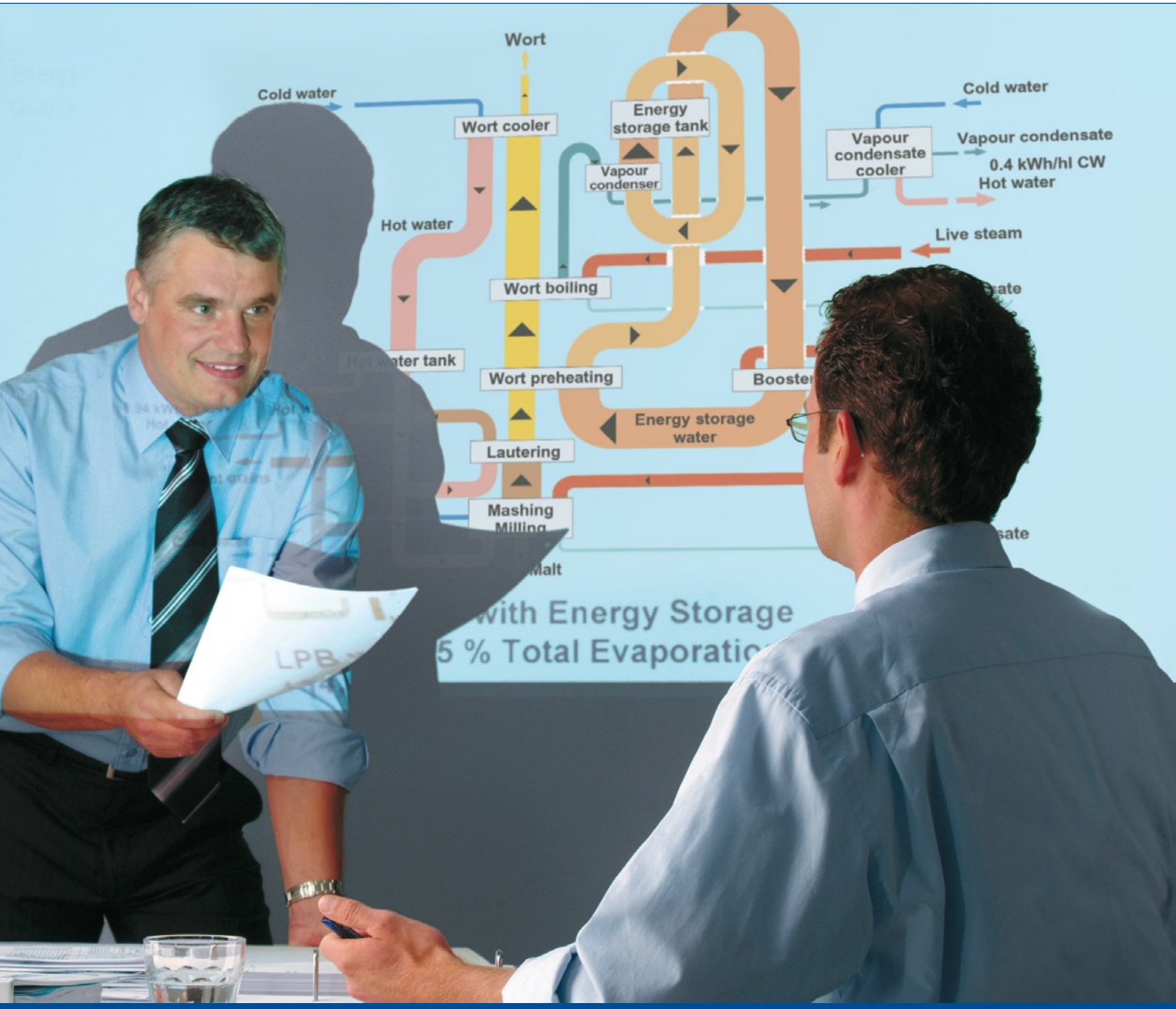
Conserving resources,

reducing energy costs.

GEA Brewery Systems
Huppmann Tuchenhagen

Energy and environment are in the focus...



FACTS & FIGURES

Exploring the opportunities together
Determining the energy savings potential in your brewery requires direct communication. With our extensive experience we can make specific optimization suggestions. We mostly work out optimization programs with several stages, so that you can make production more efficient step by step and monitor the ROI at any stage.

...we provide optimum system solutions.

Increasingly, we are all facing rising energy costs, stricter environmental regulations or even taxes on energy or emissions.

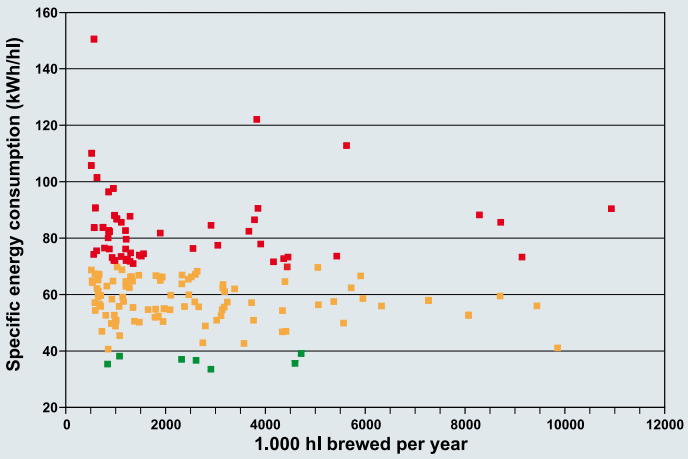
There are many ways to address the rising costs in the field of energy management and environmental technology. With consistent and structured optimization of brewing technology and plant equipment it is possible to cut energy costs and to meet legal requirements in a commercially reasonable manner.

Each energy management project begins with an assessment of the current state of the brewery with respect to energy and material flows. Our experience shows that there is great potential for optimization particularly in the brewhouse, which is the biggest consumer of thermal energy in the brewery with a share of 40 %. In every section of the brewery we determine all relevant specific consumption figures.

This is the basis of our concept for the optimization of the processes and the associated equipment as requested by the customer. What exactly has to be done in order to cut energy consumption and costs, to reduce water consumption and waste water production and to decrease emissions? Of course, economic efficiency calculations are also taken into account. In all optimization efforts the quality of the beer is always the number one priority.

Our program includes:

- Technological consulting
- Energy technology and management
- Refrigeration and heat technology
- Fresh and waste water solutions
- Process control technology incl. data acquisition
- Measurement and control technology
- Project management with cost control



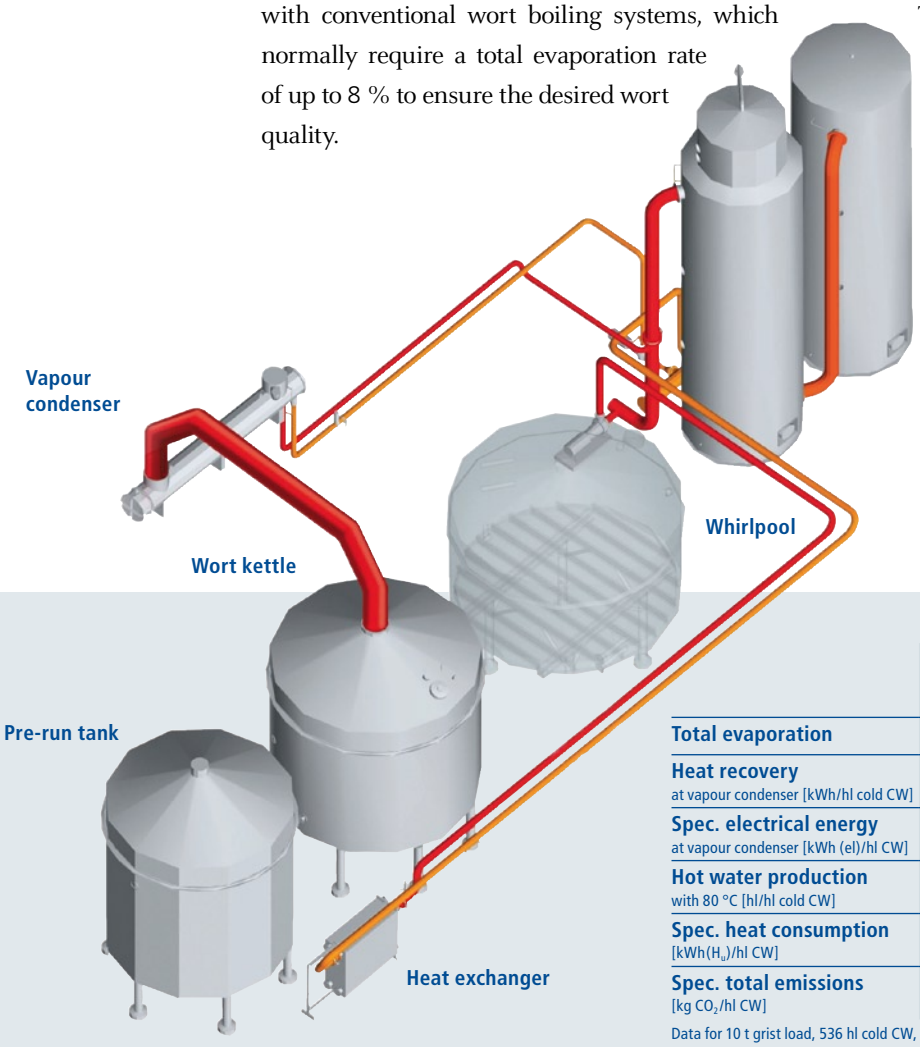
Huge savings potentials

The diagram shows the specific energy consumption of breweries compared to their annual output. The amount of energy required for a comparable output varies considerably. In other words, with the same amount of energy it is possible to obtain an output that is higher by a factor of 10. Today, the breweries that produce their output efficiently with minimum energy consumption are setting the standards. Whether large or small – with intelligent energy management and state-of-the-art plant engineering, any brewery can save considerable amounts of energy, produce more efficiently and conserve resources.

Dyn. LPB – the more efficient system in the brewhouse.

The principle of dynamic low-pressure boiling (dyn. LPB) developed by GEA Brewery Systems provides considerable advantages in terms of energy consumption, particularly in combination with the JETSTAR™ and the energy storage system (ESS). This is confirmed by the comparison with conventional wort boiling systems, which normally require a total evaporation rate of up to 8 % to ensure the desired wort quality.

A total evaporation of 4.5 % leads to an energy balance in the brewhouse. All the energy recovered from the vapours is used to heat the lauter wort of the next brew up to 94 °C. Higher evaporation rates are possible if there is a continuous demand for hot water in other sections of the brewery. Thus, the energy storage system contributes significantly to the reduction of CO_2 emissions from the brewing process.



	JETSTAR™ atmospheric without ESS	Dynamic low-pressure boiling with JETSTAR™ and ESS			Conventional boiling without ESS
Total evaporation	3.5 %	4.5 %	5 %	6 %	8 %
Heat recovery at vapour condenser [kWh/hl cold CW]	2.073	2.665	2.961	3.553	4.739
Spec. electrical energy at vapour condenser [kWh (el)/hl CW]	0.006	0.018	0.019	0.021	0.008
Hot water production with 80 °C [hl/hl cold CW]	0.296	0	0.050	0.131	0.678
Spec. heat consumption [kWh(H_u)/hl CW]	8.807	6.780	7.142	7.866	12.183
Spec. total emissions [kg CO_2/hl CW]	1.89	1.47	1.54	1.69	2.60

Data for 10 t grist load, 536 hl cold CW, 13.5 °P

FACTS & FIGURES

Energy storage system in 3D
The above illustration shows all major components of an energy storage system. The system is supplied by a vapour condenser, where the vapours produced are condensed. The hot water produced during one brew is stored in the storage tank and used to preheat the next brew to boiling temperature.

Energy in balance – sustainable and efficient.
In order to ensure that lower total evaporation rates do not affect the beer quality, we provide the JETSTAR™ boiling system which achieves excellent homogeneity in the wort kettle and thus enables intensive conversion processes. Together with dyn. LPB, efficient stripping of undesirable aromas is guaranteed. The amount of hot water produced can be adapted to individual requirements. With a rate of 4.5 %, the system is optimally balanced – without excess hot water.

Preventing emissions in the brewhouse.

The brewhouse is an interesting target for optimization, not only because of the high energy consumption. Brewers are also often under pressure to take measures against the odour emissions from mashing and wort boiling.

GEA Brewery Systems offers several possibilities to get odour emissions under control. From the vapour condenser to boiling systems with thermal vapour recompression – all systems lead to a significant reduction in vapour emissions. In order to further reduce vapour emissions, technical processes like gas scrubbing, biofilter, treatment with ionized air or direct combustion with exhaust gas post-combustion have proved successful in practice. Read more about this in our manual "Efficient use of energy in the brewhouse".

Thermal recycling of spent grains.

To ensure sustainable operations, breweries of a certain size have to consider the thermal recycling of spent grains. The advantage is that there is always a parallel increase in the amount of spent grains produced and the amount of thermal energy required in the brewery. With the special fluidized bed combustion technology, combustion conditions and thus also exhaust gas values can be optimally controlled. Up to 60 % of the required thermal energy can be provided by using the brewery's own spent grains. The resulting CO_2 certificates can be sold at the stock exchange. If only spent grains are combusted, even the ash can be utilized after certification, e.g. as fertilizer.

Plate heat exchanger for wort preheating
If an energy storage tank is used, the wort is gently heated to boiling temperature with an external plate heat exchanger. The plate heater uses the hot water from the energy storage tank. In this way, a wort temperature of up to 94 °C is reached. With the JETSTAR™, the boiling process can then start without pulsations.

Vapour condenser
Except for technically unavoidable emissions during start-up and shutdown, the vapour condenser can eliminate the emission of vapours. The efficiency of the heat exchanger, which is designed as horizontal shell and tube heat exchanger, can be up to 97 %. In combination with an energy storage system and dynamic low-pressure boiling it is possible to create a closed energy cycle in the brewhouse.

Practical examples illustrate the benefits of our energy

We show you what increased energy efficiency actually means. GEA Brewery Systems is your competent partner in the brewhouse as well as in the field of refrigeration technology.

Conversion to JETSTAR™ with energy recovery.

The environmental policy of an international brewery group requires the utilization of all energy saving potentials in upgrade projects and in new breweries. An almost 25 year old brewhouse had to be modernized to increase its capacity by 30 %. Among other measures, a JETSTAR™ for atmospheric boiling and an energy storage system were installed. Evaporation was reduced from 8 % to 5 %, overall flavour stability was improved. Compared to the old equipment, the new brewing line needs only 57 % of the primary energy and therefore the brewery needs to buy 658,000 Nm³ less natural gas per year.

FACTS & FIGURES

Energy management everywhere

All over the world, energy management is a major issue in the construction of brewery equipment today. Whether in the brewhouse or in the refrigeration plant, in existing or new facilities – the systematic utilization of energy resources is of paramount importance. With network thinking, GEA Brewery Systems can achieve maximum efficiency here.

Upgrade of a refrigeration plant.

An older refrigeration plant can become a real expense factor in energy management. In the course of a modernization project, the refrigeration equipment was therefore upgraded in 3 stages – engineered by GEA Brewery Systems.

Phase 1: Installation of ammonia evaporative condensers instead of shell and tube condensers. The result: Savings of over 10 %.

Phase 2: Instead of shell and tube condensers, there are now two plate heat exchangers operated with ammonia pumps. The result: Another 10 % energy savings and reduction of the refrigerant quantity by two thirds.

Phase 3: In the third phase of construction, the plant was divided into three temperature circuits, 0° C, –5° C, –10° C. The result: Savings of another 13 % compared to the previous energy consumption.

Summary: Total savings of 29.5 %, increased operational safety, reduced maintenance effort.

Brewhouse modernization.

The brewhouse modernization of an international brewery group aimed not only at process technology improvement and capacity increases. Energy efficiency also had to be optimized. The brewhouse has two brewing lines with 600 hl/brew. The table shows the savings that could be guaranteed for the conversion of an existing boiling system to dyn. LPB or dyn. LPB with energy storage tank.

	Existing atmospheric boiling	Dyn. low-pressure boiling	Dyn. LPB energy recovery
Total evaporation (%)	10	6	6
Boiling time (min.)	60	60	60
Heating up the wort from 48 °C to 77 °C	4.77 MJ	4.77 MJ	4.77 MJ
Heating up the wort from 72 °C to 97 °C from 91 °C to 97 °C	6.03 MJ	5.81 MJ	1.39 MJ
Boiling / Evaporation	11.67 MJ	7.01 MJ	7.01 MJ
TOTAL	**22.47 MJ**	**17.59 MJ**	**13.17 MJ**
Savings Modernization of boiling procedure	4.88 MJ = 2.16 t steam		
Energy recovery system		4.42 MJ = 1.96 t steam	
Total savings in the brewhouse	**9.30 MJ = 4.12 t steam**		
Surplus for other consumers	**2.03 MJ = 0.9 t steam**		

The figures speak for themselves

The table shows that 4.12 t steam per 600 hl brew could be saved by the conversion of the existing boiling system to dyn. LPB with energy storage tank. In addition, the hot water equivalent of 0.9 t steam/brew could be provided for other consumers.

Sustainability – Efficient energy and resource management

That means optimum process design for breweries in terms of energy consumption, use of production plants with high energy efficiency and the utilization of all economical heat recovery options.

Process Engineering

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