
**ECOPLANTS TECHNOLOGIES – ECOLOGIC AND ECONOMIC SOLUTIONS
FOR THE FERRO-ALLOY INDUSTRY**

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ABSTRACT

The future holds a great potential for the field of energy and environmental solutions in metallurgical processes. SMS Siemag brought different innovative concepts to market and has been awarded for several of these new technologies.

Rising requirements for sustainable and cost-efficient production of metals lead to a growing demand for energy recovery solutions and the usage of combustible exhaust gases. Therefore we offer an integrated solution how to use different energy sources available in a metallurgical plant complex most efficiently. Energy recovery systems work for open/semi-open type SAF off-gas heat or converter heat while process gases from closed type SAF are utilized in steam generators.

All metallurgical processes generate exhaust gases which contain thermal and to some extent chemical energy. To use the thermal energy, we developed a Waste Heat Boiler enabling to regain up to 80% of the otherwise lost energy – typically using off-gas with temperatures up to 700°C.

Furthermore metallurgical processes yield a large range of gaseous byproducts like SAF-gas, blast furnace gas, coke oven gas and converter gas that have high energy content in the form of combustible components like CO and H₂. Utilizing these gases as primary fuel in a firing plant contributes significantly to increased energy efficiency in steelworks, and therefore reduces the overall metal production costs and saves CO₂ emissions. For the systematic utilization of these gases to generate e.g. steam for production and/or to generate electricity in a complete power station process, SMS Siemag offers a wide range of part-standardized Industrial Steam Generators.

Our portfolio of environmental technologies contains also complete water treatment plants and technologies for treating and recycling of byproducts like dusts, slag or used acids.

We are also committed to expand our activities in Energy Management solutions. Therefore we have developed an integrated Energy Monitoring System for all parts in a steelmaking plant. This X-Pact[®] Energy Advisor helps plant managers to detect current capabilities and develop long-term competitive advantages. The clear visualization permits a fast overview of the energy situation and leads by a cause-related allocation of costs to a quick identification of cost-cutting potential.

The presentation will sum up the ecoplants technologies and services introduced so far, give an overview about the references and give an outlook on the potentials of the new industrial power plants.

1. UTILIZATION OF WASTE HEAT AT SAF

For more than 100 years it has been our business and tradition to work out solutions in the field of submerged-arc furnaces and electric smelters. Our technology assures the success of our customers in the ferroalloy and non-ferrous metal industries. Our plants are characterized by innovative design and “Made in Germany”-qualitative manufacturing. References from all over the world demonstrate the economic success which is achieved through stable and safe operation.

Along the metallurgical production processes, there are several operating sequences that require enormous amounts of heat. These accumulated, hot exhaust gases often remain unused.

Based on this background SMS Siemag has developed energy recovery systems producing steam from exhaust gases coming from different furnances - e.g. SAF and AOD-Converter.

Depending on the process up to 80 % of the wasted energy can be recovered. This steam can be used for heating, cooling or generation of mechanical or electrical energy.

Forced by these technologies, tens of thousands of tons of CO₂ emissions are saved, which allow the disposition of emission permits.

First we want to have a closer look at open furnace design SAF where full combustion occurs. The off-gas flow amounts to 50,000-120,000 Nm³/h, reaching a dust content between 8-12 g/Nm³.

The innovative furnace door design makes it possible to control the inlet air flow and thus the off-gas temperature. This reaches degrees around 600°C – at least at modern plants.

The continuous SAF process is suitable for the generation of superheated steam in the Waste Heat Boiler.

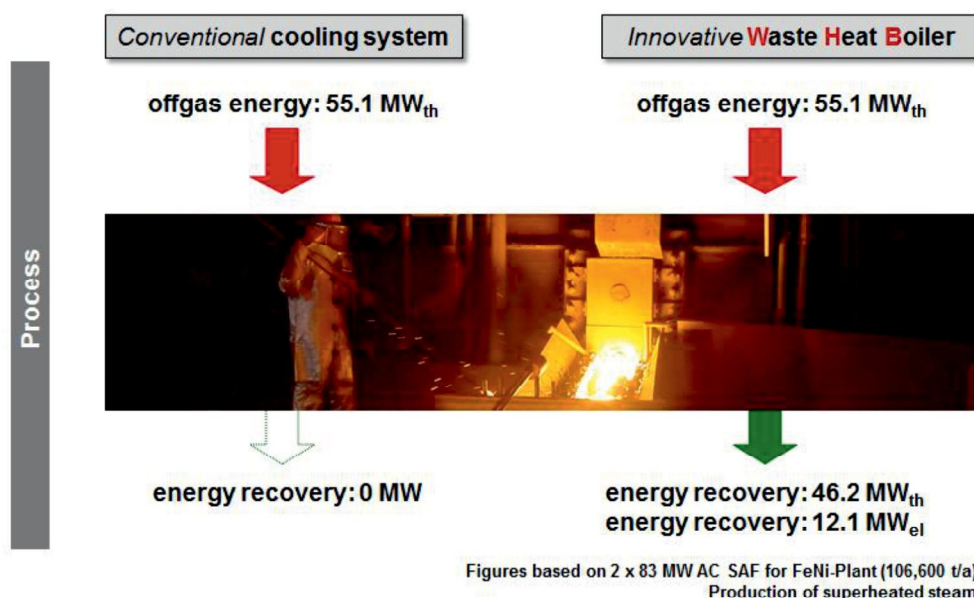


Figure 1: Energy Recovery at SAF – Open furnace design

In any way the cooling is necessary, before the gas can be cleaned in the bag filter. Now, by using this energy recovery plant, superheated steam is generated. The produced steam can be utilized for various applications, e.g. for generation of electricity, for heating or for running drives.

Eti Krom is a Turkish ferrochrome producer who has placed an order for two additional reduction furnaces (SAF) from SMS Siemag. Both of them are equipped with energy recovery systems using thermal energy from up to 600°C hot furnace gases for generation of superheated steam. The energy content of the steam is used to drive a steam turbine which produces electrical power with a 5 MW - generator. Eti Krom is expecting an amortization period of less than four years by this method of producing electrical power.

In some Si-metal and FeSi processes up to 22 % of the input electric power can be recovered.

Scope	Energy recovery system including a complete gas cleaning technology for two FeCr-SAF at Eti Krom .
Brief description	The energy from the approx. 600°C-hot exhaust gas is converted into superheated steam. By using this steam a turbine generating 5 MW of electrical energy is driven.
ecoplants-criteria	Ecological advantage: Recovery of 11% of the total input energy; saving of around 25,000 tons of CO₂ p.a.; Previously: no dedusting, today: max. 10 mg dust / Nm³ in the offgas. Economic advantage: Power generation: approx. 3.8 mio € p.a.; Amortization period: approx. 3 ½ years.



Figure 2: Ecoplants– solutions for our customer Eti Krom

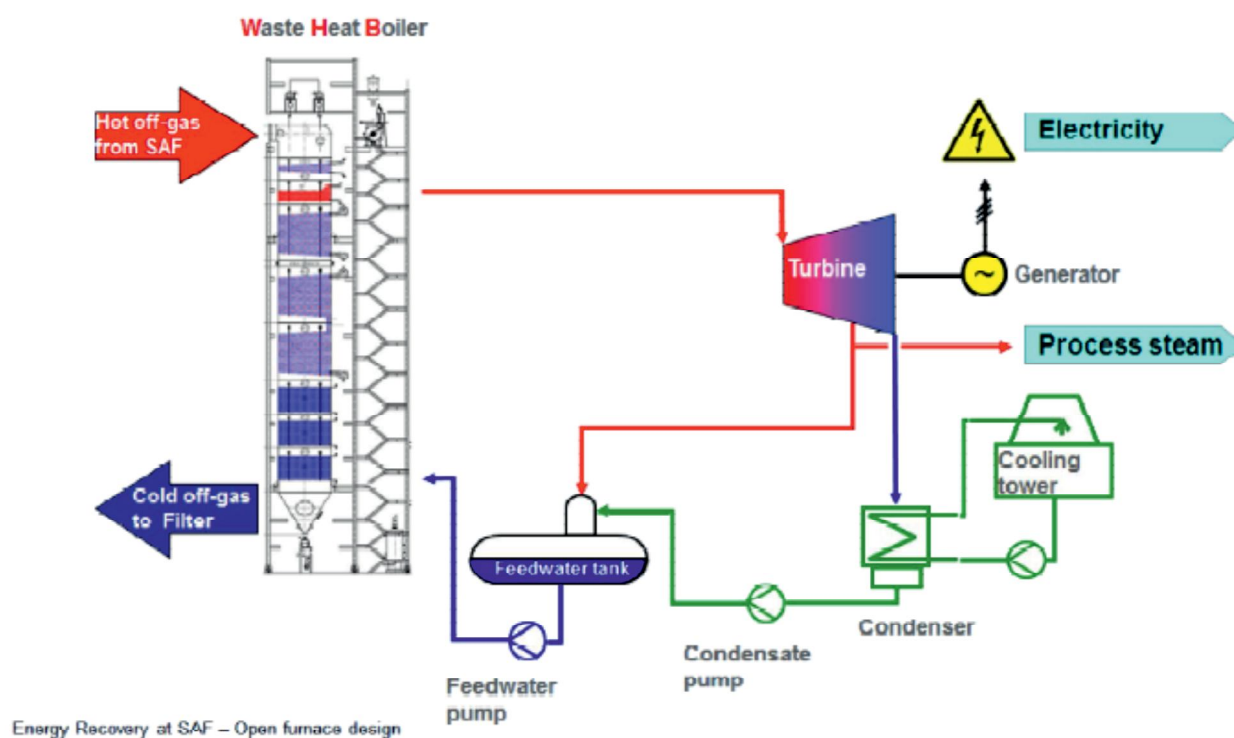


Figure 3: Typical flow chart – energy recovery system

2. USAGE OF EXHAUST GAS

The large range of gaseous byproducts as SAF-gas, blast furnace gas, coke oven gas and converter gas have high energy content in terms of combustible components.

Having a closer look at SAF-gas in a closed furnace design there is no combustion of process gas.

But combustible off gas can be used after treatment (e.g. Venturi Scrubber) in a Process Gas Boiler to generate superheated steam. The Off-gas flows about 6,000 to 12,000 Nm³/h. Depending

on alternating current or direct current the high dust load ranges between 70 and 200 g/Nm³, temperatures start at 300 up to 1800°C in maximum.

Utilizing gaseous byproducts in general as primary fuel in an industrial power plant contributes significantly to increased energy efficiency in steelworks and therefore reduces the overall steel manufacturing costs and saves CO₂ emissions.

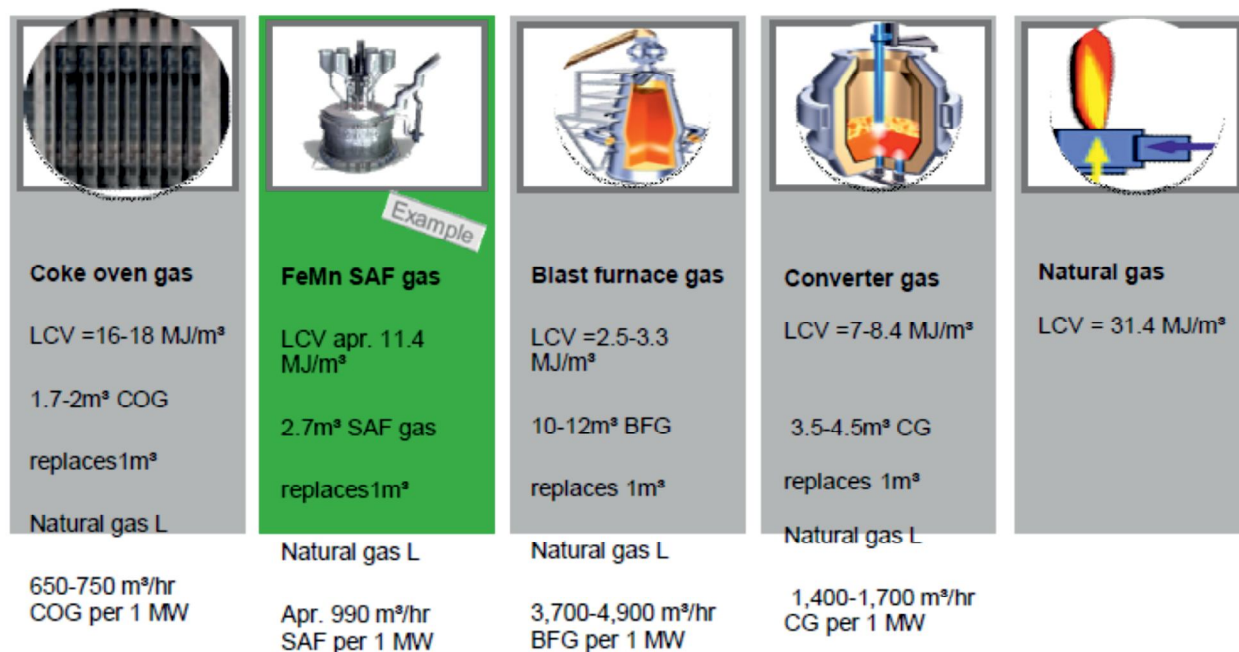


Figure 4: Specific values for different process gases

For the systematic utilization of these gases, e.g. to generate steam for production and/or to generate electricity in a complete power station process, SMS Siemag offers a wide range of part-standardized steam generators. In this context SMS Siemag focuses on taking into account the many demands that influence the choice of steam generator type. Examples for these requirements are:

Low Emissions	variable and fixed-pressure mode
Wide range of fuels	daily start/stop
Compact design	High availability
Fast starting capability	High cost-effectiveness
Flexibility:	

The SMS Siemag range comprises suspended or self-supporting natural-circulation steam generators with high to top outputs:

- Live steam pressures up to 160 bar
- Live steam temperatures up to 540°C
- Up to 150 MW_{el}

We supply single or multi-pass types that can be adjusted to a wide variety of tasks.

Existing plants have a high potential for the optimization of air- and fuel supply. Low calorific gas burners often operate with conservative combustion parameters that are highly prone to

failures, which can lead to increased downtimes. Our experts have the required Know-how to optimize these burners and to ensure smooth operations.

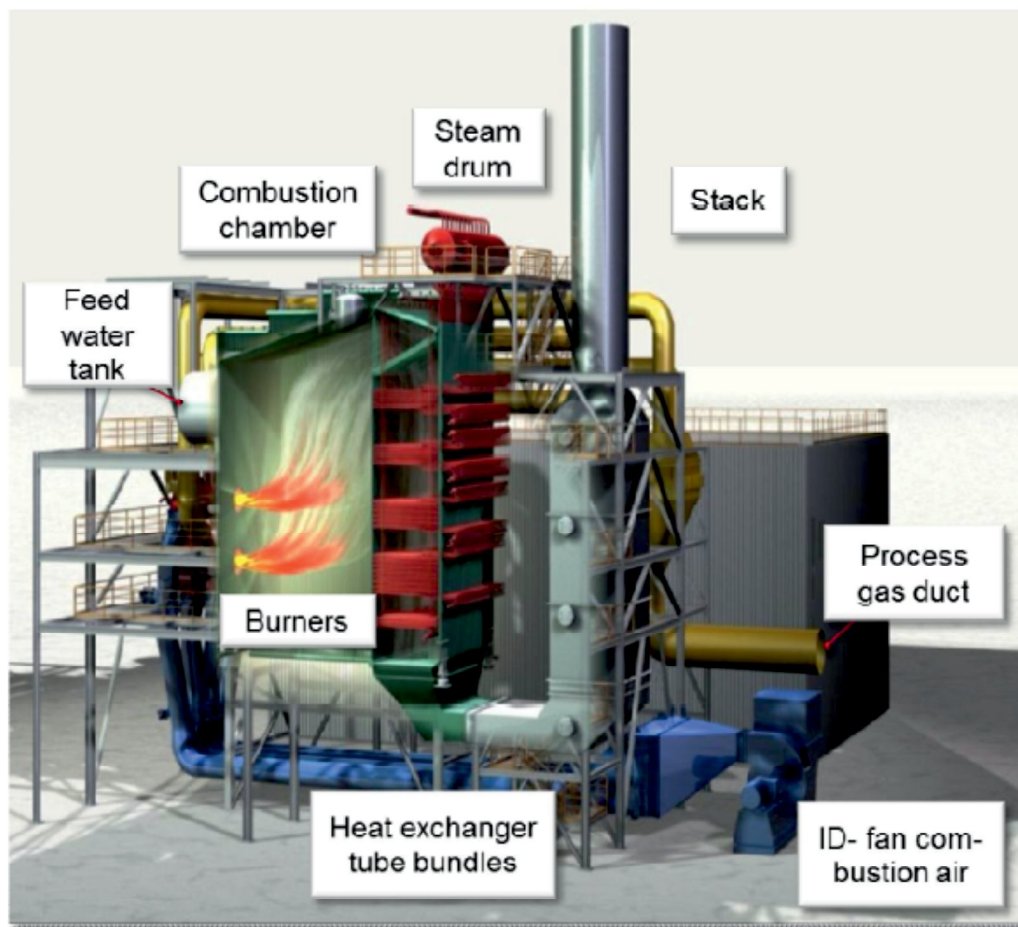


Figure 5: Typical two-pass steam generator

3. WATER TREATMENT

As a supplier of integrated systems, the portfolio of SMS Siemag comprises also a wide range of fresh and waste water systems, from design to construction and commissioning. These include fresh water treatment for the production of demineralized water as well as open and closed cooling systems. In addition, SMS Siemag also offers innovative wastewater treatment facilities. The neutralization or microfiltration facilitates the return of the treated water in the production process. Our latest innovation allows for the recovery of 75 % of the wash water in the pickling of stainless steel. The portfolio in this area includes new facilities as well as the renovation and expansion of existing plants. The water circuits as lifelines within a steelworks carry large amounts of fresh water and waste water. For example, in a conventional hot rolling mill around 25000 cubic meters of water per hour is needed. This represents more than double the drinking water consumption of a German metropolis. Thanks to modern techniques of SMS Siemag, it is possible to create virtually lossless closed circuits. SMS Siemag upgraded to the water management of the works, for example, with a whole range of customized cooling and filtration systems. In this way, almost the entire amount of water is returned to the production process.

In the above example of a hot rolling mill, usually 98 % of the water is cooled, cleaned, treated, and returned to the circulation. This recycling rate can be increased up to about 99.8 % by means of special technologies. More than 70 references in the last decades have proven the competence of SMS Siemag in that field.

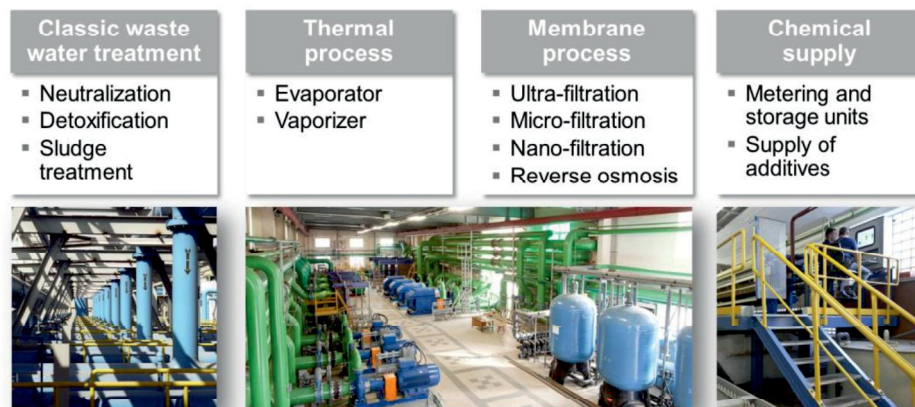


Figure 6: Waste water treatment product range

4. ENERGY MANAGEMENT

Rising energy costs, limited capabilities and political requirements call for an integrated Energy Management, to strengthen future competitive advantages and keep the production efficient and at minimum cost.

The X-Pact[®] Energy Advisor is a holistic Energy Management System and supports plant managers to detect current potentials and maintain them in long term. It is the essential tool for tackling this growing challenge and bringing the energy costs constantly down. Moreover, the X-Pact[®] Energy Advisor can be integrated easily in any corporate-structure and assists with the certification to DIN EN 16001 and DIN ISO 50001.

It is assembled in three levels:

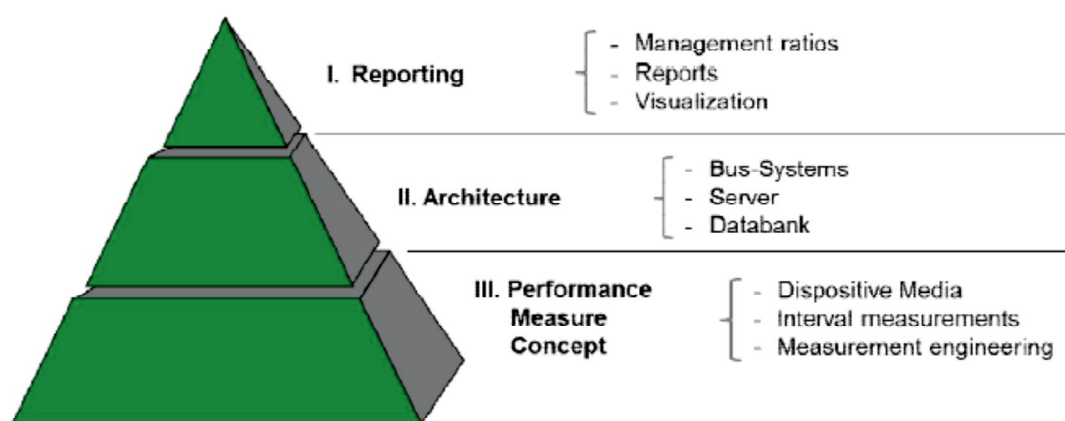
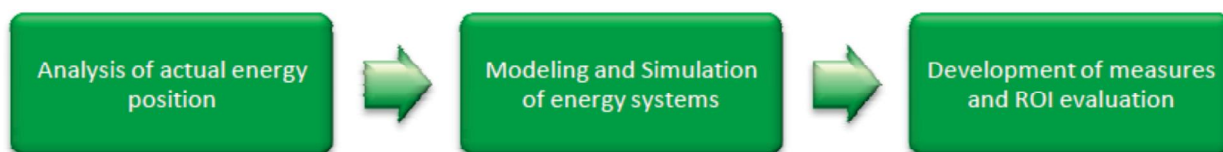


Figure 7: Assembling of X-Pact[®] Energy Advisor

Further Advantages:

Reduced energy costs	due to continuous monitoring and utilization of savings potentials identified
Competitive advantages	due to increased efficiency and reduced energy input
Enhanced cost-effectiveness	due to simple calculation of efficiency measures
Increased transparency	due to a clear-cut presentation of all energy-relevant data in a single system
Evaluation of energy efficiency	due to analysis of variables and application of key figures
Early warning system	due to direct notification by email or text message
Increased production stability	due to early recognition of errors with the help of ratio figures
Documentation and reports	on energy-relevant procedures, for use in internal and external audits

Our competent Energy Consulting Team provides expert advices with regard to energy efficiency.



Energy costs can be reduced in three steps.

