The work on 4GDH in Denmark

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4GDH

- Relevance
- Concepts
- Technologies
- Demonstration
- Implementation plans

4DH
4th Generation District Heating Technologies and Systems

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Why 4GDH?

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- All Danish buildings fossil free heated in 2035
- Energy savings and renewable energy supply
- What are the best technologies?
- What is the best implementation plan?

Concept of 4GDH

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Low temperature DH: Supply/return: 50C / 20C

Heat supply: No fossil fuels & no biomass fuels

Low temperature district heating necessary because:

- **renewable heat from geothermal plants (60-70 C)**
- **acceptable heat loss from network for low-energy houses**

Technologies – Supply of heat

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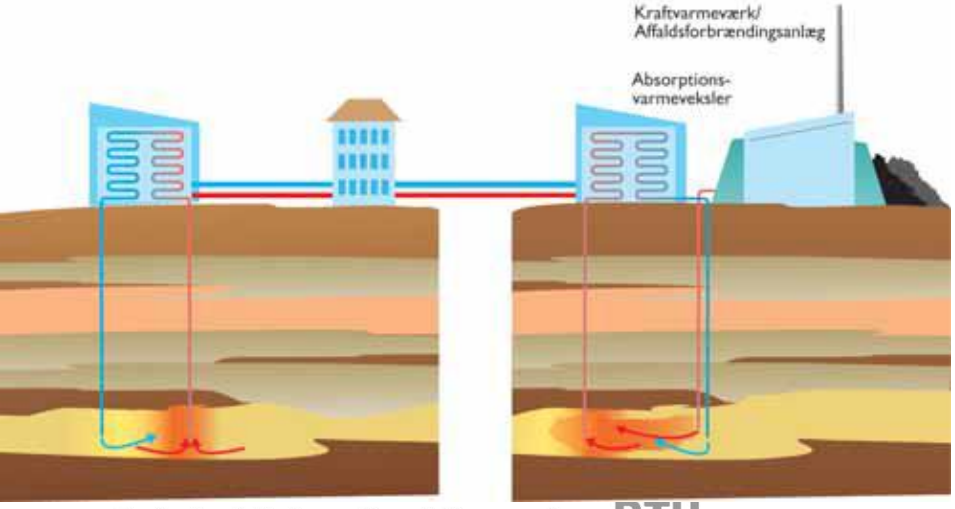
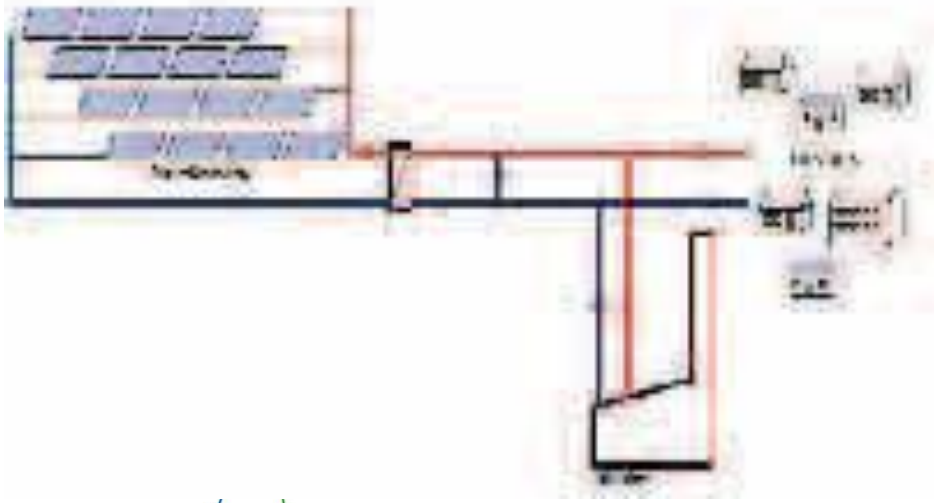
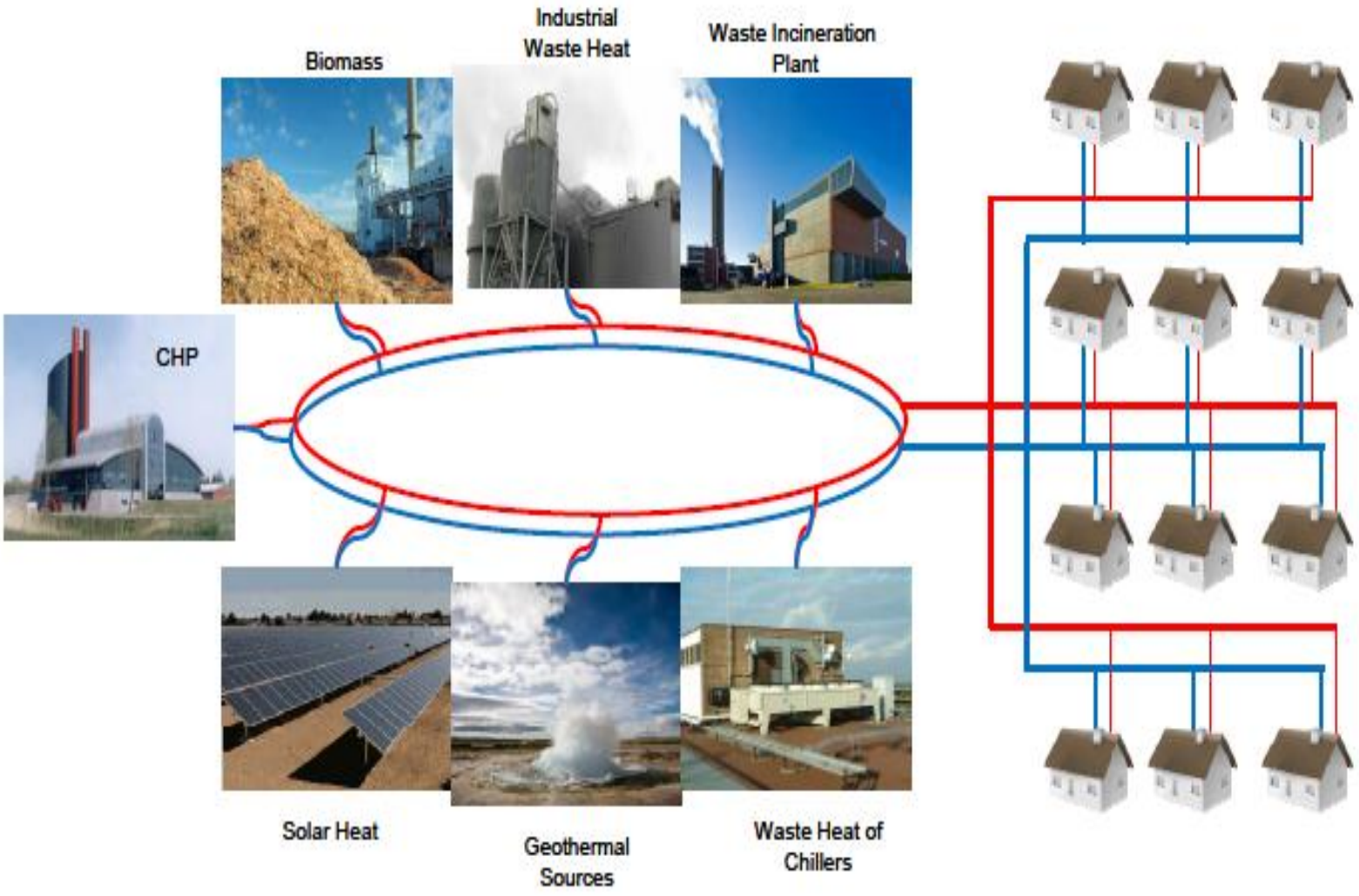
Geothermal heat
Central solar heating
Waste incineration





EFFICIENCY INCREASE OF EXISTING SOURCES
NEW LOW TEMPERATURE HEAT SOURCES



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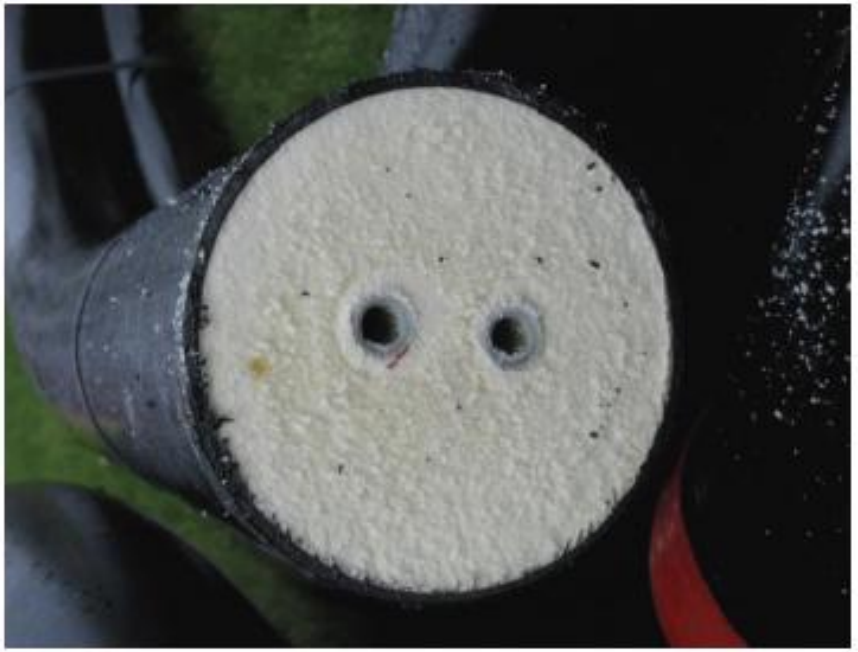
Technologies - Distribution

Twinpipes with small diameter pipes and small heat losses



Figur 12 Tværsnit af det fremstillede prototyperør 14/14/110 mm

Technologies – Grids or Network layouts

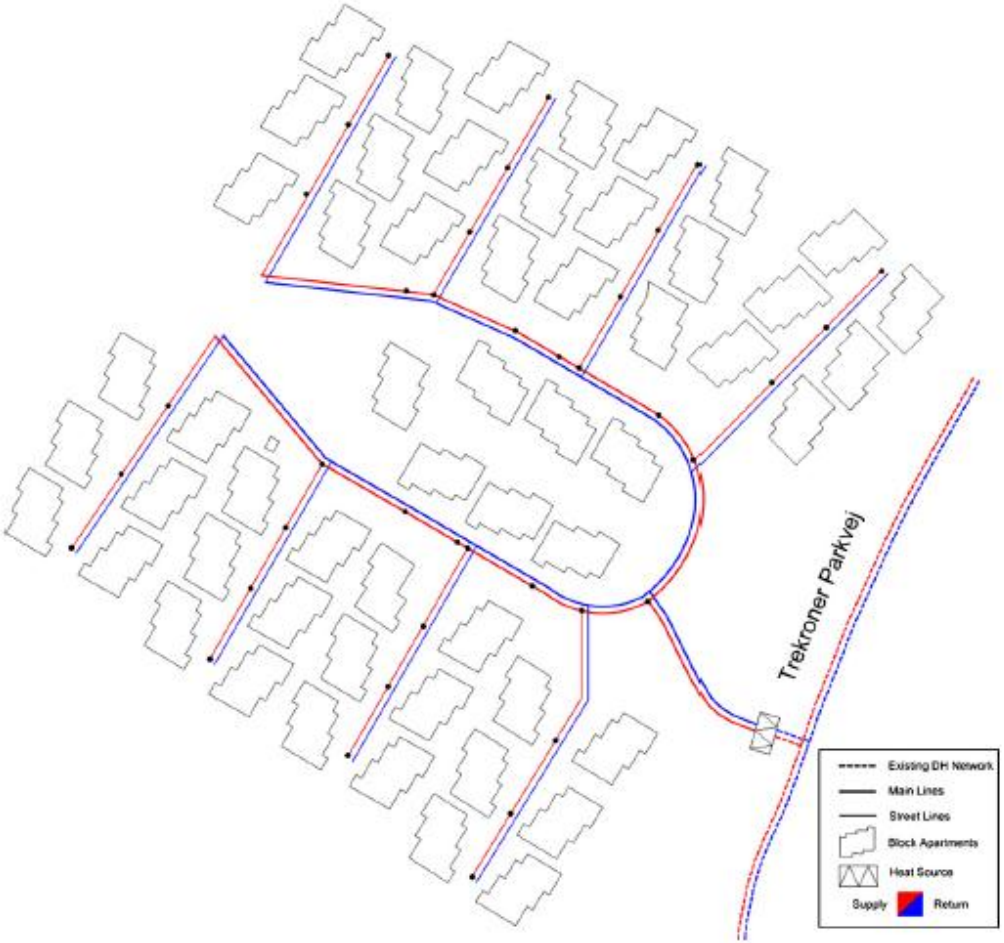


Fig. 1. Branched network layout considered for use in the Trekroner Area.

Technologies – Substations
Heat exchanger for DHW

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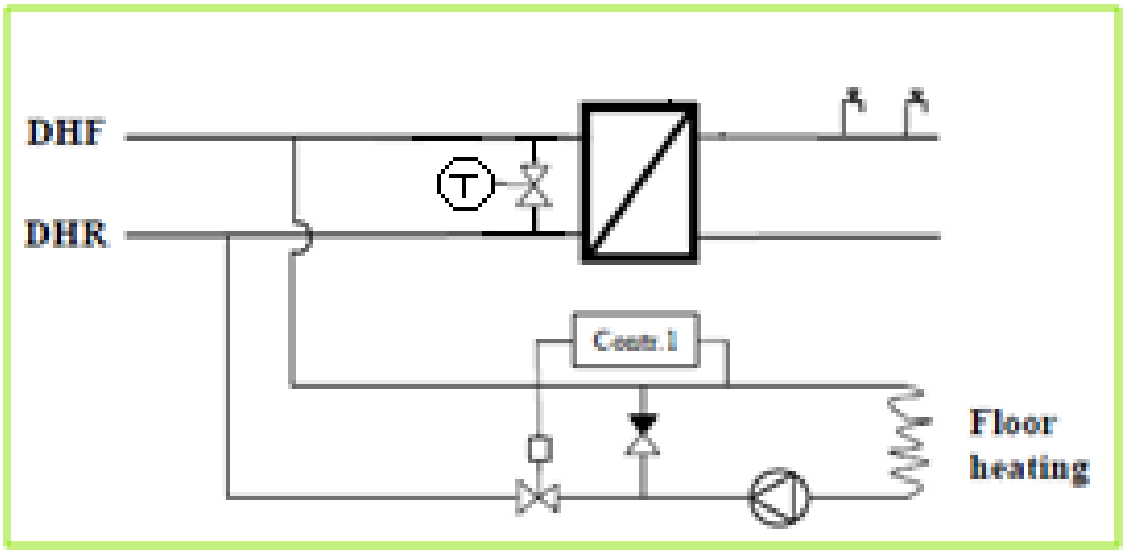
High efficiency –

Supply temp. district heating: 50 C

DHW : 45 C



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Technologies – substations Buffertank with DH-water

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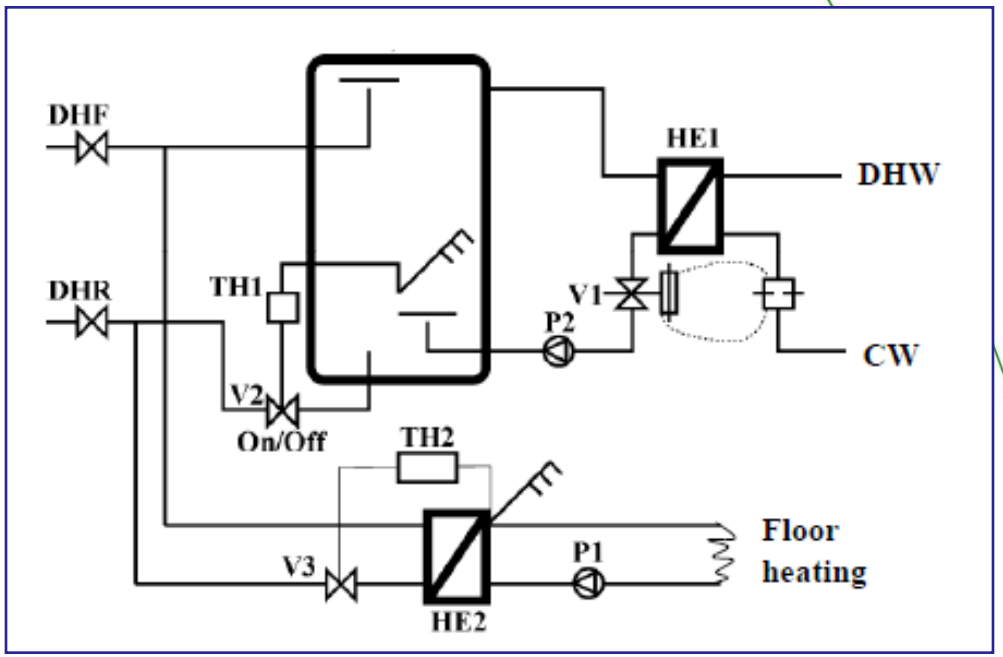
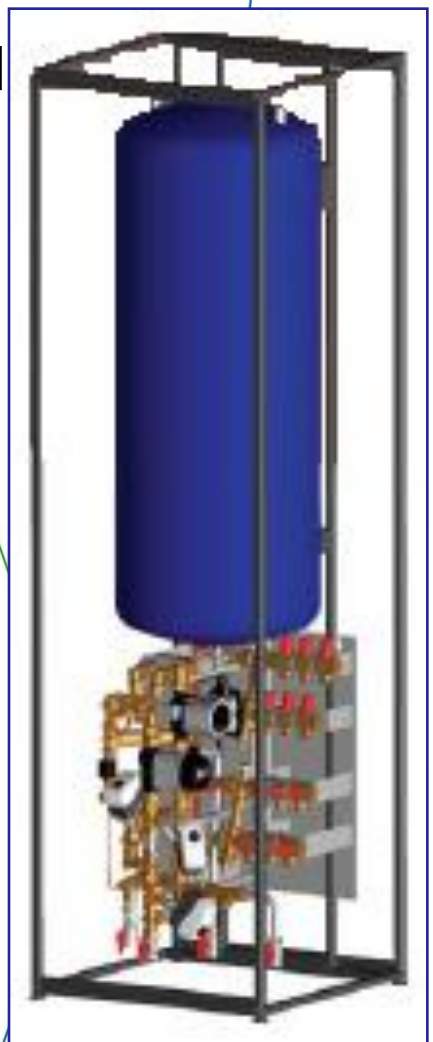
Reduce peak load from DHW in DH





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Technologies –
District heating supply temp of 40

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Micro-booster unit – prototype and the final product

Danfoss

- COP ≈ 4,5 – 4,8
- DH return temperature of 26 – 28°C

Technologies – DHW in large buildings with circulation

Thermal or UV disinfection

Danfoss ThermoClean or Wallenius UV

Wallenius AOT 5 duo with sensor

Demonstration
EUDP - projects

- ***2001-2004**:* EFP-2001: District heating supply to low-energy areas
- ***2006-2009**:* EFP-2007: Development and demonstration of low-energy district heating for low energy buildings
- ***2008-2011**:* EUDP 2008-II: CO_2 reductions in low-energy buildings and communities by implementation of low-temperature district heating systems. Demonstration cases in EnergyFlexHouse and Boligforeningen Ringgården
- ***2011-2014** (expected completion):* EUDP 2010-II: Full-scale demonstration of the future low-temperature district heating in existing settlements (Fuldskala demonstration af fremtidens lavtemperatur fjernvarme i eksisterende bebyggelser, in Danish). The project is ongoing.
- ***2011 – 2014** (expected completion):* EUDP – Heat Pumps in District

Show case in Lystrup [1,2]

- EFP/EUDP projects (2007, 2008, 2010)
- 40 row-houses class 1 (BR08) – 37 kWh/m^2·yr
- DH design parameters: 50/25°C, 10 bar
- District heating network
  - AluFlex Twin pipes (insulation series 2)
  - reduced pipe sizes -> higher pressure drop
  - annual distribution heat loss approx. 15%
- Development of two in-house substations concep
  - no problem with Legionella and comfort
- System runs already 2 years , no complaints

Implementation plans
Example: Pre study on energy renovation of buildings and 4GDH
3 Scenarios

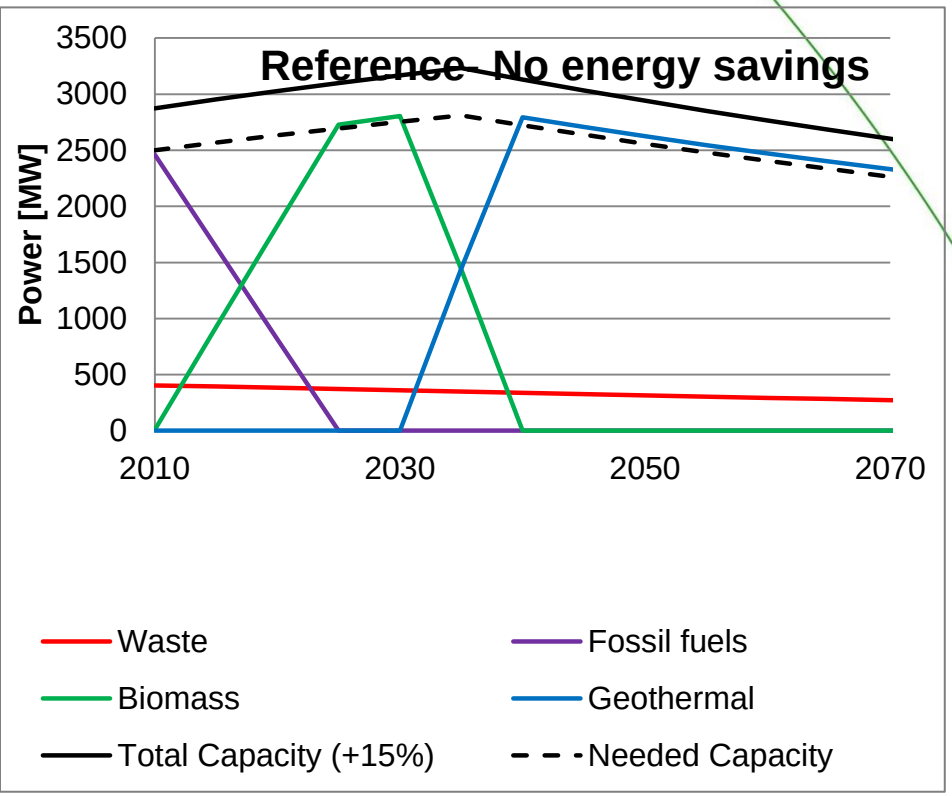
- All scenarios contain a natural replacement on 1% of the existing building mass with newly constructed buildings.

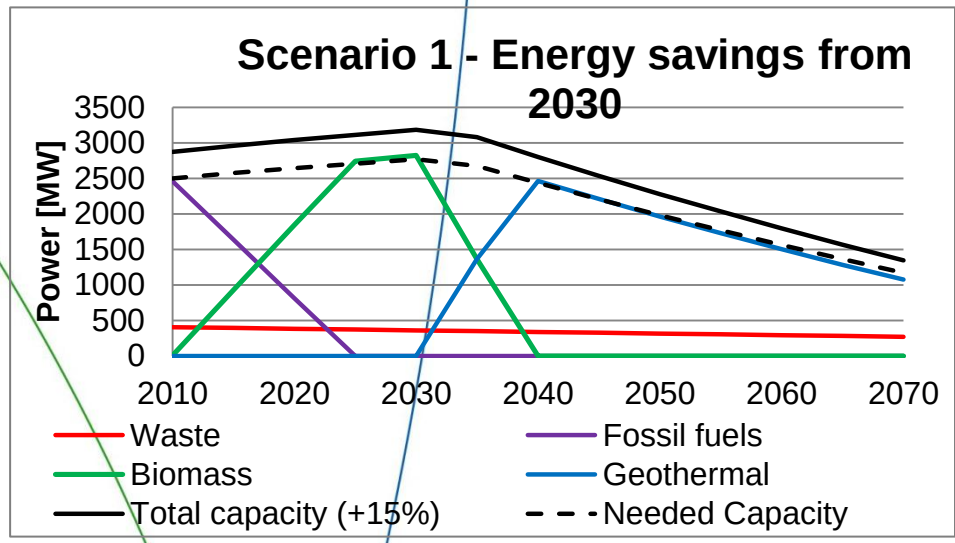
- **Reference scenario - No heat savings**
  - *Represents the extreme case where nothing is done. Supply for the full unchanged heat demand.*

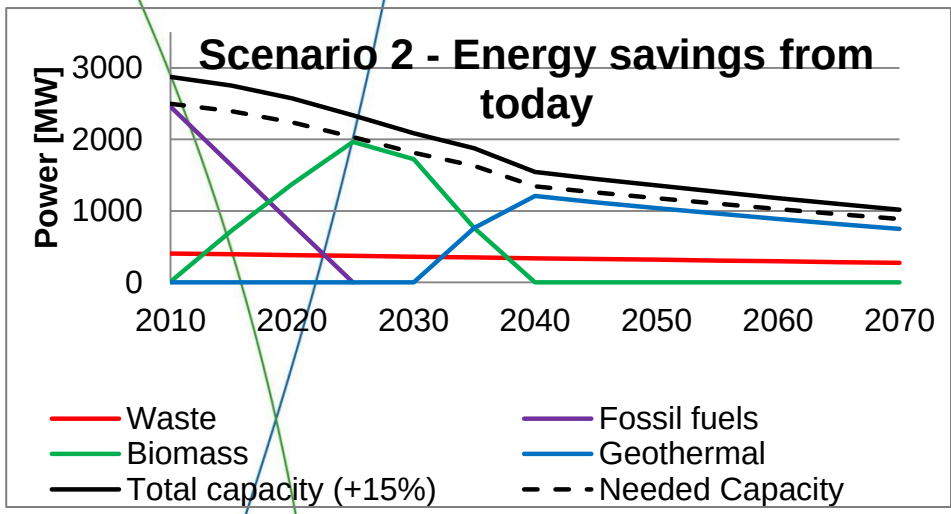
- **Scenario 1 - Accelerated energy renovation from 2030-2070 (65 %)**
  - *Nothing is done in the near future due to low DH-supply prices. Investment in new capacity will increase the supply price and as a consequence heat savings are carried out.*

- **Scenario 2 - Accelerating energy renovations from today (65%)**
  - *Heat savings are implemented from today, resulting in decreased heat demand before investment in new capacity.*

Capacity – Peak loads







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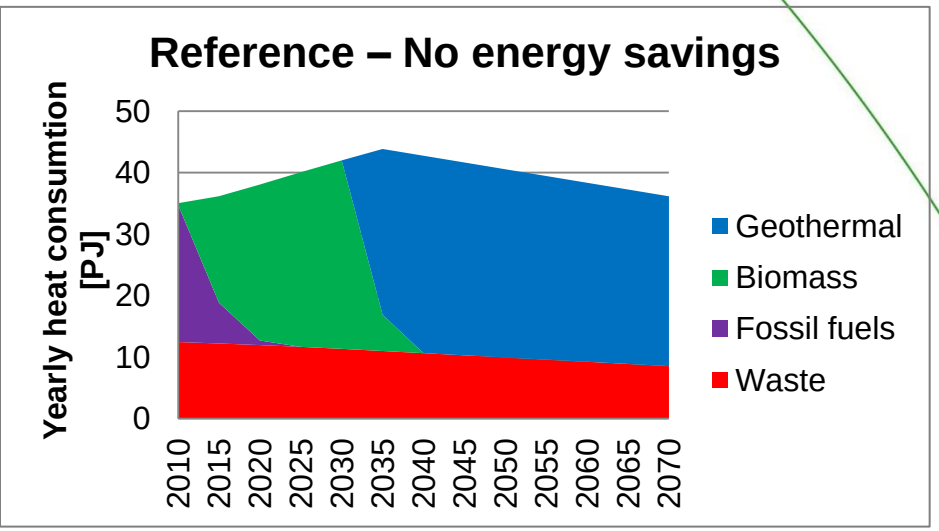
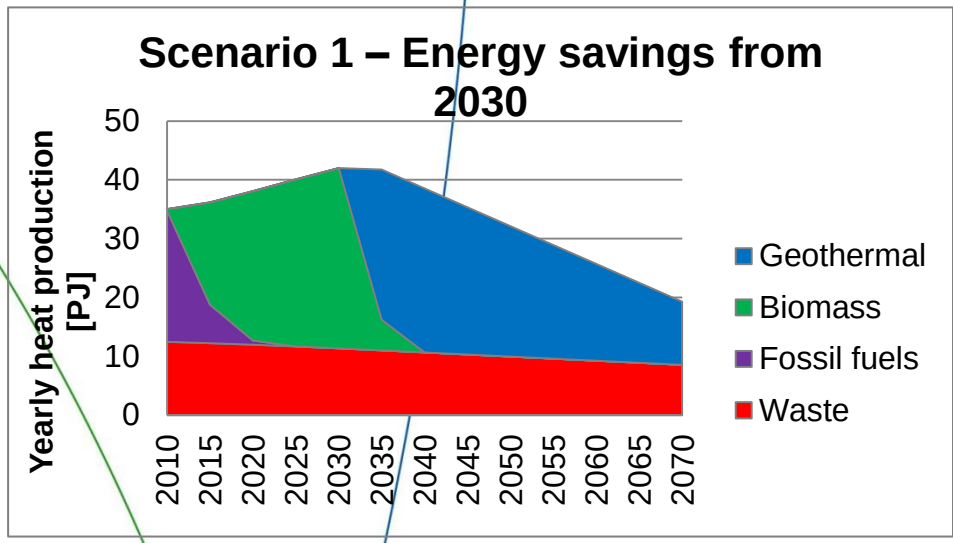
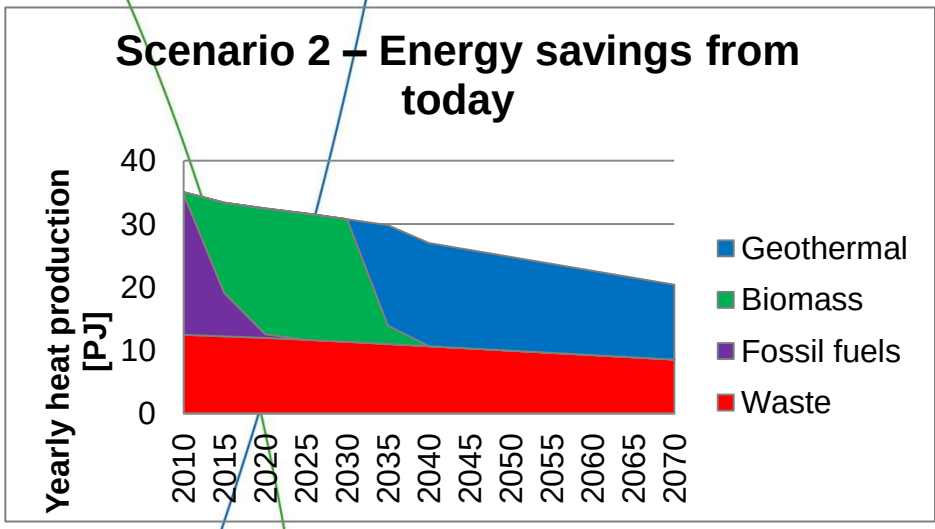
Yearly heat production 2010 - 2070







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Costs

		Reference	Scenarie 1	Scenarie 2
Geothermal				
Capacity	[MW]	2793	2464	1207
Capital investment	[mil €]	7498	6614	3241
DH-system				
Total DH -production in 60 years	[PJ]	2379	2114	1656
Geothermal production in 40 years	[PJ]	1110	838	543
Total costs for DH	[mil €]	12162	10521	6227
Renovation				
PJ saved by energy renovating (65%)	[PJ]	-	265	723
Cost for energy renovation	[mil €]	-	2205	6021
Total cost for each scenario	[Bil €]	26	29	25

Investment -50% If energy savings are carried out now

Total costs are similar due to energy renovation is costly

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Implementation plans - conclusions

Detailed investigations needed

- Based on new 4GDH technologies
- Based on an optimised energy system
  - Fossil free
  - No imported biomass for fuels

Optimal solutions

Political implementation needed