Aalto-yliopisto
Insinööritieteiden
korkeakoulu

Fundamentals of HVAC Design EEN-E4004

Lecture 3, 13.2.2019

Comparison and choice of heating systems

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Comparison and choice of heating systems

Heating system consist of two main parts:

- Heat production system (f.ex. district heating, heat pump)
- Heat distribution method (f.ex. radiators, floor heating)

Things to take into account when choosing heating systems:

- Needs and wishes of client (living comfort)
- Heat distribution systems (temperatures)
- Energy effiency (E-figure)
  - Primary energy factors (PFE) of energy sources
  - Energy effiency class (A…G)
- LCC (Life Cycle Cost) of system
- CO2 emissions
- Lifetime of equipments and parts
- Space reservation for installations
- Site and location (possibilities for District Heating or geothermal wells)

Comparison and choice of heating systems

Heat production systems

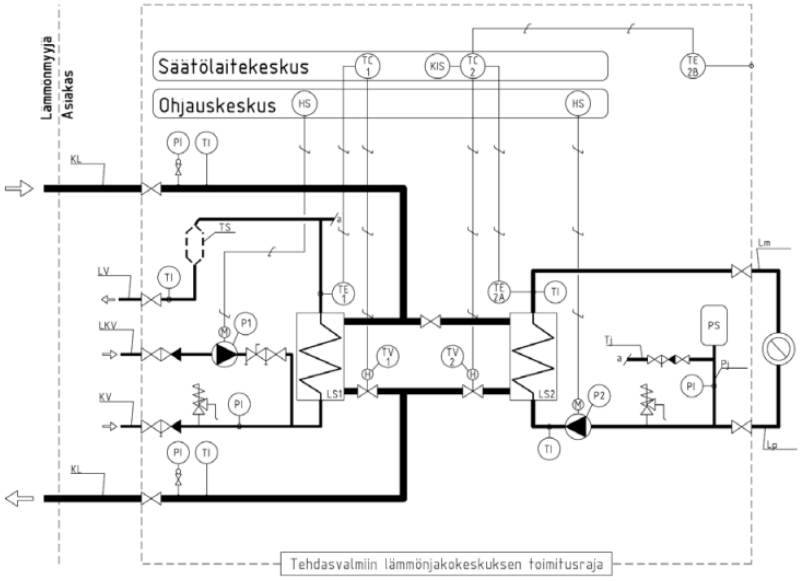
- District Heating
- Heat pumps
  - Geothermal heat pump
  - Air to water heat pump
  - Exhaust air heat pump
- Electric heating (straight or boiler)
- Oil boiler
- Wood boiler
- Wooden pellet

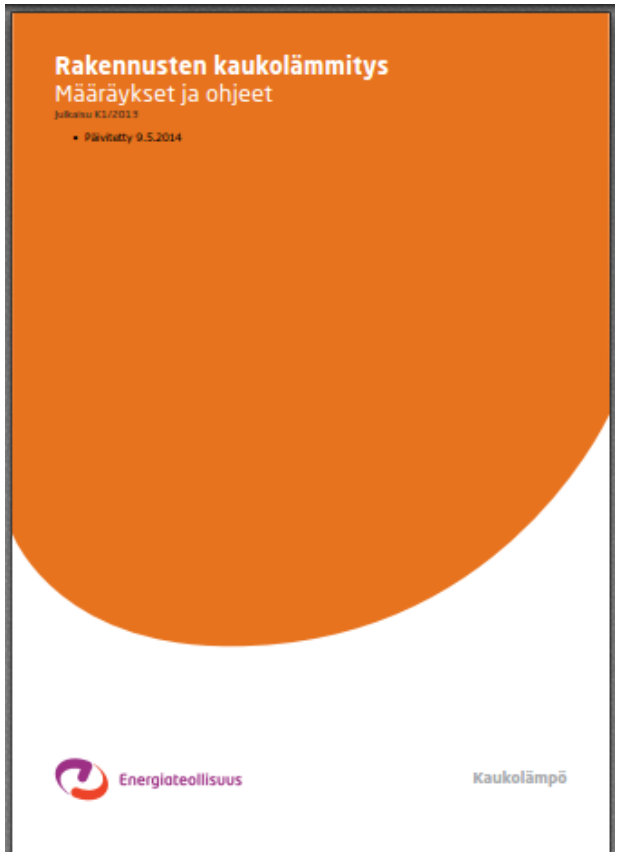
Supplementary heat production

- Fireplaces
- Electricity
- Air to air heat pump
- Solar collectors

District Heating

- www.helen.fi, www.fortum.fi
- www.gebwell.fi

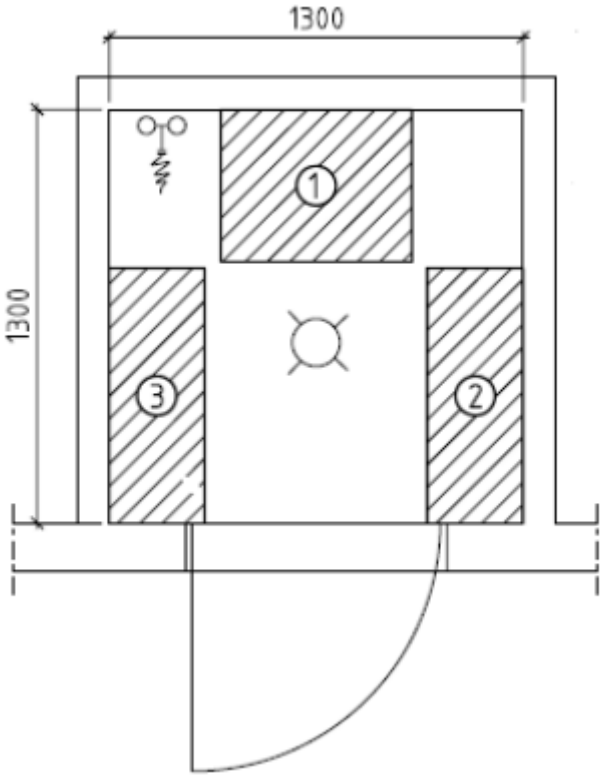




Energiateollisuus, Distric Heating Guide, K1 (fin)

District Heating

Heat distribution center, in small buildings.
Needed space reservation is relatively small.



Minimum space demand for distric heating distribution center (K1)

Geothermal heat pumps

- Gebwell (www.gebwell.fi)
- Nibe (www.nibe.fi)
- IVT (www.ivt.fi)
- Oilon (www.oilon.fi)

Liquid from well

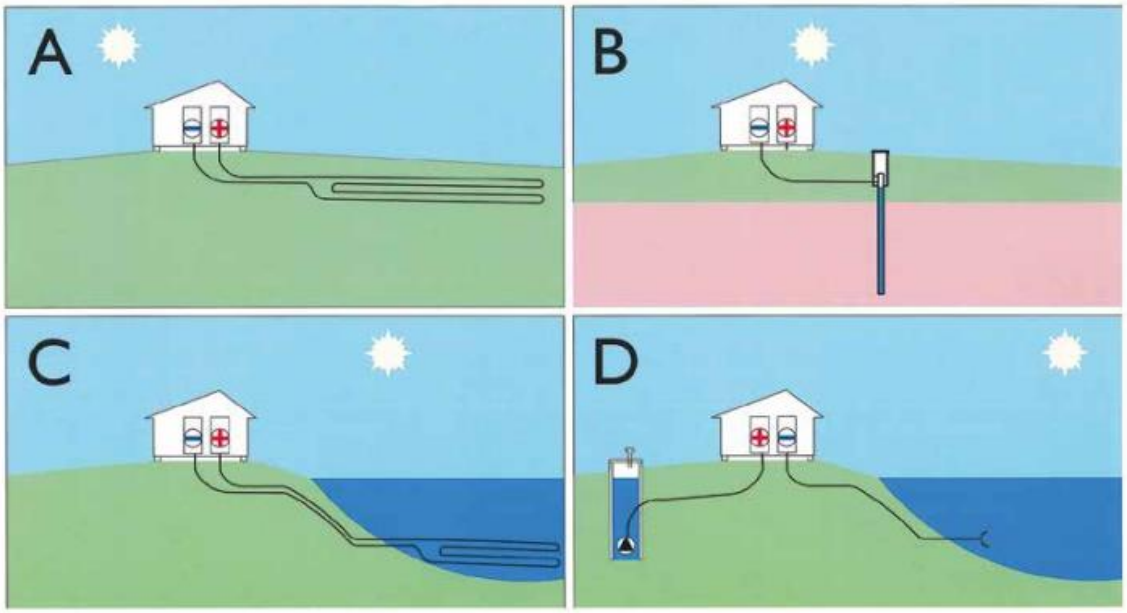
Water to heating system

LVI-numero			5361940	5361941	5361968	5361998
Tehotiedot:						
Lämmitysteho (0°/35° ja 0°/55°)	Heat output	kW	5,3 / 4,9	7,4 / 6,8	9,4 / 8,5	13,3 / 12,2
Jäähdytysteho (0°/35° ja 0°/55°)	Cooling output	kW	4,2 / 3,2	5,8 / 4,4	7,4 / 5,6	10,5 / 8,1
Ottoteho (0°/35° ja 0°/55°)	Power demand	kW	1,1 / 1,7	1,6 / 2,4	2,0 / 2,9	2,8 / 4,1
COP (0°/35° ja 0°/55°)			4,8 / 2,9	4,6 / 2,8	4,7 / 2,9	4,8 / 3,0

- Tehot ilmoitettu lämpötiloissa 0°/35° ja 0°/55° SFS-EN 14511

Geothermal heat pumps

- Installation options of collector pipes

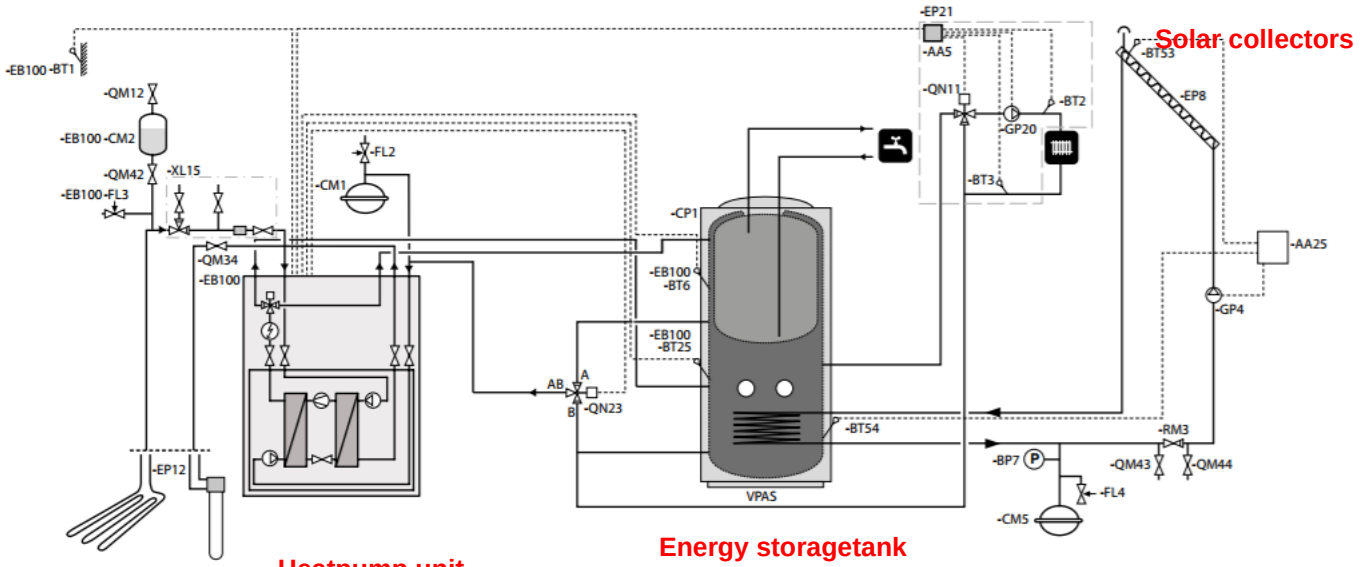


A) Horisontal collector pipes, B) Drilled energy well,
C) Collector pipes in water, C) Open circuit collector pipes

Photo from Energy well guide (fin).

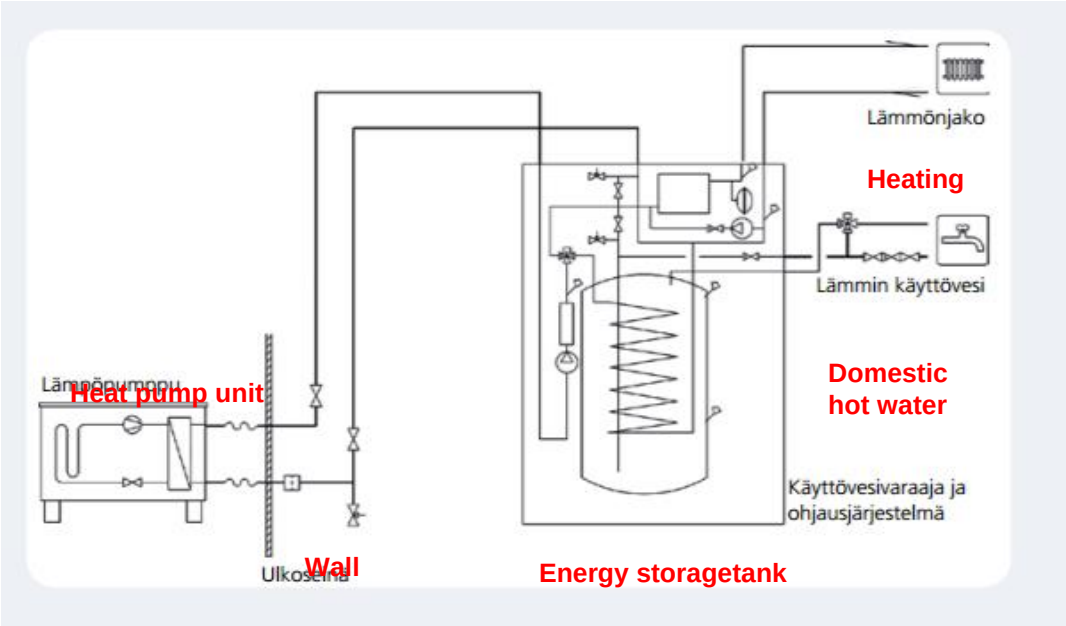
Geothermal heat pumps

- Geothermal heatpumps (schematic diagram)



Air to water heat pumps

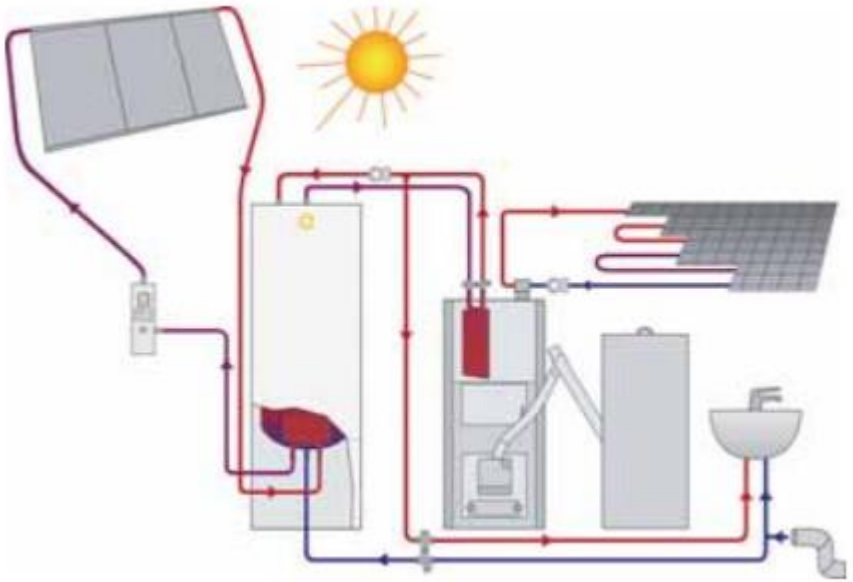
- Air to water heat pumps:
  - Nibe (www.nibe.fi)
  - IVT (www.ivt.fi)



Wooden pellet

f.ex. www.jaspi.fi

Jäspi Pelletti XL Jäspi Solar Economy PAK:n yhteydessä

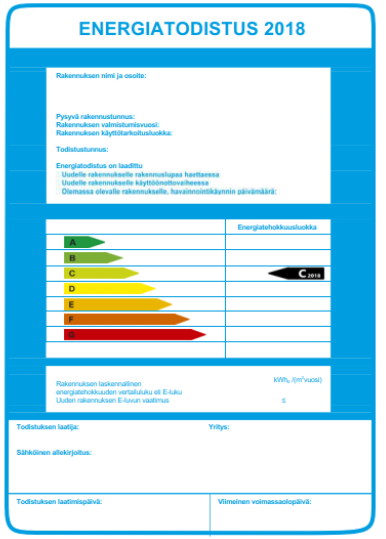


Energy performance certificate

- Energy effiency regulations in Finland state that all buildings[1] must have a Energy Performance Certificate (Energiatodistus).
- Helps consumers compare buildings' energy efficiency in a simple way.
- Classes A-G (new building must be A, B or C)
- E-figure is is composed of the building's calculated annual consumption of purchased energy, weighted with the factors of various forms of energy

150 m²< A_{netto} ≤ 600 m², A_{netto} on rakennuksen lämmitetty nettoala

Energiatehokkuusluokka	E-luku ($kWh_E/(m^2vuosi)$)		
A		E-luku	≤ 83 - 0,02×A_{netto}
B	83 - 0,02×A_{netto} <	E-luku	≤ 131 - 0,04×A_{netto}
C	131 - 0,04×A_{netto} <	E-luku	≤ 173 - 0,07×A_{netto}
D	173 - 0,07×A_{netto} <	E-luku	≤ 253 - 0,07×A_{netto}
E	253 - 0,07×A_{netto} <	E-luku	≤ 383 - 0,07×A_{netto}
F	383 - 0,07×A_{netto} <	E-luku	≤ 453 - 0,07×A_{netto}
G	453 - 0,07×A_{netto} <	E-luku	



- See: https://www.finlex.fi/fi/laki/alkup/2017/20171048 https://www.finlex.fi/data/sdliite/liite/6822.pdf (both in finnish)

1) Except: <50m2 buildings, cottages, temporary buildings, industrial buildings, shelters, churches, military buildings etc.

Energy performance certificate

- Choise of heat production system has big effect on energy performance of building.
- Buildings calculated annual consumption of purchased energy is weighted with the Primary Energy Factors (PFE) of energy sources.

  PFE-factors in Finland (according act 788/2017):

  - Electricity 1,2
  - District Heating 0,5
  - District Cooling 0,28
  - Fossil fuels 1,0
  - Renevable fuels used in building 0,5

1) Except: <50m2 buildings, cottages, temporary buildings, industrial buildings, shelters, churches, military buildings etc.