INTERSEASONAL HEAT STORAGE

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Building Solutions
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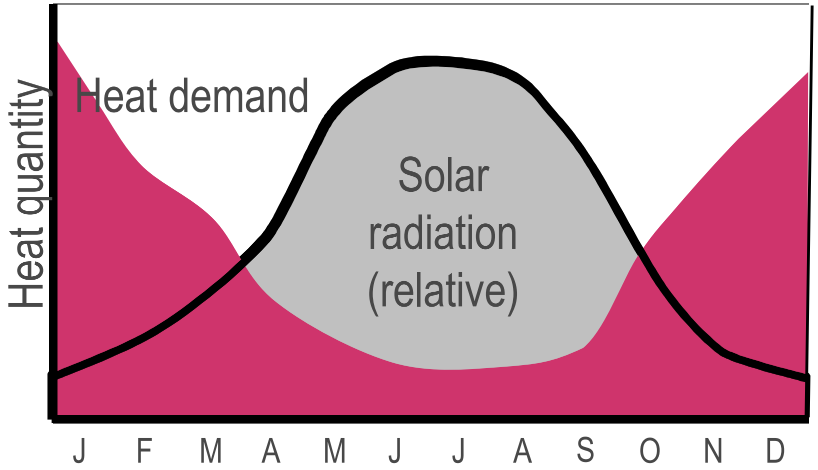
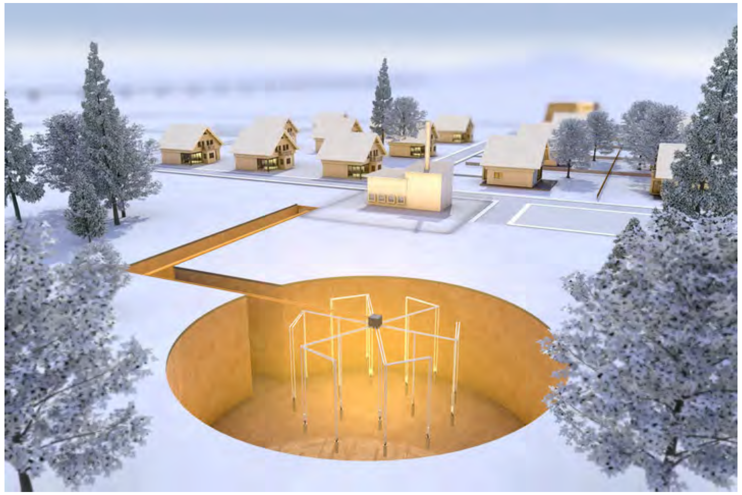
UNDERGROUND THERMAL ENERGY STORAGE

BASICS OF SEASONAL HEAT STORAGE

In district heating networks with renewable energy sources (e.g. solar thermal), excess heat is wasted in the summer.



This excess heat can be efficiently stored in summer and then utilised in winter to improve the whole system efficiency.



UNDERGROUND THERMAL ENERGY STORAGE

REQUIREMENTS / PRECONDITIONS

System requirements:

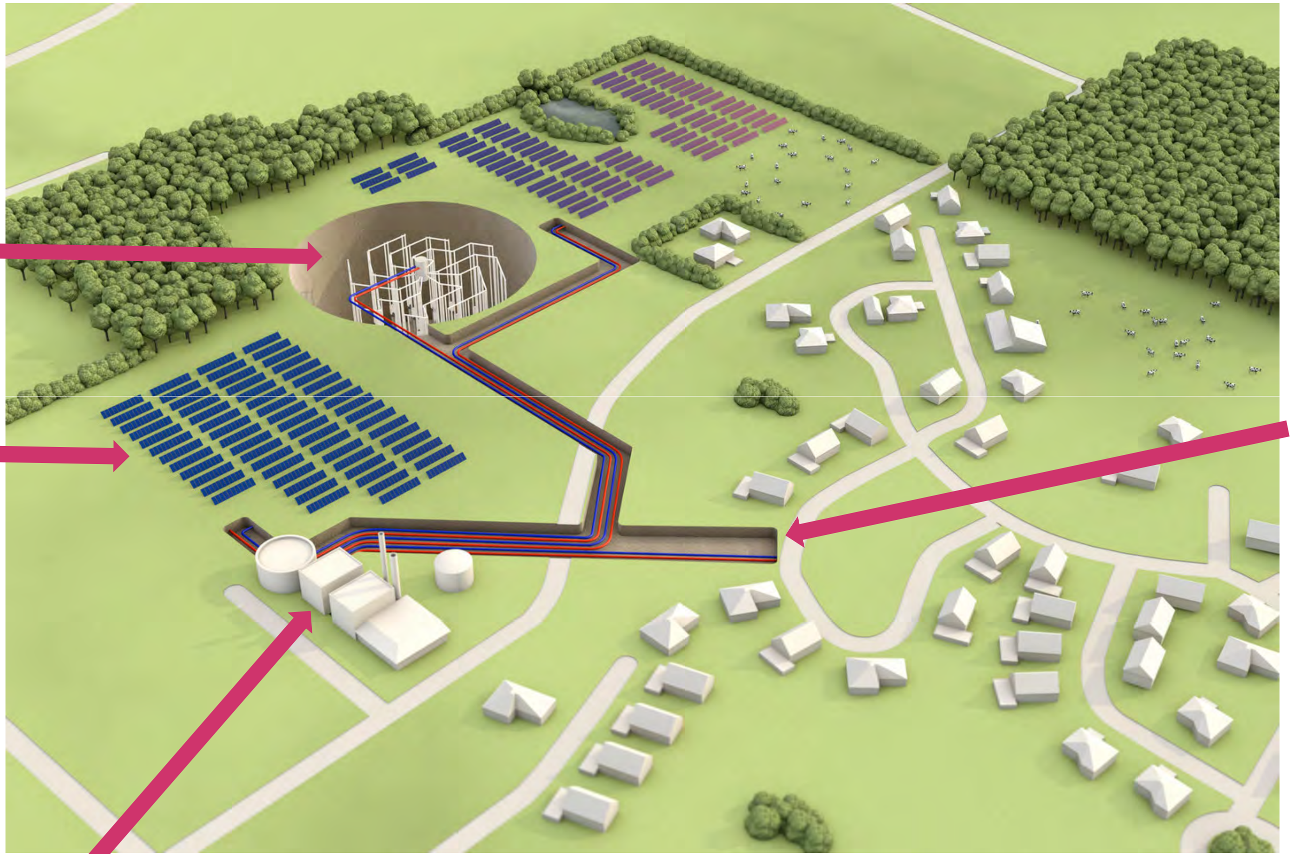
- System with predominantly a heating demand
- Housing areas / apartment buildings / industrial areas **> 100kW**
- Long-term storages are ideal min. 1,000m^3, preferably >10,000m^3
- Sufficient excess heat (e.g. from solar energy)

Ideal ground conditions:

- No groundwater, or very slow moving (<1m/a)
- Ground with good thermal properties
- Storage between 30 - 100 m deep

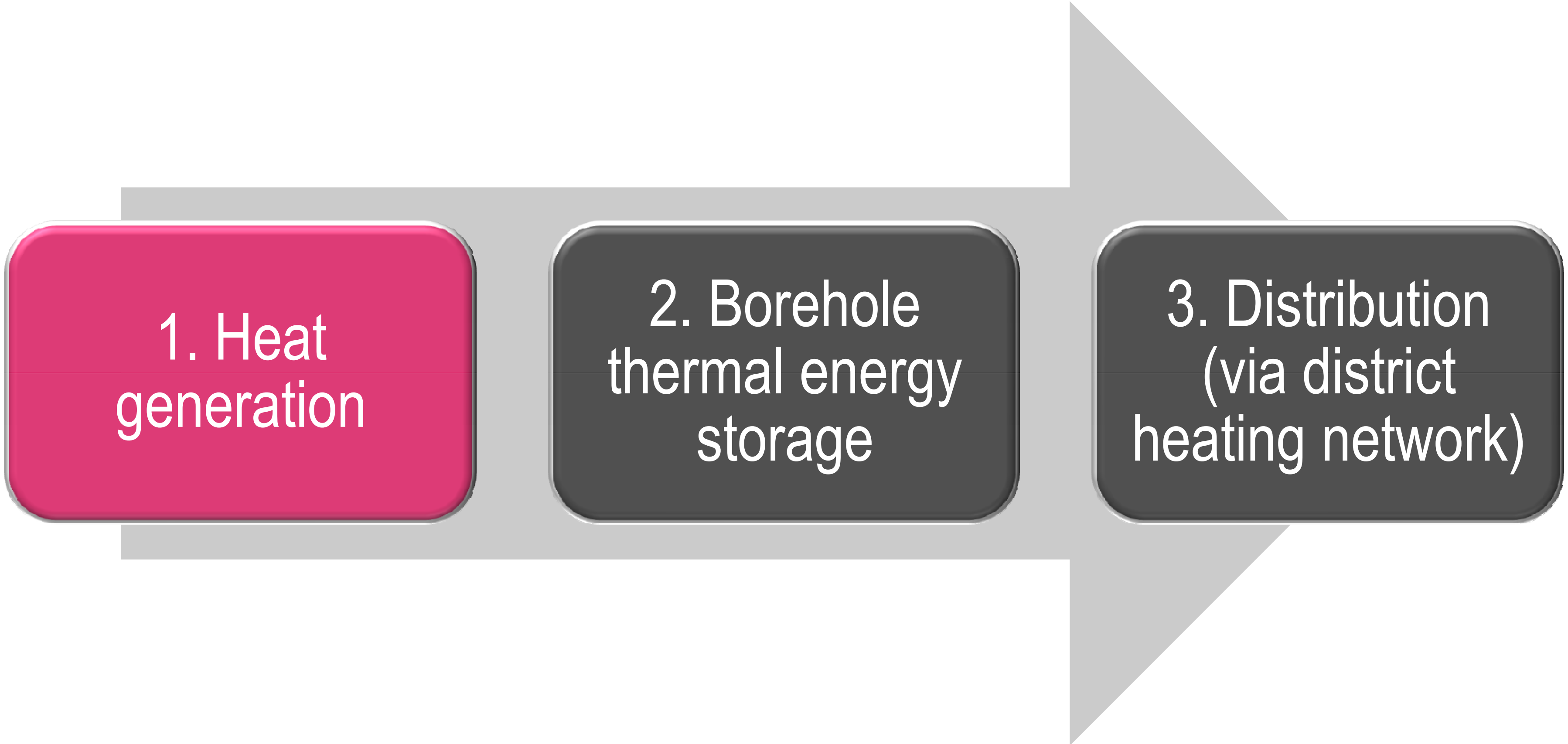
UNDERGROUND THERMAL ENERGY STORAGE

EXAMPLE SCHEMATIC



UNDERGROUND THERMAL ENERGY STORAGE

SYSTEM OVERVIEW



Integral system design and thermal modelling by specialist design teams

1. HEAT GENERATION

POSSIBLE HEAT SOURCES

The following heat sources are possible for this systems in order to meet the heat demand:

Solar Thermal

Solar Absorber

Industrial waste heat

CHP

1. HEAT GENERATION

SOLAR THERMAL AS THE ENERGY SOURCE

The most common heat source used in these schemes are solar thermal collector.

Example: Crailsheim, Germany

1. HEAT GENERATION

SOLAR ABSORBER

Solar energy in asphalt / concrete areas is extracted by integrating PE-Xa pipes just below the surface.

Lower cost compared to solar thermal but lower temperatures achieved.

PE-Xa multilayer pipe

Made of cross-linked PE-Xa with integrated aluminium layer:

Installation in cast & rolled asphalt – up to 240°C

Standard PE-Xa pipe

Made of cross-linked PE-Xa:

Installation in concrete (resistant up to 95°C).

1. HEAT GENERATION

COMBINED HEAT AND POWER PLANT AS AN ENERGY SOURCE

Current state: CHP with biogas as fuel (500 kW_{el})

CHP 500 kW_{el} power generation

ca.3.5 Mio kWh power

600kW condenser for summer operation

Wastes >1.6 Mio kWh heat per summer!

1. HEAT GENERATION

USING WASTE HEAT FROM INDUSTRIAL USES

Chillers and condensers reject a huge amount of heat into atmosphere. This heat can then by stored in a UTES system.

Manufacturing and food / beverage production often also produce large amounts of waste heat which can be reused.

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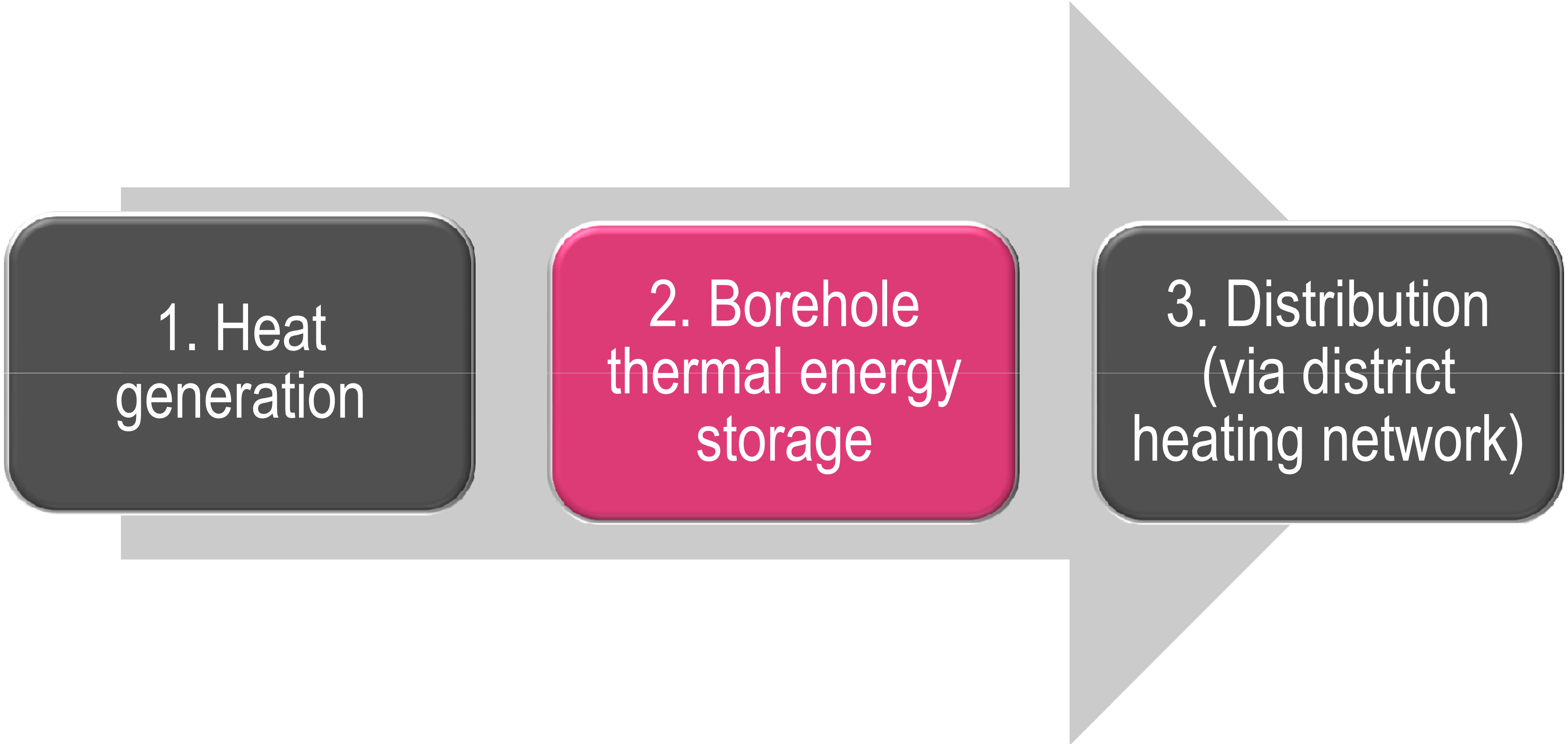
SYSTEM OVERVIEW



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2. BOREHOLE THERMAL ENERGY STORAGE

PROPERTIES OF PE-Xa PROBES

Probes for borehole thermal energy storage need to be made of PE-Xa due to higher temperature resistance (up to +95°C)

PE-Xa probes have a unique patented design with no weld at the probe tip, a jointless system.

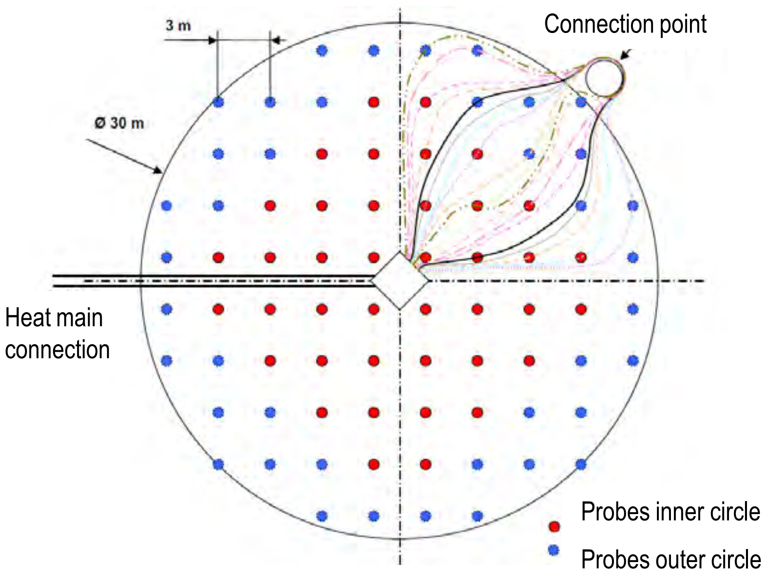
Durability (safety factor SF=1,25) Pipe SDR 11(25x2,3 and 32x2,9)			
PE–Xa		PE 100	
20 °C	**100 year** / 15 bar	20 °C	**100 year** / 15.7 bar
30 °C	**100 year** / 13.3 bar	30 °C	50 year / 13.5 bar
40 °C	**100 year** / 11.8 bar	40 °C	50 year / 11.6 bar
50 °C	**100 year** / 10.5 bar	50 °C	15 year / 10.4 bar
60 °C	50 year / 9.5 bar	60 °C	5 year / 7.7 bar
70 °C	50 year / 8.5 bar	70 °C	2 year / 6.2 bar
80 °C	25 year / 7.6 bar	80 °C	-
90 °C	15 year / 6.9 bar	90 °C	-

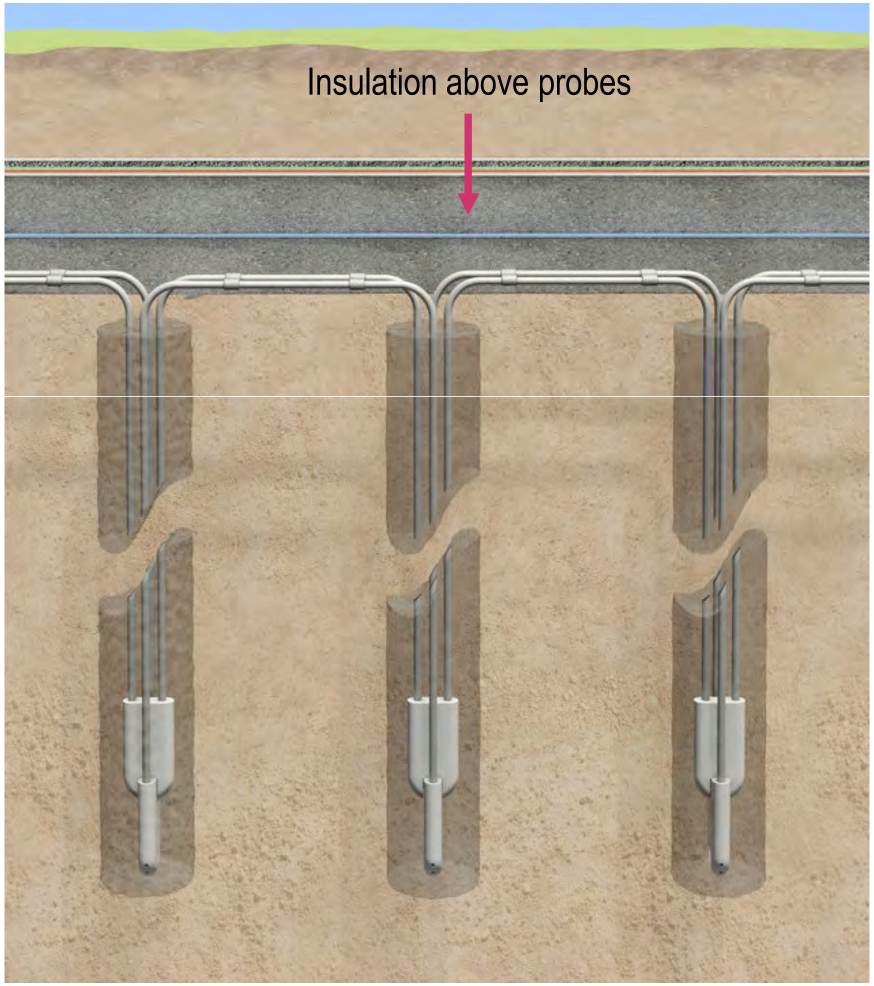
2. BOREHOLE THERMAL ENERGY STORAGE

TYPICAL LAYOUT OF BOREHOLE FIELD

The key differences to standard GSHP boreholes are:

- Insulation above the probe field
- Typically <50m deep
- Spaced close together (3-4m)





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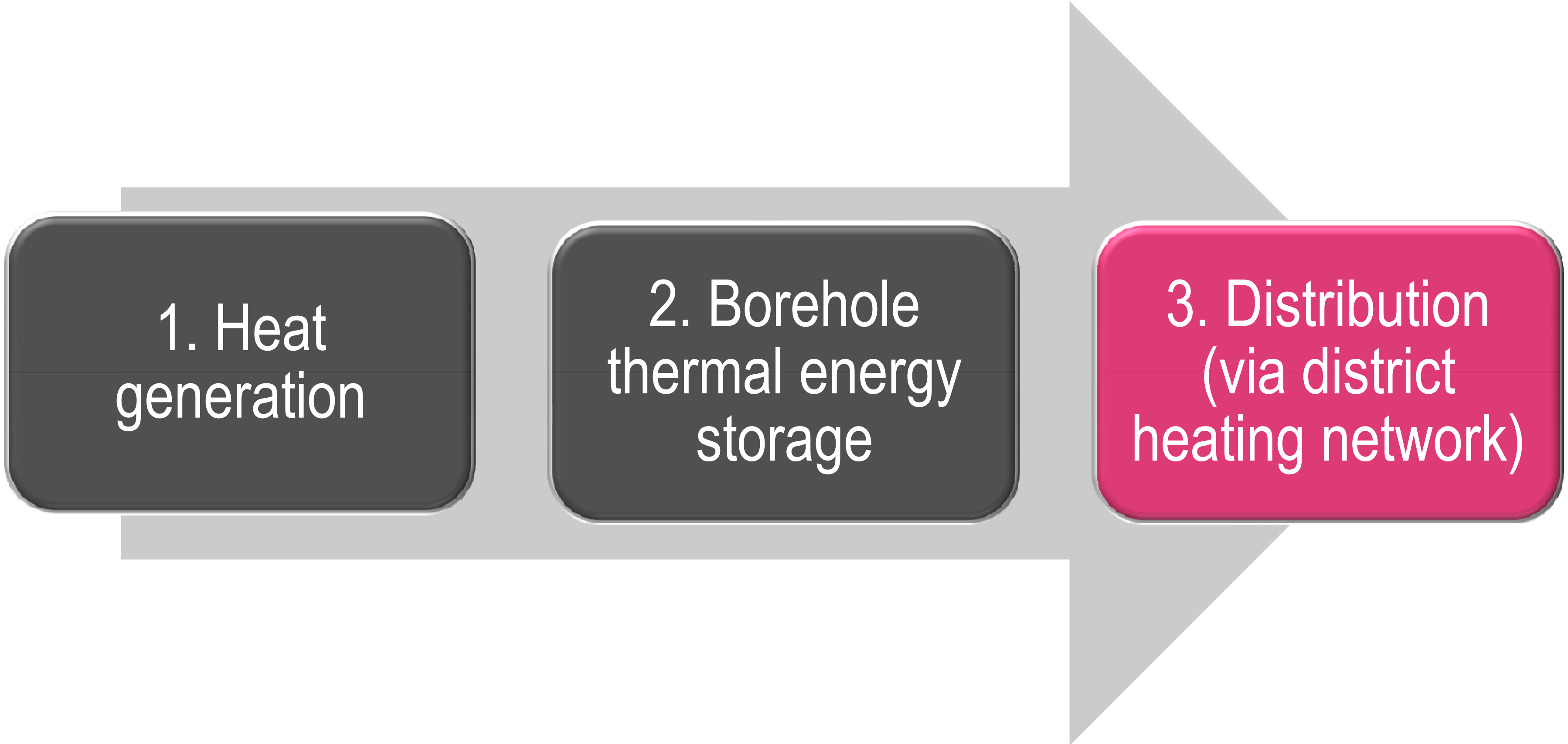
SYSTEM OVERVIEW



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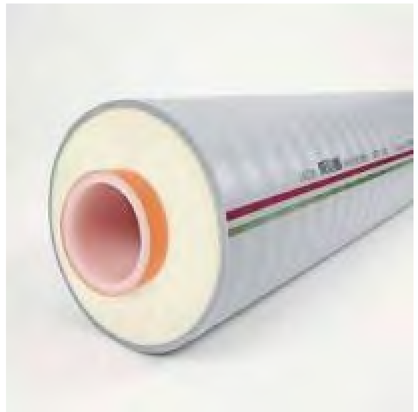
3. DISTRICT HEATING NETWORK

PRE-INSULATED PIPE FOR THE DISTRICT HEATING NETWORK

There are 2 main options of insulated pipe for heat networks, both using PE-Xa carrier pipe:

Closed cell foam:

- Polyurethane (PU) closed cell foam
- Excellent insulation values
- Ideal for long runs



Open cell foam:

- PE-X open cell foam
- High flexibility
- Good insulating properties

UNDERGROUND THERMAL ENERGY STORAGE

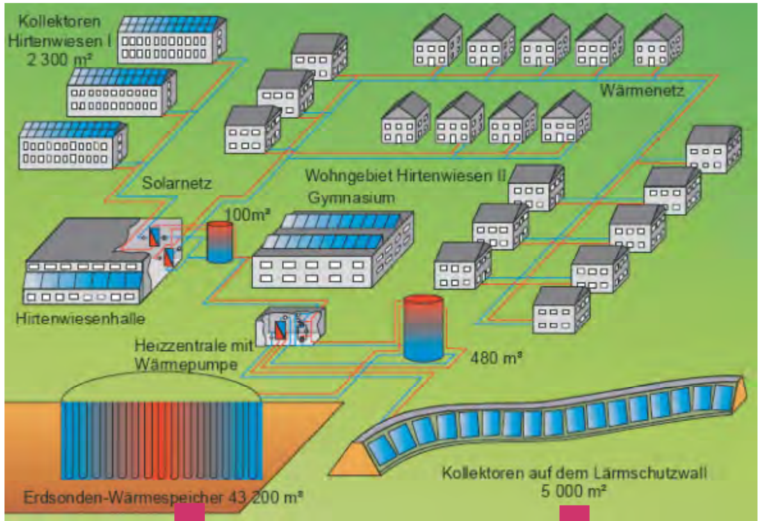
CASE STUDIES – UTES

Solar Storage Crailsheim, Germany

System description
-260 dwellings, school, sports hall
-Network flow/return temperatures 65/35°C

Heat sources:
- 7,300m² solar collectors with 5,1MW peak output
- 750 kW heat pump
- Supplementary heating through district heating network

Heat storage:
- 100m³ high temperature peak load storage (hot water)
- 480m³ buffer storage (hot water)
- 43,200m³ ground-source probe underground storage (80 PE-Xa probes)



UNDERGROUND THERMAL ENERGY STORAGE

CASE STUDIES – UTES

Braedstrup District Heating & Solar Park, Denmark

System description
- 6MW system (3,800 MWh/a) for 1400 homes

Heat sources:
- 17,000m² solar collectors

Heat storage:
- 48 PE-Xa probes at 45m deep and 7000m³ buffer tank

UNDERGROUND THERMAL ENERGY STORAGE

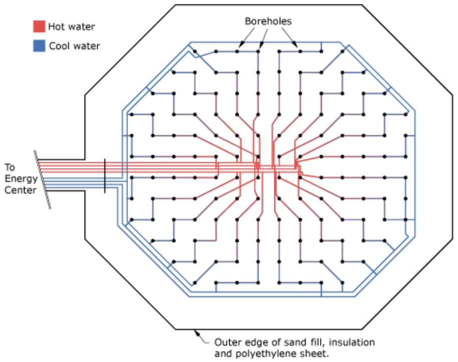
CASE STUDIES – UTES

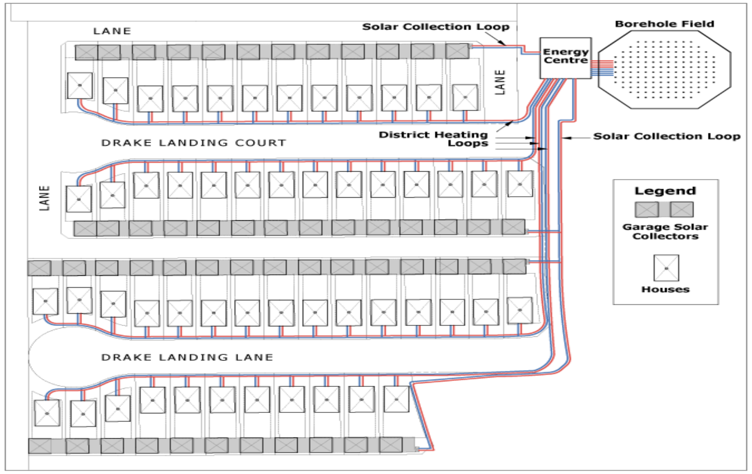
Drakes Landing Solar Community, Okotoks, Canada

System description
- 52 house community

Heat sources:
- 800 solar thermal collectors (ca. 2300m2 area)

Heat storage:
- Borehole thermal energy storage of 144 x 25mm PE-Xa probes at 35m depth





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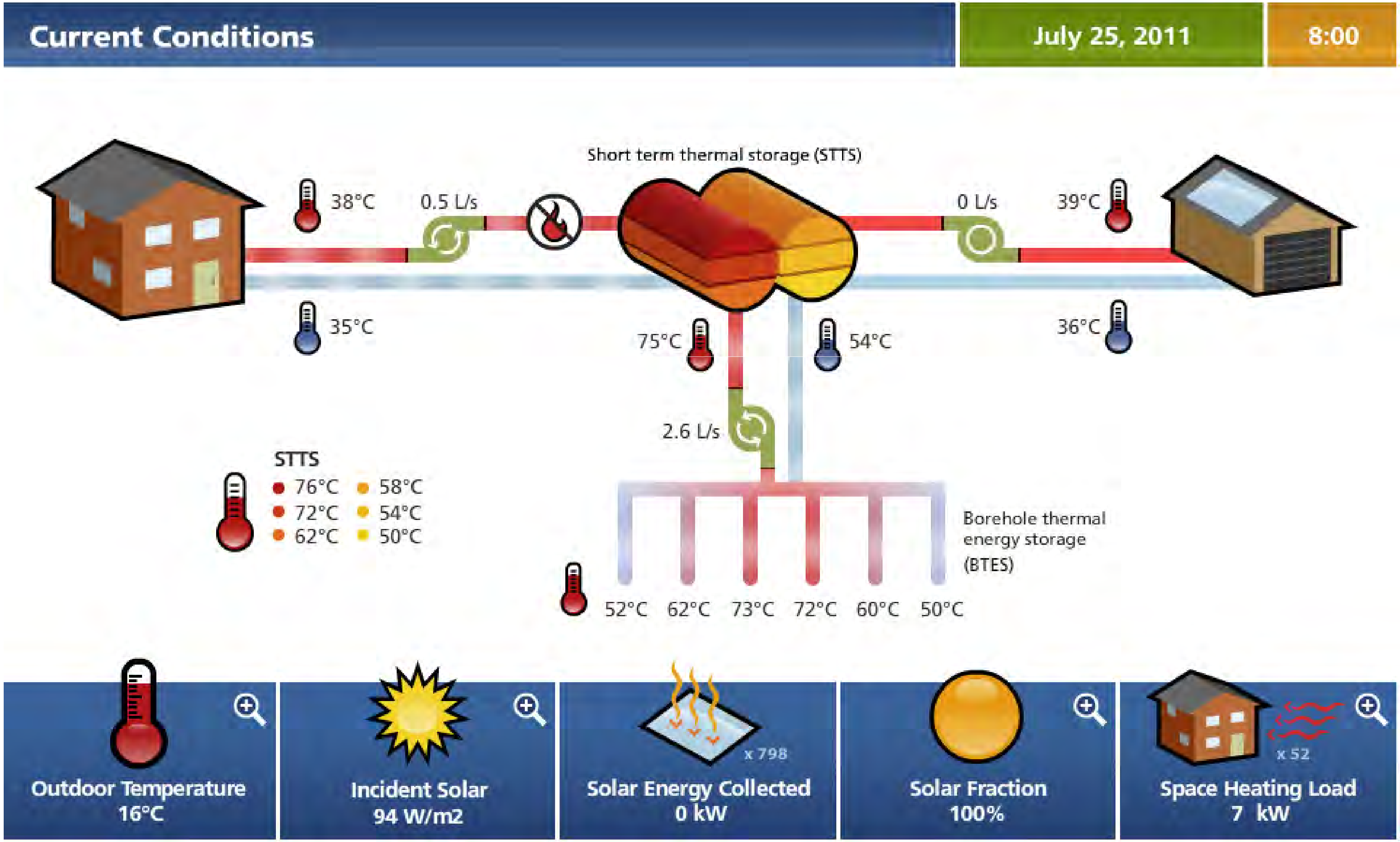
CASE STUDIES – UTES - LIVE DATA AT WWW.DLSC.CA



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CASE STUDIES – SOLAR ABSORBER

Suffolk One College, Ipswich

Used ICAX interseasonal heat transfer system for 20,000m² building.

Solar absorber: 1,560m² bus turning area, using 14km of 25mm RAUGEO PE-Xa

Underground storage: 18 x 100m PE-Xa probes

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THANK YOU FOR YOUR ATTENTION

ANY QUESTIONS?