

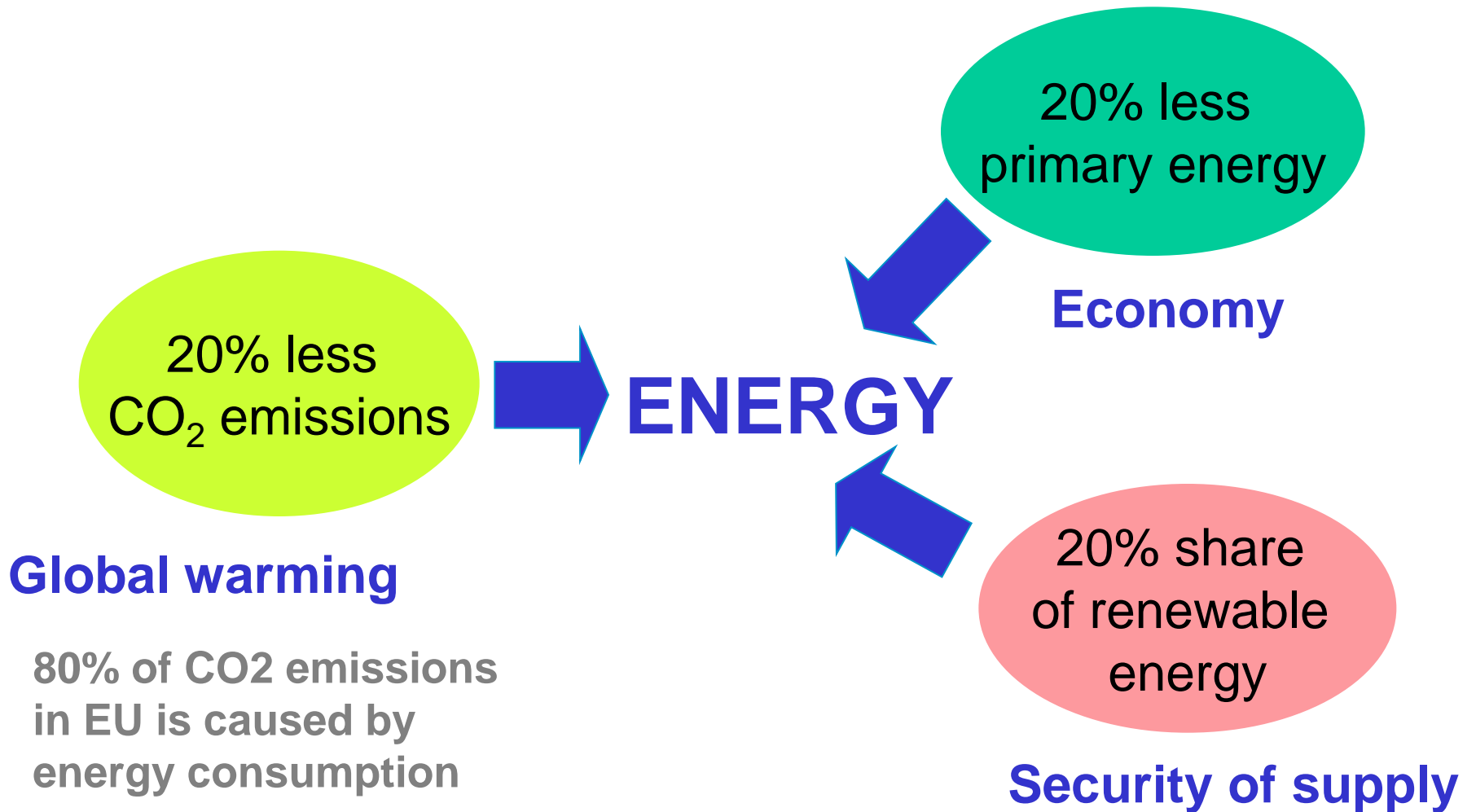
FFG
FORSCHUNG WIRKT.



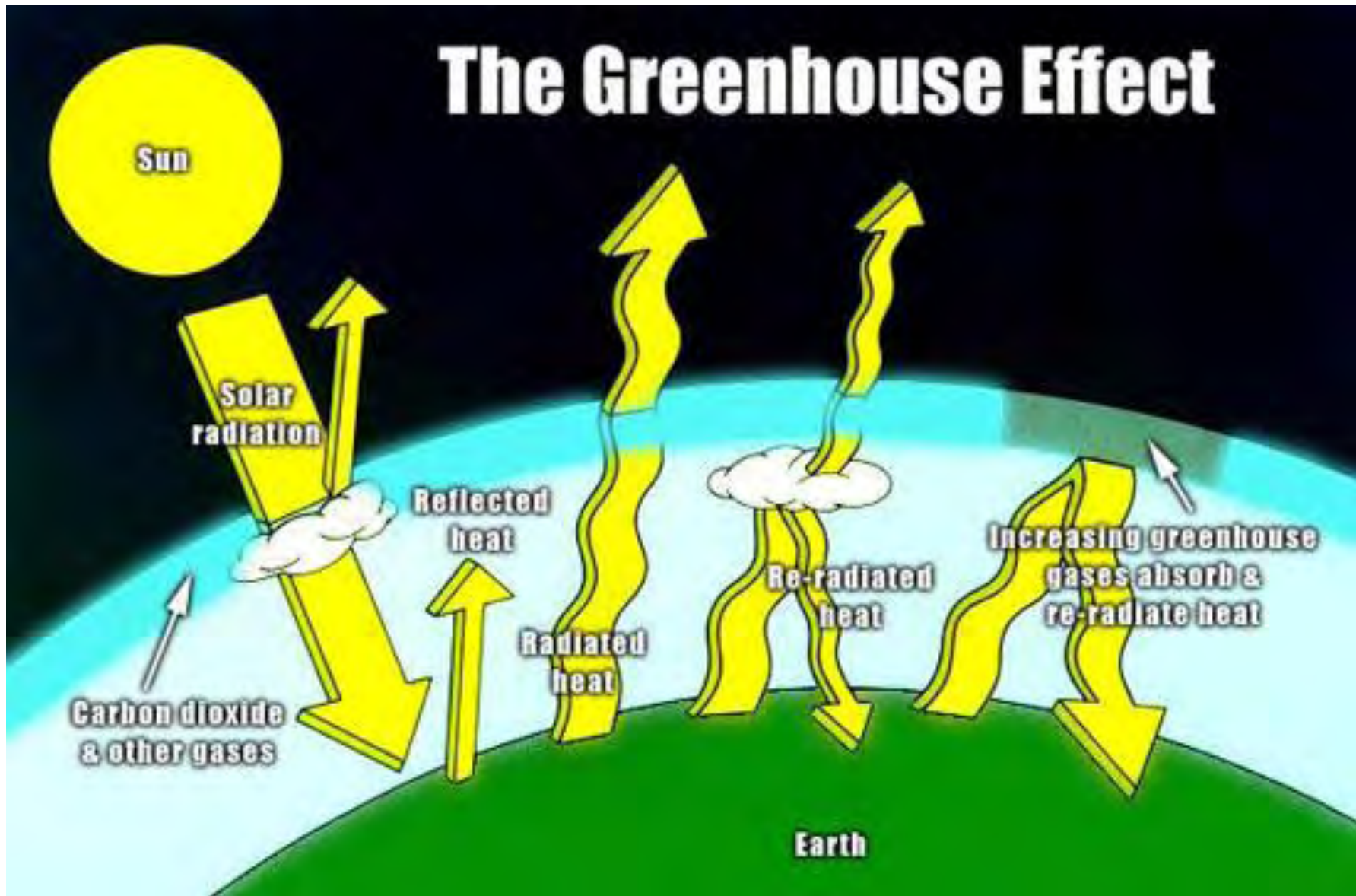
Buildings, Heat Pumps and Distributed Energy Storage Systems

Hermann Halozan

Graz University of Technology, Austria

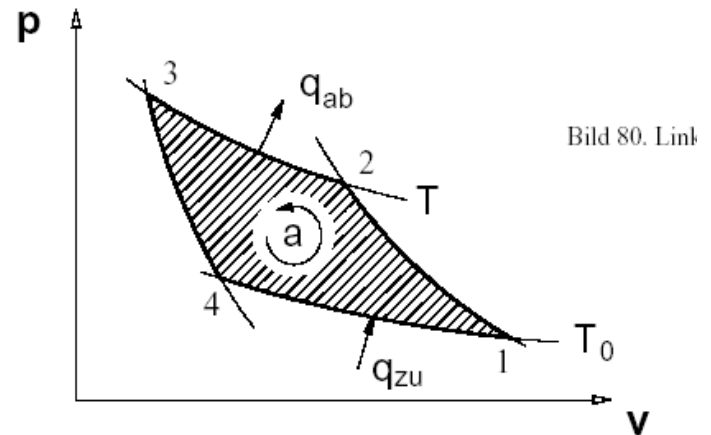
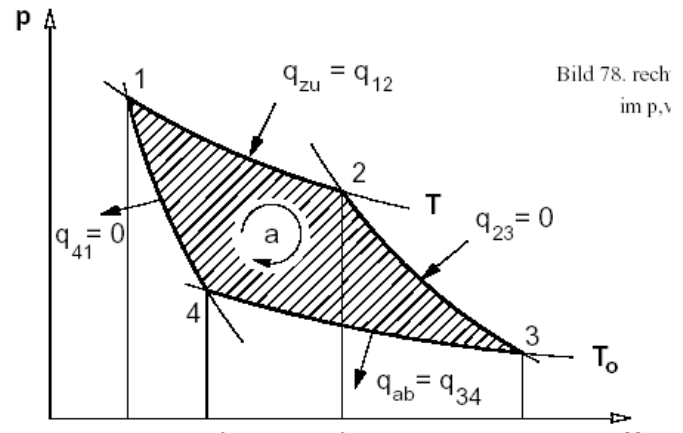


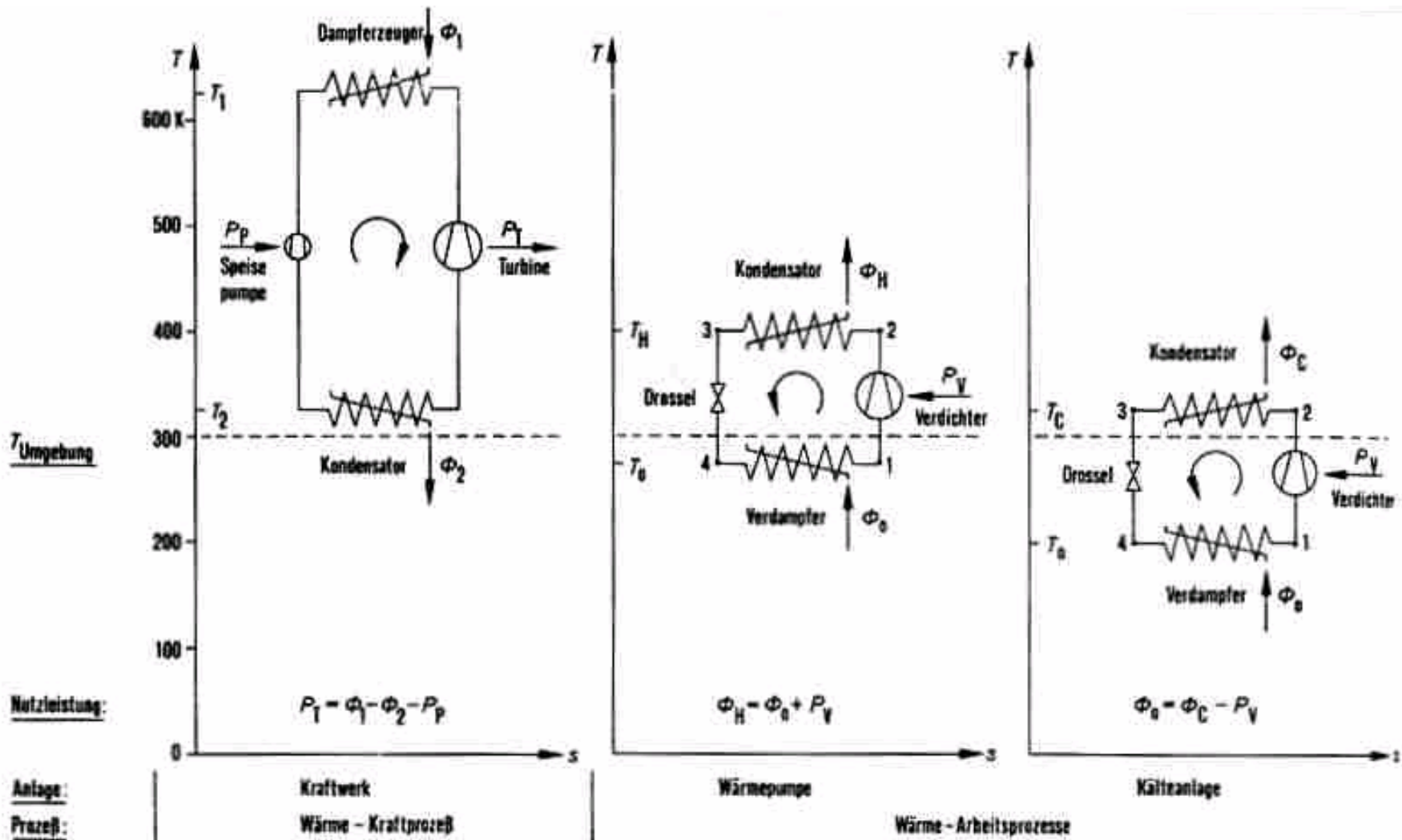
The Greenhouse Effect

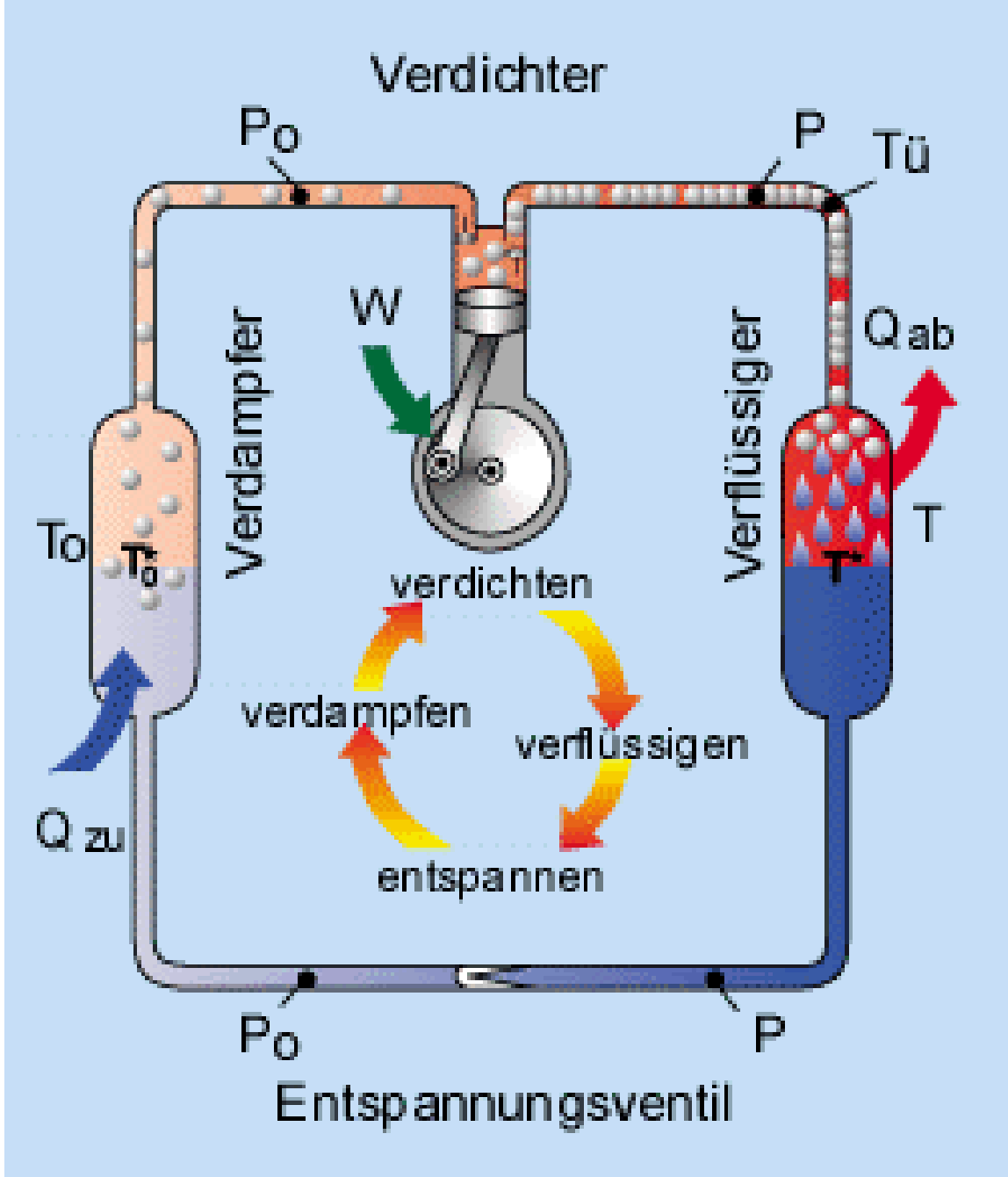




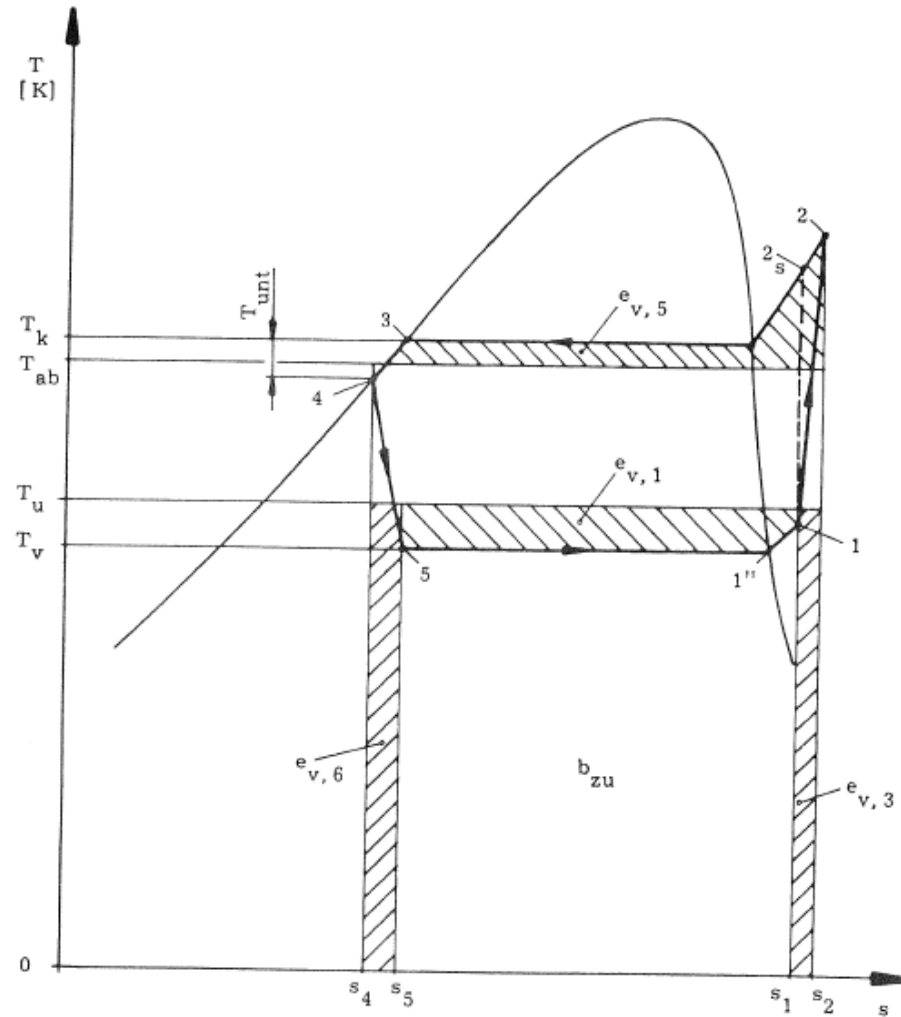
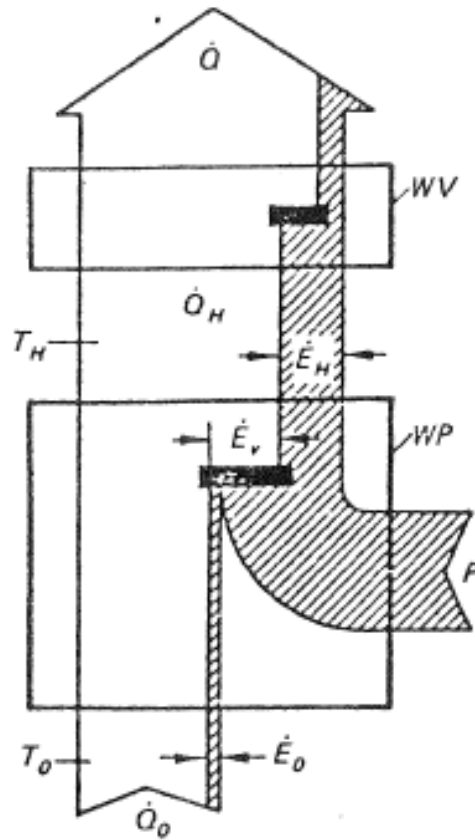
Carnot, Sadi (1796-1832)

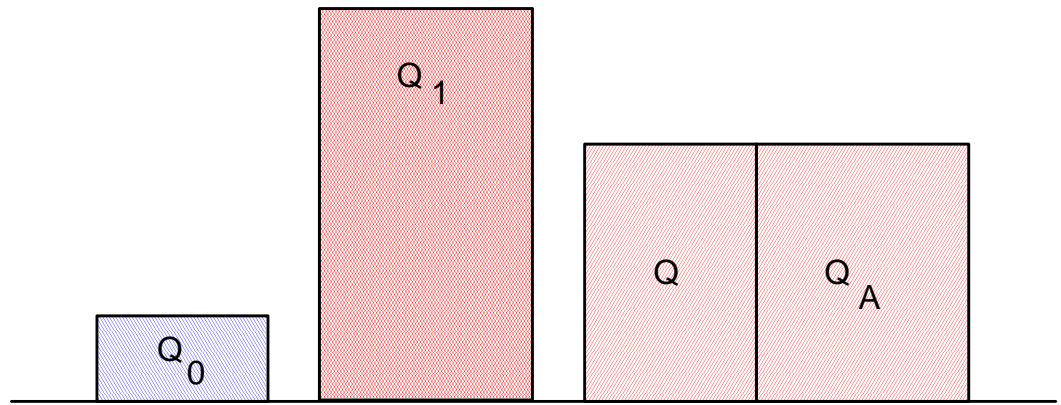
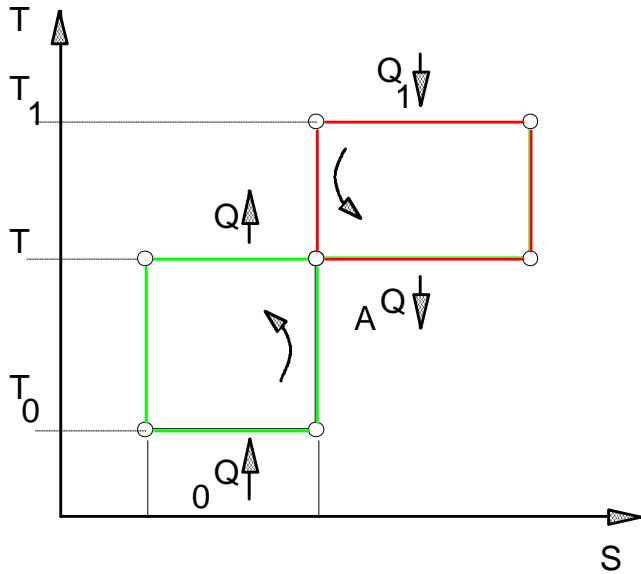
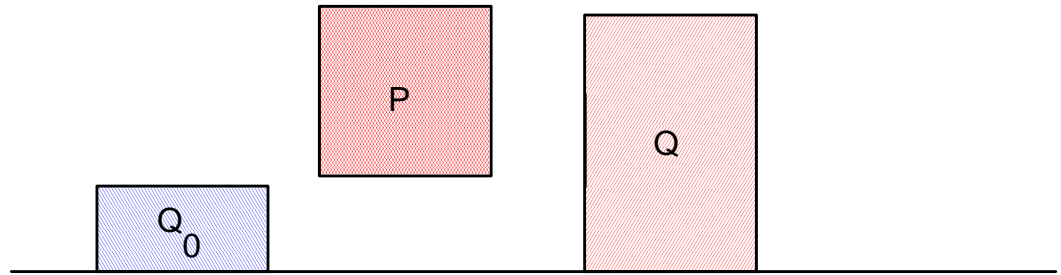
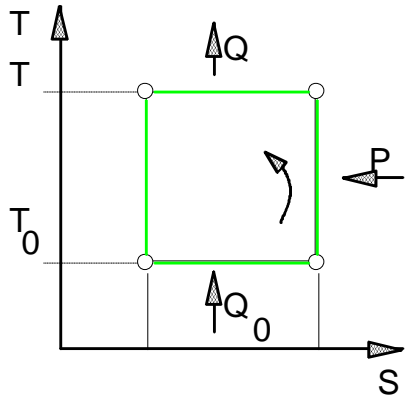






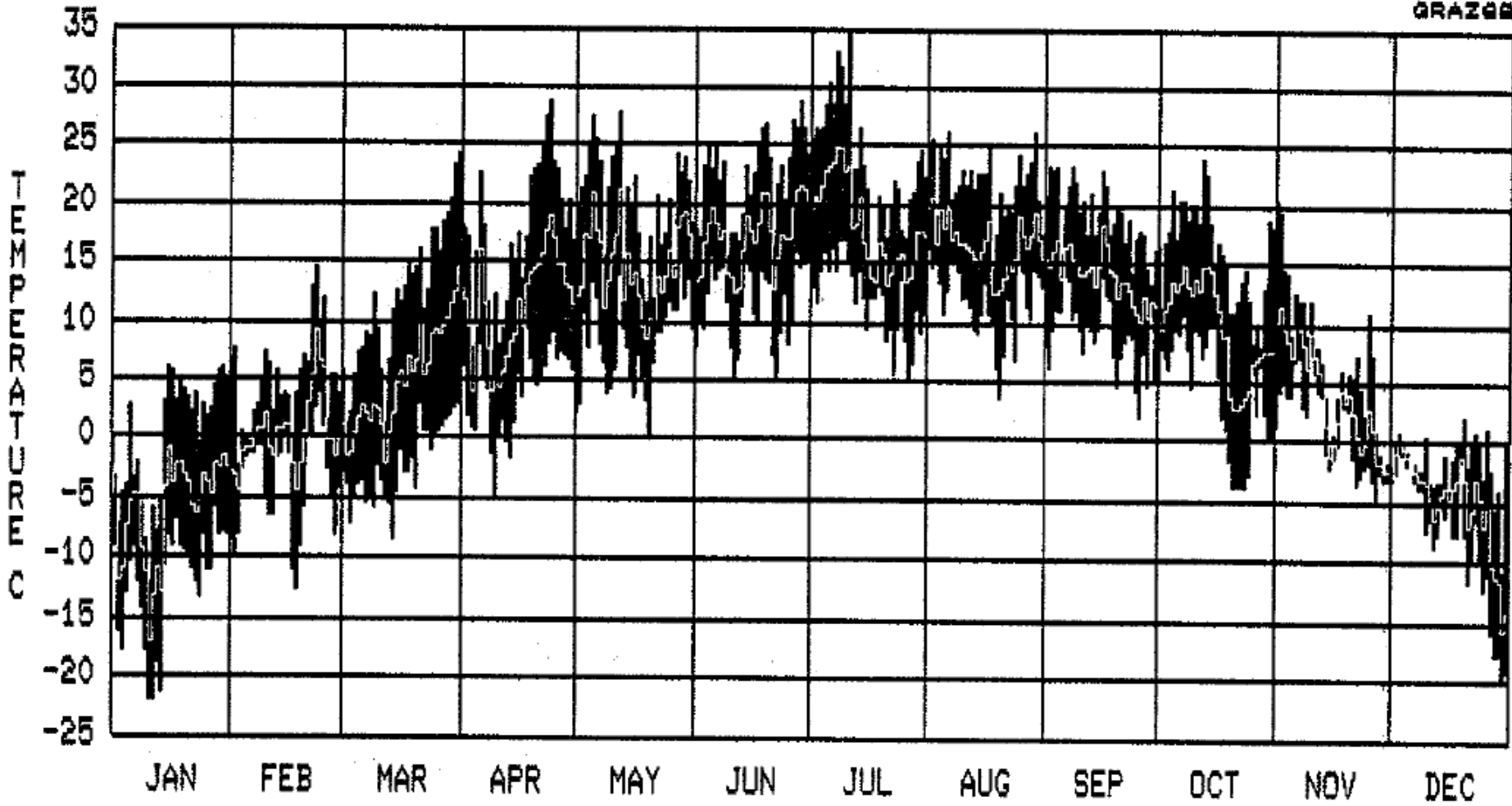
Energy- and Exergyflow in a Heat Pump



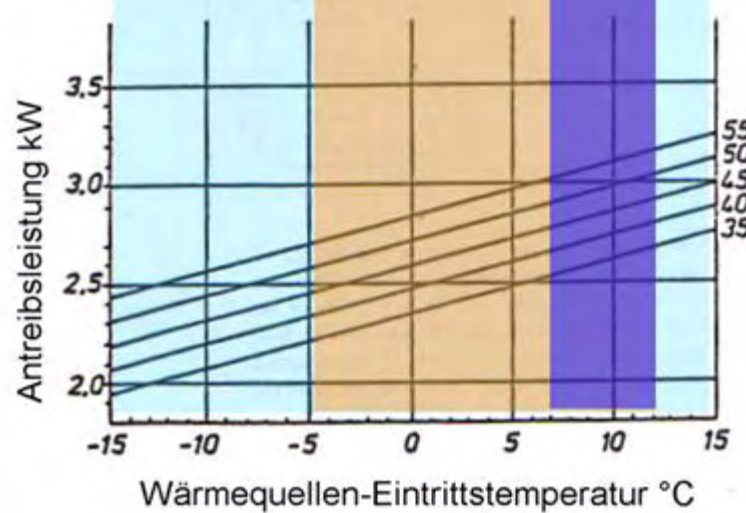
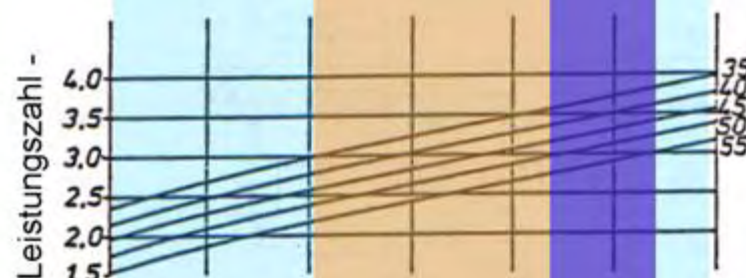
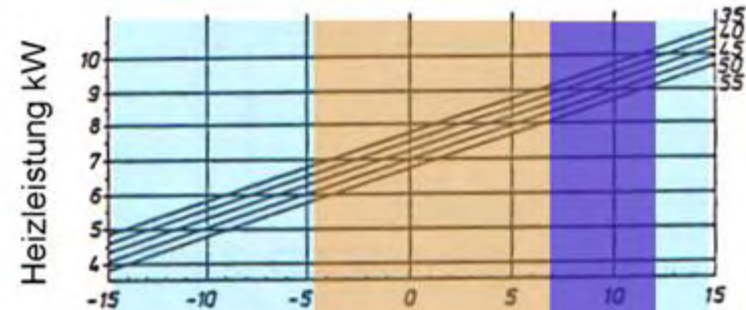
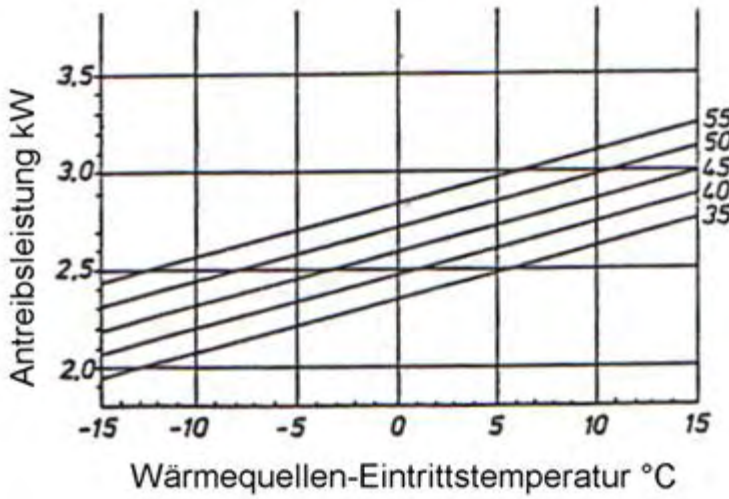
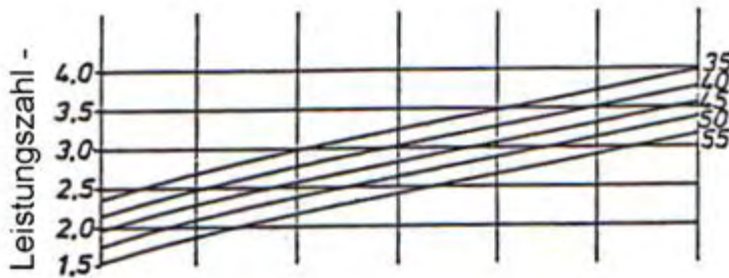
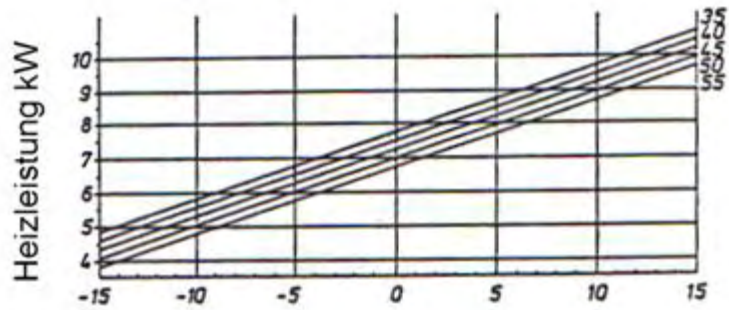




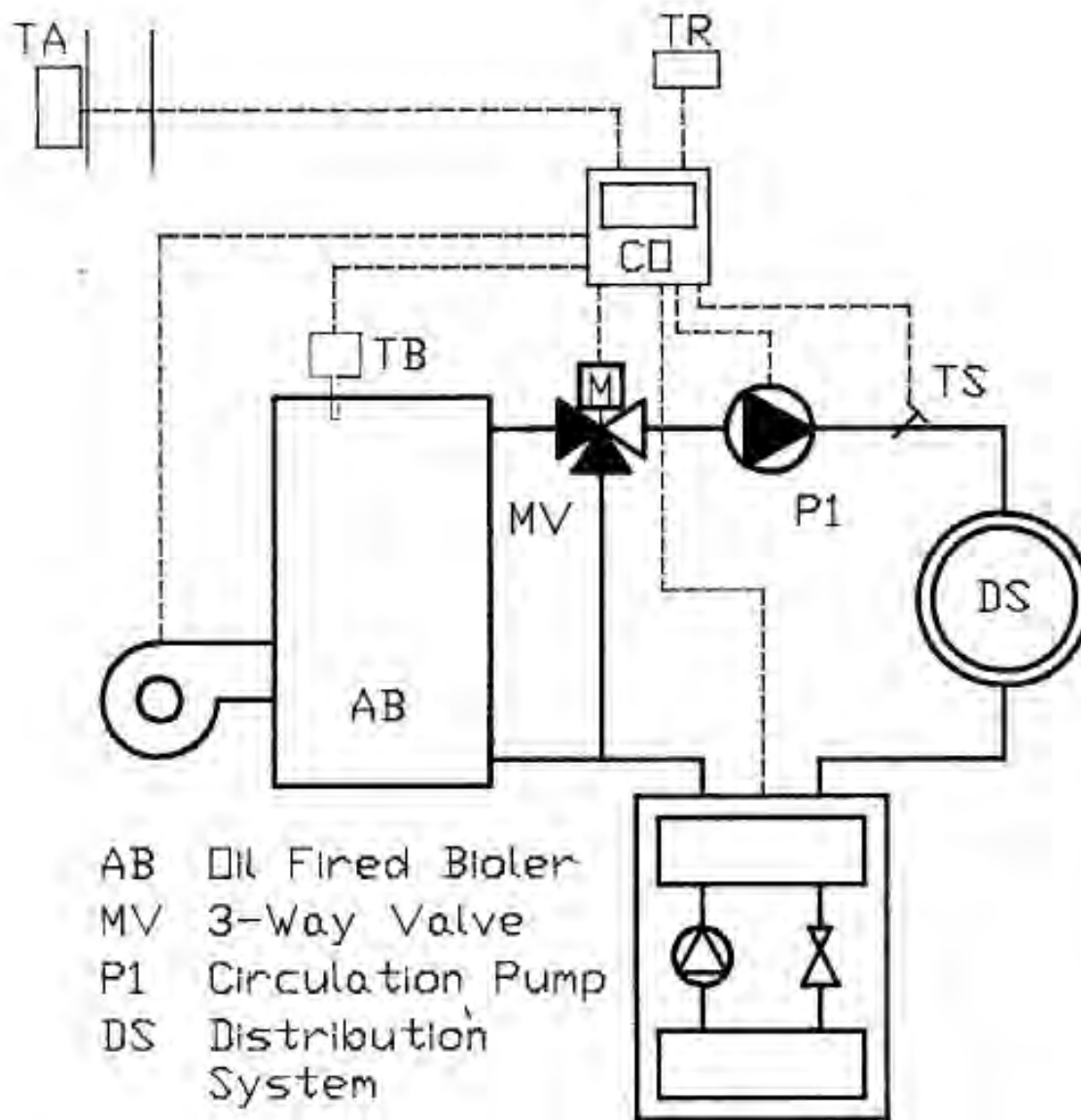
GRAZ68

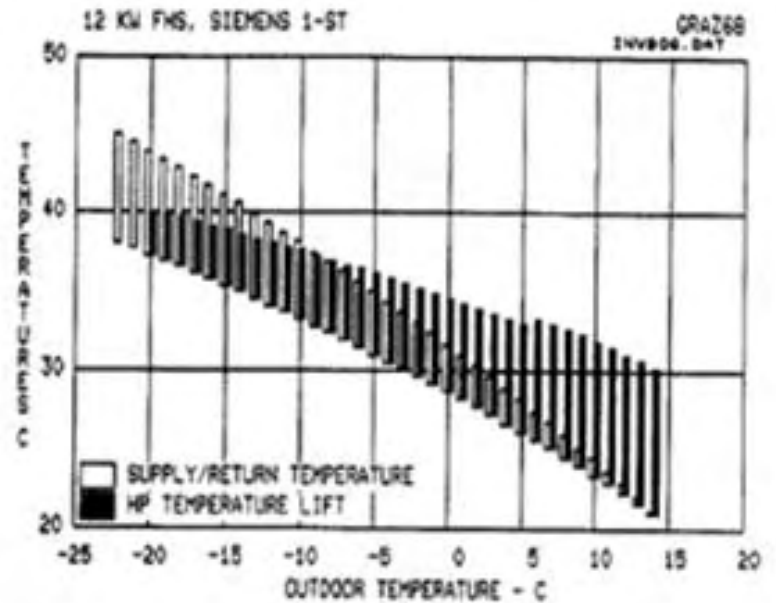
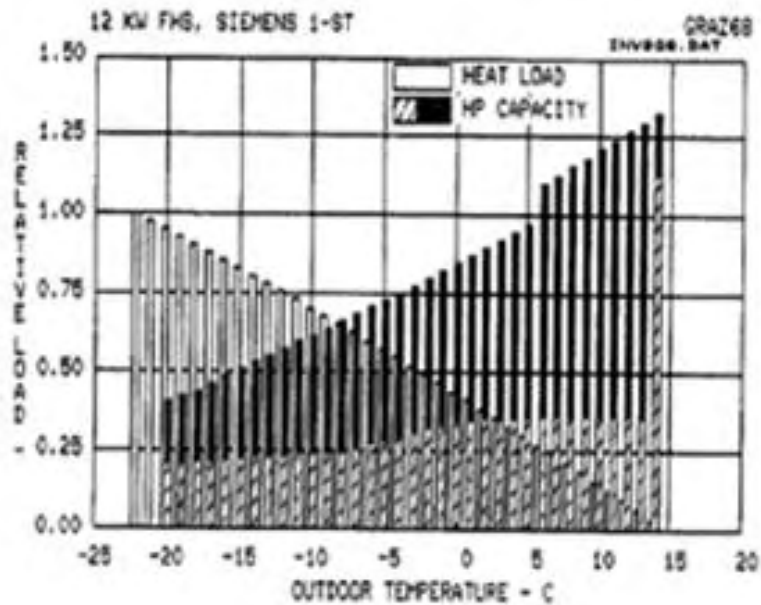


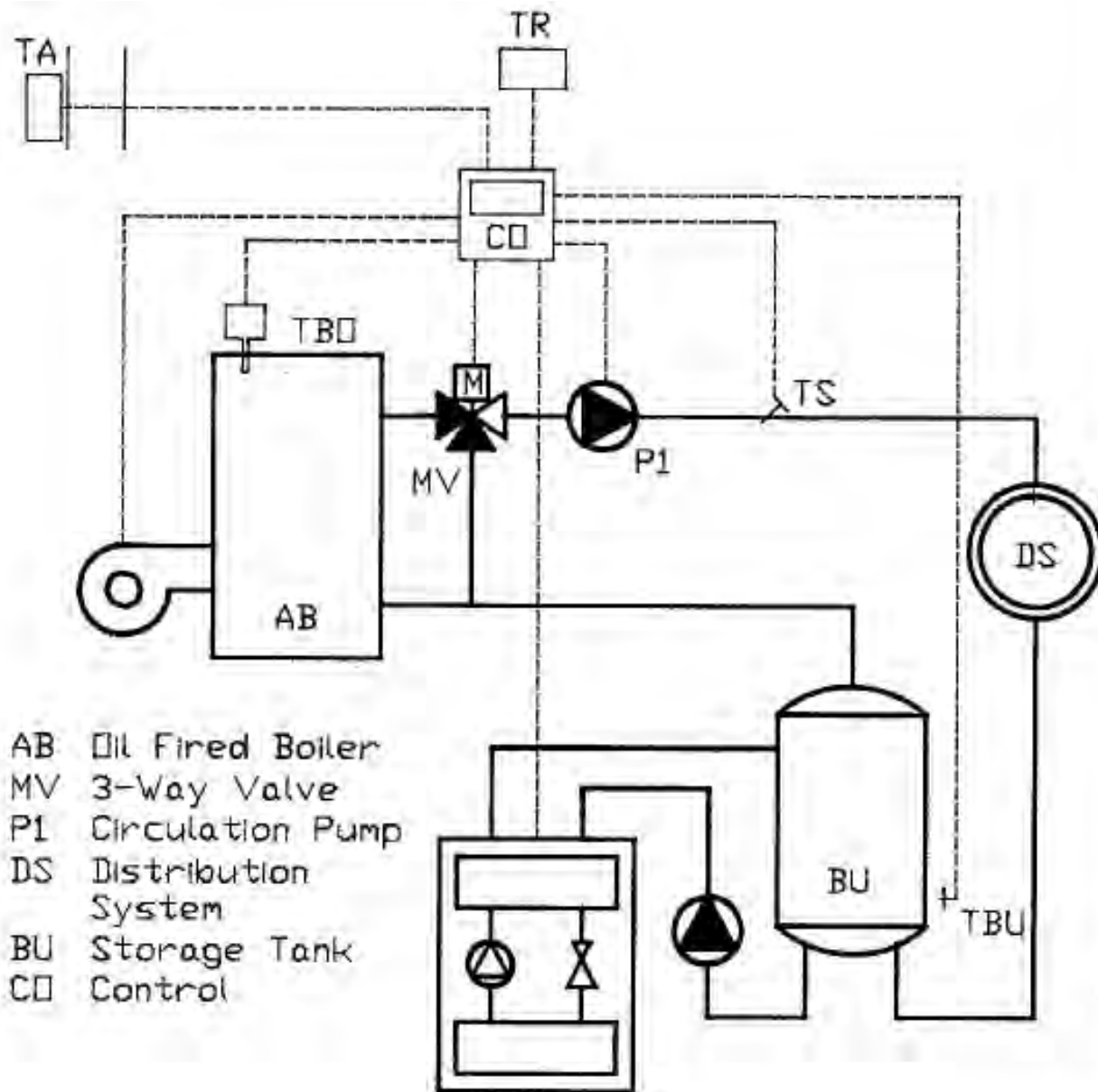
GRAZ68: YEARLY AVERAGE 8.35 C

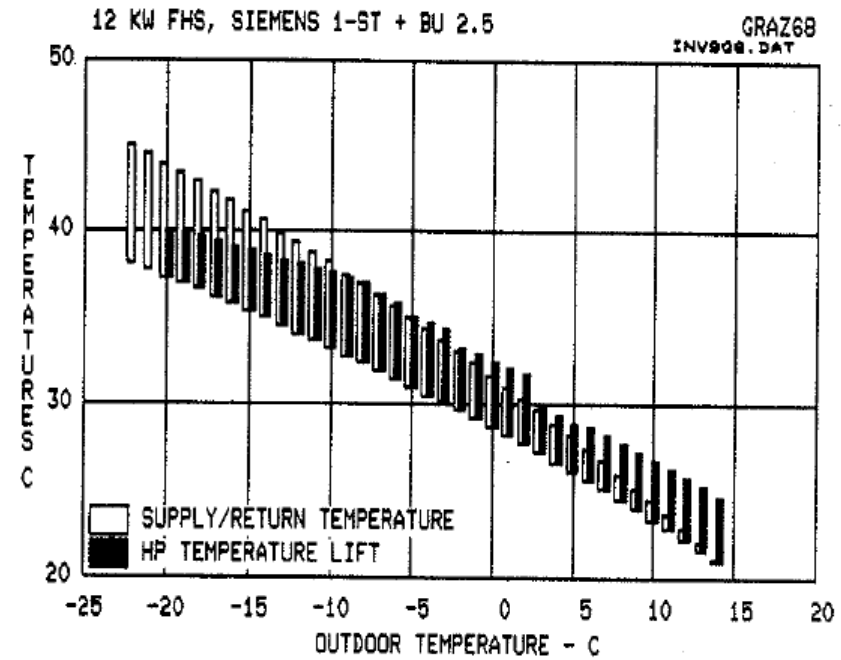
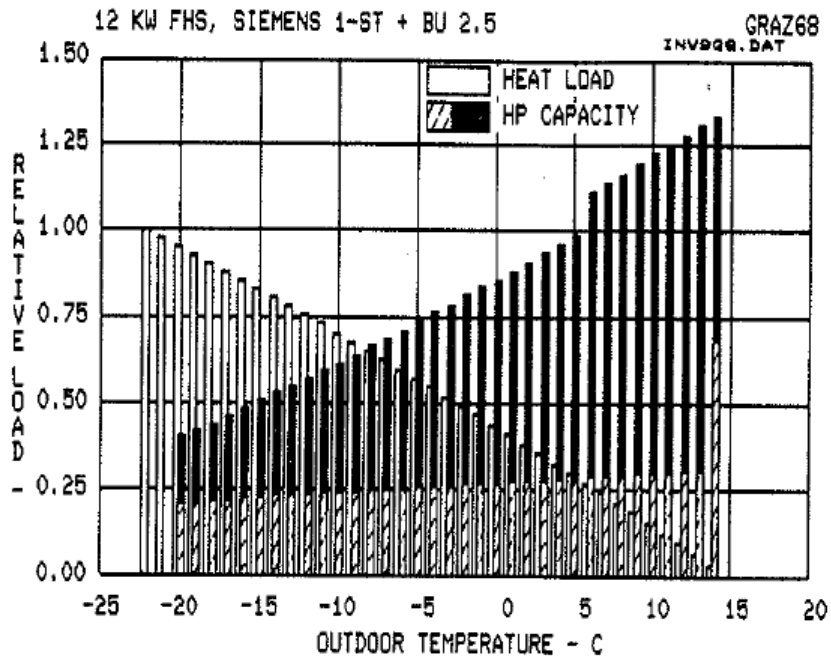


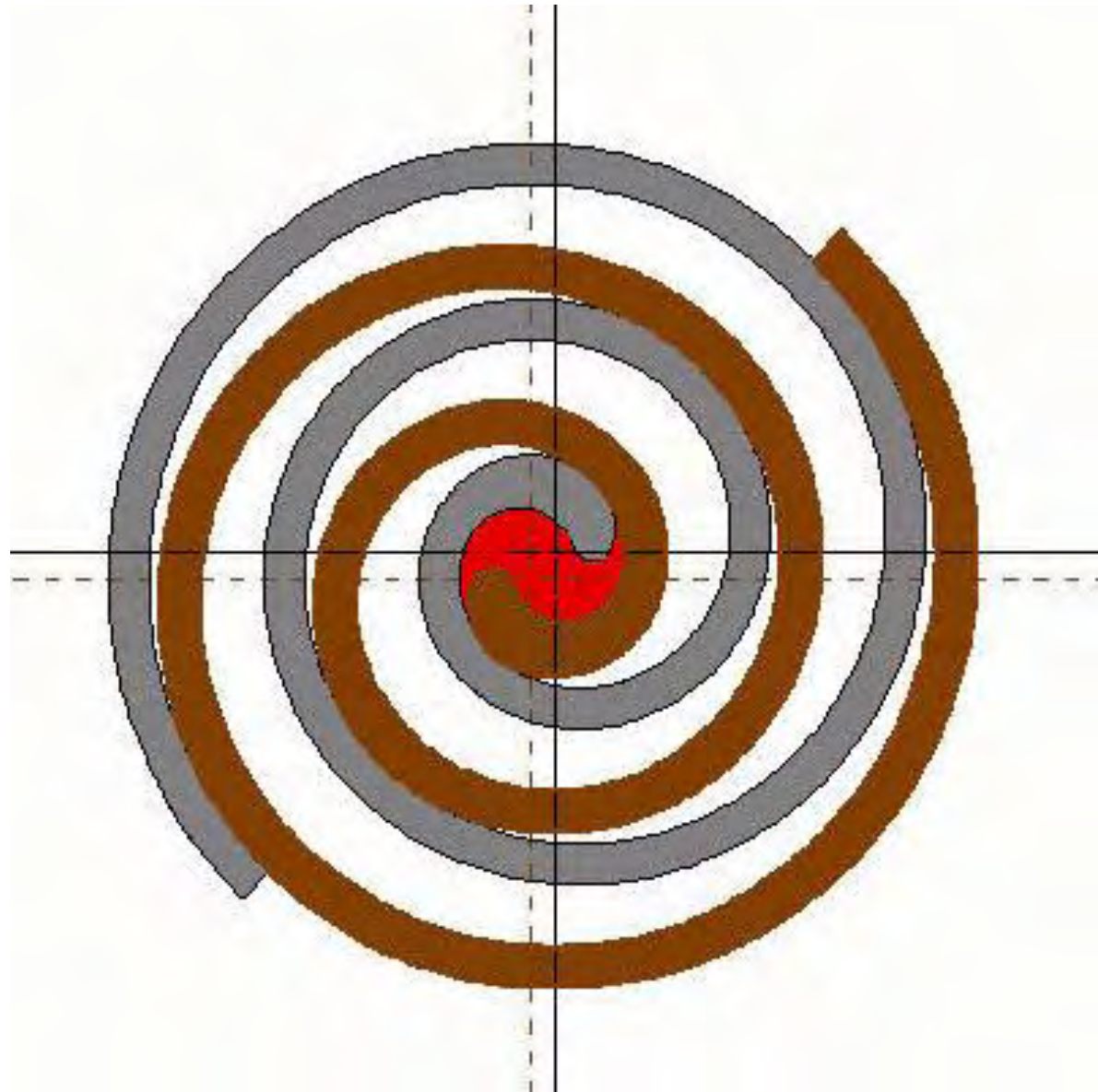
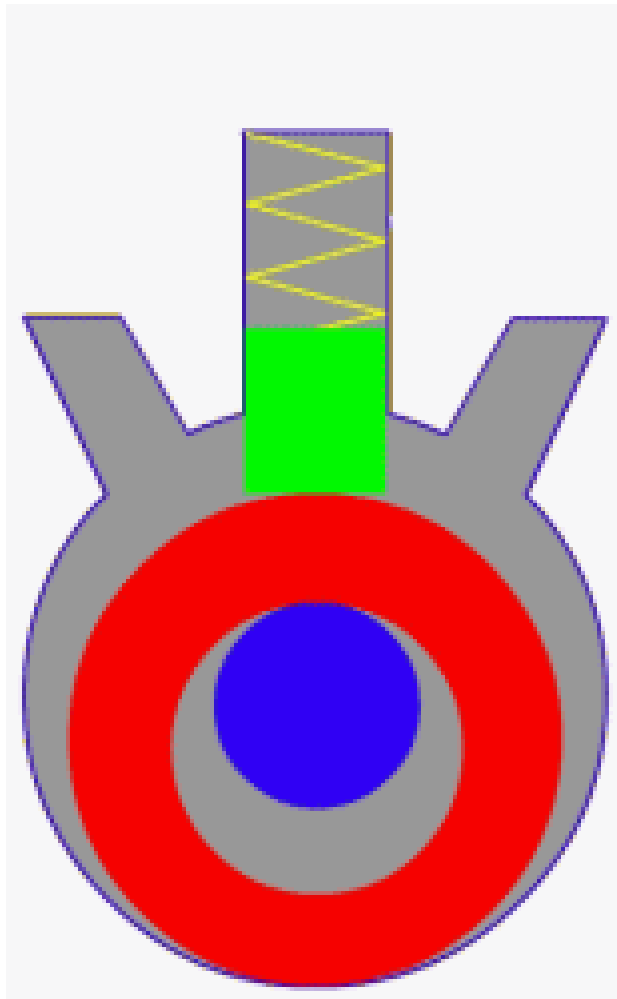


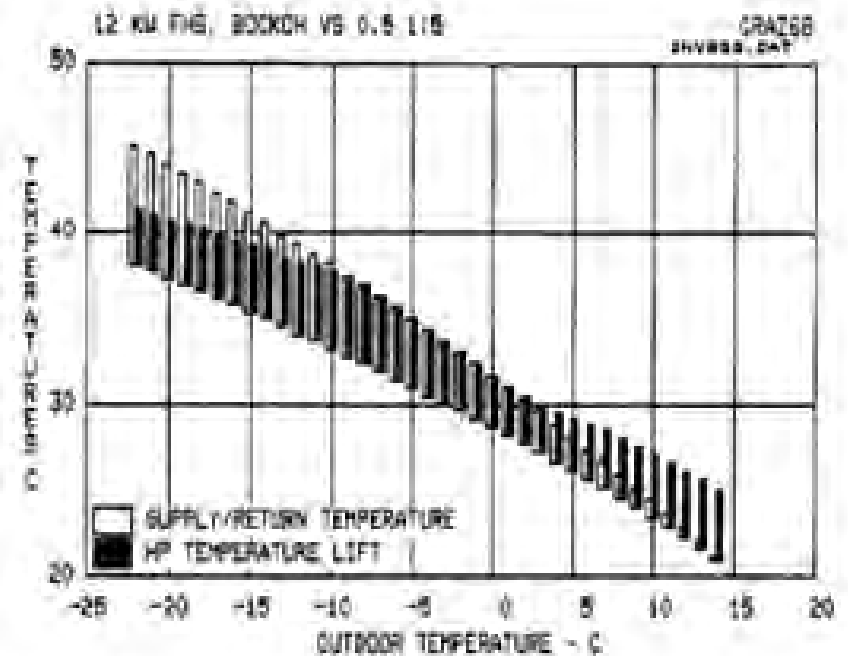
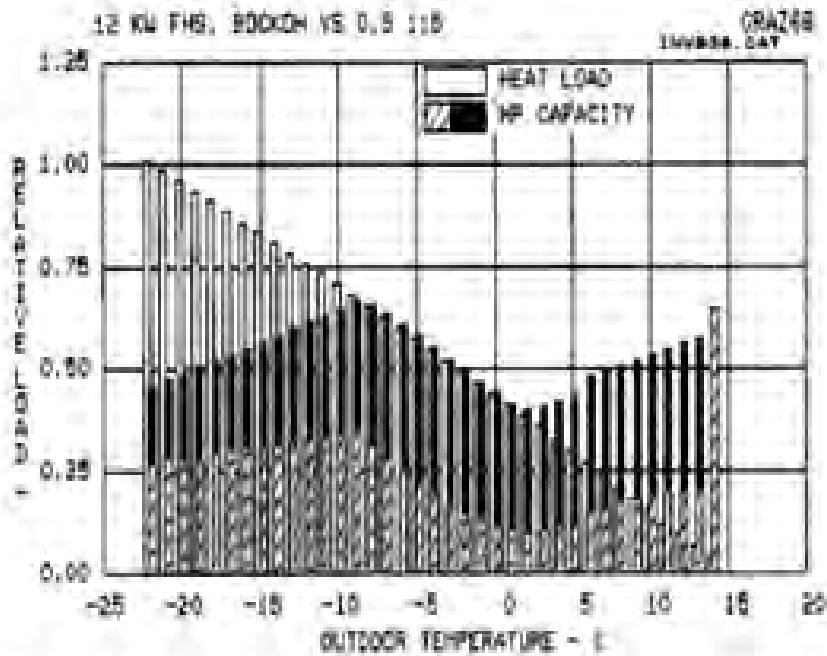


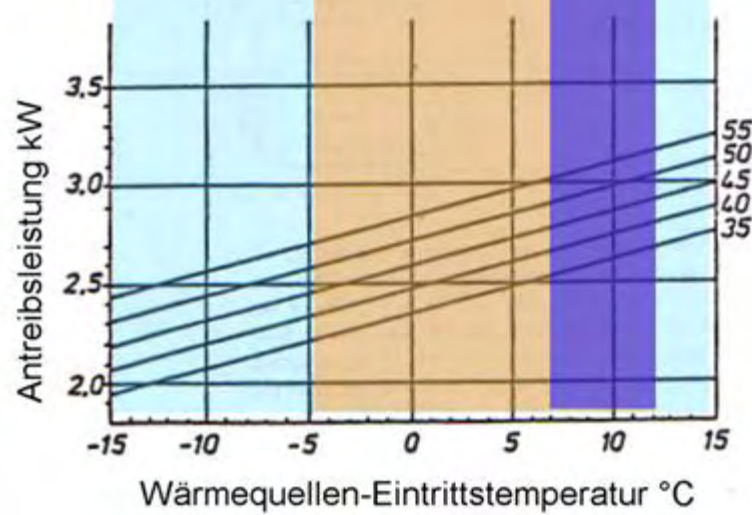
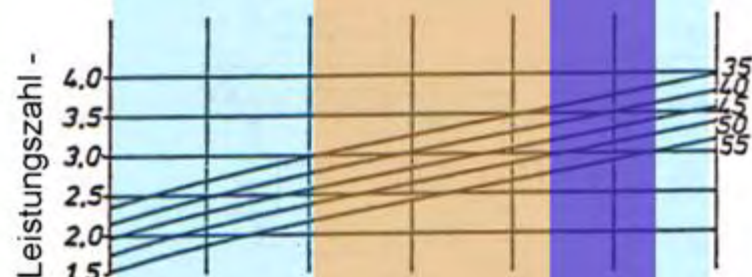
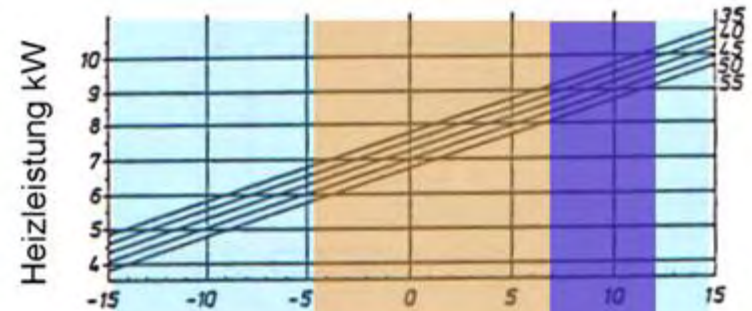
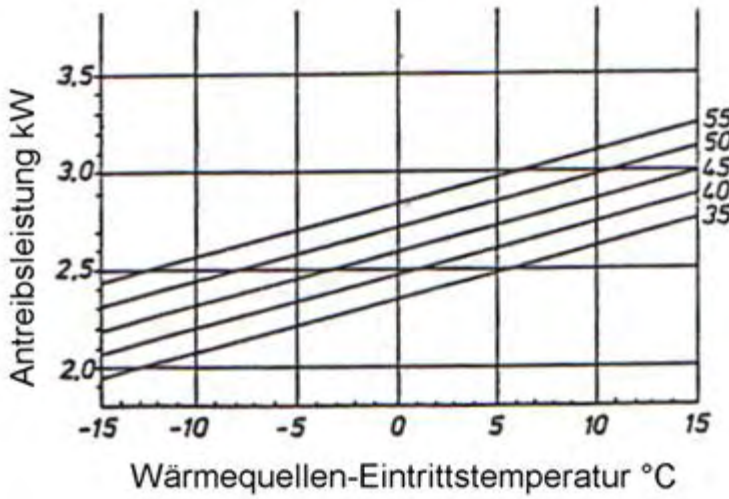
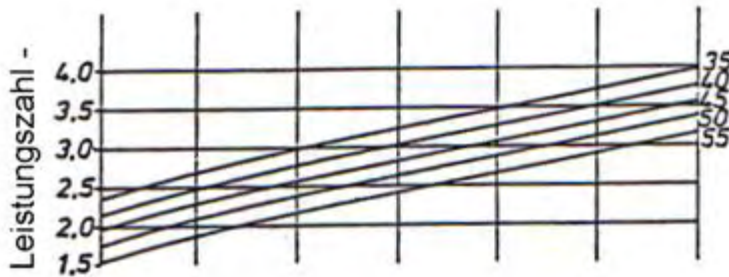
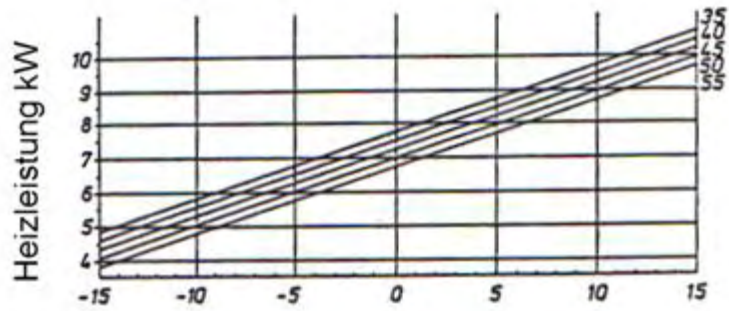


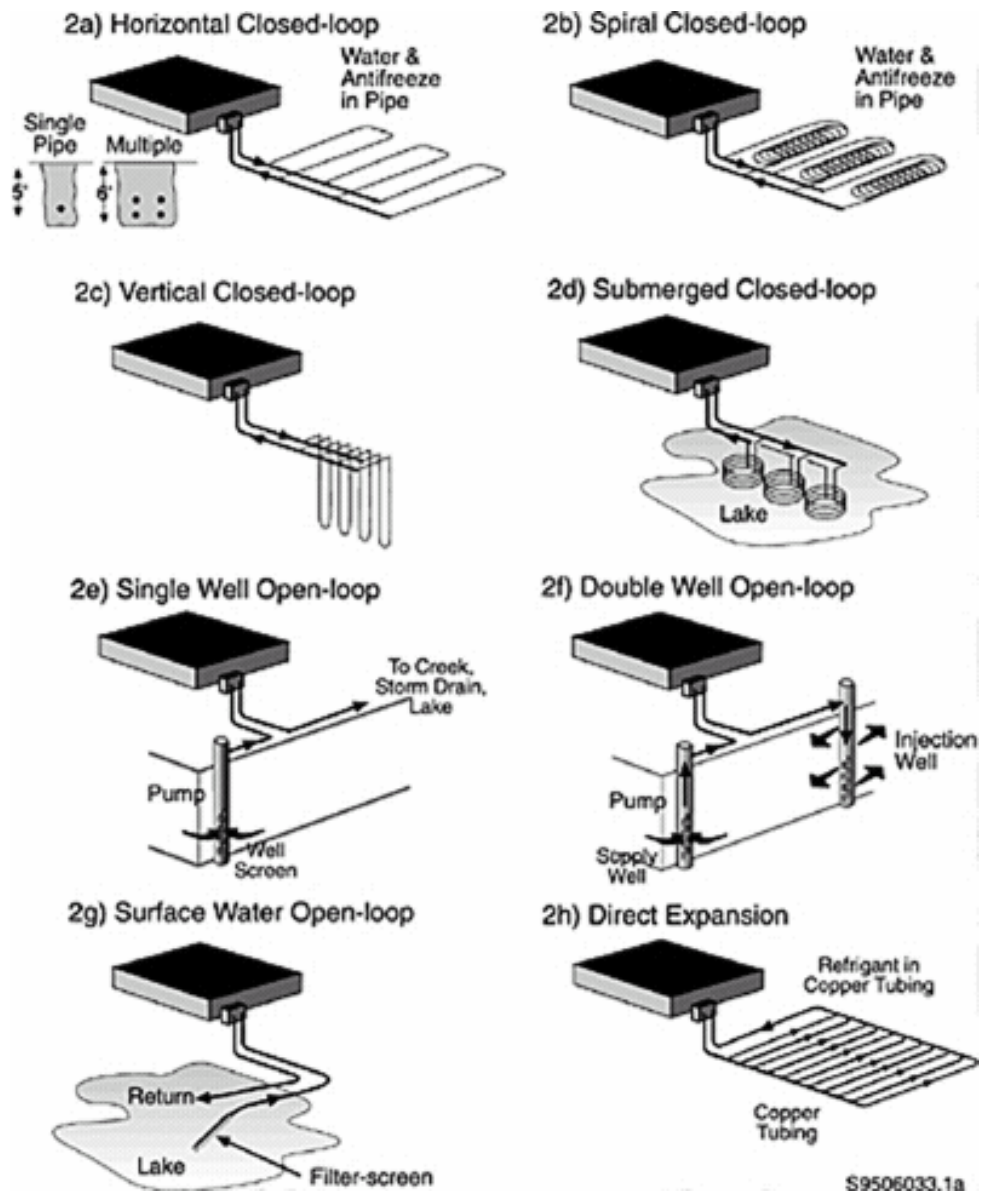




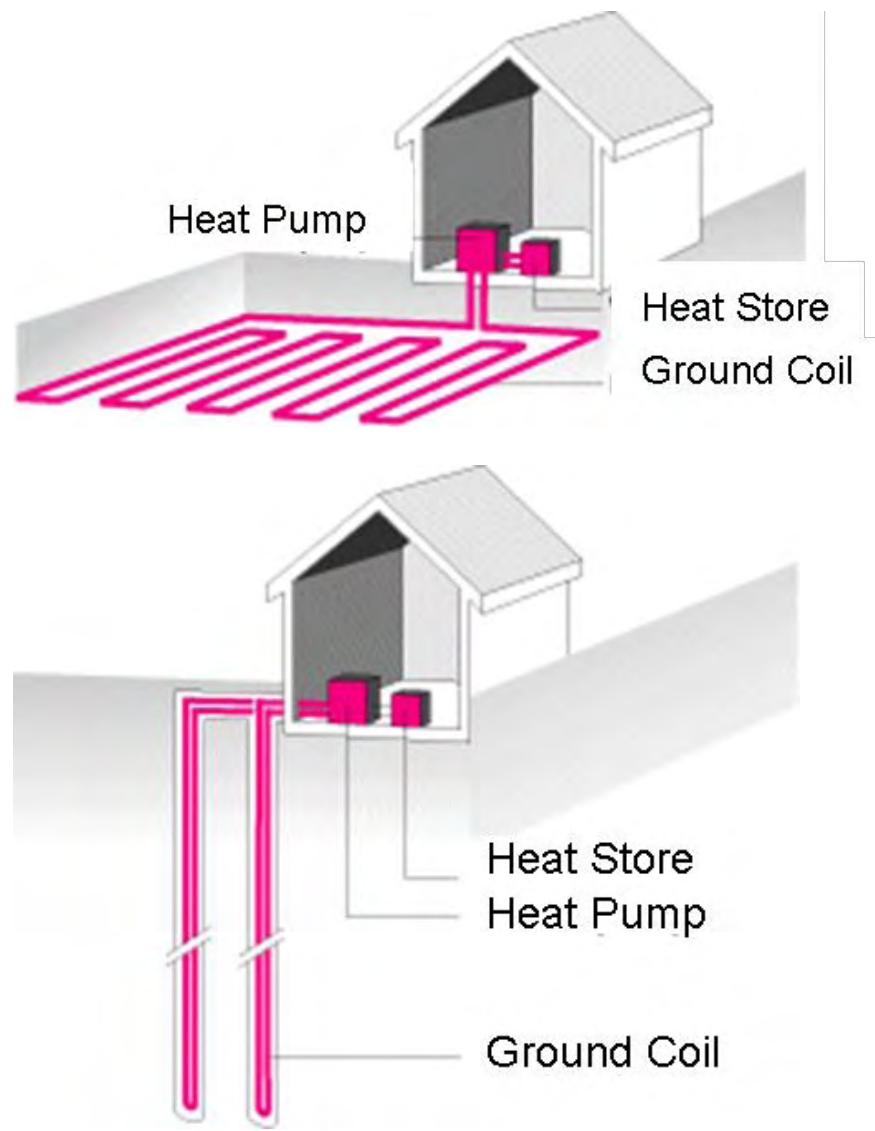


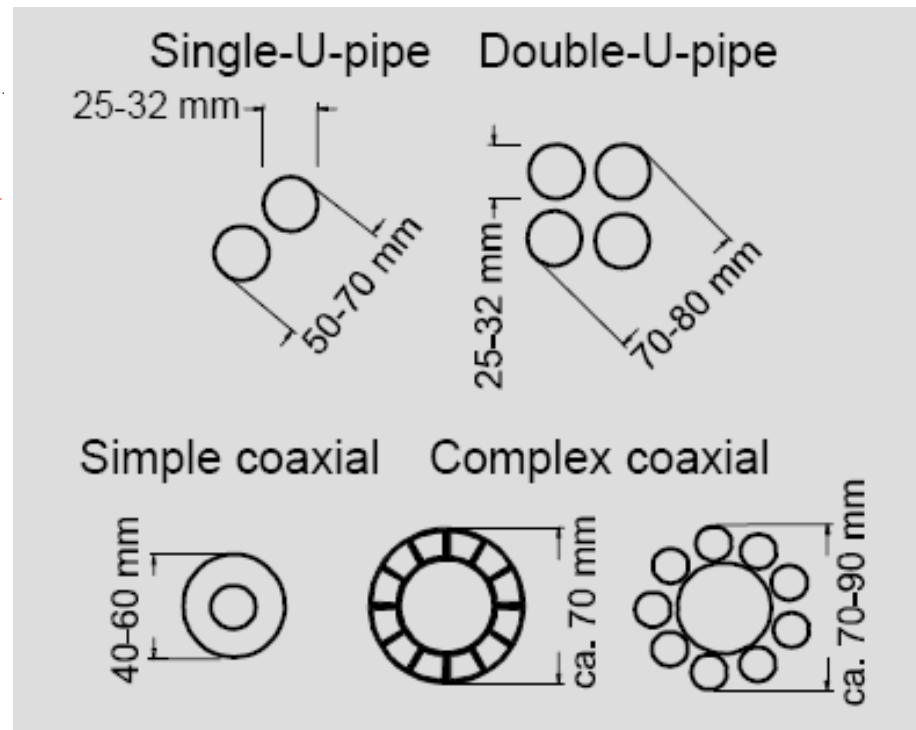
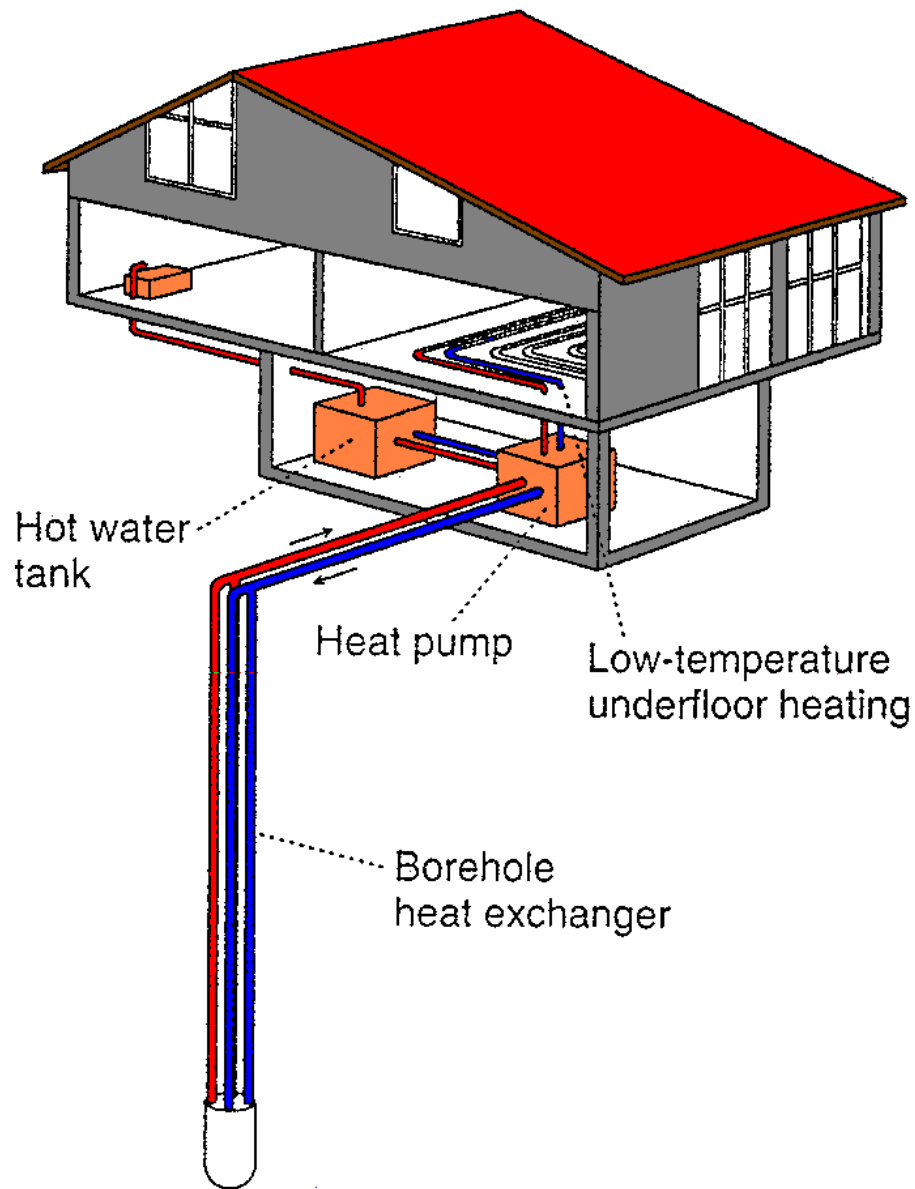


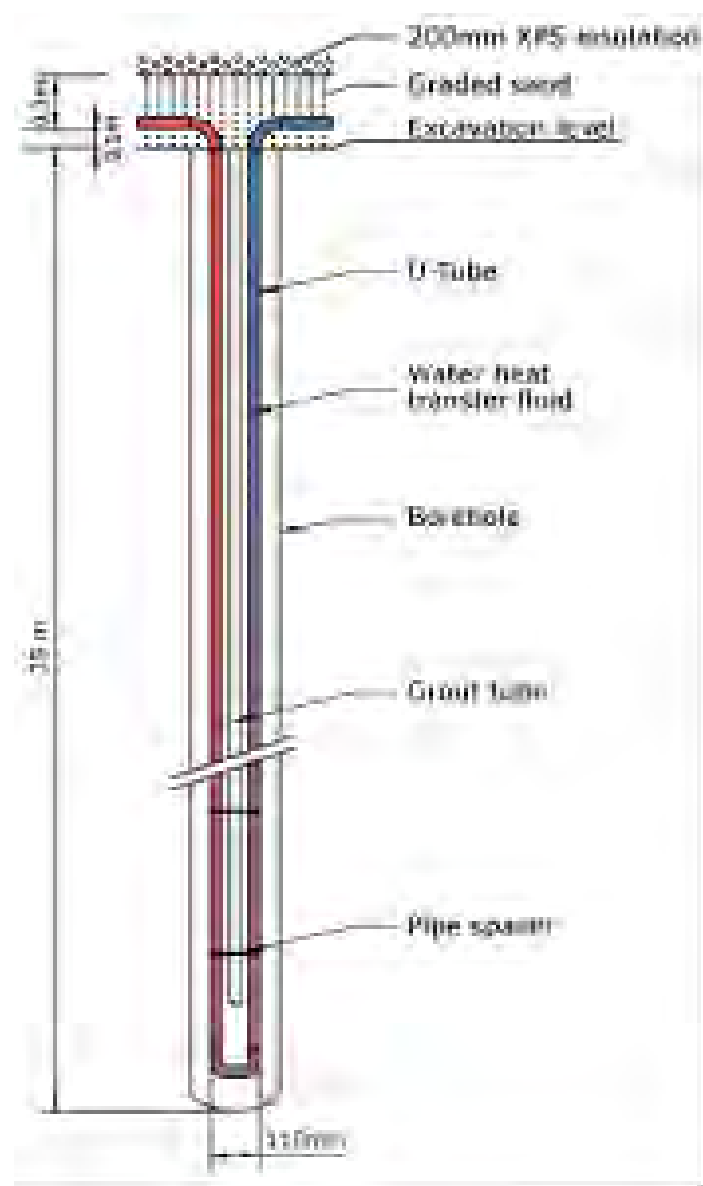
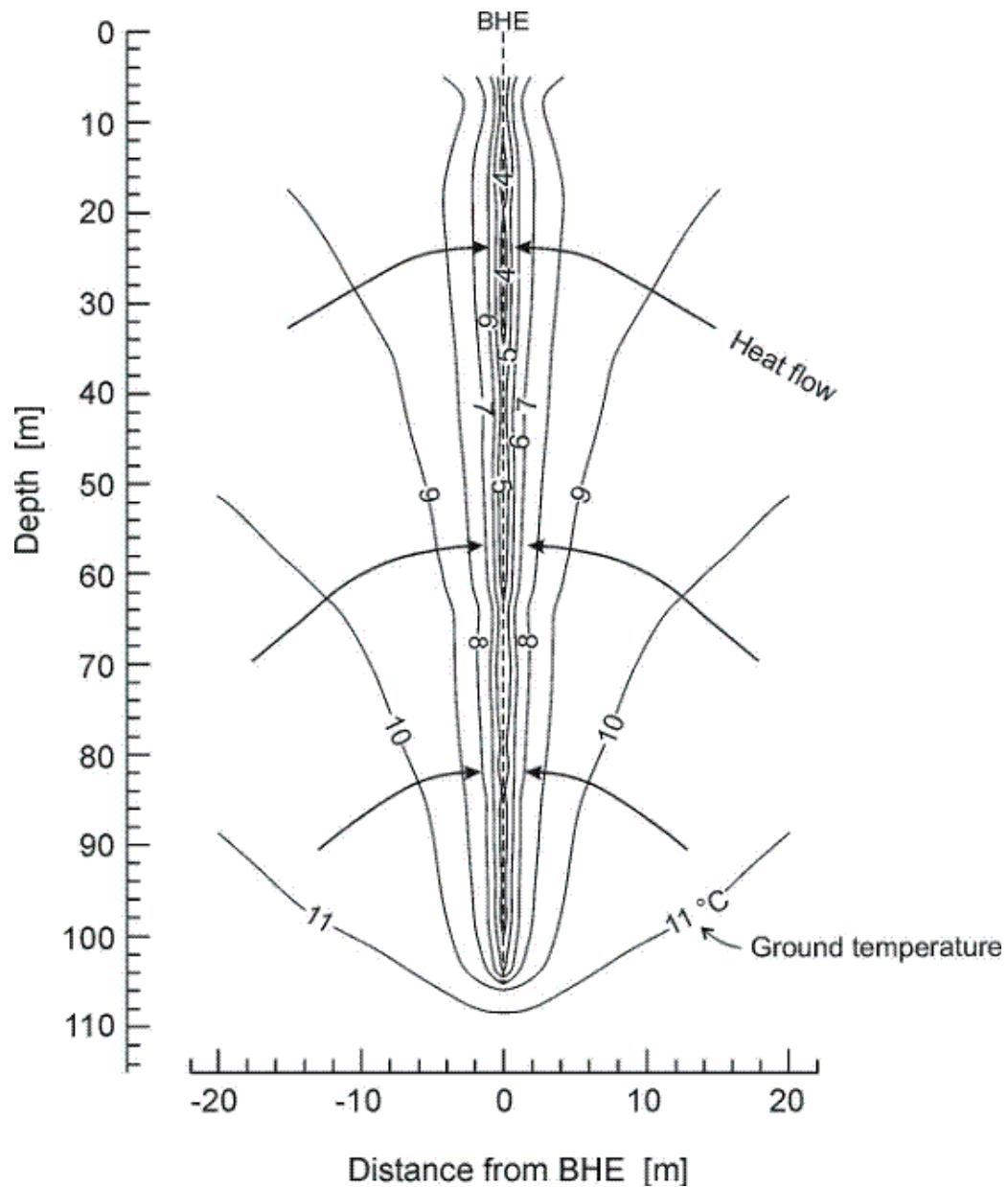




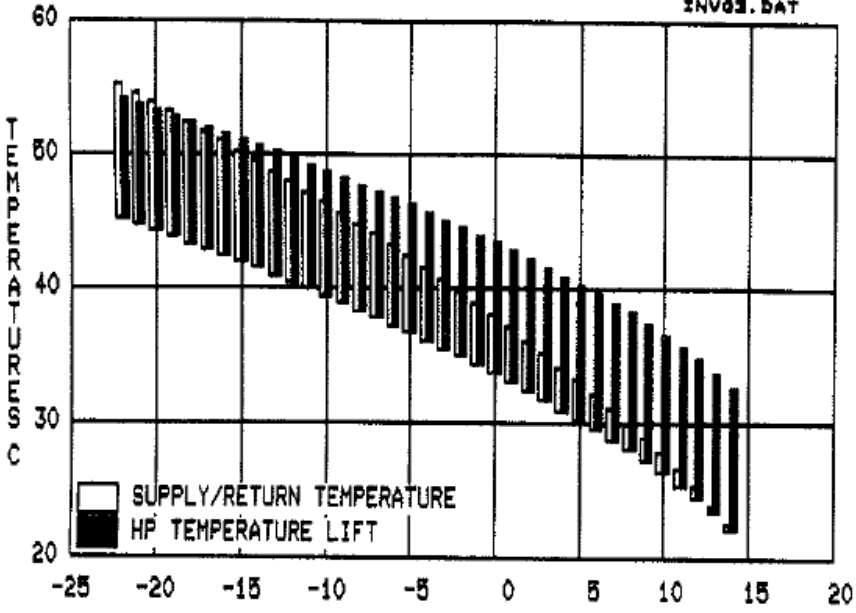
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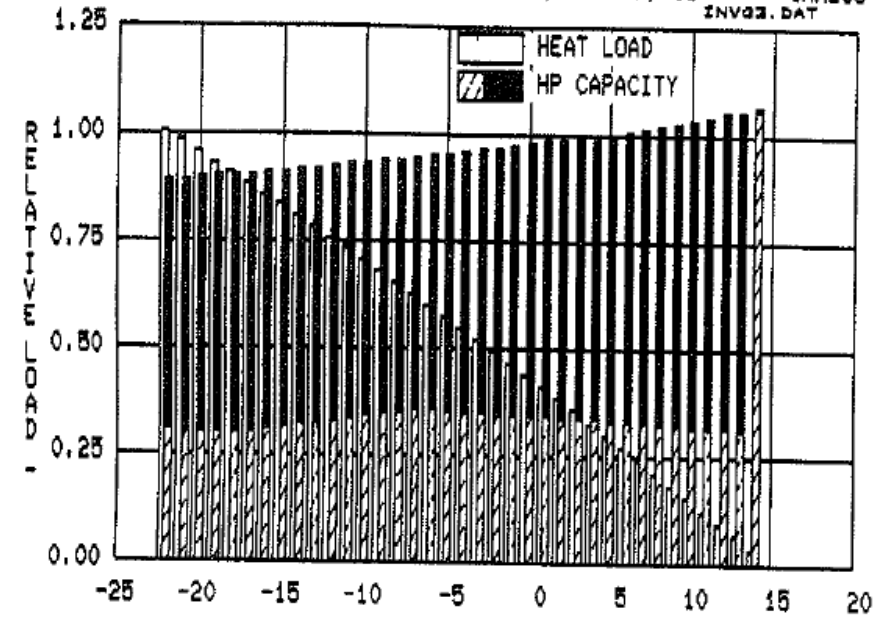




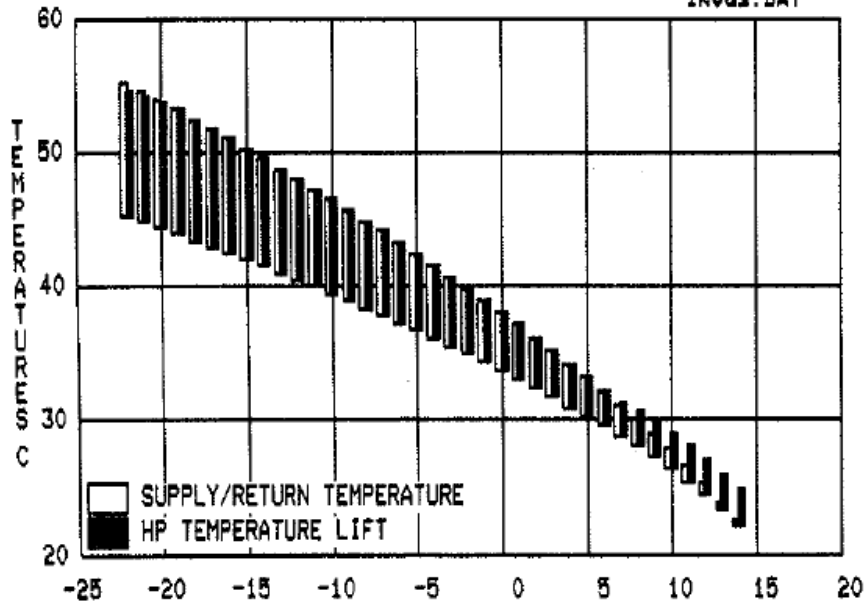
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INV03.DAT



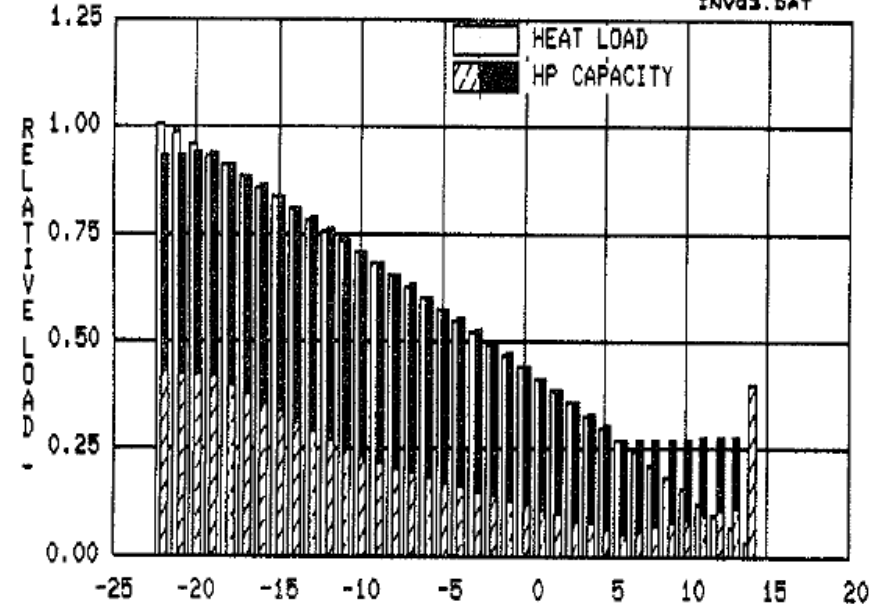
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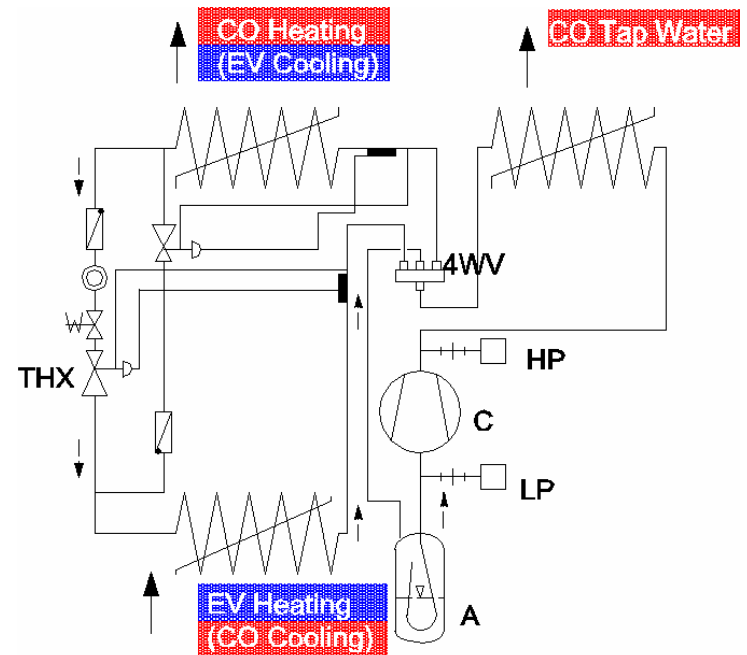
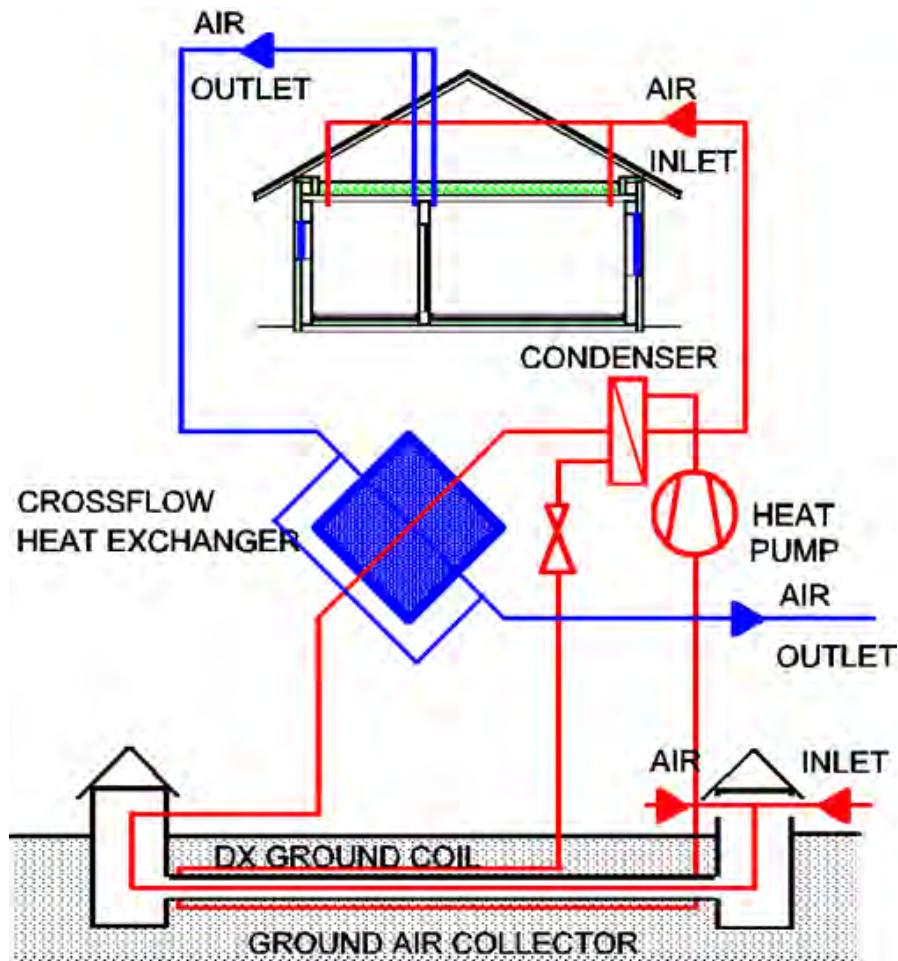


12 KW LTS, BOILER + W/W HEAT PUMP, 3.0 HP, VS 5.0 GRAZ68
INVQ3.DAT

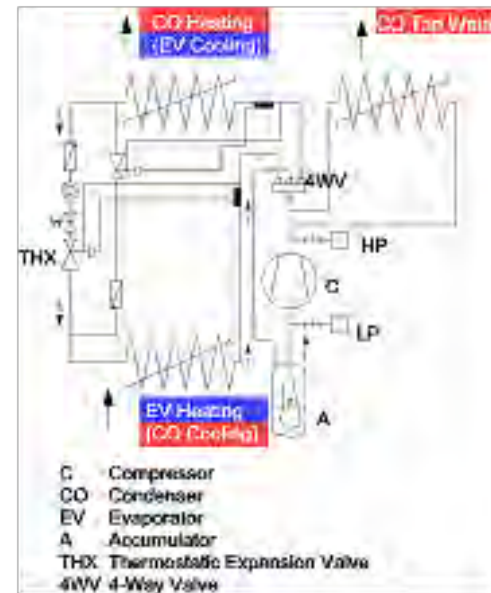
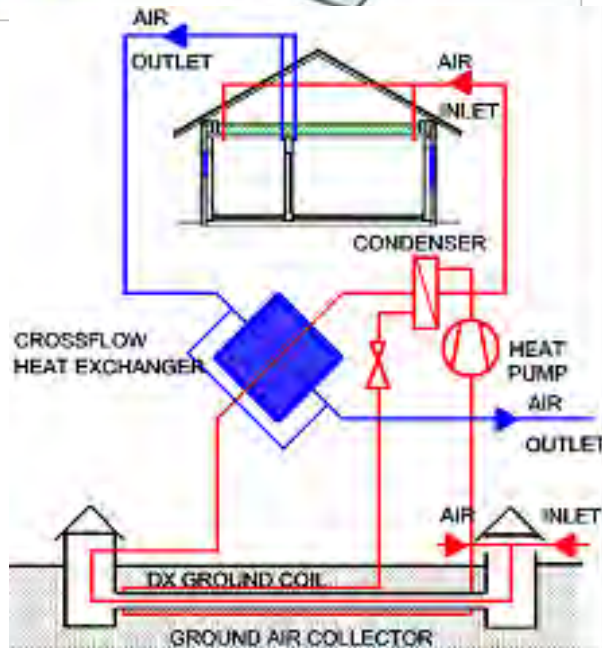
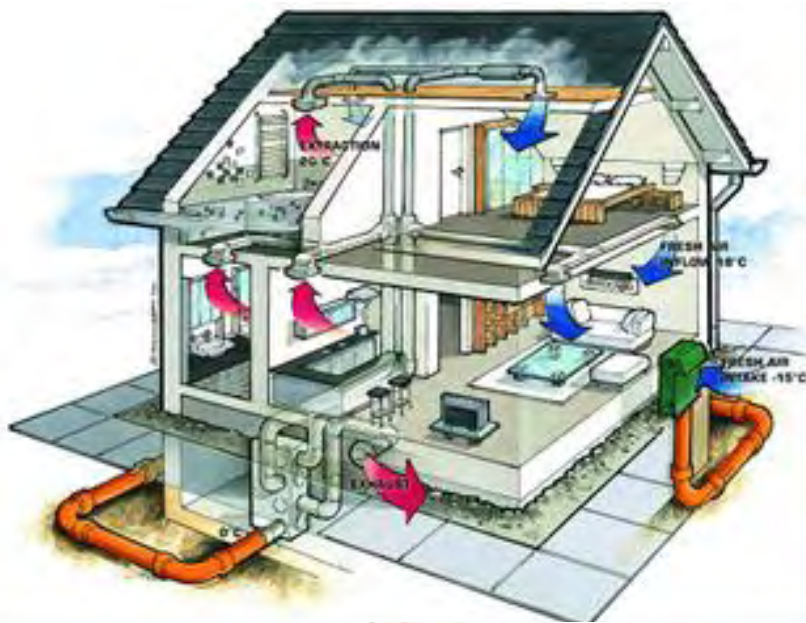


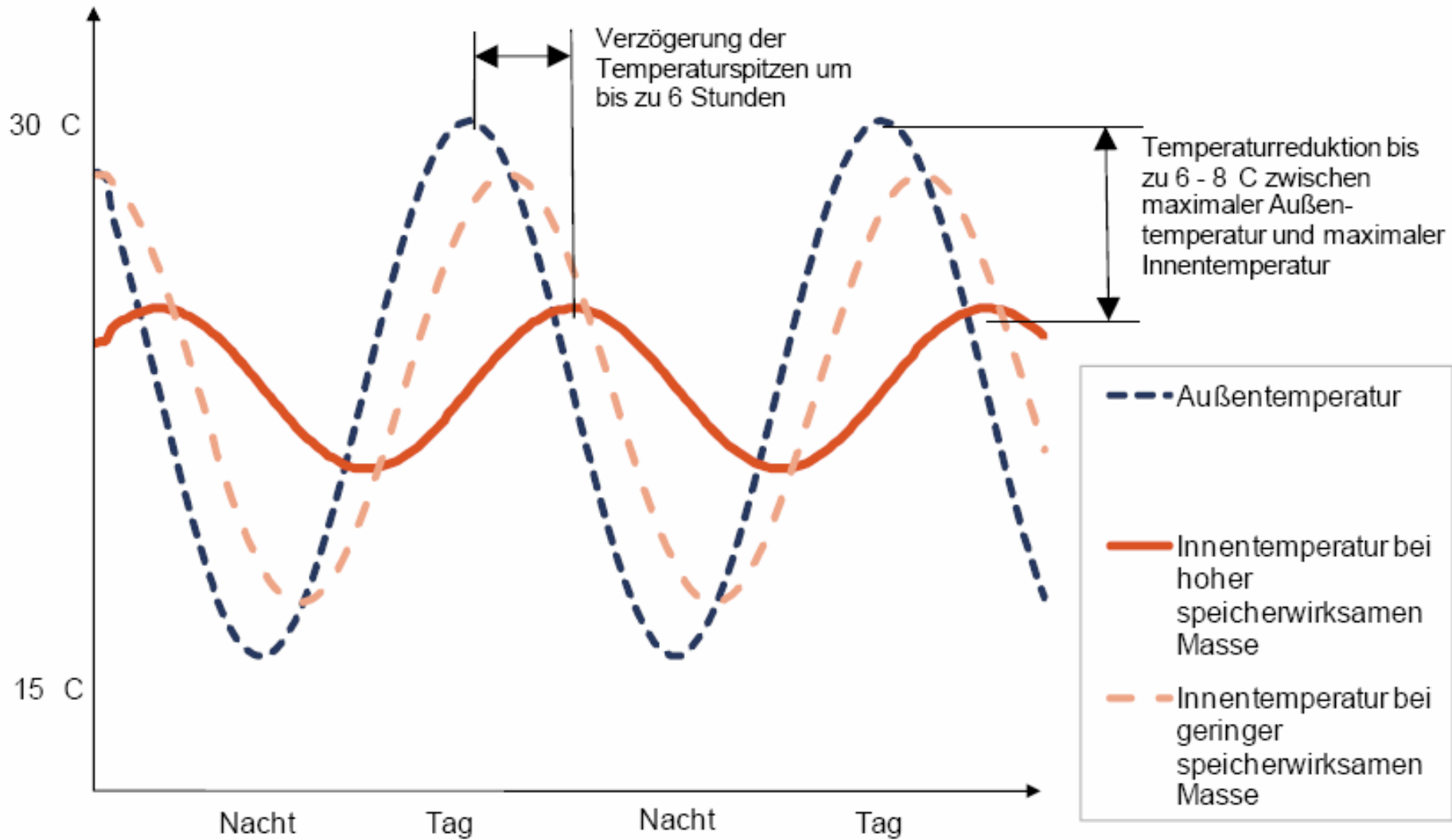
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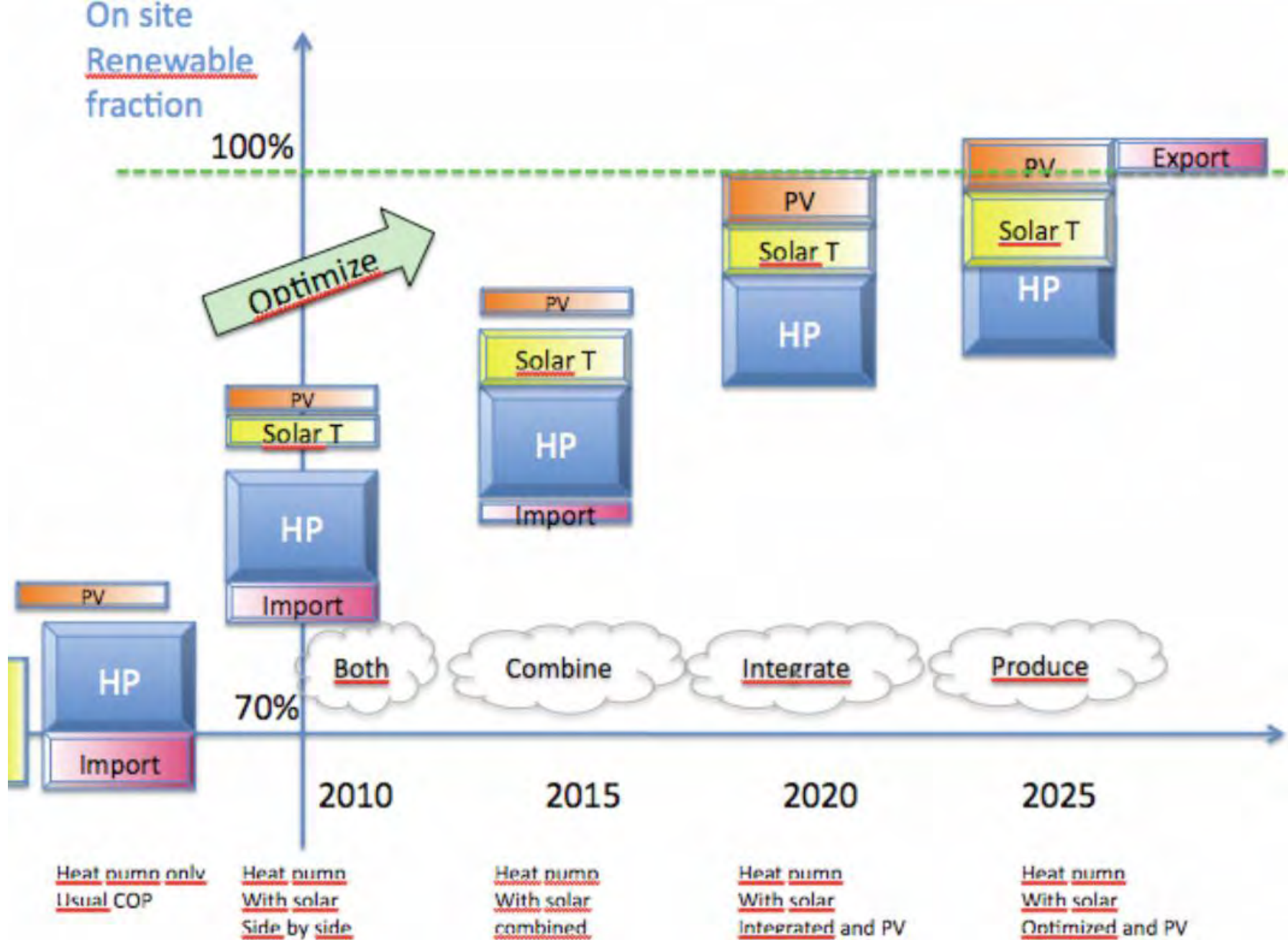


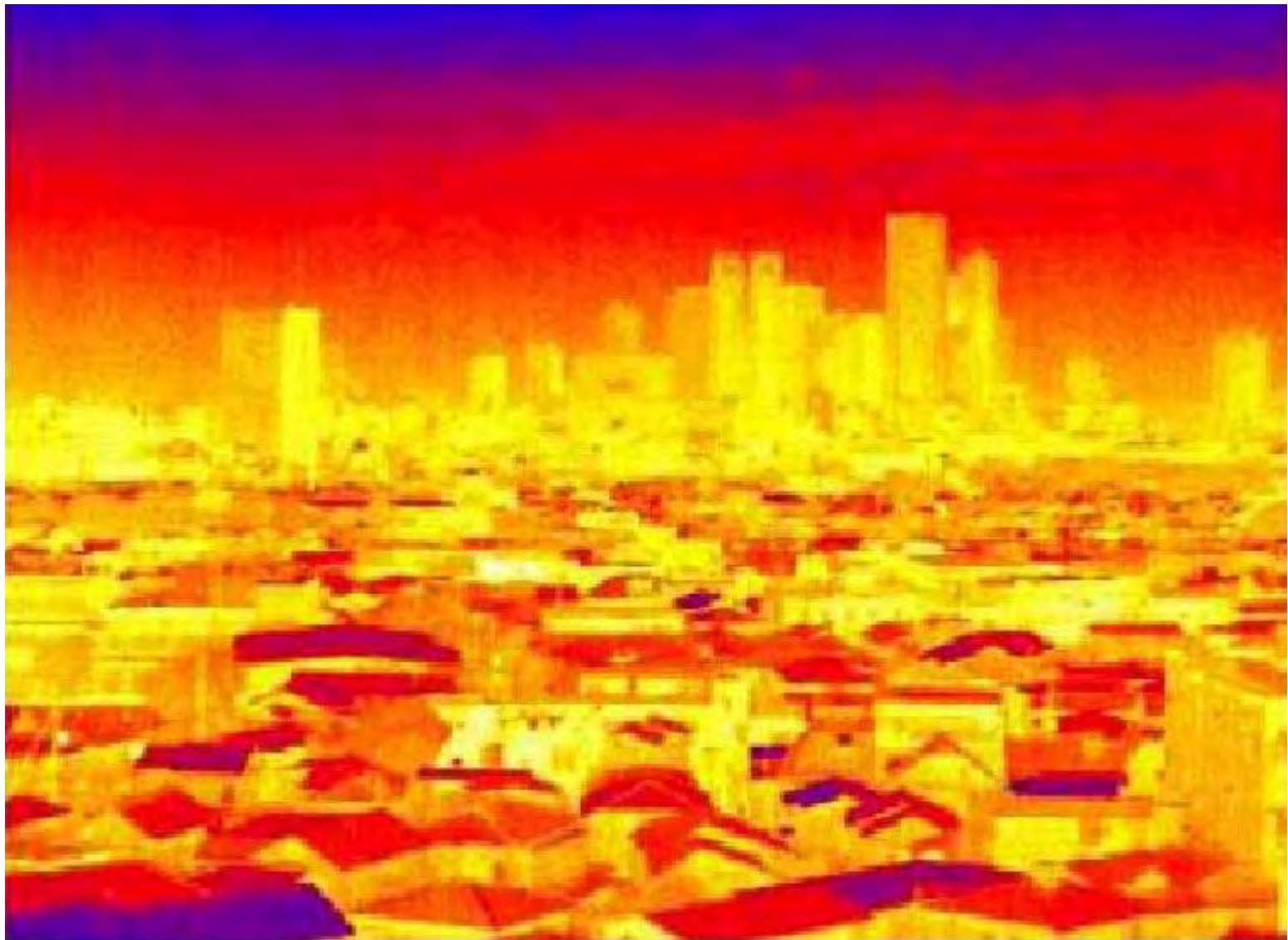


- C Compressor
- CO Condenser
- EV Evaporator
- A Accumulator
- THX Thermostatic Expansion Valve
- 4WV 4-Way Valve



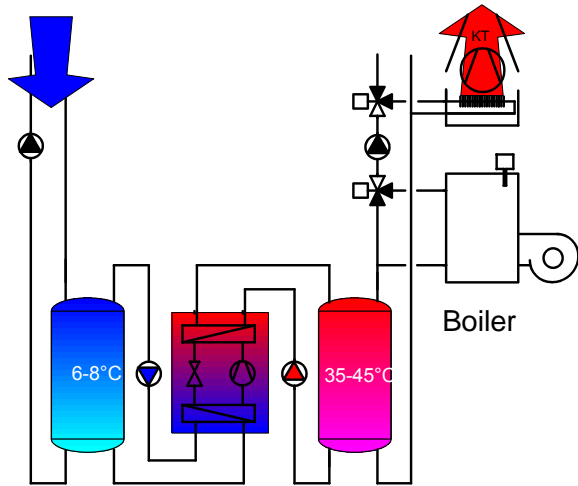
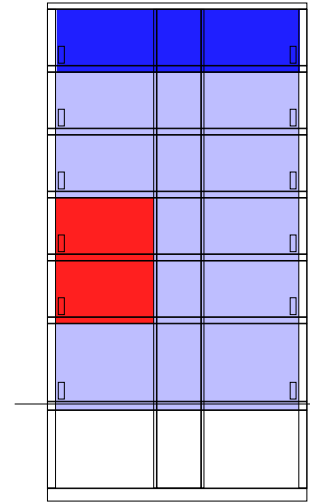
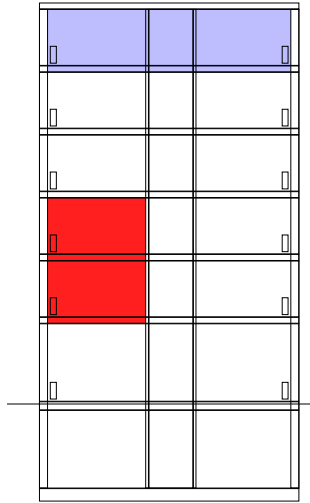
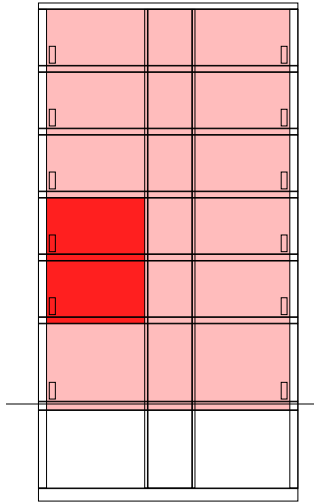




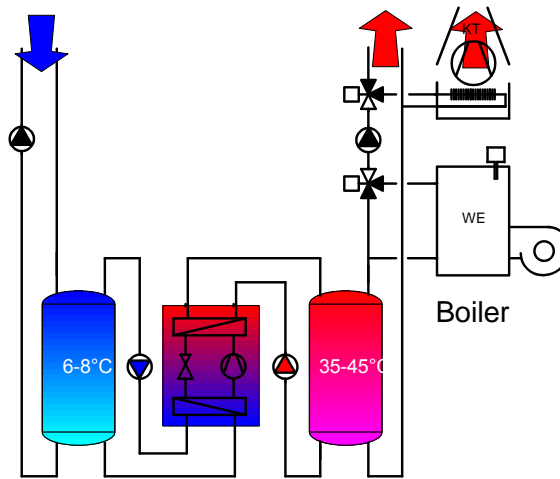


Heat Islands in Large Cities

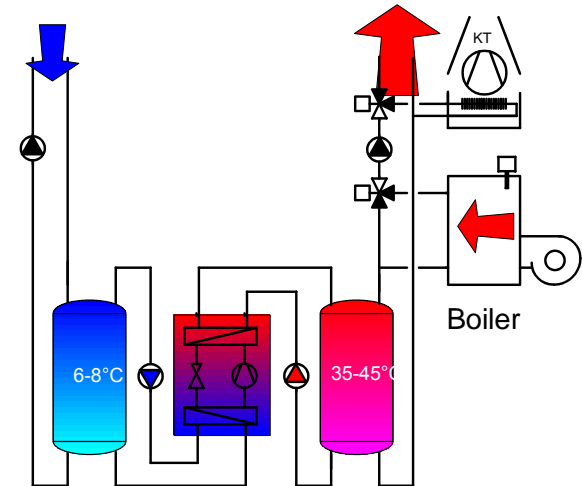




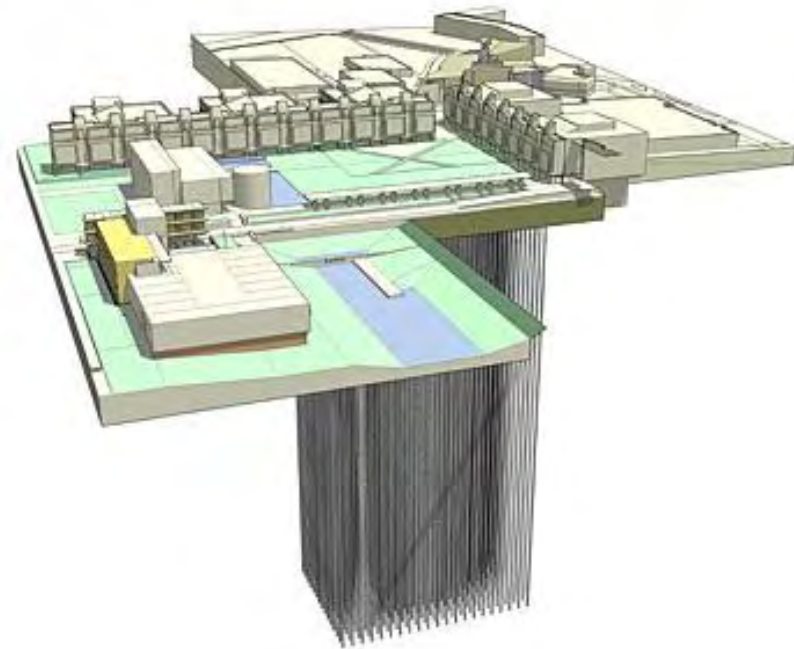
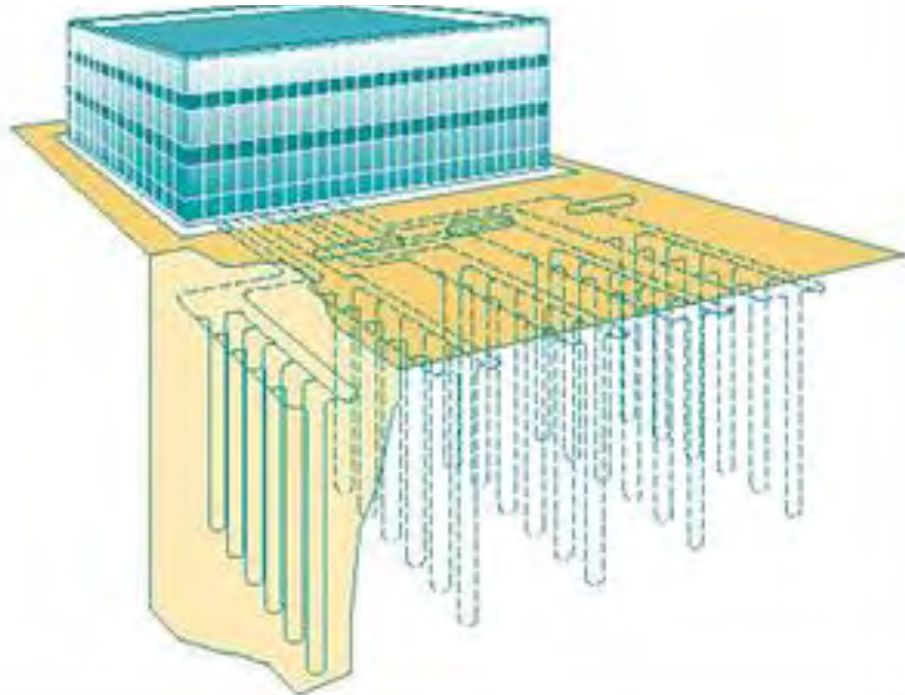
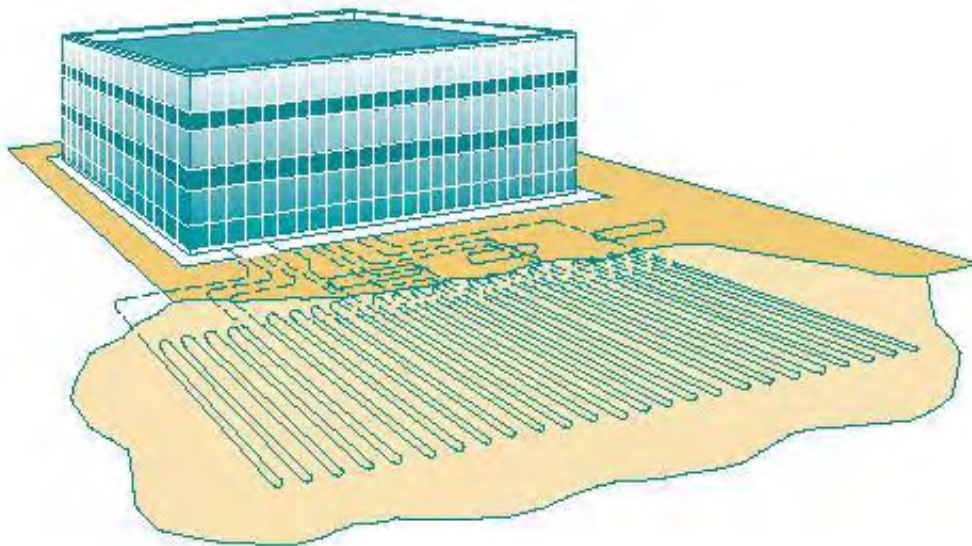
Cooling



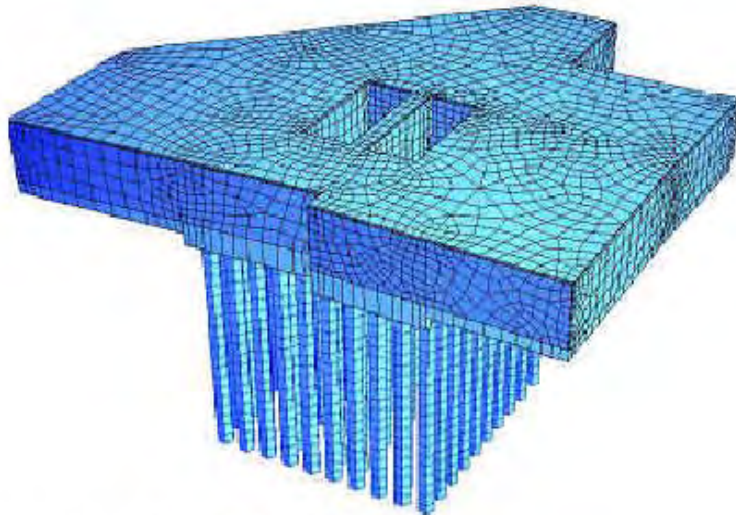
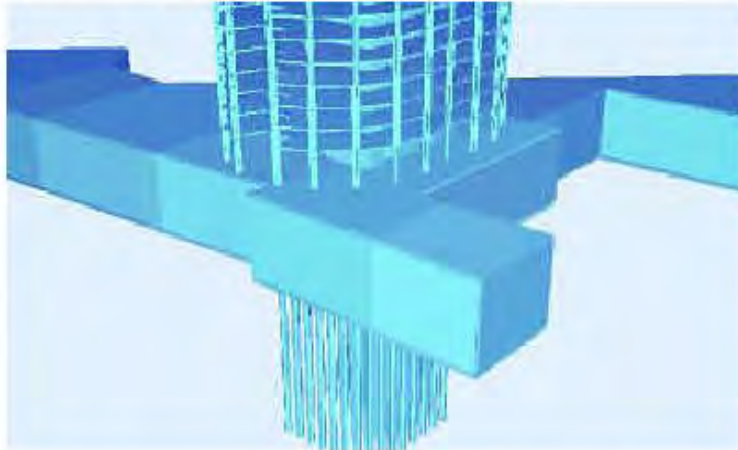
Cooling and Heating



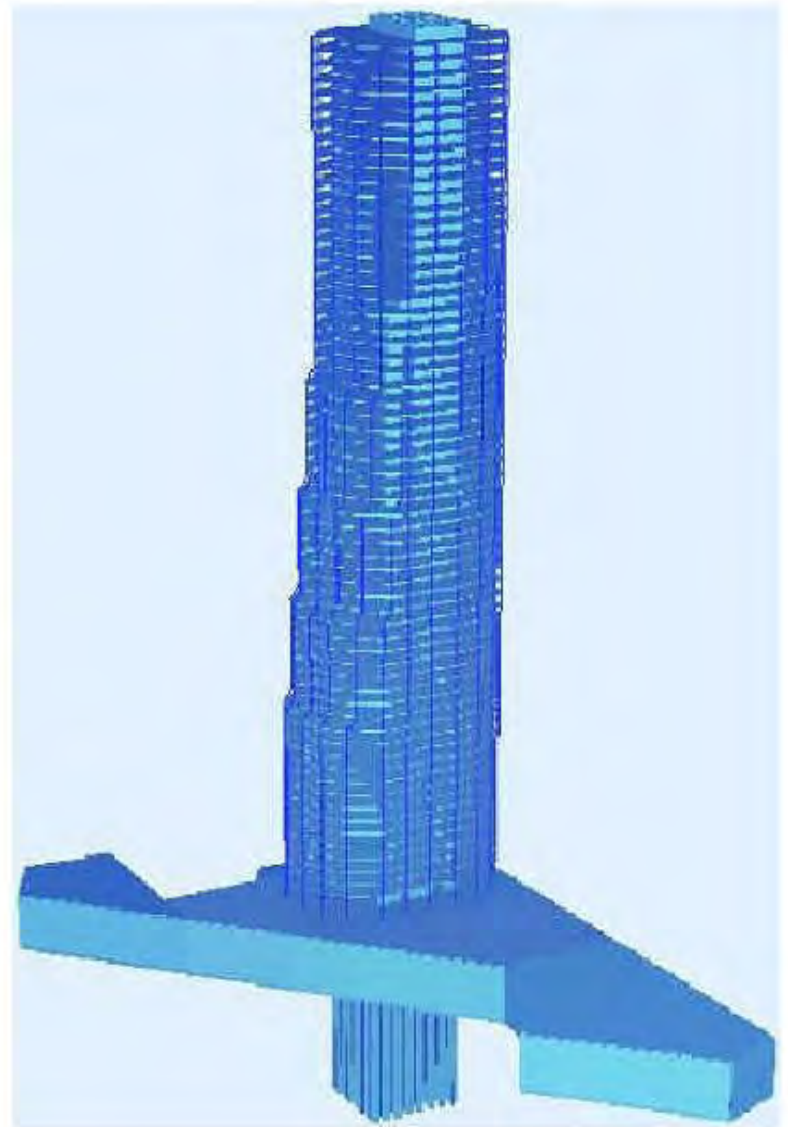
Heating

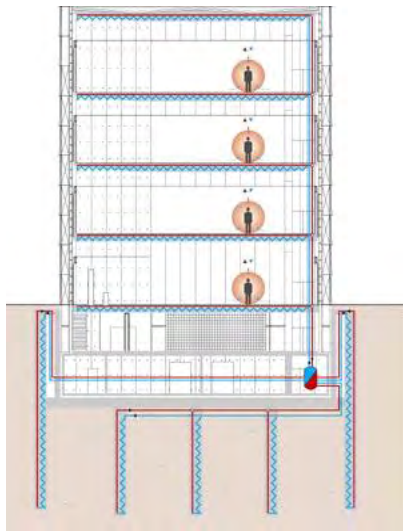


Gründung von Hochhäusern

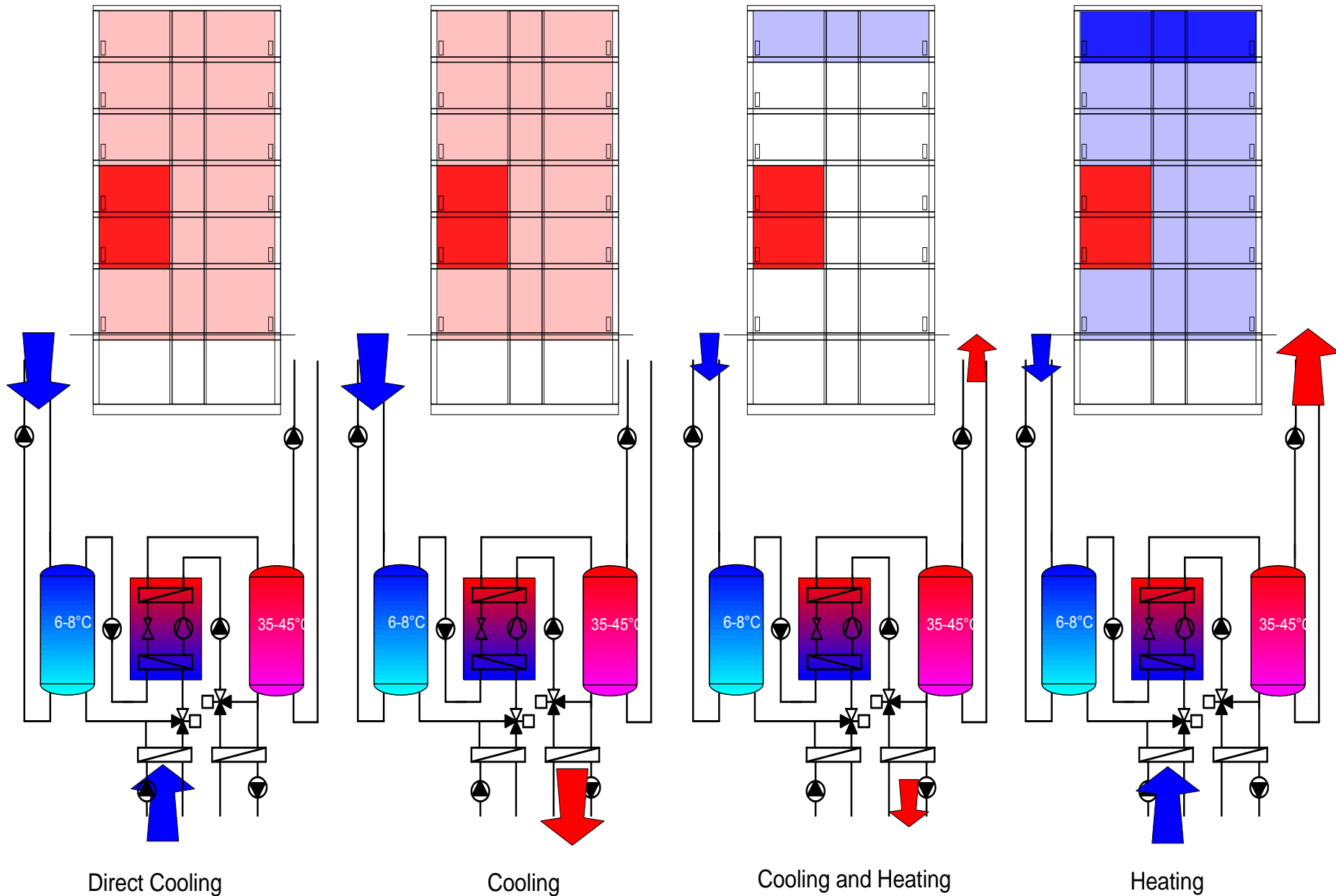


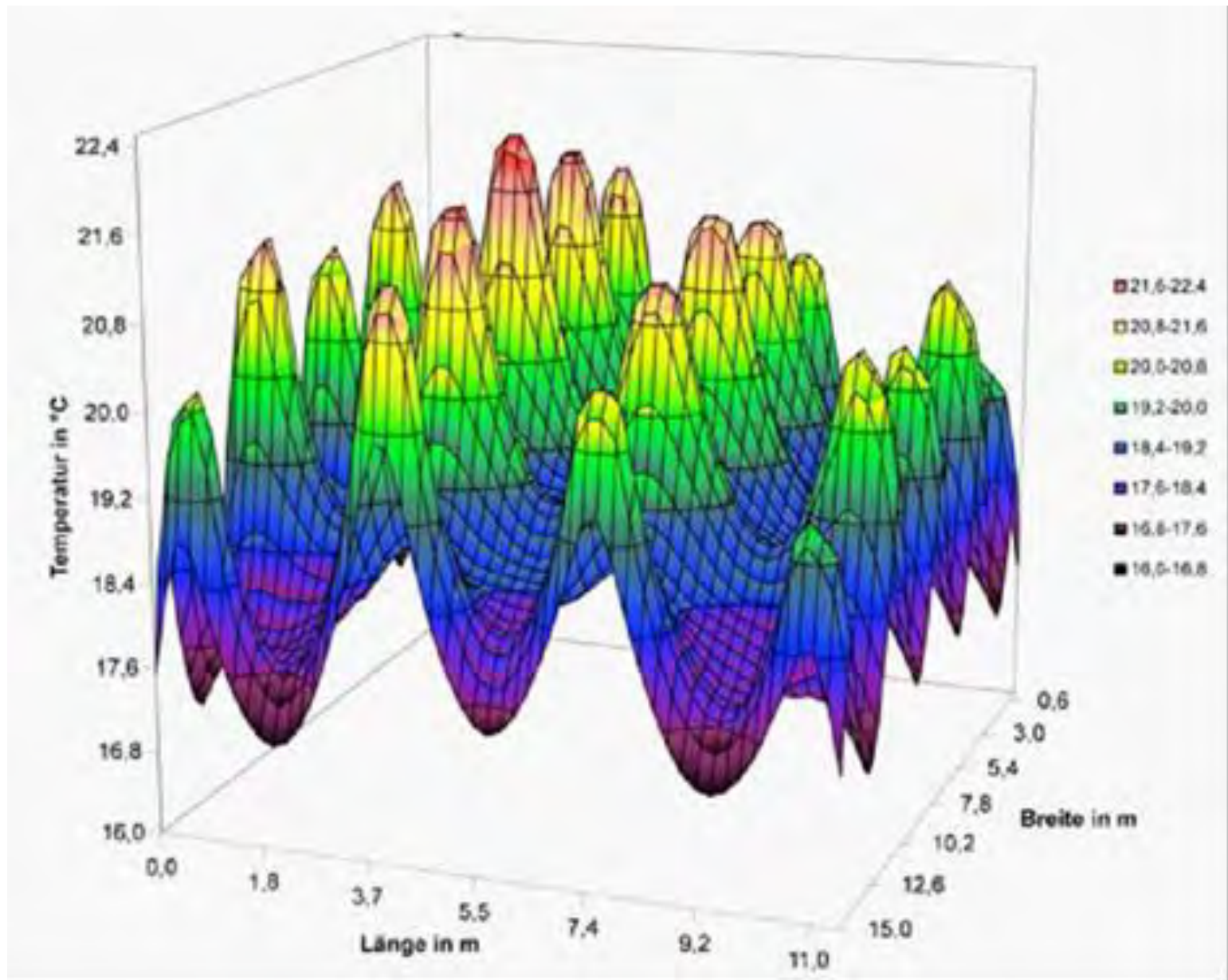
Hochhaus MAX, Frankfurt / Main
(A: Murphy/Jahn, I: Werner Sobek Ingenieure)

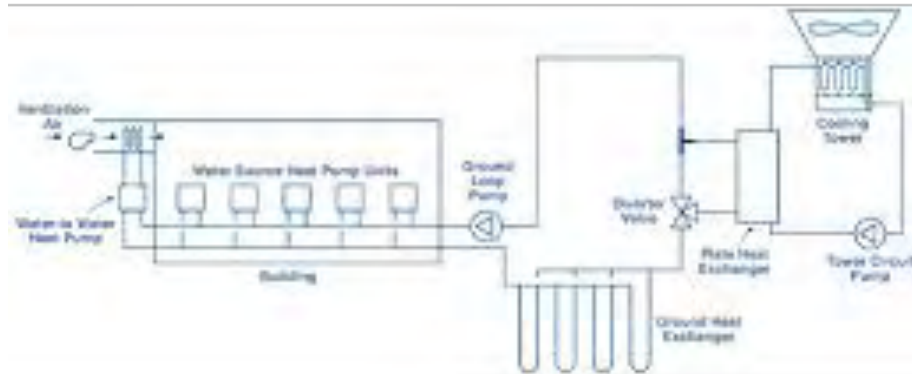
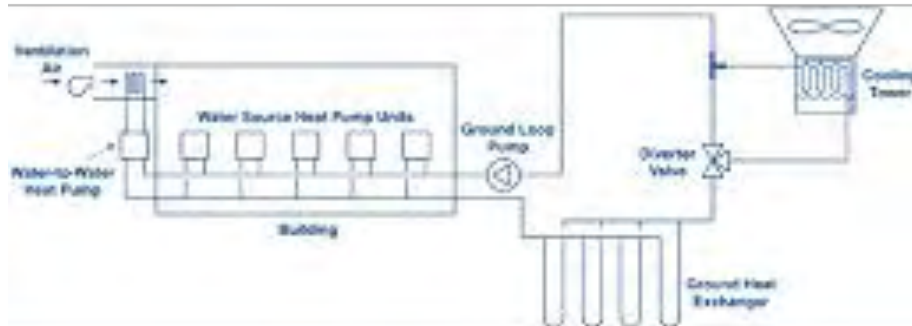


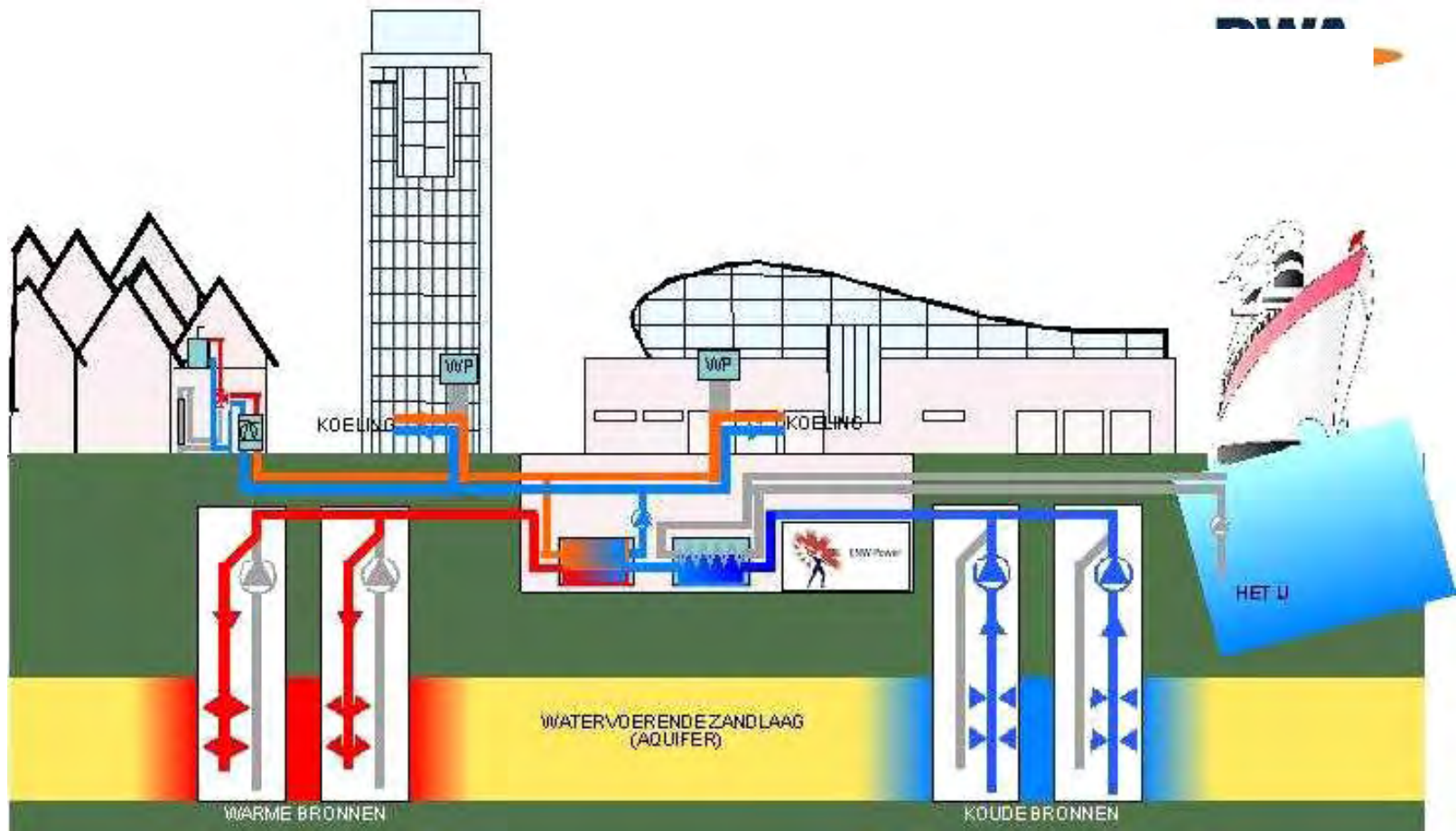




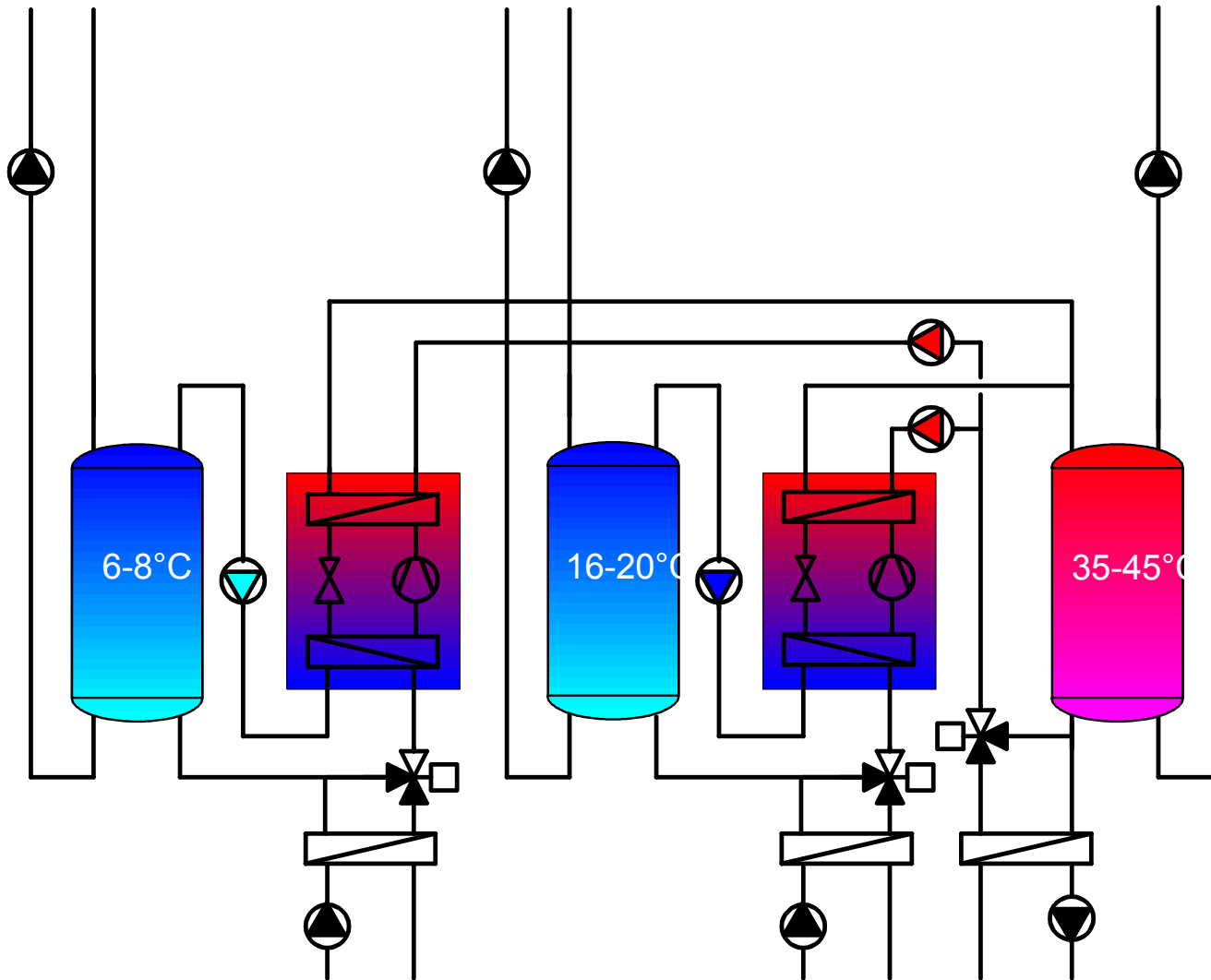




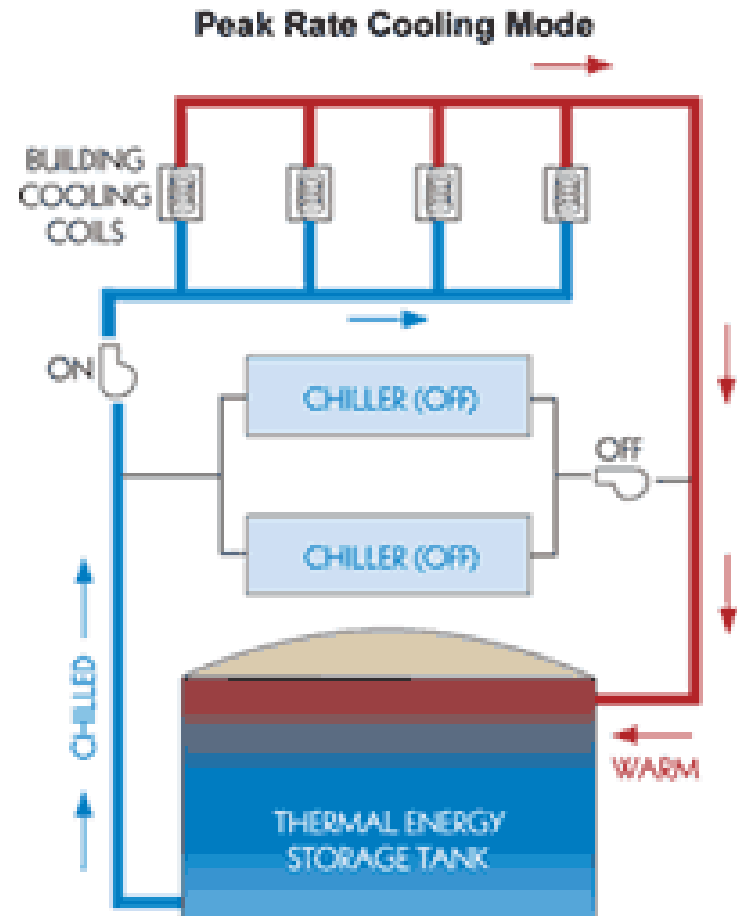
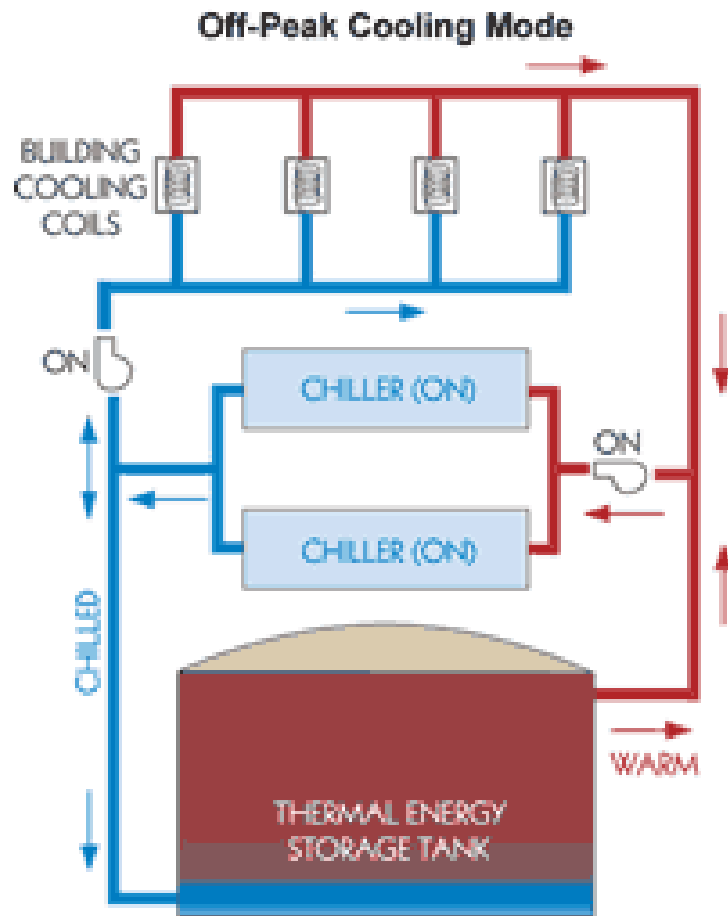


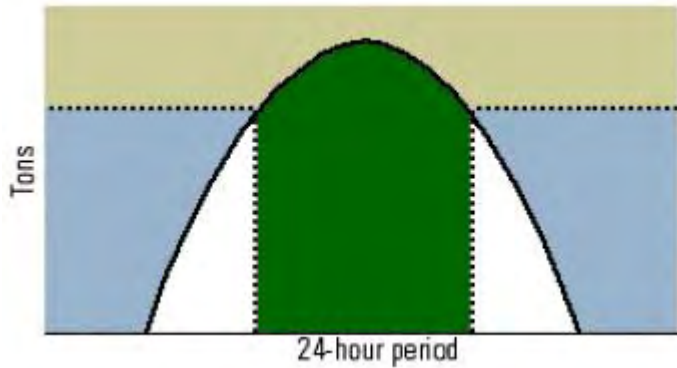


Low-Ex Systems

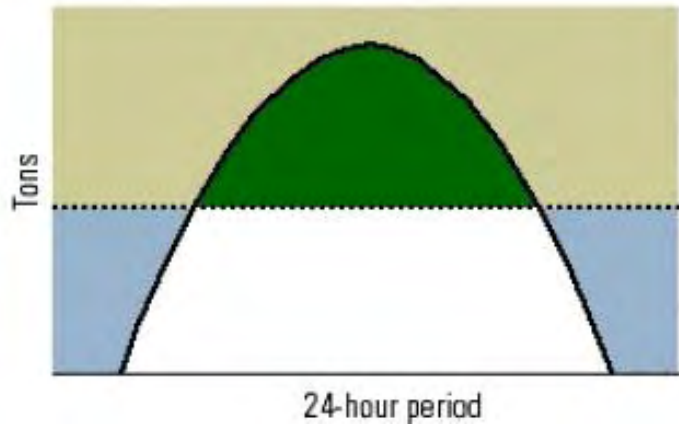
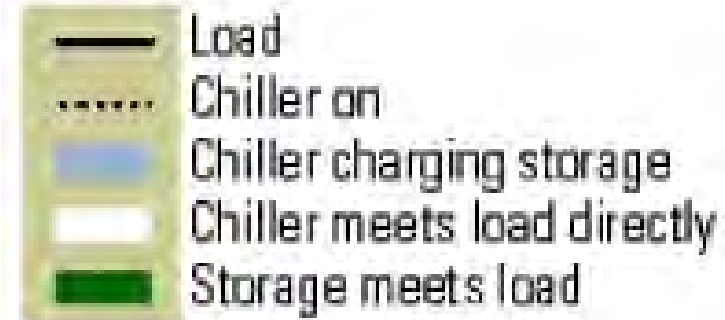




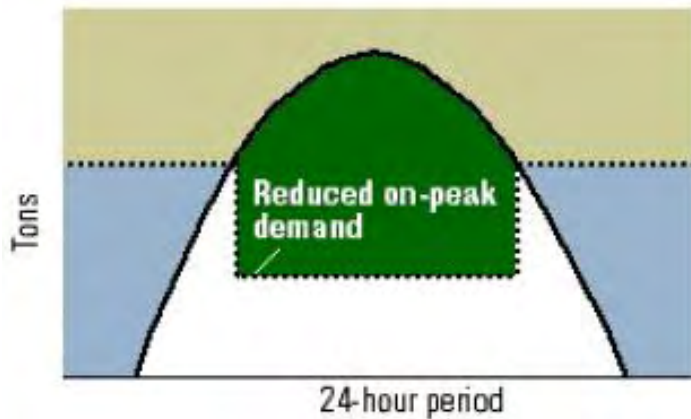




Full Storage

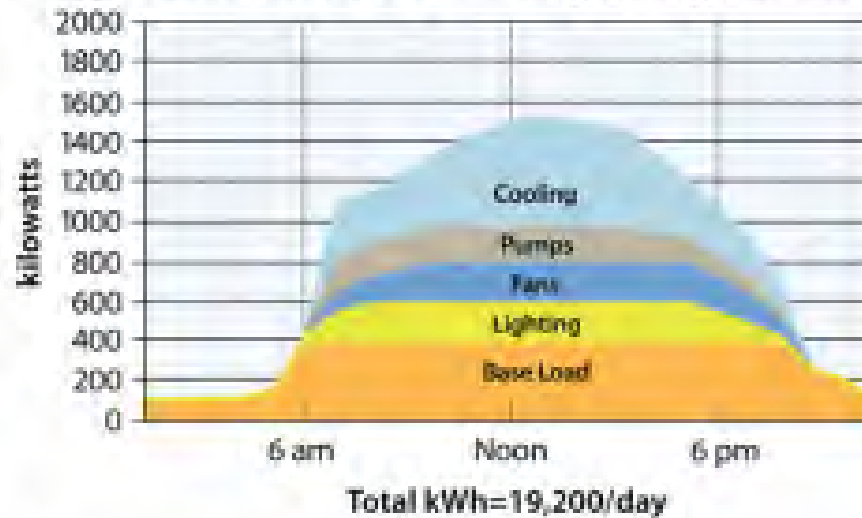


Partial Storage Load Levelling

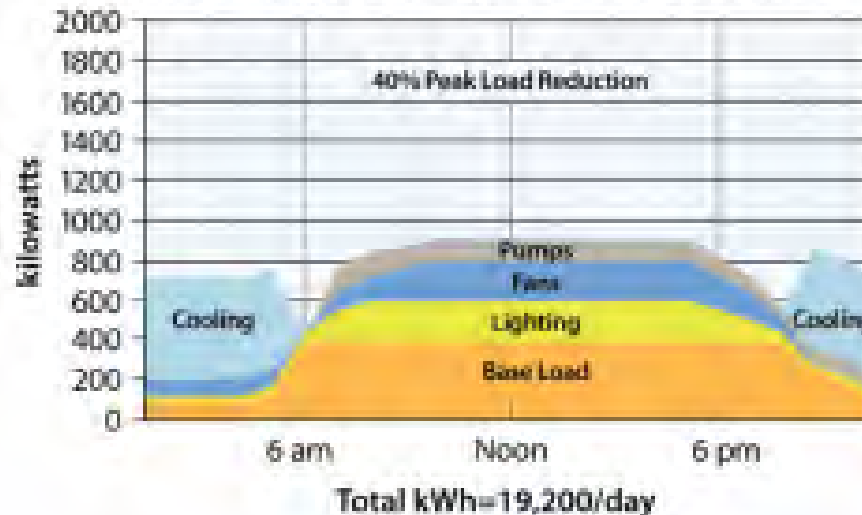


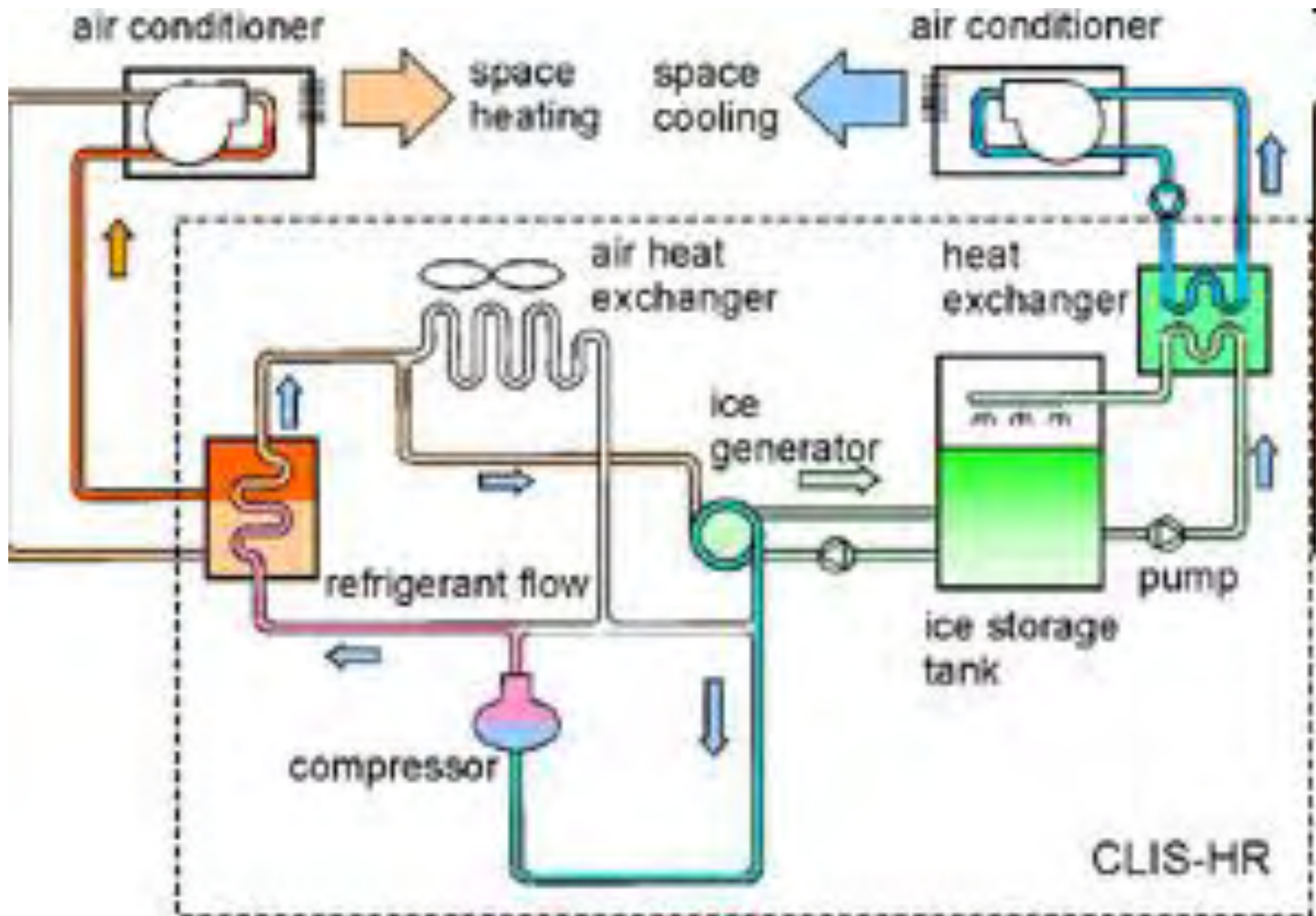
Partial Storage Demand Limiting

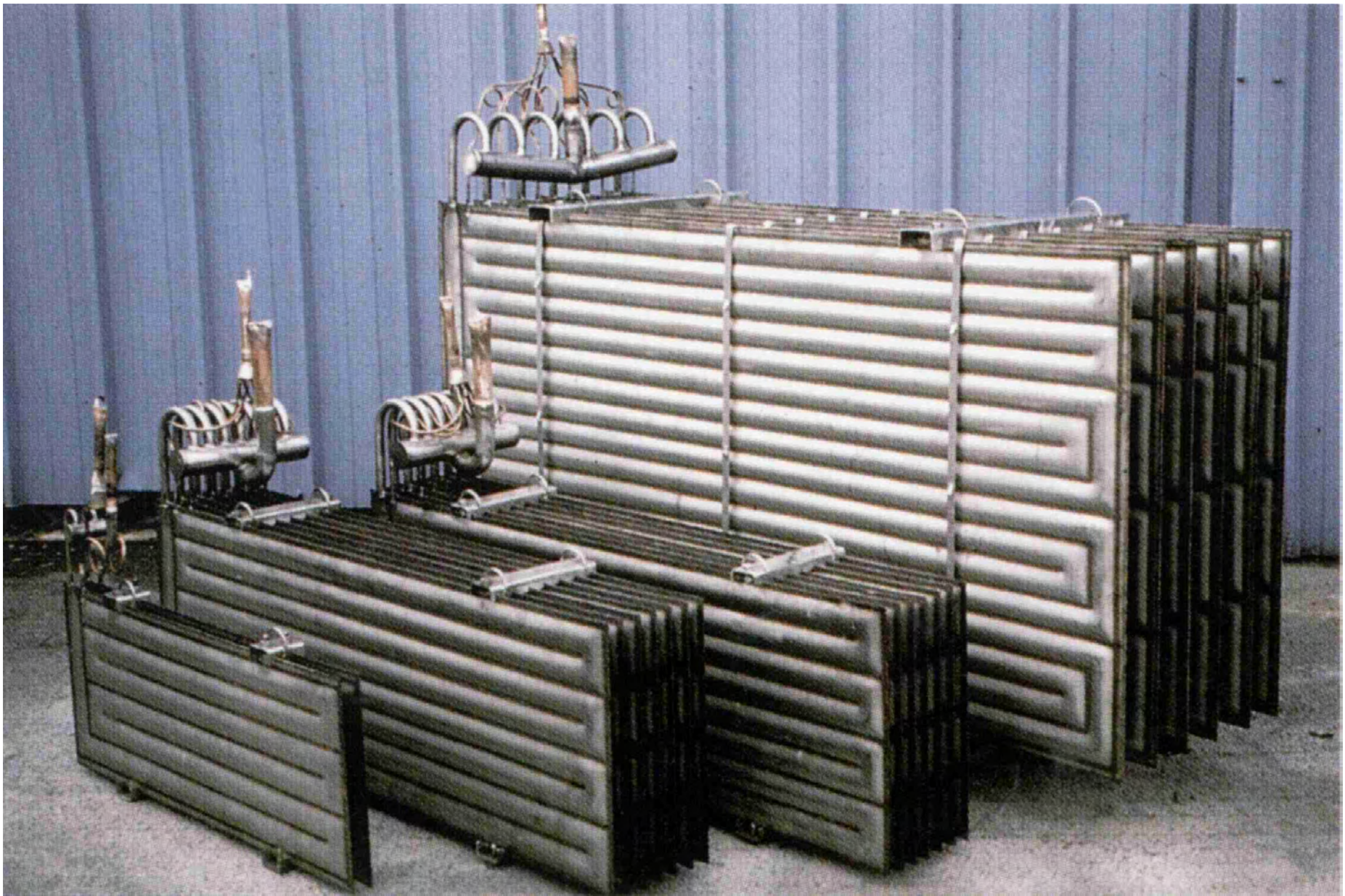
Conventional Office Building Using Chillers



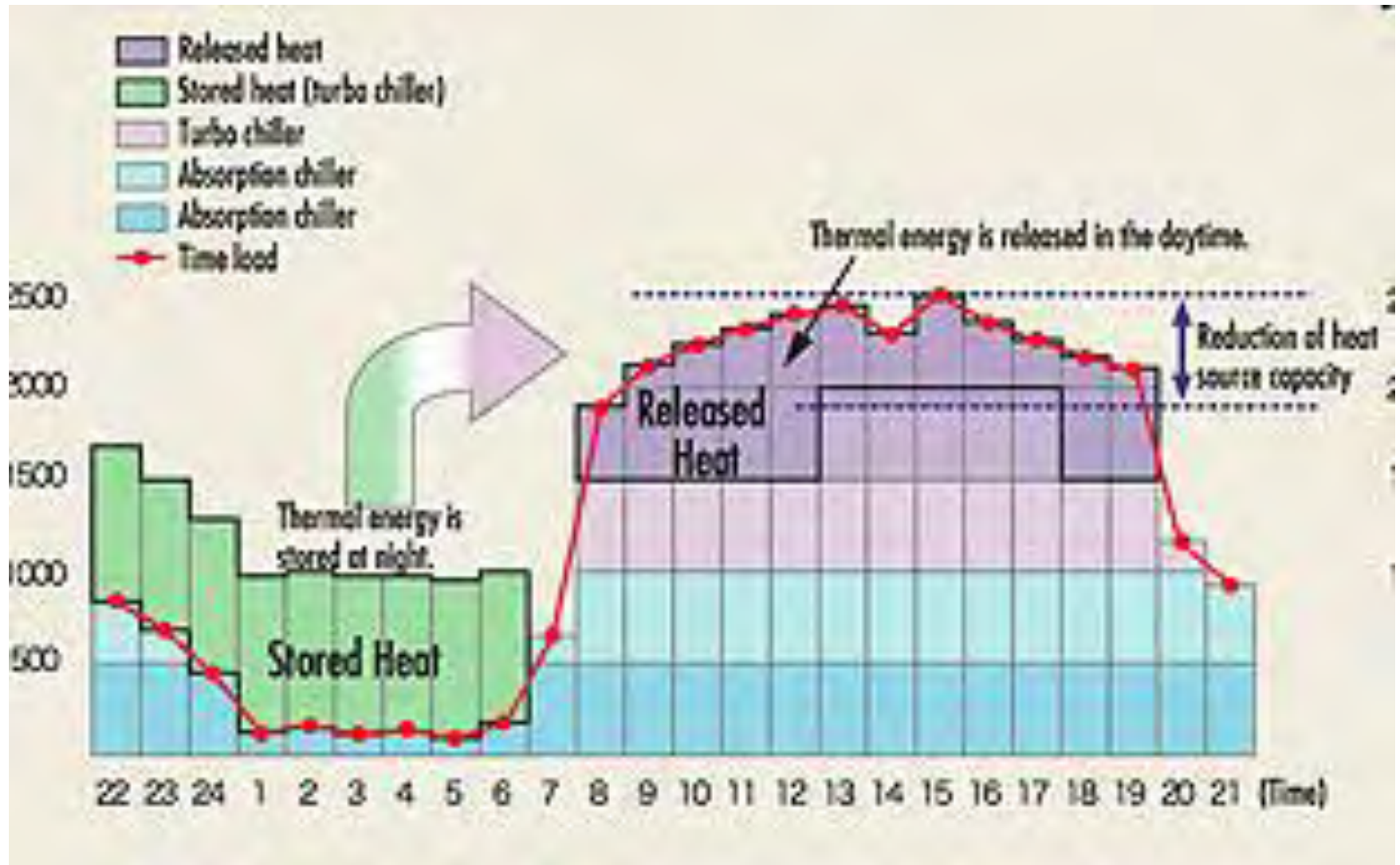
Thermal Energy Storage Electrical Profile

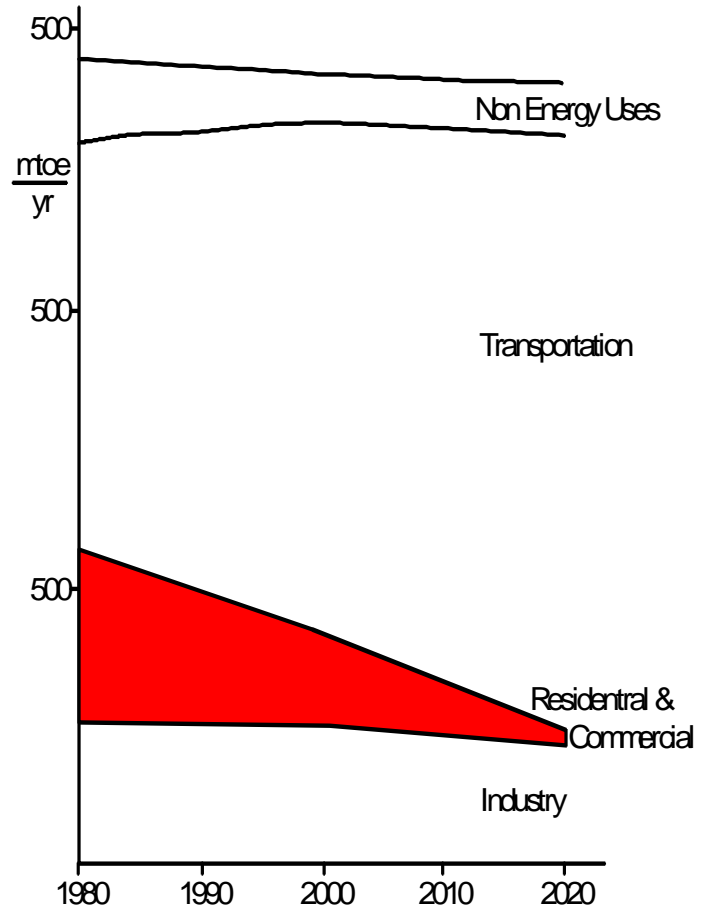
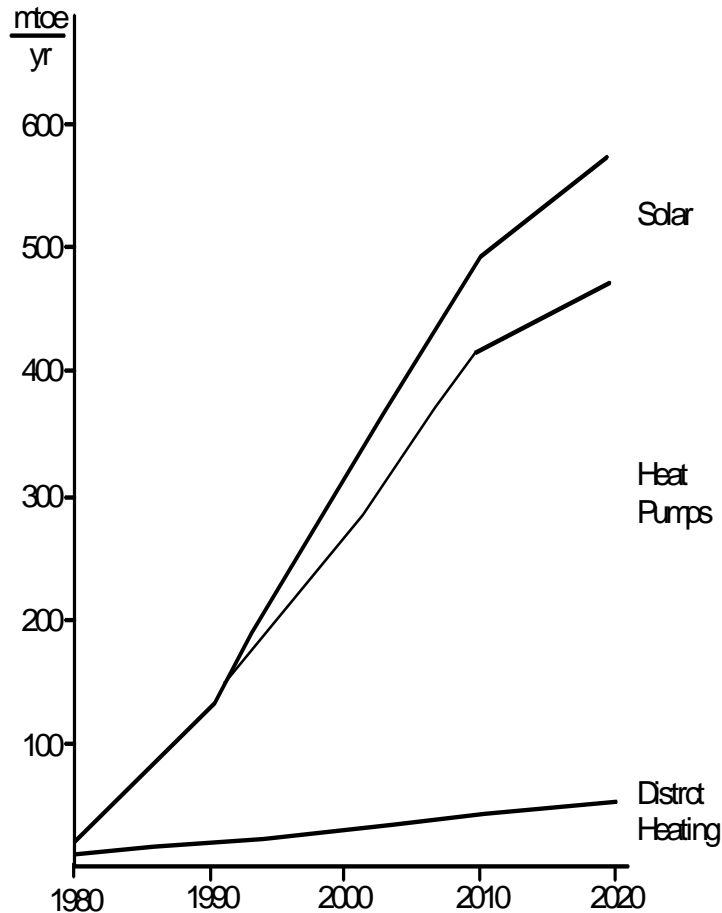












Strategy Study of the IEA 1980

Storage systems required

Building structure

Thermal energy stores at the condensor side (hot side)

- Sensible Stores

Thermal energy stores at the evaporator side (cold side)

- Sensible stores
- Latent heat stores

Electricity stores