

16.12.2019

# Innovatiivsed lahendused kaugküte ja kaugjahutuse valdkondades

**Igor Krupenski**

HeatConsult OÜ  
Member of the board, Ph.D

**Aleksandr Ledvanov**

HeatConsult OÜ  
Member of the board

# ESTIS-e koolitused 2020. aastal

17.01.2020

## Kaugküte ja kaugjahutuse teemaline koolitus

- Koolituse kava lukus, avalikustame käesoleval nädalal
- Lektorid ja teemad:

**Andres Siirde, Timo Tatar, Teet Tark**

Kaugküte ja kaugjahutuse arend ja trendid, KVJ väljakutsed seoses liginullenergiahoonete nõuetega, Kaugküte ja kaugjahutuse perspektiiv riigi seisukohalt, Hoonesiseste jahutuse süsteemide projekteerimine kaugjahutuse seisukohalt, Kaugkütte arendus teistes riikides

Kevad 2020

## Soojusenergeetika valdkonna koolitus (kaugküte, gaas, soojusallikad, soojusseadmed, külmaseadmed, soojusmajandus)

- Koolituse kava lukus 2020 aasta alguses (korraldame koostöös TTÜ Avatud Ülikooliga)
- Maht: ca 40 TP
- Osalejate arv: ca 30-40

# Tänapäevased teemad

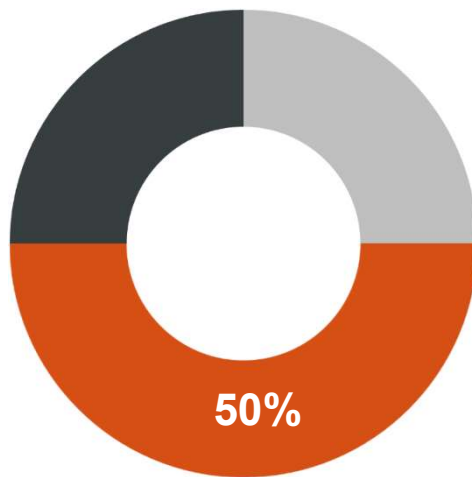
Kaugjahutuse võrgu arendamine ja 2. põlvkonna areng

Kaugküttevõrgu tagasivoolu alandamise  
praktilised võimalused (Austria kaugküttevõrgu näitel)

Madaltemperatuurilise kaugküttevõrgu arendamine  
kõrgetemperatuurilise kaugküttevõrgu tagasivoolu abil  
(Paekalda piirkonna *case study*)

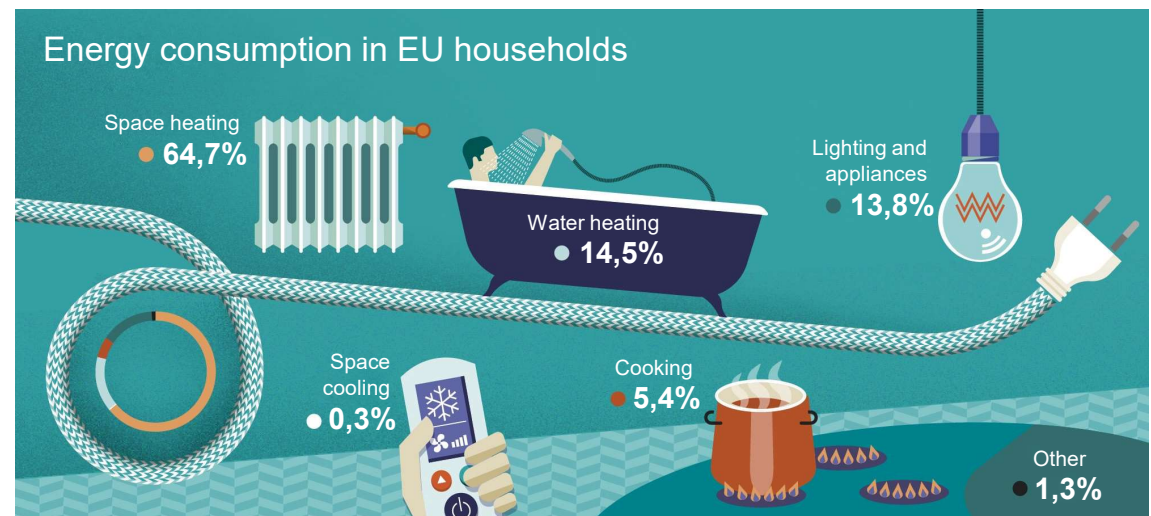
# Energia kulu kodumajapidamistes

Heating & Cooling represents **50%** of the EU total annual energy consumption



● Electricity ● Transport ● Heat

Heating & Hot water, in EU households account for **79%** of total final energy use



[ec.europa.eu/eurostat](http://ec.europa.eu/eurostat)

# Esimene EU strateegia küttele ja jahutusele alles 2016!



European  
Commission



Europe launches its  
**1<sup>st</sup> Heating & Cooling  
strategy.**

Homes, buildings and industries  
will become more efficient

[ec.europa.eu/energy](http://ec.europa.eu/energy)

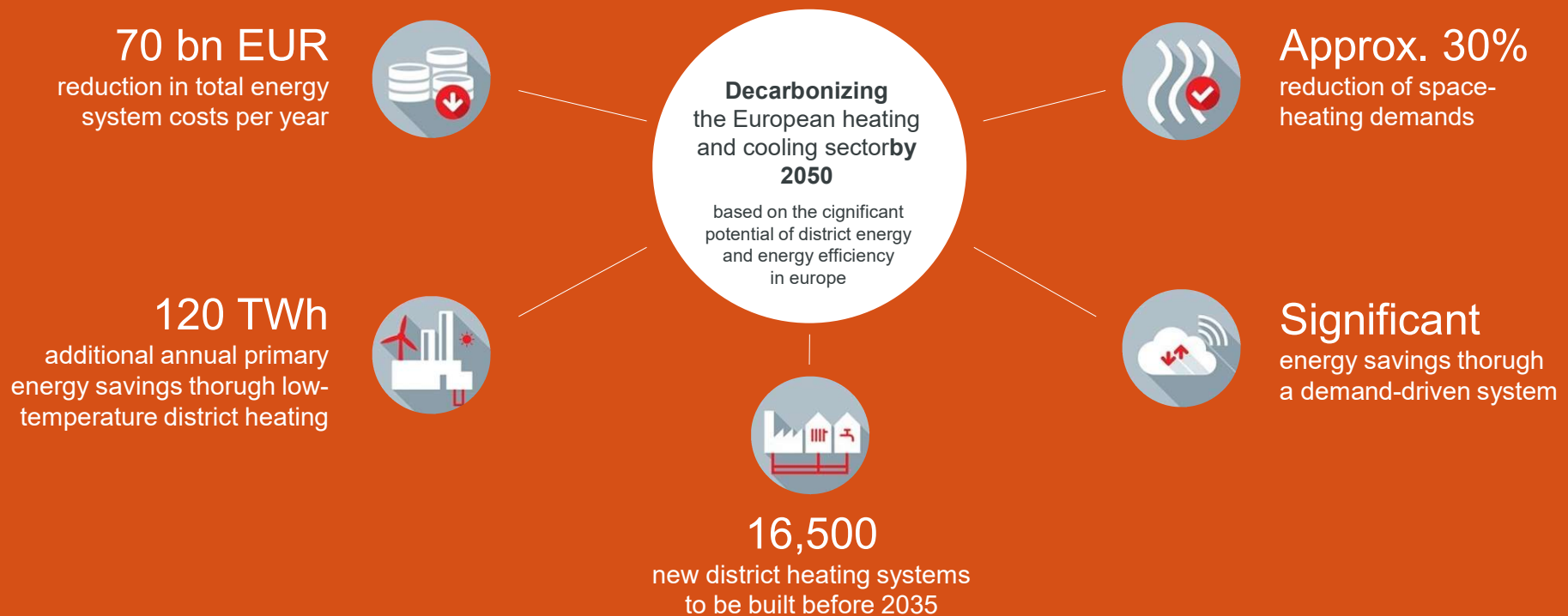
[@Energy4Europe](https://twitter.com/Energy4Europe)

Energy

February 2016.  
Source: EC  
Communication  
on Heating and  
Cooling

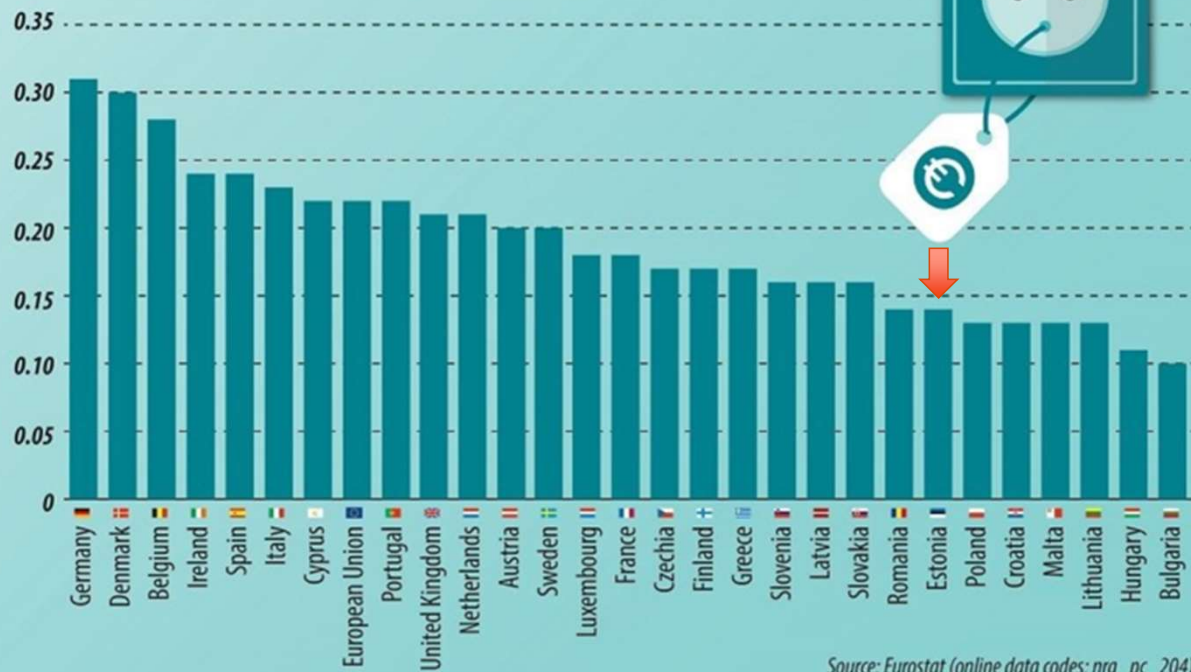
# Mis juhtub kaugküttega EU-s 2050-ks?

## Five key takeaways:



## First semester 2019

EUR per kWh



[ec.europa.eu/eurostat](http://ec.europa.eu/eurostat)

# Elektrienergia maksumused EU-s

## 34 Companies that offering district cooling in Sweden



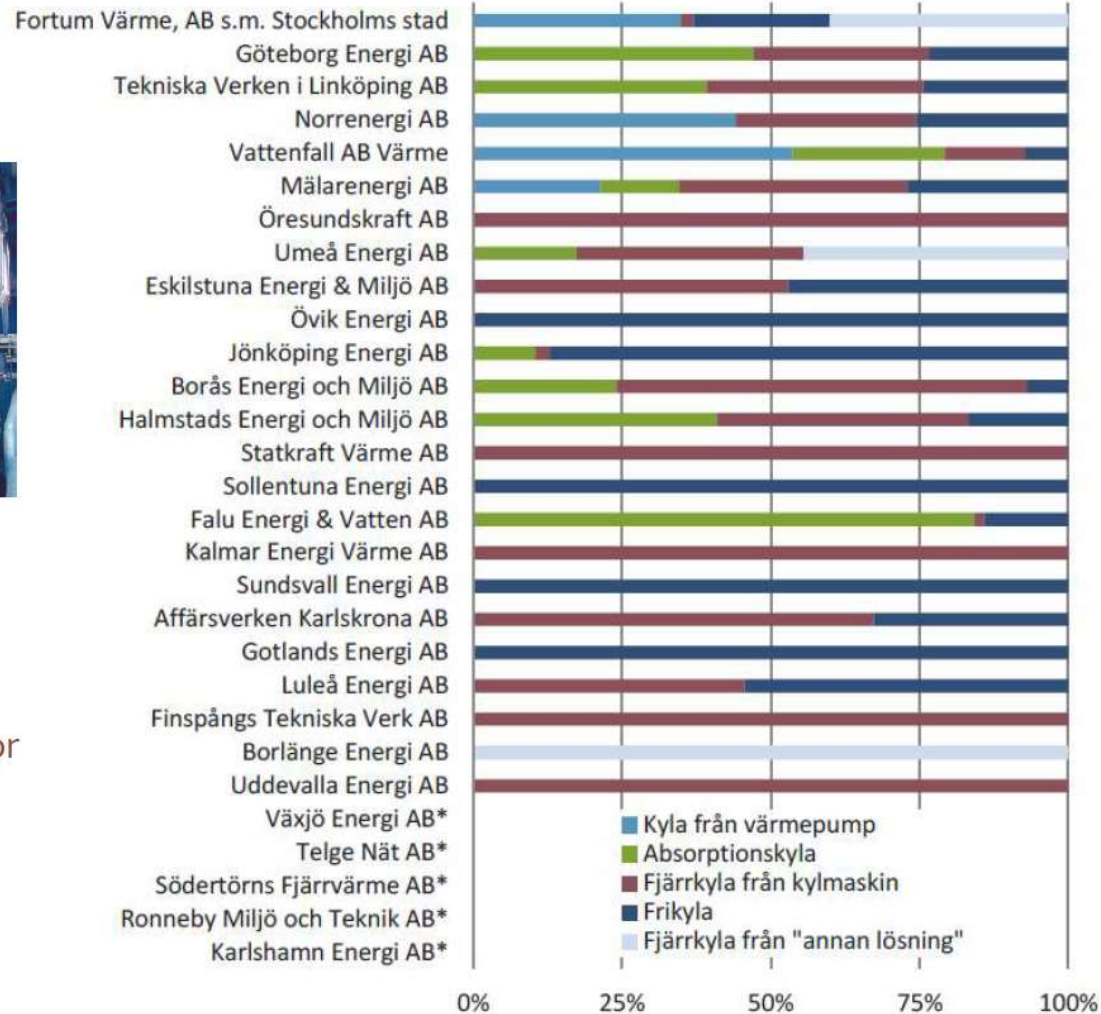
Absorption chillers

Heat pump (Cooling production)

Conventional compressor

Free cooling

Heat pump (Heat production)



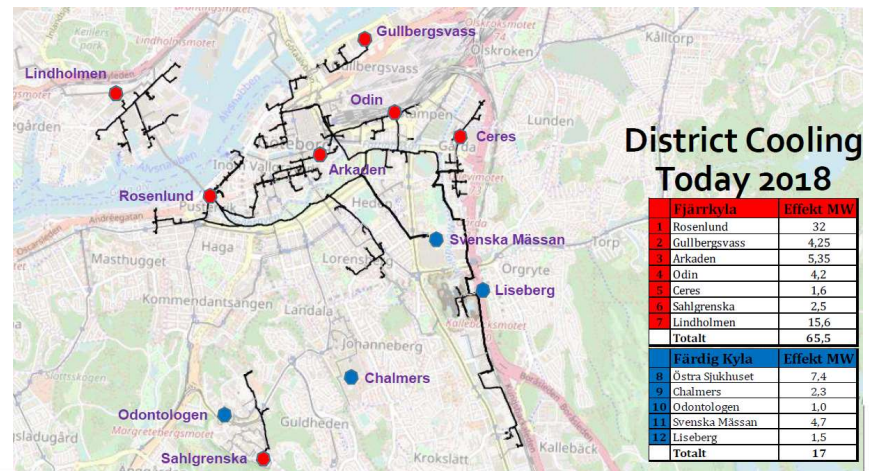
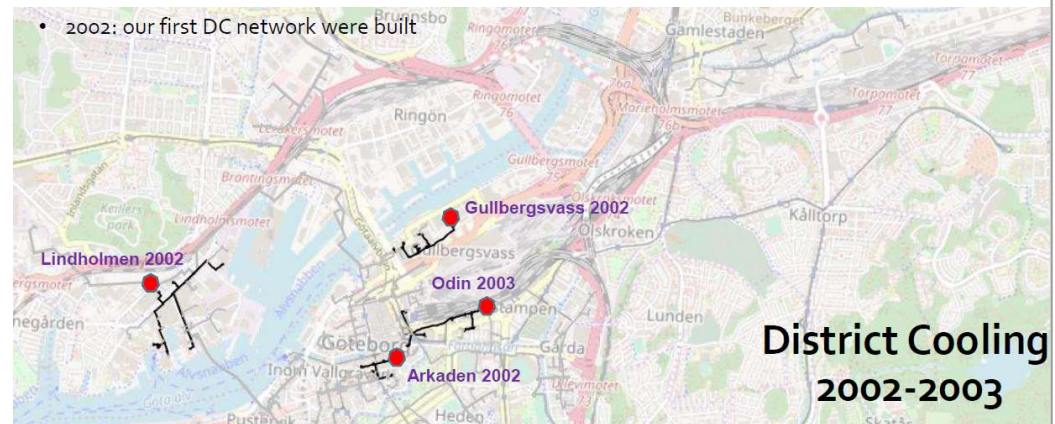
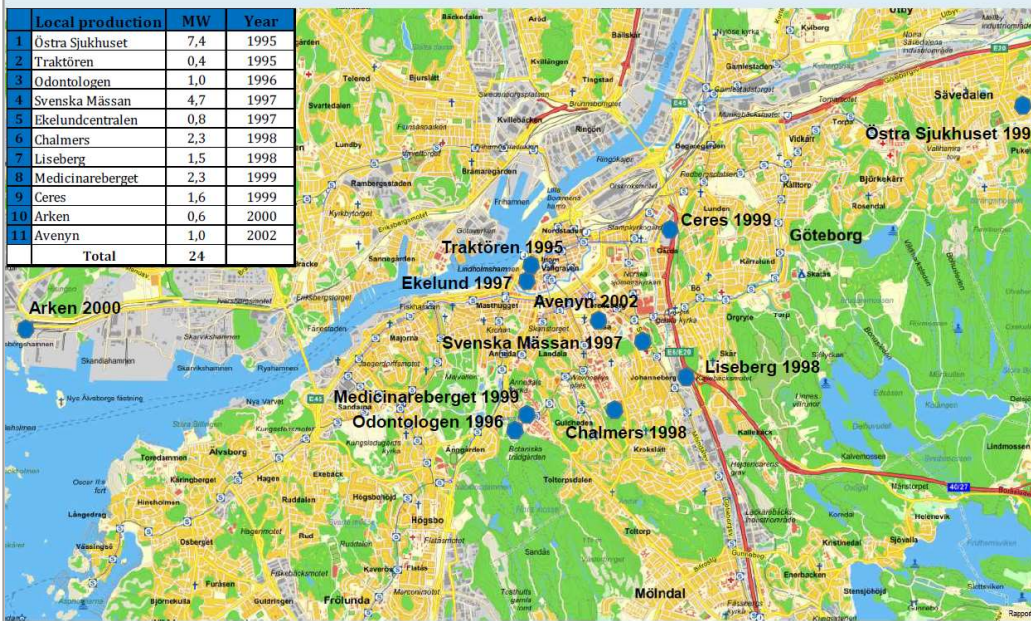
# Kaug- jahutus Rootsis



# Näidis Göteborgist – ajalugu

## History 1995-2002 (Local production built up)

Local production	MW	Year
1 Östra Sjukhuset	7,4	1995
2 Traktören	0,4	1995
3 Odontologen	1,0	1996
4 Svenska Mässan	4,7	1997
5 Ekelundcentralen	0,8	1997
6 Chalmers	2,3	1998
7 Liseberg	1,5	1998
8 Medicinareberget	2,3	1999
9 Ceres	1,6	1999
10 Arken	0,6	2000
11 Avenyn	1,0	2002
<b>Total</b>	<b>24</b>	

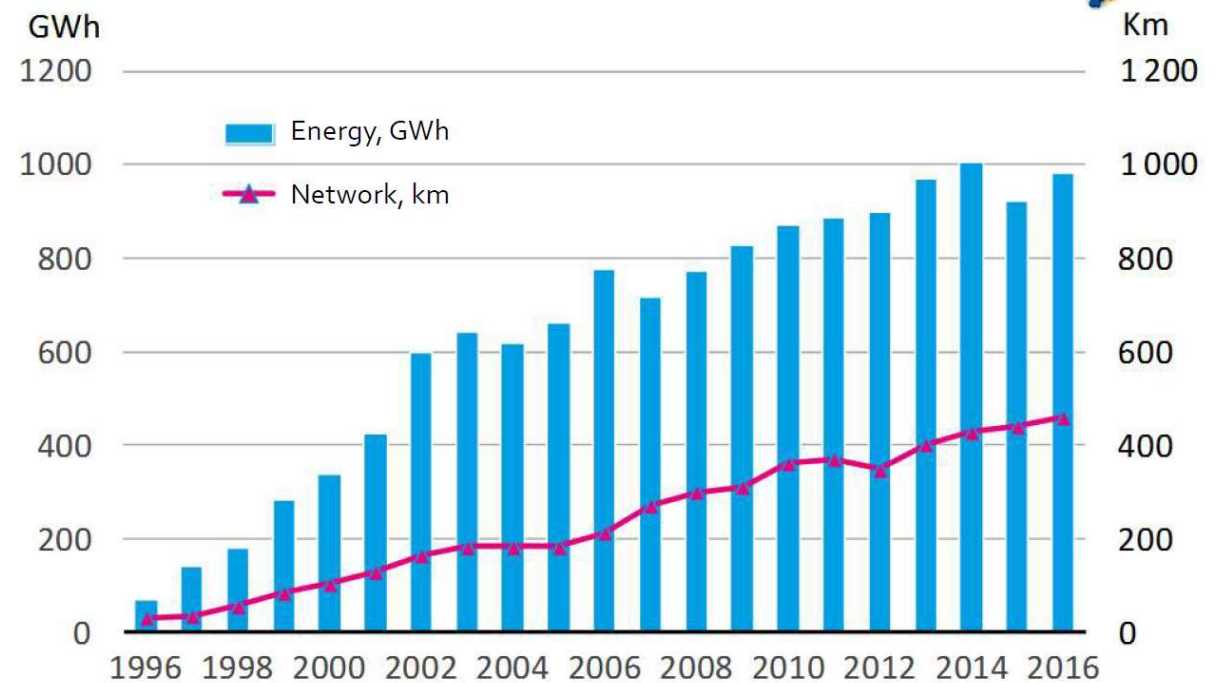


# Rootsi KJ müük + võrgu pikkus

## Võrdluseks (kaugküte):

- Müük 50 000 GWh
- Võrk 25 000 km

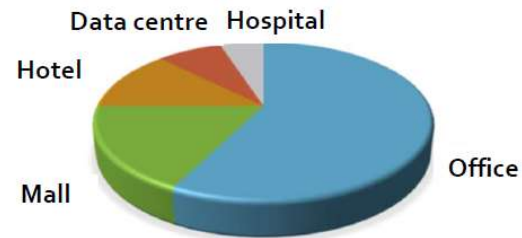
DC Delivery and network in Sweden



## District cooling main selling point

- High delivery dependability (99.7% in the agreement)
- The subcentral only requires one investment,
- Takes little space and is quiet
- Simple, with total operating and cost control
- No worries with new refrigerant laws
- You do not need personal with refrigerator skills
- Stable price with index control
- Energy efficient with low power consumption. COP of 9

District cooling customers in Gothenburg



## Nu ska Göteborg få bukt med bullret

Takfläktar stör göteborgarna mest



Dunkande musik och berusade människor i all ära. Men det som stör göteborgarna mest är brummande fläktar.

Foto: OSCAR MAGNUSSON/bildbyrå

**Brummande fläktar och kylanläggningar stör göteborgarnas sömn allra mest.**

– Klagomålen på de här lågfrekventa ljuden ökar i centrala stan, säger Björn Närlundh, utredningschef på miljöförvaltningen.

Dunkande musik från krogar, berusade människor på uteserveringarna och oljud från trafiken är välkända bullerproblem för närboende. Men det allra vanligaste bullerklagomålet i Göteborg rör fläktar och kylanläggningar, ofta på innergårdar. Miljöförvaltningen håller just nu på med en utredning.



# Kaugjahutuse võrk Göteborgis

## Price model today and in the past

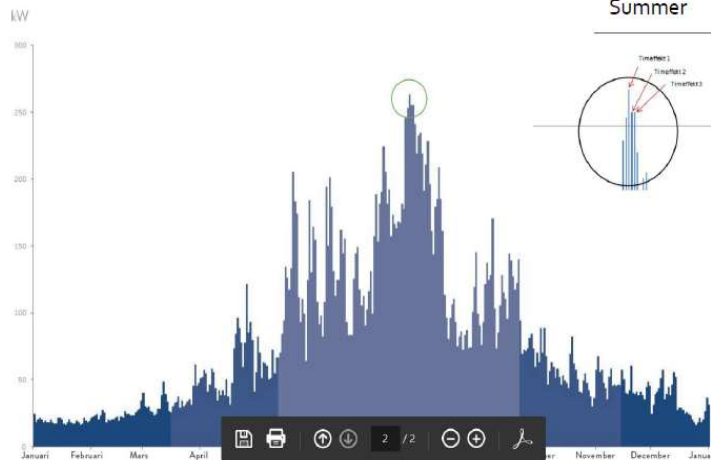
During the build up phase (2002-2015) we gave the customer a price that matched their alternative.

- Quickly get a customer base that can carry the initial investment and organization costs.
- Be more competitiveness since you can always match customers alternative
- Demanding and can be perceived as unfair.

Today we use a price list. (2016-today)

Season	Price Energy	Month
Winter	170 kr/MWh	januari, februari, mars, december
Spring /autumn	260 kr/MWh	april, oktober, november
Summer	330 kr/MWh	maj, juni, juli, augusti, september

Max power	Fixed price	Variable price
0-50 kW	5 000 kr/år	720 kr/kW
51-100 kW	10 000 kr/år	620 kr/kW
101-201 kW	16 000 kr/år	560 kr/kW
201-300 kW	52 000 kr/år	380 kr/kW
301-500 kW	67 000 kr/år	330 kr/kW
501-1000 kW	102 000 kr/år	260 kr/kW
1000 kW-	122 000 kr/år	240 kr/kW



# Kaugjahutuse maksumus Göteborgis

# Kaugjahutus Eestis



Tartu



Pärnu

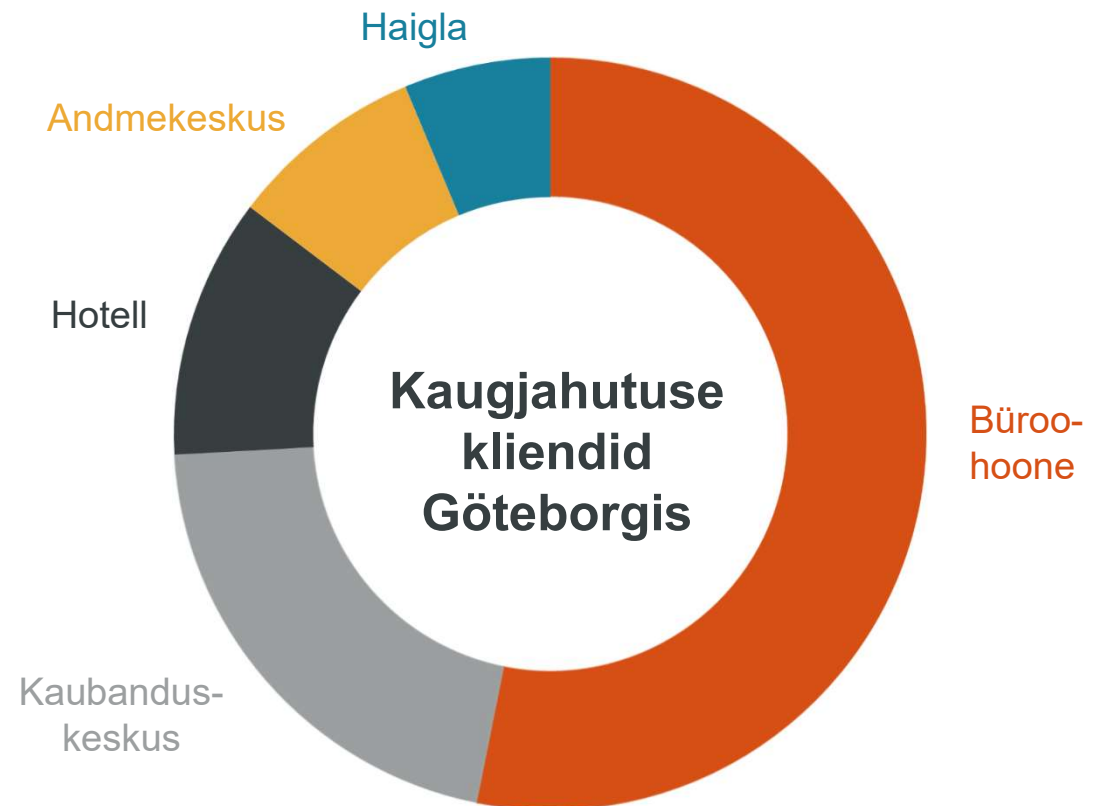


Tallinn

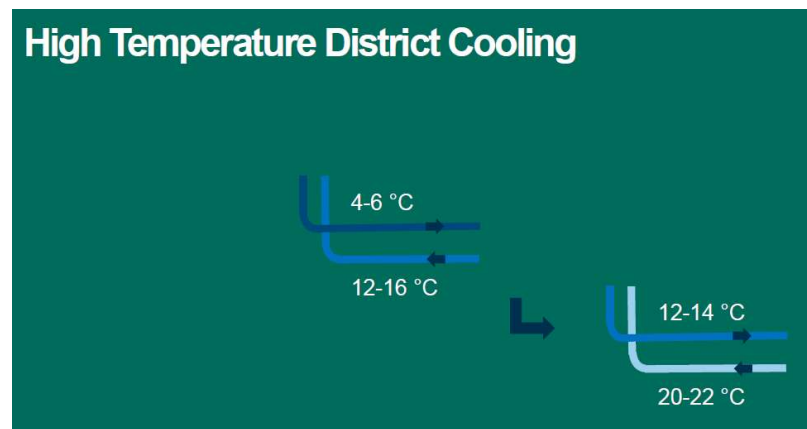
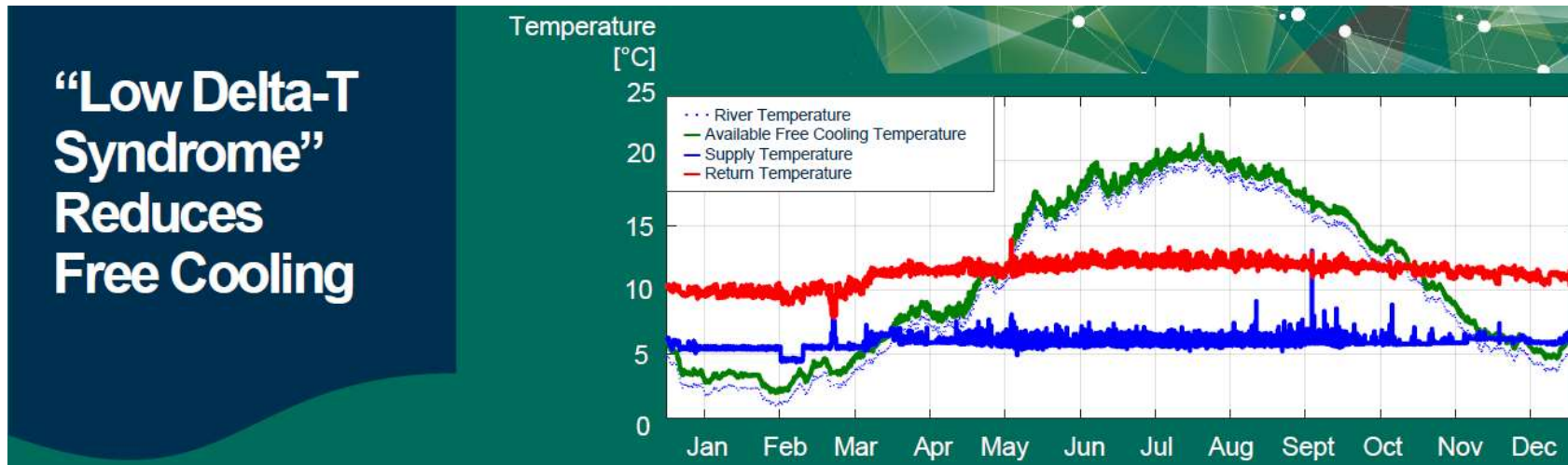
# Kaugjahutuse potentsiaal Tallinnas

- Büroohooned
- Kaubanduskeskused
- haiglad (?)
- serverid (?)

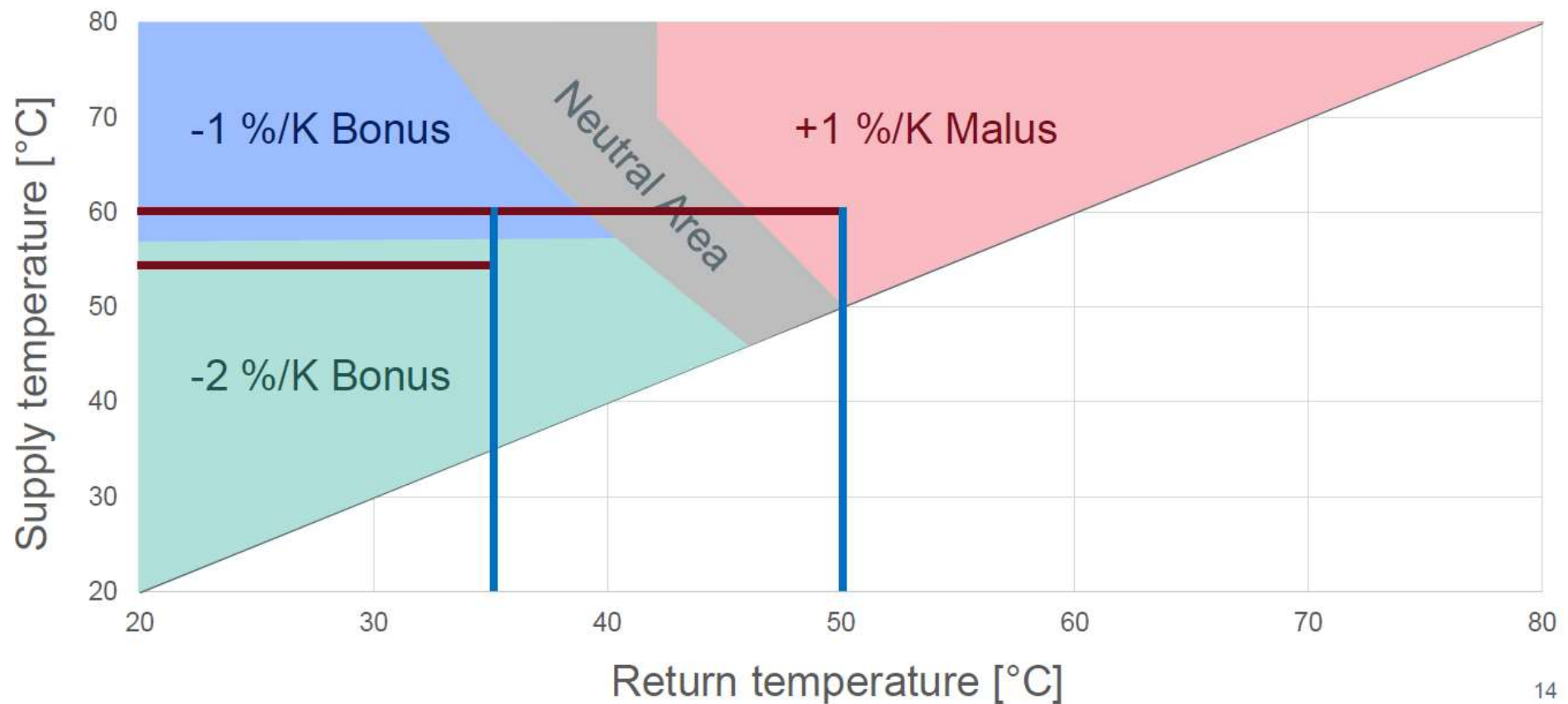
MW ja MWh ?!



# Kaugjahutuse 2.põlvkond?



# Kuidas motiveerida alandada tagasivoolu?





## LOW TEMPERATURE DISTRICT HEATING NETWORK ENERGY CASCADE CONNECTION TO RETURN LINE OF HIGH TEMPERATURE DISTRICT HEATING NETWORK

I.Krupenski, A.Volkova, A.Ledvanov, E.Latõšov, A.Hlebnikov, K.Lepiksaar, V.Mašatin  
Tallinn University of Technology, HeatConsult OÜ, Utilitas Tallinn AS

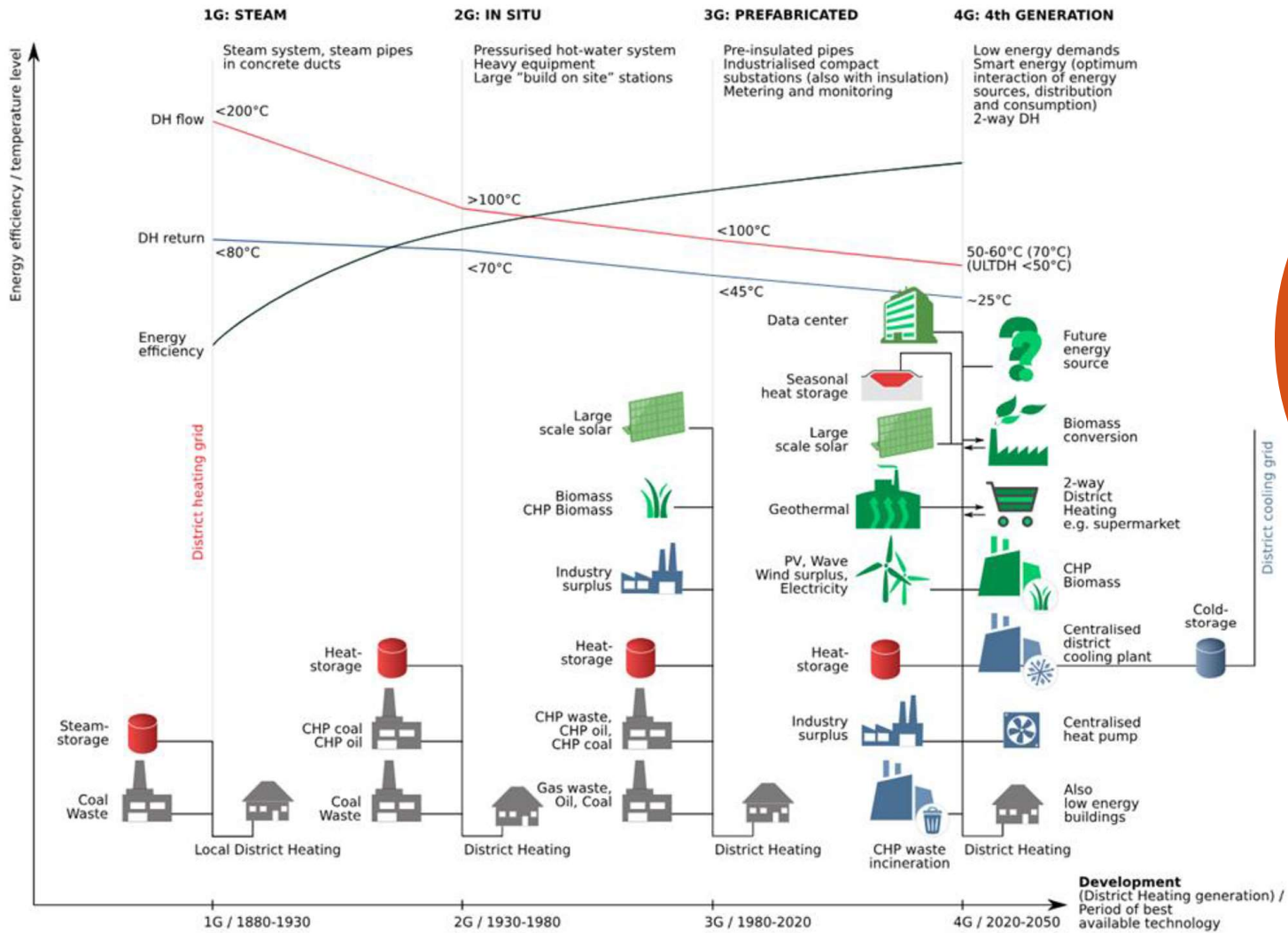
# Paekalda *case study*

### **Ettekanne:**

Smart Energy Systems konverentsil  
Kopenhagenis septembriis

### **Teadusartikkel (1.1):**

ajakiri „Energy“, plaanime avaldada  
järgmise aasta esimeses pooles

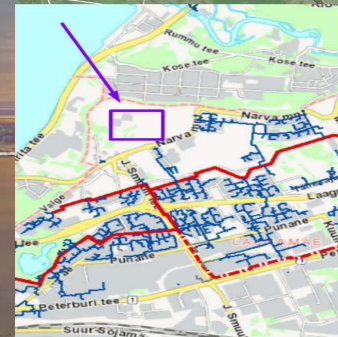


# Kaugkütte põlvkonnad (1, 2, 3, 4)

Allikas: Ajakiri „Energies“



# Paekalda piirkond



17 ha

Arendus 180 000 m<sup>2</sup>  
37 hoonet (korterelamud)

Põrandaküte + soe vesi  
Soojuslik võimsus 15 MW

# Tehniline lahendus

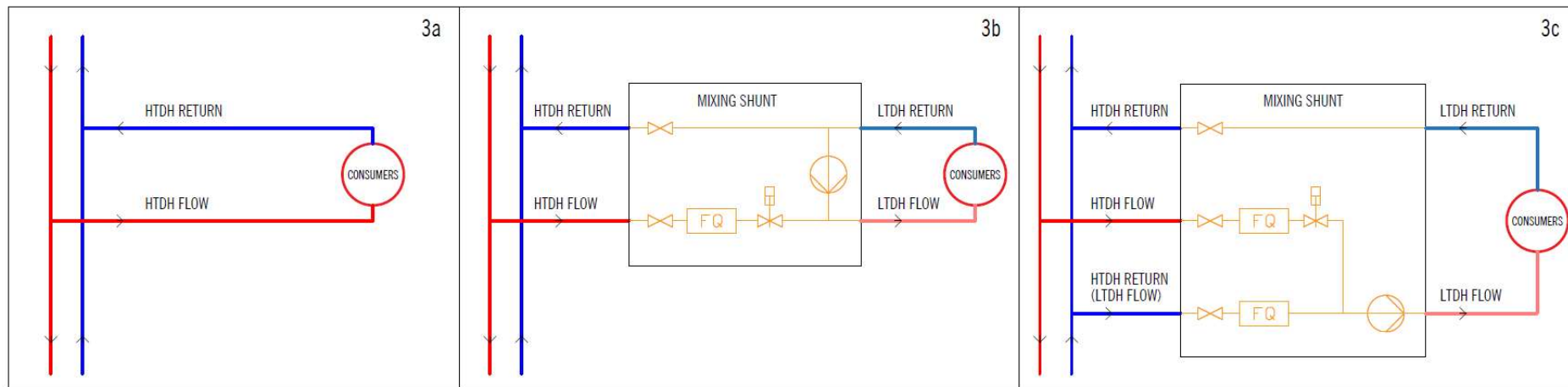


Table 2: Energy production increase due to return temperature decrease by 1°C

Benefit	Capacity increase	Working hours	Produced energy
Additional electricity generation in Tallinna CHP 1	100 kW <sub>el</sub>	8400 h	840 MWh <sub>el</sub>
Additional electricity generation in Tallinna CHP 2	100 kW <sub>el</sub>	8400 h	840 MWh <sub>el</sub>
Additional heat recovery generation in Tallinna CHP 1	300 kW <sub>th</sub>	8400 h	2 520 MWh <sub>th</sub>
Additional heat recovery generation in Tallinna CHP 2	300 kW <sub>th</sub>	5700 h	1 710 MWh <sub>th</sub>

Heat sources	
1. Tallinna CHP 1	electrical power 25 MW <sub>el</sub> ; heat capacity 49 MW <sub>th</sub> ; FGC 18 MW <sub>th</sub> ; total heat 67 MW <sub>th</sub> (with FGC); fuel: wood chips mainly and peat; heat production (90% wood chips/10% peat) 500 GWh <sub>th</sub> ; electrical production 190 GWh <sub>el</sub>
2. Tallinna CHP 2:	electrical power 21,4 MW <sub>el</sub> ; heat capacity 76,5 MW <sub>th</sub> ; fuel: wood chips mainly and peat; heat production (100% wood chips) 320 GWh <sub>th</sub> ; electrical production 150 GWh <sub>el</sub>
Network parameters	Length ~140 km, average diameter 287 mm.
Average ambient temperature during heating period	+2.3°C
Supply temperature of HTDHN	+84°C
Average HTDHN heat load	123.5

# Arvutused

Table 3: Length of DH piping for 1st and 2nd options

Length of DH piping, m*		
Option	1	2
DN300	102	313
DN250	217	67
DN200	212	337
DN150	208	110
DN125	176	85
DN100	35	13
DN80	57	44
DN65	107	111
DN50	4	
<b>TOTAL</b>	<b>1118</b>	<b>1080</b>

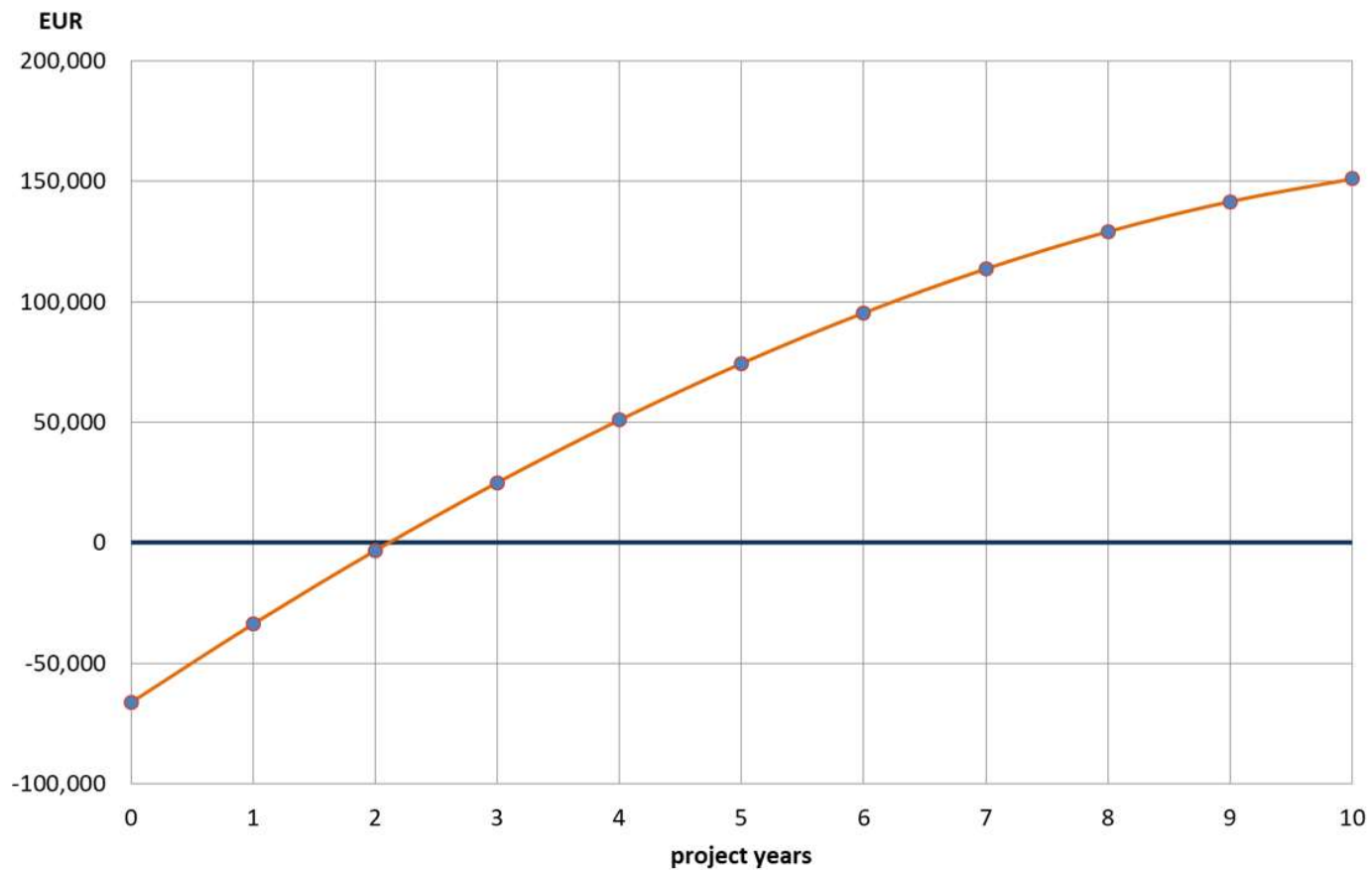
\* 1m of piping is 1m feed pipe + 1m return pipe

Table 4: Benefits due to 2<sup>nd</sup> option implementation

Benefit	Amount	Price	Income
Heat losses decrease in large DH networks	207 MWh	35 EUR/MWh	7 245 EUR
Electricity generation increase	400 MWh <sub>el</sub>	90 EUR/MWh	36 000 EUR
Heat recovery increase in FGC	1015 MWh	35 EUR/MWh	35 525 EUR
Heat loss savings in new LTDHN sector	31 MWh	35 EUR/MWh	1 085 EUR
		<b>Total</b>	<b>79 855 EUR</b>

Option	Piping without fittings (EUR)	Fittings (EUR)	Piping with fittings (EUR)	Pumping station (EUR)	Heat exchangers (EUR)	Total
1	200,246	103,922	304,168	0	41,050	345,218
2	228,488	56,396	284,884	49,100	77,514	411,498

# Tulemused



The return temperature of the main network will gradually decrease by approximately **0.39 °C** from 49.7°C to 49.31°C throughout the heating season

# Kokkuvõte

## Hetkeolukord

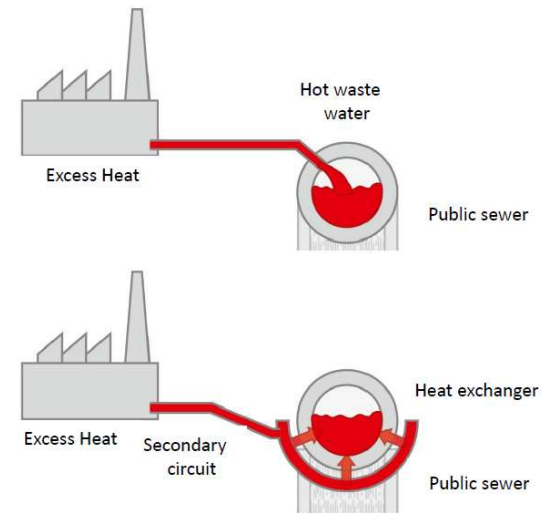
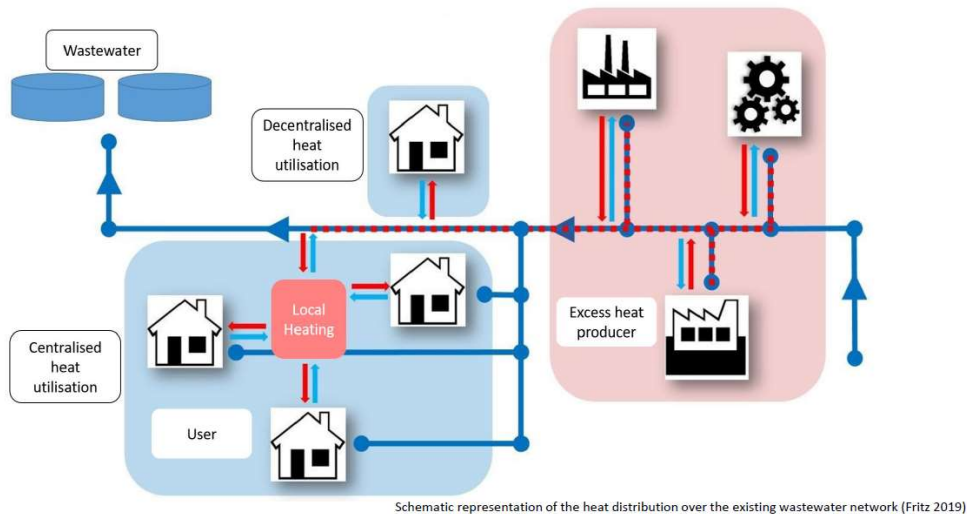
- Ei paku suurt huvi Arendajatele
- Pakuks huvi Võrguvaldajale (soojatootjatele)

## Võimalikud win-win-win variandid

- Tariifide süsteem (nt odavam Tarbija jaoks, väiksem primaarenergia tegur...)
- Osa investeringutest katab Võrguoperaator (väiksem investering Arendajal)
- Tarbija suhtumine / arusaam



# Reovesi soojuskandjana?





# TÄNAME TÄHELEPANU EEST!

Küsimused?