_{th}
Waste-water heat pump: 75 MW_{th} (planned for 2026)
Waste incineration: 99 MW_{th}

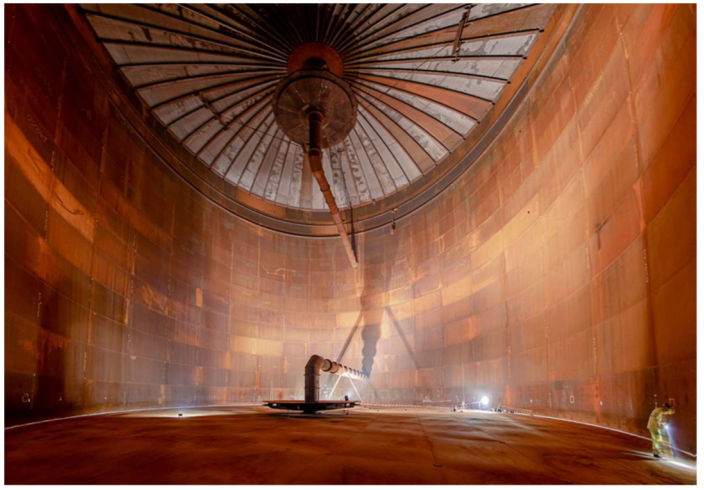


Photo: Vattenfall

About the distribution DHN

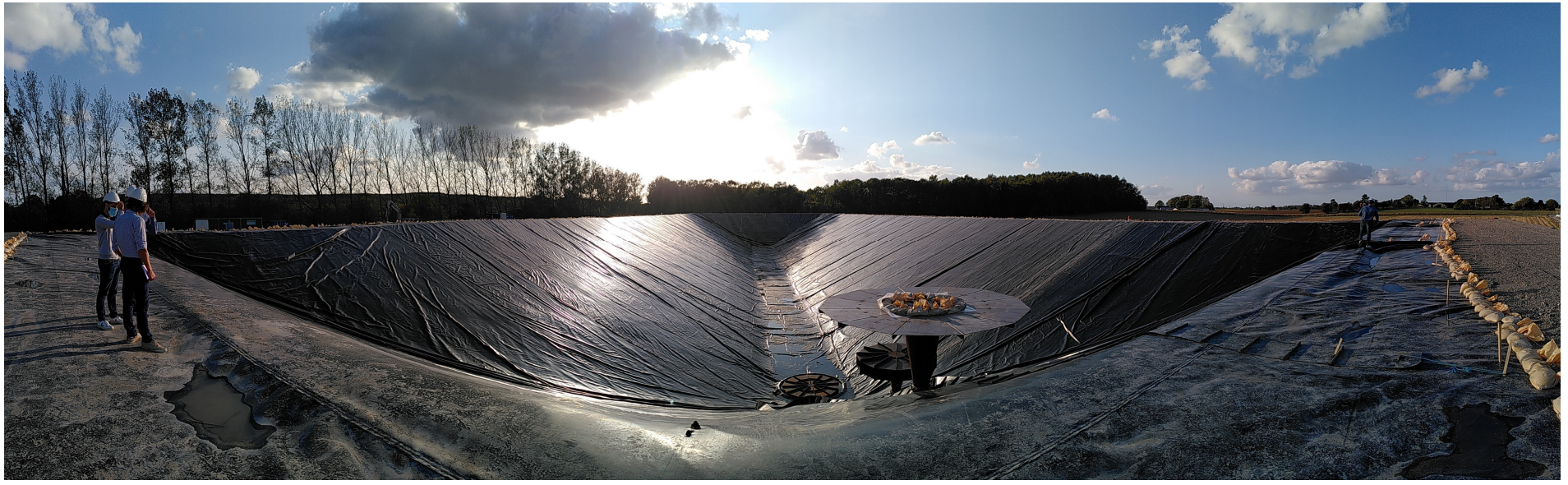
Owner: Vattenfall Wärme Berlin AG (Germany)
Name: Berlin district heating
Type of ownership: private
Network length: > **2'000** km
Consumers connected: **1.4 Mio** household equivalents
Total heat production: **10.2** TWh/year
Total heat sold: **9.6** TWh/year

PlanEnergi

energy storage
IEA Technology Collaboration Programme

INTERESTED IN LTES?

- Contact the Task 39&41's Task Manager or your national IEA ES TCP delegate, or me (see https://iea-es.org/)

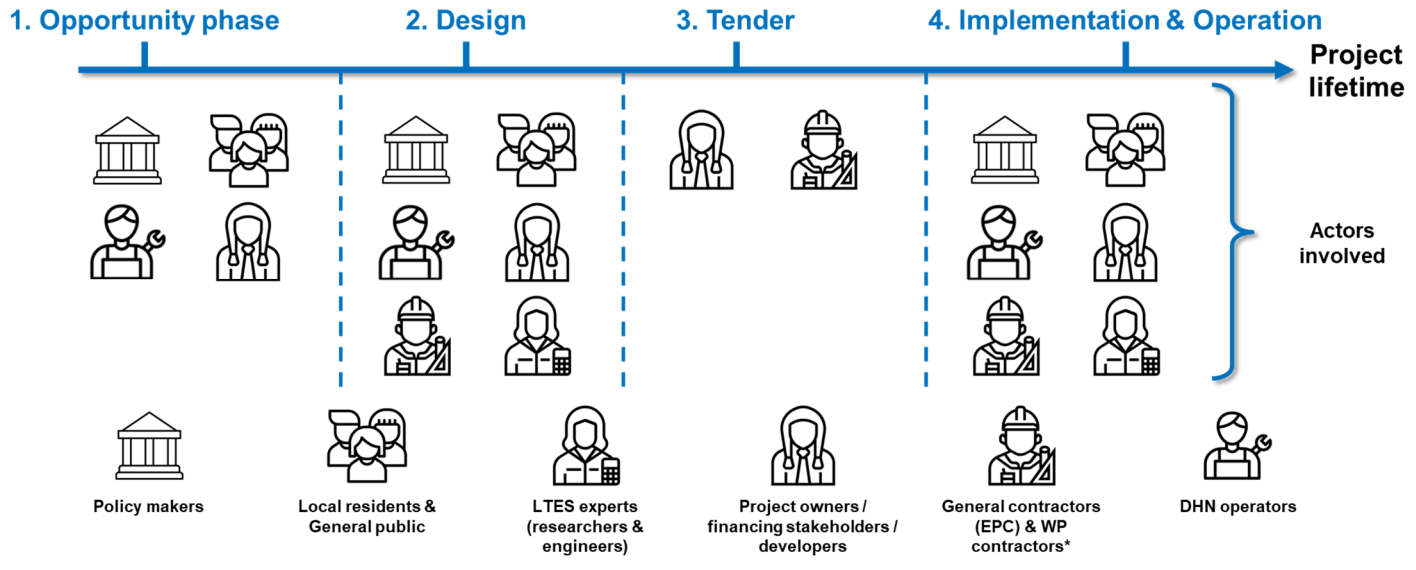


PlanEnergi

energy storage
IEA Technology Collaboration Programme

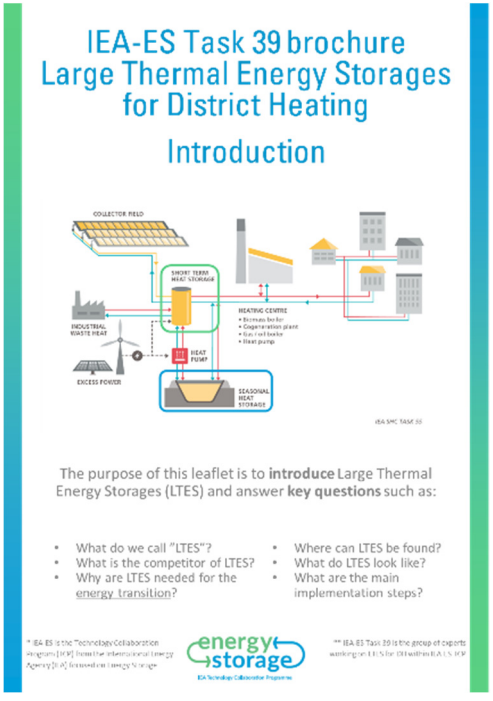
DISSEMINATION MATERIALS FROM TASK 39

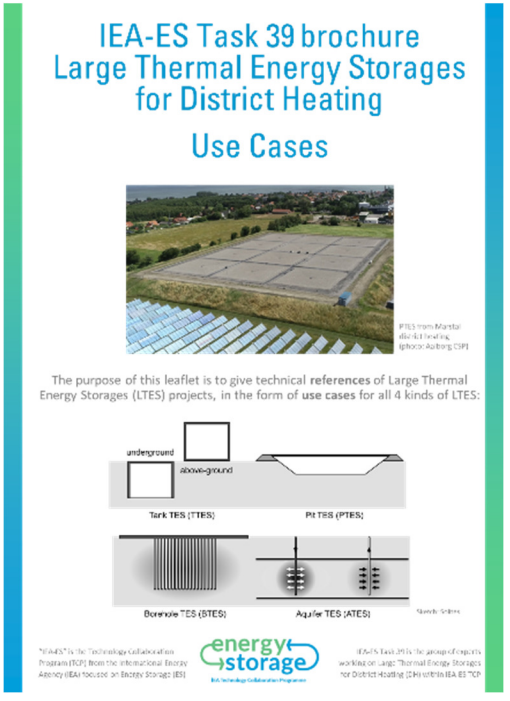
IEA-ES Task 39 will distribute information materials for all 4 stages of LTES projects



DISSEMINATION MATERIALS FROM TASK 39

IEA-ES Task 39 will distribute information materials for all 4 stages of LTES projects





IEA-ES Task 39 brochure preview

PlanEnergi

energy storage
IEA Technology Collaboration Programme

THANK YOU!

Geoffroy Gauthier

gg@planenergi.dk

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

PlanEnergi

energy storage

IEA Technology Collaboration Programme