

ERCS

ENERGY RECOVERY
& CLEANING SYSTEMS



MAXIMUM ENERGY GAIN
FROM FLUE GASES

scheuch
TECHNOLOGY FOR CLEAN AIR

KNOW-HOW FOR PROCESS-ADAPTED HEAT RECOVERY

Since the beginning of the 1990s, we have used our various dedusting technologies to also clean flue gases generated by biomass-fired combustion plants. The spectrum of technologies ranges from centrifugal separators and electrostatic precipitators to fabric filters that can be supplemented with our own sorption-based processes for the removal of pollutants.

One of Scheuch's maxims is to analyze the processes and requirements of our customers and to understand them in such detail that we can provide in each case the best solution — both technologically and commercially — for a variety of challenges. For us, the next obvious step was to find a way to extract the thermal energy contained in cleaned flue gas and to put this energy at the disposal of the plant operator in an advantageous way.

Our first flue gas condensation plant for the purpose of heat recovery was put into operation back in 1996. By using empirical data and intensive R&D efforts to constantly improve this technology, we were able over the years to develop the ERCS process (Energy Recovery & Cleaning Systems). Now patented, this system ensures maximum heat extraction for boiler outputs up to 100 MW.

Individually Engineered for Maximum Energy Recovery

This modular standardized plant system is individually engineered based on the fuel type, boiler output and available options for heat utilization so that the maximum amount of energy can be recovered for the plant operator. Three different heat exchanger modules optimized for this type of application extract heat at different temperature levels and transfer the thermal energy to carrier substances like water, water/glycol or air.



Range of Applications for Recovered Thermal Energy

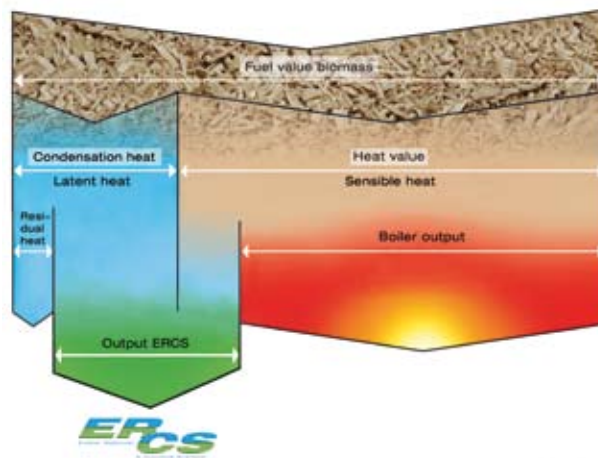
For example, thermal energy recovered from the flue gas can be used to advantage in the following applications:

- Improved efficiency of long-distance and local heating networks
- Process heat (e.g., for steam- or ORC processes)
- Drying of wood chips, fuel or lumber
- Removal of steam plume at exhaust stack outlet

ERCS BOOSTS EFFICIENCY SIGNIFICANTLY ABOVE 100%

As fuel water content increases, the energy content of the fuel decreases and the percentage of latent heat simultaneously increases. Thus, the heat value of wet fuels is clearly lower than the fuel value.

Our patented ERCS condensation plants (ERCS = Energy Recovery & Cleaning Systems) recover up to 50% of the boiler's thermal energy output from the latent and sensible heat contained in the otherwise unused flue gas.



The latent (hidden) heat corresponds to evaporation and condensation heat and is recovered via condensation of the flue gas. In addition, a portion of the sensible heat can be extracted as a result of the reduction in temperature in the condensation plant.

This makes it possible to achieve an increase in overall plant efficiency levels of considerably more than 100% and to realize a significant increase in the operating efficiency of the biomass-fired heating plant.

Benefits of our ERCS heat recovery system include:

50% of the boiler thermal output can be recovered

30% fuel savings

**20% reduction in the investment costs
for the heating plant**

Short Amortization Period

The costs for the integration of ERCS systems in new plants or the retrofitting of ERCS systems in existing plants are self-amortizing with an ROI of circa two years.

Additional Dedusting Effect

Depending on the combination of equipment, ERCS plants reduce fine dust levels by 30 – 60 %.

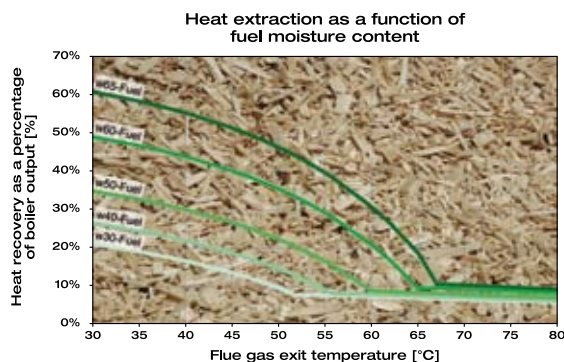
In the case of new plants, this reduces the investment costs for dedusting components because these can be implemented more compactly and more cost effectively. If output increases, the dedusting effect of a retrofitted ERCS plant makes it possible to again comply with existing emission limits.

ERCS: THE SYSTEM THAT WINS THREE WAYS

50% of the Boiler Thermal Output can be Recovered

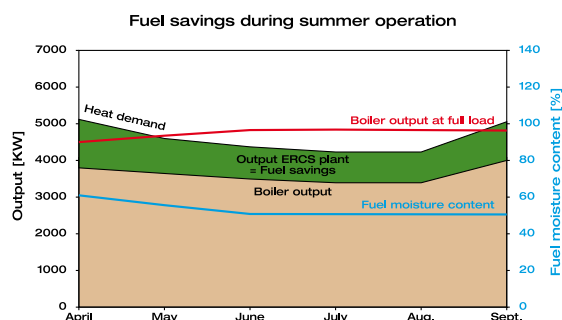
Generally speaking, the following applies: the wetter the fuel and the lower the return temperature, the higher the extractable heat energy and, therefore, the shorter the amortization time for the ERCS system. The extraction of heat is therefore so efficient that the flue gas exit temperature is only a few degrees higher than the network return temperature.

If fuels with water content of up to w65 are used during winter, up to 50 percent of the boiler thermal output can be recovered from the exhaust gas. Depending on the application, i.e., the plant configuration and return temperatures, experience has shown that an annual average of between 10 and 25 percent of the boiler output can be realistically recovered.



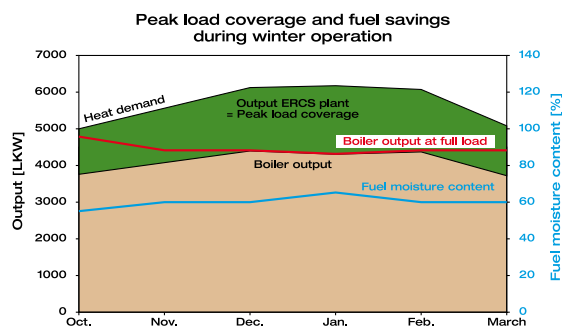
30% Fuel Savings

In the months in which the maximum heat is not completely used, the boiler plant can operate at a reduced output level. Overall fuel savings amount to about 30%. This reduces fuel costs and CO₂ emissions accordingly.



20% Reduction in Investment Costs for the Heating Plant

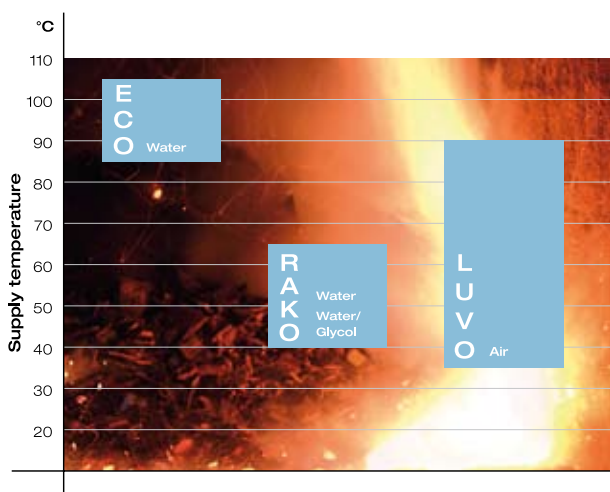
Boiler plants cannot operate at full load if fuel water content is extremely high. As a rule, however, it is at times of the year when fuel water content is highest because of weather conditions that the greatest amount of heat is required. Because the output of ERCS plants is highest exactly under these conditions, Scheuch's heat recovery systems can play an important role in providing peak load coverage. They can even assume the function of a peak load boiler. Investment costs are reduced by up to 20 percent because of the smaller dimensioning of the entire heating plant and because the dedusting effect of the ERCS unit makes it possible to use less expensive dedusting equipment.



ERCS: THE HIGHLY FLEXIBLE SYSTEM

Optimal Heat Utilization

In order to achieve flexible heat utilization, it is often necessary to extract the thermal energy at two different temperature levels. For example, an ERCS unit is the only commercially available system that can make available part of the heat with a temperature of 85-105° C and the other part with 40-65° C.



Standardized Modules for Highest Efficiency

Depending on the temperature range and the heat transfer medium, we use three different kinds of heat exchangers that are specially optimized for this application: an economizer (ECO), a flue gas condenser (RAKO) or an air pre-heater (LUVO). The patented tower design makes possible a plant configuration that saves space and energy.

Low Operating Costs Through Dry Dedusting

Dedusting the flue gas before the heat energy is extracted has a positive impact on operating costs and plant availability. In addition, the system is virtually maintenance free. Because of this process configuration, the dust content in the condensate is so low that no expensive processing is required. As a rule, simple neutralization or a sedimentation tank suffice to allow excess pro-

cess water to be inexpensively released into the sewer system. Furthermore, the disposal costs for sludge created by wet dedusting are ten times higher than the cost to dispose of the fly ash generated by dry dedusting.

Minimal Plume Removal Costs

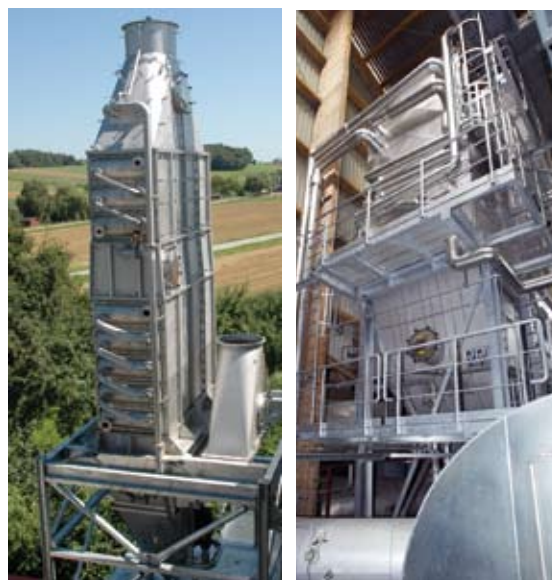
In order to ensure that only the actual required amount of energy is used for plume removal, we use a patented software tool developed in house to regulate the required volume of air.

Lower Investment Costs for Dedusting

Although dry electrostatic precipitators are larger in size than wet electrostatic precipitators, dry ESPs have lower investment costs because they require neither expensive materials nor costly water processing systems.

Easy Retrofitting

Because of the compact footprint of ERCS systems, Scheuch's heat recovery systems can be easily and cost effectively retrofitted to existing boiler plants.



Patented tower design

VARIANT: HEAT RECOVERY AT TWO TEMPERATURE LEVELS

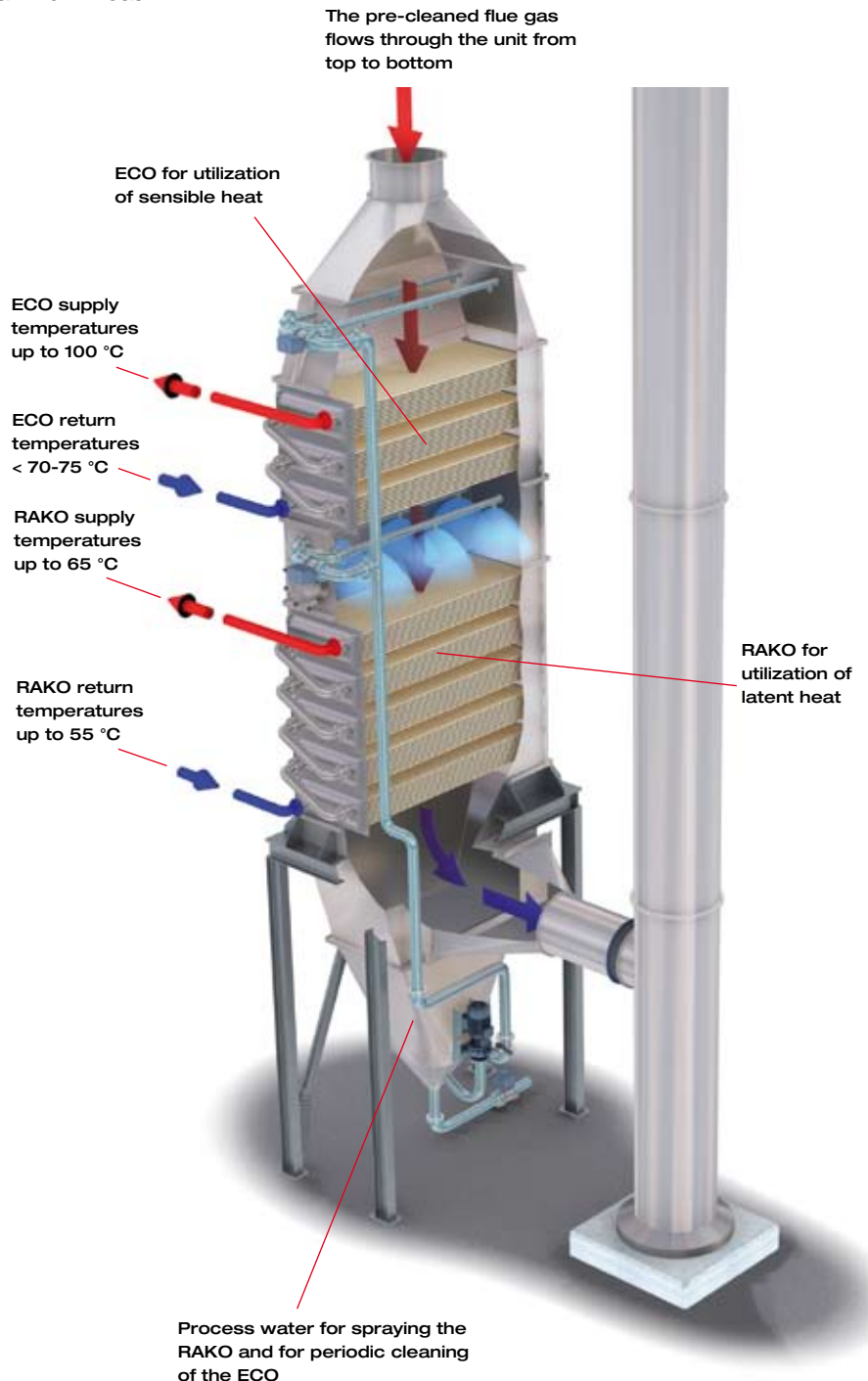
Under certain conditions, it is necessary to extract the thermal energy at two different temperature levels in order to facilitate maximum heat utilization.

Extraction of Latent and Sensible Heat

In the first stage, the ECO (Economizer) is used for the water-side recovery of sensible heat at a temperature level of circa 100 °C. This energy can be reused at temperatures between 90 and 100 °C, for example in district heating networks, for process heat or for standard drying plants.

In the second stage, the RAKO (flue gas condenser) is used for the waterside extraction of latent heat at a temperature level of circa 60 °C. This energy is used for local or long-distance heating networks and to dry wood chips, fuel or lumber (e.g., in low temperature drying cabins).

The energy efficiency of the condenser increases as the return temperature decreases. For example, if the heat is transferred to a dryer via a secondary process loop (water/glycol), the return temperature to the condenser decreases during winter operation. This means that the energy efficiency of the condenser also increases at this time.



ERCS - PRACTICAL EXAMPLE

Project Requirements

Extract the maximum energy from the flue gas generated by a biomass-fired boiler operating in a pellet manufacturing plant with a rated output of 4.6 MW. The extracted energy will be used to pre- and post-heat the air supply for a belt dryer.

Technical Solution by Scheuch

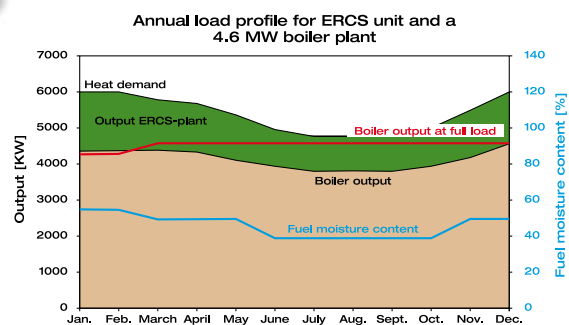
The boiler flue gas is dedusted upstream of the ERCS plant using a multi-cyclone and dry electrostatic precipitator. The heat content recovered from the RAKO is fed in its entirety to a low temperature pipe bundle and used to pre-heat the incoming fresh air of the belt dryer. The ECO is used to heat hot water with a temperature of 80°C from the ORC process to a temperature of about 100°C and then fed to the belt dryer via a high-temperature pipe bundle.



Overall, the ERCS unit recovers in the course of a year on average about one-third of the required heat from the otherwise unused flue gas. The high supply temperature also causes an increase in throughput in the belt dryer and an increase in the efficiency of the ORC process.

Savings Potential

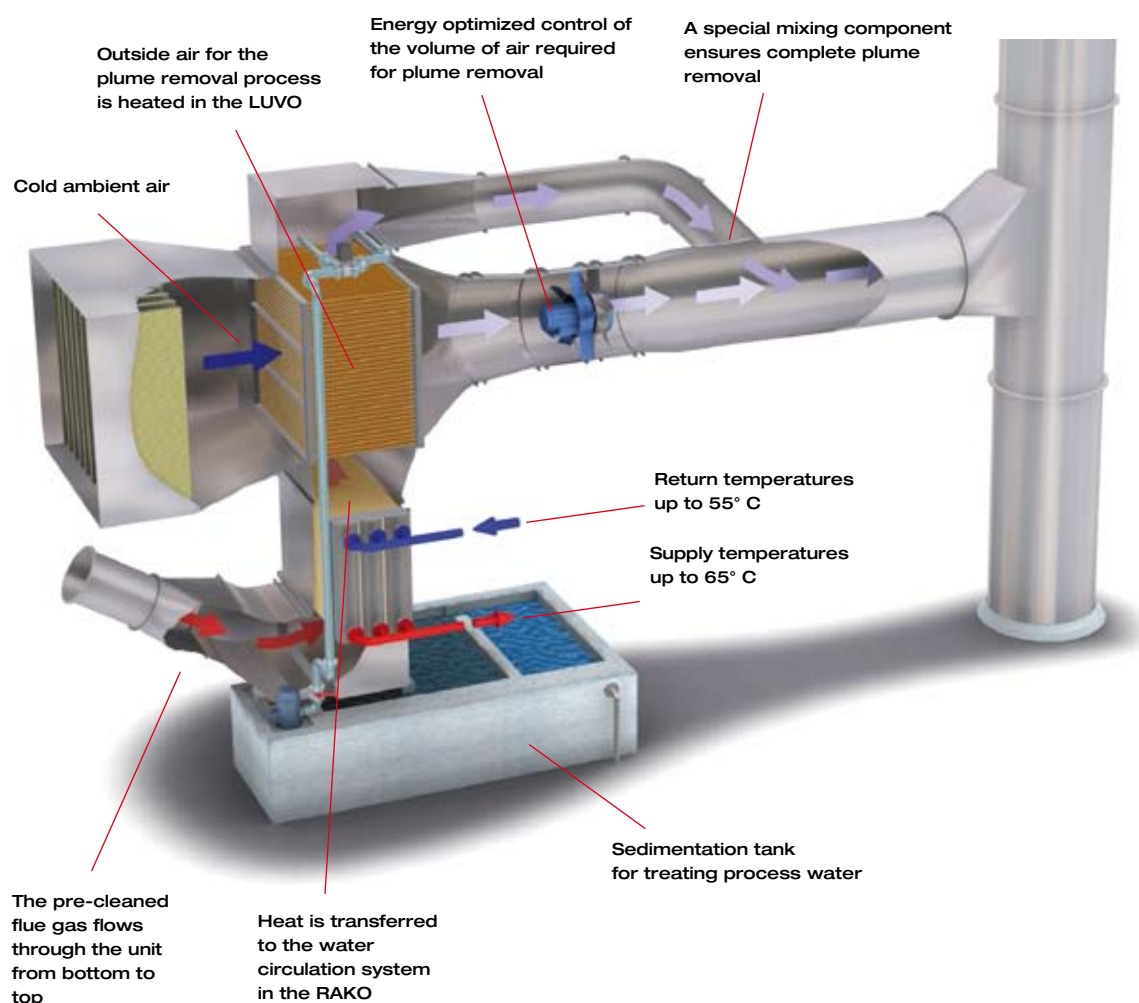
Assuming an average mix of fuel water content in the range w40 – w55 and 4,850 hours of full load operation, the annual output of the ERCS unit is 7,254 MWh. This corresponds to 32% of the boiler output. Because fuel must be purchased from outside sources in this project, the fuel savings has a very positive impact on the cost effectiveness of the pellet production process.



VARIANT: HEAT RECOVERY WITH PLUME REMOVAL

For a variety of reasons, the steam plume must not be visible during the cold winter months. This requirement is satisfied by using air pre-heaters (LUVOs) for plume removal. For economic rea-

sons, however, a plant of this type should always be combined with a flue gas condensation stage (RAKO).



Energy Optimized Plume Removal

Cold outside air is preheated by the flue gas in the cross-flow LUVO and then mixed with the flue gas upstream of the exhaust stack in a special mixing component. This makes it possible to guarantee complete plume removal, even in the case of sub-freezing temperatures.

In order to ensure that only the actual required amount of energy is used for plume removal, we use a patented software tool developed in house to regulate the required volume of air.

Besides plume removal, the heat energy extracted by the LUVO can also be used, for example, to dry fuel or to pre-heat air used to dry wood chips and lumber.

ERCS: PRACTICAL EXAMPLE

Project Requirements

Two boiler plants with outputs of 3 and 1.5 MW are installed in a biomass-fired heating plant that supplies a local heating network. In addition to reliable compliance with emission limits of less than 50 mg/Nm³, the project requirements specify the use of a condensation plant to eliminate the steam plume and increase the efficiency of the heating plant.

Technical Solution by Scheuch

In order to ensure the stable and cost-effective operation of the ERCS unit, the flue gases are dedusted using a dry electrostatic precipitator from Scheuch. The flue gas condensation plant increases separation of fine dust particles by a factor of 30 to 60 percent, making it possible to reliably comply with clean gas dust emissions of less than 20 mg/Nm³ at nominal load.

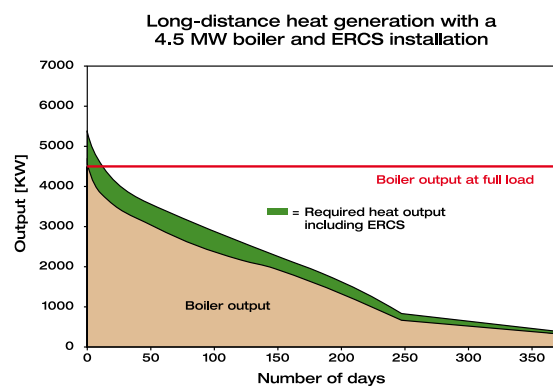


The ERCS plant is implemented in two stages to recover otherwise unutilized heat energy from the flue gas and to de-plume the wet exhaust gases. The RAKO extracts sensible and latent heat content from the exhaust gas. The downstream LUVU removes the remaining heat necessary for complete plume removal from the flue gas.

The patented tower design increases the performance of the condensation plant by up to 40 percent compared to similar plants using conventional designs.

Savings Potential

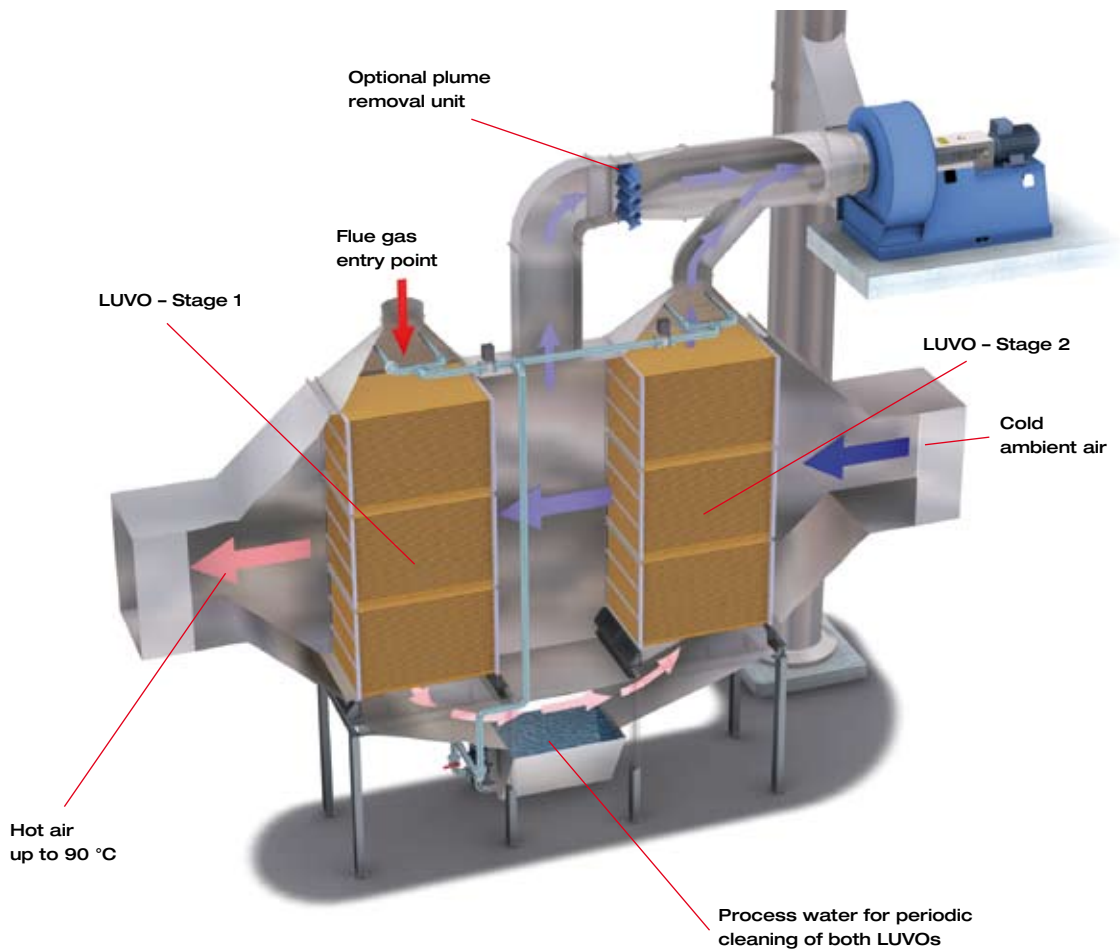
Based on the available empirical data, one can expect the ERCS unit in this plant configuration to extract about 2,600 MWh of heat energy annually. This corresponds to more than 20 percent of the actual boiler output per year. This in turn amounts to a savings of about 1,300 tons of wood chips annually.



VARIANT: HEAT RECOVERY FOR HOT AIR GENERATION

If the heat from flue gases is to be used to generate hot air, we use several LUVO stages in our ERCS plants. Direct utilization of the flue gas heat requires only a very simple form of heat transfer.

Thus, this system is extremely efficient because no transfer losses to a secondary process loop can occur.



Technical Solution by Scheuch

The pre-cleaned flue gas flows through the plant in two stages in a cross current flow. Cold ambient air is drawn in and fed to the ERCS plant via the second LUVO stage. The flue gas cools beneath the dew point in the process, causing the latent heat to be released. The pre-heated fresh air is warmed to a temperature of up to 90 °C in the first LUVO stage by extracting the sensible heat from the flue gas.

Savings Potential

At a firing thermal capacity of 5,000 kW_{therm}, for example, it is possible to achieve maximum heat extraction of 2,120 kW with fuel water content of w65 and an outside temperature of -10 °C. This corresponds to 42 percent of the boiler output. Based on empirical data, a mean annual average output of 1,520 kW can be assumed. Thus, about 11,565 MWh per year of otherwise unused energy can be profitably recovered.

BROAD RANGE OF APPLICATIONS FOR ERCS SYSTEMS



Biomass-fired Heating Plant for Local Heating Networks

Dedusting: Multi-cyclone and dry electrostatic precipitator
ERCS: RAKO and LUVO
Boiler output: 1,400 kW thermal
Fuel water content: w50
Total heat extraction: 455 kW (at -10°C)
Useful heat in condenser: 170 kW
Utilization: Local heating networks and plume removal



Energy Supply Industry

Dedusting: Multi-cyclone and bag filtration plant
ERCS: Two-stage ECO and RAKO
Boiler output: 38 MW thermal
Fuel water content: w41
Useful heat: 3.2 MW
Utilization: Long-distance heating and heating of feed water for steam cycle



Biomass-fired Heating Plant for Local Heating Networks

Dedusting: Multi-cyclone and dry electrostatic precipitator
ERCS: Two-stage LUVO
Boiler output: 3,300 kW
Fuel water content: w35
Flue gas entry temperature: 120°C
Total heat recovery: 550 kW (at -5°C)
Utilization: Drying of fuel and plume removal



Sawmill with Pellet Manufacturing

Dedusting: Multi-cyclone and dry electrostatic precipitator
ERCS: RAKO
Boiler output: 43.7 MW thermal
Fuel water content: w65
Useful heat: 9.5 MW
Utilization: Belt dryers

TAILOR-MADE SOLUTIONS FOR FLUE GAS CLEANING

With a complete program for dedusting, heat recovery and pollutant reduction, we offer customers tailor-made specialized solutions that perform at the highest technological level with respect to both ecology and energy efficiency.

Dry Electrostatic Precipitators

Extremely low operating costs and high separation rates speak for the use of dry electrostatic precipitators in flue gas dedusting. Our customers value the high levels of operational availability, the low maintenance costs and the outstanding level of accessibility for service personnel.

Bag Filtration Systems

Because of their exceptional filtration performance, fabric filter plants are extremely well suited for filtering fine dust to guaranteed levels of $< 3 \text{ mg/Nm}^3$ and for use in combination with sorption-based processes to reduce pollutants.

Sorption Processes

For the energetic utilization of treated and contaminated fuels, as well as waste and residual materials, Scheuch has developed its own adsorption and absorption methods for the cleaning of exhaust gases.

