



## Initiative

A district heating company have a good reason to lower the temperature in the network. It gives a lot of different possibilities compared to a network with high temperatures and in the end it gives the possibility to be competitive towards other heating technologies. The district heating company is in control of the supply temperature, and is able to reduce it in times of lower heat consumptions. But many times the return temperature set the boundary on how low it's possible to lower the temperature. And the return temperature is in the control of the consumer.

To a consumer this is low interest. They want a heat sources that is easy and present, so their comfort needs will be satisfied. And the price has to be low enough to be compatible. The consumer is disloyal if another opportunity calls.

So to be able to lower temperature substantially, the district heating company must find a way to motivate the consumers.

## The benefits

To be able to motivate the consumers it's important that the consumers can be explained what the benefits from low temperature is. Below is a list of benefits.

### Low supply temperature

- Better production efficiency of heat pumps, solar heating, geothermal, ect.
- Low heat loss
- The pipes last longer.
- Cheaper investments in pipes due to the smaller forces in the pipes, and below 85 °C there is no need for compensating of the pipes
- The possibility to use plastic pipes

### Low return temperature

- Low heat loss
- Less pump energy
- Better production efficiency, of fluegas condensation, solar heating, geothermal. Ect.
- Possibility to use the net to even more consumers.

## Setting the goals

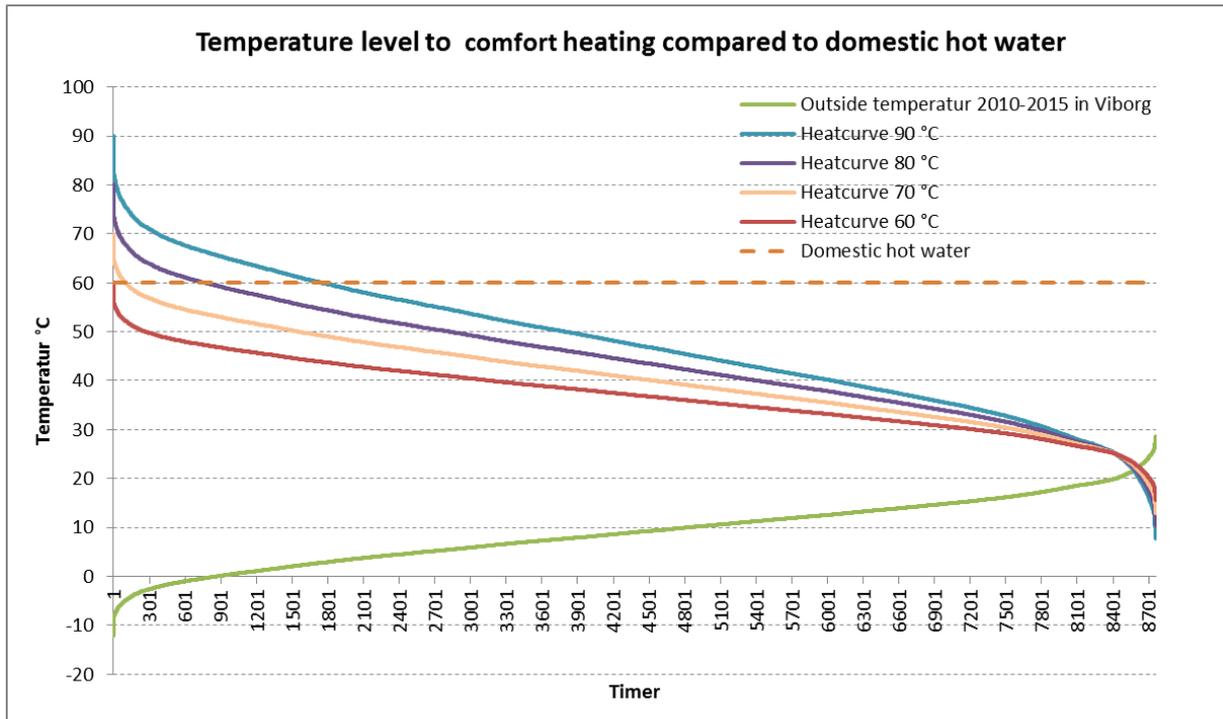
### Supply temperature

The short goal of the supply temperature must be a temperature high enough to supply a good running installation. But the long term goal should be a temperature of the best technology and then a bit lower, because technology evolves over time.

In Denmark the district heating supplies two heat sources. The domestic hot water and the comfort heating of the houses. In some there is also supplied to industrial customers.

The comfort heating has a temperature need that varies over the year. The highest demand is when the outside temperature is coldest. When the comfort heating is peaking, then the comfort heating sets the temperature level, but when the temperature outside raises above zero degrees Celsius, then the domestic hot water begins to set the temperature level.

The figure below shows the normal temperature needs over the year at the consumer. Figure has different heatcurves for comfort heating, because the houses has been dimensioned different over the periode of time, and if it is possible to section net district heating network, then it is possible to take advantaged of this in the design of the network.. But as it is showed the domestic hot water at a temperature levels at 60 °C sets the temperature most of the year.



### Return temperature.

The return temperature is more or less set by the temperature level of the 2 heat deliveries. The comfort heating, supplies to have a comfort heating in the houses at around 21 °C. The theoretical return temperature is therefore close to this temperature. Normally around 5 degrees higher is possible. So a goal of 25 °C from the comfort heating is not impossible 2 reach.

The domestic hot water has a temperature need for circulation at 50 degree, so normally the return temperature from this is higher than from comfort heating. If there is no circulation the domestic hot water can have a return temperature at the same temperature as comfort heating, since the temperature on the cold side I the domestic cold water.

## Motivation

To be able to motivate the consumers, there must be a goal for them individually. In Denmark there are different models on how to do that. Some of them are used because the energy meters cannot collect the data needed for a model as described hereunder.

The motivation tariff used in Viborg is a model, where the supply temperature as a yearly average is used to calculate the goal for the return temperature. Both the average supply and return temperature can be collected from the Energy meters used in Viborg and are from Kamstrup A/S.

## Calculation of return in Viborg

The calculation can be describe as below, where the calculated return is higher the lower the supply temperature is, this is what we show to the consumers, and is easily understood.

Supply temperature	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Calculated return	41	41	40	40	39	39	39	38	38	37	37	37	36	36	36	35	35	35	34	34	34

The formula used is the same as is used to describe a Radiators parameters.

Varmeståbi, kap. 9.

$$t_r \cong t_f - \left\{ 1,08 - 0,8 * \left\{ \Phi * \left( \frac{t_f - 20}{70} \right)^{-n_1} \right\}^{\frac{2}{n_2}} \right\} * (t_f - 20) - 2$$

where

- Φ is "normaliseret ydelse" and is in Viborg set to 0,36
- t<sub>f</sub> is Supply temperatur [°C]
- t<sub>r</sub> is returtemperatur [°C]
- n<sub>1</sub> is "radiatoreksponenten at standard volumeflow" and is in Viborg set to 1,3.
- n<sub>2</sub> is "radiatoreksponenten at changed volumeflow" and is in Viborg set to 1,6

Φ can be change if the goal is another than Viborg

- 0,36 =60/35 °C used in Viborg
- 0,4 =65/35 °C
- 0,33 =60/30 °C

Can also be changed if the radiator. Viborg currently use 1,6 but will change to 1,3 in a few years.

$n_2 = 1,9$

$n_2 = 1,6$

$n_2 = 1,3$



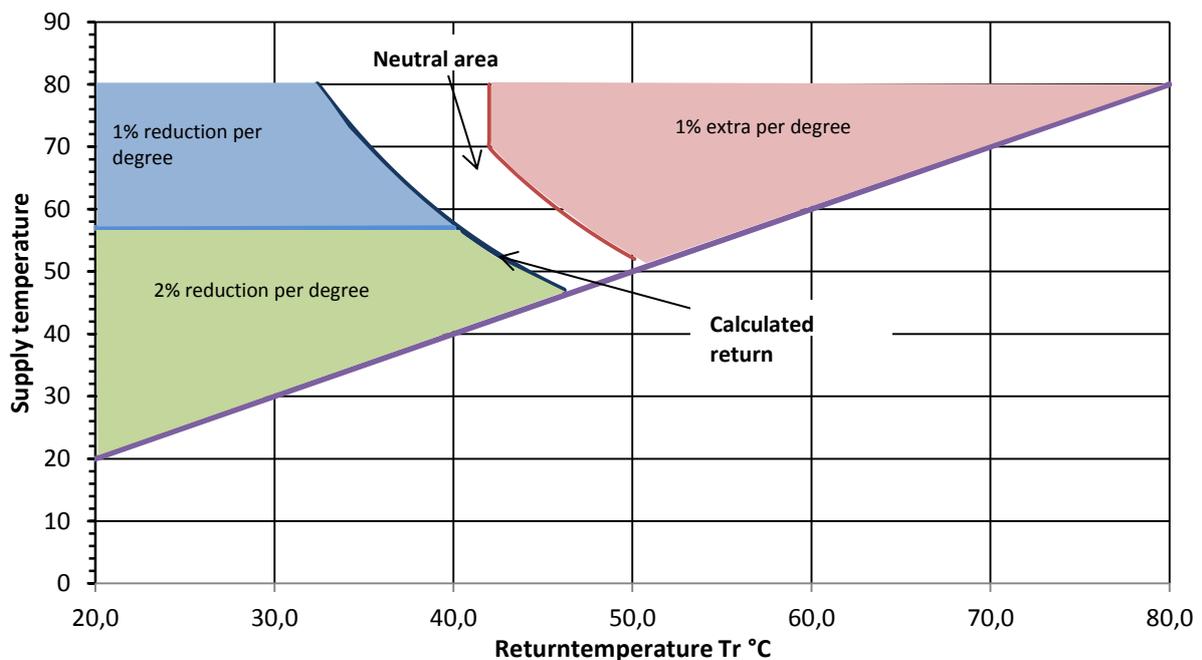
## Motivationmodel

The model Viborg District heating use are as below. If the consumer have a return temperature as calculated return, then he just pays the bill. But if it is lower, then he gets a reduction on the price. And the reduction is divided in 2 so if they accept a lower temperature than we promise then they can get a double reduction.

If the return temperature is higher than the calculated then there is a neutral area where they still just pays the bill. But if it's higher, than the neutral area then they need to pay extra.

This has proven very effective, and the reduction is the area that has the biggest effect.

## Motivation tariff 2017



## Results

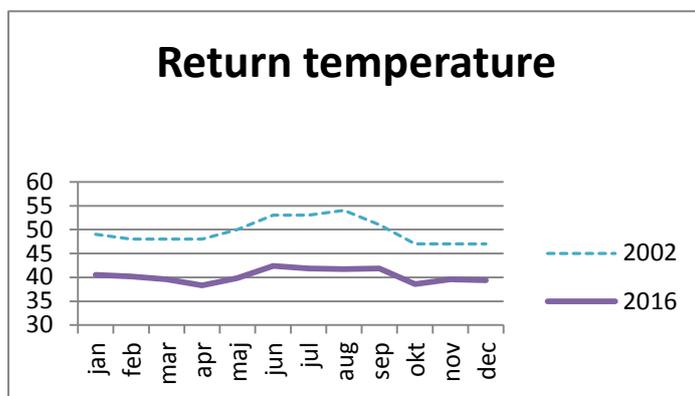
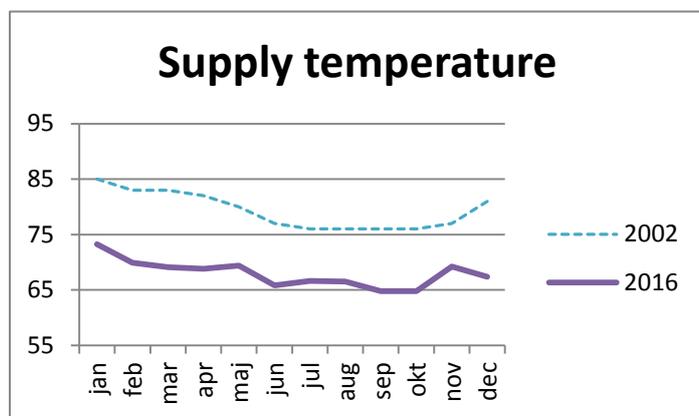
In Viborg District heating, this has been a focus area since 1995 and still is.

We introduced the motivations tariff in 2002 and since then the temperature has dropped.

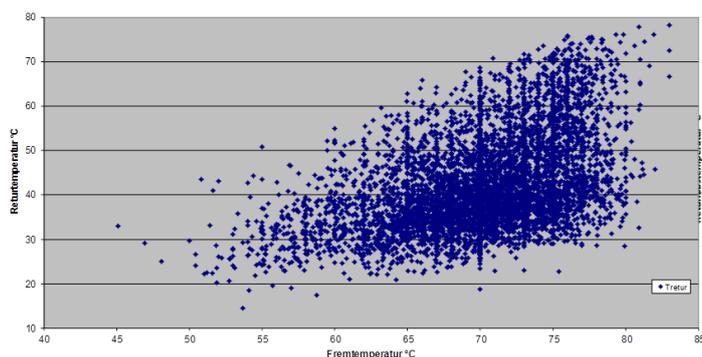
The yearly average supply temperature was in 2002 80 °C and is in 2016 68 °C

The yearly average return temperature was in 2002 50 °C and is in 2016 40 °C

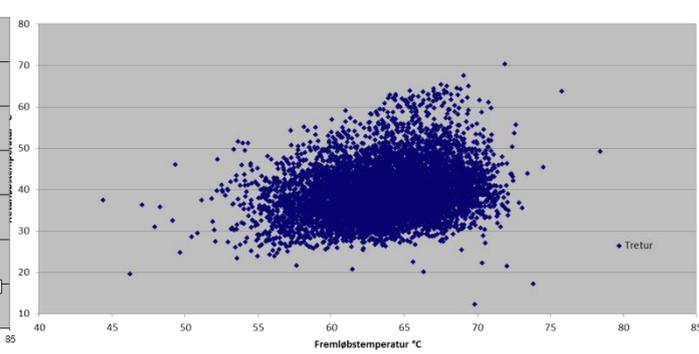
We have calculated that the supply temperature can go 4-5 °C lower on a yearly basis, and still cover the comfort needs of our consumers. But we need the return temperature to go down as well.



The motivations tariff sends more money in reductions than we get back in extras, so the model by it's own have 2 mill kr. In negative balance, but when the reduction in heatloss are taken into the calculation, then Viborg District heating saves 5 mill kr. And that gives a total of 3 mill kr. to the district heating, and In Viborg that's means **10 % lower heatloss cost** than before we had the model.



2002



2009