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

Best Practice	LEAK DETECTION AND REPAIR	STEA-05
Application	Steam systems	
SME sector	Processing and manufacturing industries	
SME Sub-sector	Food processing, paper, and cardboard manufacturing sectors, pharmaceutical, chemicals, distilleries, etc.	
Technical description	Steam is an expensive utility. Steam losses due to leakage might lead to a significant economic loss and can be as high as 19% of the total steam energy production costs (Swagelok Energy, 2014). Apart from that leak can also present a safety hazard. Steam leaks occur everywhere but most common in places such as flanges and joints, pipe fittings, valves, steam traps and pipe failures. The losses caused by even a small leak can be significant.	
Recommendation for optimisation	A continuous maintenance program based on finding and eliminating steam leaks is essential to the efficient operation of a steam system. This can be done, for example, by metering the steam as it leaves the boiler and when it arrives at its destination. A sudden increase in the difference between the measured values may indicate a leak. Apart from that leak can also be identified by the means of ultrasonic technology. Ultrasonic leak detectors translate the high frequency sound which is emitted by small leaks to a sound at lower frequencies which can be heard through headphones. Leaked steam flow can also be identified at the steam meter right after the boiler, during a period without steam identified consumers. Typically, the steam loss magnitude through a leak is difficult to determine. A gross estimate of the steam loss through an orifice can be provided by the Napier's choked flow equation: $m_{steam} = 0{,}695 \times A_{orifice} \times P_{steam}$ where: m_{steam} is the steam leakage flow rate (in kg/h), $A_{orifice}$ is the area of the orifice through which the steam is leaking (in mm2) P_{steam} is the header pressure (in bars absolute)	

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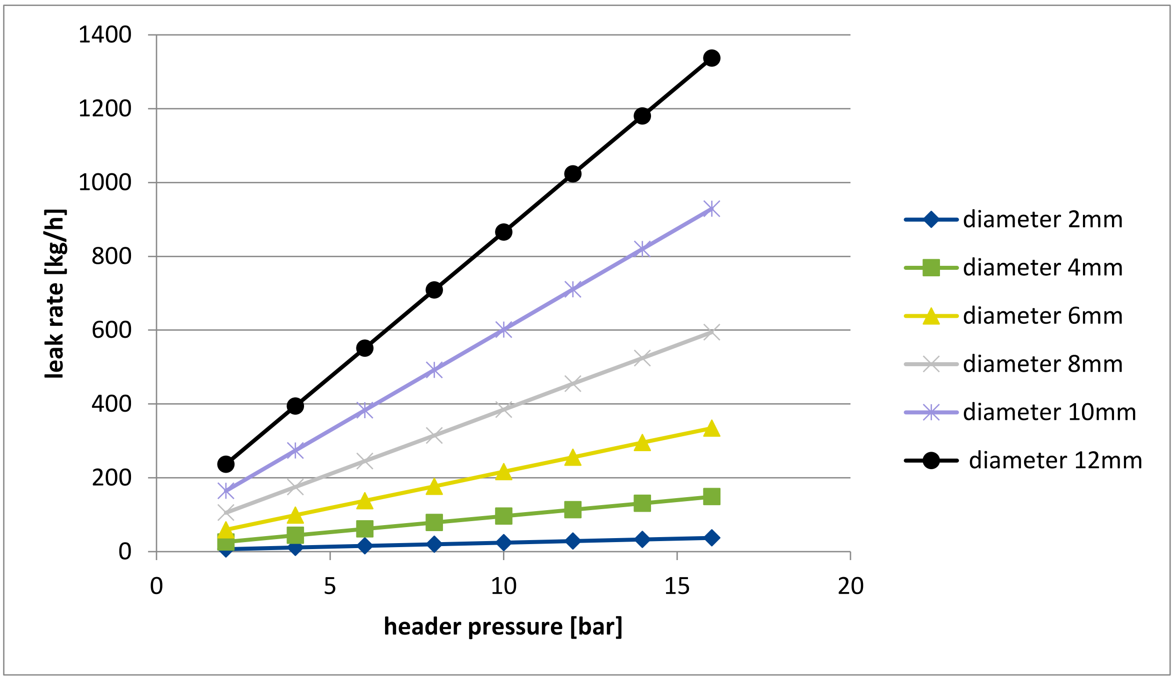
Schemes and diagrams	 Diagram rate of steam loss through a hole [source: CRES, ISNOVA] The figure shows the leakage rate calculated for holes of different diameters depending on the pressure in the head.
Economics	Most leakages can be corrected without high costs Equipment for detecting steam leaks: from 500 EUR
Energy savings	Lower consumption of fuels for steam production.
Economic savings	Up to 20% of the total costs of energy used for steam production
Average Payback Time	Less than 3 years
Emissions	Approx. 3,100 tCO_2/tonne of steam (the amount of CO_2 refers to the amount of steam produced)
Environmental benefits	Reduction of CO_2 and other substances such as SO_2 and NOx
Main NEBs (Multiple benefits)	☒ Environmental benefits ☐ Increased productivity ☒ Work environment/Health/Safety ☐ Increased competitiveness ☐ Maintenance In addition to the environmental benefits, resulting from the reduced energy required, repairing steam leaks also increases the safety of the staff working there.

Replicability	High
Related measures	• STEA-01: Reduction of energy demand
Case study	Gas leakage detection, food consortium (Italy, 2011) • Initial Situation: the leakage research, which was conducted for a consortium specialized in the direct production of tomatoes, had as its objective the technical-economic deepening of the site's steam service to improve the efficiency of the plant and reduce the natural gas consumption of the plant. To produce steam, natural gas consumption amounted to 9,478,780 Sm^3/year and dense oil of 56,830 kg/year, for a total cost of 2,495,600 EUR/year, which is equivalent to a steam production estimated at 112,0002 tons/year. • Description of the optimisation: 125 steam traps were inspected, and vapor leaks were detected on 38 of them (30%). In this case the steam traps work 1,400 hours/year (in the parts of the plant operating only during the campaign period) and 7,000 hours/year (for the other areas). • Implementation costs: not available • Payback Time: not available
References	Blessl and Kessler, 2017, Energieeffizienz in der Industrie, Springer Vieweg, DOI: 10.1007/978-3-662-55999-4 CRES, ISNOVA: STEAM UP WP4: TRAINING MATERIAL PREPARED BY CRES Kulterer, K.: klimaaktiv Leitfaden für Energieaudits in Dampfsystemen, Österreichische Energieagentur im Rahmen des Programms des Lebensministeriums, Wien X3Energy - Case history - More efficiency for the steam plant

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