HUTTER FREI POWER GMBH

Company - Presentation

History

HUTTER FREI POWER GMBH was formed from

the company **FRIEDRICH HUTTER GMBH** in Germany,
which developed and introduced 1988 the Combined Gas Turbine and Steam Turbine CHP Station SYSTEM HUTTER
(CHP = Combined Heat and Power)
into the market.

The multiple built **Combined Cycle CHP Station SYSTEM HUTTER** was developed specially
for highest total efficiencies and CO_2-emission reduction.
Combined Cycle CHP Stations SYSTEM HUTTER are used in various industry sectors with the aim of
highest possible fuel utilisation factors with innovative technologies and of
low emission and highly reliable energy supply.

Product- and Services-Strategy

High-grade energy conversion plants
are the better answer
to the global challenge of preserving the CO_2 balance.

With the aim of efficiency increase, that means fuel savings, and of emission reductions,
innovative technologies were created, which are the basis of our products.

Our **products of**
Combined Heat and Power Stations, **Thermal Power Stations** and **Residue Waste-to-Energy Plants**
achieve **highest fuel utilisation factors (total efficiencies)** and **time reliabilities.**
Our products lead with their primary energy savings (fuel savings) and very low air pollutant emissions to environmentally-beneficial and highly economical solutions.

Based on the **competence** and **experience** of our Engineers
HUTTER FREI POWER
offers a huge variety of engineering services and products
in the power plant sector.

Overview of Activities

Our Company is **acting**:

- on the one hand as **Consulting-**, **Planning- & Executing Engineer (Owner's Engineer, General Planer, EPCM)**, and
- on the other hand in the **Development**, **Design**, **Engineering, Procurement** and **Supply** of **Combined Heat & Power (CHP) Stations, Power Stations**, **Heating Plants** and **Waste-to-Energy Plants (Component Supply, EPC/Turn-key).**

Our **Customers** are:

- **Industries**, **Energy Supply Companies**, **(Public) Utilities**, **Waste Disposal Companies**, **Investors**, **Banks** and **State-owned Institutes**.

Our **Products**:

- **are based on innovative**, **high-grade** and **low emissioning** technologies, and
- form together with **competent** and **experienced** Employees the basis for successful solutions.

Solutions: We offer **solutions**, which are **tailor-made** and **optimised** for the **individual** Customer needs.

Know-how: By means of our **combined know-how** in Consulting, technical Planning and as Supplier:

- we have the **latest state of the art** at our disposal and consider and analyse **all available technological solutions**.
- Consequently we are in a position to really **optimise** the **Customer benefit**.

Overview of Products

Development, Planning, Design, Engineering, Supply and Commissioning
of high-grade, high-efficient, environmentally-protecting, operation-flexible and low-emissioning
Combined Heat and Power Stations, **Power Stations**, **Steam Generators, Residue Waste-to-Energy**,

and as Consultant, General Planer or EPCM-Contractor
of large **Power Stations** and entire **Waste Incineration Plants**

- Combined Cycle CHP Stations SYSTEM HUTTER with own-developed Radiation-type Steam Generator
- Gas Turbine CHP Stations with Heat Recovery Steam Generator
- Steam Turbine CHP Stations
- Heating Plants and Steam Generator Plants
- Thermal Power Stations (up to medium size)
- Residue Waste-to-Energy Plants
- Waste Incineration Plants
- Consulting & Engineering (Consultant, Owner's Engineer, General Planer, EPCM-Contractor)
- Process Automation & Distributed Control Systems

Overview of Services

HUTTER FREI POWER offers
all Services in all Project-Phases of our Products,

- in the Consulting Phase:
  - General Planning for the Electrification of Regions and Planning of regional Power Station Parks
  - Project Developments
  - Pre-Studies
  - Parameter Studies
  - Feasibility Studies
  - Pre-Engineering

- in the Project Execution (Realisation) Phase:
  from the order through the Design, Planning, Engineering, Supplier Control to the Hand-over
  - Pre-Engineering
  - Services as Consulting and/or Executing Engineer
  - Services as General Planer or EPCM-Auftragnehmer

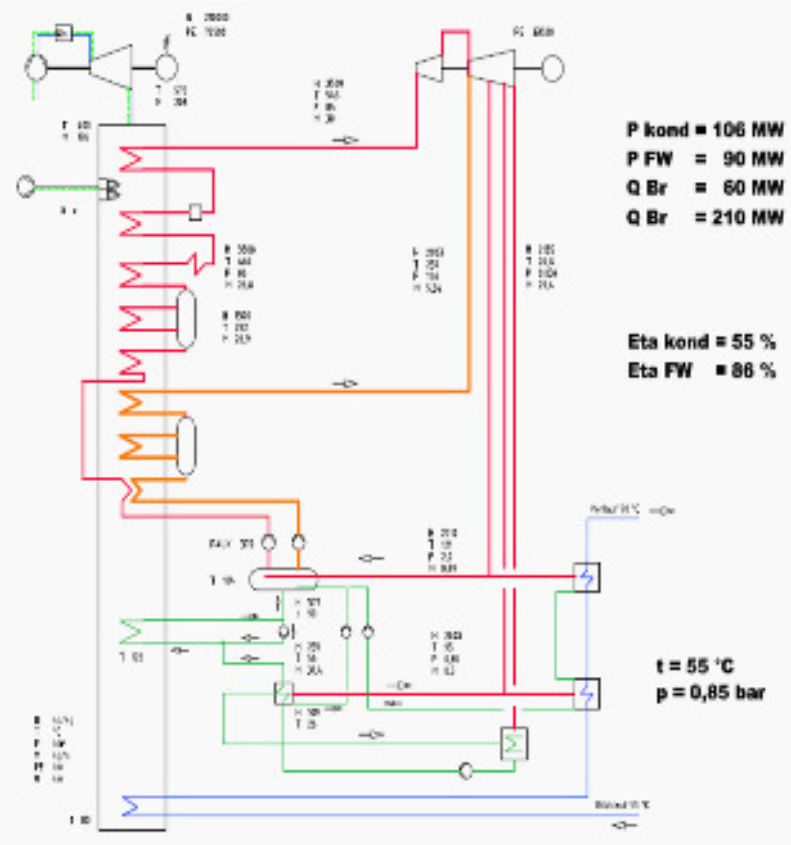
- in the Operation Phase:
  - Service-Provider
  - Operation Support, Plant Assessments
  - Modernisations, Power- and Efficiency-Upgrades

Choice of Turbine-based Power Station Cycle for pure Electricity Generation

Optimisation of Gas-fired Power Station Cycles for pure Electricity Generation leads to:

Gas Turbine with **unfired or low fired multiple-pressure cycle Heat Recovery Steam Generator** with subcritical live steam conditions, and

extraction-condensing Steam Turbine



Choice of Turbine-based Cogeneration Plant Cycle

Heat Recovery Steam Generator after Gasturbine:

Low Steam Generator Firing or unfired Steam Generator after Gas Turbine, therefore:

- Oxygen Content in Flue Gas after Steam Generator is high (15 – 8 Vol.-% O_2), and
- Flue Gas Temperature after Steam Generator Firing is low (normally limited at 800 °C), therefore:
  - Steam Generator Design is Heat Recovery Steam Generator without significant radiation type heat transfer
- **Steam Generator efficiency is low** due to high Flue Gas Massflow and high Flue Gas Temperature at stack
- Steam Generator needs more volume and more space

Radiation-type Steam Generator after Gasturbine:

High Steam Generator Firing after Gas Turbine, therefore:

- Oxygen Content in Flue Gas after Steam Generator is low (2 – 8 Vol.-% O_2), and
- Flue Gas Temperature after Steam Generator Firing is higher (> 1000 °C), therefore:
  - Steam Generator Design is Radiation-type Steam Generator with significant radiation type heat transfer
- **Steam Generator efficiency is high** due to low Flue Gas Massflow and low Flue Gas Temperature at stack
- Steam Generator is a compact design and needs only a smaller space

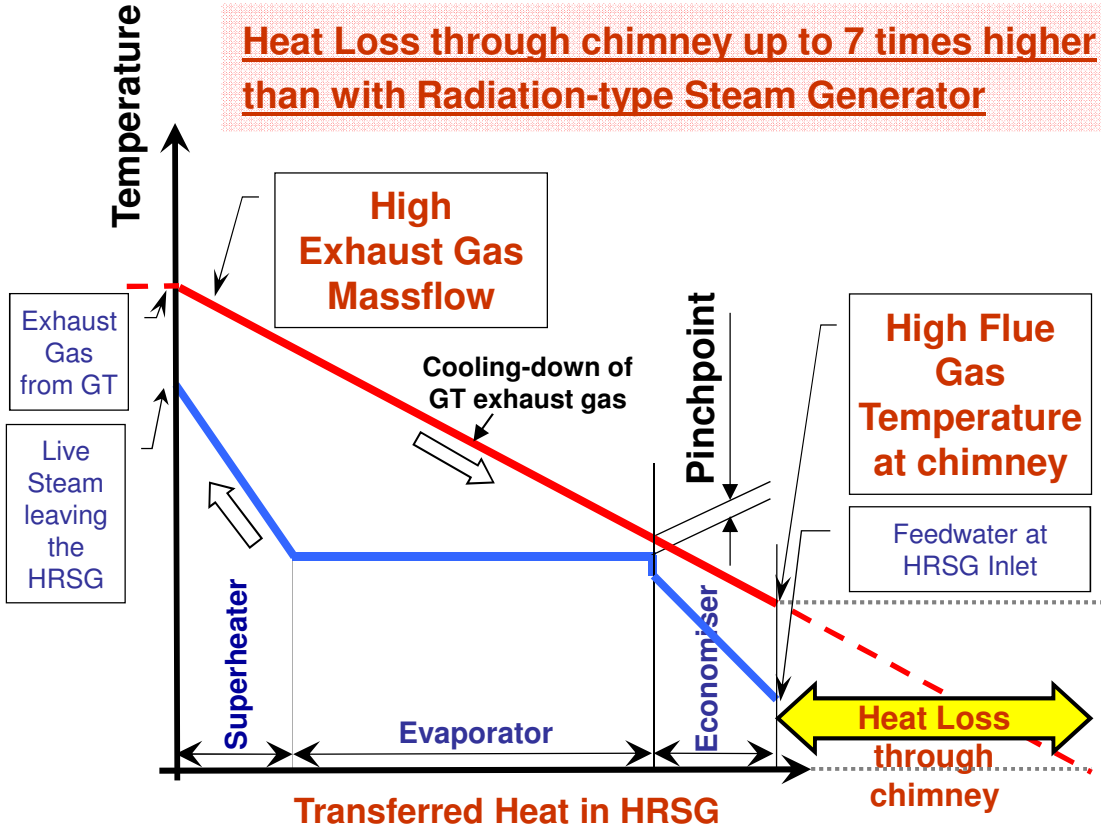
Choice of Turbine-based Cogeneration Plant Cycle

GT with Heat Recovery Steam Generator HRSG

Flue Gas Mass Flow up to 5 times higher

Flue Gas Temperature at chimney up to 40% higher

Heat Loss through chimney up to 7 times higher than with Radiation-type Steam Generator

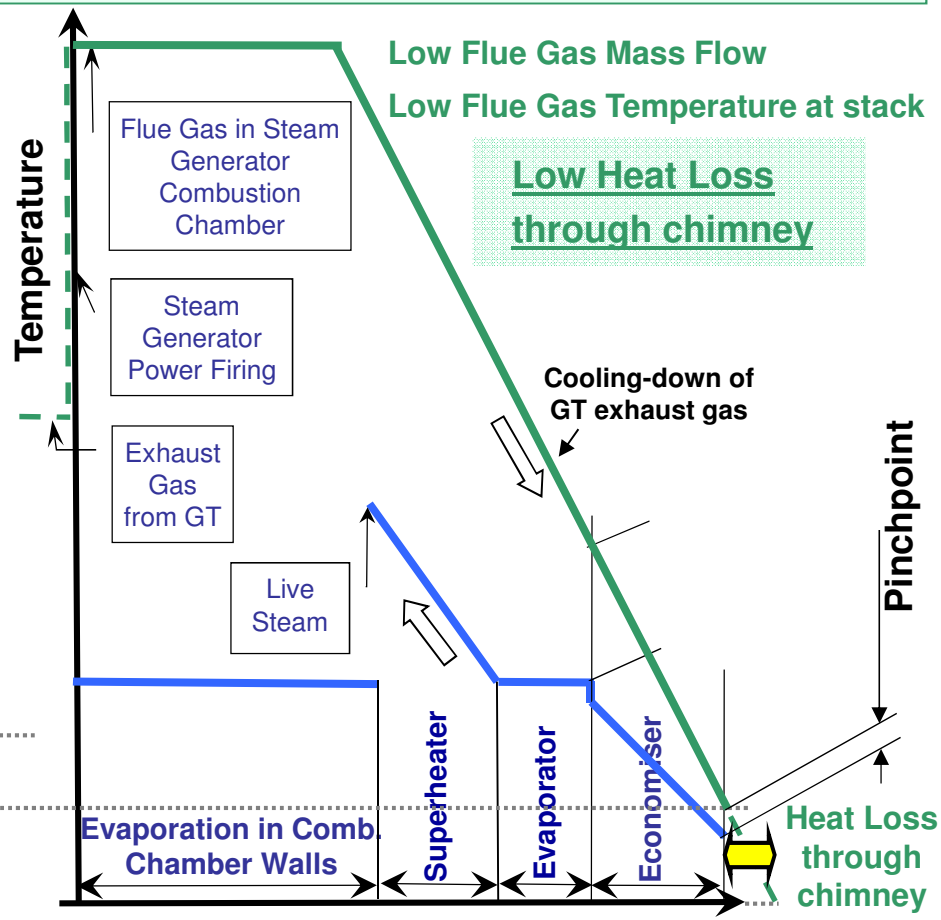


GT with Radiation-type Steam Generator

Low Flue Gas Mass Flow

Low Flue Gas Temperature at stack

Low Heat Loss through chimney



Heat Loss through chimney ~ Flue Gas Mass Flow x Flue Gas Temperature

Choice of Turbine-based Cogeneration Plant Cycle

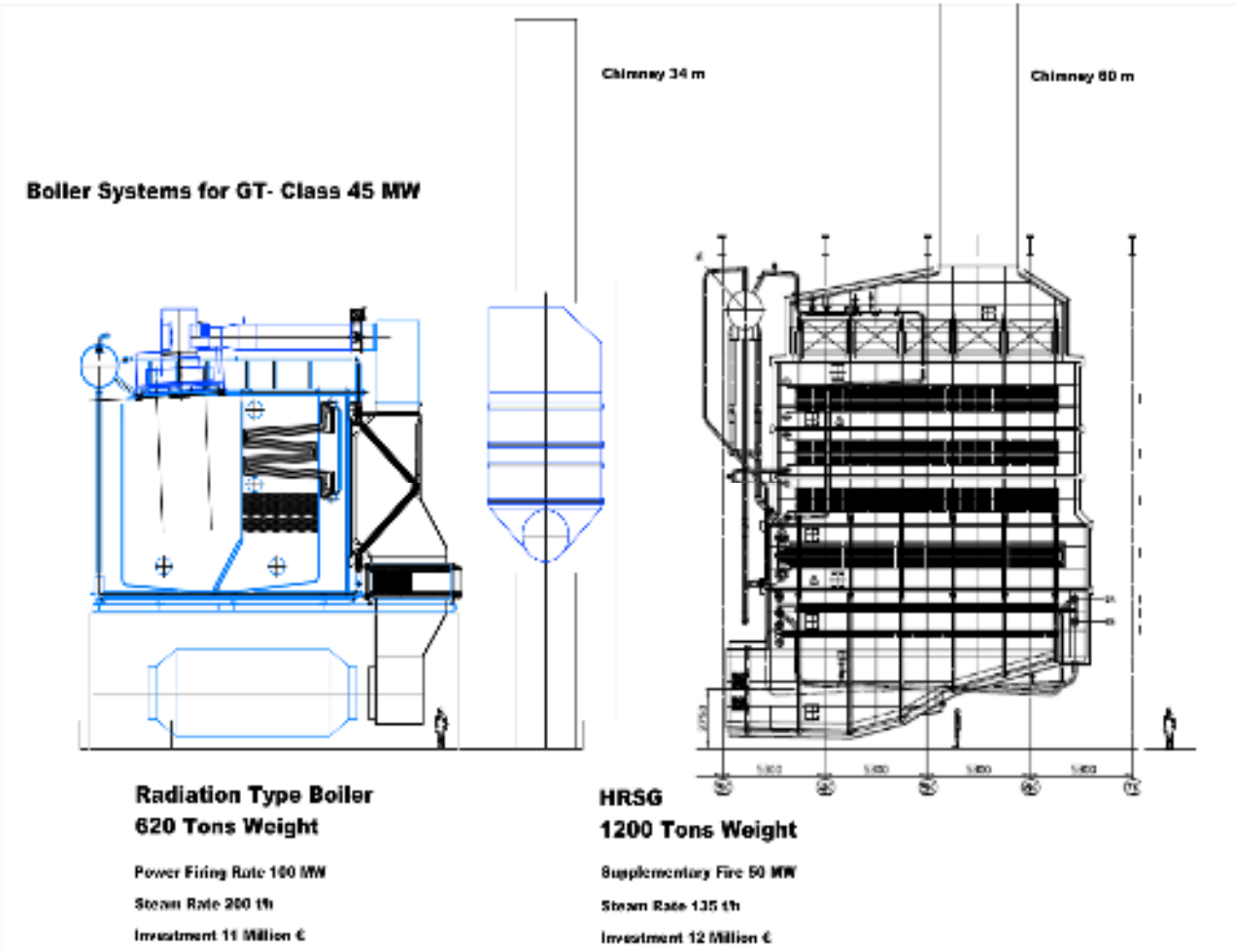
For the same Gas Turbine: **Heat Recover Steam Generators have up to double weight and 35% lower nominal live steam mass flow than Radiation-type Steam Generators**

Radiation-type Steam Generator:

The **combustion chamber** is cooled by Evaporator walls (**membrane walls**), to take the radiation heat from the Steam Generator firing.

The **heat transfer by radiation** in the combustion chamber is **by factors more effective** than in the convection heat exchangers.

The Radiation-type Steam Generator needs less heat exchanger surfaces and steel.



Heat Recovery Steam Generator:

If fired, the supplementary firing is located either in the exhaust gas duct or in a **combustion chamber**, which consists of refractory setting walls (**un-cooled walls**).

Consists **only of convection heat exchangers**. Only small content of heat transfer occurs as radiation, biggest part as convection, therefore **less effective heat transfer**.

The Heat Recovery Steam Generator needs more heat exchanger surfaces and more steel.

Choice of Turbine-based Cogeneration Plant Cycle

Turbine-based Cogeneration Stations
can due to technical reasons **not have at the same time**
highest Electricity Generations and highest Fuel Utilisations

Turbine-based Cogeneration Stations for useful steam without Condensation Steam Turbine have at given Cogeneration-Cycle and at const. Live Steam Pressure and -Temperature with **increasing Electricity-to-Heat Ratio above approx. 0.4 decreasing Fuel Utilisation Factors**, resulting in:

- increasing Electricity Generation,
- excessively-increasing Fuel Consumption and Fuel Costs,
- increasing Sensitivity against Fuel Price Escalation,
- increasing Environmental Costs / CO_2-Costs.
- The Economics is dependent i.e. on Price Ratio “Electricity / Fuel”

Consequently there are two technical extreme directions for the Optimisation:

1. Turbine-based Cogeneration Power Stations with **highest Fuel Utilisation** (lower “Electricity-to-Heat” Ratio)
2. Turbine-based Cogeneration Power Stations with **highest Electricity Generation** (higher “Electricity-to-Heat” Ratio)

Choice of Turbine-based Cogeneration Plant Cycle

Steam Turbine CHP Station

- with classical Radiation-type Steam Generator
- highest Fuel Utilisation Factor (Total Efficiency)
- lowest Fuel Heat Input
- less sensitive against Fuel Price Escalation
- generate less Electricity than Combined Cycle CHP Station SYSTEM HUTTER

Gas Turbine with Heat Recovery Steam Generator (and Steam Turbine)

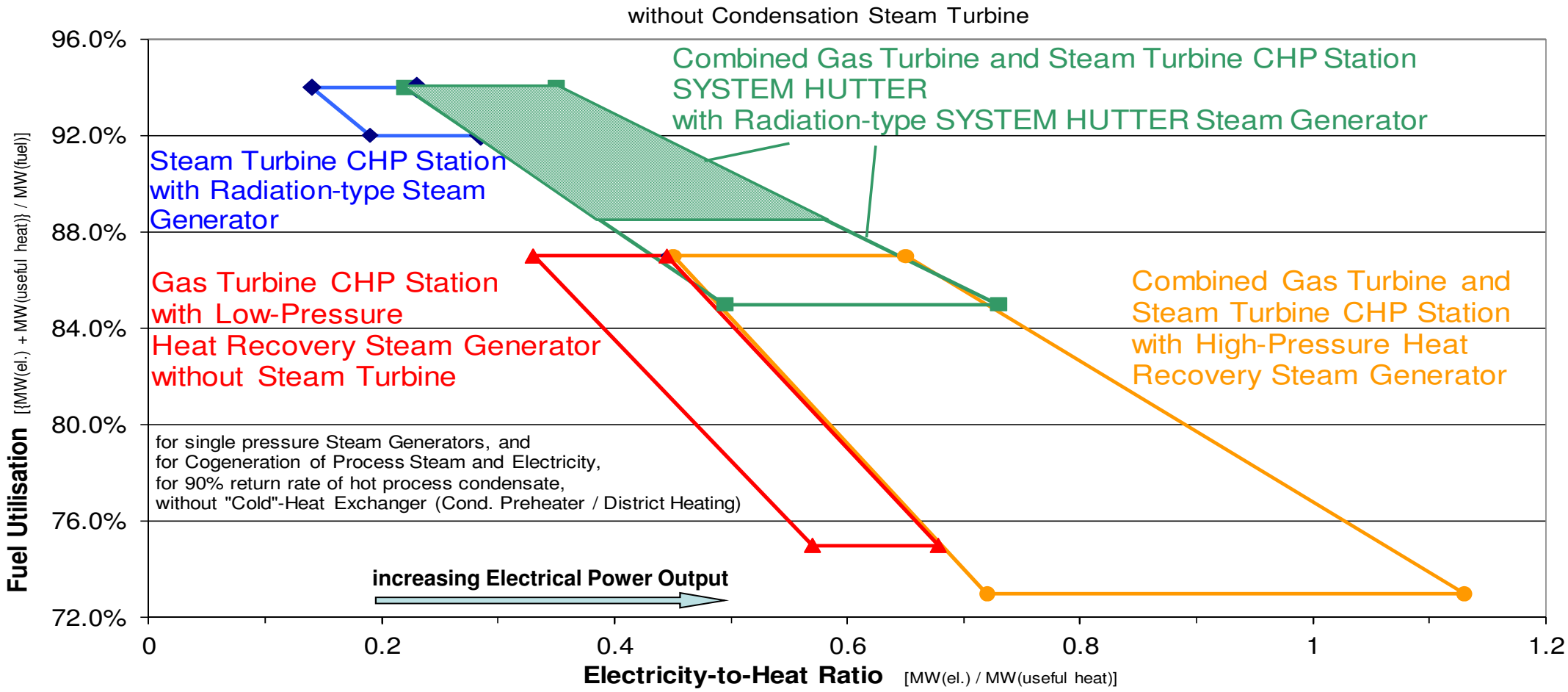
- significantly reduced Fuel Utilisation Factor
- significantly more Fuel Heat Input than Combined Cycle CHP Station SYSTEM HUTTER
- highly sensitive against Fuel Price Escalation
- restricted operation flexibility

SYSTEM HUTTER (Combined Gas Turbine & Steam Turbine CHP Station)

- with radiation-type SYSTEM HUTTER steam generator instead of heat recovery steam generator
- same highest Fuel Utilisation Factors than Steam Turbine CHP Stations
- less sensitive against Fuel Price Escalation
- generate significantly more Electricity than Steam Turbine CHP Stations
- extended operation flexibility and the ratio between electricity- & steam generation is adjustable
- most economical in a wide area of variable boundary conditions
  (e.g. typically at Price Ratio “Electricity / Fuel” between approx. 3.6 and 1.8)

Choice of Turbine-based Cogeneration Plant Cycle

Design Range of Gas Turbine and/or Steam Turbine based Combined Heat and Power Station Types



Remark: This diagram does show the possible Range of 100% Load Points, but not the Operation Range of one particularly designed Plant

Choice of Turbine-based Cogeneration Plant Cycle with fossil fuels

Price Ratio Electricity / Natural Gas in Europe is without big crises expected to stay between ~ 1.8 and 3.5 in the medium term

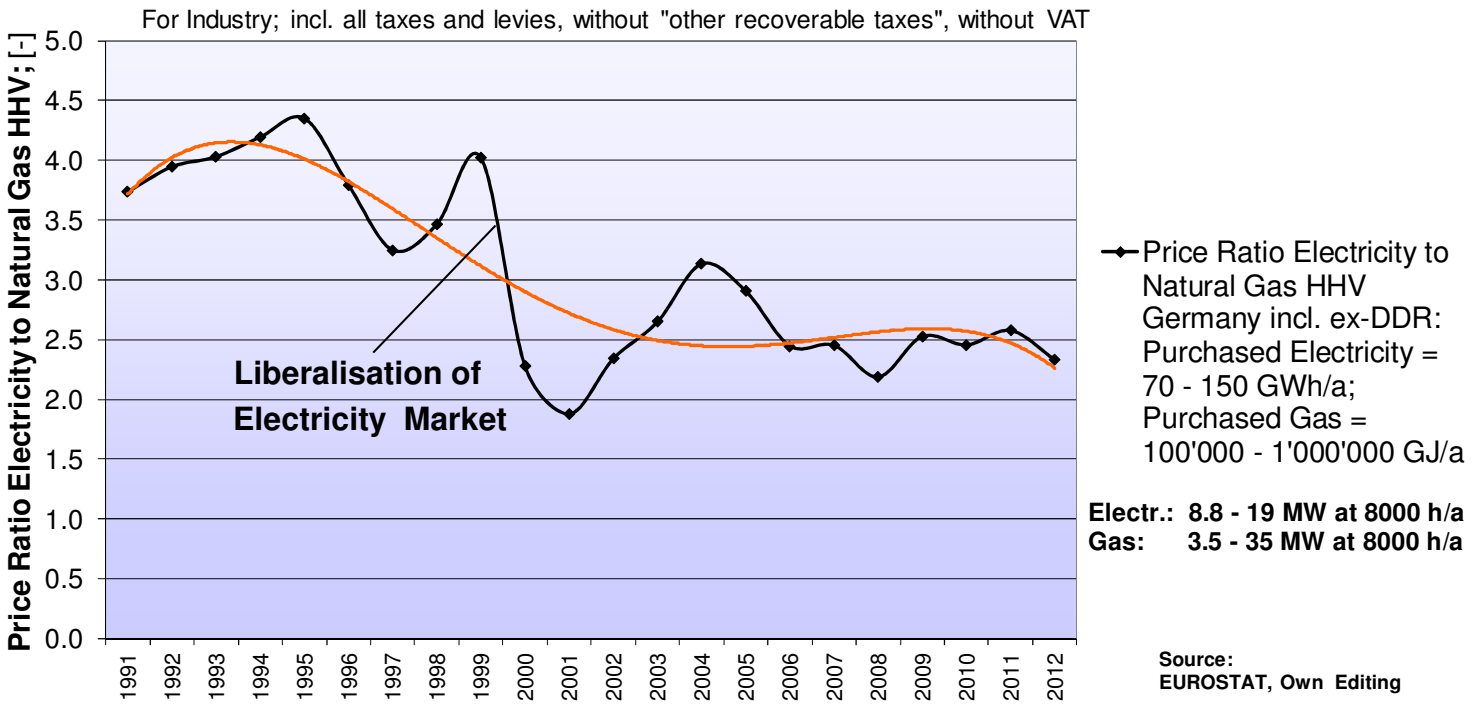
Natural Gas:

Natural Gas price still is correlated to Fuel Oil price. In the future this will change. Higher demand is covered by new pipelines. There is no supply bottle-neck in the mid term. Prices are especially influenced by crises situations or latest to a certain extent by speculation.

Electricity:

Price and demand correlates with economic growth rates. Price is heavily dependant on political / legal boundary conditions for the different Electricity Generation Technologies. There is no significant dependence between Natural Gas and Electricity price level

Purchase Price Ratio "Electricity to Natural Gas" at Germany



Choice of Turbine-based Cogeneration Plant Cycle with fossil fuels

Typical economically optimal Range

of Turbine-based Cogeneration (Combined Heat & Power) Stations
with fossil fuels for useful steam,
expressed with Price Ratio Electricity / Fuel;
without subsidies,

	Economic Optimum at Price Ratio Electricity / Fuel	Achievable Fuel Utilisation Factor	Achievable Ratio Electricity-to-Process Heat
Radiation-type Steam Generator with Steam Turbine (Steam Turbine CHP Station)	less than 1.8	> 90 %	0.1 – 0.3
Gas Turbine with Radiation Type SYSTEM HUTTER Steam Generator and Steam Turbine (Combined Cycle CHP Station SYSTEM HUTTER)	1.8 to 3.6	88 - 94 %	0.2 – 0.8
Gas Turbine with Heat Recovery Steam Generator (HRSG) and Steam Turbine (Combined Cycle CHP Station with HRSG)	more than 3.6	70 – 87 %	0.3 – 1.2

for 1-pressure Steam Generators,
without Condensation,
without „cold"-heat exchangers (Condensate Preheater / District Heating)

Choice of Turbine-based Cogeneration Plant Cycle with fossil fuels

Cogenerations for useful steam (Price Ratio Electricity / Fuel < 1.8):

The optimisation typically leads to
forced-draught fan operated **Radiation-type Steam Generator**
with subcritical live steam conditions, and
(extraction-) back-pressure steam turbine (**Steam Turbine CHP Station**)

Gas-fired Cogenerations for useful steam (Price Ratio Electricity / Fuel 1.8 - 3.6):

The optimisation typically leads to
Gas Turbine with exhaust gas operated **Radiation-type Steam Generator** with maximum possible Steam Generator power firing, using all remaining oxygen from gas turbine exhaust gas,
with subcritical live steam conditions, and
(extraction-) back-pressure **Steam Turbine** (**SYSTEM HUTTER CHP Station**)

Gas-fired Cogenerations for useful warm water or high electricity-to-heat ratio demands:

The optimisation typically leads to
Gas Turbine with single or multiple-pressure cycle **Heat Recovery Steam Generator** (HRSG) with additional Steam Generator firing, with subcritical live steam conditions, and
(extraction-) back-pressure or condensing **Steam Turbine** (**Gas Turbine CHP Station with HRSG**)

Choice of Turbine-based Cogeneration Plant Cycle with fossil fuels

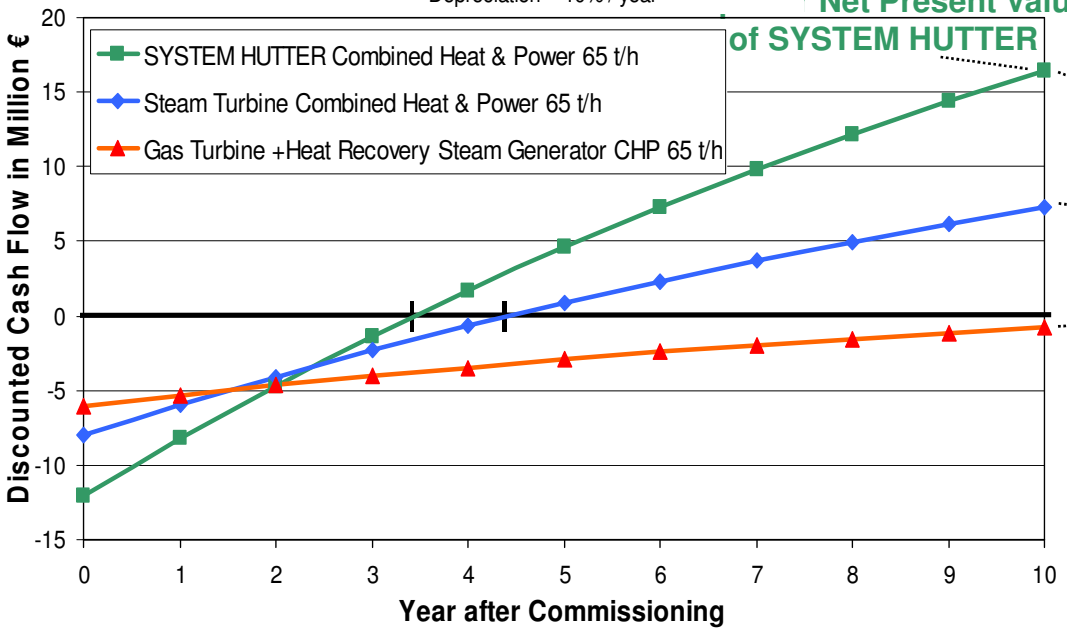
Economical Comparison:

Base is Steam Generator Plant and
Purchasing of all Electricity

Fuel: Natural Gas

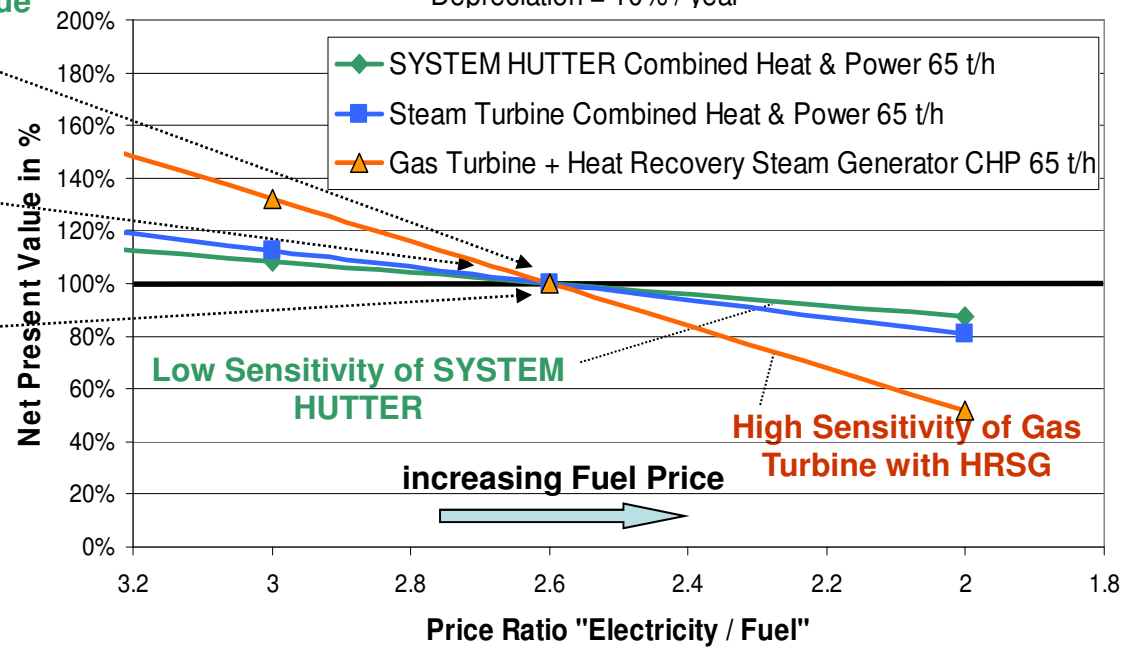
Discounted Cash-Flow DCF & Net Present Value

Price Ratio "Electricity / Fuel Gas" = 2.6
Rate of Interest = 7%
Depreciation = 10% / year



Sensitivity of Net Present Value

Price Ratio "Electricity / Fuel Gas" = 2.6
Rate of Interest = 7%
Depreciation = 10% / year



for single pressure Steam Generators, and
for Cogeneration of Process Steam and Electricity and 90% return rate of hot process condensate,
without Condensation
without "Cold"-Heat Exchanger (i.e. condensate preheater / District Heating)

Products

Combined Cycle CHP Stations SYSTEM HUTTER

Delivery of patented Combined Gas Turbine and Steam Turbine CHP Stations with radiation-type SYSTEM HUTTER steam generator for the simultaneous generation of useful steam & electricity, total efficiencies > 90% and great operation range

Gas Turbine CHP Stations with Heat Recovery Steam Generators (HRSG)

Delivery of Gas Turbines with Heat Recovery Steam Generators (and Steam Turbine), when the useful heat is used in form of hot water or in case of ratios Electricity to Fuel Price above 3.6

Steam Turbine CHP Stations

Delivery of radiation-type steam generators with steam turbines with fuels gas, oil, coal, biomass or bio fuels, when Gas Turbine CHP Stations are not the economically optimal or if Gas Turbines can not be used, or with biomass

Heating Plants & Steam Generator Plants

Delivery of Steam Generators for SYSTEM HUTTER-, Gas Turbine- and Steam Turbine CHP Stations.
The Steam Generators can be equipped with different fuel systems according to the boundary conditions

Thermal Power Stations (up to medium size)

Delivery of Thermal Power Stations up to medium size, with all turbine-based technologies, with fuels gas, oil, coal, biomass or bio fuels, for the generation of electricity, with time-reliabilities up to > 99%

Products

Residue Waste-to-Energy Plants

Delivery of Residue Waste-to-Energy Plants; for residual material in paper- and cardboard-production with bubbling fluidised-bed combustions with own developed combustion; for other fuels also with circulating fluidised-bed combustions

Waste Incineration Plants

in case of waste incineration plants we act as planning and executing engineer and deliver the water steam cycle with electricity- and heat generation. The waste firing and flue gas cleaning is not in our scope of supply.

Consulting & Engineering (Consultant, Owner‘s Engineer, General Planer, EPCM-Contractor)

electrification & master plans; project development, pre-studies, parameter- & feasibility studies, pre-engineering; design, engineering, project management, specifications, supplier control, site-, erection- & commissioning management

As Consultant, Owner’s Engineer, General Planer or EPCM-Contractor

- we act with our delivery products, if the Customer doesn’t want a turn-key- / EPC-Supplier
- we act for products to build Power Plants, which are not in our hardware delivery program, as e.g. large power stations (large Combined Cycle Power Stations, large Coal Power Stations) or entire Waste Incineration Plants

Process Automation & Distributed Control Systems

process-inputs for the process automation as for example process function plans, step sequence diagrams, control schematics, logic diagrams, control schematics, system descriptions & failure reactions of the plants. For deliveries including steam generators, we deliver the entire distributed control system with our specially designed steam generator controls.

Products – Technologies of Thermal Combined Heat and Power Stations

Heating Plant (Steam Generator only)	Low Pressure Steam Generator without electricity generation (purchasing of all electricity)
Steam Turbine CHP Station (CHP = Combined Heat and Power)	Radiation type High Pressure Steam Generator back-pressure, extraction and/or condensing Steam Turbine
Gas Turbine with Low Pressure HRSG (HRSG = Heat Recovery Steam Generator)	Gas Turbine with unfired or fired Low Pressure Heat Recovery Steam Generator (without Steam Turbine)
Gas Turbine with High Pressure HRSG & ST	Gas Turbine with unfired or fired High Pressure Heat Recovery Steam Generator back-pressure, extraction and/or condensing Steam Turbine
GT with Multiple-Pressure HRSG & ST (GT = Gas Turbine)	Gas Turbine with unfired or fired Multiple-Pressure Heat Recovery Steam Generator back-pressure, extraction and/or condensing Steam Turbine
Combined Cycle CHP SYSTEM HUTTER	Gas Turbine with Radiation-type SYSTEM HUTTER Steam Generator back-pressure, extraction and/or condensing Steam Turbine

Products - Repowering of Steam Turbine Power Plants to SYSTEM HUTTER

- existing Steam Turbine CHP-Stations can be extended to a Combined Cycle CHP Station SYSTEM HUTTER (Repowering)
- existing Steam Generator can be reused; the Steam Generator Firing need to be replaced
- Heavy Oil- or coal-fired Steam Generator can be modified to Natural Gas-fired Steam Generator
- only a few conditions at the existing Steam Generator need to be fulfilled for modifying it into a SYSTEM HUTTER Steam Generator
- the existing Steam Turbine and Water-Steam Cycle can be re-used
- It is **neither necessary** to install a **new Steam Turbine** nor a complete **new Steam Generator** or **Heat Recovery Steam Generator**

Repowering from Steam Turbine-CHP-Station to SYSTEM HUTTER leads to:

- Increase of the Electricity Generation
- Maintaining the high Fuel Utilisation Factor of the Steam Turbine CHP Station
- Reduction of the Investment Cost by re-use of large components
- Improvement of the Profitability of the CHP Station

Capabilities and Services

- Consulting Engineer (Owner‘s Engineer)
- Planning- and Executing Engineer
- General Planer / EPCM-Contractor
- Component-Supplier
- Turn-key Supplier (EPC-Contractor)

In all project phases HUTTER FREI POWER offers competent and independent Services:

Analysis and Design

- Electrifications, Master Plans, Integrated Infrastructure Concepts, Site Investigations, Project Developments, Pre-Studies, Parameter Studies, Feasibility Studies, Environmental Impact Assessments, economic-technical Analysis, Plant Concept Designs, Preliminary Planning & Design Planning, Pre-Engineering

Planning and Procurement

- Overall Planning, Conceptual Planning, Permitting Studies, Execution Planning, Plant specification, Inquiry Specifications (ITT), Bid Evaluations, Contract Award Negotiations and -Recommendation, Contract Preparation

Execution / Project Realisation

- Project Management, Interface Management, Supplier- & -Document Control, Factory Acceptance Test, Site- & Overall Erection Management, Overall Civil Mgmt., Commissioning Management, Environmental Health & Safety Coordination, Training, Acceptance Tests, Trial Run, Documentation, Warranty Support

Operation

- Process Optimisations, Environment-, Risk- and Quality-Management, Maintenance Planning, Operation Optimisation

General Consulting

- Market Analysis, Energy Tariff Studies, Project Development, Project Financing, Lender's Engineer, Due Diligence, Portfolio Management for Energy Purchasing

Capabilities and Services

Detailed Component Design & Commissioning:

Steam Generators

- Detailed Design with preparation of Steam Generator Model
- Calculation with special Steam Generator calculation program
- Determination of heat exchanger configuration, geometry, material and heat exchanger type for all heat exchangers
  (incl. number of tubes, wall thicknesses, distances, etc.)
- Calculation of Thermal Calculations, Water Calculations
- Preparation of open-loop and closed-loop controls for Steam Generators
- Hot Commissioning of Steam Generators
- Performance Measurement of Steam Generators

Exhaust Gas System

- Detailed Design of GT Exhaust Gas Duct System with
  Special Dampers, Exhaust Gas Ducts, Exhaust Gas Impact Plate Diffusor, Expansion Joints

Overall Distributed Control System (DCS)

- Detailed Input for DCS application program with
  step sequence diagrams, logic diagrams, control schematics, system descriptions, failure reactions and maintenance supervision of the plant
- Commissioning of DCS application program

Each CHP / Power Station is individually designed for Customer's Needs

Sequence for Design, Engineering and Purchasing

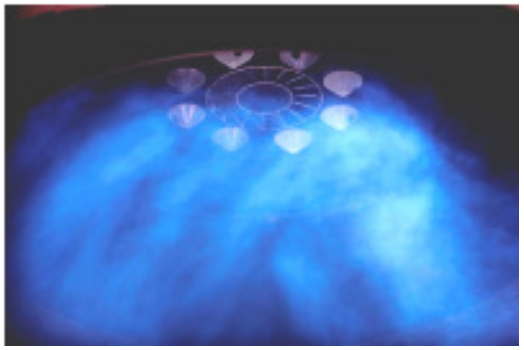
- 1. Step: Overall Plant – Preparation of overall cycle concept and heat balances
- 2. Step: Develop the optimal variant of the overall cycle and select possibly the most optimal suiting Gas Turbine
- 3. Step: Preparation of overall operation and control concept
- 4. Step: Preparation of Component-Specifications and inquire Supplier proposals
- 5. Step: Evaluation of Supplier proposals with the technical necessary quality, competence incl. delivery schedule; subsequently placing of orders to Suppliers

- ➢ the only in-depth standardisation is with the Gas Turbine; all other components are individually designed and purchased by our Engineers
- ➢ the Competence and Experience is the key for each individual Project

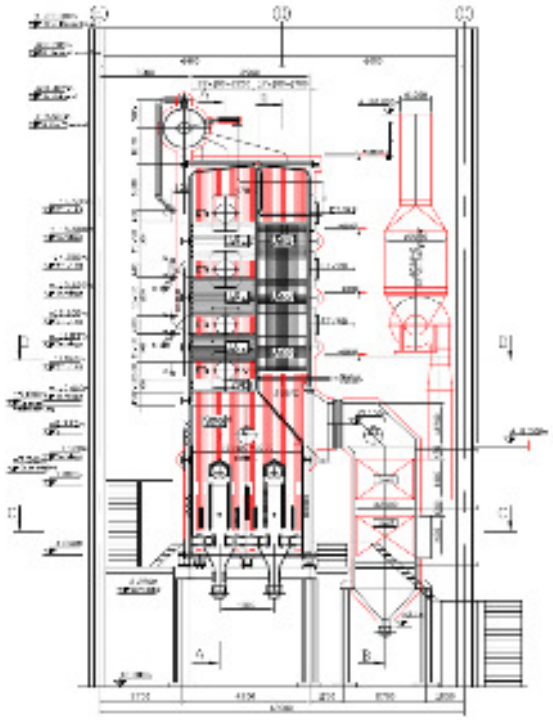
Patent Rights

Our Company is holder of Patent Rights:

- on low emission technology of Steam Generator Firing, and on special thermal Steam Generator configuration of Radiation-type SYSTEM HUTTER Steam Generators downstream Gas Turbines to reach highest total efficiencies and consequently fuel savings and reductions of CO_2 emissions
- on CO reduction technologies on bubbling fluidized-bed Combustion Plants



Cut-away Gas Turbine ROLLS ROYCE KB5
in the Zellcheming Fair in Wiesbaden, Germany



Design of optimised Bubbling Fluidized-Bed Combustion for rejects from paper- and card-board- production with high-pressure Steam Generator

Competent and experienced Employees for

- Consulting and Studies
- Development of innovative plant technologies
- Customer Support, e.g. with the preparation of permit application
- Expert Know-how of Plant Engineering and Components of power plants, at latest state of the art
- Planning, Design, Engineering, Procurement, Supplier control, Construction control, Turnkey supply
- Steam Generator detailed design
- Innovative open-loop- and closed-loop control concepts, e.g. for steam generator
- Project management
- Site management, Overall Erection Management,
- Overall Commissioning Management
- Commissioning
- Acceptance tests measurement

Our Customers

Our Customers are looking for a Partner for a high-grade solution,

- which provides for CHP Stations simultaneously useful heat and electricity and for Power Stations purely electricity
- which turns out to be the optimal plant variant considering all applicable power plant technologies
- which are individually optimised to his needs
- which uses high efficient and environmentally protecting technology
- and which offers the needed flexibilities in the type of operation and in the operation range

Our Customers are looking for a Partner,

- who analyses continuously the technical and economic developments in the (CHP-)Power Plant business
- acts competently and experienced
- keeps at least the agreements
- can successfully lead a power plant project
- and acts in line with the Overall Project Interest

Customers and Operators of CHP Stations

Companies, which continuously and simultaneously need
Useful Heat (Steam or Warm water) as well as Electricity:

UPM Nordland Paper Mill, Dörpen, Germany

- Paper- and Cardboard
- Textile
- Automobile
- Steelwork
- Cement
- Chemistry
- Aluminium
- Mines
- Oil refinery and Oil production
- Sugar
- Food
- District Heating, Airports, Industrial Parks
- Process Industry
- Residue-Waste-to-Energy / Waste Incineration Plants

Customers and Operators of Thermal Power Stations

Companies, which either
need pure Electricity or
continuously and simultaneously need
Electricity and a relatively small portion of Useful Heat:

- Power Utility Companies
- Municipal Utilities and Service Providers
- Independent Power Producers
- Industries

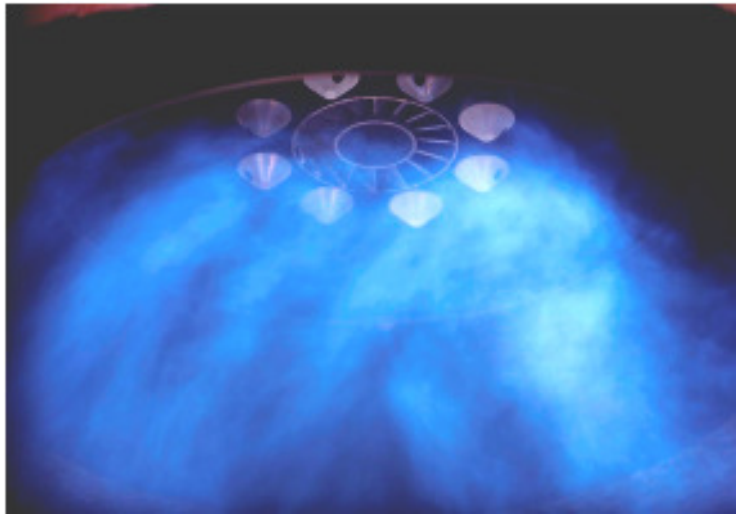
Three Combined Cycle CHP Stations SYSTEM HUTTER Varel 1, 2, 3

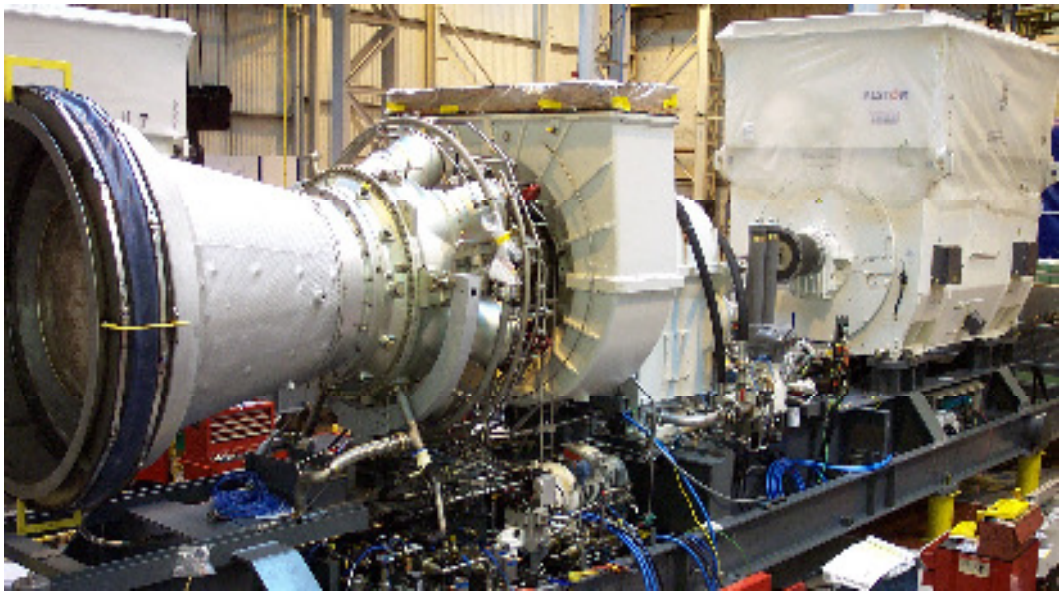
Three Combined Cycle
CHP Stations SYSTEM
HUTTER
at the Paper and Board Mill
Varel, Germany,

Varel 1; 1990; 211‘000 OH

Varel 2; 2003; 91‘000 OH

Varel 3; 2007; 56‘000 OH





Combined GT & ST CHP Station SYSTEM HUTTER

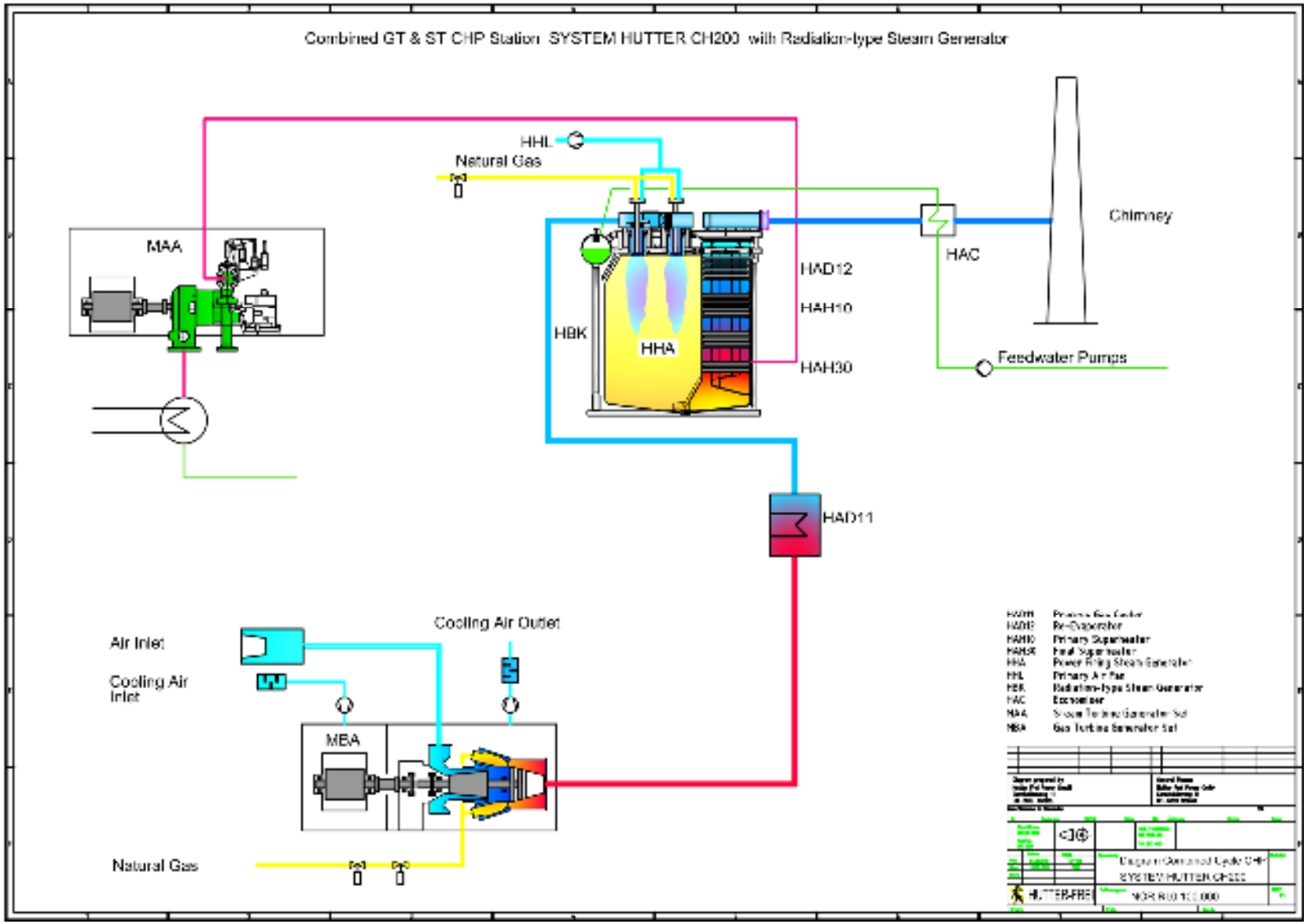
is a high-grade Combined Gas Turbine- and Steam Turbine-CHP Station,
own developed and based on **own patents**,
achieving highest fuel utilisation factors and
superior economy,
saving CO_2-emissions and reducing CO_2-Costs,
using a Radiation-type SYSTEM HUTTER Steam Generator
instead of a Heat Recovery Steam Generator (HRSG)

SYSTEM HUTTER

is designed for Cogeneration / Combined Heat & Power (CHP) Applications
in Industries and District Heating Systems,
for the simultaneous generation of
Electricity and Process Steam or District Heating Steam

Combined Gas Turbine & Steam Turbine CHP Stations SYSTEM HUTTER

Combined Cycle CHP Station
SYSTEM HUTTER
with
Gas Turbine on down-stream-arranged Radiation-type High Pressure SYSTEM HUTTER Steam Generator and
Steam Turbine



Combined Gas Turbine & Steam Turbine CHP Stations SYSTEM HUTTER

SYSTEM HUTTER are the **solution** of investigations concerning **optimisation** of

- thermal plant cycle concepts
- economic plant parameters
- macro-economic scenarios

Advantages:

- Superior Economy (i.e. Net Present Value, Internal Rate of Return)
- Lower Sensitivity against Fuel Price Escalation
- Highest Fuel Utilisation Factors (Total Efficiencies) up to 94 % – Reduced Fuel Costs
- Reduced CO_2-Emissions – Reduced CO_2-Costs
- Extended Operating Range down to 20 - 30 % of nominal steam generation
- Operation Field (ratio between electricity- & steam generation adjustable) without Condensing Steam Turbine
- High Operation Flexibility with fast process steam load changes
- Highest Time-Reliability
- Environmental Protection by low Air Pollutant Emissions – No Secondary Emission Reduction Costs
- Repowering of existing Steam Turbine CHP Stations or GT with Heat Recovery Steam Generators possible

Combined Gas Turbine & Steam Turbine CHP Stations SYSTEM HUTTER

SYSTEM HUTTER Modules for single-line configuration

- Electrical Power from 2 MW to 78 MW
- Steam Generation from 12 t/h to 200 t/h

SYSTEM HUTTER Plant Types	Nominal Electrical Power Gas Turbine MW	Nominal Steam Generation t/h	Total Nominal Electrical Power Output MCR (max. contin. rating) MW	Nominal Live Steam Parameter of Steam Generator (values will be optimised depending on the commercial value for efficiency) bar a / °C
CMK3	1.2	12 - 18	2.0 – 3.8	45 / 450
CH30	3.5 - 4	36	8.5 - 9	64 / 450
CH45-EUROPA	5.0	45	10.6	64 / 450
CH65	6.0 - 7.8	65 - 80	15 - 17	70 / 480
CH100	2x6 - 18	100	26 - 32	90 / 480
CH200	25 - 45	200	58 - 78	92 / 505

Total Nominal Electrical Power Output are valid for Plants without condensation and depending on process steam parameter

Gas Turbine CHP Stations with Heat Recovery Steam Generator

For applications with
warm water as useful heat or with high electricity-to-heat ratio demands
can **Gas Turbines** with **Heat Recovery Steam Generators** (HRSG) and Steam Turbines
be the economically-optimised solution.

We optimise the design of the HRSG
individually to the boundary conditions of the project
to achieve **increased fuel utilisation factors** together with **increased generation of electricity** and
low air-pollution emissions.

Our optimisation for Cogeneration Plant Cycles with Fuel Gas / Diesel leads among others to
multiple-pressure cycle Heat Recovery Steam Generator with special designed boiler firing concept
with **lower rate or higher rate of Steam Generator firing** and
elevated subcritical live steam conditions.

Economy of Turbine-based CHP Stations for useful steam

- 15 percent point differences of the total efficiency η determine a Return of Investment between an IRR (Internal Rate of Return) of Zero (η = 75%) to 35 % (η = 90%)
- The emphasis of the design is placed on a maximisation of the Steam Turbine Power in the Steam Turbine back-pressure process
- The Investment-Security increases (Sensitivity decreases) with an increasing Fuel Utilisation Factor

Operation Experience of Combined Cycle CHP Stations SYSTEM HUTTER

7 CHP Stations SYSTEM HUTTER in Operation

Cumulative Operation Experience:

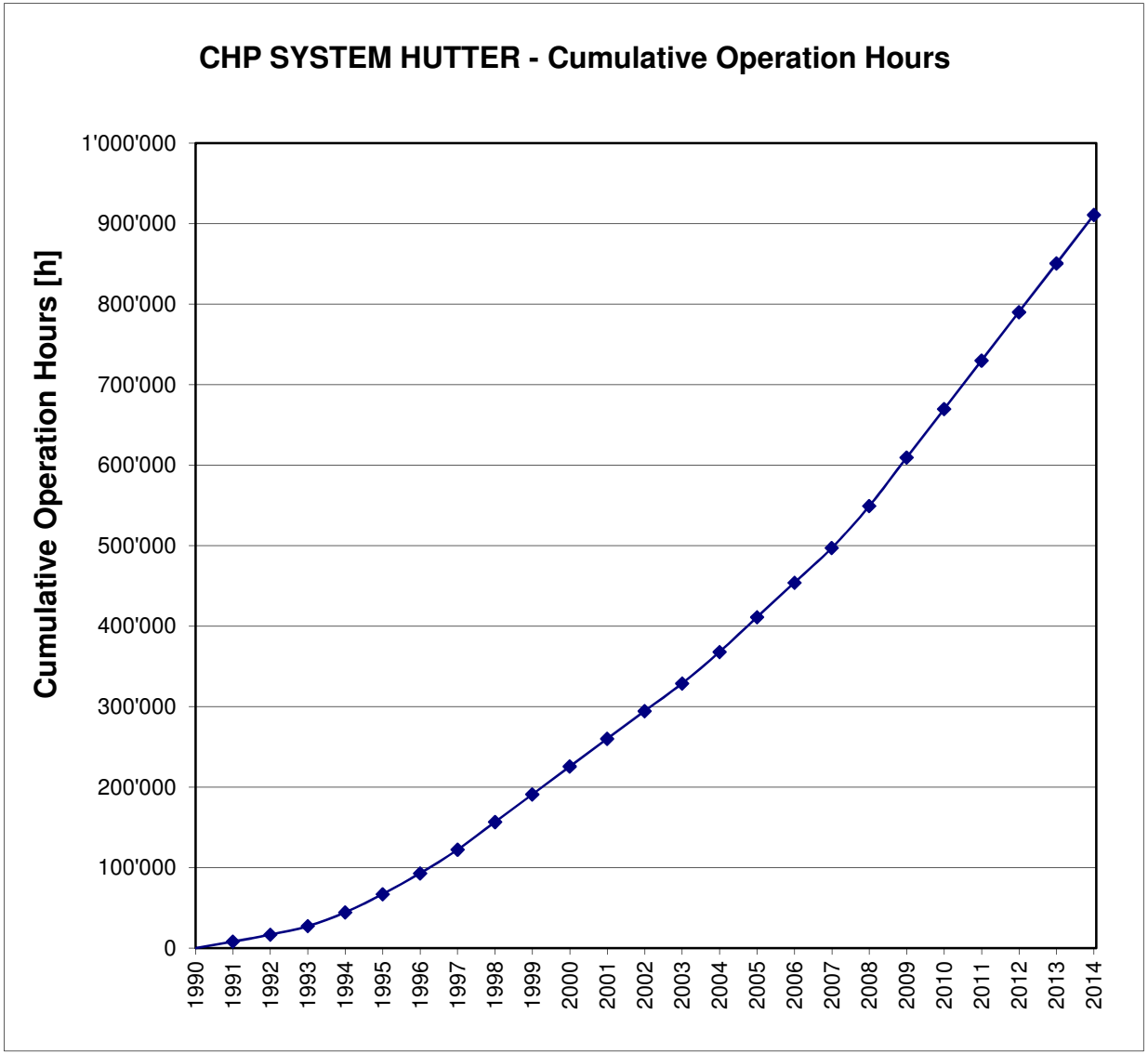
- 106 Years
- 911’000 Operation Hours

Longest Operation Experience:

- 24 Years
- 211’000 Operation Hours

Time-Reliability:

- > 99.5 %



References of delivered SYSTEM HUTTER and further CHP Stations

- **Combined Cycle CHP Station SYSTEM HUTTER Varel 1**
  for Paper- and Board Mill VAREL; Varel, Germany
- **Combined Cycle CHP Station Repowering to SYSTEM HUTTER Buchmann 1**
  for Board Mill BUCHMANN; Annweiler-Sarnstall, Germany
- **Combined Cycle CHP Station SYSTEM HUTTER Smurfit Kappa Badische Karton & Pappenfabrik (BKPO) 1**
  for Board Mill SMURFIT KAPPA BADISCHE KARTON & PAPPEN; Obertsrot, Germany
- **Combined Cycle CHP Station SYSTEM HUTTER Smurfit Kappa Europa Carton Hoya 1**
  for Paper Mill SMURFIT KAPPA EUROPA CARTON; Hoya, Germany
- **Combined Cycle CHP Station SYSTEM HUTTER Varel 2**
  for Paper- and Board Mill VAREL; Varel, Germany
- **Combined Cycle CHP Station SYSTEM HUTTER Varel 3**
  for Paper- and Board Mill VAREL; Varel, Germany
- **Combined Cycle CHP Station SYSTEM HUTTER Buchmann 2**
  for Board Mill BUCHMANN; Annweiler-Sarnstall, Germany
- **Extension of Heating Plant with Steam Turbine Plant - Refurbishment and Modernisation of a used Steam Turbine**
  Paper Mill STORA ENSO UETERSEN, Uetersen, Germany
- **Waste Incineration Plant Mainz Line 3** – Overall Concept, Integration, Engineering and Delivery of Energy part around Steam Turbine
  KRAFTWERKE MAINZ-WIESBADEN – Entsorgungsgesellschaft Mainz mbH, Mainz, Germany
- **Combined Cycle CHP Station SYSTEM HUTTER UPM Nordland Papier 1** (Design, Pre-Engineering, Authority Permitting)
  UPM NORDLAND PAPIER; Dörpen, Germany

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