This project has received funding from the European Union's H2020 Coordination Support Action under Grant Agreement No. 894356.

<table>
<tr><td>Best Practice</td><td>LOWER CONDENSING TEMPERATURE RAISE OF EVAPORATION TEMPERATURE</td><td>COOL-03</td></tr>
<tr><td>Application</td><td colspan="2">Cooling system</td></tr>
<tr><td>SME sector</td><td colspan="2">Industrial: food industry, refrigeration, cold storage</td></tr>
<tr><td>SME Sub-sector</td><td colspan="2">Breweries</td></tr>
<tr><td>Technical description</td><td colspan="2">The evaporation temperature and condensation temperature define the COP of the chiller. Therefore, they have a great impact on the efficiency of the cooling system. However, these parameters are often poorly set and offer savings potential

Common cooling, evaporating and condensing temperatures
<table><tr><th></th><th>Cooling temperatures</th><th>Evaporating temperatures</th><th>Condensing temperatures</th></tr><tr><td>Air conditioning</td><td>+15°C</td><td>+5°C</td><td>30-45°C</td></tr><tr><td>Chilling</td><td>15°C</td><td>-5°C</td><td>30-45°C</td></tr><tr><td>Medium temperature refrigeration</td><td>0°C</td><td>-10°C</td><td>30-45°C</td></tr><tr><td>Low temperature refrigeration</td><td>-20°C</td><td>-30°C</td><td>30-45°C</td></tr><tr><td>Quick-freezing</td><td>-35°C to -45°C</td><td><-45°C</td><td>30-45°C</td></tr></table></td></tr>
<tr><td>Recommendation for optimisation</td><td colspan="2">• Raise of evaporation temperature
Check if evaporating temperatures are set as high as possible for the different applications:
If applications with different temperature levels are supplied with the same cooling circuit, the lowest cooling temperature defines the needed evaporation temperature. However, this is not advisable as different temperature levels should be supplied via different circuits.
Evaporation temperature can be raised by avoiding unfavourable circulation of air in the room due to stacked goods blocking the air flow. Heat exchangers need to be cleaned and bent lamella should be straightened. Damaged ventilators or blades should be repaired. Correct settings of the expansion valve determine the super-heating and should also be checked.
A raised evaporation temperature implies an increase in the suction pressure and thus increases the efficiency of the compressor. This leads to an increase in cooling capacity that needs to be controlled.

• Lower condensing temperature
If a system works at a fixed minimum condensation temperature of 40-45°C, it is necessary to control the condensation temperature adjustments. The nominal value can probably be reduced. Although the system operates at a variable condensation temperature, a minimum value is often set, below which the temperature does not</td></tr>
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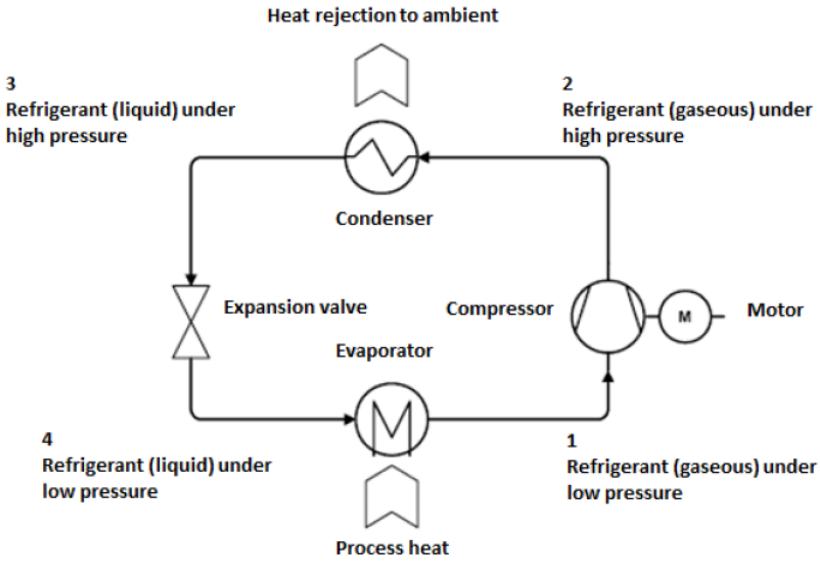
	fall, despite the lowering of the ambient temperature. In these cases, a reduction may also be possible. Ensure that other important parameters, such as minimum head pressure required by some technologies (expansion devices, hot gas defrost etc.) are still met. The design of old heat exchangers is often too small resulting in higher temperature differences. Dirt on the heat exchanger/damaged ventilation leads to a decreased heat transfer and should be removed/repaired. Unfavourable location of heat exchangers can lead to an inlet temperature of the air above the ambient temperature. A heat exchanger should not be located too close to a wall or near other heat exchangers. Also, the housing needs to fit closely to prevent air from re-circulating around the condenser. Since the pressure is below the ambient pressure in the parts of the cooling system, non-condensable gases can enter the cooling system. These gases accumulate in the heat exchangers and unnecessarily raise the pressure. In that case venting of the system is needed.
Relevant technical considerations	The unfavorable location of heat exchangers can lead to an air inlet temperature higher than the ambient temperature. A heat exchanger should not be placed too close to a wall or near other heat exchangers. In addition, the housing must be mounted in close contact to avoid recirculation of air around the condenser.
Schemes and diagrams	 Refrigeration cycle diagram
Economics	Several factors affect investment costs, and a case-by-case assessment is necessary.
Energy savings	Up to 3% per Kelvin in increased evaporating temperature Up to 3% per Kelvin in lowered condensing temperature

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Economic savings	The economic savings are closely linked to the reduction of electricity used to power the cooling system.
Average Payback Time	The payback time for an increase in set-point functions is a few months.
Emissions	Emissions depend on the characteristics of the refrigerant gas.
Environmental benefits	Environmental Benefits through the reduction of CO_2 emissions.
Main NEBs (Multiple benefits)	☒ Environmental benefits ☐ Increased productivity ☐ Work environment/ Health/Safety ☐ Increased competitiveness ☐ Maintenance
Replicability	Medium
Related measures	• COOL-01: Cooling load reduction and free cooling • COOL-02: Compression control • COOL-04: Efficient fans and regulation • COOL-05: Loss reduction • COOL-06: Heat recovery
Case study	Raise of evaporation temperature, "B&R Industrial Automation GmbH" (Austria, 2016) • Initial Situation: 7 chillers are in operation at the Eggelsberg production site. The cooling capacity is controlled based on the ambient temperature. The plant is used to provide cold to conditioned environments and process cooling. The waste heat is dispersed in the room (a heat pump uses part of the waste heat). Different circuits are used for the conditioning of the rooms and for the cooling of the production process. The nominal temperature of the cooling circuits was 9°C and 6°C respectively • Description of the optimisation: the intervention was carried out due to the obligations imposed by the law for energy efficiency. The temperature of the primary circuit has been increased by 1°C, which directly implies an increase of 1°C in the evaporation temperature as well. The optimization yields energy savings of about 3%. • Implementation costs: not available • Payback Time: few months

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References	Kulterer, K., Mair, O., Horvath, C.: Leitfaden für Energieaudits in Kältesystemen, klimaaktiv energieeffiziente betriebe, Vienna 2017

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