

# Renewable cooling technology solutions including heat pumps

Dr. Sibylle Braungardt

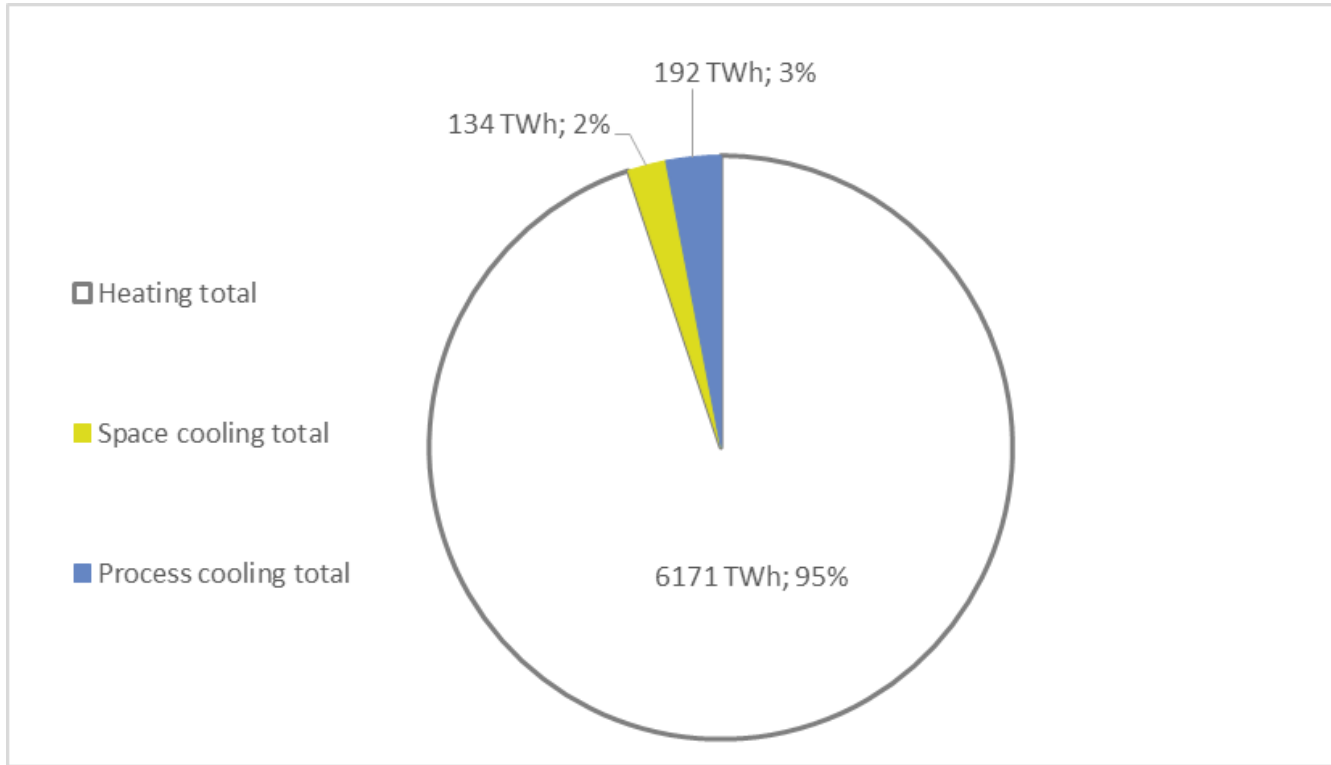
Workshop on Regional Heating and Cooling priorities in the framework of the Smart Specialisation Platform

Brussels, 20/5/2018

# Agenda

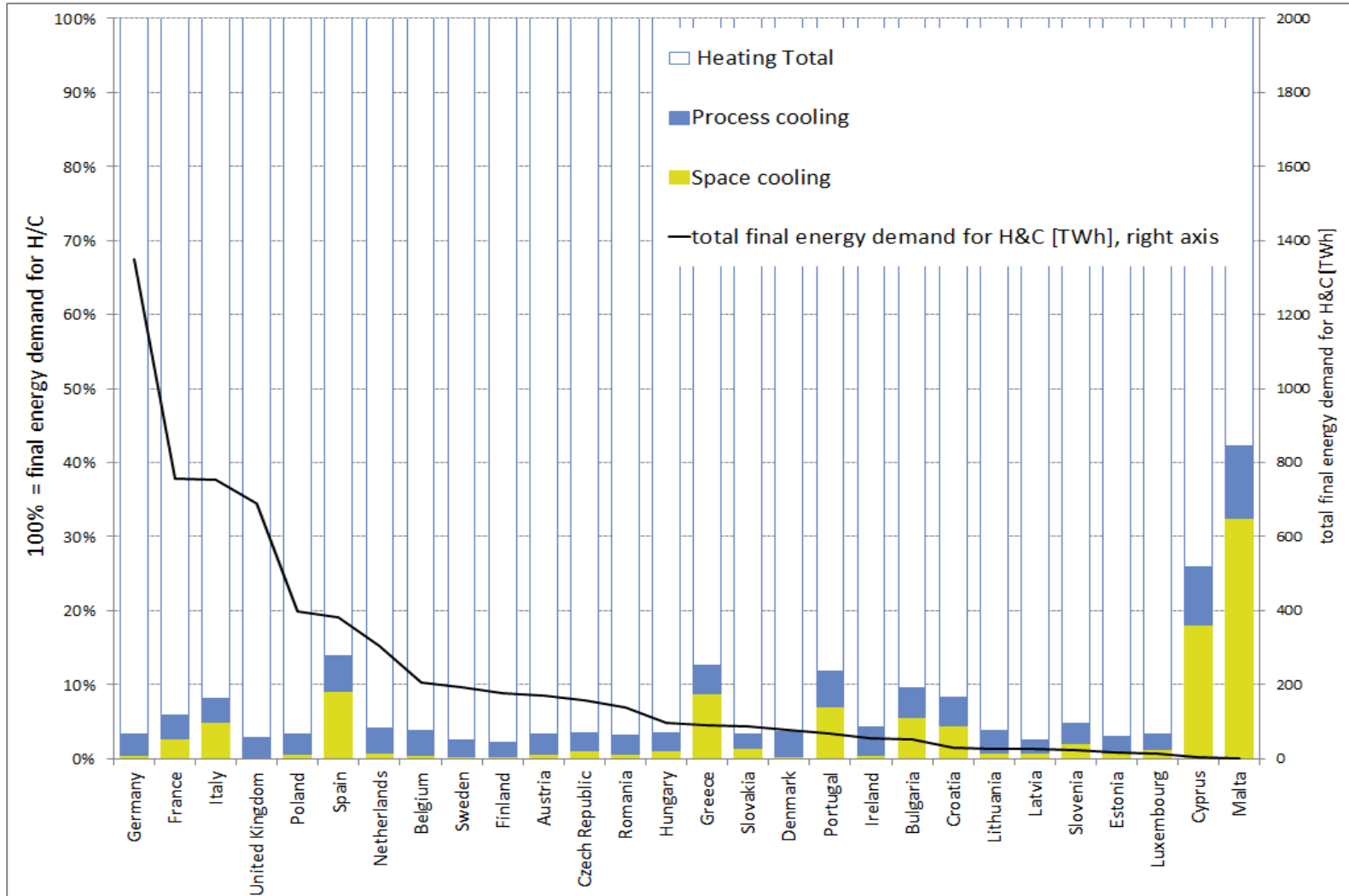
- 1** Current and future cooling demand in the EU
- 2** Overview of cooling technologies
- 3** Renewable cooling

# Final energy demand for heating and cooling in the EU (2012)



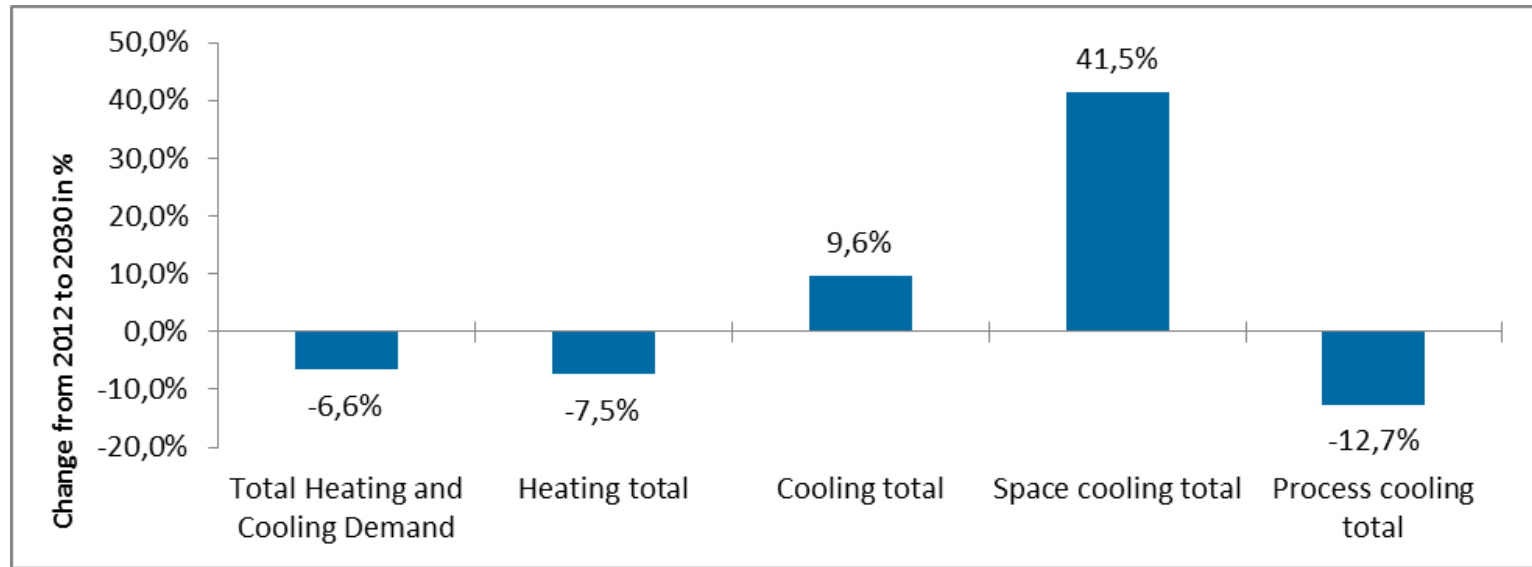
Source: Fraunhofer ISI et al: Mapping EU heat supply: Mapping and analyses of the current and future (2020 - 2030) heating/cooling fuel deployment (fossil/renewables)

# Final energy demand for heating and cooling by country (2012)



Source: Fraunhofer ISI et al: Mapping EU heat supply: Mapping and analyses of the current and future (2020 - 2030) heating/cooling fuel deployment (fossil/renewables)

# Projected development of heating and cooling demand until 2030



Source: Fraunhofer ISI et al: Mapping EU heat supply: Mapping and analyses of the current and future (2020 - 2030) heating/cooling fuel deployment (fossil/renewables)

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# Overview of cooling technologies

2<sup>nd</sup> law of thermodynamics: Heat flows spontaneously from an object or space at a higher temperature to an object or space at a lower temperature

**Free cooling** using a heat sink  
*Natural heat flow in line with the 2nd law*

Cooling with **external energy** input  
 Heat flow against the natural direction

**„Passive cooling“:**  
 Prevention of heat loads, e.g. shading, insulation

- Aquifer cooling and ATES
- Snow and ice storage
- Sea/ River/ Lake cooling
- Geothermal heat pumps in passive mode

**Energy input:** Ambient energy + electricity

Electricity-driven systems

Compression cooling

**Energy input:**  
 Ambient energy + electricity

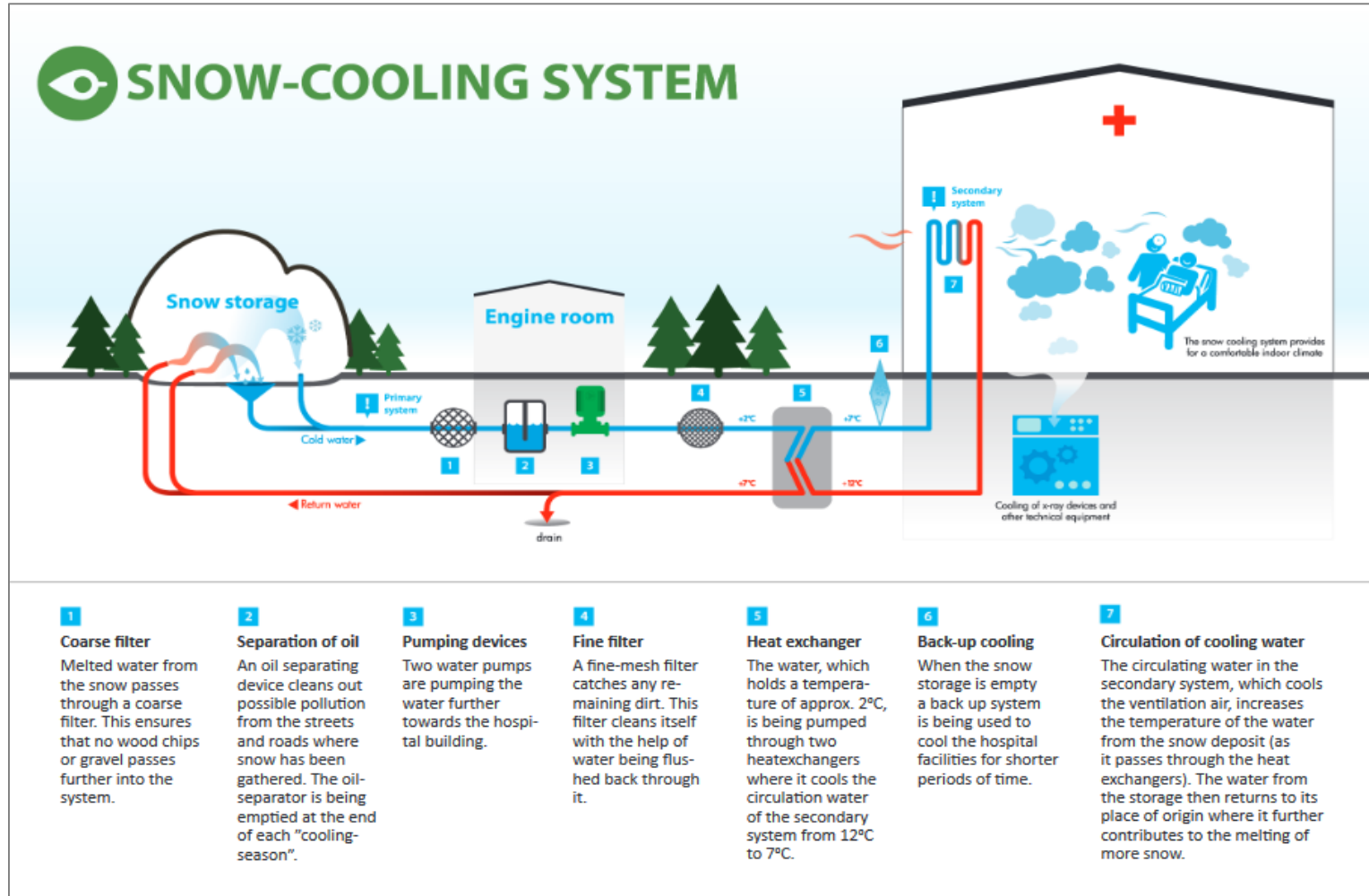
Heat-driven systems

Absorption cooling

Adsorption cooling

**Energy input:**  
 Ambient energy + heat

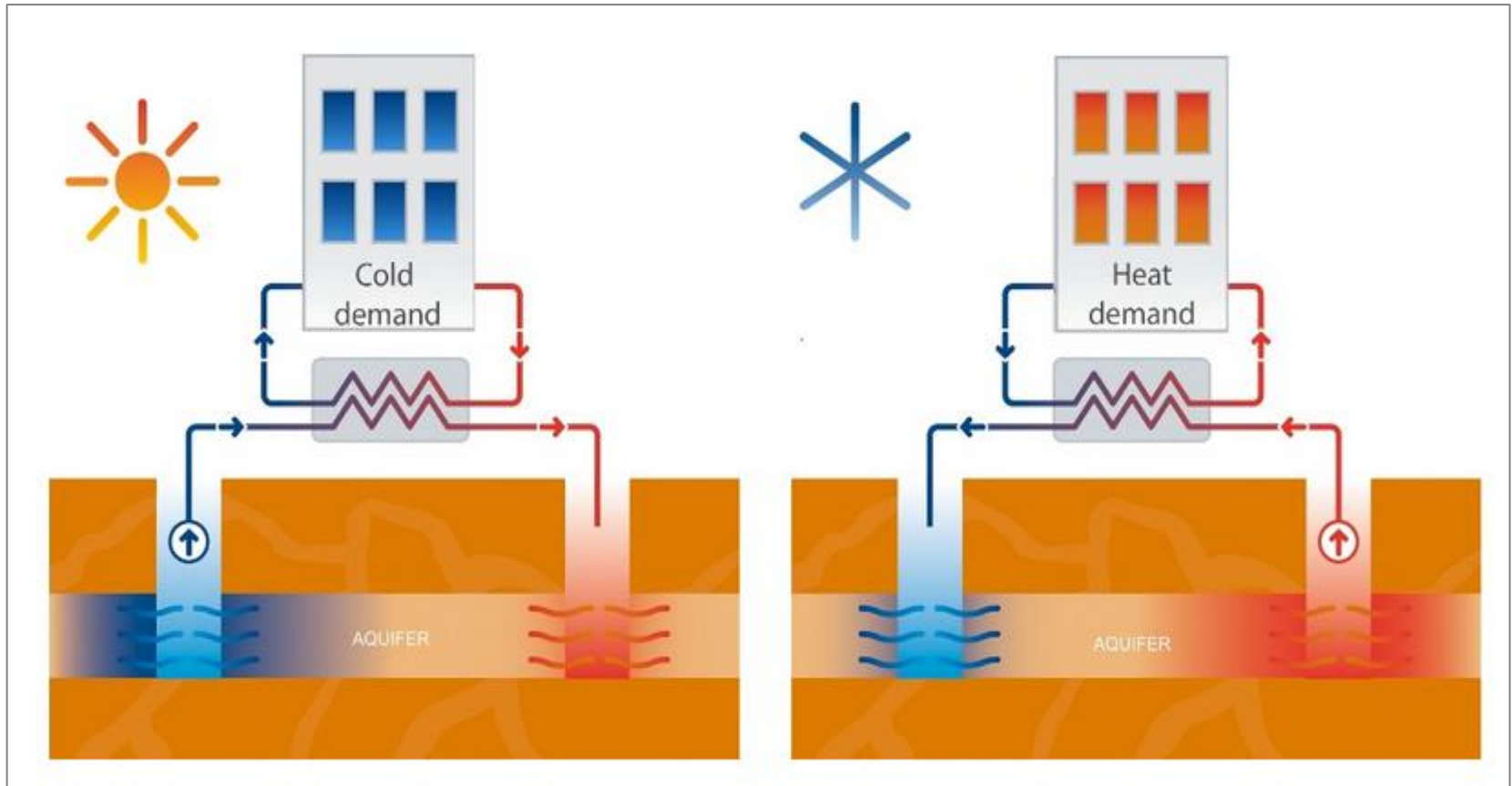
# Examples for free cooling technologies: Snow cooling



Source: <https://www.rvn.se/sv/v1/In-english/In-english/Environment-and-energy/Energy-Factor-2/Snow-cooling-in-Sundsvall/>

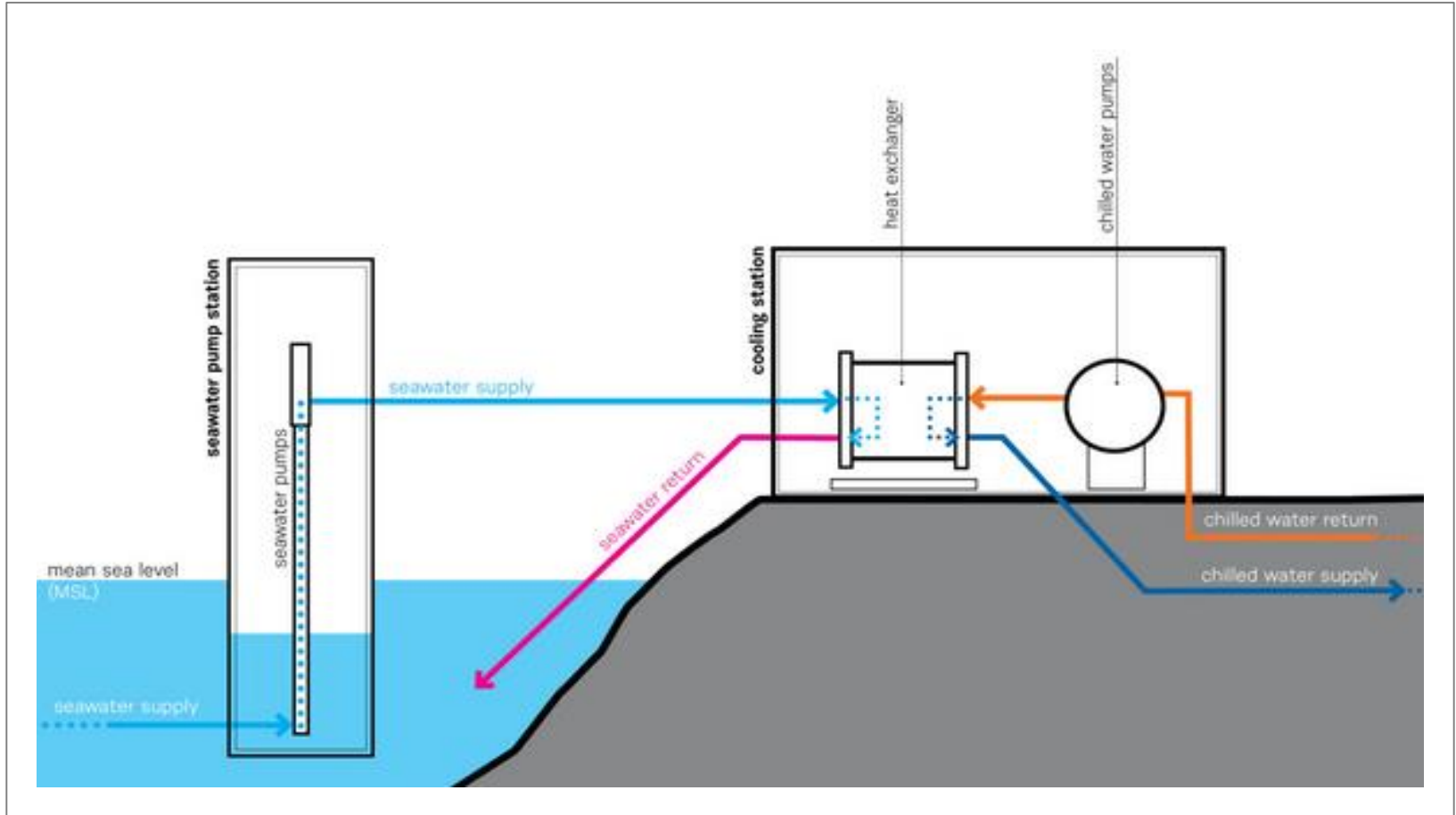


# Examples for free cooling technologies: Seasonal Aquifer Thermal Energy Storage (ATES)



Source: <http://www.iftechnology.nl/aquifer-thermal-energy-storage-wko-in-dutch-is-catching-on-in-japan>

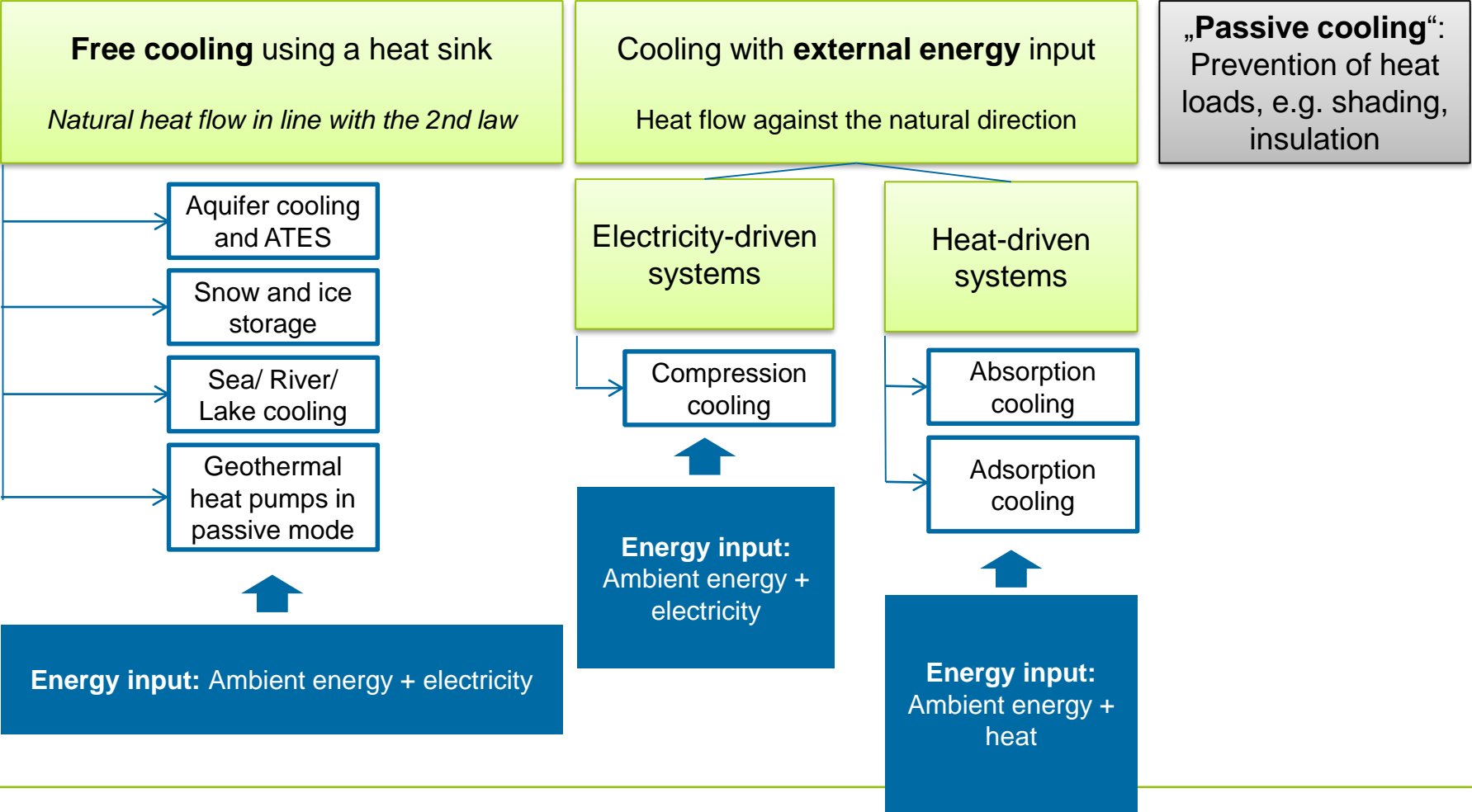
# Examples for free cooling technologies: Sea water cooling



Source: <https://www.clarknksen.com/project/sea-water-air-conditioning-swac-study/>

# Overview of cooling technologies

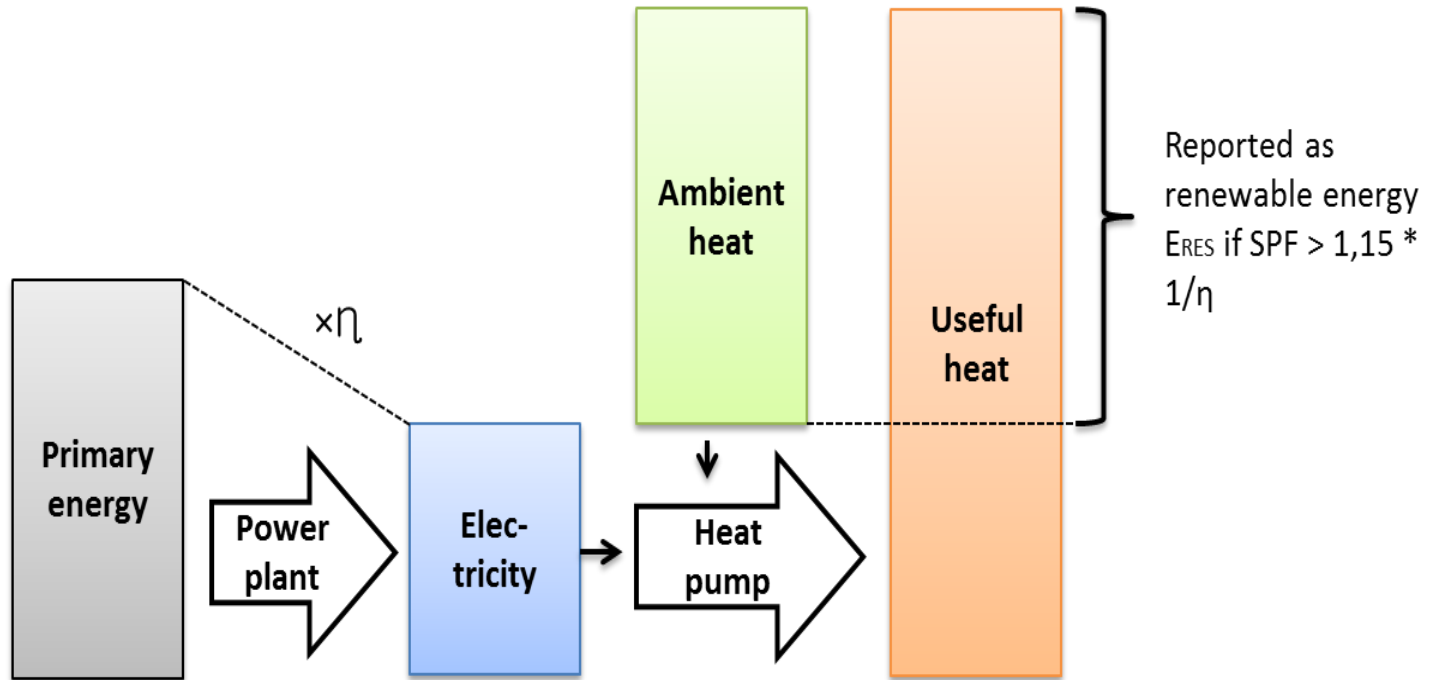
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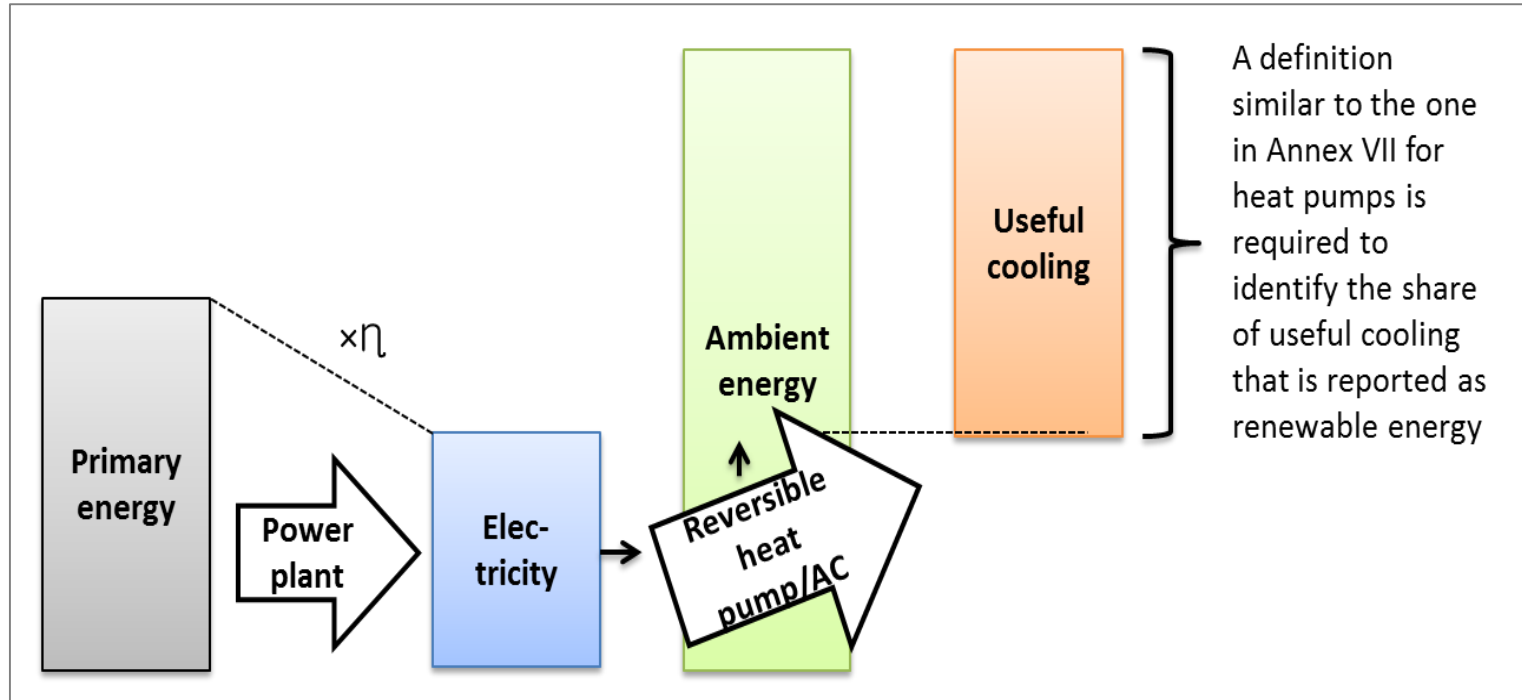
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# Ambient heat as renewable energy in the Renewable Energy Directive: Approach for heat pumps



SPF: seasonal performance factor

# Ambient energy as renewable energy for cooling: currently no definition for renewable cooling



## Summary and conclusions

- 1) Cooling currently accounts for around 5 % of the EU's final energy demand for heating & cooling
- 2) Space cooling demand is expected to increase significantly in the EU and globally
- 3) Currently space cooling demand is mainly provided by electricity-driven vapour compression systems, however several low-carbon cooling technologies based on renewable sources are available
- 4) For electricity-driven vapour compression cooling systems, the main strategies towards low-carbon cooling are to increase the efficiency of the cooling system and maximizing the share of renewable electricity
- 5) For cooling systems driven by heat, the main strategies towards low-carbon cooling are to increase the efficiency of the cooling system and maximizing the share of renewable heat
- 6) Free cooling systems using natural heat sinks can reduce CO<sub>2</sub> emissions for space cooling
- 7) Currently there is no common definition of renewable cooling and cooling is not included in EU energy statistics

# Thank you for your attention!

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