SOLARNEXT

clean energy for you

chillii® Heat Pump

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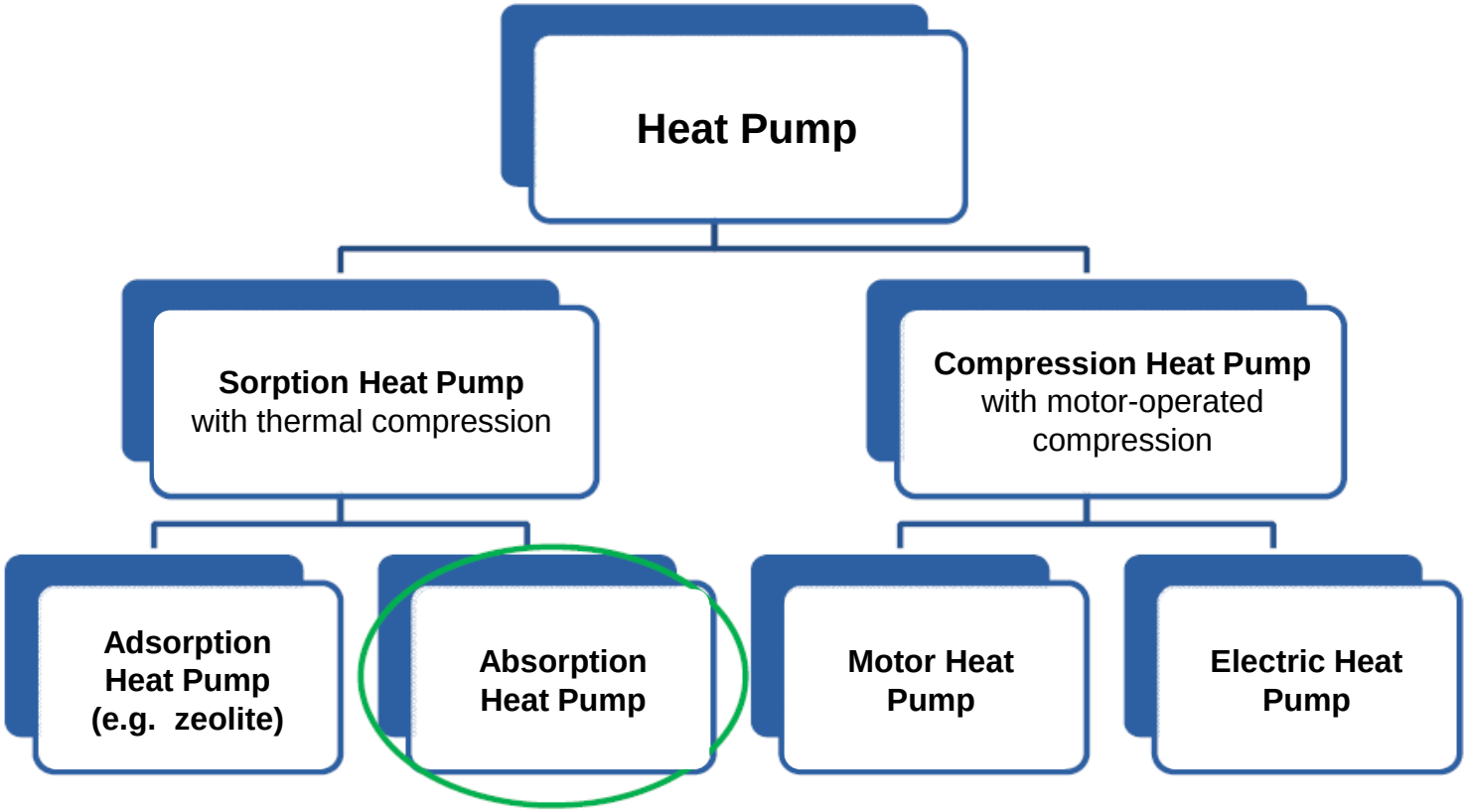
Ad- and Absorption Heat Pump in Cooling Mode

	Adsorption chiller	Absorption chiller
Physical cooling effect	Evaporation of refrigerant (vapour compression cycle)	
Driving energy	Heat energy 55°C – 95°C	Heat energy 70°C – 95°C
Refrigerant	Water with solid adsorbent (silica Gel, zeolith)	Water with LiBr or NH_3 as absorbent
Cooling capacity	10 kW - 500 KW (module)	18 kW – 4.500 kW (module)
Cold water temperatures	+6°C to +20°C (out)	+3,5°C to +20°C (LiBr) -20°C to +20°C (NH_3)
COP_{th}	0.5 – 0.65	0.65 – 0.85

Condensing Gas Boiler vs. Gas Absorption Heat Pump

	Condensing Gas Boiler	Gas Absorption Heat Pump
Driving energy	Gas	Gas
Heating + Cooling	Only heating possible	Heating + Cooling possible
Heating capacity	10 kW - 50 MW	100 kW – 10 MW (module)
Hot water temperatures	usually 35° – 95° C (on request also other temperatures possible)	35° – 95° C (on request also other temperatures possible)
COP_{th}	0.90 – 1.10	1.45 – 1.75

Available Heat Pump Technologies



Distinction of Gas Heat Pumps

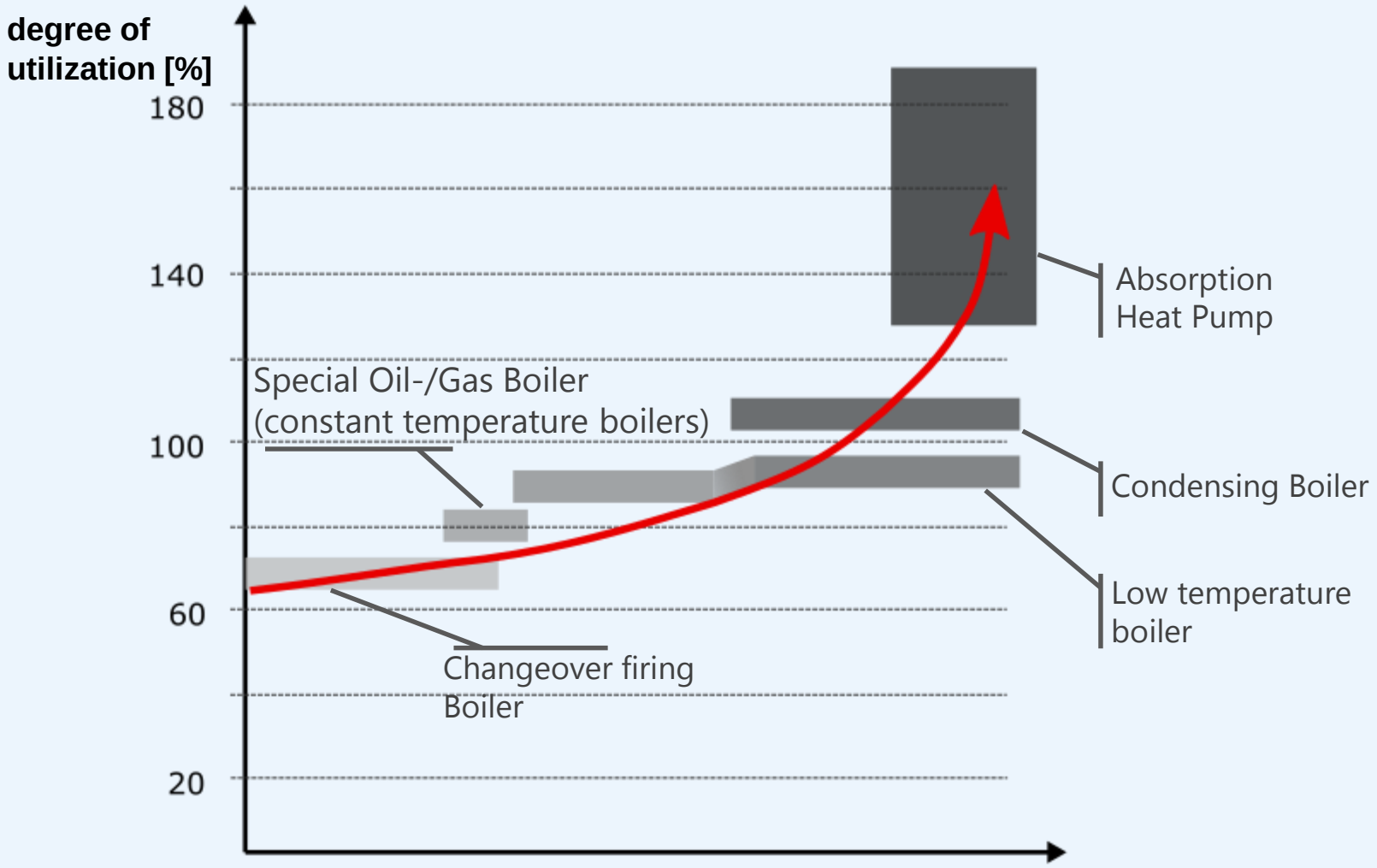
Gas Engine Heat Pumps:

- Operates like Electric Heat Pumps with a mechanical compressor
- This techologically silmple variant is state of the art and is applied since years in higher capacity

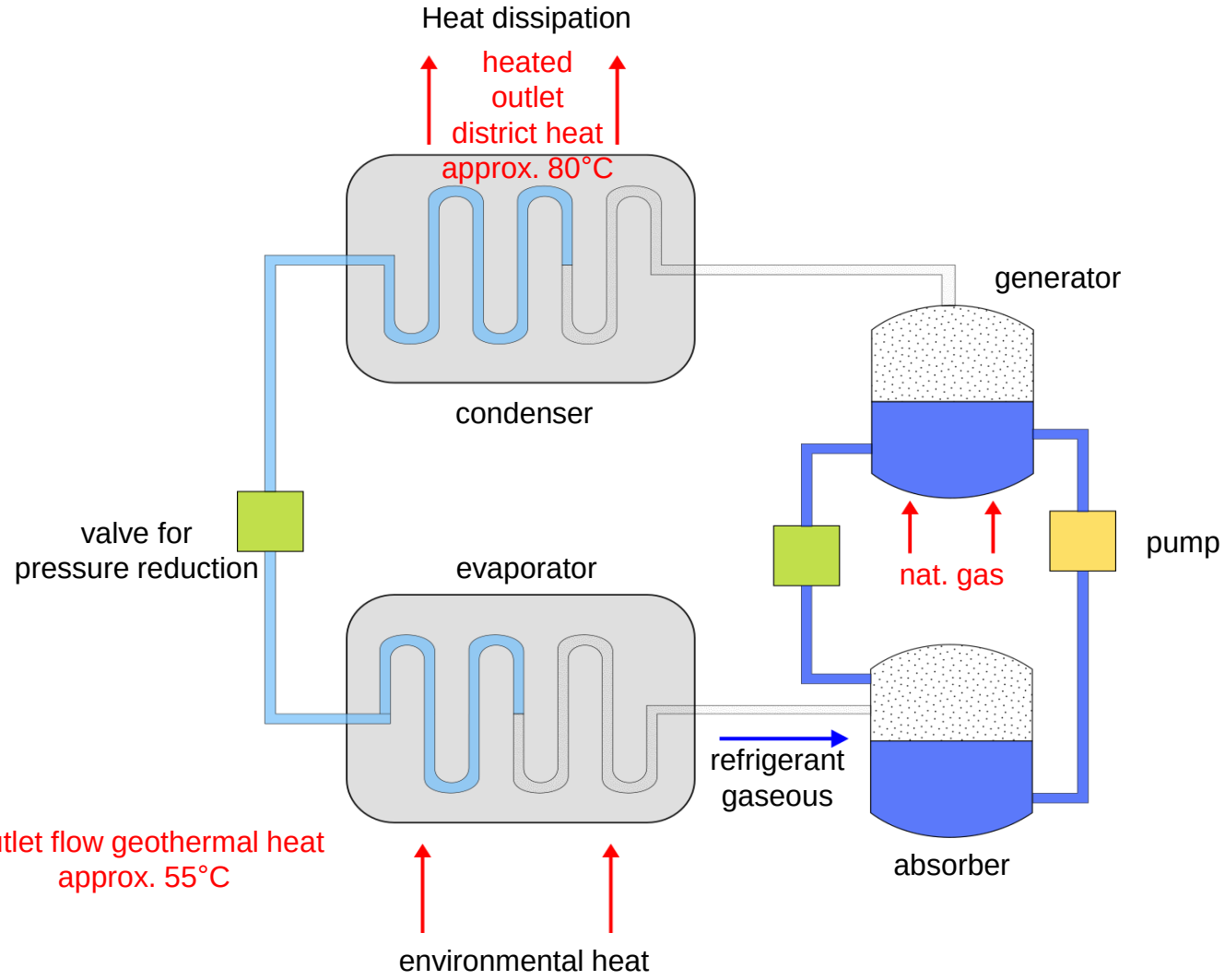
Absorption Heat Pumps:

- The Absorption Heat Pumps are based on the principle of sorption, i.e. on the thermal compression in sorption processes
- High efficiency

Efficiency of Different Heat Generators



Working Principle of Absorption Heat Pump with Geothermal Source



Working Principle of Absorption Heat Pump (Phase 1 - 4)

1. Phase: Evaporation of the refrigerant in the der Absorption Heat Pump
In the first step of the cycle the liquid refrigerant gets into the evaporator. Theregy it takes the energy from the connected environmental heat source and therefore heats up. Conequently the refrigerant undergoes a phase change and gradually evaporates.

2. Phase: Uptake by a liquid sorbent
In the subsequent step the refrigerant vapour streams to the so called Absorber. Here a specific liquid absorbs the vapour (Absoption) and ensures the pressure stays low.

3. Phase: Driving out the refrigerant with gas
When the sorbent is saturated, it is transported by a pump to an other heat exchanger. Here the saturated sorbent is heated up by a gas burner and the refrigenrant
Is driven out from the saturated solution.

4. Phase: Transfer of Heat to Heating Systems
The refrigerant the streams to the condenser and releases the process heat to the heating system. As the medium cools down, it gradually begins to liquefy. A special valve then brings it back to its original state and ensures that the process can start again.

Advantages of Gas Absorption Heat Pumps (1 von 4)

- Significantly lower electricity consumption (over electrically driven heat pumps)
- High efficiency and environmental protection
  (significantly higher COP compared to condensing gas boilers)
- Heating and cooling with only one machine possible
- Low maintenance and long life time

- Environmental-friendly (F-gas free machine) → positive marketing effect

Advantages of Gas Absorption Heat Pumps (2 von 4)

In comparison to electrically operated heat pumps, an absorption heat pump requires **significantly less electricity**, since **no electrically operated compressor is required to raise the temperature of the refrigerant**. A thermal compressor consists of a generator, an absorber, a solvent pump and an expansion valve. This means that compression in the gas absorption heat pump does not take place like in other heat pumps with an electrically driven compressor, but with the help of thermal heat energy.

Advantages of Gas Absorption Heat Pumps (3 von 4)

According to the Federal Association of the German Heating Industry, gas absorption heat pumps rank first among all types of heating that use fossil fuels when it comes to efficiency and low primary energy requirements. Because in addition to gas, environmental heat serves as an additional heat source. Gas heat pumps achieve efficiencies of up to 165%. For comparison: a gas condensing boiler has an efficiency of up to 111%.

In addition, there is a reduction in harmful greenhouse gases of up to 30% compared to other heating systems that run on fossil fuels. This makes an important contribution to the energy transition. Gas heat pumps **also meet the legal requirements of the Renewable Energy Heat Act (EEWärmeG)**, provided that **50% of the heat energy requirement** is covered by environmental heat such as solar, water and geothermal energy.

Advantages of Gas Absorption Heat Pumps (4 von 4)

By reversal of the heat pump function, gas absorption heat pumps can be used in **addition to heating also for cooling the building**. This modern type of heating can therefore be used for heating and cooling in a sensible way.

Typical areas of application are hotels, restaurants, food manufacturers and hospitals.

chillii® Gas-Powered Absorption Heat Pump

- chillii® Gas-powered Absorption Heat Pump
- ready for mounting
- maintenance-friendly

Advantages of Ad- and Absorption Heat Pumps

Active climate protection

- Energy savings/ increased energy efficiency
- Significant CO_2-reduction
- Reduction of the Global Warming Potential (GWP) by 99,9 %, because
  - ➡ no F-gases and therefore environmentally harmful refrigerants **instead** **water as refrigerant**

Cost savings

- Reduction of electricity consumption and energy costs (> 75 % less electrical power consumption compared to compression heat pump)
- Lower gas costs because of higher efficiency compared to condensing boilers
- Heating and cooling with one machine possible (investment advantage)
- Low maintenance costs, longer life time, significantly lower overall

Cost savings with simultaneous improvement of the eco-balance

Optimal conditions for economically interesting Gas Absorption Heat Pumps

- Available Heat => environmetal heat e.g. geothermal or industrial waste heat
- Use of the system as a thermal cooling system in the summer months
- Heat production needed at least for 4.000 operating hours per year
- Overall electricity price of > 12 ct/kWh
- Increased environmental awareness of the client (CO_2-reduction, energy efficiency, reduction of greenhouse gases)

➡ **short pay-back period of < 3 years**