LOGST

Low-temperature district heating grids

Secure the lowest Total Cost of Ownership in district heating networks

2nd international conference on Smart Energy Systems and 4GDH

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The LOGSTOR Group & global presence



Agenda



- Service life cost/Total Cost of Ownership (TCO)
 - the most important design parameter
- Heat loss and service life cost at low temperature grids (55/25 °C)
 - Example distribution pipe lines and service pipe lines
 - Example distribution pipe lines
- Return of investments
- Alternative pipe materials

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





Service life cost/Total cost of ownership (TCO)



Focus on total cost of ownership (TCO)

Temperature	System Parameters	Finance	CO2-emission
Winter Summer Flow 85 75 Return [°C] 55 45 Ambient [°C] 4 14 Days 215 150	Definition λ PUR calculating year Soil cover (h) mm Ambient Certificate Iambda	Currency GBP V price / kWh 0.03 Interest rate [%] 4	Fuel type Natural Gas Efficiency [%] 85 Operation 8760 Time/Year
Beair(eq.) Steel Trad ■ Pair(GBP x 1.000 DN 100 Serie 1 DN	eq.) Steel Conti 100 Serie 2	W/m D2 Diff. Lambda Win. / Sum. MWI	Cost Cost
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	ROI 13,8 Year 3 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 Year	D2 Diff. Lambda Wiff. / Suff. Wiff. 200 0.027 38.91 / 27.12 298.4 225 0.027 31.97 / 22.28 245.1 200 Image: Comparison of the state of th	HI 108000 200000 25000 Image: Cost pipe HI 10000 210000 25000 Image: Cost pipe HI 140000 205000 25000 Image: Cost pipe HI

Low temperature grid project example



Liseborg Bakke

- Project in Viborg, 20 houses
- New build area
- Investigation of designing area for low temperature DH
- Different pipe scenarios where investigated
- 55/25°C
- Distribution pipes
 - 343 m DN20 DN50, TwinPipe
 - 7 m single pipe
- service pipes
 - 185 m 20-16 AluFlextra Double pipe
- Comparison series 2 and series 3
- Budget prices all inclusive
- Total Cost of Ownership
- Return of investment



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Budget prices – all inclusive





Liseborg Bakke;									
104-142	Pipe trench	dimension	service pipe		Inv	estment cos	t (budget)		
							service pipe	connection	
				Materials	pipe work	excavation	material	pipe work	total
	m kanal	mm	antal	kr	kr	kr	kr	kr	kr
TwinPipe/LOGSTOR	68,2	ø60,3-60,3/225	0	36.335	19.163	36.499			91.997
TwinPipe/LOGSTOR	43,1	ø48,3-48,3/180	2	38.473	18.557	23.622	1.894	3.663	86.212
TwinPipe/LOGSTOR	76,7	ø42,4-42,4/180	5	14.781	15.437	39.347	4.736	9.158	83.464
TwinPipe/LOGSTOR	25,6	ø33,7-33,7/160	2	10.148	9.273	13.133	1.894	3.663	38.114
TwinPipe/LOGSTOR	131,9	ø26,9-26,9/140	11	33.916	30.481	67.665	10.419	20.148	162.640
AluFlextra_double pipe	185	ø20-26/125		25.774	6.793	72.927			105.494
Pair of pipes/LOGSTOR	1,5	ø88,9/200		2.336	3.847	770			6.953
Pair of pipes/LOGSTOR	3,2	ø60,3/160		2.896	2.666	1.642			7.204
	535,2		20	164.659	106.217	255.605	18.943	36.634	582.058

Heat loss calculation series 2 and 3

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55/25°C

7

Pair(eq.)

8 Pair(eq.)

✓ Steel Conti ✓

✓ Steel Conti ✓

1

3

150

3 🗸 80 🗸

Те	mperature	ature System Parameters			Finance							CO2-em						
Flo Rei (°C Am (°C Da	Win Si turn 25 abient 8 j 365	iter			Definition λ PUR calculating year Soil cover (h) mm Ambient PUR, use λ certicate	Average per 30 600 soil, λ= 1.6 V	iod N/m K	> 		Currency price / kV Interest r	Wh ate [%]	О.35 4		~		Fuel type Efficiency (9 Operation Time/Year	\$	
1.	Liseborg Ba	akke	serie 2											C	alculate	Add pipe Delete	pipe Copy Project	Delete project
No	Type of syste	em	PipeSystem	Length (m) C (mm)	Series d1		d1	D1	Ser	ies d2		d2	D2	Diff.	Lambda	W/m	MWh/year
1	TwinPipe	~	Steel Conti 🗸 🗸	68		2	 	• •	225	2	~	50	~	225	at a	0.023	6.03	3.59
2	TwinPipe	~	Steel Conti 🗸 🗸	43		2	- 4	• •	180	2	~	40	~	180	1	0.023	6.19	2.33
3	TwinPipe	~	Steel Conti 🗸 🗸	76]	2	- 3	2 🗸	180	2	~	32	~	180	4	0.023	5.32	3.54
4	TwinPipe	~	Steel Conti 🔷 🗸	25]	2	· 2	5 🗸	160	2	~	25	~	160	1	0.023	4.82	1.06
5	TwinPipe	~	Steel Conti 🗸 🗸	131]	2	• 2	• •	140	2	~	20	~	140	1	0.023	4,54	5.22
6	Double Pipe	~	AluFlextra 🗸	185]	2	· 2	• •	125	2	~	26	~	125	1	0.022	4.13	6.69
7	Pair(eq.)	~	Steel Conti 🗸 🗸	1	150	3 1	· 8	o 🗸	200	3	~	80	~	200	1	0.023	10.84	0.09
8	Pair(eq.)	~	Steel Conti 🗸 🗸	3	150	з ,	· 5	• •	160	3	~	50	~	160	1	0.023	8.98	0.24
2. No	Liseborg B	akke	Serie 3 PipeSystem	Length	(m) C (mm)	Series d1	L	d1	D1	Sei	ries d2		d2	D2	Calculate	Add pipe Delete	Total MWh/year e pipe Copy Project W/m	22.76 t Delete project MWh/year
1	TwinPipe	~	Steel Conti 🗸	68]	3	~ !	50 🗸	250	3	~	50	~	250	4	0.023	5.20	3.10
2	TwinPipe	~	Steel Conti 🗸	43		3	~	40 🗸	200	3	~	40	~	200	4	0.023	5.42	2.04
3	TwinPipe	~	Steel Conti 🗸	76		3	~	32 🗸	200	3	~	32	~	200	4	0.023	4.75	3.16
4	TwinPipe	~	Steel Conti 🗸	25	-	3	~	25 🗸	180	3	~	25	~	180	1	0.023	4.30	0.94
5	TwinPipe	~	Steel Conti 💊	131	-	3	~	20 🗸	160	3	~	20	~	160	1	0.023	4.01	4.60
6	Double Pipe	~	AluFlextra 🗸	185		3	~	20 🗸	140	3	~	26	~	140	4	0.022	3.72	6.03

200 3

150 3 v 50 v 160 3 v 50 v 160 V

✓ 80

~ 200

1

0.023

0.023

	Heat loss
Serie 2	22,76 MWh/year
Serie 3	20,20 MWh/year



0.09

0.24

10.84

8.98

Service life cost over 30 years, 55/25 °C

Service Life Cost Price pipe Price Install Cost heat loss DKK x 1.000 850 800 750 700 17% 122 19% 138 650 600 550 500 450 55% 398 400 55% 398 350 300 250 200 150 28% 204 100 26% 184 50-0 Liseborg Bakke serie 2 Liseborg Bakke Serie 3 719806,68 DKK 724570,13 DKK

Service life cost over 30 years, 80/40 °C



10% saving on total cost by going for lower temperature if anything else is equal

Low temperature grid project example

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Hedeskrænten

- Project in Viborg, 12 houses
- New build area
- Investigation of designing area for low tempetaure DH
- Different pipe scenarious where investigated
- 55/25°C
- Distribution pipes (no service pipes)
 - 268 m DN20 DN40, TwinPipe
 - 2 m single pipe
- Comparison series 2 and series 3
- Budget prices all inclusive
- Total Cost of Ownership
- Return of investment



Hedeskrænten, only distribution network

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Budget prices – all inclusive





Hedeskrænten 85- 107	Pipe trench	dimension	service pipe	Investment cost (bu	udget)	
				Material cost	pipe work	excavation
	m kanal	mm	antal	kr	kr	kr
TwinPipe/LOGSTOR	70,5	ø48,3-48,3/180	0	31.909	14.036	40.447
TwinPipe/LOGSTOR	67	ø42,4-42,4/180	0	13.240	9.986	21.708
TwinPipeLOGSTOR	58,1	ø33,7-33,7/160	0	11.260	9.374	18.824
TwinPipeLOGSTOR	73,3	ø26,9-26,9/140	0	12.454	9.441	28.838
Pair of pipes/LOGSTOR	1	ø139,7ł280	0	4.672	5.219	1.187
Pair of pipes/LOGSTOR	1	ø26,9/125	0	1.531	3.034	621
	270,9			75.066	51.090	111.625

Heat loss calculation series 2 and 3

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55/25°C

Те	mperature		S	ystem Para	meters	;				Finance						CO2-em	ission			
Flo Re	Winter 55 turn 25	Summer 55 25	D	efinition λ PUR alculating year oil cover (h)	Average 30 600	perio	d ·	~		Currency price / kWł Interest rat	h te [%]	DKK 0.35 4		~		Fuel type Efficiency [9 Operation	Natural Gas 85 8760	~		
[°C An [°C Da] nbient 8] ys 365	8	A P C	nm imbient UR, use λ erticate	soil, λ= 1 No	1.6 W/	mK	~								Time/Year			Serie 2	2
			D	lataset	LOGSTO	R-3		*											Serie 3	3
1.	Hedeskrænten	serie 2												C	alculate	Add pipe Delete	pipe Copy Project	Delete project		
10 1	Type of system	PipeSystem	Length (m)	C (mm)	Series	d1	d1		D1	Series	s d2	d2	*	D2	Diff.	Lambda	W/m	MWh/year		
2	Pair(eq.)	Steel Conti	1	150	3	* *	125	~	280	3	~	125	~	280		0.023	12.51	(h) 0.11		
3	TwinPipe 🗸	Steel Conti 🗸	73		2	~	20	~	140	2	~	20	~	140	A	0.023	4.54	2.91		
4	TwinPipe 🗸	Steel Conti 🗸 🗸	58		2	~	25	~	160	2	~	25	~	160	1	0.023	4.82	2.45		heat loss(MWh/
5	TwinPipe 🗸	Steel Conti 🗸 🗸	67		2	~	32	~	180	2	~	32	~	180	s.	0.023	5.32	3.12	14 13	
6	TwinPipe 🗸	Steel Conti 🗸 🗸	70		2	~	40	~	180	2	~	40	~	180	1	0.023	6.19	3.80	13 12 12	
																	Total MWh/year	12.44	11 - 11 - 10 - 10 -	
2.	Hedeskrænten	; serie 3												C	alculate	Add pipe Delete	pipe Copy Project	Delete project	9- 9- 8-	
No	Type of system	PipeSystem	Length (m)	C (mm)	Series	d1	d1		D1	Series	s d2	d2		D2	Diff.	Lambda	W/m	MWh/year	7 · 7 · 6 ·	100
1	Pair(eq.) 🗸	Steel Conti 🗸 🗸 🗸	1	150	З	~	20	~	125	3	~	20	~	125	A.	0.023	5.84	0.05	6 · 5 · 5 ·	12
2	Pair(eq.) 🗸	Steel Conti 🗸 🗸 🗸	1	150	З	~	125	~	280	3	~	125	~	280	s.	0.023	12.51	0.11	4 - 4 - 3 -	_
3	TwinPipe 🗸	Steel Conti 🗸 🗸 🗸	73		з	~	20	~	160	3	~	20	~	160	1	0.023	4.01	2.57	3 · 2 · 2 ·	
4	TwinPipe 🗸	Steel Conti 🗸 🗸 🗸	58		З	~	25	~	180	3	~	25	~	180		0.023	4.30	2.19		
5	TwinPipe 🗸	Steel Conti 🗸 🗸 🗸	67		З	~	32	~	200	3	~	32	~	200		0.023	4.75	2.79		Hedeskrænte
6	TwinPipe 🗸	Steel Conti 🗸 🗸	70		з	~	40	~	200	3	~	40	~	200	1	0.023	5.42	3.32		

Heat lossSerie 212,44 MWh/yearSerie 311,03 MWh/year

heat loss(MWh/year)	Saving		
		11%	
100% 12		89% 11	
 Hedeskrænten serie	2	Hedeskrænten: serie 3	

Total MWh/year 11.03





Service life cost over 30 years, 80/40 °C

Service Life Cost Price Install Price pipe Cost heat loss DKK x 1.000 420 400 380 360 340 320 300 34% 122 31% 108 280 260 240 220 200 180 46% 163 160 45% 163 140 120 100 80 60 24% 83 40 21% 75 20 0 Hedeskrænten series 2 - 80/40°C Hedeskrænten; series 3 - 80/40°C 360062,32 DKK 354439,52 DKK

12% saving on total cost by going for lower temperature if anything else is equal

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Simple return of investments series 2 vs series 3





Conclusions heat loss at 55/25 °C

- The heat loss is between 17-25% of the life cycle cost
 - The design of the trench has huge influence
 - The length of the service pipes has huge influence
- There is a potential in optimizing on pipe work and excavation
 There is too much "that is how we are used to work"
- With an energy price of 350 Dkk/MWh or more series 3 is getting interesting
- Return of investment is shortest at service pipe lines where dimensions are small
- Use service pipe lines that are diffusion tight against water vapour diffusion (steel, coppar or Alupex)
 - Secures that insulation proporties is not getting worse over time
- Use diffusion barrier in the casing
 - Secure that the insulation gasses stay in the foam
 - Insulation proporties will remain the same over life time
- In the hydraulic calculation the maximum effect for house connections must be evaluated
 - Secure that sevice pipes are not over sized
 - Eco-showers or Waterfall showers







Comparison Pex vs Steel as distribution pipe line

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- PexFlextra, Twin 63 x 63 mm
 - Limited in casing pipe diameter and higher insulation series
 - More expensive than steel
 - Flexibility when there are a lot of branches????
- Steel, Twin ø60,3, series 1,2,3
 - Possible to make system with much lower heat loss than PexFlextra in coils
 - · Higher insulation series are possible
- Assumptions for the calculation
 - Actual material cost
 - Base case on installation cost is TwinPipe steel where pipe material is 30%, pipework is 25% and excavation is 45%
 - Installation of PexFlextra 5% cheaper than TwinPipe steel series 1
 - Installation of TwinPipe steel series 2 and 3 is 5% more expensive per increase of series



Pipes in coils in bigger dimensions will only be competitive when there are no branches or fittings

Service pipe lines

- Chose a media pipe with no water vapor diffusion to the PUR foam
 - Alupex
 - Steel
 - Coppar
- Chose a Pre insulated pipe with diffusion barrier in the casing
 - To secure the low heat loss during entire life time





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