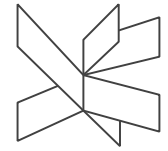


4<sup>th</sup> International Conference on Smart Energy Systems and 4th Generation District Heating  
Aalborg, 13-14 November 2018

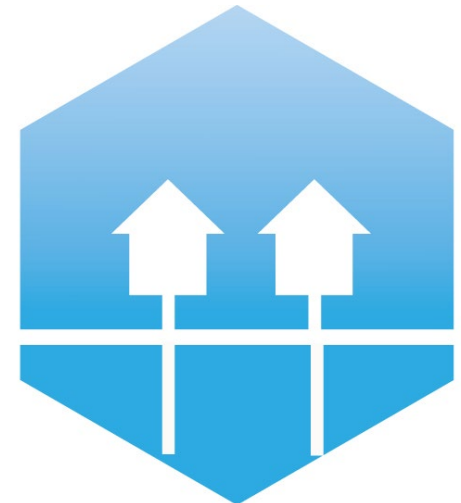
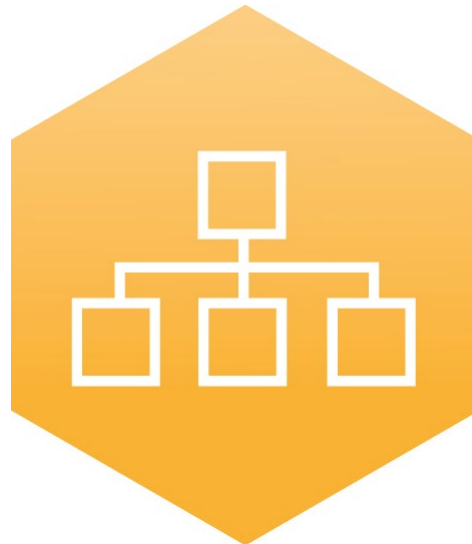


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Bring ideas to life  
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# Integration of heating and ventilations systems in households



**AALBORG UNIVERSITY**  
DENMARK

4th International Conference on Smart Energy  
Systems and 4th Generation District Heating 2018  
#SES4DH2018

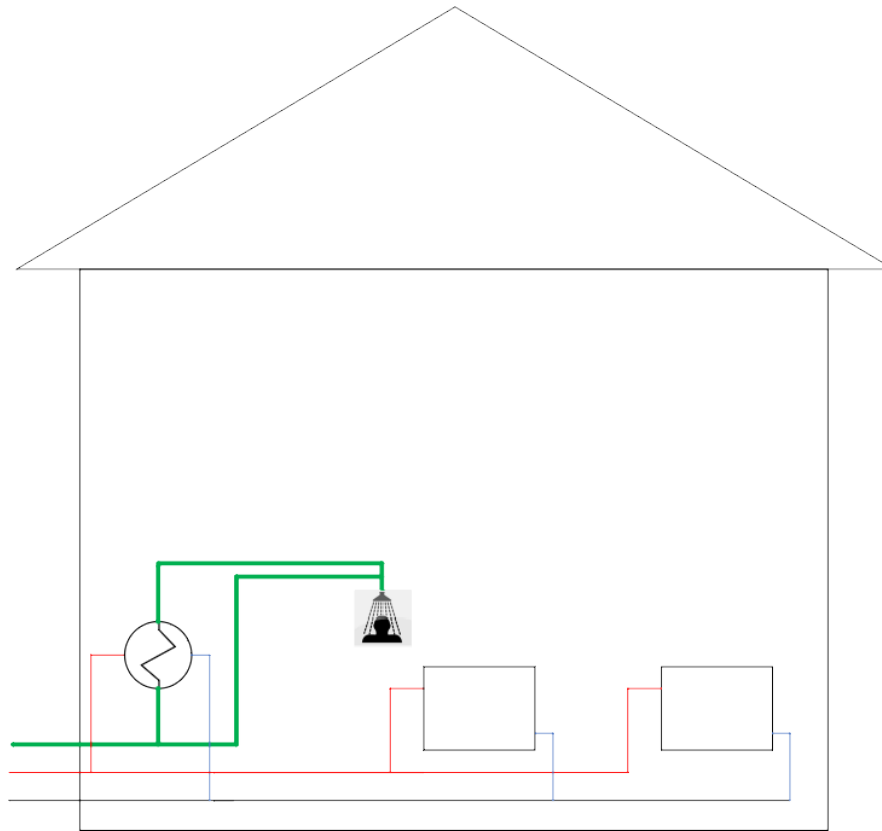
**4DH**  
4th Generation District Heating  
Technologies and Systems

Why discuss house installations at a district heating conference?

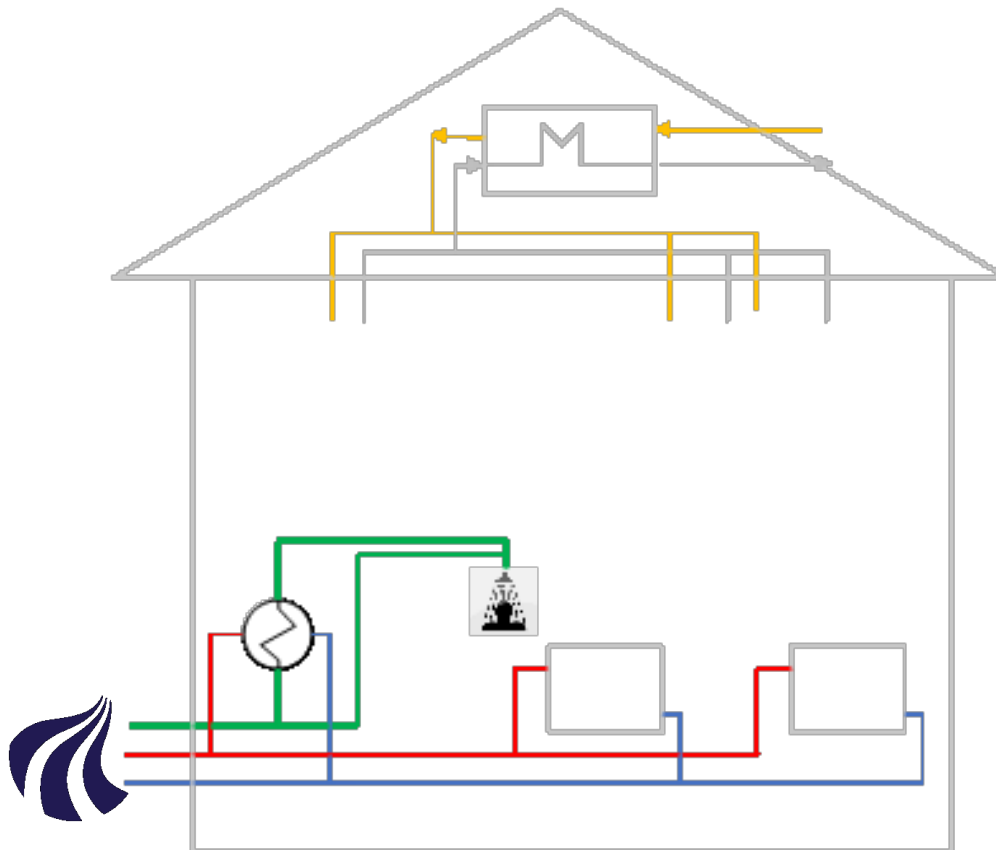
Because ventilation system influences district heating system and offers interesting opportunities.



# House with traditional heating system



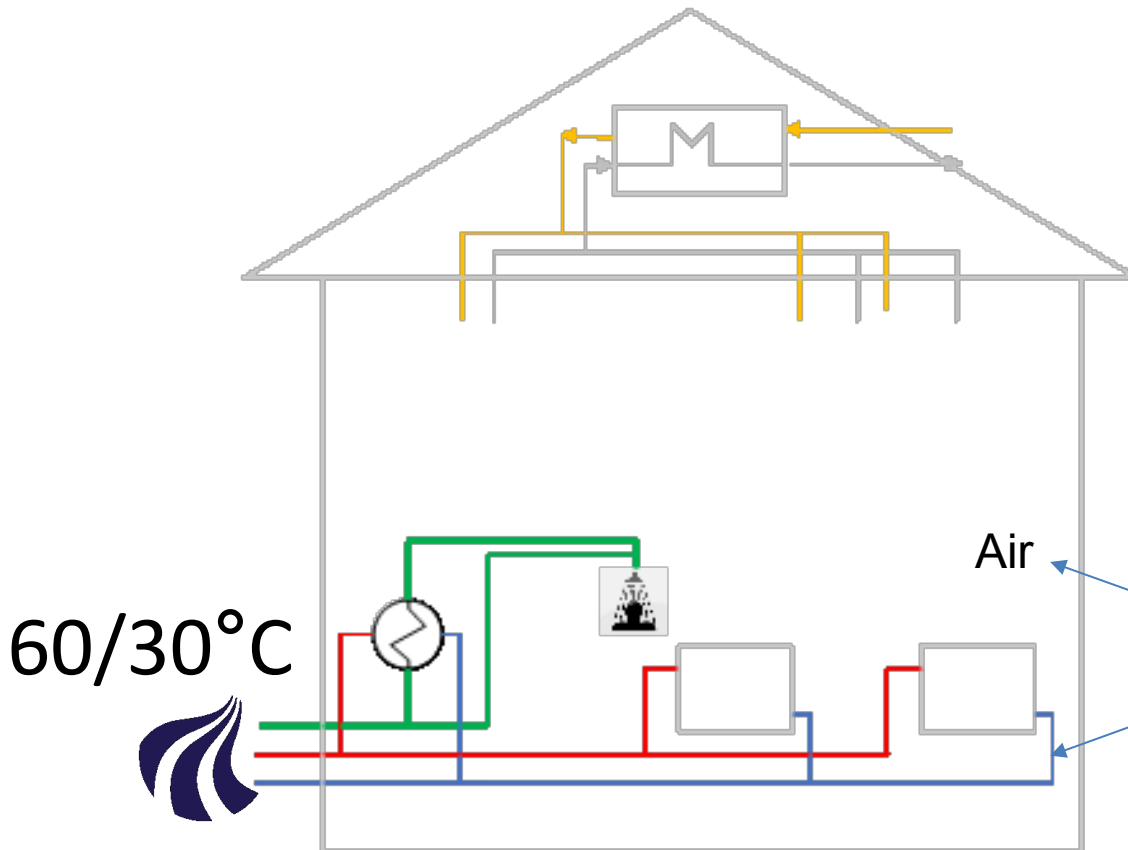
# House with ventilation:



Question:  
what happens if somebody  
like to have a little more heat  
and turn up for the heating  
system or start using the  
stove?



# Temperature differences



Indoor temperature  $\approx 22^\circ\text{C}$ .  
 $T_{\text{return}} \geq 27^\circ\text{C}$

Is it possible to cool to DH water  
to temperatures lower than  $27^\circ\text{C}$ ?

60/30°C



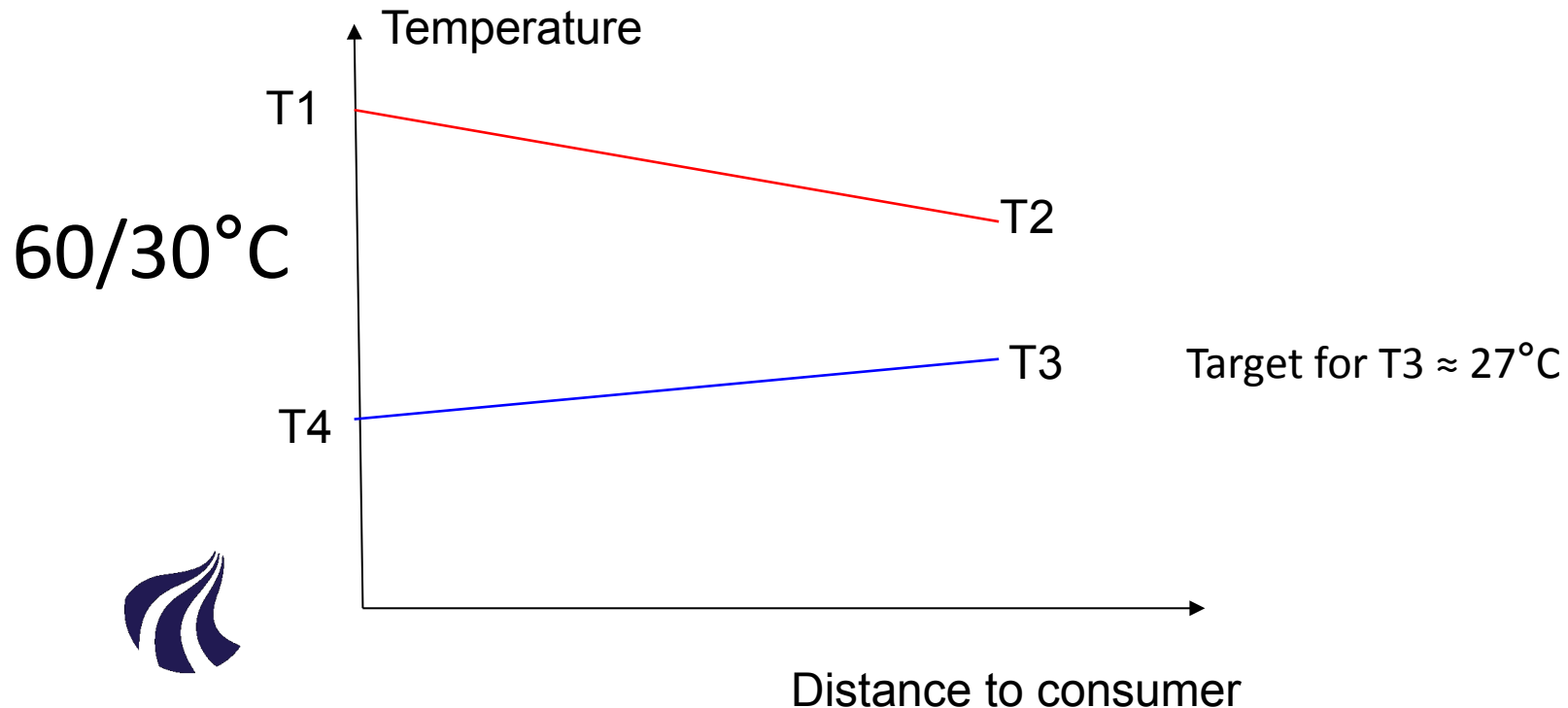
Well working  
 $\Delta T < 5$

# Temperatures in grid

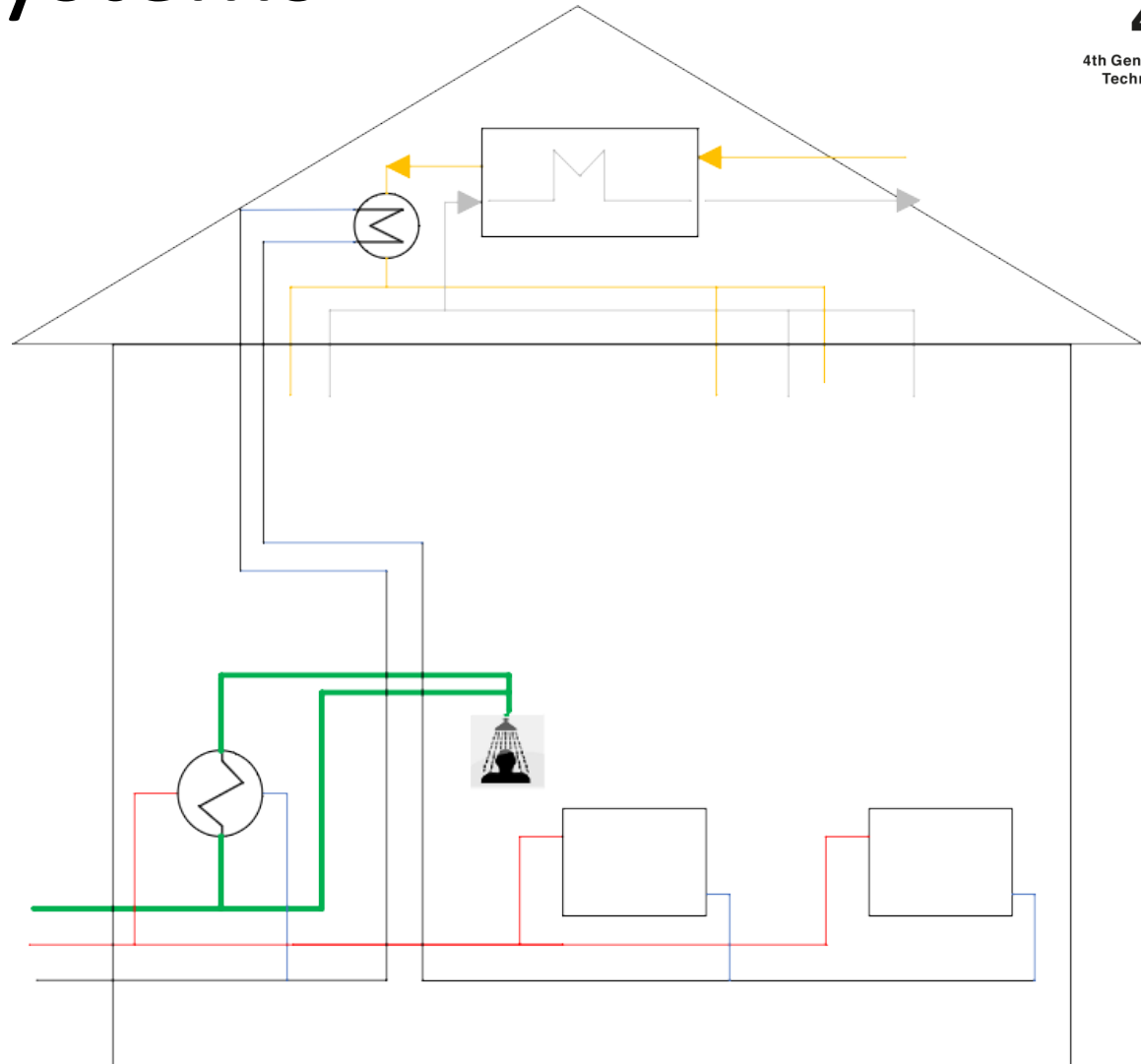


What is the temperatures at the consumer:  
Grid loss: 20%

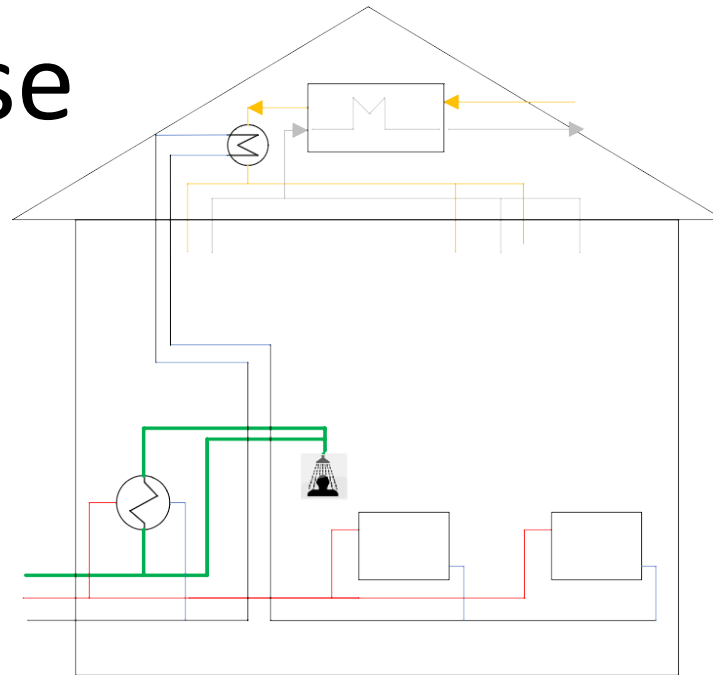
$T_1=60$      $T_2=55,8$      $T_3=31,8$      $T_4=30$



# How to integrate ventilation and heating systems



# Ordinary house

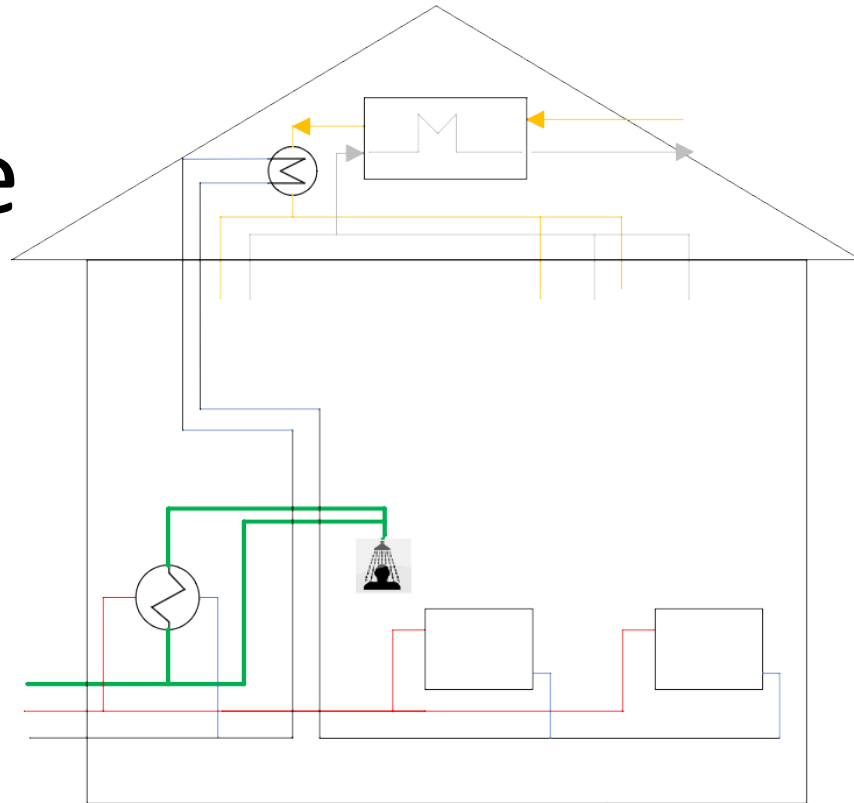


Ventilation	
	0,3 l/s/m <sup>2</sup>
	150 m <sup>2</sup>
	162 m <sup>3</sup> /h
	0,054 kg/s

T <sub>out</sub>	25	20	15	8	0	-12	°C
T <sub>in</sub>	27	23	22	22	22	21	°C
Hour	200	1550	2000	3000	2000	10	
Q <sub>house</sub>	0,00	0,00	0,44	2,00	3,77	6,43	kW
T DH water return	30	30	30	30	30	30	°C
T DH water return after HX	30,0	30,0	26,5	24,4	25,5	26,0	°C
T air in after ventilation	26,5	22,25	20,25	18,5	16,5	12,75	°C
Q transferred in HX	0,0	0,0	0,1	0,5	0,5	0,7	kW



# Super low energy house

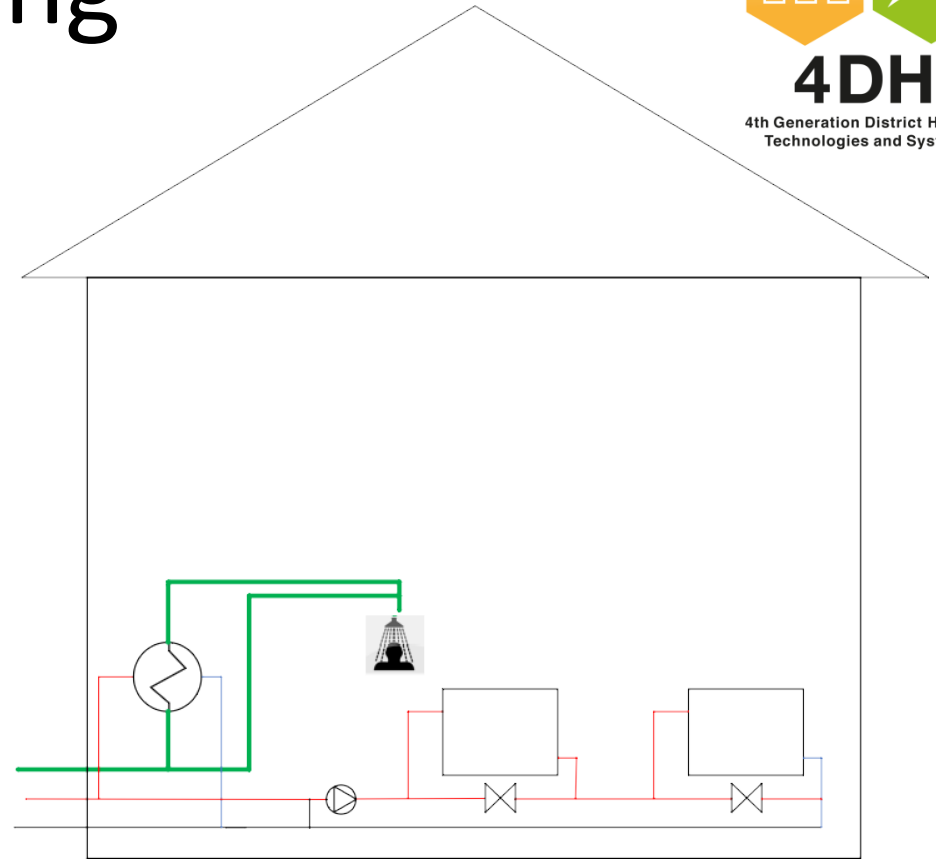


<b>T_out</b>	<b>25</b>	<b>20</b>	<b>15</b>	<b>8</b>	<b>0</b>	<b>-12</b>	°C
T_in	27	23	22	22	22	21	°C
Hour	200	1550	2000	3000	2000	10	hour
Q_house	0,0	0,0	0,1	0,4	0,8	1,3	kW
T DH water return after h	30,0	30,0	26,5	24,4	22,9	20,8	°C



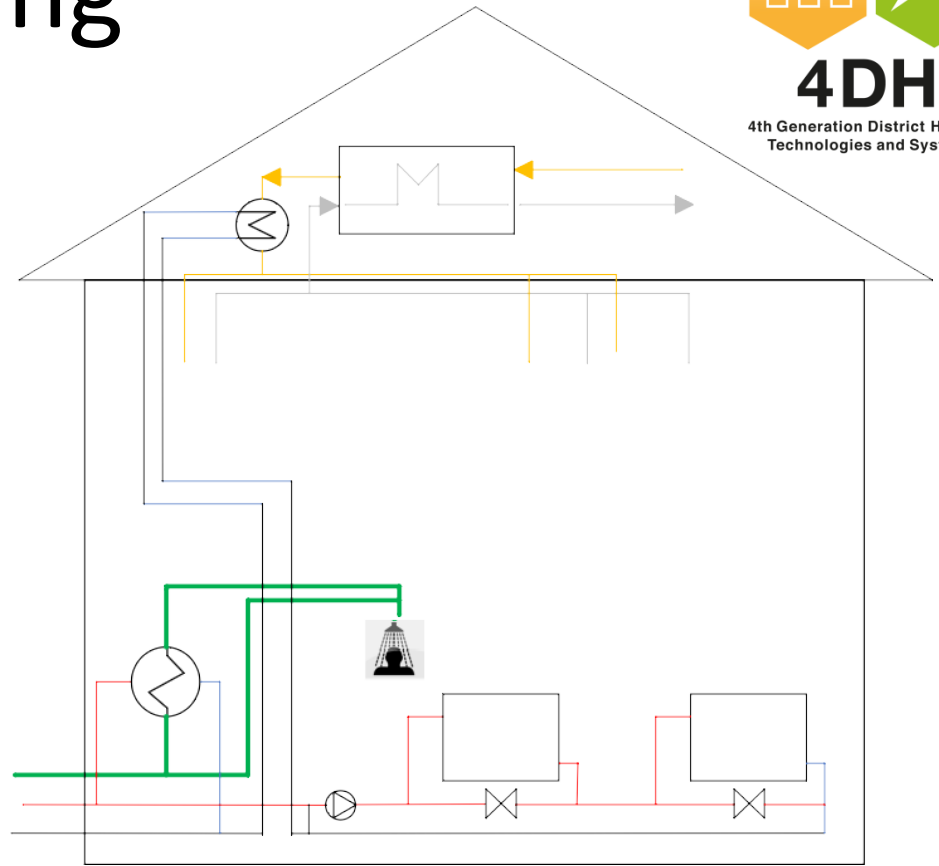
# One string heating

## Special opportunities



# One string heating

## Special opportunities



T <sub>out</sub>	[°C]	25	20	15	8	0	-12
T air in after ventilation	[°C]	26,5	22,3	20,3	18,5	16,5	12,8
T air after HX	[°C]	26,5	22,3	26,2	37,1	36,5	38,8
Q transfered in HX	[kW]	0,000	0,001	0,340	1,052	1,131	1,478

# Conclusion



## Advantages:

- Lower return temperature (5 -10°C)
- Warmer supply air inlet
- Good match with floor heating (Dynamics)
- Houses with 1-string heating systems
- Compensate for failures in the heating system

Disadvantages: Need for a ventilation system

