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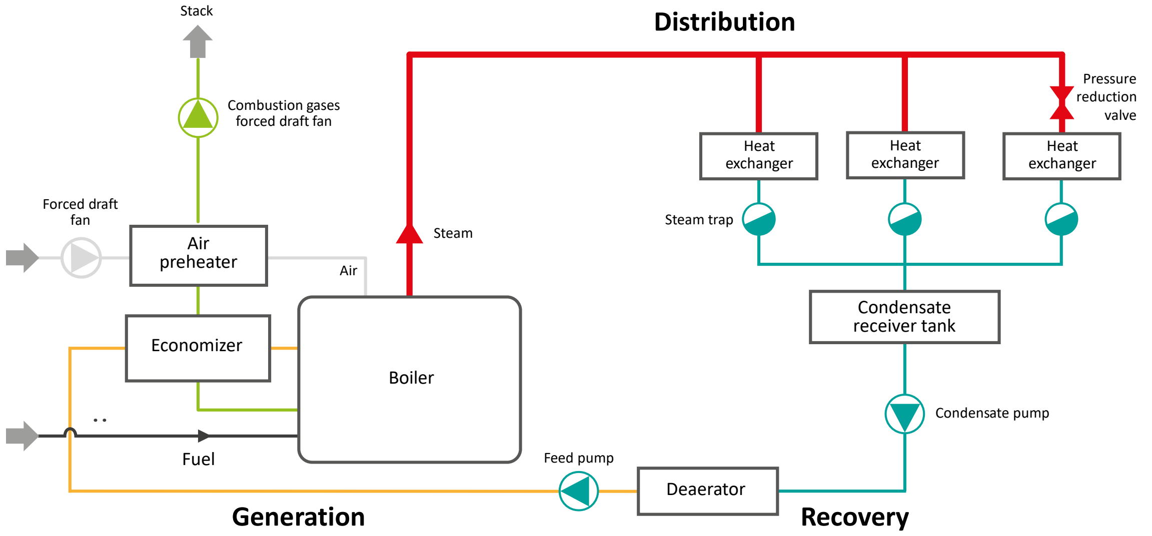
Best Practice	OPTIMISE BURNER	STEA-03
Application	Steam systems	
SME sector	Processing and manufacturing industries	
SME Sub-sector	Food processing, paper, and cardboard manufacturing sectors, pharmaceutical, chemicals, distilleries, etc.	
Technical description	Heat is essential for many industrial processes, where steam can provide it. Steam as heat source can be delivered at many different temperature levels. Always related to a temperature level is the pressure, which is an important design parameter and is commonly elevated for steam systems. To produce steam, water is heated by burning fuels such as natural gas, natural gas, oil, biomass, or others in a burner. The required oxygen is commonly provided via air which is supplied via a burner.	
Recommendation for optimisation	• Air/Oxygen pre-heating: the temperature of the oxygen feed (e.g., air) influences the exhaust gas temperature. In case the temperature level is low (not pre-heated) a part of the produced heat is used internally to heat up the oxygen (and other air components if air is used). This reduces the efficiency. Therefore, a pre-heated oxygen/air flow increases the overall system efficiency. The required heat can be retrieved via heat exchangers (e.g., from the exhaust gas) or by a smart design where, for example, the air of higher levels of the boiler plant is used, as it has an increased temperature. • Increased oxygen levels: the required oxygen can be supplied and used in pure oxygen burners, which have the highest combustion efficiency. In terms of total efficiency, it is necessary to analyse case by case since the production of oxygen requires a certain amount of energy. In addition, oxygen-enriched air can be an alternative to pure oxygen. • Burner replacement: sometimes replacing the current system with state-of-the-art equipment is the most interesting option from an economic and energy-saving point of view. Several typologies of burners are known: - cold air burner (40% efficiency) - hot air burner (efficiency of 50%) - central recovery burner (65% efficiency) - recovery burner (65% efficiency) - regeneration burner (80% efficiency) - rotary regenerator (80% efficiency) - oxygen burner (oxygen content of at least 90%, efficiency of 90%) Thanks to the reduction in the volume of exhaust gases, their dimensions are smaller. They can be used with any type of fuel and are very suitable if used with fuels that have a low calorific value.	

	• Alternative fuels: fuel switch (e.g., from coal to natural gas) can significantly reduce the CO_2 footprint and maintenance needs. Sometimes, the energy efficiency can be increased. • Speed-controlled fan: to ensure the correct amount of oxygen/air for several loadings, the implementation of a speed-controlled fan could reduce up the electricity consumption (of the fan) by up to 75 %. The measure is also strongly related to "minimise excess air" measure, described in a different factsheet. • Stepless burner-control: with the implementation of a step-less burner control, instead of turning it on an off, the annual consumption index can be improved by 1÷2 %. However, the fuel efficiency stays the same. • Replacement: sometimes the replacement of the current system with a state-of-the-art equipment is the most energy saving and economically interesting option
Schemes and diagrams	 Scheme of steam generation and distribution
Economics	The application of pure oxygen costs approx. 80 EUR/kW
Energy savings	Pre-air heater: 3% With air/oxygen preheating, up to 2% of fuel consumption can be saved
Economic savings	Up to 20% in cost of fuels
Average Payback Time	Less than 3 years The average payback time highly depends on the taken measure and must be evaluated on a case-by-case basis. When using an oxygen burner, the payback time is 2.5-3 years

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Emissions	Reduction of NO_x emissions	
Environmental benefits	When switching to a nitrogen-free fuel (e.g., methane) in combination with an oxygen burner, the complexity of the process decreases since there is no longer a need for the removal/treatment of NO_x	
Main NEBs (Multiple benefits)	☒ Environmental benefits ☒ Increased productivity ☐ Work environment/Health/Safety ☐ Increased competitiveness ☒ Maintenance	Depending on the measures chosen, the overall performance increases and this leads to an increase in competitiveness. Energy savings (e.g., reducing the temperature of exhaust gases) often lead to a reduction in emissions of contaminants such as CO_2 from the moment less fuel is required. If so, the spread of sustainability can be increased. This can lead to increased sales.
Replicability	Medium	
Related measures	• STEA-04: Minimizing excess air	
References	Blessl and Kessler, 2017, Energieeffizienz in der Industrie, Springer Vieweg, DOI: 10.1007/978-3-662-55999-4 Bosch, 2018, Planungshandbuch für Dampfkesselanlagen, TT/MKT-CH_de_Planungshandbuch_Dampf_01 Kulterer, K.: klimaaktiv Leitfaden für Energieaudits in Dampfsystemen, Österreichische Energieagentur im Rahmen des Programms des Lebensministeriums, Wien, 2017 Statistik Austria, 2019, Nutzenergieanalyse für 2017	

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