Challenge efficiency

SWEP Brazed Plate Heat Exchanger

CHALLENGE EFFICIENCY

Taking on the global energy challenge

- Specialized in Brazed Plate Heat Exchangers (BP
- Founded in 1983
- World-leading manufactu
- Pioneers in BPHE techn

ade

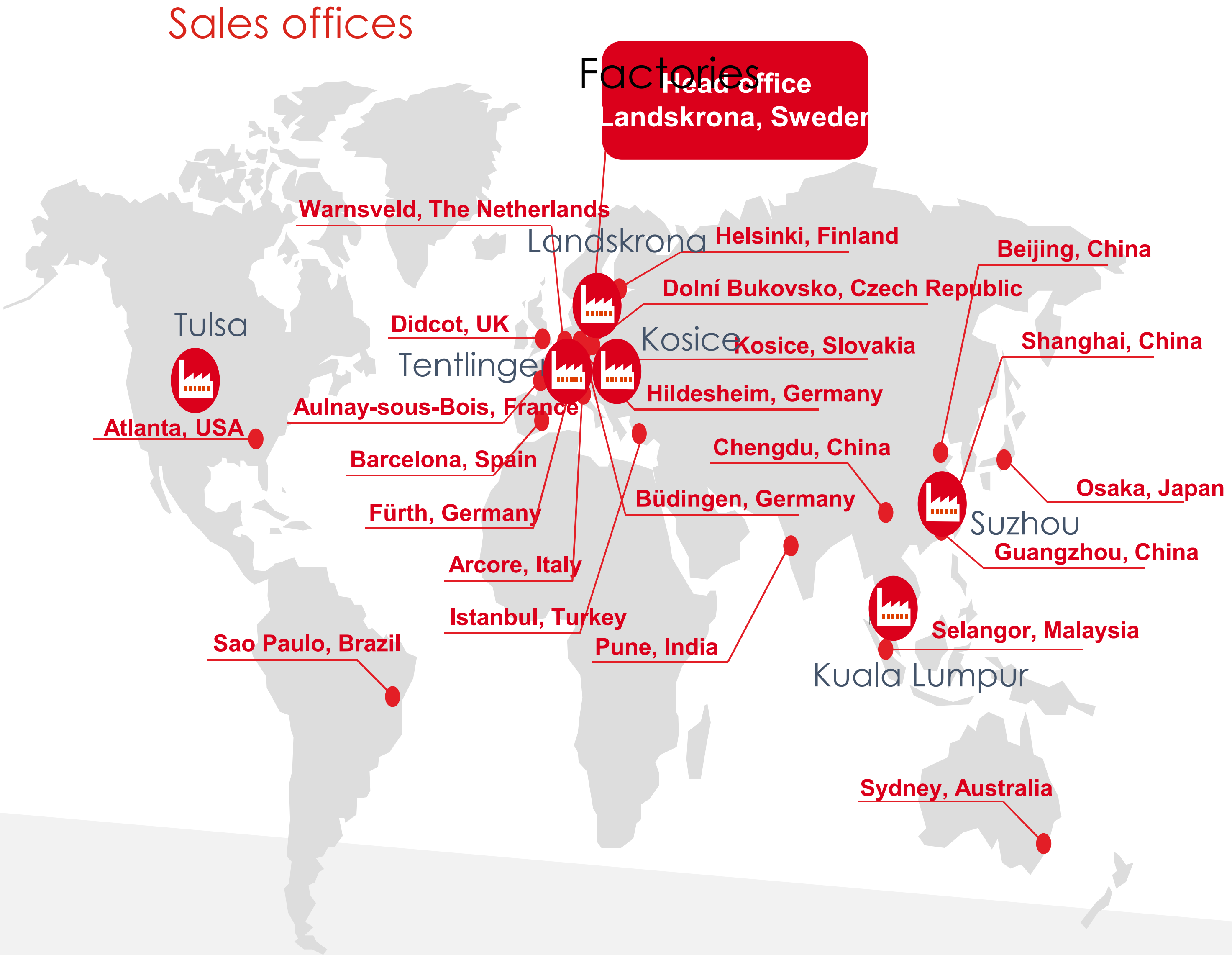
CIBSE
PATRONS

ukDEA.org.uk
The UK District Energy Association

CIBSE CPD

CHALLENGE EFFICIENCY

Global presence meets local demand



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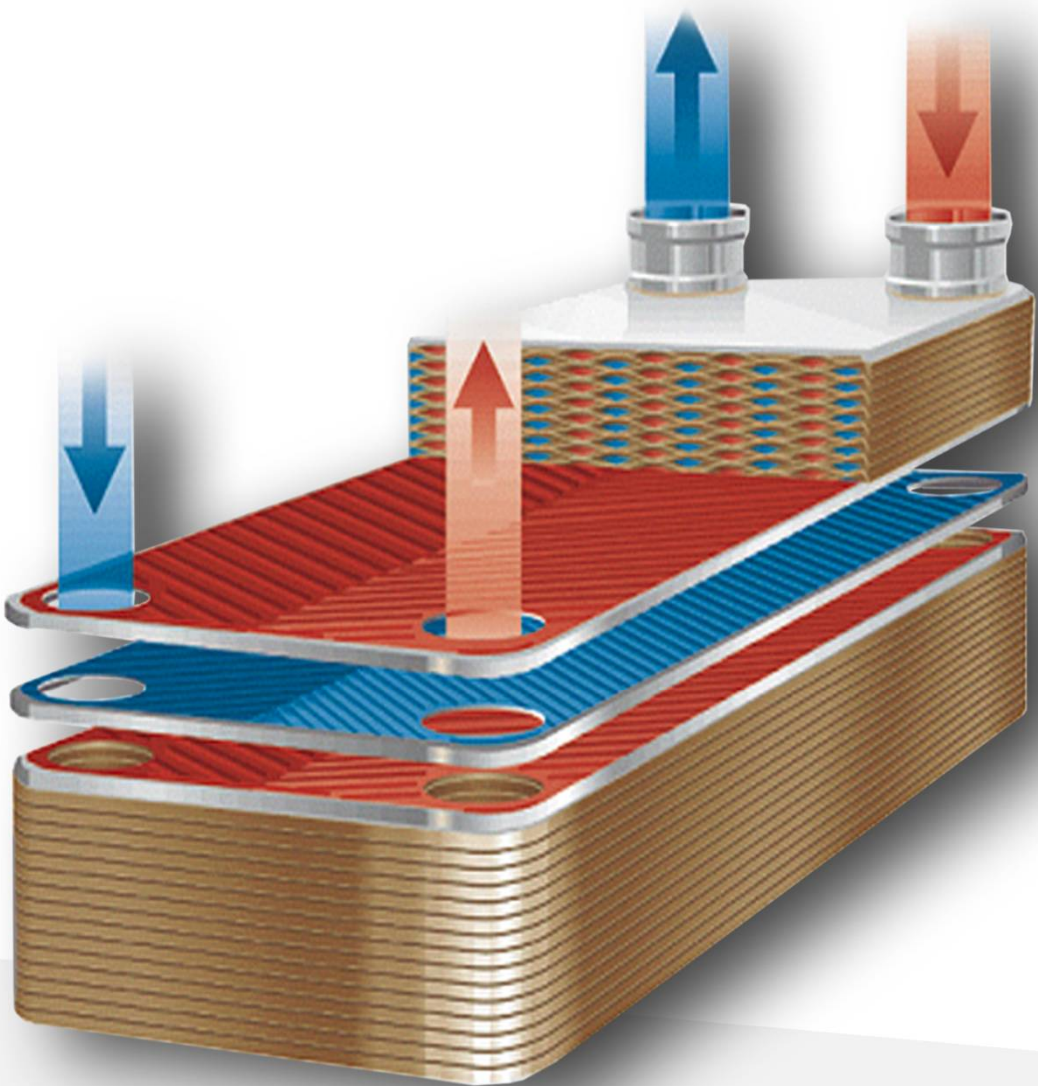
How a BPHE works



CHALLENGE EFFICIENCY

The importance of a large range

E5AS
Dimensions
:
72 x 187
mm
2.84 x 7.45
in

E5T
Dimensions
:
72 x 187
mm
2.84 x 7.45
in

B5
Dimensions
:
72 x 187
mm
2.84 x 7.45
in

E8T
Dimensions:
73 x 315 mm
2.84 x 7.45 in

B8T
Dimensions
:
72 x 310
mm
2.84 x 7.45
in

B10T
Dimensions:
117/119 x
287/289 mm,
4.61/4.68 x
11.31/11.37
in

B12
Dimensions
:
117 x 287
mm
4.61 x
11.31 in

B15
Dimensions
:
72 x 465
mm
2.84 x
18.32 in

B16
Dimensions
:
119 x 376
mm
4.69 x 14.8
in

B16D W
Dimensions:
119 x 377
mm
4.69 x 14.85
in

B25T V25T
Dimensions:
117/119 x
524/526 mm
4.61/4.68 x
20.65/20.71
in

B28
Dimensions
:
119 x 526
mm
4.69 x
20.72 in

B80 V80 P80 Q80
Dimensions
:
119 x 526
mm
4.69 x
20.72 in

B35
Dimensions
:
243 x 393
mm
9.57 x
15.48 in

B56
Dimensions:
243 x 525
mm
9.57 x 20.69
in

B57
Dimensions
:
243 x 693
mm
9.57 x
27.30 in

B60
Dimensions
:
364 x 374
mm
14.34 x
14.74 in

B120T
Dimensions:
243 x 525
mm
9.50 x 20.65
in

B427
Dimensions:
304 x 694
mm
11.97 x 27.32
in

B439
Dimensions:
304 X 979
mm
38.57 x 11.98
in

B649
Dimensions:
1232 mm x
537 mm
48.5 x 21.14

CHALLENGE EFFICIENCY

SWEP

Key Components

Heat Source → **Distribution Systems** "the buried network of pipes" → **Consumer Interface** "HIU or thermal substation or metering station → **The Customer** "the Building"

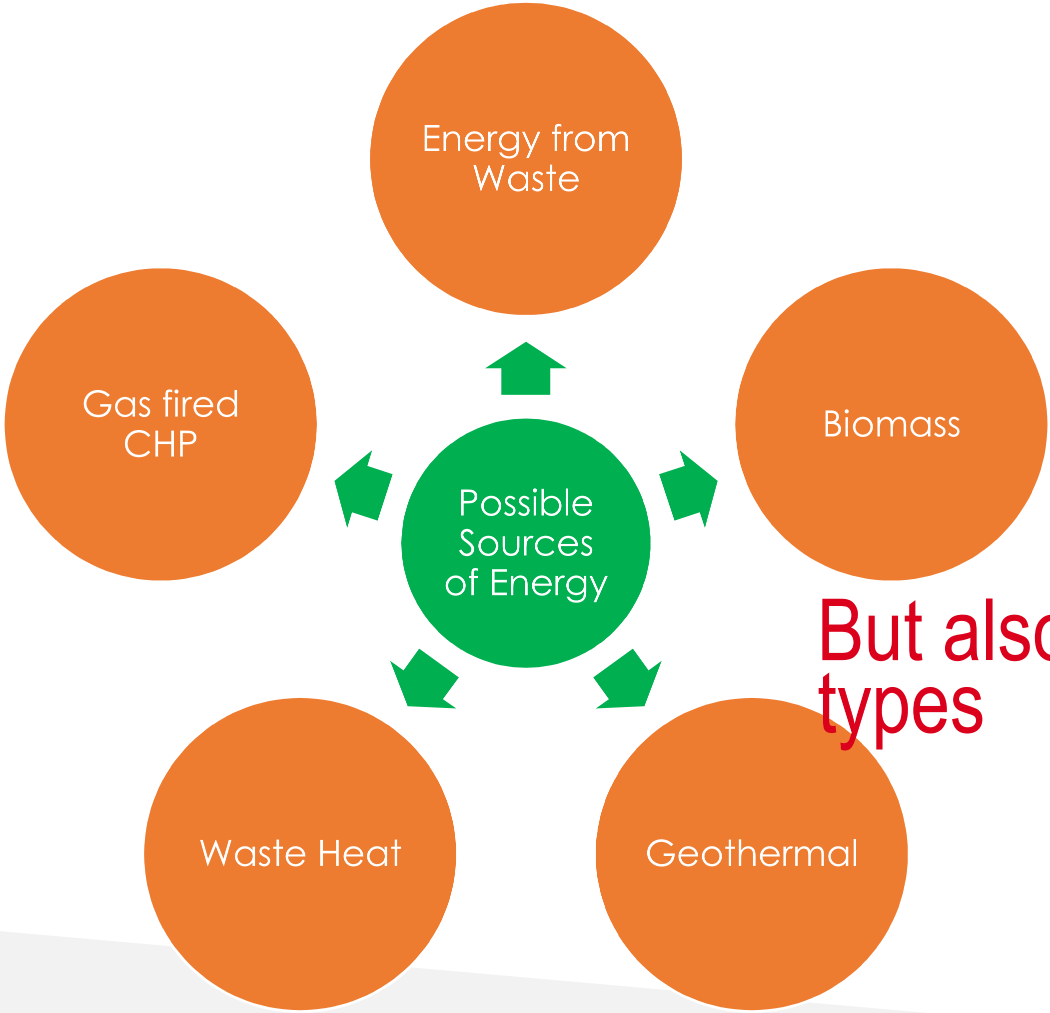
CHALLENGE EFFICIENCY

Source:

ukDEA .org.uk The UK District Energy Association

SWEP

District Energy ....it's Technology Agnostic



But also a mix of building types

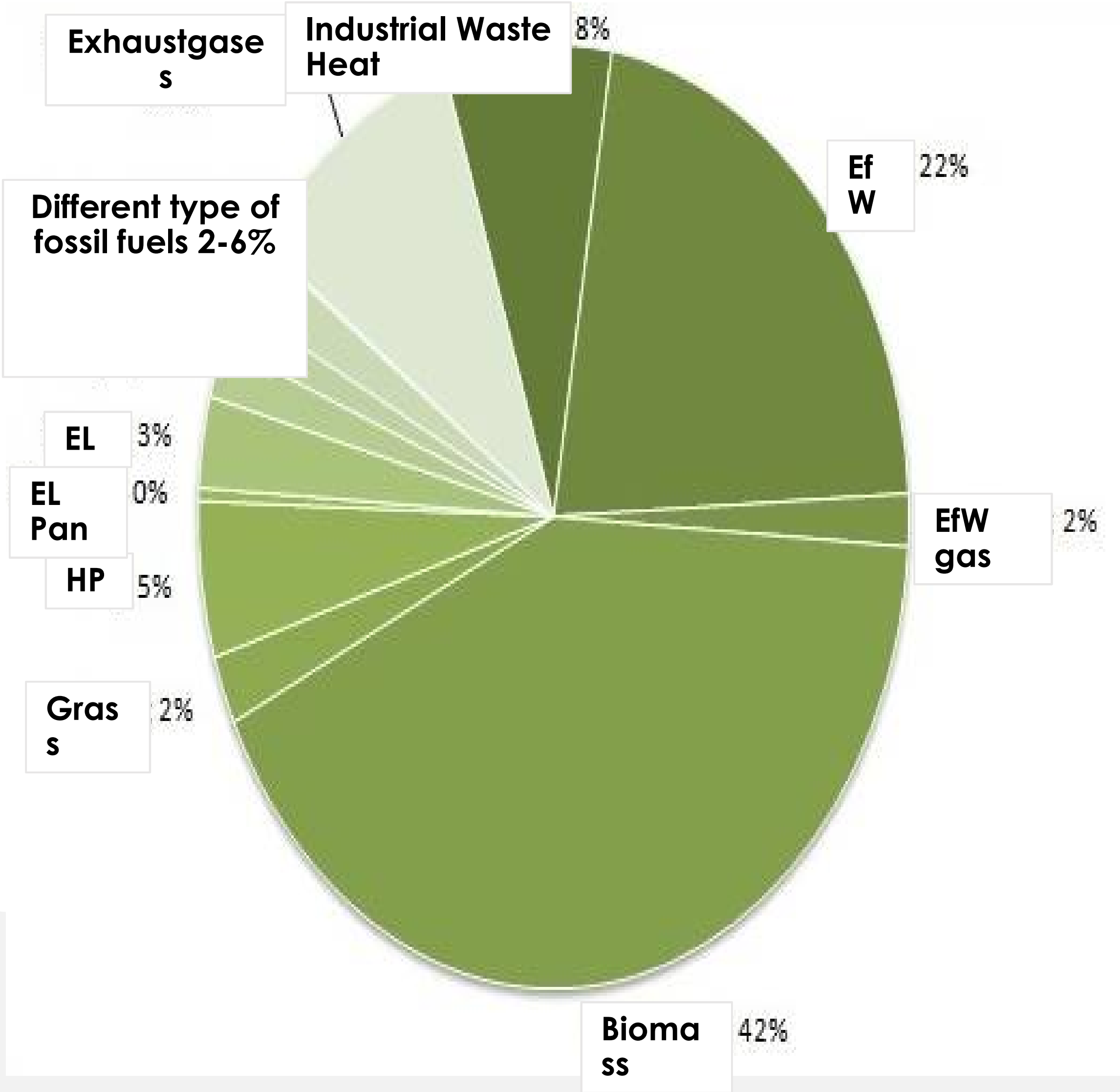
Source:

ukDEA .org.uk The UK District Energy Association

CHALLENGE EFFICIENCY

SWEP

Heat – Where does it come from?

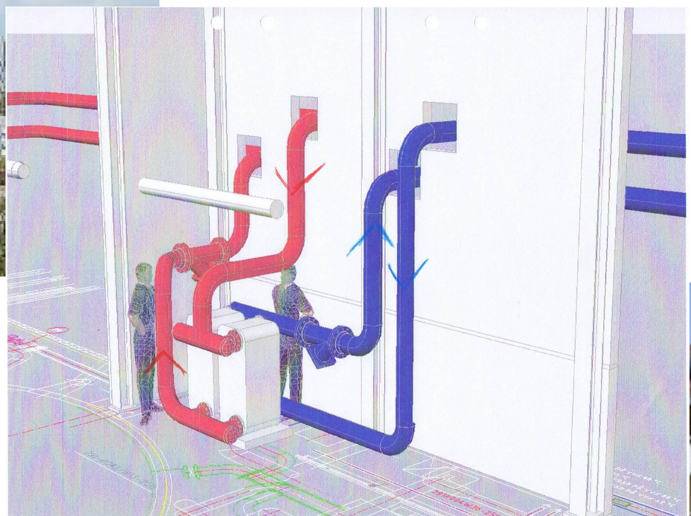


CHALLENGE EFFICIENCY

SWEP

Waste Heat

VÄRMEVÄRDEN - INDUSTRIAL WASTE HEAT (STORA ENSO GRUMS, SWE)



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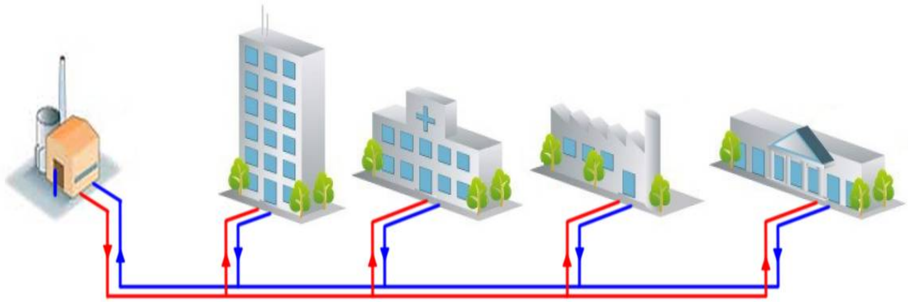
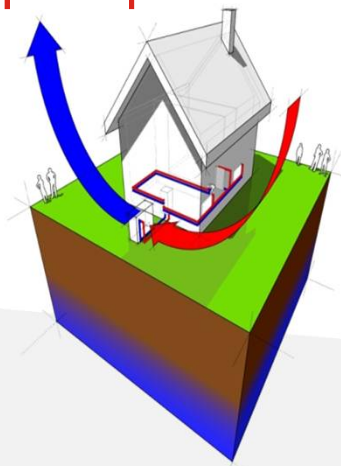
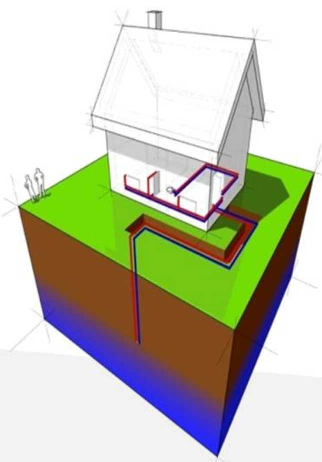
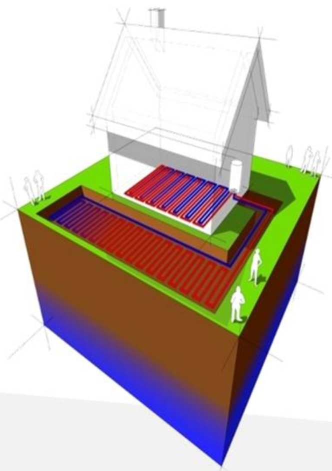
Heat Pump in District Heating……



……and not to be mixed with residential heat pumps







CHALLENGE EFFICIENCY

Evolution of Energy Transfer Stations

1st GENERATION
STEAM

2nd GENERATION
WATER
>100˚C

3rd GENERATION
WATER
<100˚C

4th GENERATION
WATER
<60˚C

Direct Systems

Block level

Building level

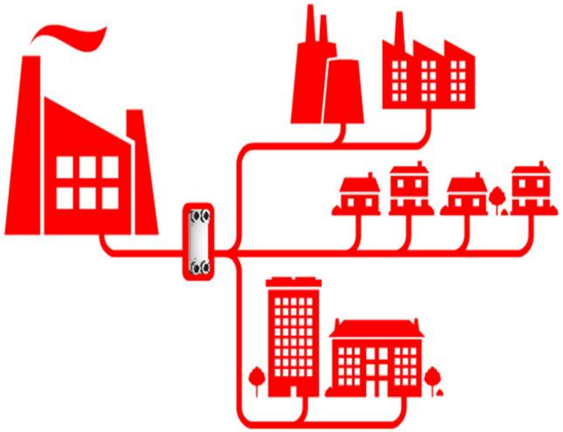
Apartment level / Hybrid systems

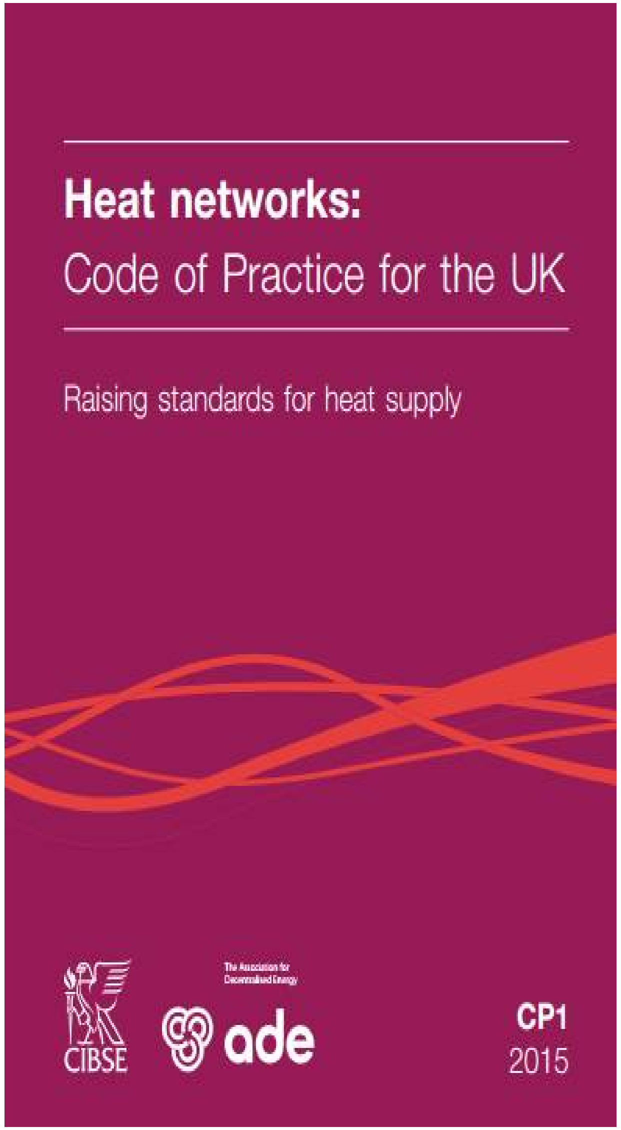
BPHE Application in District Heating

Energy system of today

CHALLENGE EFFICIENCY

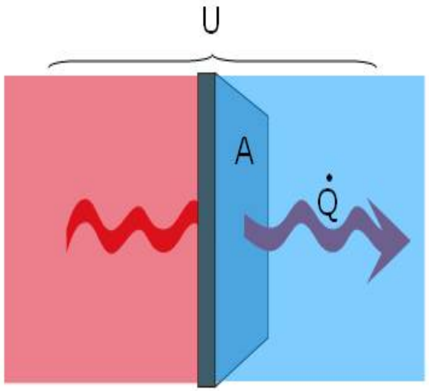
Design - the value of standardisation





Energy balance

$$\dot{Q} = U \cdot A \cdot LMTD$$

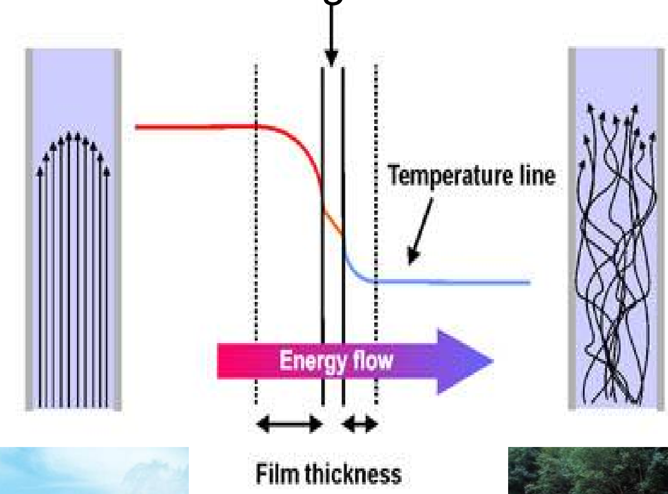


The energy content of a fluid

$$Q_{Fluid} = m \cdot c_P \cdot dT$$

Turbulence vs. pressure drop

- The resistant in the plate channel →pressure drop
- Pressure drop in the plate channels is good
- Turbulent flow
    - increases the heat transfer coefficient
    - reduces the risk of fouling



CHALLENGE EFFICIENCY

Investments analysis and LCC

(Heat Demand x Heat Tariff) + non-heat revenue + Capital

Investments cost + running cost

= IRR %

CHALLENGE EFFICIENCY

SWEP

Oversized – What actually happens?

DUTY REQUIREMENTS		Side 1	
Heat load	kW		2000
Inlet temperature	°C	105,00	
Outlet temperature	°C	75,00	
Flow rate	kg/s	15,85	
Max. pressure drop	kPa	50,0	
Thermal length		5,160	

PLATE HEAT EXCHANGER		Side 1	
Total heat transfer area	m²		57,7

List Price £ 4.347

DUTY REQUIREMENTS		Side 1	
Heat load	kW		450,0
Inlet temperature	°C	105,00	
Outlet temperature	°C	75,00	
Flow rate	kg/s	3,565	
Max. pressure drop	kPa	50,0	
Thermal length		5,160	

PLATE HEAT EXCHANGER		Side 1	
Total heat transfer area	m²		8,28

List Price £ 540

CHALLENGE EFFICIENCY

SWEP

Oversized – What actually happens?

DUTY REQUIREMENTS		Side 1	
Heat load	kW		450,0
Inlet temperature	°C	105,00	
Outlet temperature	°C	98,27	
Flow rate	kg/s	15,85	
Max. pressure drop	kPa	50,0	
Thermal length		0,400	

PLATE HEAT EXCHANGER		Side 1	
Total heat transfer area	m²		57,7

List Price £ 4.347

CHALLENGE EFFICIENCY

Diversity curves

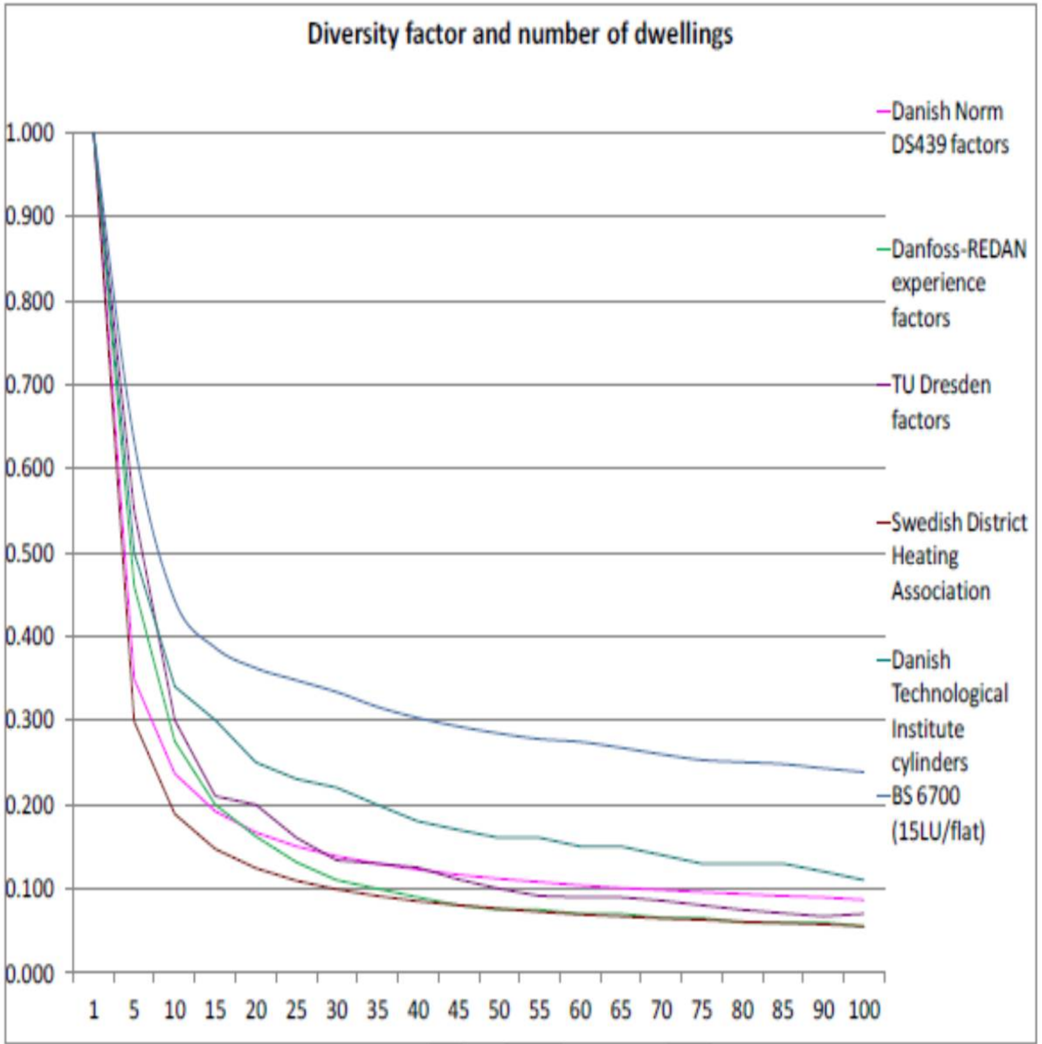
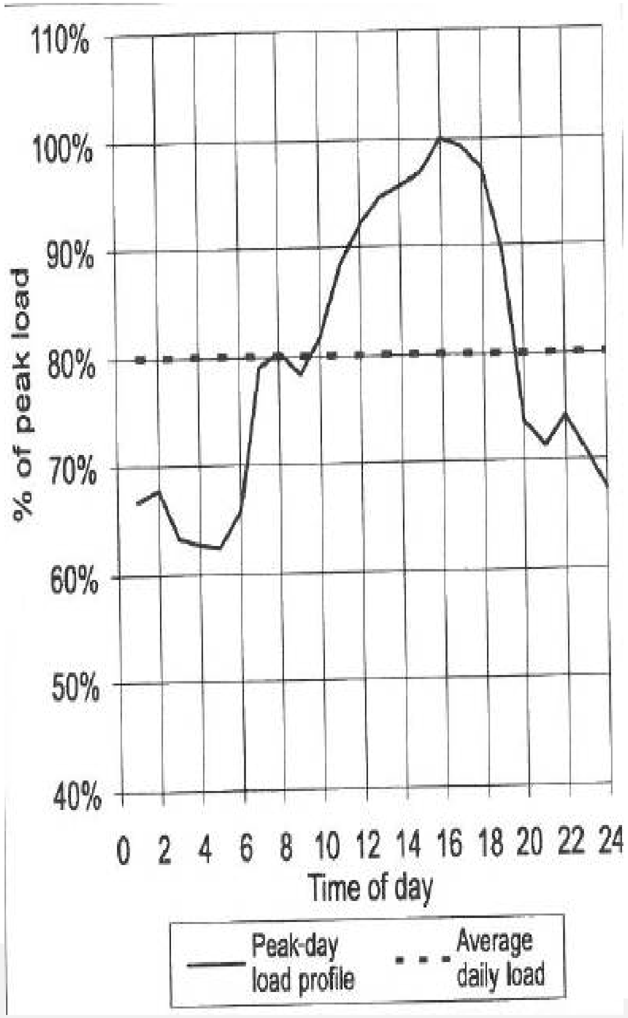


Figure 3.2 – Diversity factors for instantaneous domestic hot water systems for dwellings (with acknowledgement to SAV Ltd)

Load profile vs nominal conditions vary a great deal



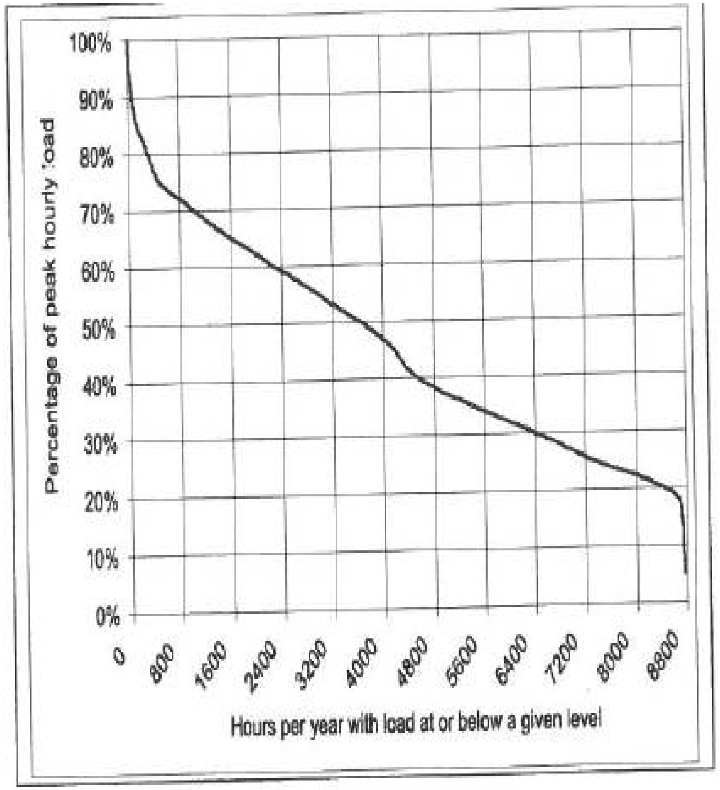
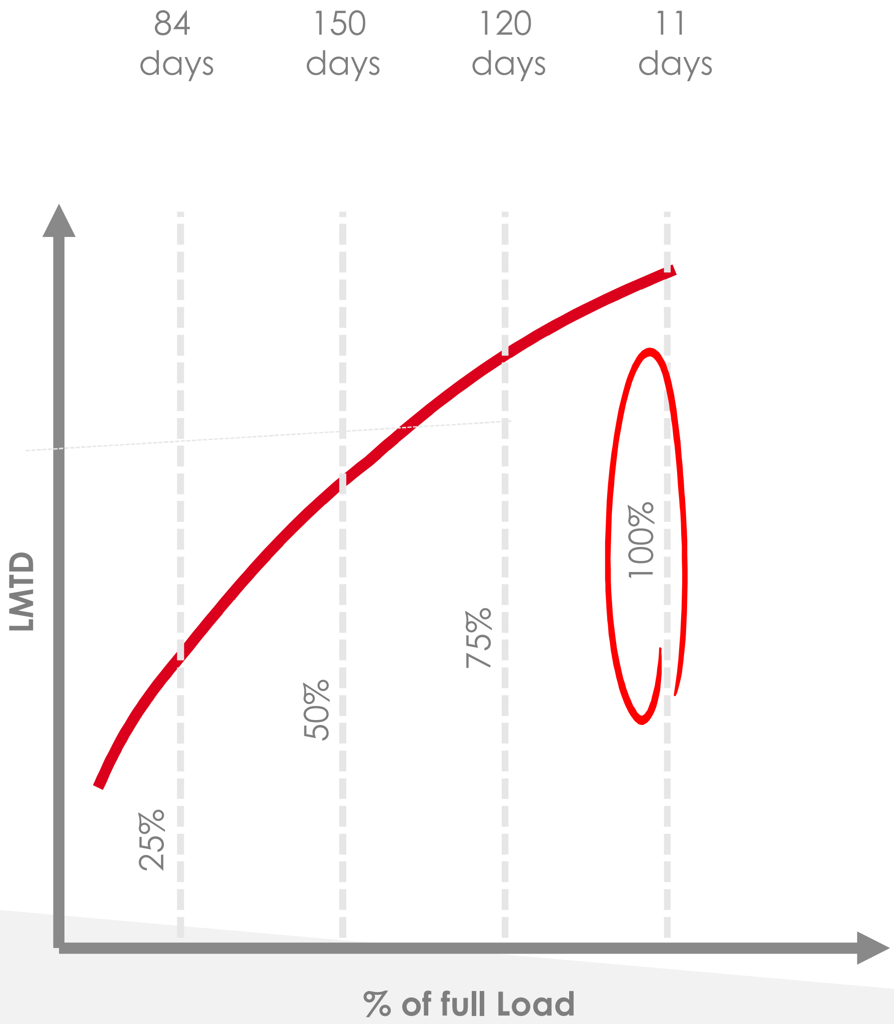


Figure 4-5. Illustrative district cooling annual load-duration curve.

ESEER (European seasonal energy efficiency ratio) calculation - what is realistic?



CHALLENGE EFFICIENCY

Investments analysis and LCC

$$\frac{\text{(Heat Demand x Heat Tariff) + non-heat revenue + Capital}}{\text{Investments cost + running cost}} = \text{IRR \%}$$

CHALLENGE EFFICIENCY

Parameters to consider

PROJECT TITLE	**LCC Plate Heat Exchanger**					
REFERENCE						
DATE OF ANALYSIS	**03-jul-15**					
DISCOUNT RATE USED FOR ANALYSIS	**3**	**STUDY PERIOD**	**15**	It is usual to enter the discount rate in % per annum and the study period in years, but other units can be chosen provided both are consistent		
				GPHE	**BPHE**	Eth Glycol 30%, 12 - 6 C Eth Glycol 30%, 10 - 4 C
Study period (if different)				15	15	Normal techical life time
Construction NPV				**€ 10 395,15**	**€ 12 669,90**	Real quotations
Maintenance NPV				**€ 8 595,86**	**€ 0,00**	Regasketting every 5th year
Operation NPV				**€ 0,00**	**€ 0,00**	Heat looses in the units
Occupation NPV				**€ 0,00**	**€ 0,00**	
End of Life NPV				**€ 385,12**	**€ 170,72**	Decommissioning cost
TOTAL LIFE CYCLE COST				**€ 19 376,12**	**€ 12 849,62**	
EQUIVALENT ANNUAL COST				**€ 1 623,07**	**€ 1 076,37**	
NET SAVING				**€ 6 526,50**		
SAVINGS-TO-INVESTMENT RATIO (SIR)				**4,15**		

Alternative 1 has lowest Life cycle cost

CHALLENGE EFFICIENCY

Nya Karolinska Sjukhuset, Stockholm (hospital building)

- Started in 2010
- First phases equipped with Gasketed Plate Heat Exchangers (PHEs)
- Change to BPHEs: Operational dependability and low life cycle costs
- 150 SWEP BPHEs supplied in phase 4 & 5

CHALLENGE EFFICIENCY

Low Return Temperature: perpetual debate with British consultants

DUTY REQUIREMENTS		Side 1		Side 2
Heat load	kW		500,0	
Inlet temperature	°C	75,00		20,00
Outlet temperature	°C	60,00		60,00
Flow rate	kg/s	**7,956**		2,991
Max. pressure drop	kPa	50,0		50,0
Thermal length		0,588		1,569

DUTY REQUIREMENTS		Side 1		Side 2
Heat load	kW		500,0	
Inlet temperature	°C	75,00		20,00
Outlet temperature	°C	40,00		60,00
Flow rate	kg/s	**3,414**		2,991
Max. pressure drop	kPa	50,0		50,0
Thermal length		2,014		2,301

DUTY REQUIREMENTS		Side 1		Side 2
Heat load	kW		500,0	
Inlet temperature	°C	75,00		20,00
Outlet temperature	°C	22,00		60,00
Flow rate	kg/s	**2,257**		2,991
Max. pressure drop	kPa	50,0		50,0
Thermal length		8,215		6,200

CHALLENGE EFFICIENCY

Heat losses: perpetual debate with British consultants

- Ground/Ambient Temperature – 10DegC
- Conductivity – 1.5W/mK

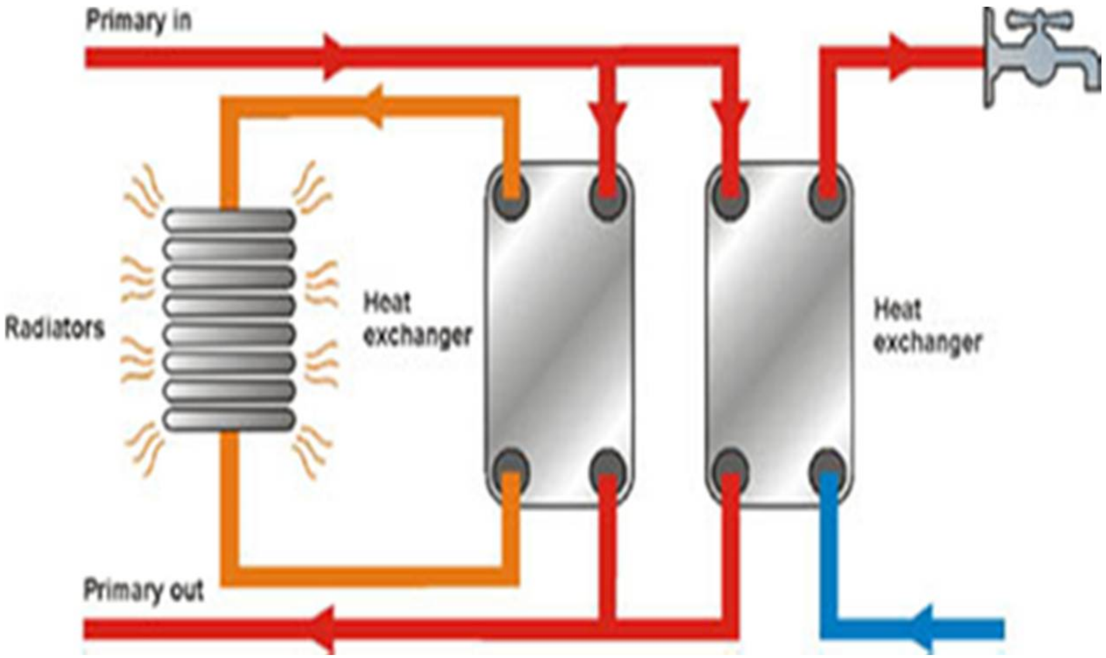
Cover - 600mm

Flow	Return	Differential	Series-1	Series-2	Series-3	Series-4	Unit
95	75	20	352.8	295.8	257.5	226.9	W/mK
75	45	30	235.2	197.2	171.7	151.3	W/mK
Reduction in Losses			**117.6**	**98.6**	**85.8**	**75.6**	**W/mK**

CHALLENGE EFFICIENCY

SWEP

A substation – Parallel System



System description

By using separate heat exchangers for the space heating and the hot tap water systems, the primary heat carrier is cooled in only one stage per system . A district heating substations with this arrangement is categorized as a one-stage configuration or more commonly a parallel configuration. The SWEP concept corresponds to the parallel configuration due to its simplicity and robustness. This layout is simpler that the two-stage layout.

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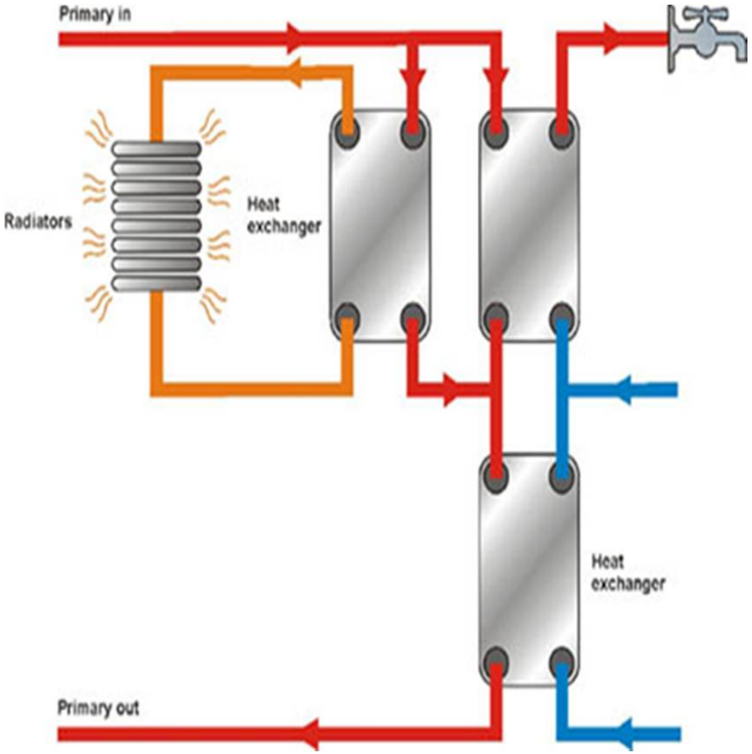
A substation – 2 Stage System



<u>System description</u>

The primary return flow from the radiator heat exchanger is mixed with primary flow from the so-called after-heater. The mixed flow then enters a third heat exchanger, the preheater. The main purpose of the preheater is to preheat the cold water before it enters the after-heater. This utilizes some heat from the radiator system and ***cools the primary heat carrier before it returns to the production plant***. The after-heater and the preheater are often in one heat exchanger known as a two-stage heat exchanger.

Space Heating

Temperature levels for secondary space heating systems

Heating system	District heating system supply temperature High- / low-temp. system	District heating system return temperature	Space heating system supply temperature	Space heating system return temperature
Space heating systems in new buildings	100/75 °C	<22 °C <48 °C <43 °C	40 °C 60 °C 60 °C	20 °C 45 °C 40 °C
Ventilation systems in new buildings	100/75 °C	<33 °C	60 °C	30 °C
Space heating systems in older buildings built in accordance with 1975 Building Regulations or earlier	100 °C	<63 °C	80 °C	60 °C

Table 4. Temperature levels for secondary space heating systems.

Table 3.1 - Preferred operating temperatures for new building services systems

Circuit	Flow temperature °C	Return temperature °C
Radiators	max 70	max 40
Fan-coil Units	max 60	max 40
Air Handling Unit	max 70	max 40
Underfloor heating	See Note	See Note
Domestic DHWS instantaneous heat exchanger on load	min 65	max 25
Domestic DHWS cylinder with coil heat up from cold	min 70	max 45
DHWS calorifier with external plate heat exchanger	min 70	max 25

Note: underfloor heating systems will typically operate with floor temperatures below 35°C and typically flow temperatures of 45°C which is advantageous for heat networks as this will result in low return temperatures

TELE2 Arena

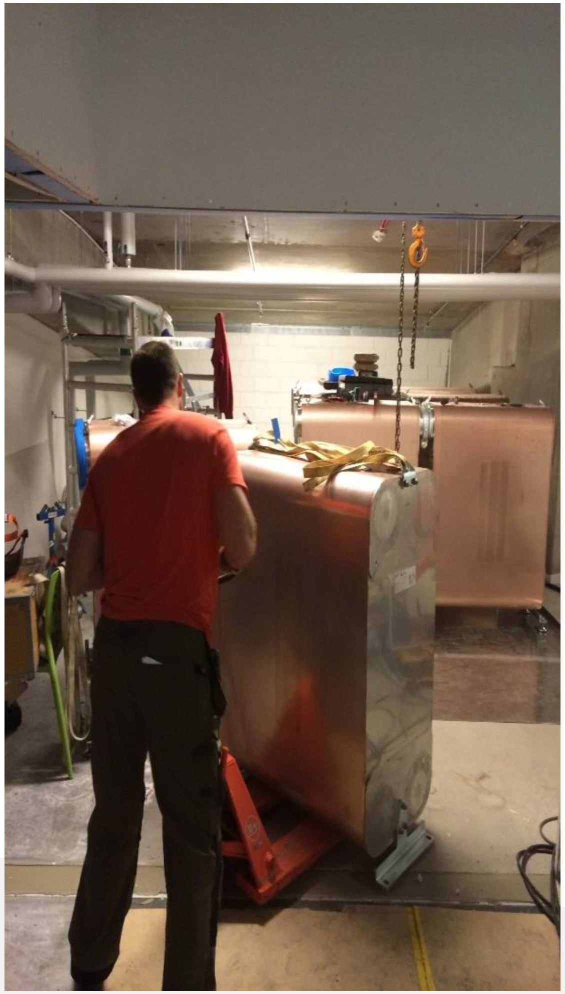
CHALLENGE EFFICIENCY

SWEP

Delivery through a standard door (90 cm) in one hour

CHALLENGE EFFICIENCY

Eight units: positioned with a hand truck in one hour



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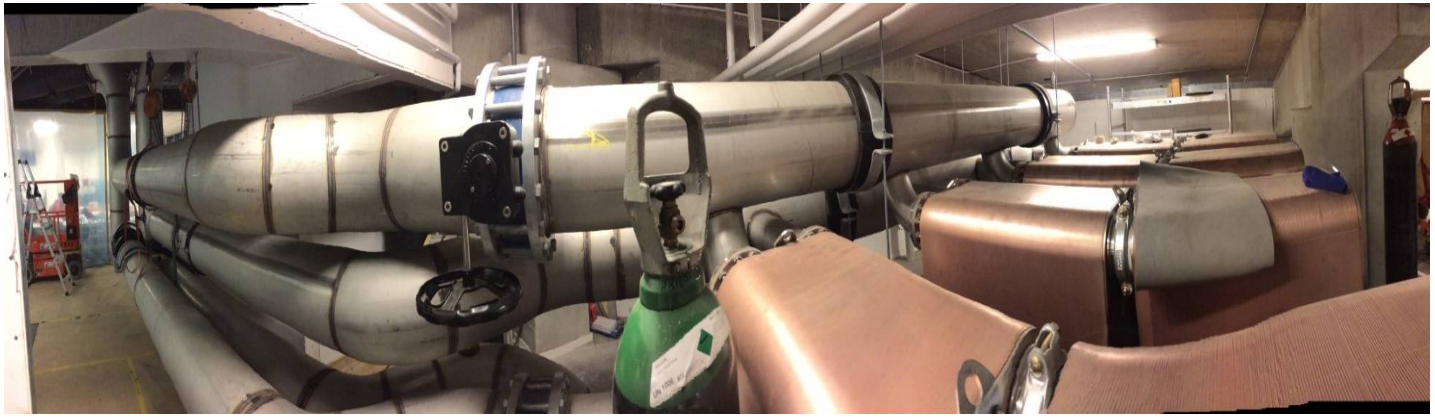
SWEP

A quick change from green grass to hard ice



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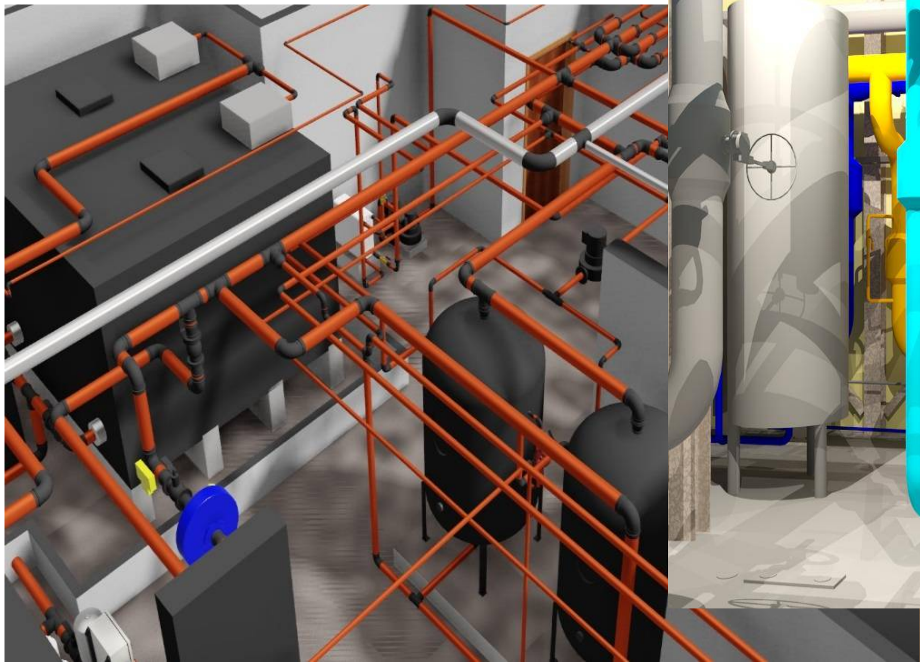
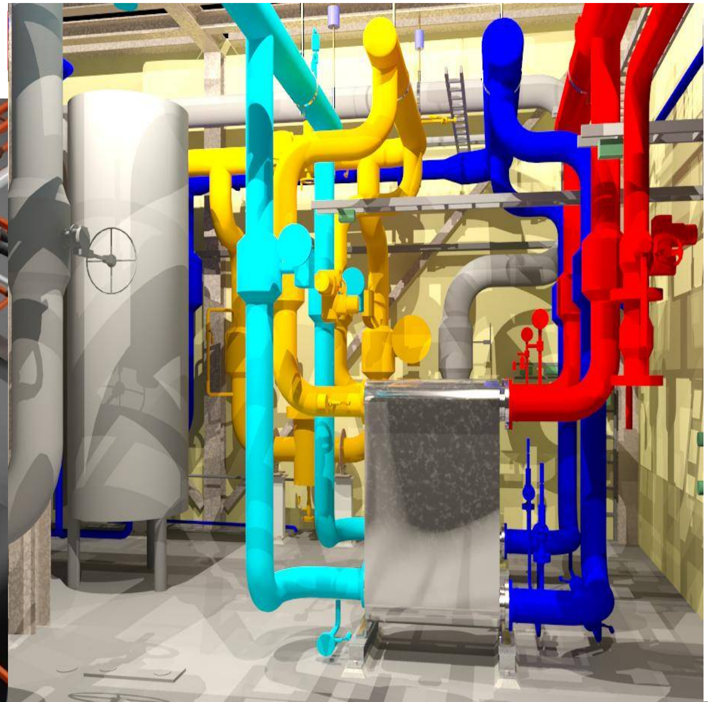
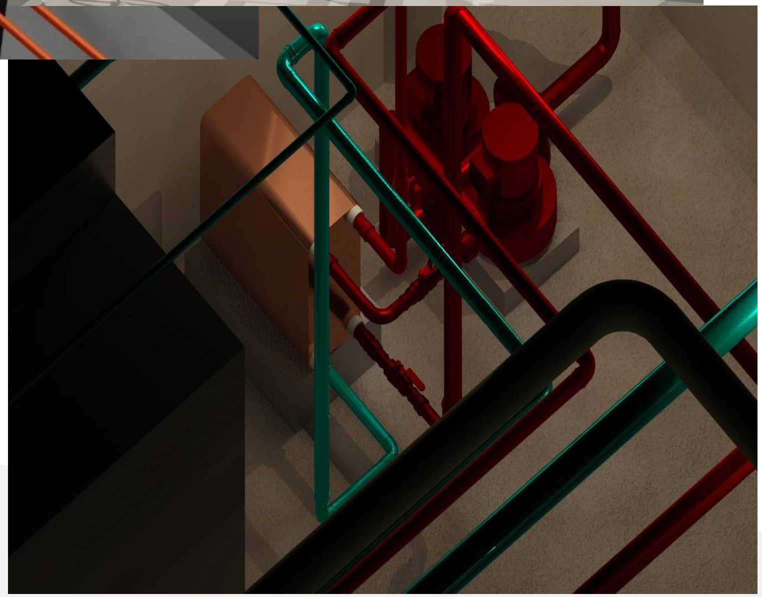
SWEP in NBS BIM Li







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Thank You!

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