



Mission 'Energy Efficiency'

German-Philippine Chamber of Commerce and Industry

06 May to 10 May 2019

Status: May 2019



Company outline

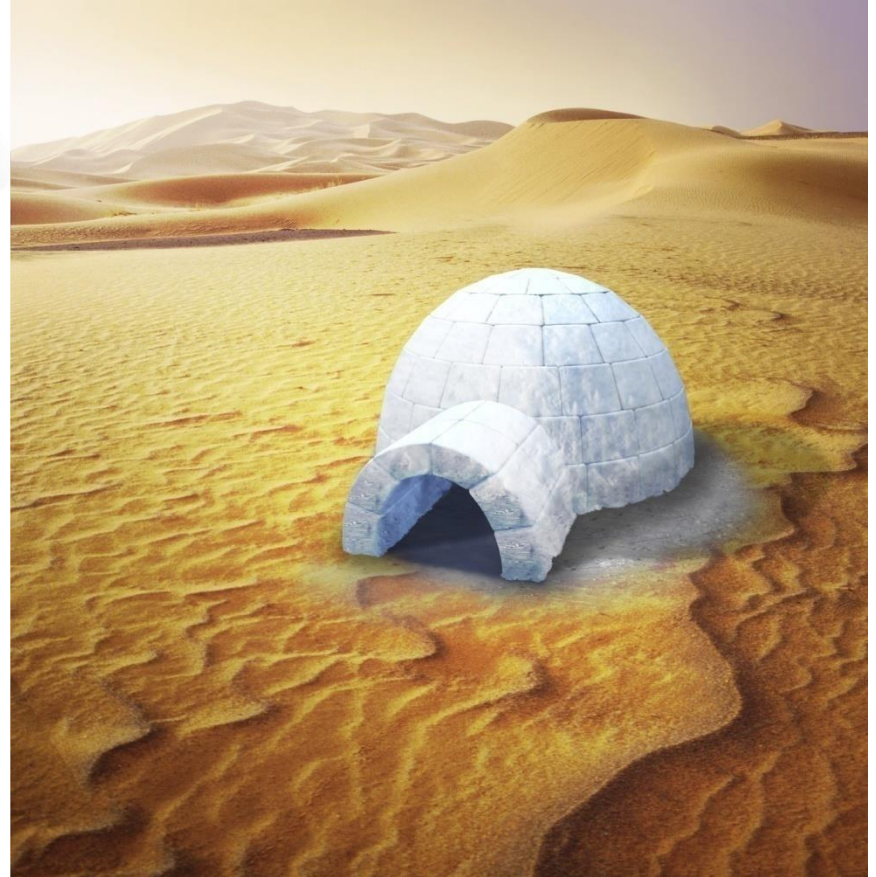
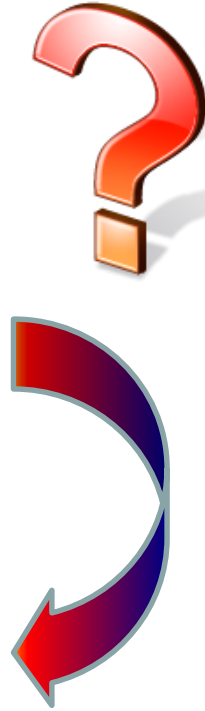
- 🌶️ Founded in 2000, Pioneer of the ‚Cooling Kit‘ solution
- 🌶️ Specialist for system solutions & systems integrator in the field of thermal cooling
- 🌶️ Design, engineering and sales as well as maintenance of thermal cooling solutions from 3 RT to 3.000 RT (10 kW to 10 MW) cooling capacity
- 🌶️ more than 100 systems realised worldwide
- 🌶️ ISO 9001 certified
- 🌶️ Continually awarded by the Stifterverband for R&D since 2014



Headquarter at Bernau am Chiemsee

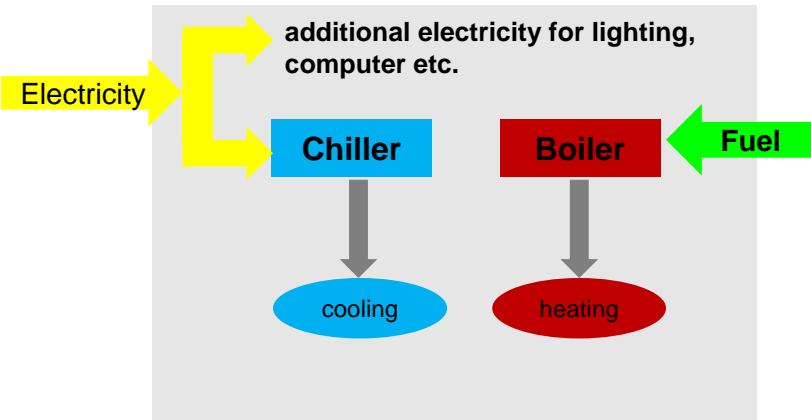


From **Heat** → **Cooling**

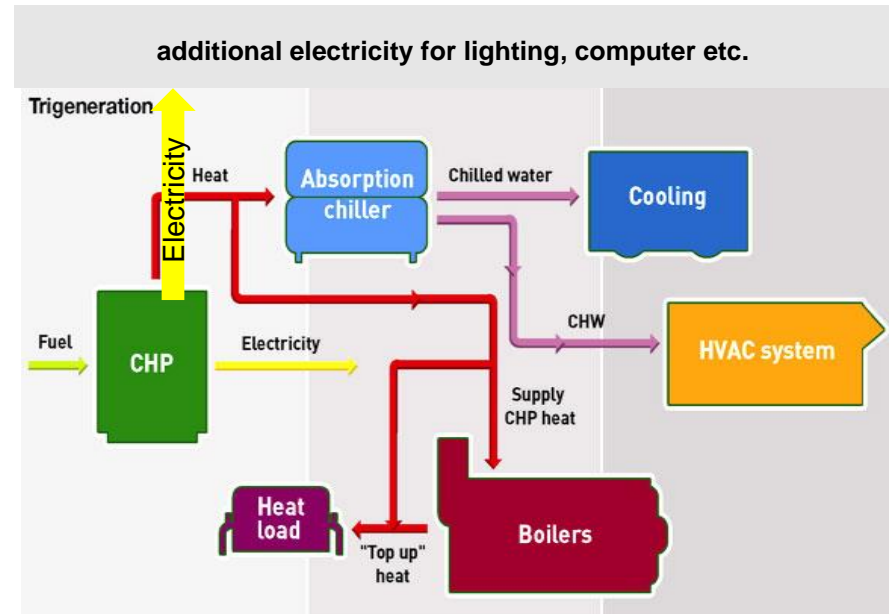


Advanced and climate friendly cooling solution

Traditional cooling solution



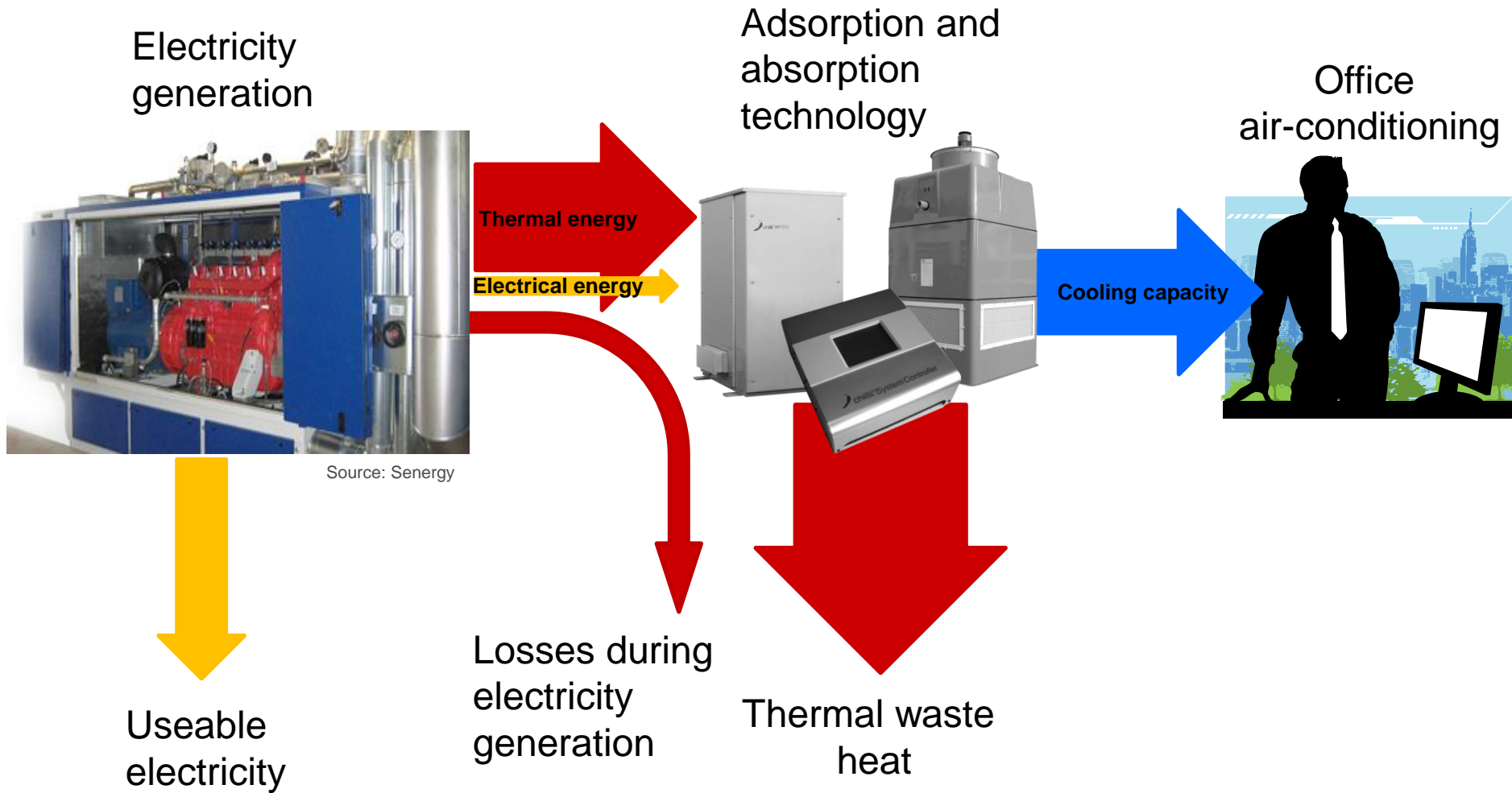
Advanced cooling solution



- Energy saving / energy efficiency
- CO₂ reduction
- Increase of operating hours of CHP unit
- Base load covered
- Reduction of electrical peak load



Thermally driven chillers – Energy flow diagram



Market trends & drivers

- 🌶️ The global market for Absorption Chillers is projected to exceed US\$ 1.1 billion by 2022, driven by the rising demand for energy efficient cooling systems in response to the urgent need to replace energy-guzzling compressor-based systems.
- 🌶️ The future growth in the market will be driven by the growing focus on energy saving against the background of increasing concerns over
 - uninhibited rise in energy consumption,
 - shortfalls in electricity supply,
 - rising electricity costs,
 - global warming and depletion of ozone layer.
- 🌶️ Kyoto Protocol implementation benefits the demands for solar & waste heat powered chillers
- 🌶️ Urbanisation: a mega trend spurring demand for air cooling & conditioning solutions



Advantages of absorption chillers compared to compressor-based cooling systems

- 🌶 less electricity consumption (> 75% of savings regarding electricity costs)
- 🌶 lower operating costs (because of very few mechanical components)
- 🌶 non-usage of refrigerants as CFCs and HCFCs for cooling that are typically associated with ozone layer damaging greenhouse gas emissions
- 🌶 lack of issues related to mechanical vibrations
- 🌶 stable coefficient of performance (COP)
- 🌶 easy maintenance and longer life time
- 🌶 environmental-friendly solution

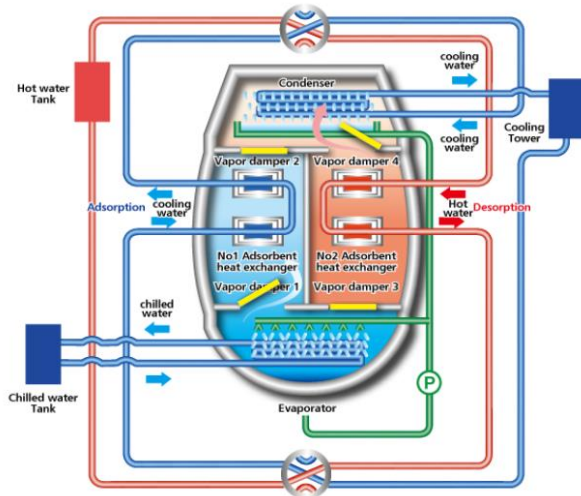


Basis of the **adsorption** and **absorption** chiller

	Adsorption chiller	Absorption chiller
Physical cooling effect	Evaporation of refrigerant (vapour compression cycle)	
Compression principle	Thermal (Adsorption of water vapour)	Thermal (Absorption cycle)
Driving energy	Thermal energy 55°C - 95°C	Thermal energy 70°C - 95°C
Refrigerant	Water with solid adsorbents (silica gel, zeolith)	Water with LiBr or NH3 as absorbents
Cooling capacity	8 kW - 500 kW (per module) 3 RT - 150 RT (per module)	18 kW - 5,000 kW (per module) 5 RT - 1,500 RT (per module)
Chilled water temperatures	+6°C to +20°C (flow temperature)	+4°C to +20°C (LiBr-chiller) -20° to +20°C (NH3-chiller)
COP (th)	0.5 - 0.65	0.65 - 0.85
COP (el)	8 - 10	10 - 20

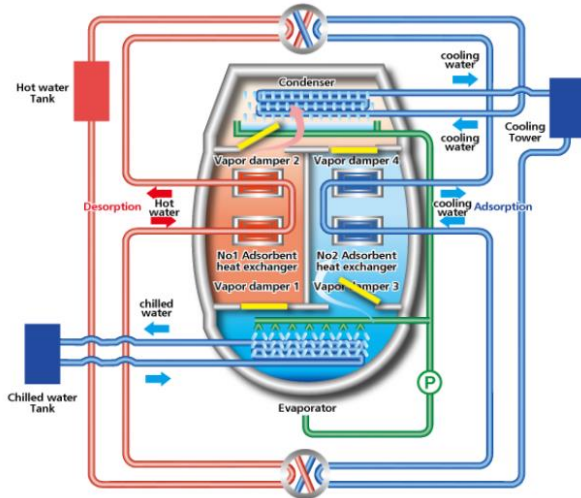


System principle of an **adsorption** chiller



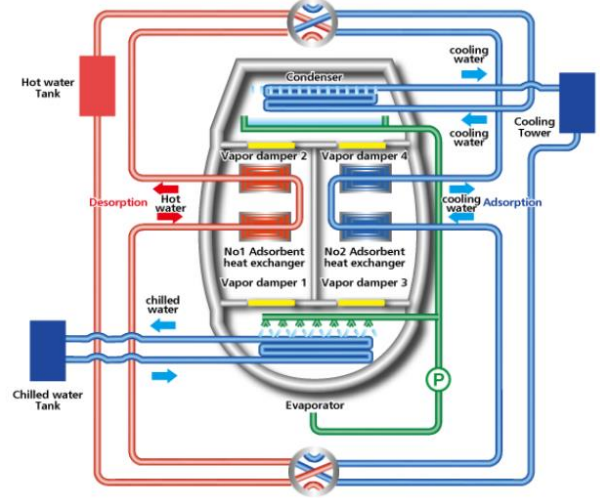
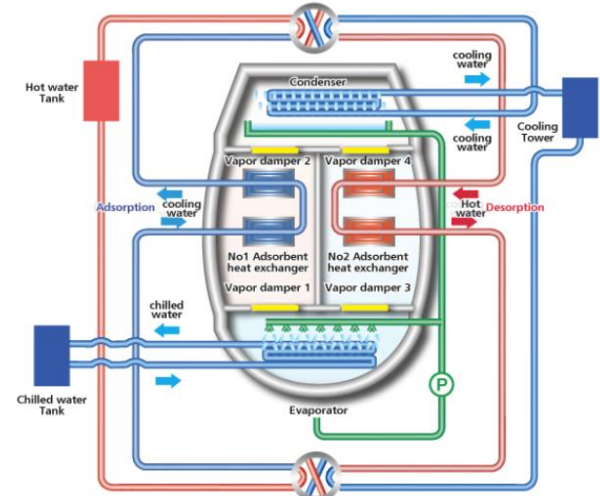
Chilled water is cooled by the vaporization heat when the water (refrigerant) which was sprayed to chilled water circulation tubes in the evaporator in the vacuum circumstance with evaporates. Vapor damper (1) or (3) opens by the pressure of the refrigerant vapor which occurred in the evaporator.

As adsorbent silica gel adsorbs the refrigerant vapor which produced in the evaporator. There are cooling water circulation tubes through adsorption heat exchanger units filled with silica gel to accelerate adsorb of refrigerant vapor.

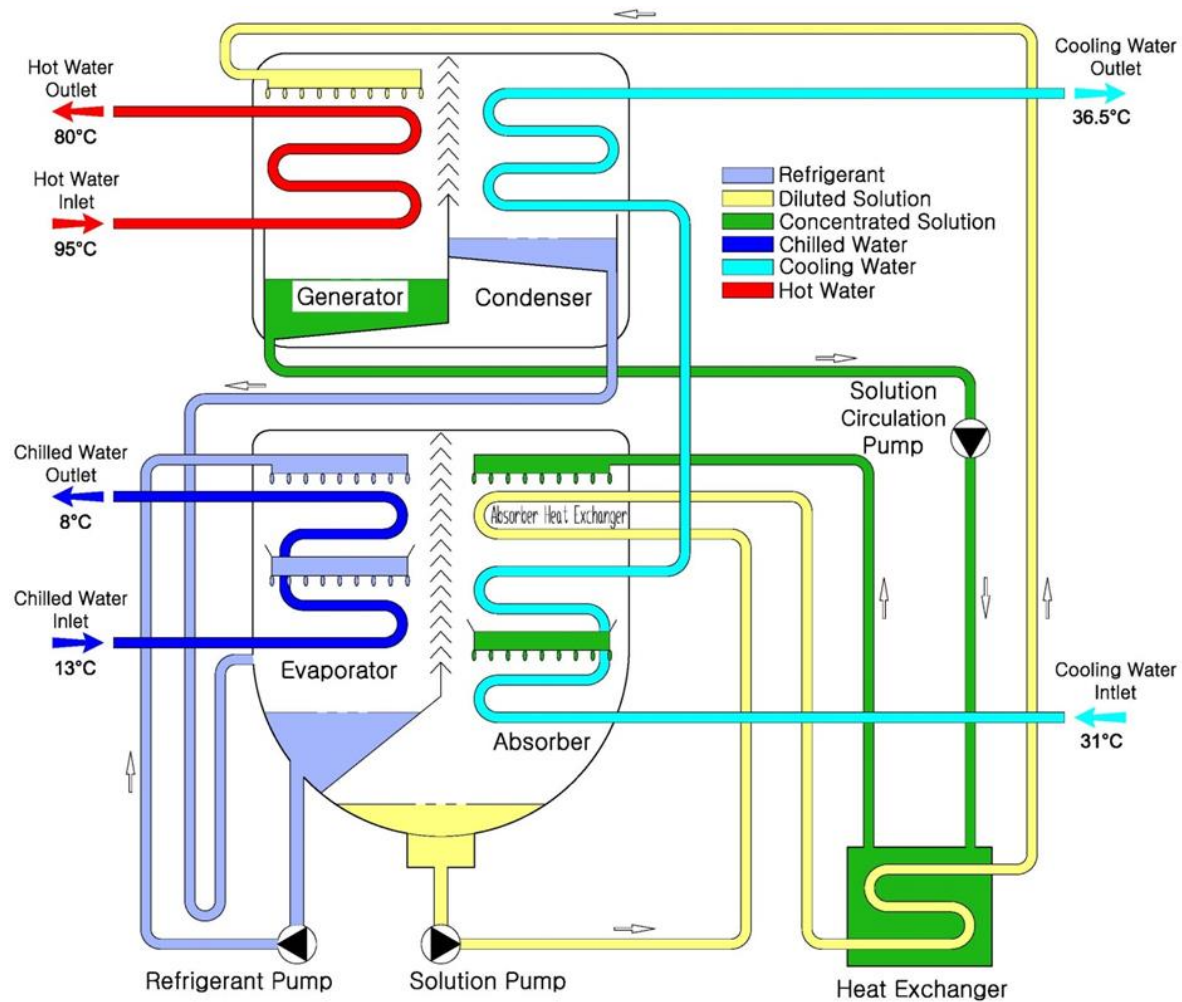


Hot water flows through the tubes of the adsorption heat exchanger that heats the silica gel. Heated silica gel makes a water (refrigerant) evaporate, and vapor damper (2) or (4) opens by its pressure.

The water vapor (refrigerant) created in the adsorption heat exchanger is cooled on the outside of the tubes that causes the water vapor to become the water. The water is transferred into the evaporator and can be used again for the evaporation.



System principle of a single-effect absorption chiller



Heat sources for sorption cooling

CHP - Cogeneration



Solar thermal system



Waste heat from compressed air

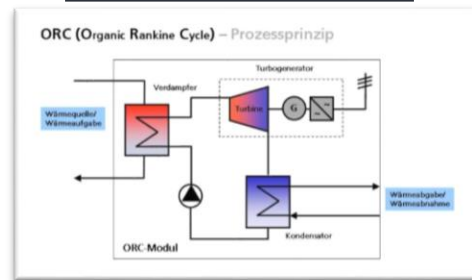


Process heat



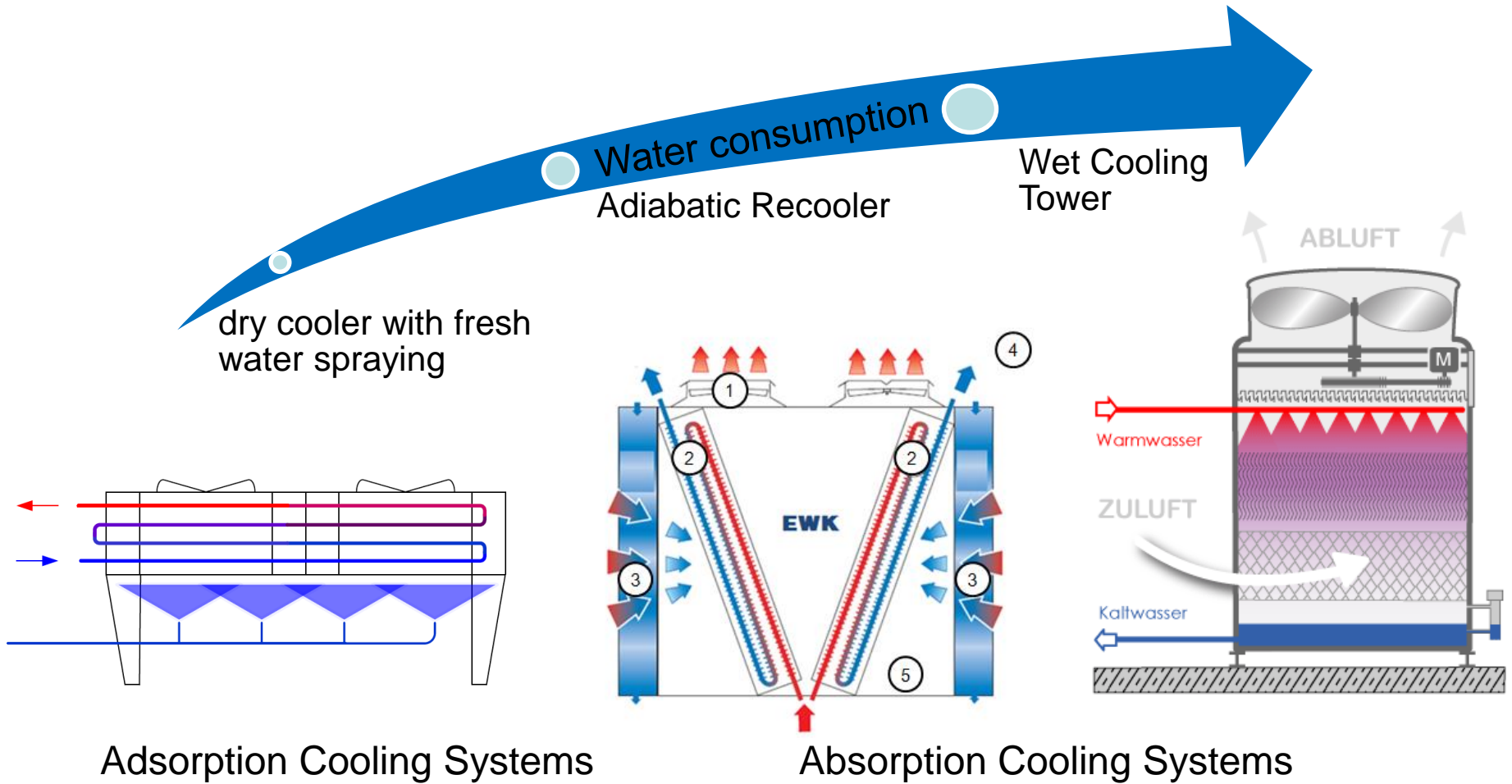
**Adsorption and
absorption technology**

ORC technology
Waste heat from condenser



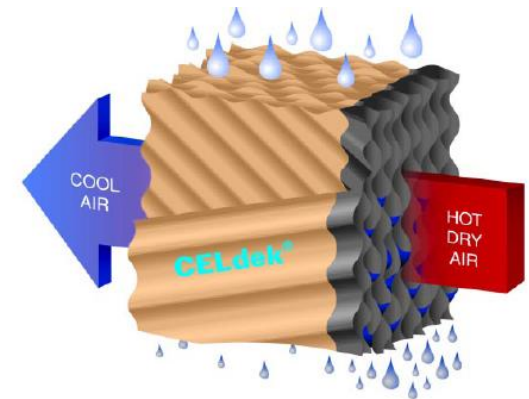
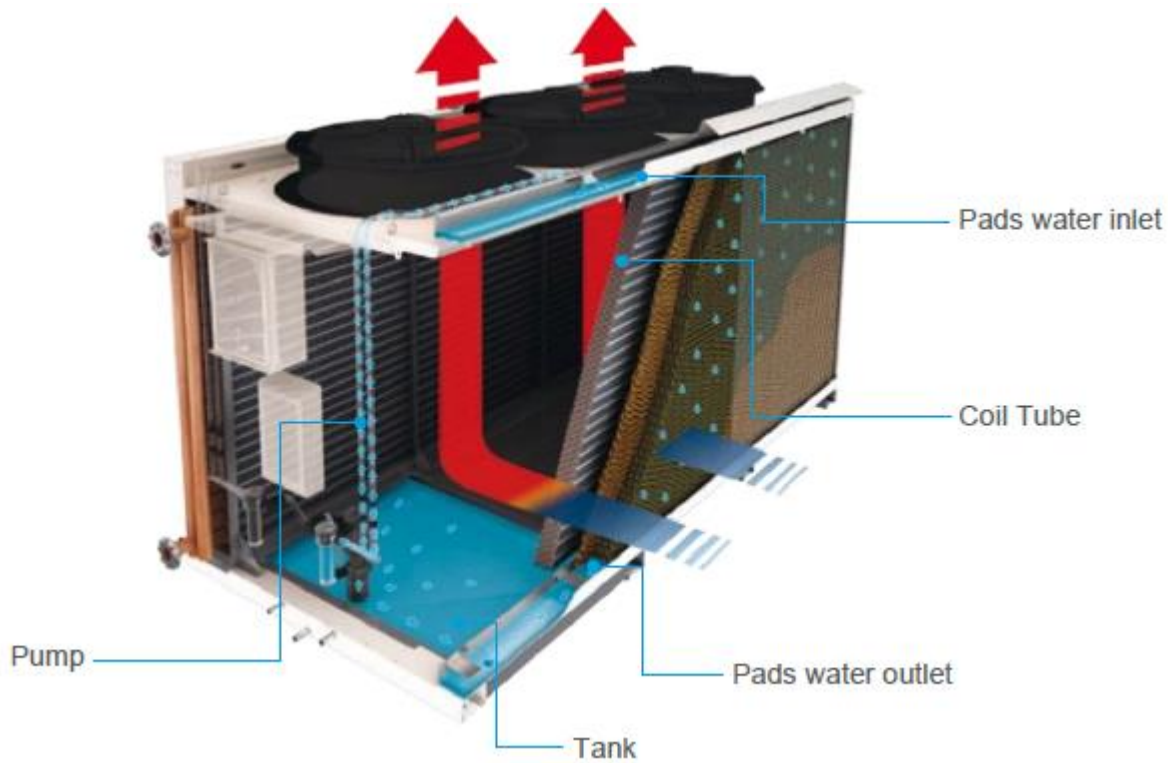


chillii® Cooling Kit – Suitable Heat Exchanger



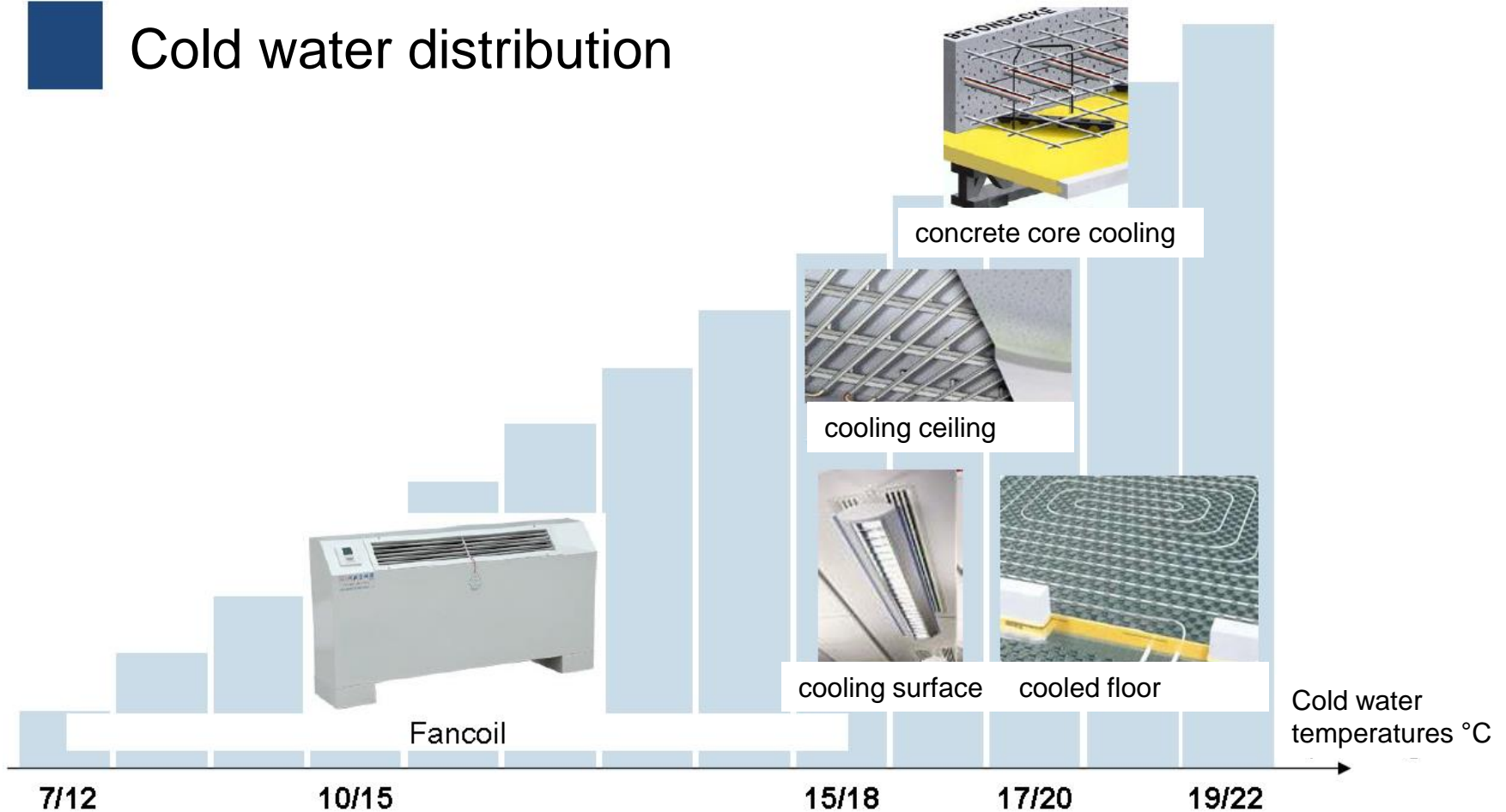


chillii® Cooling Kit – Adiabatic Recooling

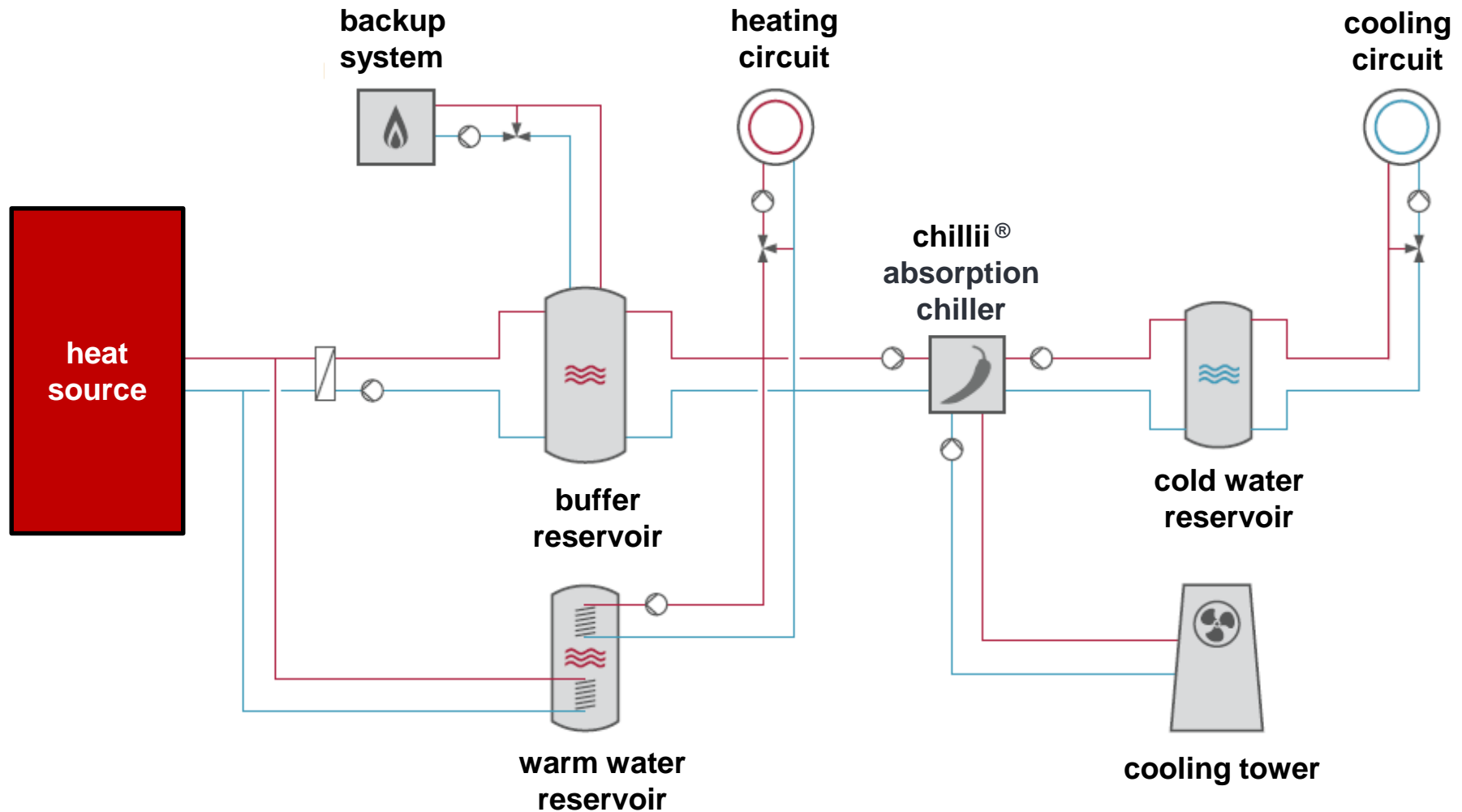


Ways of distributing chilled water

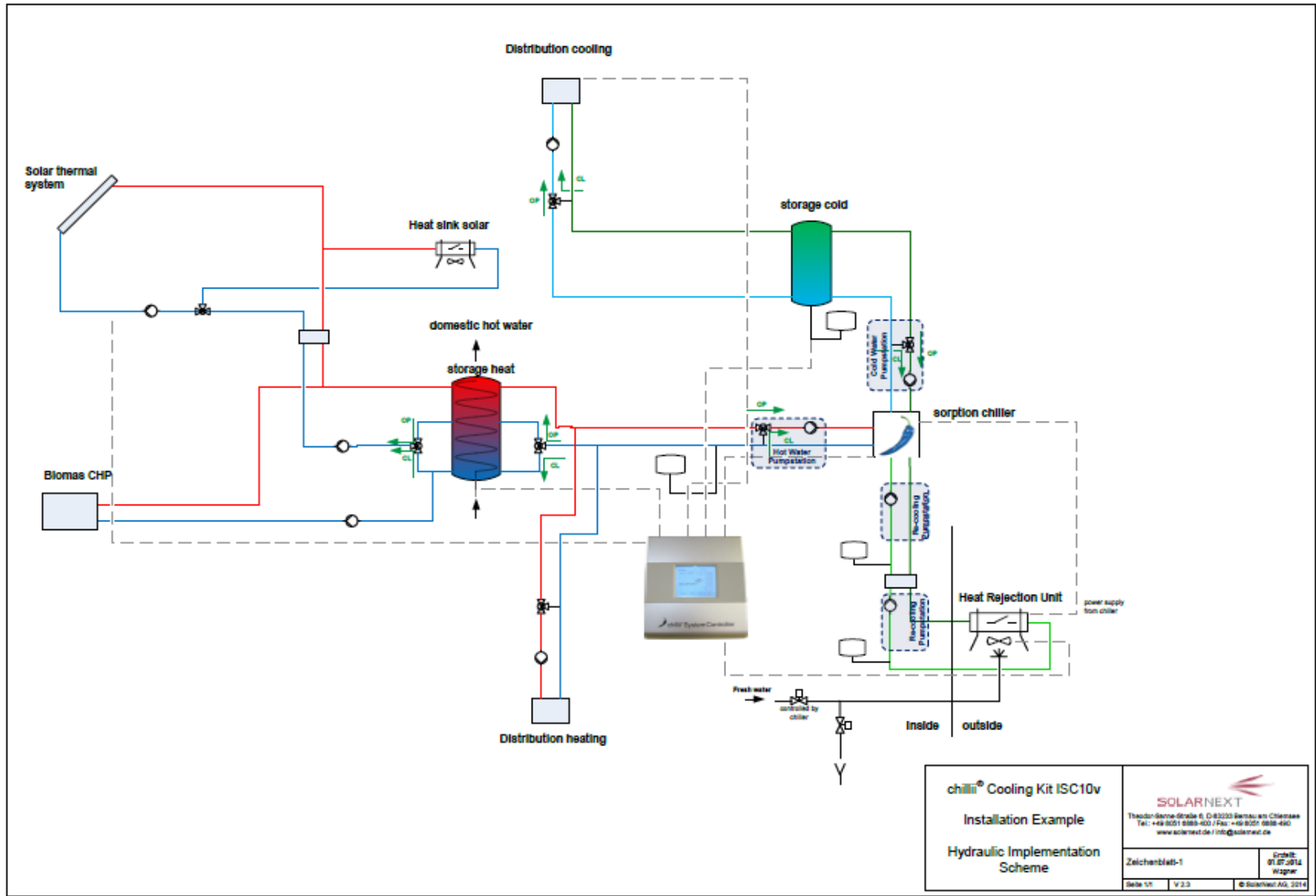
Cold water distribution



Installation Principle – Hydraulic System



Installation Example – Hydraulic System





Components of a chillii® Cooling Kit



Ad- or Absorption chiller



Re-cooling system



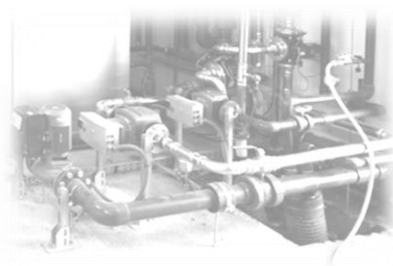
Optional: Cold and hot water storage



Pumps and mixer



System Controller and electric cabinet



Other components (e.g. temperature sensors)









chillii® Cooling Kits < 1 MW Cooling Capacity



Adsorption chillii® Cooling Kit

-  optimally harmonized system components
-  system solution for your application
-  ready-to-install solution
-  no layout and dimensioning required by customer

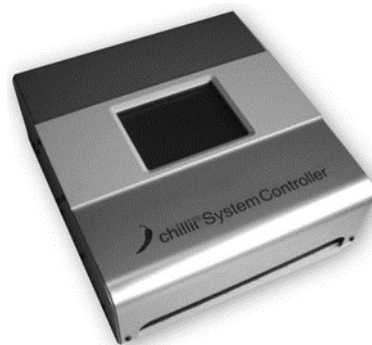
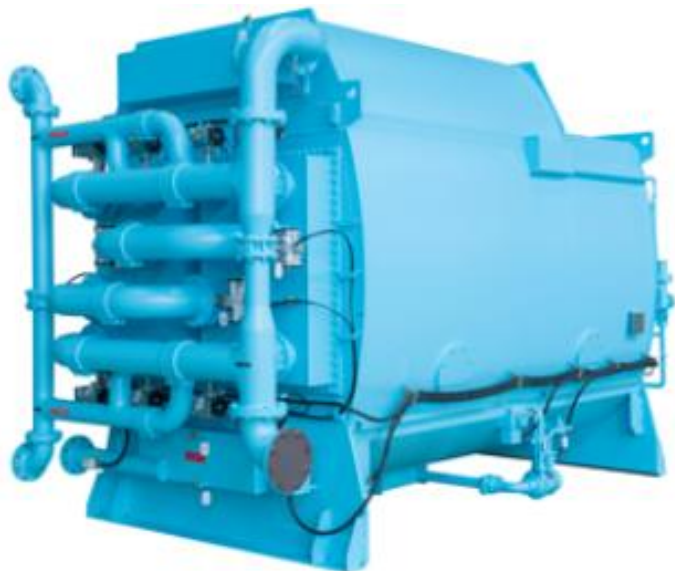


Absorption chillii® Cooling Kit









In future: chillii® Cooling Kits with adsorption chiller up to 600 kW Cooling Capacity



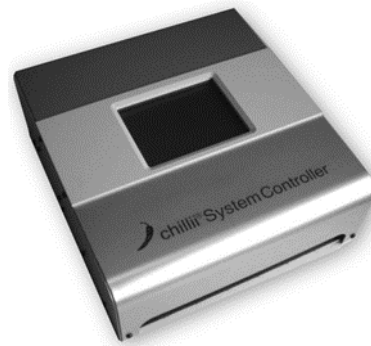
Adsorption chillii® Cooling Kit

-  optimally harmonized system components
-  system solution for your application
-  ready-to-install solution
-  no layout and dimensioning required by customer









chillii® Cooling Kits (water-fired chiller) > 1 MW Cooling Capacity



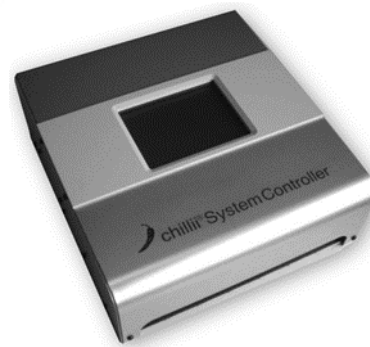
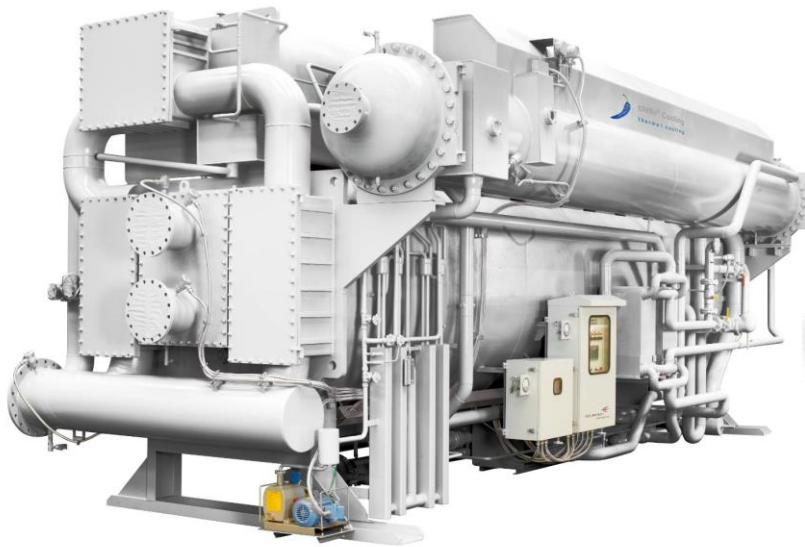
Absorption chillii® Cooling Kit

-  optimally harmonized system components
-  system solution for your application
-  ready-to-install solution
-  no layout and dimensioning required by customer









chillii® Cooling Kits (steam-fired chiller) > 1 MW Cooling Capacity



Absorption chillii® Cooling Kit

-  optimally harmonized system components
-  system solution for your application
-  ready-to-install solution
-  no layout and dimensioning required by customer









chillii® Cooling Kits (direct-fired chiller) > 1 MW Cooling Capacity



Absorption chillii® Cooling Kit

-  optimally harmonized system components
-  system solution for your application
-  ready-to-install solution
-  no layout and dimensioning required by customer





chillii® System Controller



- different heat sources
- back-up system for heat
- thermal cooling machine
- additional system for cooling
- heat and cold air reservoir management
- domestic water heating
- heat rejection system
- heating and cooling circuit



chillii® System Controller – State of the Art

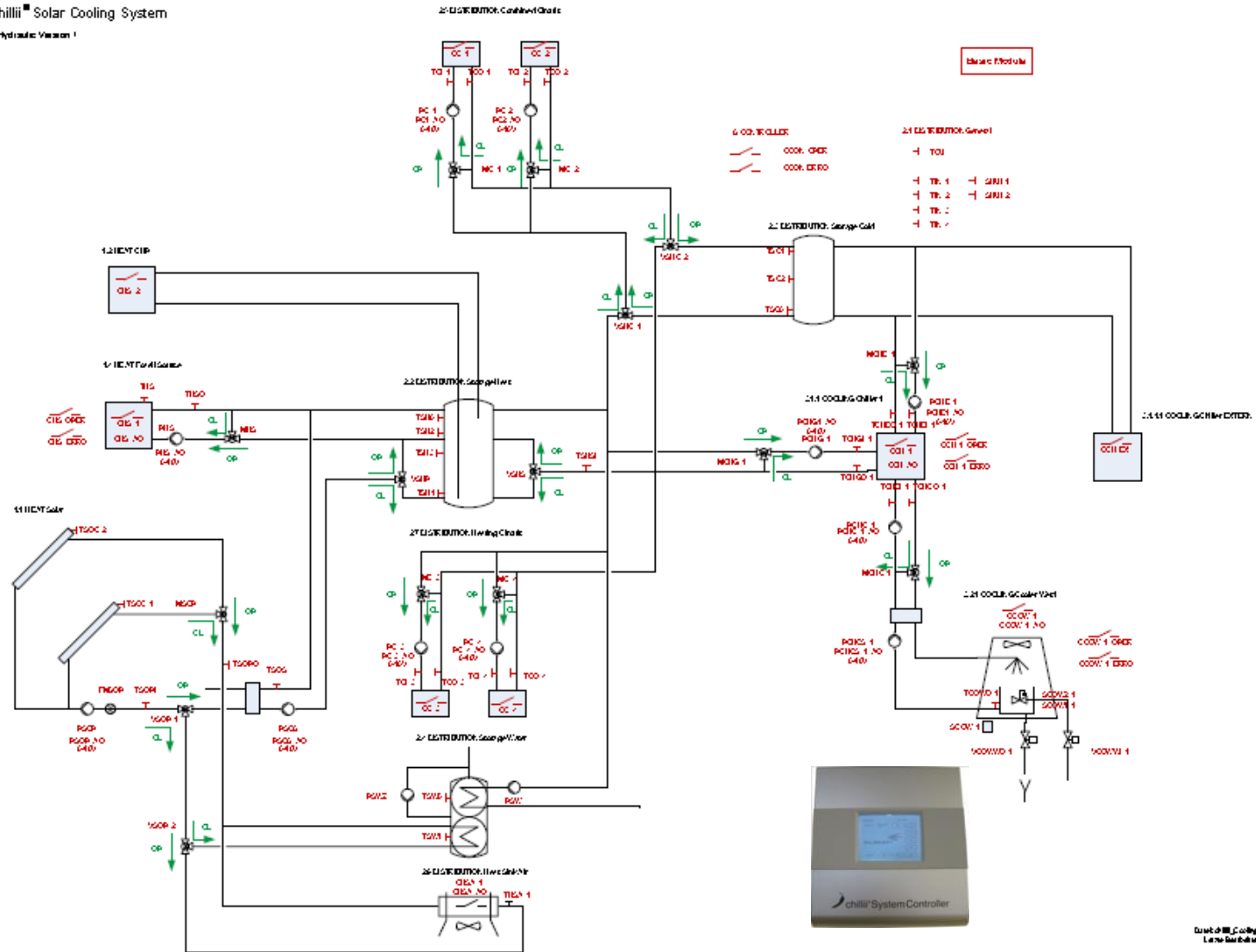


- 🌶️ system adaptation by parameterisation
- 🌶️ multi user levels
- 🌶️ data logging
- 🌶️ remote access
- 🌶️ remote maintenance
- 🌶️ external interface (GLT integration)



Installation principle – Hydraulic / sensor

chillii[®] Solar Cooling System
Hydraulic Version I



chillii® System Controller – Output data logging to SD card

Log file:

- 🌶 Measurements are saved on the **SD card**. (**csv format**)
- 🌶 **Data can be imported** into spreadsheets (e.g.: Microsoft Excel)
- 🌶 Actively switching the data logger → permanent recording
- 🌶 **Measurement time frame** (adjusted by the operator) of one day (e.g. 7 a.m. to 11 p.m.)
- 🌶 **Measurement interval** individually selected (starting from: 1.5 s → e.g. 60 min.).
- 🌶 Recording of **instantaneous values**.
- 🌶 Data points with **date and time** recorded
- 🌶 **Fixed range** of relevant **measurement and operational data**.

Excerpt of possible measurements:

Temperatures:	Hot water storage as a buffer	4 volume flows
	Cold water storage as a buffer	Pump output
	Inlet and outlet flow of cooling unit	Solar thermal collector
	Inlet and outlet flow of unit circuit	

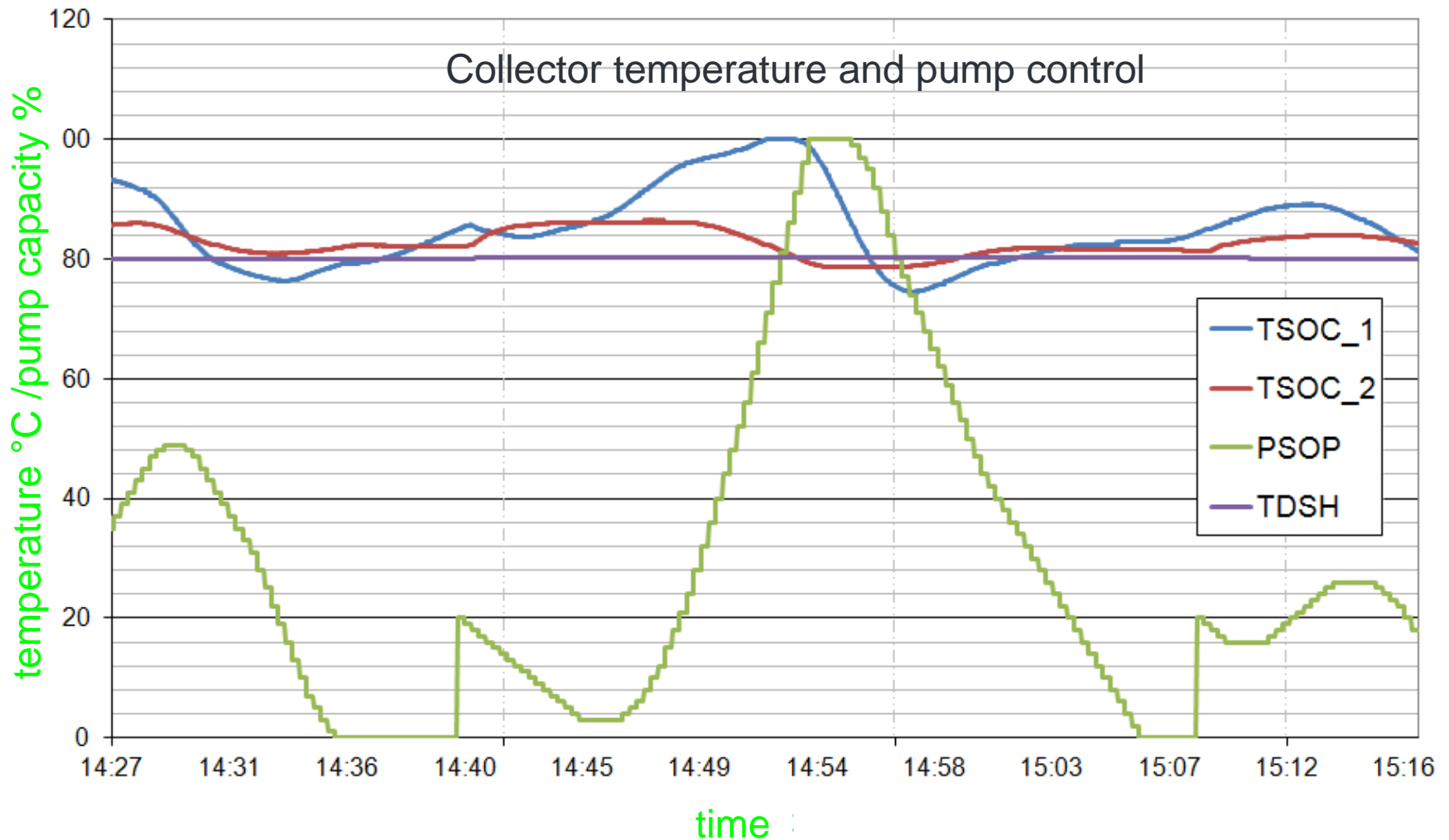


Imported and formatted log file

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G516 77,3										
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522	13.07.2011	14:40:39	85,5	82	19	61,3	77,1	69,4	10	1



Representation over a period of time (example time frame)





chillii[®] Cooling Kit
thermal cooling

Conclusion



Advantages of Sorption Cooling

Active Climate Protection

- 🌶️ Energy saving / increased energy efficiency
- 🌶️ Strong CO₂-reduction
- 🌶️ Reduction of the Global Warming Potential (GWP) by 99,9 %
no toxic and environmental unfriendly refrigerants
➡️ **instead:**
water as refrigerant

Cost savings

- 🌶️ Reduction of electricity consumption and energy costs (Ø 75% less electrical power consumption compared to compression cooling)
- 🌶️ Increased autonomy regarding energy suppliers
- 🌶️ No peak shaving
- 🌶️ Lifetime extension of CHP
- 🌶️ Less maintenance costs
- 🌶️ Significant reduction of total costs



Cost savings with a simultaneous improvement of the eco-balance





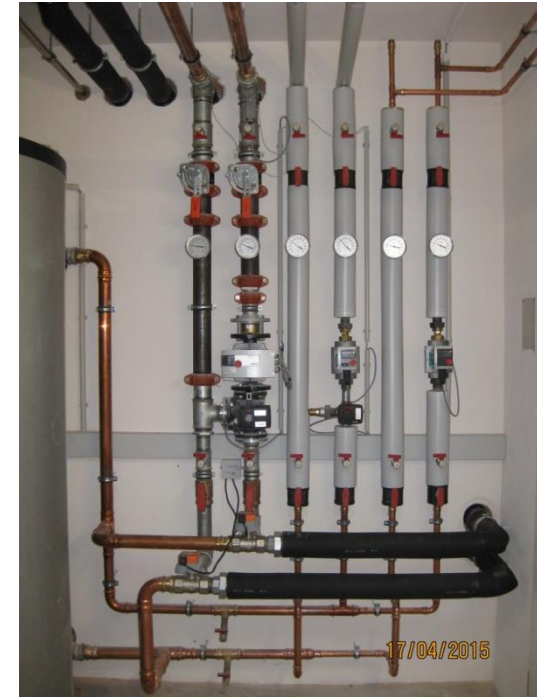
chillii[®] Cooling Kit
thermal cooling

Excerpt of References









chillii® Cooling Kit WFC35

Air-conditioning of an office building, Bavaria, 2014



chillii® Cooling Kit WFC35

-  Energy source: industrial waste heat
-  Absorption chiller: **chillii® WFC35** (water / lithium bromide), 35 kW nominal capacity
-  Wet cooling tower with performance control and automatic draining in danger of frost
-  Cooling distribution by underfloor cooling and floor convectors
-  High-efficiency circulating pumps, energy label A
-  System controlled by superior control unit: **chillii® System Controller**



chillii® Cooling Kit WFC175

Process Cooling of a factory, Baden Wuerttemberg, 2019

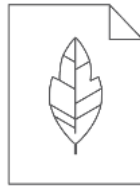
TIBERINA-Group

WAGON AUTOMOTIVE



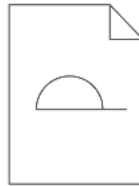
Quality

ISO 9001 / ISO TS 16949



Environment

ISO 14001



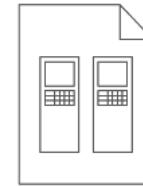
**Health and
Safety**

BS OHSAS 18001



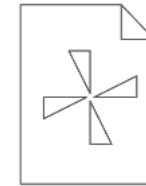
**Ethic and Social
Responsibility**

SA 8000



**Information
Security**

ISO IEC 27001








**Energy /
Management**

ISO 50001

Source: TIBERINA Group

chillii® Cooling Kit WFC175

-  Energy source: combined heat and power unit (CHP) + heat from air compressors
-  Chiller: **chillii® WFC175** (water / lithium bromide), 175 kW nominal capacity
-  Adiabatic recooling unit with performance control
-  High-efficiency and energy saving circulating pumps, energy label A
-  System controlled by the **chillii® System Controller**



chillii® Cooling Kit WFC175

Process Cooling of a factory, Baden Wuerttemberg, 2019



chillii® Cooling Kit WFC175

Process Cooling of a factory, Baden Wuerttemberg, 2017








Source: CERATIZIT



Source: CERATIZIT

2 chillii® Cooling Kit WFC175

-  Energy source: combined heat and power unit (CHP)
-  Chiller: **2 chillii® WFC175** (water / lithium bromide), 350 kW nominal capacity
-  Adiabatic recooling units with performance control
-  High-efficiency and energy saving circulating pumps, energy label A
-  System controlled by the **chillii® System Controller**



chillii® Cooling Kit WFC175

Process Cooling of a factory, Baden Wuerttemberg, 2017



chillii® Cooling Kit WFC175adb + WFC70adb

Air-conditioning of server rooms, Saxony-Anhalt, 2014








Source: ORWO Net AG



Source: ORWO Net AG

chillii® Cooling Kit WFC175adb + chillii® Cooling Kit WFC70adb

-  Energy source: combined heat and power unit (CHP)
-  Chiller: **chillii® WFC175** (water/lithium bromide) + **chillii® WFC70** (water/lithium bromide), 245 kW nominal capacity
-  Heat rejection unit with adiabatic and speed controlled EC-motors
-  High-efficiency circulating pumps, energy label A
-  System controlled by the **chillii® System Controller**



chillii® Cooling Kit WFC175adb + WFC70adb

Air-conditioning of server rooms, Saxony-Anhalt, 2014



chillii® Cooling Kit WFC175

Process cooling and air-conditioning of a factory, Thuringia, 2012








Source: VELUX



Source: VELUX

2 chillii® Cooling Kit WFC175

-  Energy source: process heat (by usage of industrial waste)
-  Chiller: **2 chillii® WFC175** (water / lithium bromide), 350 kW nominal capacity
-  Wet cooling tower with performance control and automatic draining in danger of frost
-  High-efficiency and energy saving circulating pumps, energy label A
-  System controlled by the **chillii® System Controller**



chillii® Cooling Kit WFC175






Process cooling and air-conditioning of a factory, Thuringia, 2012



chillii® Cooling Kit WFC70

Air-conditioning of a turkey production farm, Lower Saxony, 2012





-  Energy source: biogas CHP unit
-  Absorption chiller **chillii® WFC70** (water / lithium bromide), 70 kW nominal capacity
-  Chilled water storage: 8.000 l
-  Wet cooling tower with performance control and automatic draining in danger of frost
-  Chilled water distribution by a ventilation system



chillii® Cooling Kit WFC70

Air-conditioning of a turkey production farm, Lower Saxony, 2012









-  High efficiency and energy saving pumps
-  System controlled by the **chillii® System Controller**



chillii® Cooling Kit STC15

Cooling of a paper production machine, Switzerland, 2011










-  **chillii® Cooling Kit STC15wet**
-  Energy source: waste heat of a paper machine
-  Adsorption chiller **chillii® STC15** (water / silica gel), 15 kW nominal capacity
-  Wet cooling tower with performance control and automatic draining in danger of frost
-  Cooling water distribution by the existing ventilation system by means of a water/air heat exchanger
-  System controlled by superior control unit: **chillii® System Controller**



chillii® Cooling Kit WFC35 Air-conditioning of a factory, Bavaria, 2012



-  **chillii® Cooling Kit WFC35**
-  Energy source: industrial waste heat
-  Absorption chiller: **chillii® WFC35** (water / lithium bromide), 35 kW nominal capacity
-  Wet cooling tower with performance control and automatic draining in danger of frost
-  Chilled water distribution by cooling ceilings
-  High-efficiency circulating pumps, energy label A
-  System controlled by superior control unit: **chillii® System Controller**









chillii® Cooling Kit WFC18

Solar cooling system in a showroom, Mexico, 2010



chillii® Cooling Kit WFC18

-  Energy source: solar thermal collectors
-  Absorption chiller: **chillii® WFC18** (water / lithium bromide), 18 kW nominal capacity
-  Wet cooling tower with performance control and automatic draining in danger of frost.
-  Vacuum tube collectors
-  Cold water distribution by a ventilation system
-  System controlled by superior control unit: **chillii® System Controller**











chillii® Cooling Kit WFC18

Air-conditioning of a children's hospital, Kabul, Afghanistan, 2010



chillii® Cooling Kit WFC18

-  Energy source: solar thermal collectors
-  Absorption chiller **chillii® WFC18** (water / lithium bromide), 18 kW nominal capacity
-  Cold water storage: 5.000 l, hot water storage: 20.000 l, domestic hot water: 500 l
-  Wet cooling tower with performance control and automatic draining in danger of frost.
-  350 m² flat plate collectors
-  Heating and cooling water distribution through heating and cooling ceilings
-  High-efficiency circulating pumps, energy label A
-  System controlled by superior control unit: **chillii® System Controller**

Source: SolarNext









chillii® Cooling Kit ISC10

Solar cooling system in a public library, Australia, 2010



chillii® Cooling Kit ISC10

-  Energy source: solar thermal collectors
-  Adsorption chiller **chillii® ISC10** (water / zeolite), 10 kW nominal capacity
-  Dry heat rejection unit with speed controlled EC-motors and water sprinkling system
-  Cooling water distribution by ventilation system
-  High-efficiency circulating pumps, energy label A
-  System controlled by superior control unit: **chillii® System Controller**





chillii® Cooling Kit
thermal cooling

Thank you for your attention

Frank Molter (CEO)

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