



Best Practice	HEAT RECOVERY	COOL-06
Application	Cooling System	
SME sector	Industrial	
SME Sub-sector	All	
Technical description	Cooling systems produce waste heat that, normally, is rejected to the environment. However, if there is a heat demand elsewhere during operation, the waste heat can be put to use. The recovered heat can be used in different applications as hot water production for food processing, process heat, heating of service water or space heating.	
Recommendation for optimisation	<p>Before the implementation of a waste heat recovery unit (WHRU) is considered, all relevant temperatures have to be checked (e.g., temperature of freshwater, reflux temperature of heating system, etc.). A WHRU is especially suitable for cases where the waste heat is needed during the whole year, e.g., heating of process water. Another example is the dehumidification of air, where the air is first cooled and then heated again. The recovered heat from the cooling system (temperature 40°C) is enough to reheat the air up to 20°C, if a correctly sized heat exchanger is used.</p> <p>There are two different ways of heat recovery: low- and high-grade heat recovery</p> <ul style="list-style-type: none"> • Low grade heat recovery uses the heat at a temperature level below the condensing temperature (25-35°C). The low-grade heat comes from condensing the refrigerant. Therefore, the total waste heat of the refrigeration plant (heat extracted from cooled product/stream + electrical power used by compressor) can be used. The heat can be raised to a higher level with the use of a heat pump, if required. • High grade heat recovery comes from de-superheating the refrigerant. This heat is recovered at a temperature level of 70-80°C. However, only around 15% of the total rejected heat can be recovered as high-grade heat. <p>When retrofitting a WHRU to an existing cooling system, the amount of heat recovered can be up to 30% of the cooling capacity. In newly constructed plants, up to 100% of the waste heat can be recovered.</p>	
Technical considerations	<p>Indications for this measure include:</p> <ul style="list-style-type: none"> • Electrical power of compressor is above 3kW • Heat demand during refrigeration process • Condensing temperature high enough for desired application 	



Schemes and diagrams	<p style="text-align: center;">Heat rejection to ambient</p> <p style="text-align: center;">Sketch of a basic cooling system</p>	
Economics	Unit cost of a heat recovery system: approx. 500-1,000 EUR	
Energy savings	Up to 85% of the thermal energy can be easily used for other operations. Energy losses such as those caused by venting heated air to the outside are avoided. Heat recovery results in energy savings.	
Economic savings	Economic savings due to reductions in electricity demand (up to 85% of thermal energy).	
Average Payback Time	3-6 years	
Emissions	This measure does not involve further emissions.	
Environmental benefits	Environmental benefits through the reduction of CO ₂ emissions. Environmental benefits result from less use of conventional ways of heat production, fossil fired boilers.	
Main NEBs (Multiple benefits)	<input checked="" type="checkbox"/> Environmental benefits <input type="checkbox"/> Increased productivity <input type="checkbox"/> Work environment/ Health/Safety <input checked="" type="checkbox"/> Increased competitiveness <input type="checkbox"/> Maintenance	The produced heat can be sold leading to an increased competitiveness.
Replicability	High	



Related measures	<ul style="list-style-type: none"> • COOL-01: Cooling load reduction and free cooling • COOL-02: Compression control • COOL-03: Lower condensing temperature - Raise of evaporation temperature • COOL-04: Efficient fans and control • COOL-05: Reduction of leakages
Case study	<p>Heat recovery, company "GMS Gourmet GmbH" (Austria, 2017)</p> <ul style="list-style-type: none"> • Initial Situation: the refrigerating capacity for the shock-chilling of packed food is provided by a cooling system consisting of three screw compressor units. The waste heat of the refrigerating system was rejected through a water-cooled secondary circuit. The hot process water needed for the production process was partly heated with steam. • Description of the optimisation: a waste heat recovering unit was retrofitted to the existing cooling system, making use of the heat from de-superheating and condensing of the refrigerant. The recovered heat is used for raising the temperature of the process water from about 18°C to 55°C. During full load it is possible to recover a thermal power of 110 kW which is transferred to the hot water system. An additional benefit comes from the load relief of the cooling water system, resulting in a reduction of the condensing temperature. The annual energy savings accumulate to 197,500 kWh. • Implementation costs: not available • Payback Time: not available
References	<p>Kulterer, K., Mair, O., Horvath, C.: Leitfaden für Energieaudits in Kältesystemen, klimaaktiv energieeffiziente betriebe, Vienna 2017</p> <p>Carbon Trust: Refrigeration systems, CTG046</p> <p>Carbon Trust: How to implement heat recovery in refrigeration, CTL056</p>

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