LOGSTOR

The right pre-insulated pipe systems for large scale solar district heating networks

3rd international conference on Smart Energy Systems and 4GDH

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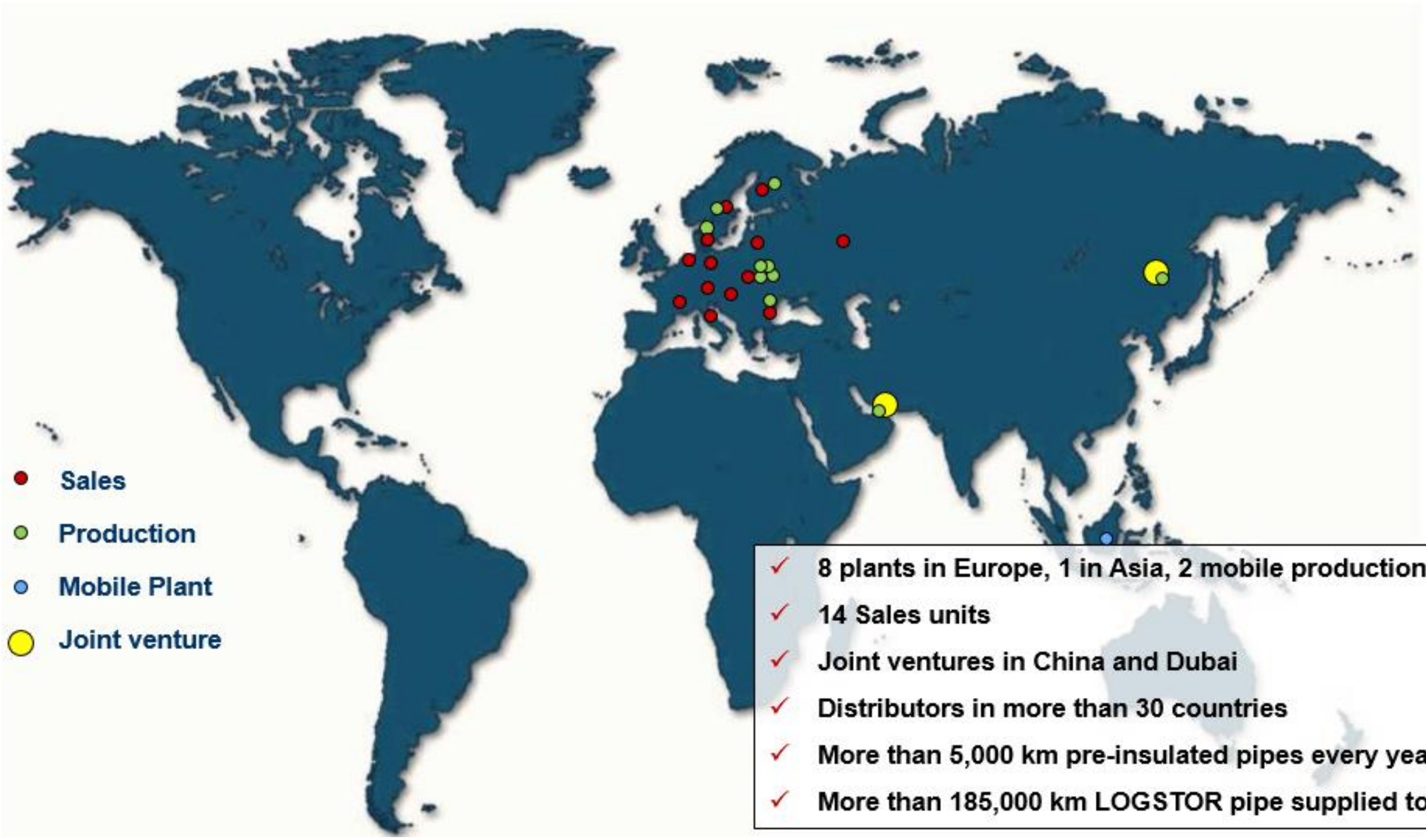
12 September 2017

The LOGSTOR Group & global presence

Headquarters in Denmark	1,500 employees	Annual turnover > 250 MEUR	Owner: Triton Fund III

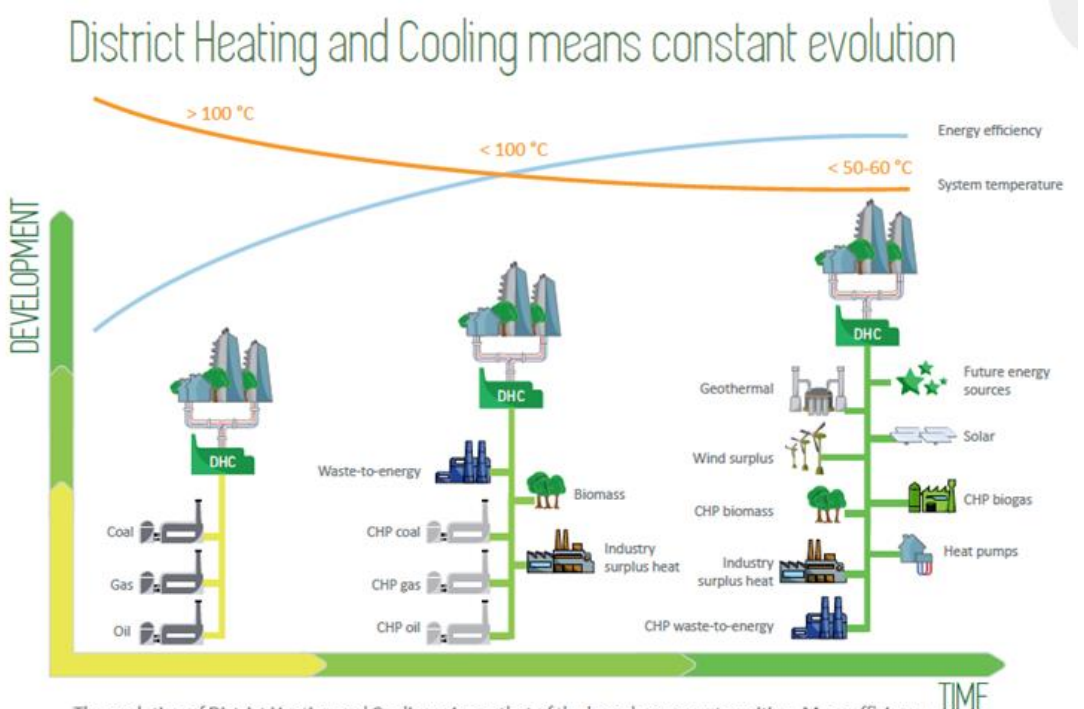


- ✓ 8 plants in Europe, 1 in Asia, 2 mobile production units
- ✓ 14 Sales units
- ✓ Joint ventures in China and Dubai
- ✓ Distributors in more than 30 countries
- ✓ More than 5,000 km pre-insulated pipes every year
- ✓ More than 185,000 km LOGSTOR pipe supplied to date

Large scale solar heating networks

Large scale solar heating networks

- Large scale solar heating networks are already today playing an important role in Denmark
- This is expected to spread to Europe in the future
- This presentation is not about research and development of a new system
- It is about learning from the history when moving ahead



The evolution of District Heating and Cooling mirrors that of the broader energy transition. More efficiency, more renewables and more flexibility means a better energy system.

Experience with solar heating networks

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- More than 20 years of experience with large scale solar district heating networks
- The first designs was based on the know how from traditional district heating projects
  - Products
  - Design of the system
- The design assumptions were insufficient in respect to
  - Temperature
  - Temperature cycles during service life

Number of temperature cycles in a solar network is up till 40 times more than in a conventional district heating system

Experience with solar heating networks

- Energy companies has experienced damages like
  - Leaking joints
    - Resulting in corroding steel
  - Fatigue failure on the steel
    - Immediate leak that will spread in the pre insulated system system
  - Corroding valve connections at the introduction to the solar panels

Fig. 1 - Branch, damaged by large movements.

Fig. 2 - Moisture spread, stemming from a casing joint, damaged by large movements.

Fig. 3 - Released copper ions from brass valve, causing corrosion of the steel pipe. The damage is on the return pipe. No damage on the flow pipe.

Fig. 5 - Dislocated casing joint due to the large number of movements

Fig. 4 - Shrink wrap peeled off due to the large number of movements.

Wrong design assumptions has lead to damages in the network

Learning from the experience

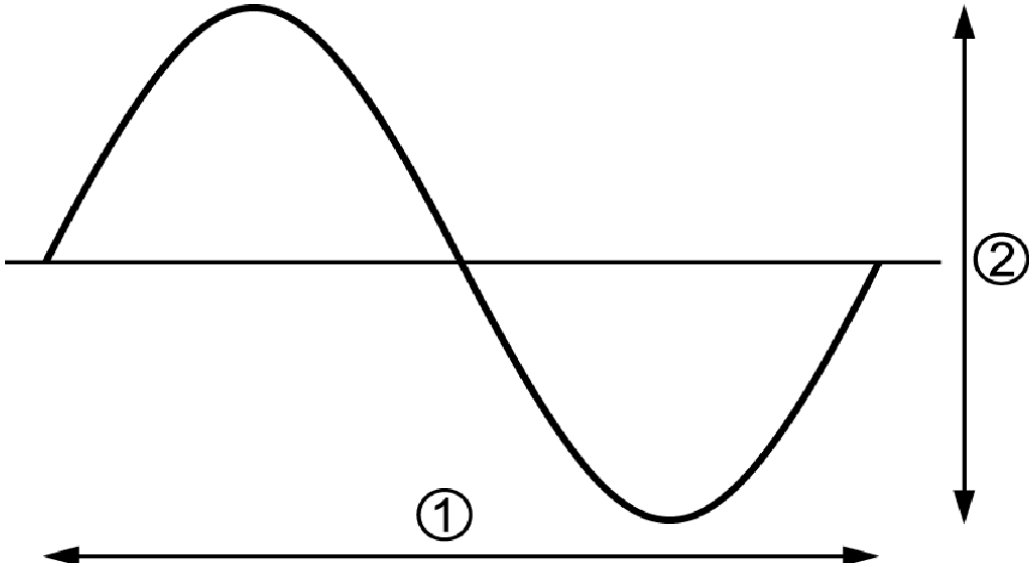
- We have today much better understanding of the design criteria's
  - Temperature in the system over the year
  - Number of temperature cycles over service life
- The right products that will withstand the loads from the temperature cycles

The expensive experience has lead to better knowledge and better design assumption

Design criterias, Temperature cycles over service life

- Standard district heating system
  - The system is designed for a minimum service life of 30 years with the number of full temperature cycles depending on type of network
  - Transmission pipelines 100 temperature cycles
  - Distribution pipelines 250 temperature cycles
  - House connections 1000 temperature cycles
- Large scale solar district heating system
  - Number of full temperature cycles over 30 years is
  - 3500 – 10950
  - Depending on the system

A full temperature cycle



1 is time
2 is the full temperature cycle

Crucial to work with the right design parameters

Example on design with different design parameters

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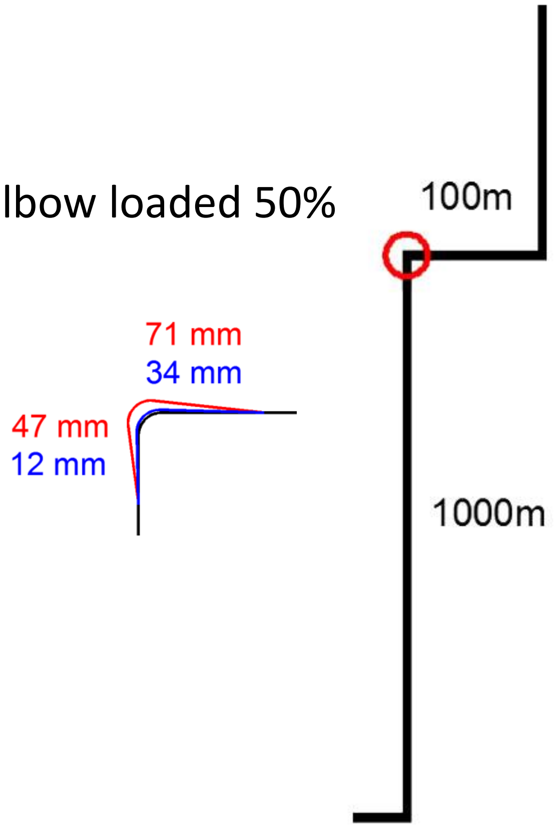
- Standard district heating system
  - Max. temperature 110 °C
  - 250 full temperature cycles over service life
- Solar district heating system, type 1
  - Max. temperature 110 °C
  - 3500 full temperature cycles over service life
- Solar district heating system, type 2
  - Temperature between 10 – 110 °C
    - 1 full temperature cycle per day
  - Shortly up till 150 °C 5 hours twice a year
  - Full temperature cycles over service life is 10950

- General assumptions
  - Installation temperature 10°C
  - Soil cover 0,6 m
  - Pressure 6 bar

Comparison of 3 different design criteria's
During winter time temperature in the pipe system can go down to -15 °C

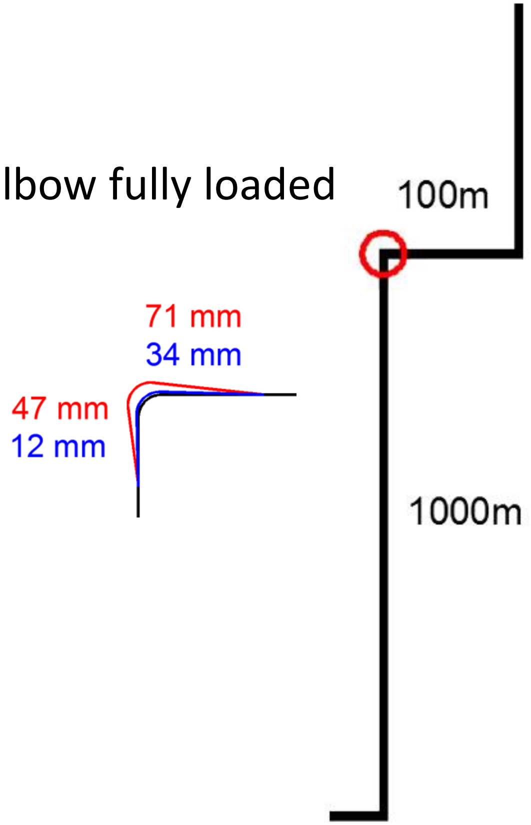
Example on design with different design parameters

Elbow loaded 50%



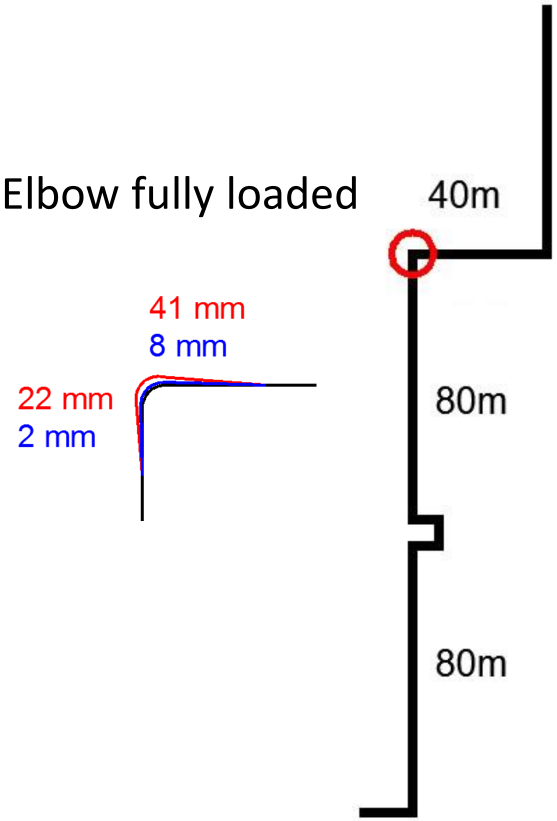
District heating
250 temperature cycles

Elbow fully loaded



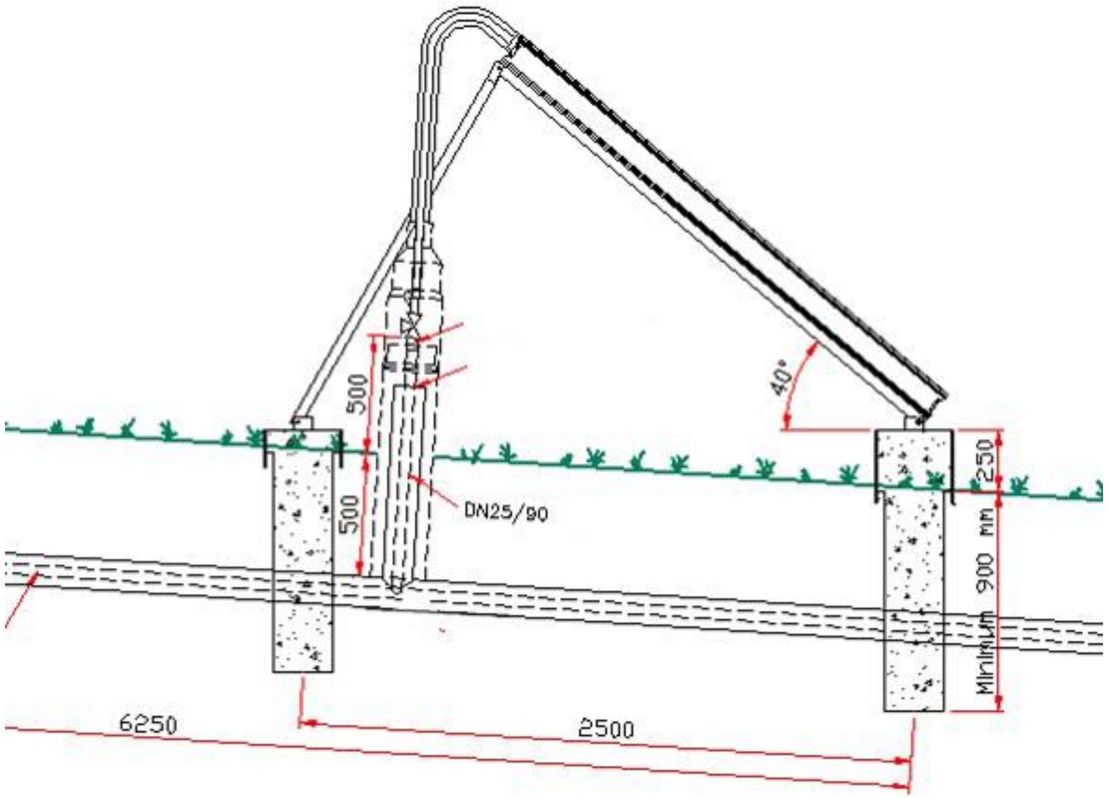
Solar heating
3500 temperature cycles

Elbow fully loaded

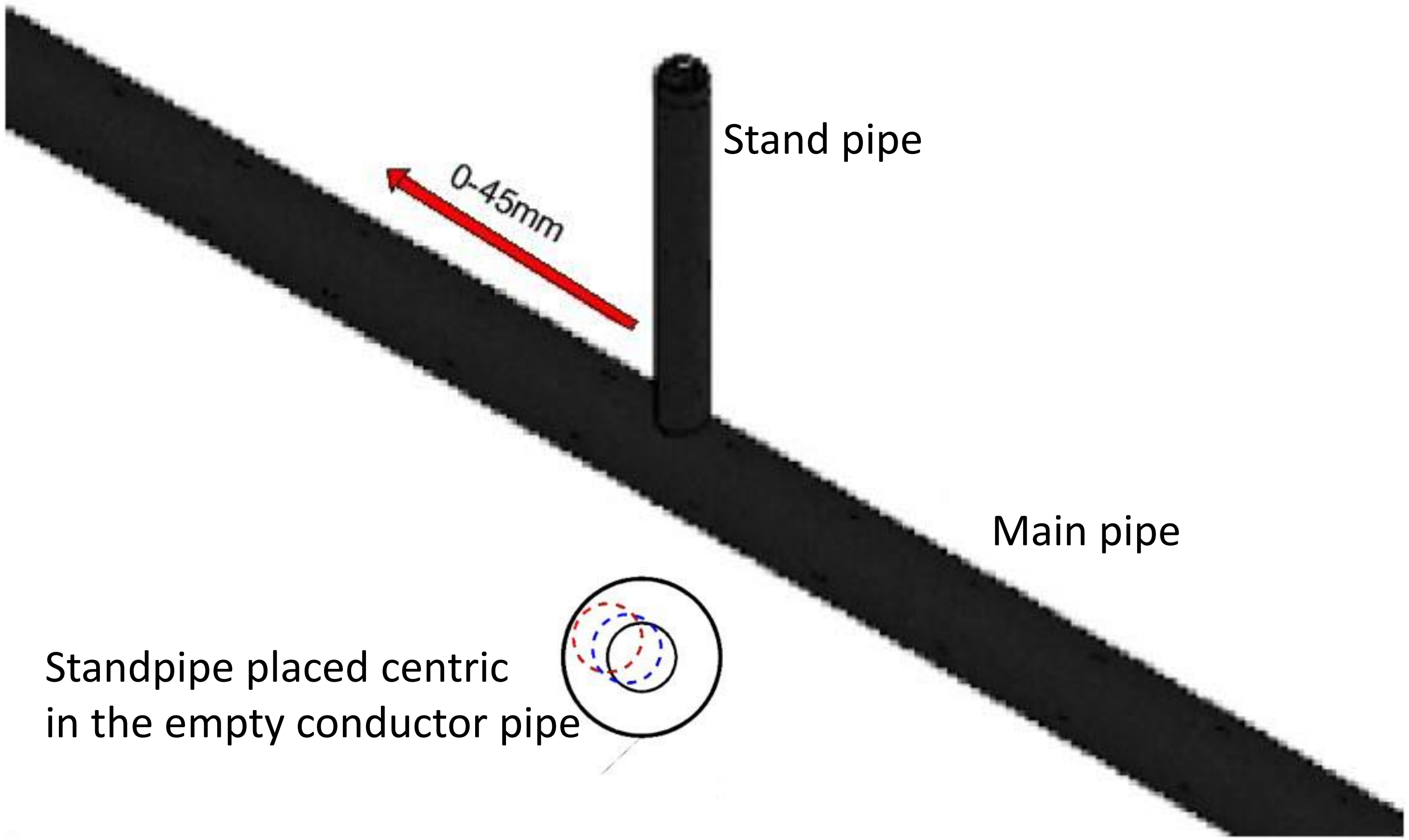


Solar heating
10950 temperature cycles

Empty conductor pipe arround the standpipe



Standpipe placed centric at the time of installation



Movement must be calculated at peak temperature
During winter time temperature in the pipe system can go down to -15 °C

Component requirements

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- Welded joints is recommended
- All standpipes to the solar panels must be placed in empty conductor pipes
- Branches and bends must be pre-insulated
- It is recommended that change in direction is done with 90° bends
- No twin pipes when number of temperature cycles is more than in a normal district heating network
- Active Monitoring system

The right components are essential for a long life time

Component requirements

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- Standpipes designed for the specific project
- Match the exact position of the solar panels
- Indoor manufacturing
- By companies specialized for this work
- Secures optimum conditions for high quality

Standpipes prepared indoor at factory site is an opportunity

Design requirements

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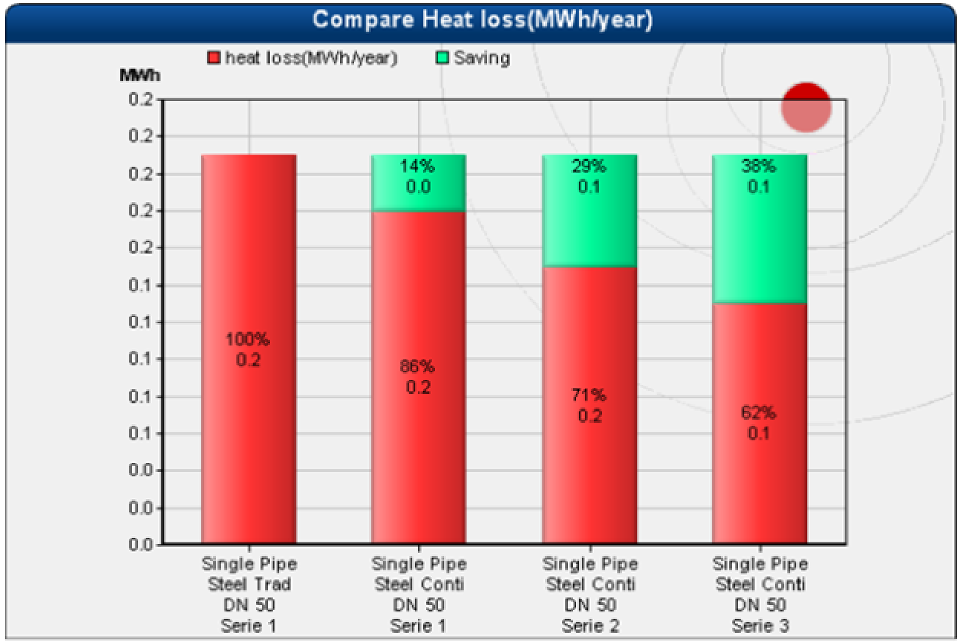
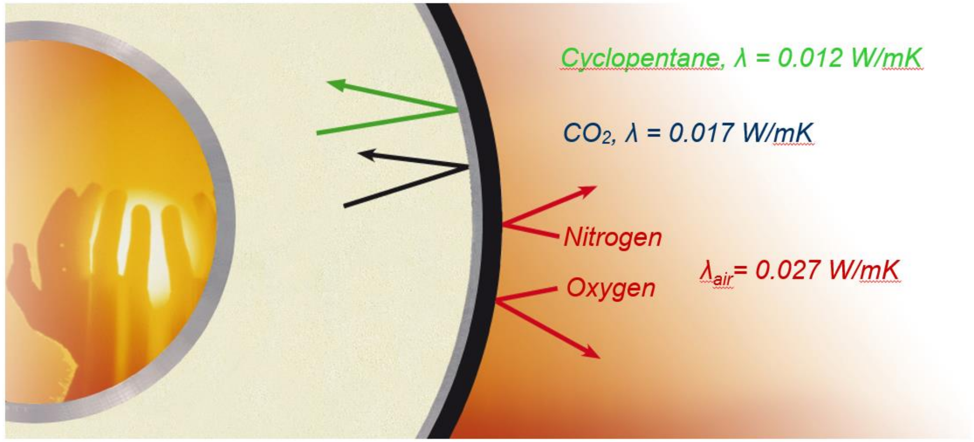
- A detailed static calculation must be done on all bends based on the number of full load temperature cycles
- The maximum pipe length section is calculated based on the “free space” in the empty conductor pipe around the standpipes
- During winter time temperature in the pipe system can go down to -10 °C till -20 °C
- Use foam pads at change of directions
- These design requirements apply in the network between the solar panels and the heat exchanger before the standard district heating network

Static calculations based on number of temperature cycles

Focus on total cost of ownership (TCO)

- Essential for a long life time is the right choice of products and the right system design
- Essential for the lowest TCO is the balance between the investment in pipe system and installation and the heat loss of the system over life time
- Lowest heat loss is achieved on systems with axial conti pipes with a diffusion barrier and low lambda value
- The diffusion barrier will secure the low heat loss in the entire life time





Focus on total cost of ownership (TCO)

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Temperature

	Winter	Summer
Flow	85	75
Return [°C]	55	45
Ambient [°C]	4	14
Days	215	150

System Parameters

Definition λ PUR	Period avg.
calculating year	30
Soil cover (h) mm	700
Ambient	soil (Normal)
Certificate lambda	No

Finance

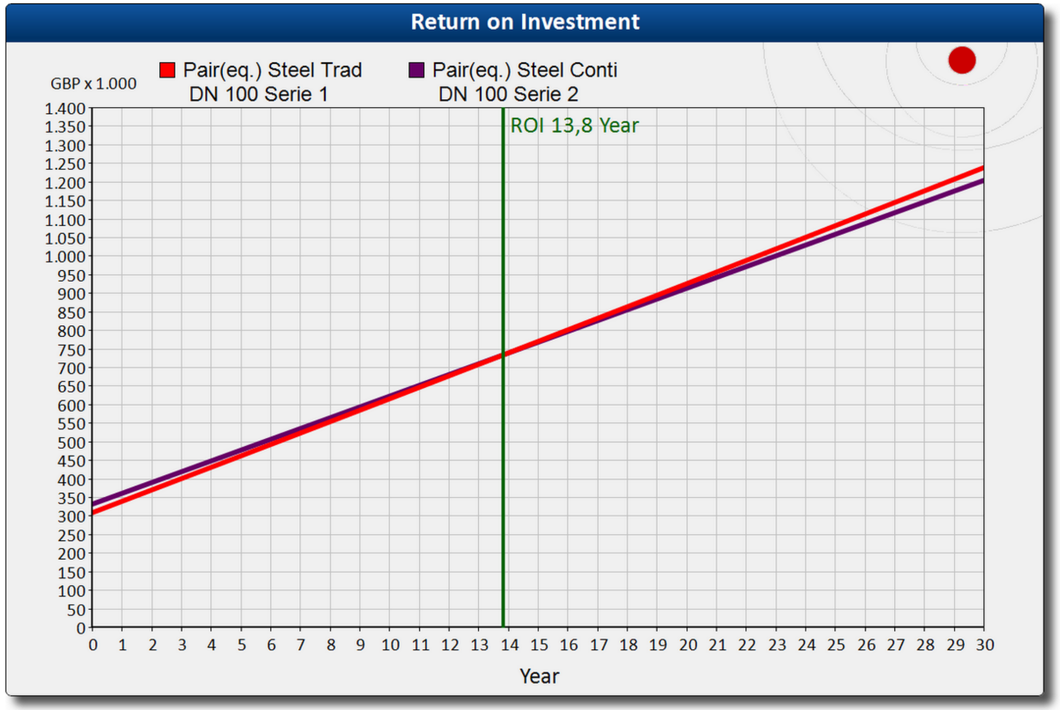
Currency	GBP
price / kWh	0.03
Interest rate [%]	4

CO2-emission

Fuel type	Natural Gas
Efficiency [%]	85
Operation Time/Year	8760

1 Longer distances

Calculate Add pipe Delete pipe Copy Project Delete project



No	D2	Diff.	Lambda	W/m Win. / Sum.	MWh/year	Cost pipe	cost install.	Cost operation	Compare
1	200		0.027	38.91 / 27.12	298.41	108000	200000	25000	✔
2	225		0.027	31.97 / 22.28	245.17	124000	210000	25000	
3	200	✔	0.023	31.52 / 21.97	241.69	117000	200000	25000	
4	250		0.027	27.25 / 18.99	209.01	140000	210000	25000	
5	225	✔	0.023	26.31 / 18.34	201.76	126000	205000	25000	✔

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