Adaptive control strategy for domestic hot water storage tank supplied by district heating

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ENGINEERING TOMORROW

Danfoss

HEAT 4.0

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Background/Motivation

Many DHW tank systems are not running optimal

- The consequence is a high DH return temperature from the service of DHW
- As well as high DH peak loads

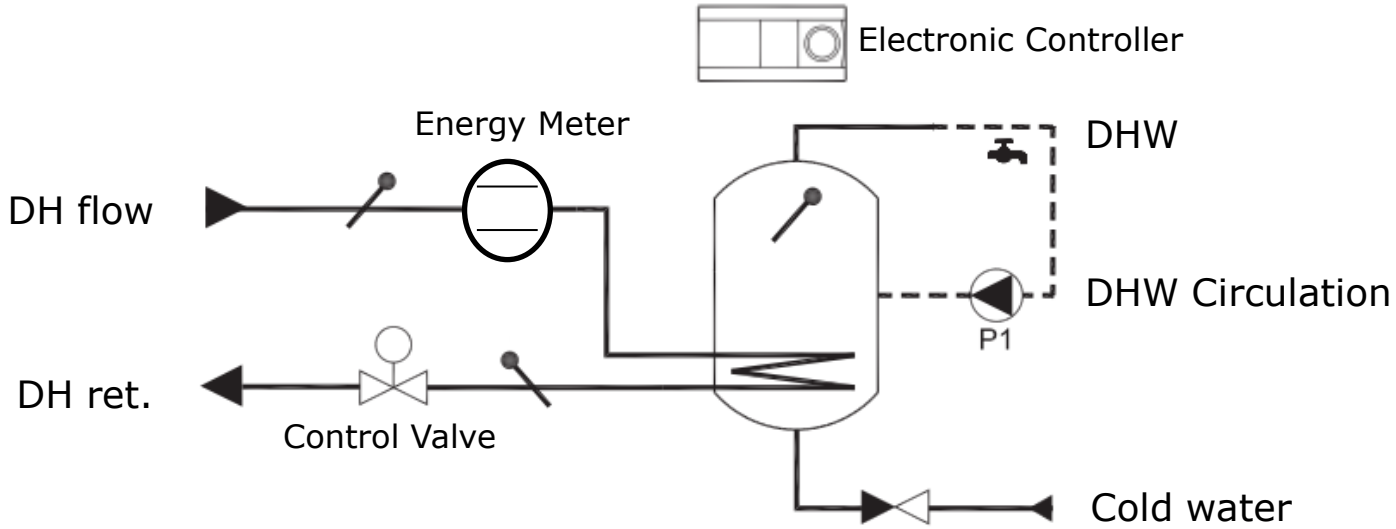
This leads to lower efficiency of the DH system because:

- Higher than needed DH return temperature results in distribution heat loss and reduced heat plant efficiency
- This can as well reduce the potential for lowering the DH flow temperature
- High peak load can create supply bottlenecks and thus activation of less favorable heat generation sources

The application and the control

- DH return temp. limiter:
  - When exceeding the DH return temp. limit **setting**, the charging is reduced

- DH power limiter (incl. M-BUS connected energy meter):
  - When exceeding the DH power limit **setting**, the charging is reduced



Focus application:

DHW preparation by storage tank with internal coil

Field test buildings:

Kolding 1	Residential, 31 flats	Data
Kolding 2	Residential, 47 flats	Data

Hillerød 1	Residential, 42 flats	Data, control
Hillerød 2	Residential, 30 flats	Data, control

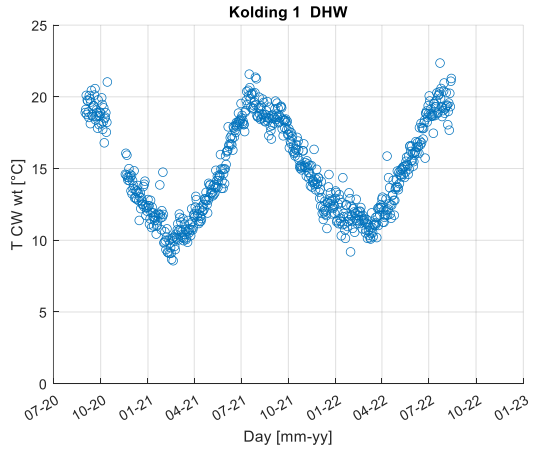
HOFOR 1	Residential	(Data), control
HOFOR 2	Institutional	(Data), control
HOFOR 3	Residential	(Data), control

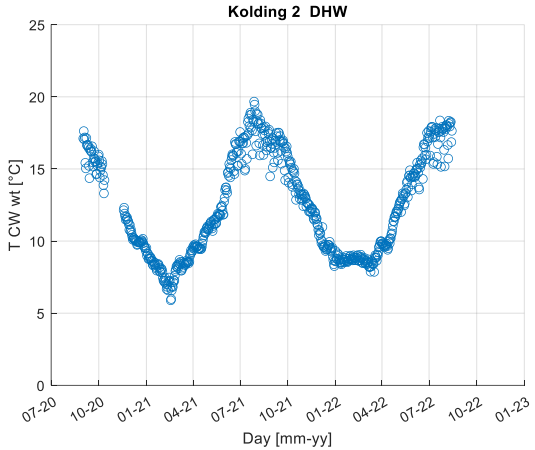
Boundary conditions

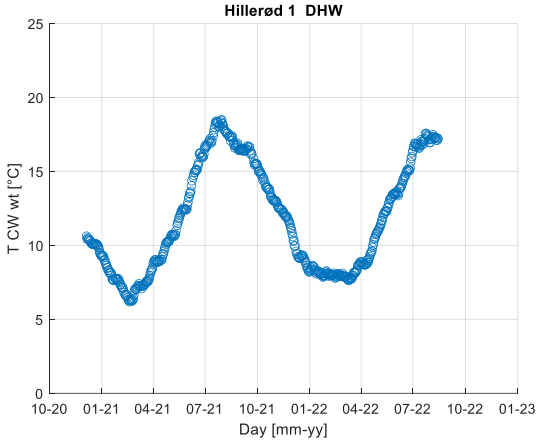
Cold Water Temperatures

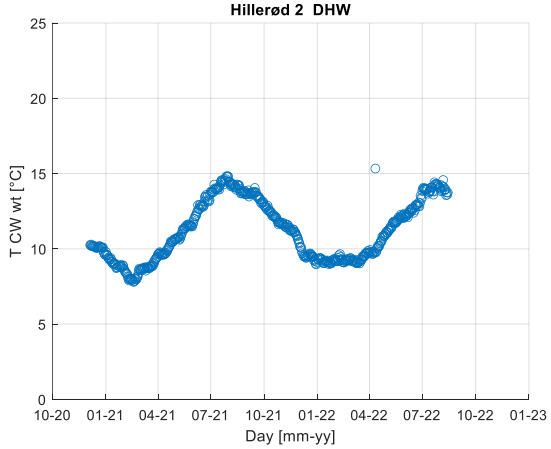
Boundary conditions

Cold Water Temperatures









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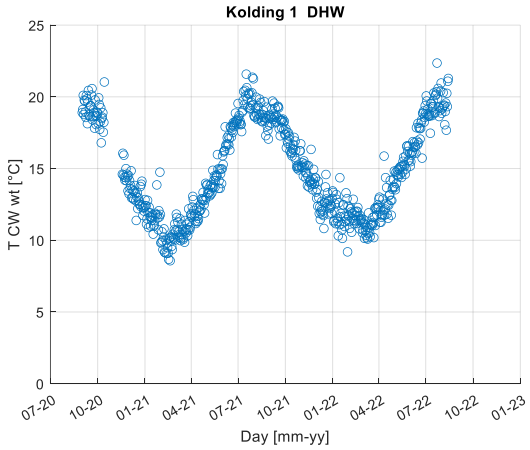
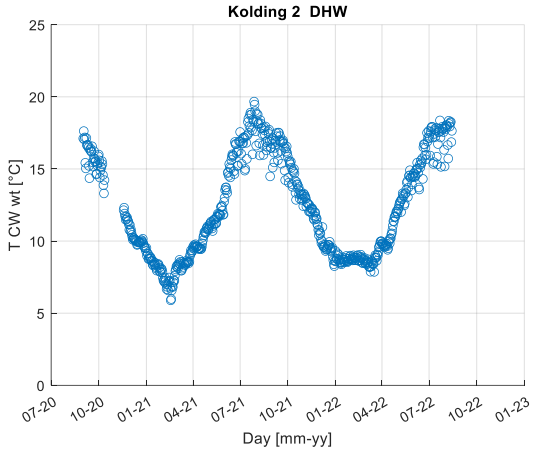
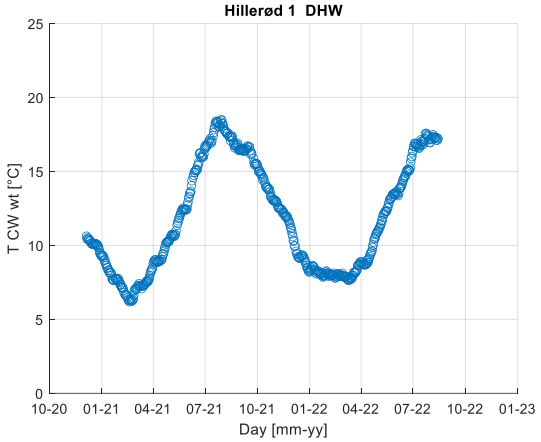
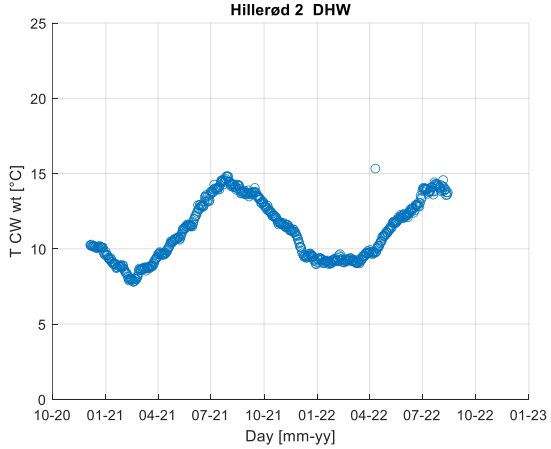
Cold Water Temperatures





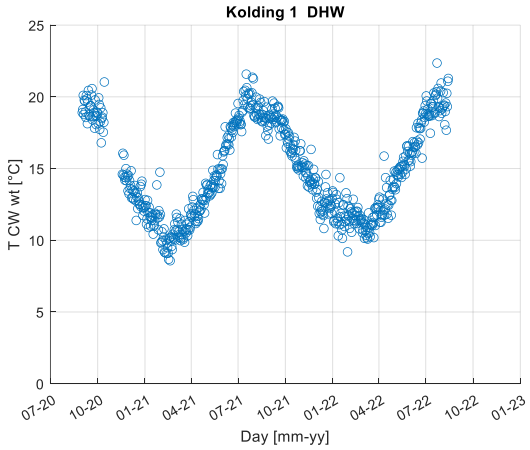


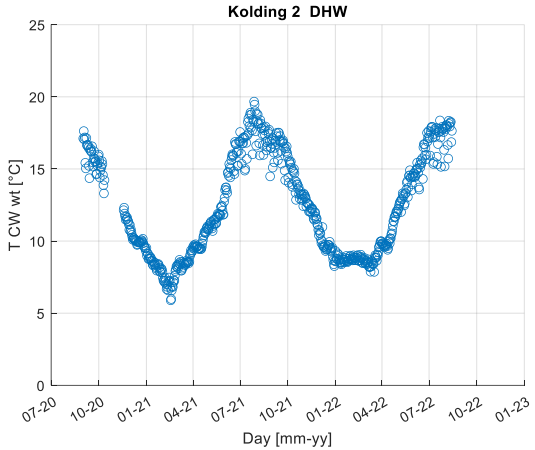


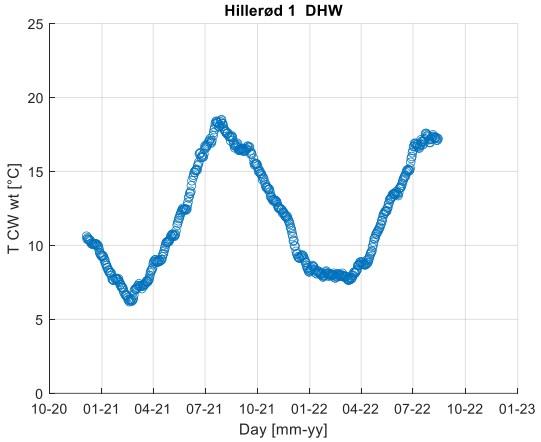
Energy Consumption for DHW (ex. circ.)

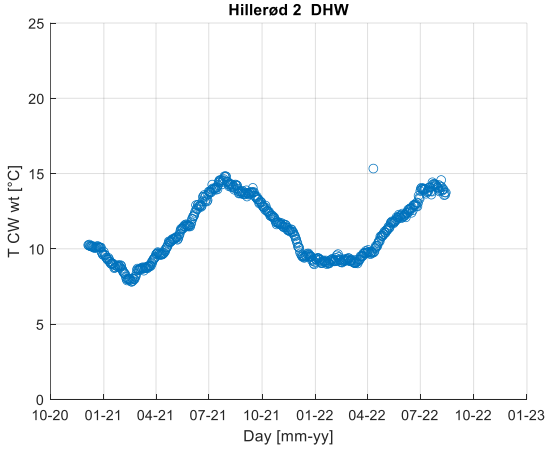
Boundary conditions

Cold Water Temperatures









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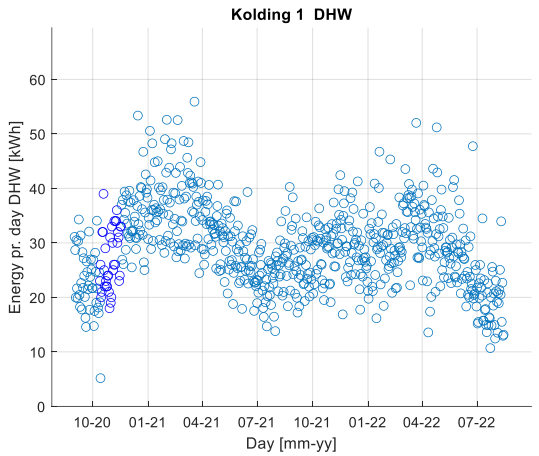
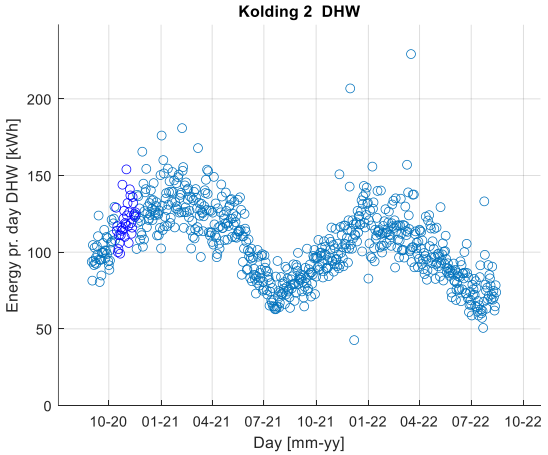
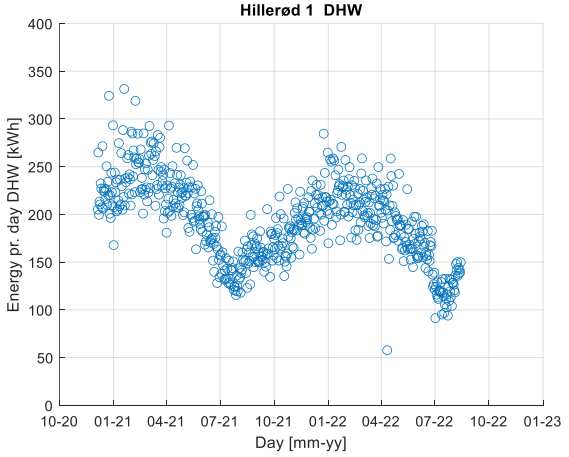
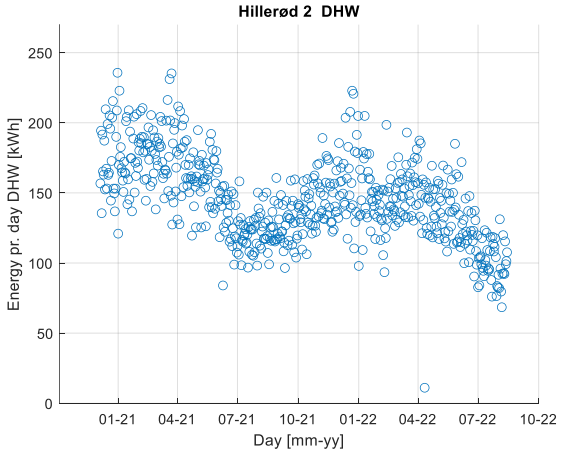


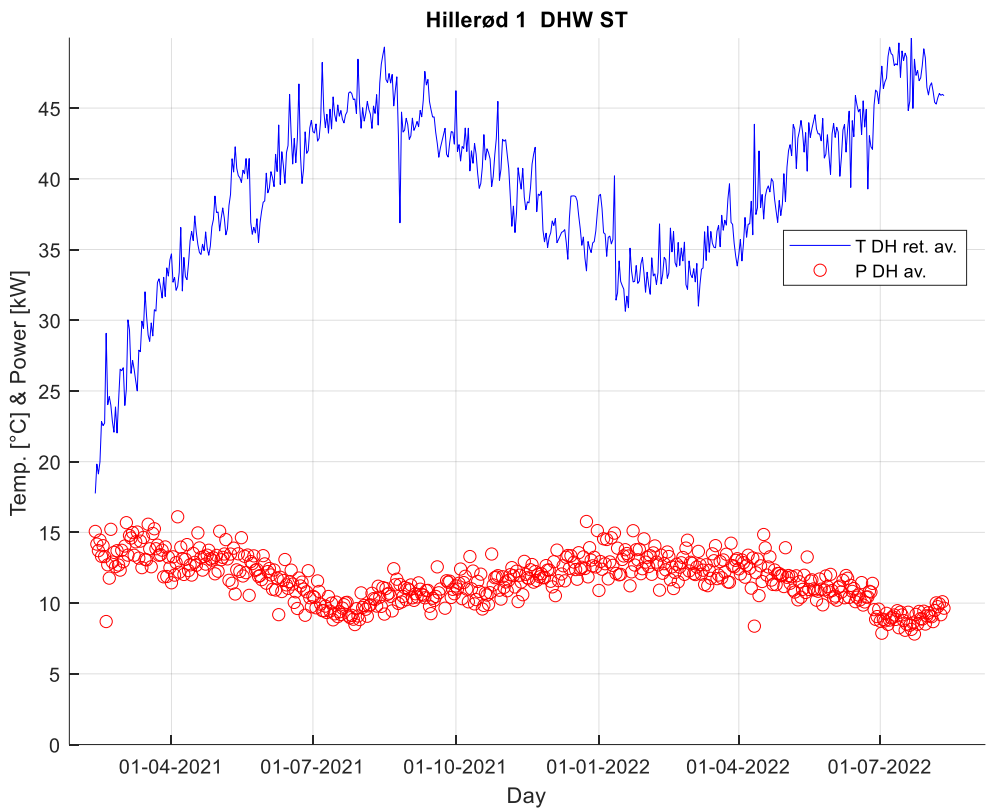




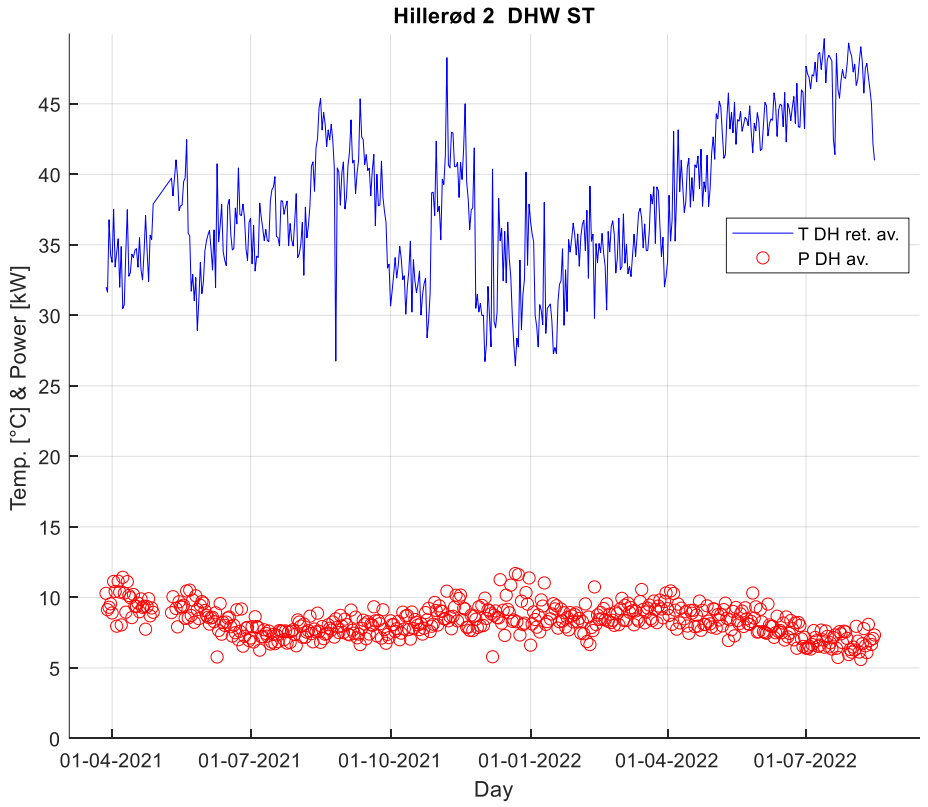


Boundary conditions

On what level to set the DH return temp. limiter or a DH power limiter ?



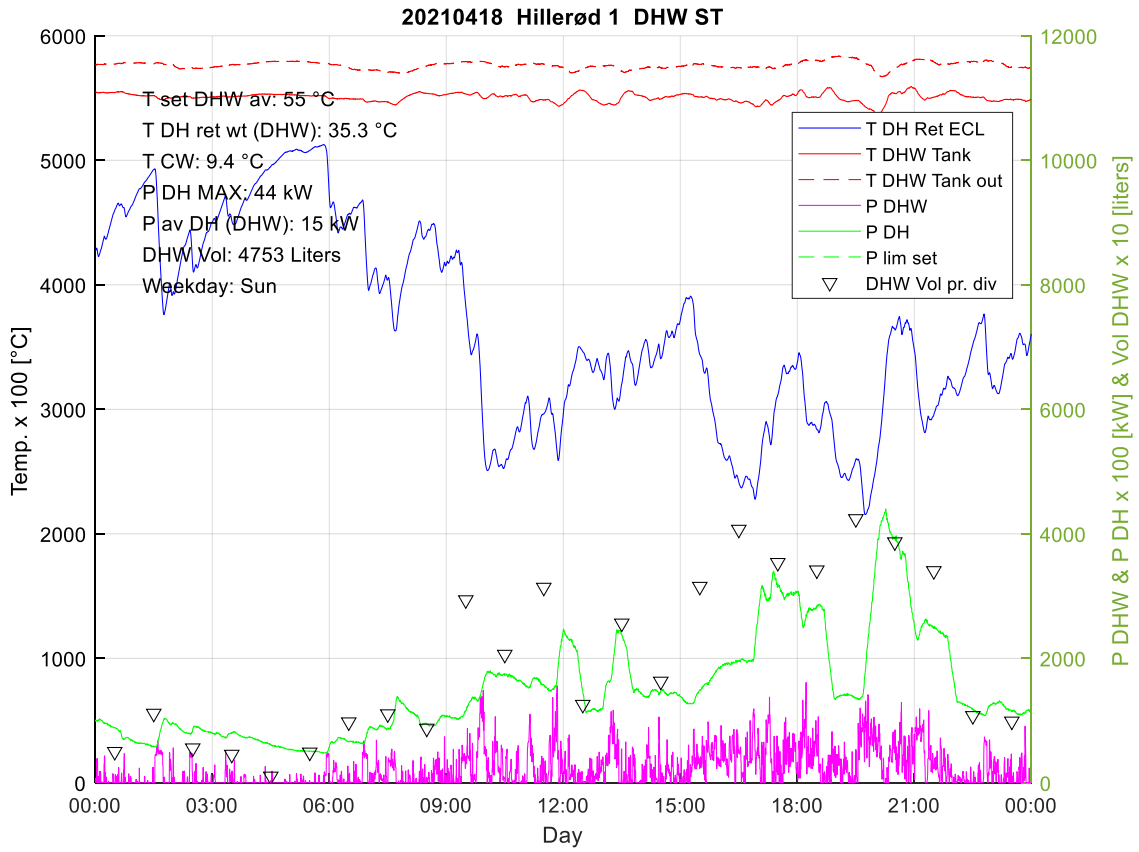
Hillerød 1



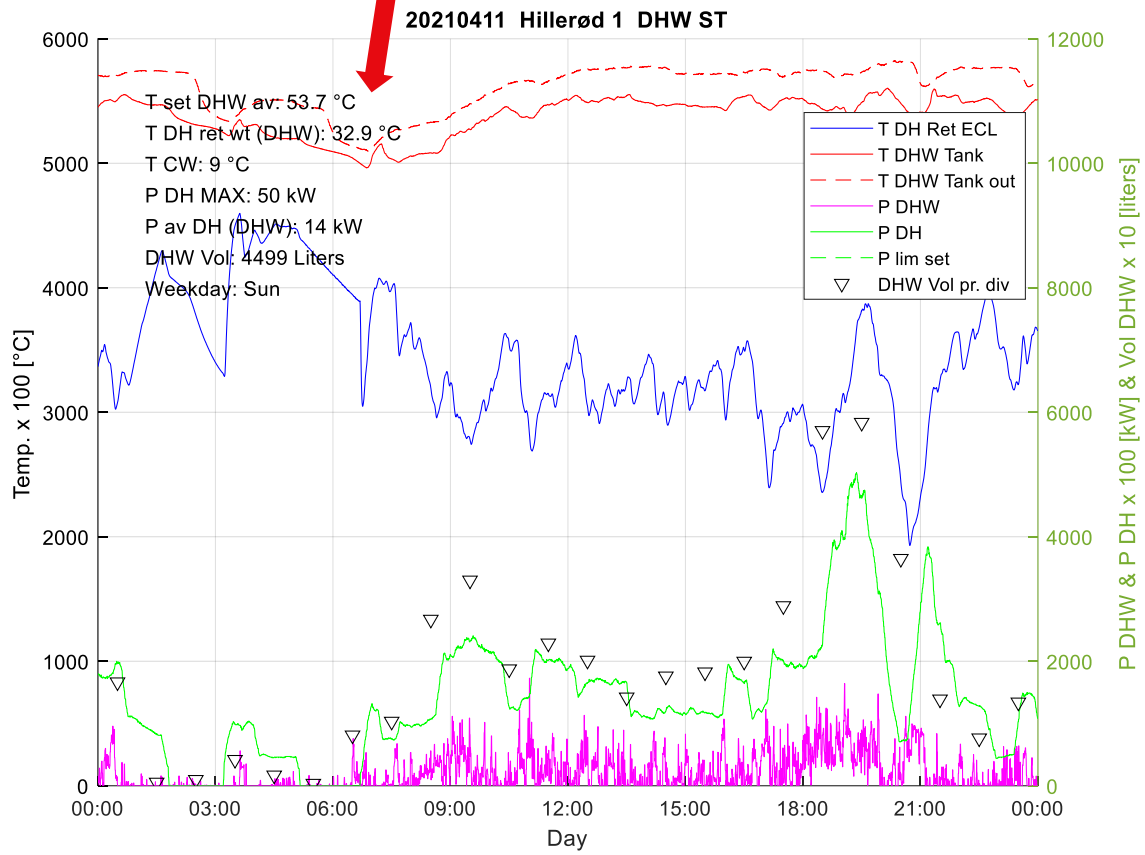
Hillerød 2

A day with and with out **DH return temp. limiter**

The control adapts to a duration period of reduced DHW tank temperature



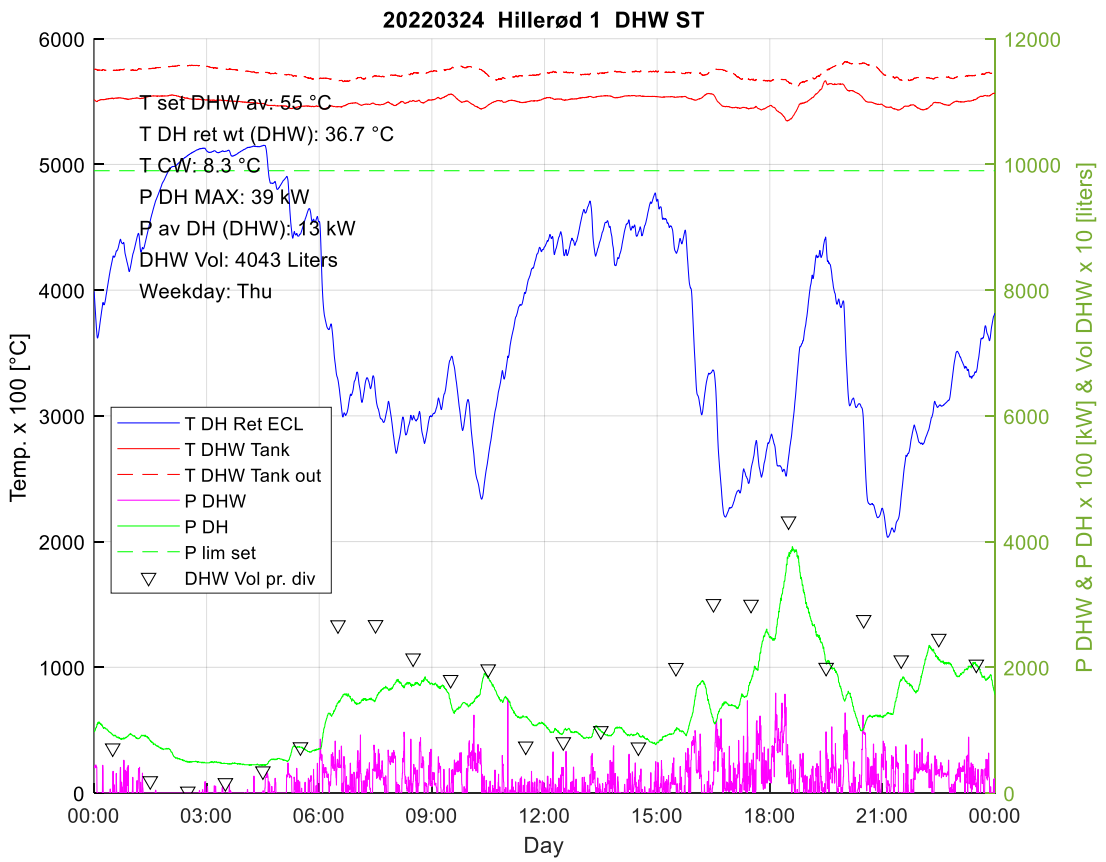
Reference control



Adaptive control

A day with and with out **DH power limiter**

The control adapts to a duration period of reduced DHW tank temperature



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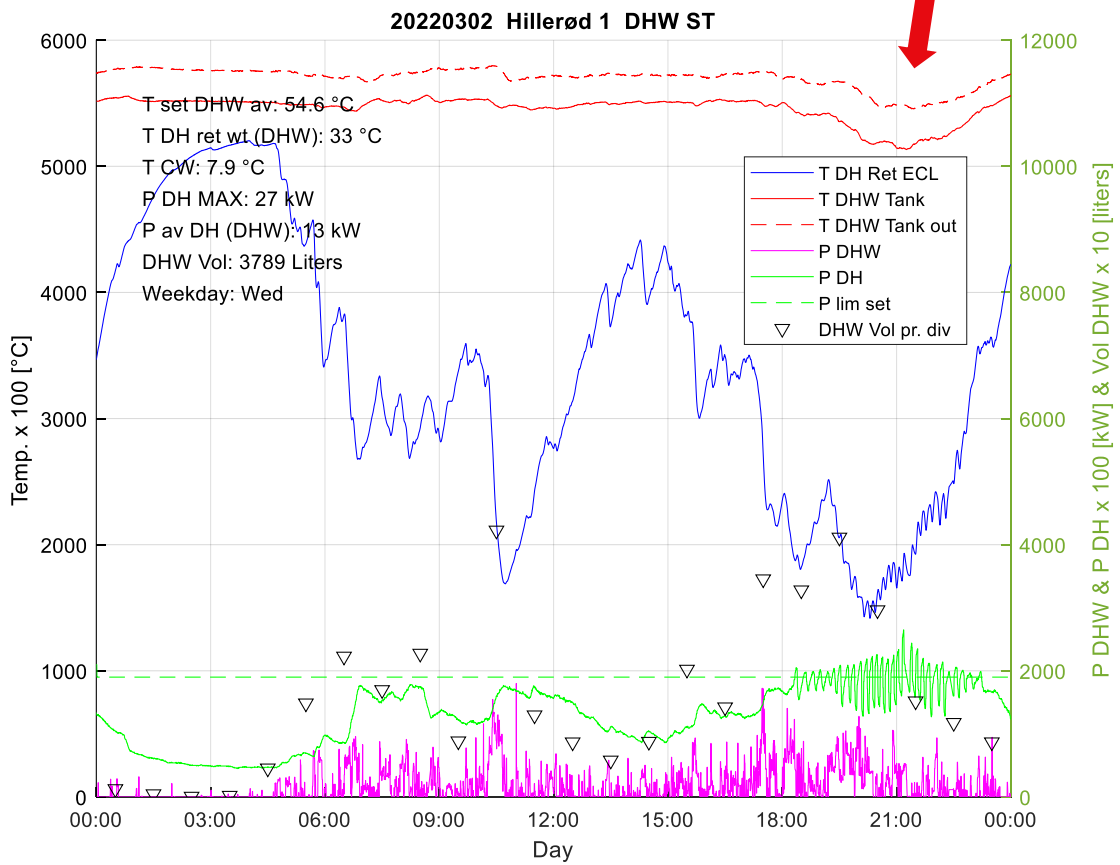
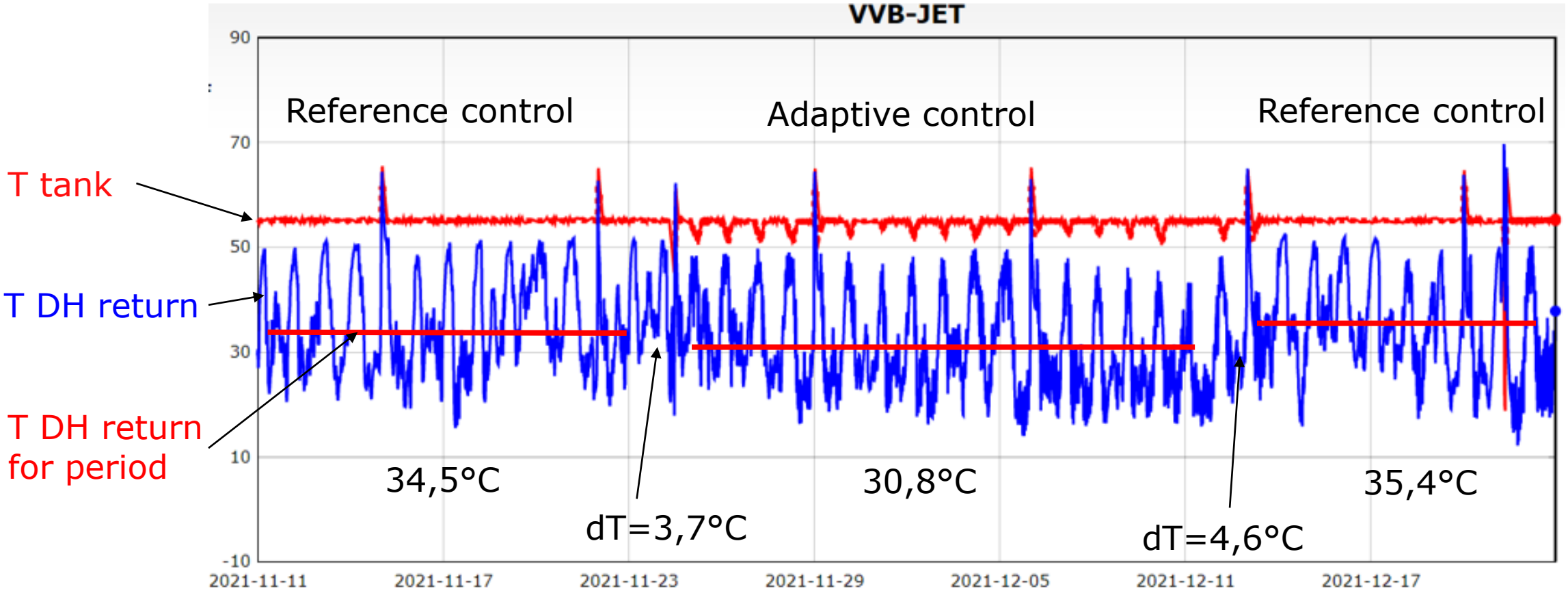
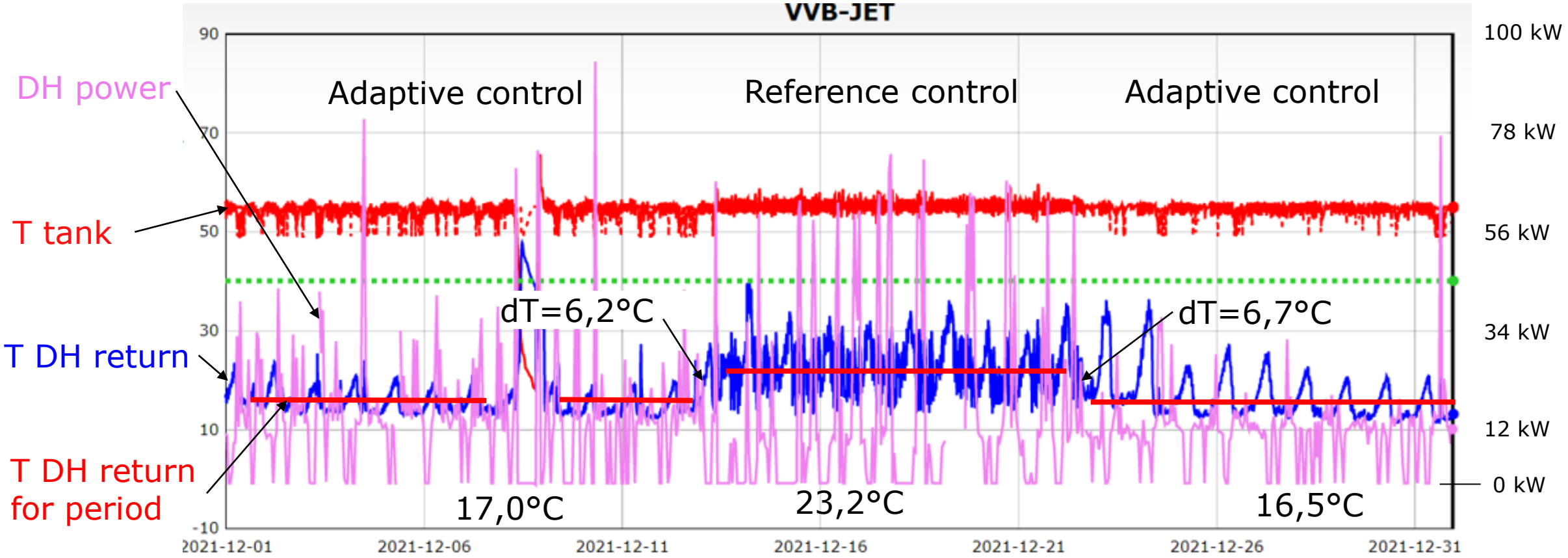


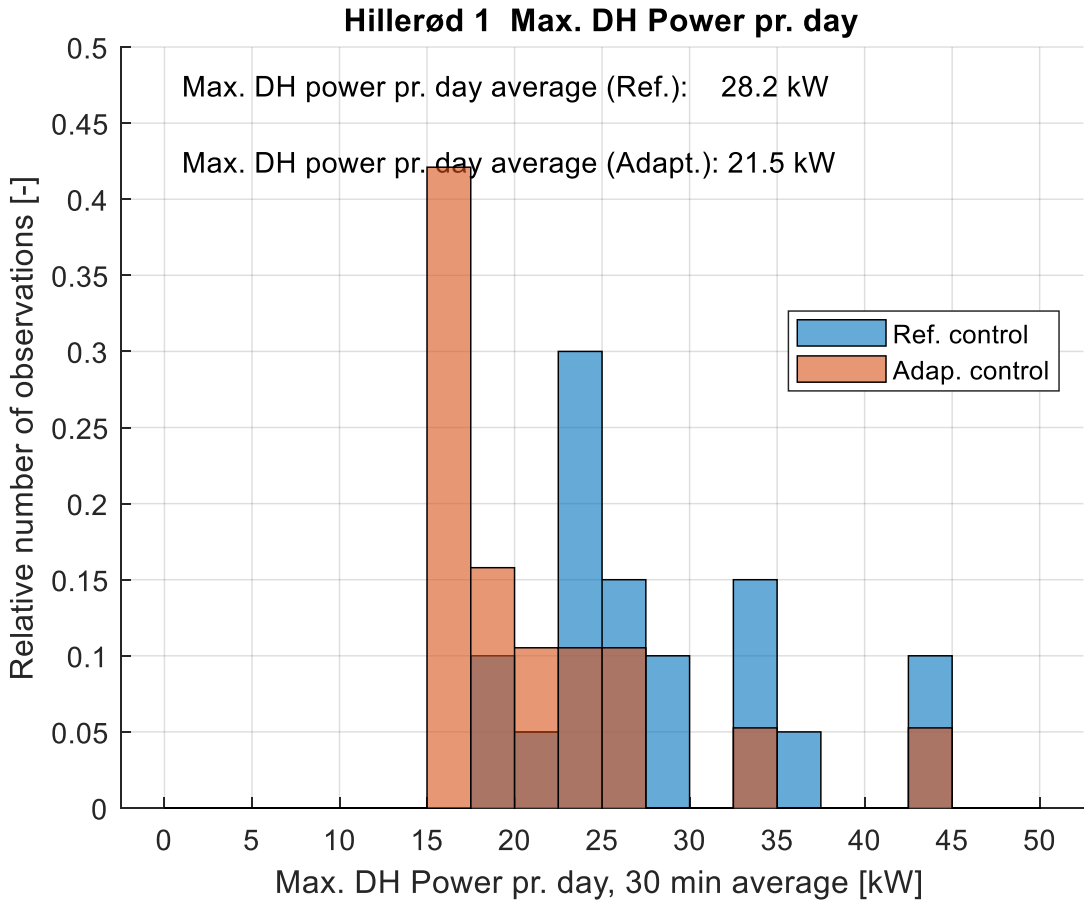
Adaptive control

A period - DH return temp. limiter (HOFOR 1)

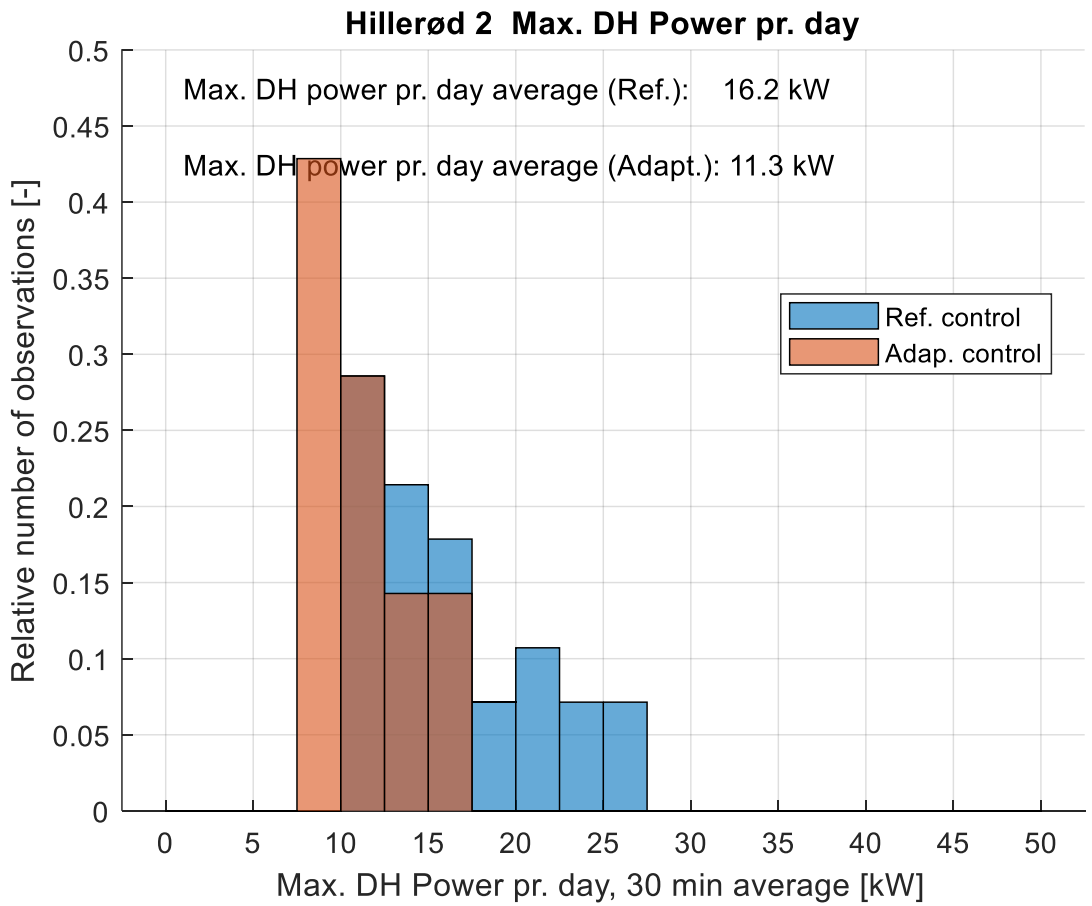


A period - DH power limiter (HOFOR 3)





25% reduction of Max. DH power



30% reduction of Max. DH power

Results

Location:	T DH ret red.	Control Method	Building type	Note
	[°C]			
Hillerød 1	~2,5	Adaptive T DH ret. lim	Residential	No aditional equipm.
HOFOR 1	~2,2	Adaptive T DH ret. lim	Residential	No aditional equipm.
HOFOR 2	~1,4	Adaptive T DH ret. lim	Institutional	No aditional equipm.
Hillerød 1	~2,9	Adaptive Power lim	Residential	DHW E-meter
Hillerød 2	~3,4	Adaptive Power lim	Residential	DHW E-meter
HOFOR 3	~5,4	Adaptive Power lim	Residential	DHW E-meter

For DH return temp. limiter, the reduction of the DH return temp. is around 2°C

For DH power limiter the reduction of the DH return temp. is around 4°C

Conclusions

- DH return temperatures are reduced in the range from 1,4 to 5,4°C, depending on control principle and location
  - For DH return temp. limiter, the reduction of the DH return temp. is around 2°C
  - For DH power limiter the reduction of the DH return temp. is around 4°C
- The DH peak power (30 min. average) is reduced by 25% - 30% for the given examples, the understanding is that this can be even more in many cases
- A minor reduction of the DHW supply temperature for shorter periods is the consequence of the limiting functions, this anyhow not an unknown when applying the functions
- The developed methods are robust and straight forward to apply. Anyhow for the DH power limiter function an additional energy meter is needed, which is becoming more usual to install for retrofit and new build

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Thank You for your attention

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Part of project: HEAT 4.0

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