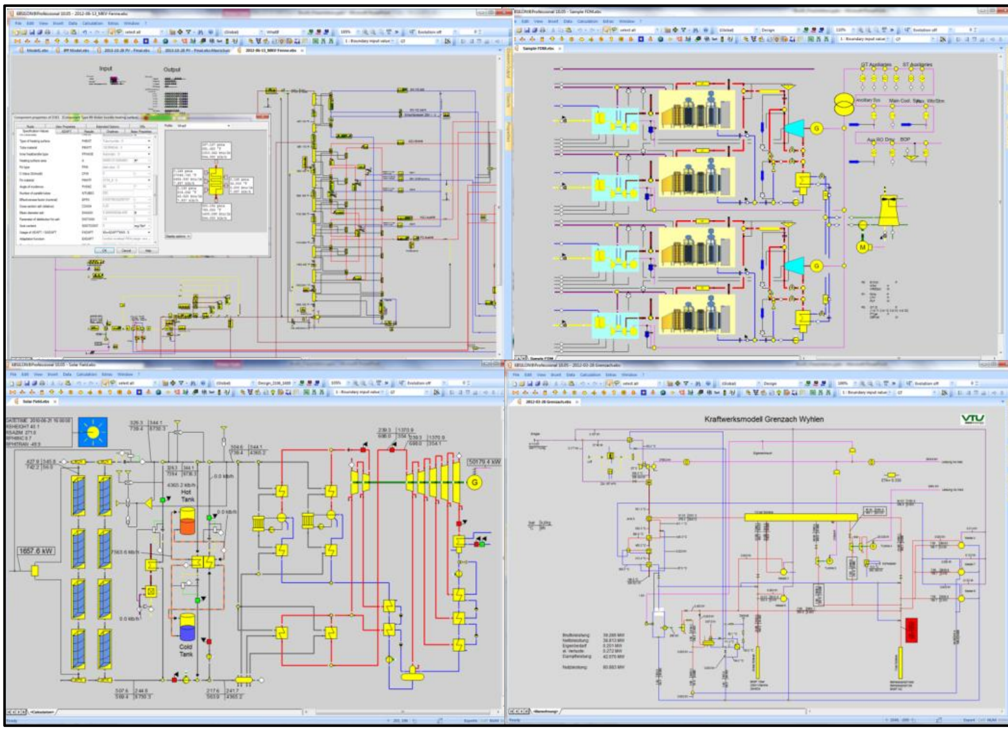
ENEXSA – formerly known as VTU Energy - is an Austrian expert company that concentrates on consultancy and software systems for the power and energy-intensive process industries.

ENEXSA’s expertise covers the entire range of thermal power generation, but in terms of the type of our products and services, ENEXSA concentrates on areas in which it excels through highest quality and can compete globally through its know-how and experience:

- Consulting based on thermodynamic simulation
- Fuel demand models and settlement systems for independent power (and water) plants
- Plant simulation models,
- Heat balance software, and
- Optimization systems.



ENEXSA Portfolio

- Consulting based on thermodynamic simulation
- Fuel Demand Models & Settlement Systems for IPP
- Plant simulation models
- Heat balance software
- Optimization systems

Why is process simulation so important for the power industry?

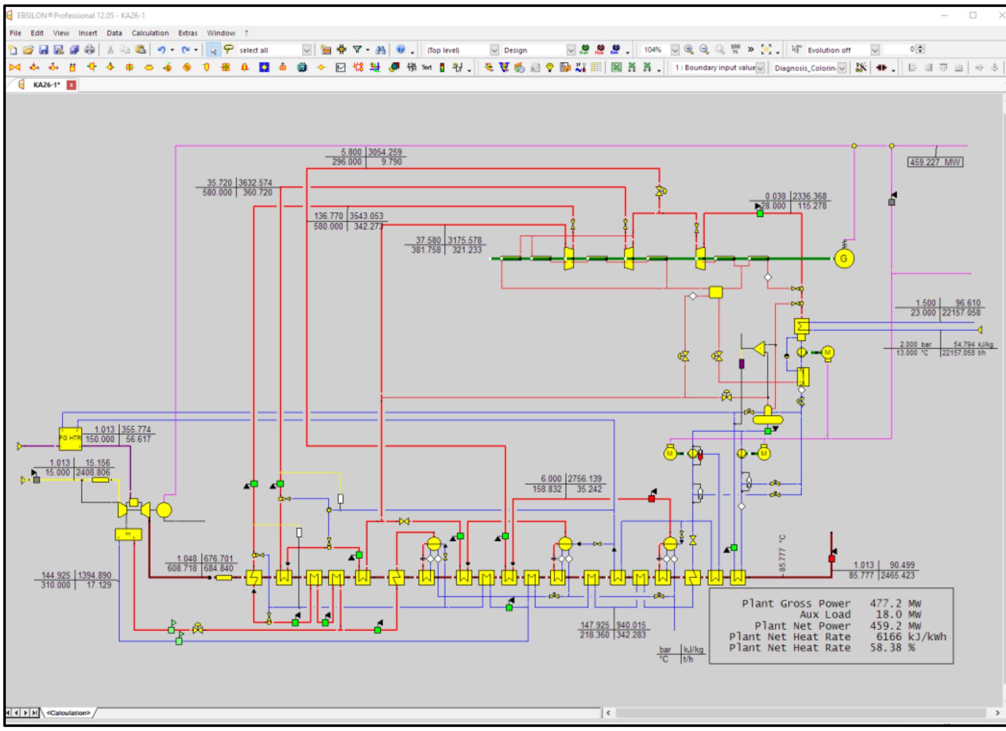
Very different to other industrial processes, the power generation process is directly linked to the consumers of its product, since electric power cannot be stored in the quantities in which the demand fluctuates over time. Thus, most of the power plants must follow the load demand and operate under conditions which are different to their design conditions for most of the time. The growing share of renewable energy in the generation mix which origins from highly fluctuating sources (wind and solar) has dramatically aggravated this situation.

In order to create an optimal design for a new power plant or the modification of an existing power plant, the engineer therefore has to evaluate his design under the entire range of expected operating conditions over the entire range of project ambient conditions.

For an existing power plant operating in a de-regulated competitive market environment, the accurate prediction of plant capacity and fuel consumption under expected conditions for the next day or week is essential to mitigate the risk of overcommitting plant capacity or to bid prices above actual current variable cost of generation.

The key differentiators for ENEXSA in the field of thermodynamic simulation of power plants are unrivalled expertise and the combination of both, software development and software application.

Although ENEXSA covers the entire range of thermal power generation processes, the majority of our projects are for gas turbine-based combined cycle (CCGT) or combined heat and power (CHP) plants. This is because gas turbines are an attractive option for fossil power generation due to their low specific investment cost and their high fuel efficiency. Since gas turbine performance shows a distinct dependence on ambient and load conditions, process simulation plays a key role in every large CCGT or CHP project.



CCGT Plant Modelling

- Gas Turbine Library
- HRSG components
- ST components
- Cooling systems
- Controllers
- Fluid libraries
- Scripting language for custom calculations

ENEXSA’s tools (the EBSILON heat balance software and ENEXSA’s Gas Turbine Library) allow to build an accurate plant simulation model that exactly reflects the equipment performance data supplied by the vendors and mimics the plant control schemes.

In a development project for a large scale independent power plant, the optimal plant concept is determined based on such a model, and in case of IWPP projects ENEXSA works closely with equipment vendors and the EPC as well as the financial adviser of the project developer to find the optimal plant concept that meets all technical requirements of the tender with the most competitive tariff for power and water, respectively.

Picture courtesy of Sembcorp Salalah O&M Company Ltd.

ENEXSA

Reference Project

Salalah IWPP

- Sembcorp Salalah Co.
- Sultanate of Oman
- 450 MWe/68,000 m³/d
- Successful bid support in OPWP tender
- Fuel Demand Model
- Model based acceptance test procedures
- Technical consultancy for performance improvements

The Salalah IWPP is a gas turbine-based cogeneration plant with a nominal power capacity of 450 MW and a nominal water production of approximately 68,000 m³/day (15 MIGD). While ENEXSA has dealt with much larger IWPP projects in the Middle East region, this plant had the specific complexity of operating in a small regional electricity grid, which led to specific constraints on the mix of power generation equipment, desalination technology and plant auxiliaries. For Singapore-based Sembcorp Industries, ENEXSA developed a plant concept consisting of 5 GE 6FA gas turbines, 2 Dong Fang steam turbines and reverse osmosis (RO) desalination units supplied by Hyflux of Singapore. The EPC for this project was Shandong Electric Power Company No. 3 (SEPCO III) from Qingdao, China.

For the hourly evaluation of the performance guarantees of the power and water purchase agreement (PWPA) for this plant, ENEXSA also supplied an on-line Fuel Demand Model which calculates guaranteed fuel consumption.

Since the electricity demand in the regional grid is still too small to consume the full plant output capability, ENEXSA supported the acceptance test of this independent water and power plant with the development of a model-based acceptance test procedure which combines the test results from individual blocks of the power plant to a hypothetical (simulated) plant reflecting measured performance with all equipment in operation.

ENEXSA continues to support the Salalah IWPP with technical consultancy, such as analysis of interim performance tests and expert advice for performance improvements.


Picture courtesy of OMV

ENEXSA

Plant Model ‘as built’

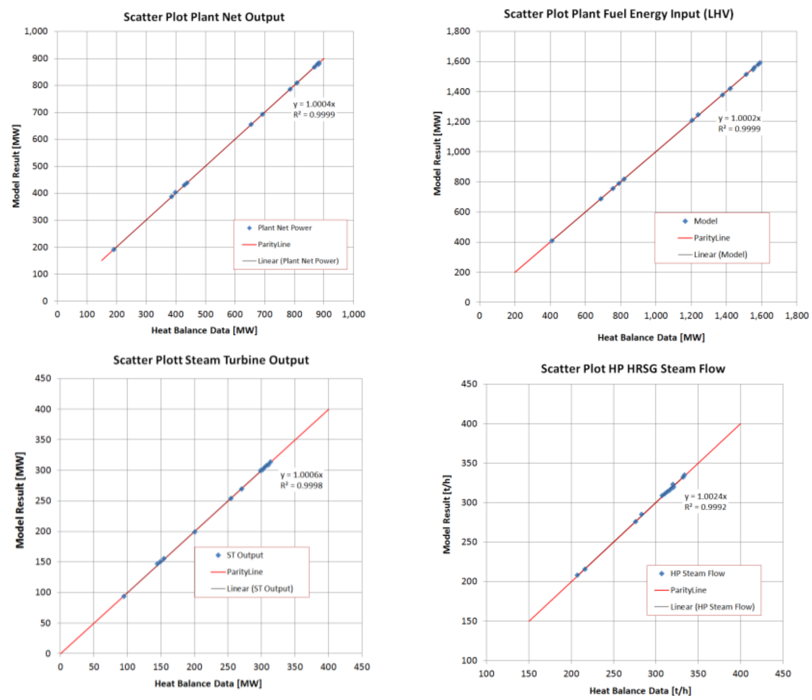
- Design heat balances
- Data reconciliation
- ‘As built’ tuning
- Operator interfaces
- Data integration
- Customized tools

By nature it is very unlikely, that a power plant will exactly match its theoretical performance as per the design calculations. In order to mitigate commercial risk, the guarantees of equipment vendors will typically include some margins; and production tolerances and the quality of the plant construction as well as equipment degradation over time will influence the degree to which actual plant performance will deviate from what is evaluated during performance tests or can be seen from the operating instrumentation.

Producing a plant model that accurately matches current plant performance on an equipment level creates significant benefits:

- The model can be used to compare individual equipment performance (gas turbine, steam turbine, heat recovery steam generator, condenser etc.) with the expected performance from the ‘as built’ model, so that degradation can be quantified and condition-based maintenance can be triggered.

- Accurate prediction of ‘as built’ plant capacity and fuel efficiency provides essential inputs for generation planning and trading.

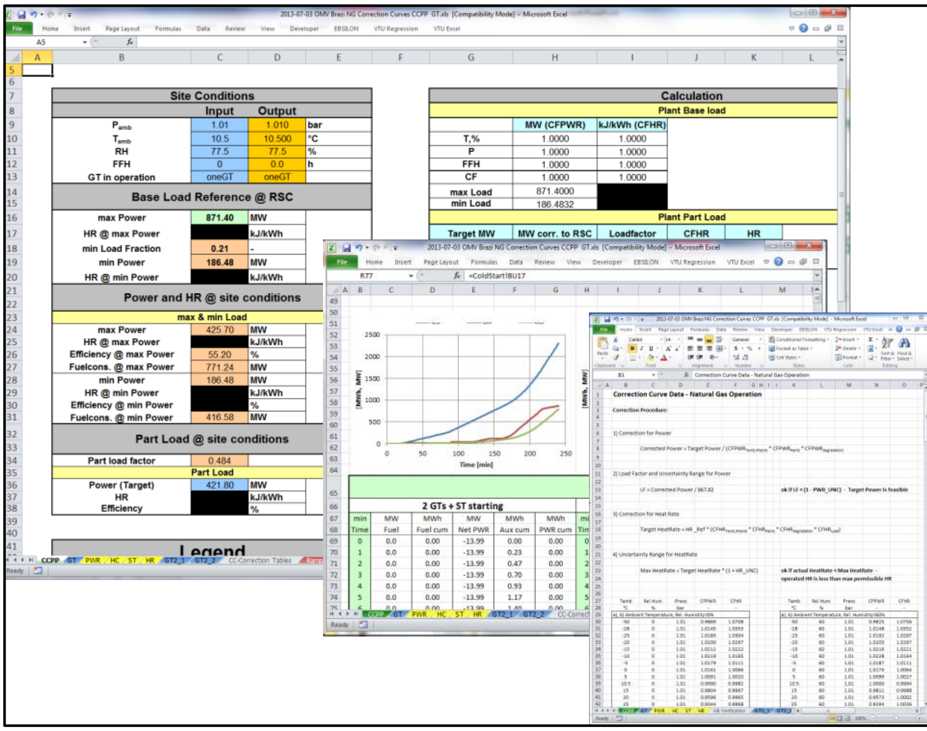


Plant Model 'as built'

- Design heat balances
- Data reconciliation
- 'As built' tuning
- Operator interfaces
- Data integration
- Customized tools

These scatter plots from a customer project demonstrate the accuracy of ENEXSA's plant model compared to plant performance data. In this example, OEM design heat balance data are compared with the respective model results for plant net electric power output, plant fuel energy consumption, steam turbine power output and steam generator flow over the entire load range of the plant. In a similar manner, a plant model can be further refined to reflect 'as built' performance information generated in acceptance or performance tests or recorded during operation.

Data reconciliation is a model-based process to verify plant measurements for consistency with the physical laws of conservation of mass and energy. Applying a special calculation mode in the thermodynamic model, certain key parameters in the model are adjusted to achieve best fit between measured data and physically correct model results. ENEXSA has gained in-depth experience in applying the EBSILON heat balance software for on-line performance monitoring systems including data reconciliation.



ENEXSA

Plant Model 'as built'

- Design heat balances
- Data reconciliation
- 'As built' tuning
- Operator interfaces
- Data integration
- Customized tools

For power plants that operate in a de-regulated market for electricity, the accurate prediction of the cost of generation under varying operating and ambient conditions is required for the calculation of the price to bid into the power pool. ENEXSA works closely with plant operating companies and trading departments in developing customized models for plant performance and cost of generation which can be integrated with trading systems or other planning tools. ENEXSA's capabilities in software engineering make ENEXSA a one-stop shop for the complex interaction between the trading system and the thermodynamic model of the power plant.


Picture courtesy of OMV

ENEXSA

Reference Project

Brazi CCGT

- OMV Petrom
- Brazi, Romania
- 870 MW (GE 209FB)
- Plant model
- Cost model
- 'As built' plant model
- Plant correction curves
- Performance analysis

For the Austrian oil & gas company OMV, ENEXSA supplied plant models and expert consultancy for their combined cycle power plants located in Brazi, Romania and Samsun, Turkey. Both are large CCGT projects with nominal power capacity larger than 850 MW and utilizing GE 9FB gas turbine technology. ENEXSA's models were used for the evaluation of performance tests, and continue to be used for ongoing performance analysis as well as for generating up-to-date performance information feeding into the optimization system of OMV's trading company.
In the course of the project, ENEXSA also developed a detailed cost model which combines performance-related variable costs of power generation with cost functions for equipment wear due to cycling operation and ramping operation.

ENEXSA

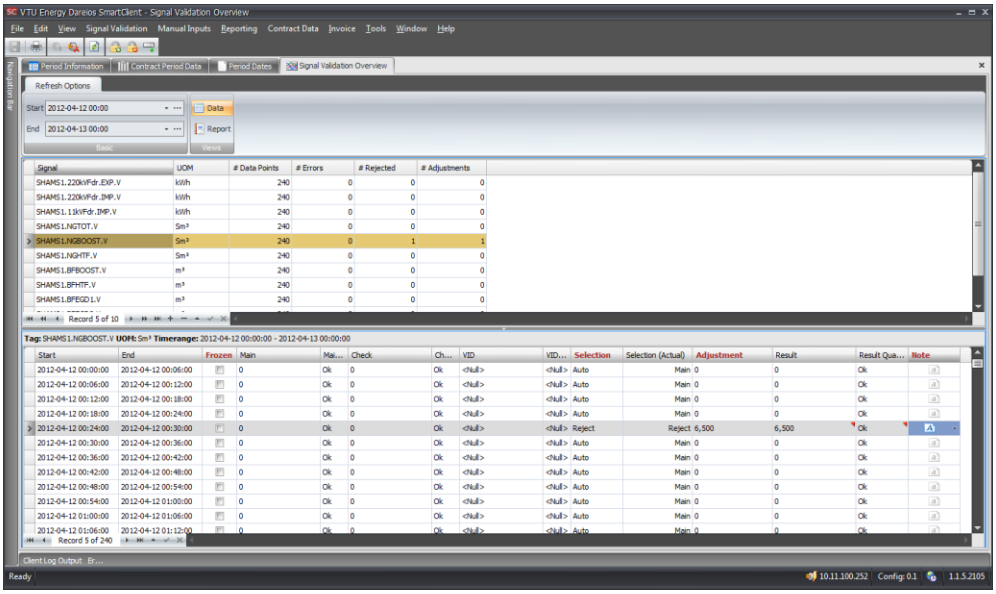
Settlement Systems

- Fuel Demand Models
- Meter accounting
- Data validation
- Manual inputs
- Invoice generation
- Turnkey systems

Settlement systems are software systems for the processing of the complex regulations of long-term power purchase agreements (PPA) or power and water purchase agreements (PWPA) as applied in independent power (and water) projects, primarily in the Gulf region. Since the government of a country with fossil fuel resources uses independent power plants to convert fuel owned by the state into electricity and - in case of IWPP – water for the government, the fuel is typically treated as a pass-through item or sold at project-specific fees which are de-coupled from world market prices.
Thus in the PWPA, particular focus is put on the performance of the independent power plants in three particular aspects: generation capacity, fuel efficiency and plant availability, and all of these criteria are formulated in specific equations for the tariff components under various operating conditions for each season of the contract year.

ENEXSA has successfully delivered turn-key settlement systems – oftentimes including detailed thermodynamic Fuel Demand Models (FDM) – for the majority of the IPP and IWPP projects in the Middle East. In December of 2017, ENEXSA successfully completed the FDM and settlement system for the Myingyan IPP, the first IPP in Myanmar. The growing number of independent power projects in Northern Africa, and South-East and South Asia indicates that the success of the Public-Private-Partnership model for large infrastructure projects in the Middle East is also appealing to other emerging economies.

ENEXSA



Settlement Systems

- Fuel Demand Models
- Meter accounting
- Data validation
- Manual inputs
- Invoice generation
- Turnkey systems

ENEXSA has developed a comprehensive suite of software modules to cover all aspects of the processing of complex PWPAs ranging from data exchange and signal verification to elaborate procedures to determine the payment components of the project-specific contract. ENEXSA's PASS Plant Accounting and Settlements Systems excel through robustness and ease-of-use, and ENEXSA's expertise in designing settlement systems which requires both, in-depth technical understanding and experience with contracts of such nature and the special contractual relationships between the government and the project developers, has been appreciated by both, project companies and authorities in the UAE, Oman, Bahrain, Saudi Arabia, Qatar, and Kuwait.

ENEXSA

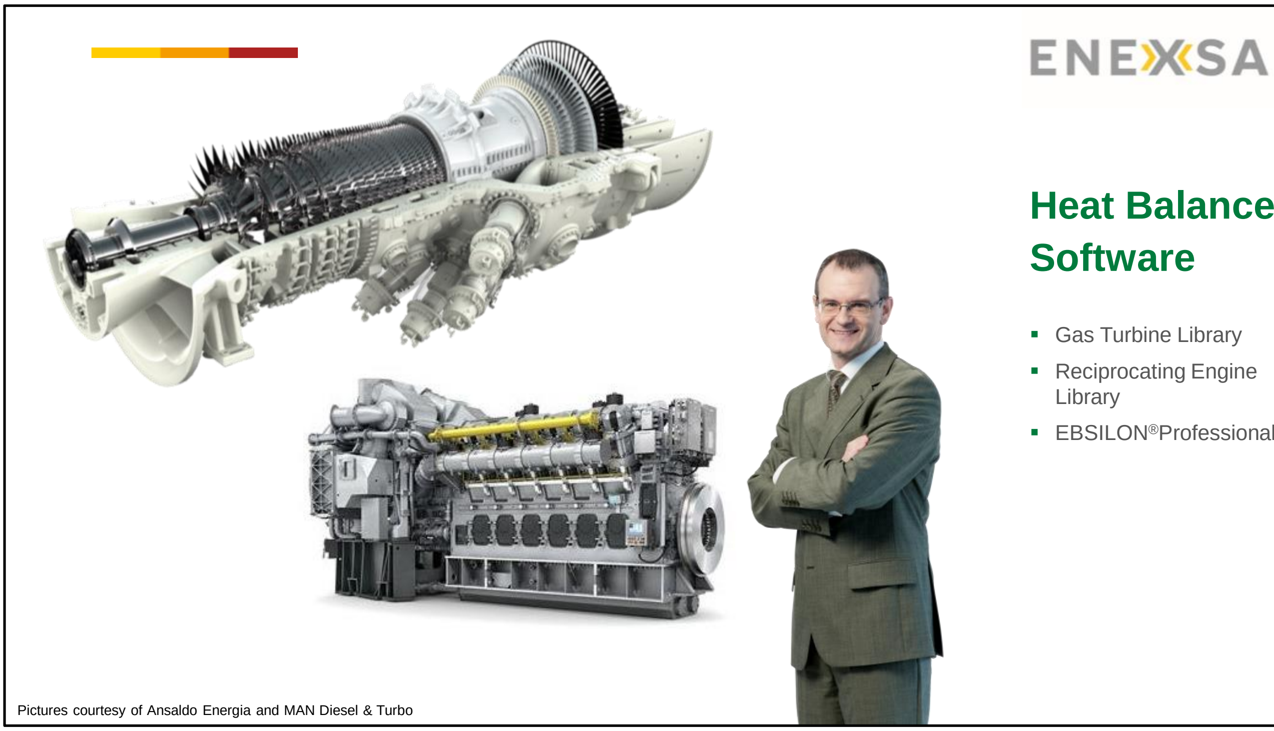
Reference Project

Shams 1 ISP

- Shams Power Company (TOTAL & Abengoa Solar)
- Medinat Zayed, UAE
- 100 MW nominal
- 25-year 'Solar' PPA
- Accounting & Settlement System
- Turn-key System plus off-taker copy (ADWEC)

Although it does not include a Fuel Demand Model as the coal/HFO-fired and gas turbine-based IPP and IWPP projects supported by ENEXSA, the Shams 1 Independent Solar Power (ISP) plant has been a milestone in the history of ENEXSA settlement systems, as it is the first solar thermal independent power project in the complex contractual environment of a Middle East PPA. ENEXSA successfully helped to define and implement a new type of PPA and the plant successfully entered full commercial operation under a 25-year PPA in September 2013.
The Shams 1 ISP is owned and operated by Shams 1 Power Company which is a joint venture between TOTAL of France, Abengoa Solar of Spain and Taqa of UAE has a nominal power capacity of 100 MW which it produces from a solar field of 768 parabolic trough collectors covering an area of 2.5 square kilometres.

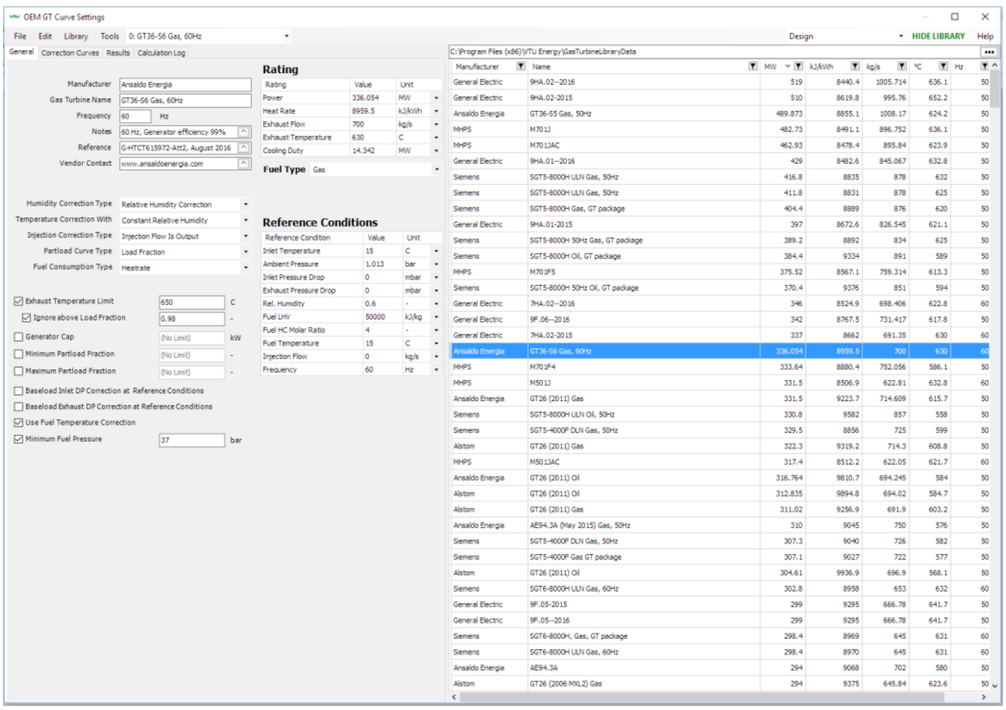
Meanwhile, ENEXSA's references for independent solar power plants also include CSP plants with thermal storage (Ouarzazate Noor 1 and Noor 2, Morocco), and solar tower technology (Noor 3). With the Sweihan PV IPP in the UAE, ENEXSA received the order for the billing system for the largest solar PV IPP world-wide that will have a capacity of 1177 MW in its final stage.



The key to ENEXSA's success is the unique combination of both, world-class engineering know-how and state-of-the art software tools.

The application of its software tools enables ENEXSA to evaluate design ideas faster and more accurately. Precisely predicting complex scenarios of future plant operation allows making better design decisions. Our customers benefit from this evaluation of the performance impact and subsequent operating cost implications of design alternatives and can base their investment decisions on profound and reliable technical information.

But ENEXSA also offers its software tools to engineering companies, equipment manufacturers, utilities and universities.



ENEXSA

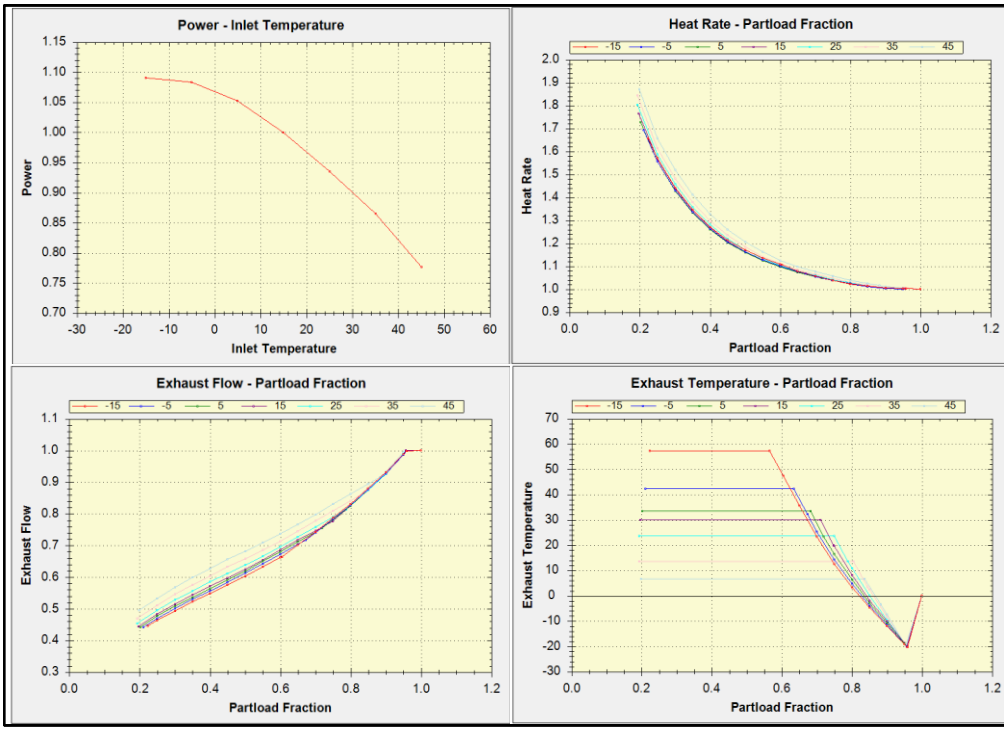
Gas Turbine Library

- Currently 750 models
- 30 kW to 567 MW
- Base load corrections
- Part load corrections
- Approved by OEM
- Editable
- Continuous updates

The ENEXSA Gas Turbine Library works exclusively in conjunction with the EBSILON®Professional heat balance software by STEAG Energy Services GmbH, Essen/Germany.

It contains more than six hundred models for gas turbines covering the entire size range from micro gas turbines to large H-class gas turbines which are based on performance data supplied and approved by the respective OEM.

ENEXSA continuously works with gas turbine vendors to grow the Gas Turbine Library to become a valuable and ‘living’ source for gas turbine performance information, so that engineers around the globe can make use of reliable and first-hand data to analyse and improve combined cycle plants.



ENEXSA

Gas Turbine Library

- Currently 750 models
- 30 kW to 567 MW
- Base load corrections
- Part load corrections
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The user can trace back to the correction factors and offsets of the individual corrections for ambient conditions and part load operation. This approach which is in accordance with standard performance test procedures has shown to be also of great help in identifying those operating parameters that have the highest impact on certain performance characteristics under current conditions.

Library (F5 ... Refresh; Ctrl+Shift+O ... Set Library Directory)

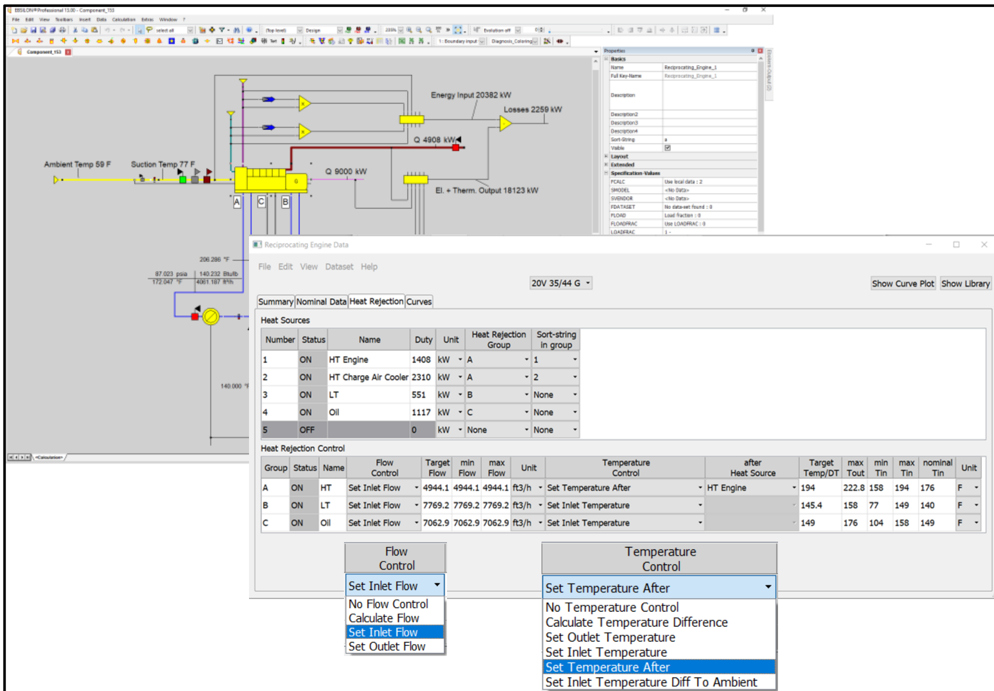
Manufacturer	Model	Year	Electrical Power	Heat A	Heat B	Heat C	Frequency	Application Type	Fuel Type
<Filter expr.>	<Filter expr.>	<Filter expr.>	<Filter expr.>	<Filter expr.>	<Filter expr.>	<Filter expr.>	<Filter expr.>	<Filter expr.>	<Filter expr.>
			kW	kW	kW	kW			
MAN	18V 51/60 G	2017	20327	6295.1 (HT)	1726.9 (LT)	1454 (Oil)	50	CHP	Gas
MAN	18V 51/60 G	2017	20327	5810 (HT)	1966 (LT)	1434 (Oil)	50	Power	Gas
GE Jenbacher	J920-B01	2017	10387	4617 (HT+Oil)	1302.2 (LT)		50	Power	Gas
GE Jenbacher	J920-B101	2017	10387	5853.4 (HT+LT+Oil)			50	CHP	Gas
MAN	20V 35/44 G	2017	10367	3851 (HT)	587 (LT)	1160 (Oil)	50	CHP	Gas
MAN	20V 35/44 G	2017	10367	3124 (HT)	797 (LT)	1080 (Oil)	50	Power	Gas
GE Jenbacher	J920-B801	2017	9339	4092.5 (HT+Oil)	1071.6 (LT)		60	Power	Gas
GE Jenbacher	J920-B8101	2017	9339	4933.4 (HT+LT+Oil)			60	CHP	Gas
Kawasaki	KG-18 (Methane) CT	2017	7800	2011 (HT)	820 (LT)	633 (Oil)	50	CHP	Gas
Kawasaki	KG-18 (Methane) Rad	2017	7800	2011 (HT)	820 (LT)	633 (Oil)	50	CHP	Gas
Kawasaki	KG-18V (Methane) CT	2017	7800	2006 (HT)	810 (LT)	633 (Oil)	50	CHP	Gas
Kawasaki	KG-18V (Methane) Rad	2017	7800	2006 (HT)	810 (LT)	633 (Oil)	50	CHP	Gas
Kawasaki	KG-12 (Methane) CT	2017	5200	1267 (HT)	627 (LT)	422 (Oil)	50	CHP	Gas
Kawasaki	KG-12 (Methane) Rad	2017	5200	1267 (HT)	627 (LT)	422 (Oil)	50	CHP	Gas
Kawasaki	KG-12V (Methane) CT	2017	5200	1264 (HT)	620 (LT)	422 (Oil)	50	CHP	Gas
Kawasaki	KG-12V (Methane) Rad	2017	5200	1264 (HT)	620 (LT)	422 (Oil)	50	CHP	Gas
Caterpillar	CG 260-16 (4.5)	2017	4500	1655 (HT)	359 (LT)	680 (Oil)	50	CHP	Gas
MWM	TCG 2032B V16	2017	4500	1655 (HT)	359 (LT)	680 (Oil)	50	CHP	Gas

ENEXSA

Reciprocating Engine Library

- Developed with OEM
- First release in 2017
- Load & ambient corrections
- Generic heat rejection scheme
- Continuous updates

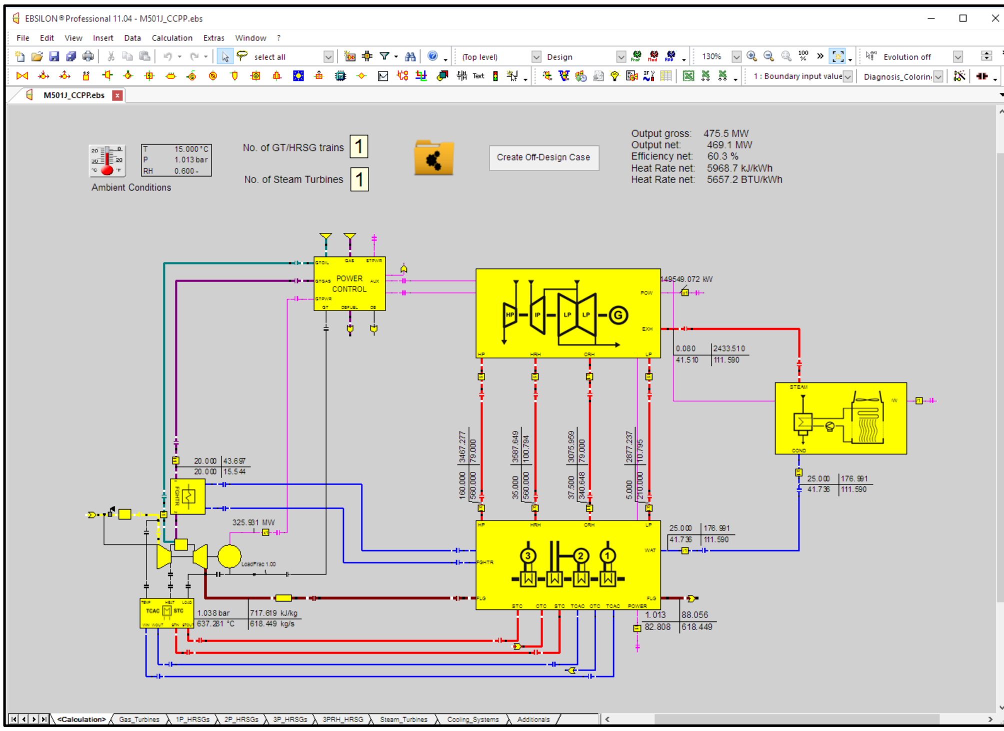
The ENEXSA Reciprocating Engine Library add-on for EBSILON has been developed in coordination with renowned gas engine OEM. Its first release in 2017 contained 36 engine models, and – similar as with our Gas Turbine Library – ENEXSA will continue to collect and process performance information received from the OEM to grow this library.



Reciprocating Engine Library

- Developed with OEM
- First release in 2017
- Load & ambient corrections
- Generic heat rejection scheme
- Continuous updates

Key differentiator of the ENEXSA Reciprocating Engine Library is that the thermal performance data are enhanced with detailed information about the control schemes for temperature and flow for the various cooling cycles of the engine. For simulating a modern highly-integrated CHP plant, it is important to include this information in the model so that the correct amount of waste heat from the engine can be determined which can be utilized in the connected systems.



EBSILON Professional

- All types of thermal power cycles
- Coal, gas, solar, ORC...
- Equipment libraries
- Powerful solver
- Part load modelling
- Scripting language
- Excel interface
- Continuous updates

Through individual model components the gas turbine and/or engine performance characteristics can be integrated with a detailed plant model, and in-depth thermodynamic analysis can be performed benefiting from the features of EBSILON®Professional, such as

- individual equipment characteristics in design and off-design mode
- full record of all gas, water/steam and electrical flows of the plant
- flexibility in equipment arrangement, plant configuration and mix of technologies
- a powerful, fast and reliable equation-based solver
- open architecture to include user-defined models for new technology or vendor data
- a state-of-the art graphical user interface and a wide variety of output options in graphical and tabular formats and
- an interface to Microsoft® Office Excel®.

ENEXSA cooperates with STEAG Energy Services in the development of EBSILON and offers customized application-specific training seminars as well as modelling services for any type of thermal power generation process. If you want to learn more about EBSILON or test this software for your specific application, please contact ENEXSA.

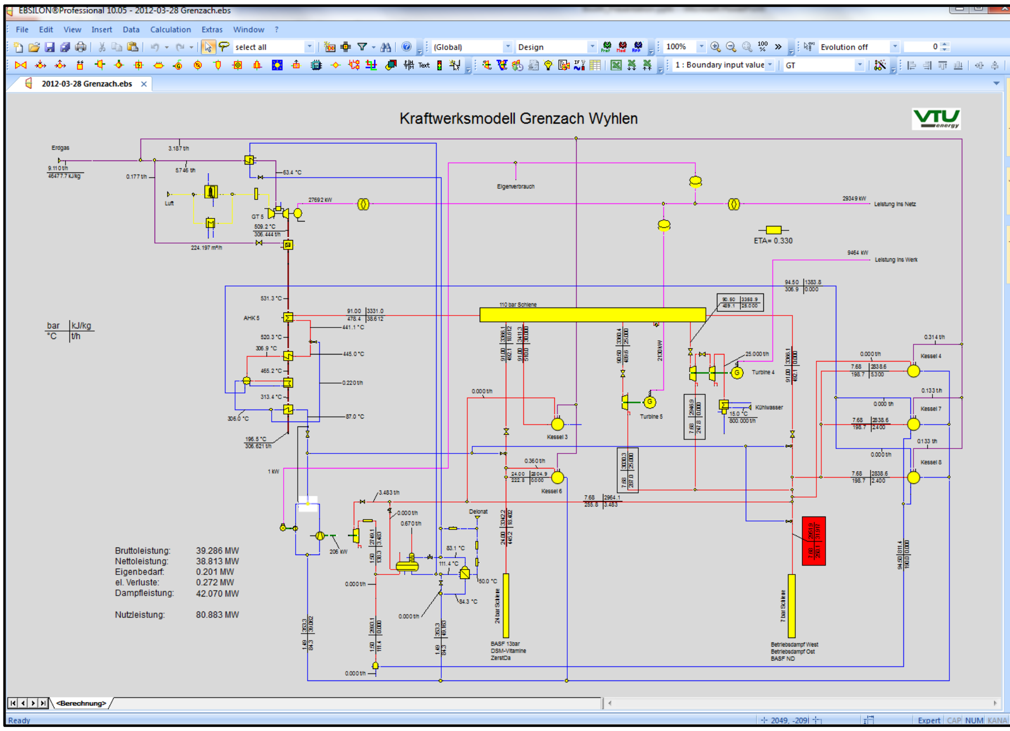
Picture courtesy of E.ON Energy Projects

ENEXSA

Cogeneration Modelling

- Process integration
- Mix of technology
- Redundancy of generation options
- What-if scenarios
- Operation maps
- Expert services for both, CHP and process plant

With their back-ground in process engineering, ENEXSA's consultants are well-versed with all aspects of industrial cogeneration, and they fully understand the requirements of the process plant that needs to be supplied.

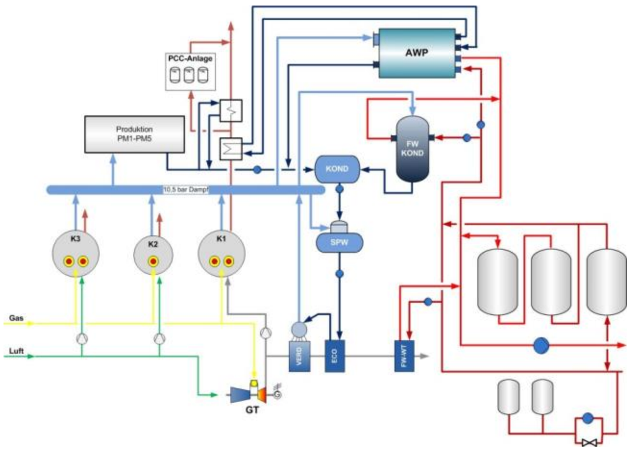


ENEXSA

Cogeneration Modelling

- Process integration
- Mix of technology
- Redundancy of generation options
- What-if scenarios
- Operation maps
- Expert services for both, CHP and process plant

Industrial cogeneration plants are designed to supply power and heat with maximum reliability. Therefore, there are always many ways to meet the demand, but there may be huge differences in fuel efficiency between these options. ENEXSA's plant models help the operators to understand and quantify the effect of different operating modes, and thus provide perfect support to make the right decisions.



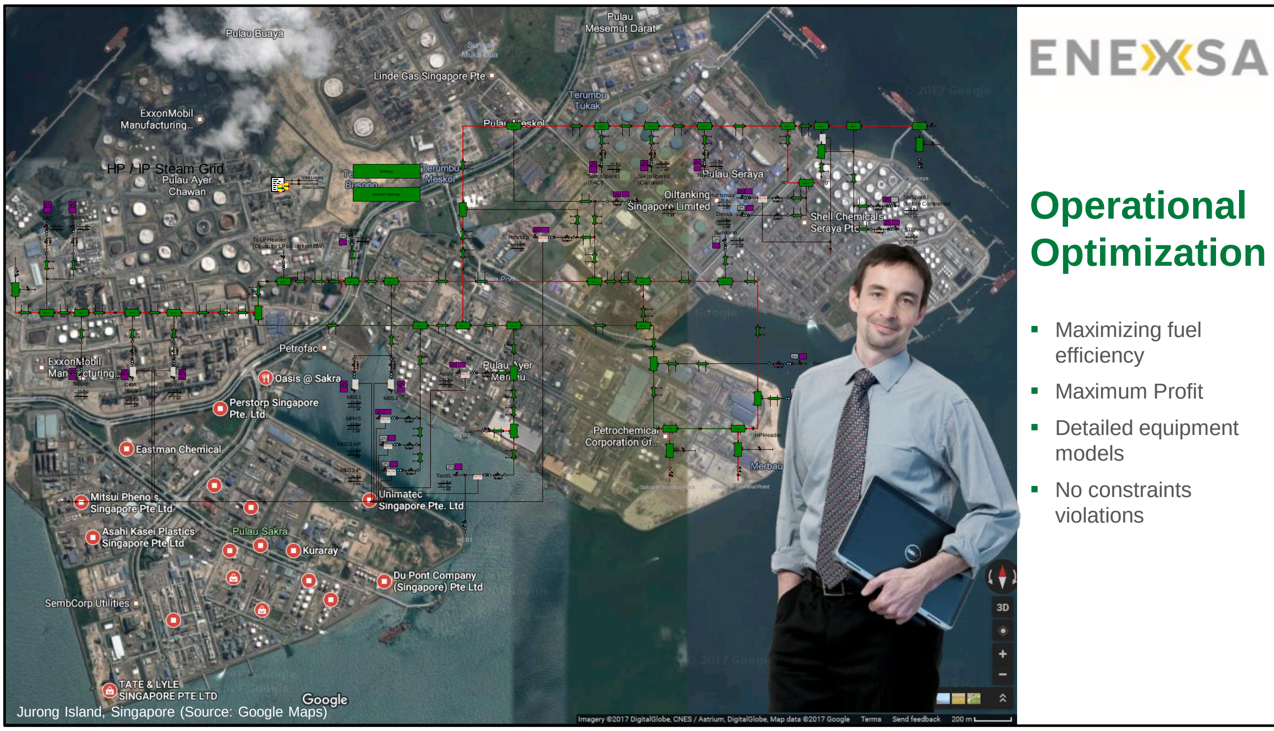
	Fernwärmeabnahme					Dampfverbräuche					
Szenario	Spitze min.	Minimal	Durchschnitt	Maximal	Spitze max.	Minimal [t]	Durchschnitt	Maximal	Minimal MW	Durchschnitt	Maximal
Jahresdurchschnitt	0.60	1.20	4.20	10.50	17.00	16.00	22.64	26.00	11001.8	14703.9	17879.0
Jahresdurch. -20%	0.60	1.20	4.20	10.50	17.00	12.80	18.11	20.80	8801.4	11763.2	14303.2
Jahresdurch. +10%	0.60	1.20	4.20	10.50	17.00	17.60	24.90	28.60	12101.9	16174.3	19666.9
Sommer	0.60	1.20	1.70	2.30	4.70	16.02	21.80	24.04	11001.8	14157.0	16507.4
Sommer -20% Prod	0.60	1.20	1.70	2.30	4.70	12.82	17.44	19.23	8801.4	11325.6	13205.9
Sommer. +10%	0.60	1.20	1.70	2.30	4.70	17.63	23.98	26.45	12101.9	15572.7	18158.1
Winter	2.40	4.00	7.00	10.50	17.00	19.98	22.84	26.04	13716.7	14833.8	17879.0
Winter -20% Prod	2.40	4.00	7.00	10.50	17.00	15.98	18.27	20.83	10973.4	11867.1	14303.2
Winter +10%	2.40	4.00	7.00	10.50	17.00	21.97	25.12	28.64	15088.4	16317.2	19666.9
T_Sommer	17.50										
T_Winter	-1.00										

Cogeneration Modelling

- Process integration
- Mix of technology
- Redundancy of generation options
- What-if scenarios
- Operation maps
- Expert services for both, CHP and process plant

For an Austrian paper mill, ENEXSA developed the concept for a gas turbine combined heat and power (CHP) plant which uses both, hot exhaust gas from the GT and steam generated from the HRSG. The hot exhaust is partially added to the combustion air to improve the efficiency of existing conventional gas-fired steam boilers of the paper mill, and steam is fed to the steam network of the mill. The local district heat grid receives hot water from the cold end of the HRSG. Striving for maximum energy efficiency, this plant also recovers low-temperature heat from a side process (PCC) which is converted to a useful temperature level by means of an absorption heat pump.

The lower part of this slide shows the matrix of scenario points (in total 135) which were used to evaluate various design alternatives for this CHP plant. Thousands of individual heat balances were produced by ENEXSA in order to support the selection process of the gas turbine type and the optimal plant concept.



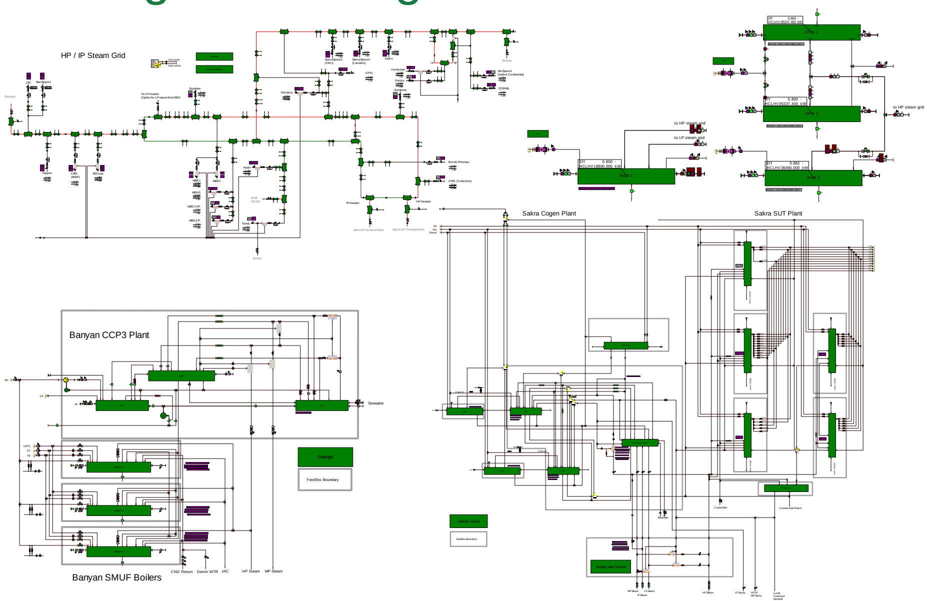
On Singapore's Jurong Island, Sembcorp Utilities own and operate one of the biggest utility plants in the world serving over 40 multinational companies and supplying power to the Singapore grid.

Cogeneration:
- Power: 1,215 MW
- Steam: 900 tph

Steam: 2,484 tph (4 pressure levels)
Natural Gas: 431 bbtu per day
Industrial Water: 4,484,552 m3/day
Industrial Wastewater Treatment: 16,320 m3/day
Reclaimed Water: 40,000 m3/day
On-site Logistics: 25 km of service corridor network

ENEXSA was tasked with an optimization system to support operations and electricity traders for this unique site including all producers and the entire distribution network. Through an Excel interface, the users can specify the operating point of interest (in terms of ambient conditions, fuel cost, waste gases and steam requirements as well as electricity prices or required power output), and ENEXSA's high-performance server-based Optimizer determines which equipment shall be operated and at which level to reach the maximum profit (or lowest cost of generation).

Jurong Island Cogeneration

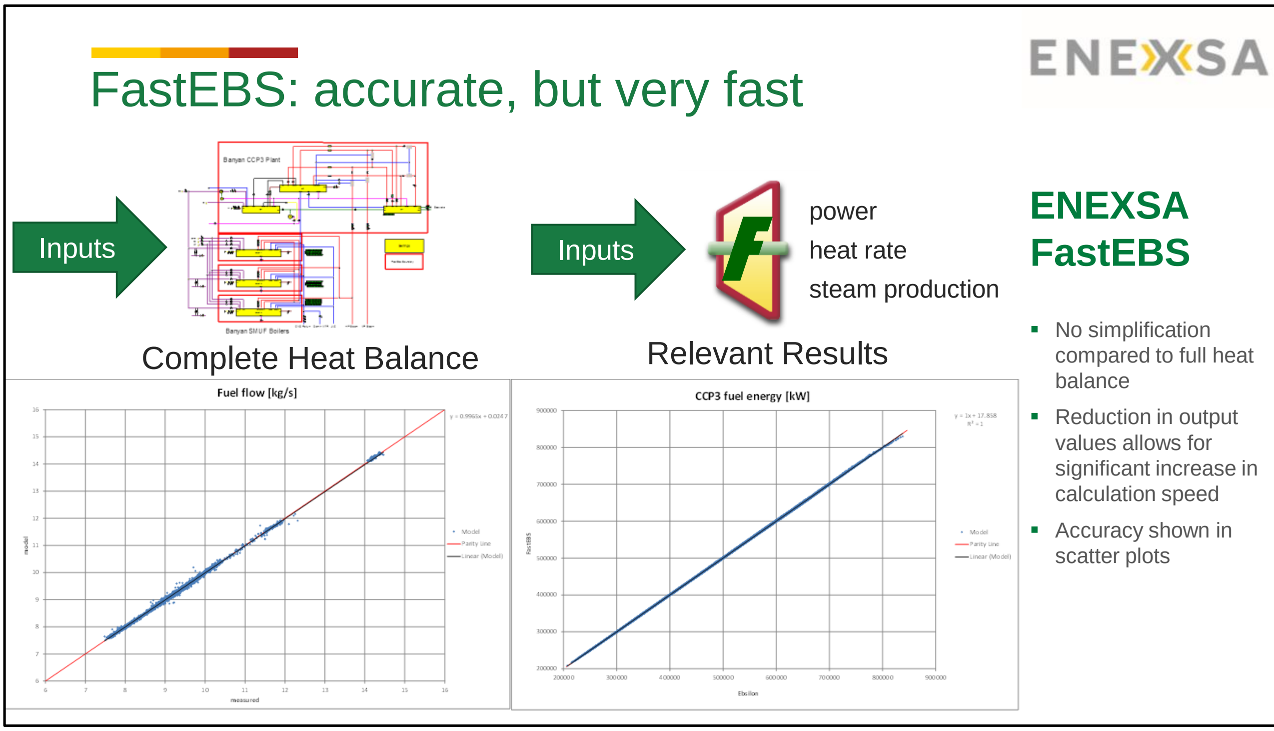


Cogeneration Complexity

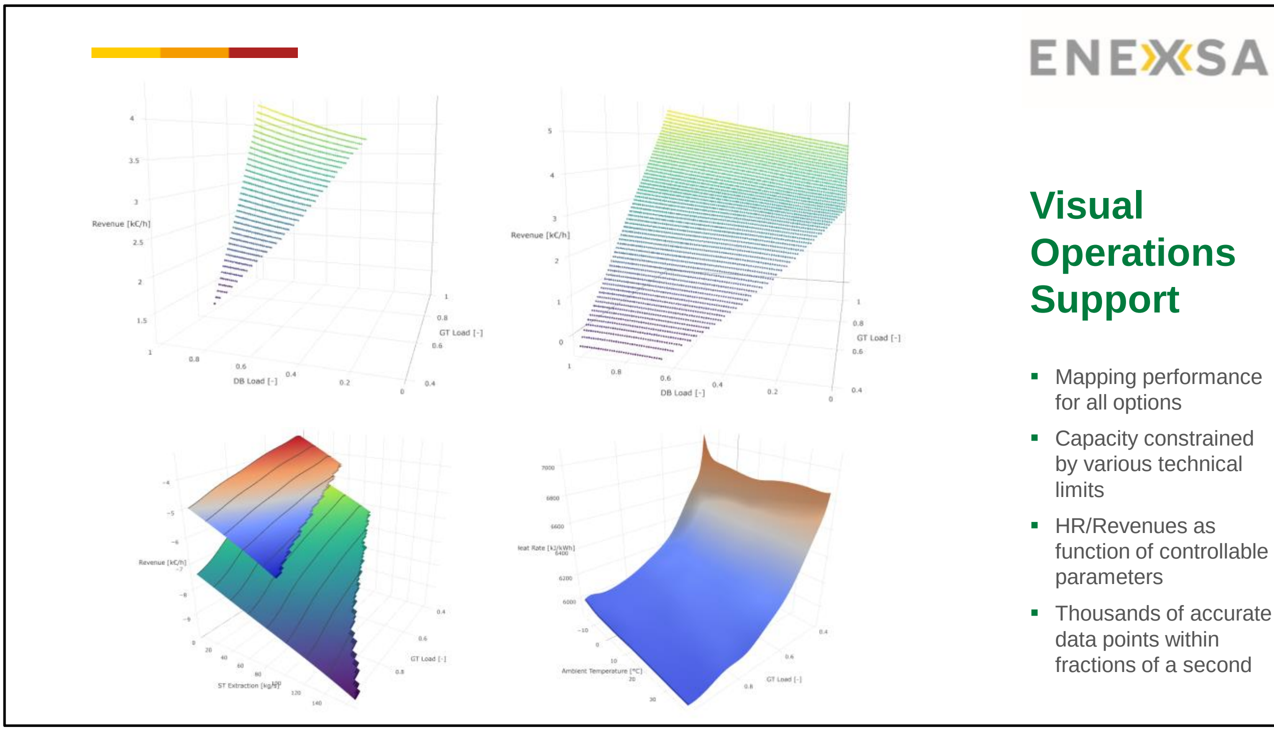
- 1 x 2GT+1ST CHP (650 MW / 500 t/h)
- 1 x 1GT+1ST CHP (480 MW / 400 t/h)
- 3 x gas/waste gas boilers (600 t/h)
- 5 x gas/oil + waste fuel boilers (450 t/h)
- 1 x VHP boiler (400 t/h)
- 2 x wood chip boilers (60 t/h)
- 2 x municipal waste boilers (170 t/h)

Modelling such complex cogeneration plants must not only exactly represent the performance characteristics of each generating equipment, but also their relevant operational constraints. All operational settings proposed by the system must not conflict with the technical limitations of the plant equipment which may be expressed in terms of mass flow, temperature or pressure. This is the reason why ‘classical’ optimization systems for the power industry oftentimes fail for cogeneration applications, since they are designed for dispatch optimization of a fleet of power plants and oftentimes deal with energy balances in terms of MW utilizing simple efficiency characteristics for the model components.

ENEXSA first models the entire plant with EBSILON and includes all necessary details to ensure that the model accurately represents the equipment performance characteristics as well as all technical constraints. These models are typically based on the information supplied by the respective OEM, but they may also be adjusted to current performance, as already shown earlier in this document.

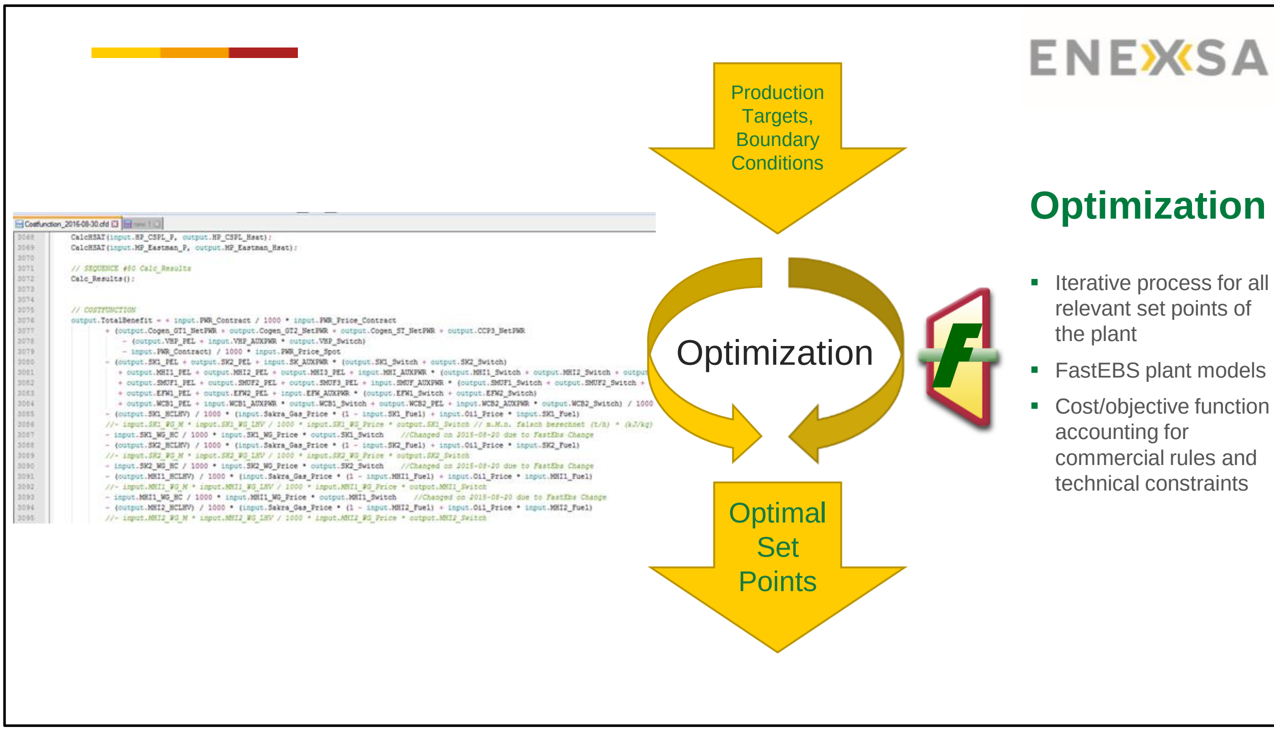


Starting from detailed thermodynamic models that accurately predict plant performance with all possible settings, fast calculation tools (called FastEBS) are generated that calculate the heat balances extremely fast, but with almost the same accuracy. This acceleration is possible due to the reduction in model output (only a few results of interest are produced, whereas an EBSILON model produces complete heat balance information for every stream and component of the model) and the use of regression/neural network models for specific aspects, such as property calculations. As can be seen from the above comparison between EBSILON model and plant data (left), and FastEBS model against EBSILON model (right), the accuracy is very good over the entire range of operating points.

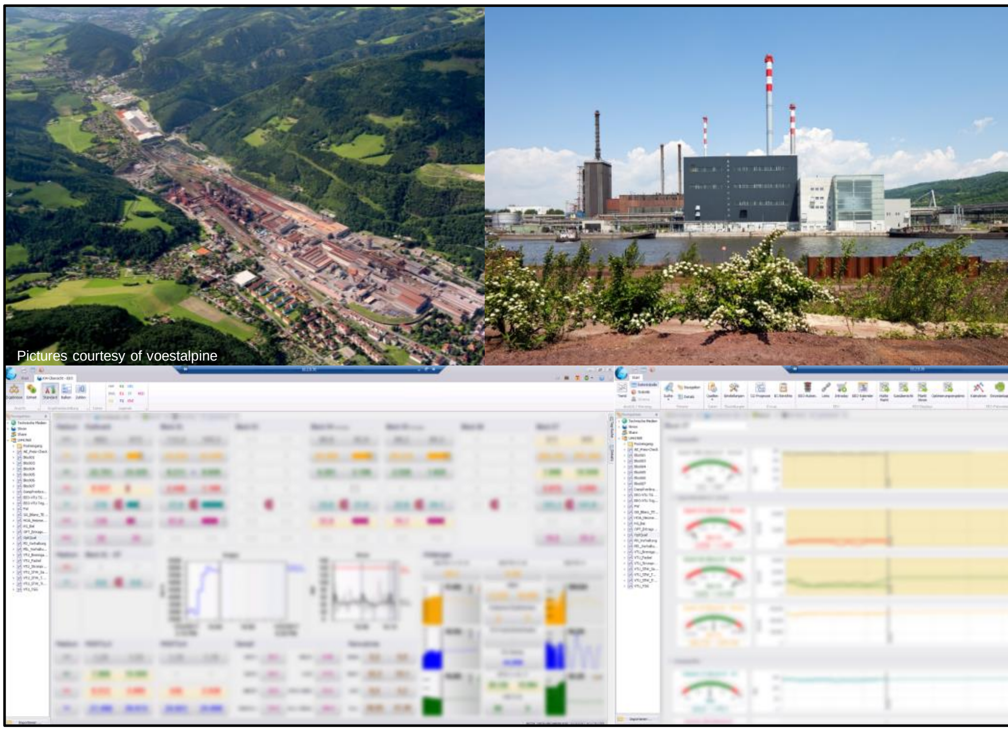


FastEBS can also produce complete operational maps of a specific plant configuration within seconds.

For visual operations support, interactive displays are generated that allow the operator to quickly view and analyze these options. The significant difference to the traditional 'single point optimization' approach: The visualization in form of a 3D-map creates a much better understanding of what the configurations under consideration can produce and what the respective limitations are, and it reveals the shape of the optimization landscape. This 'actionable' information allows for correctly assessing the various options and enables the operator to choose the optimal solution, not only for the current situation, but also in view of things to come.



Combining ENEXSA's know-how in detailed modelling of industrial plants with the ENEXSA proprietary FastEbs technology for speeding up the EBSILON calculations, ENEXSA is capable of offering systems for operational optimization of complex CHP systems. Using inputs for production targets and boundary conditions (such as ambient conditions, cost items, prices for the products), the system applies a sophisticated optimization algorithm to determine the settings for the controllable parameters of the plant which produce the best economic output expressed in terms of a cost function. The violation of technical limits are included in this process in form of penalties to ensure the optimal solution is well within the allowed area of operation for every piece of equipment of the plant.



ENEXSA

Reference Project

voestalpine LD-EEO

- 2 steel mills of voestalpine, Austria
- Optimization of waste gas usage and plant operation
- Separate energy trading system for dispatch optimization
- Visualization of results in in-house information system

For the steel mills shown in this slide, ENEXSA produced on-line optimization systems that – based on inputs on current operating conditions and production plans, electricity prices and cost of fuel, and equipment availability – determine the optimal set points for the major controllable parameters of the industrial plant. Operators are made aware of any significant deviations between the current settings and the optimization result by color-coded display of process data and trend lines providing details of the calculation results.

While there exist many offerings for optimization systems for the electricity market that focus on trading of electricity, fuels and coupled products like heat or process steam, ENEXSA's system is quite unique in providing detailed and technically profound hands-on advise to the operators in the plant control room. Therefore, it must not be seen as an alternative but as the logical addition to a trading system in order to ensure that the plant operates at its best.

Thank you very much for your interest in our offerings. We are looking forward to serving your company.

For company news and further information, please visit our web sites:

http://www.enexsa.com

https://www.linkedin.com/company/enexsa