SYMBOL AND DRIVER OF TECHNOLOGICAL PROGRESS

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ABSTRACT

Estimates of worldwide energy reserves for natural gas, oil and uranium are measured in decades. Only coal is discussed in terms of centuries. At the same time, global energy consumption continues to increase. Due to their scarcity, energy resources are becoming more and more expensive. Meanwhile the debate over world climate protection is being considered more seriously. Breweries produce an energy-intensive product and cannot remain aloof from this challenge. A contribution for the climate protection is an energy efficient production process. At the same time it means a saving of production costs. The vision, therefore, is 'efficient use of energy in breweries.

Keywords: ***social responsibility, energy saving, sustainability, heat requirements for breweries, hot water preparation, solar heating, vacuum tube collectors, renewable energies, climate protection***

INTRODUCTION

Estimates of worldwide energy reserves for natural gas, oil and uranium are measured in decades. Only coal is discussed in terms of centuries. At the same time, global energy consumption continues to increase. Due to their scarcity, energy resources are becoming more and more expensive. Meanwhile the debate over world climate protection is being considered more seriously. Breweries produce an energy-intensive product and cannot remain aloof from this challenge. A contribution for the climate protection is an energy efficient production process. At the same time it means a saving of production costs. The vision, therefore, is 'efficient use of energy in breweries.

DISCUSSION

Enviro – An Extensive Programme

The Enviro programme is a tripartite programme that focuses on the idea of Corporate Social Responsibility in terms of economy, ecology and society. Enviro provides transparency in confirming that machines and products are economical, environmentally friendly, energy-saving and ergonomically optimised in operation (***Fig. 1***). One example would be the 'Stromboli wort boiling system' which reduces energy consumption to a minimum. Depending on the initial situation a changing of the wort boiling system can lead to a saving of energy up to 50%.

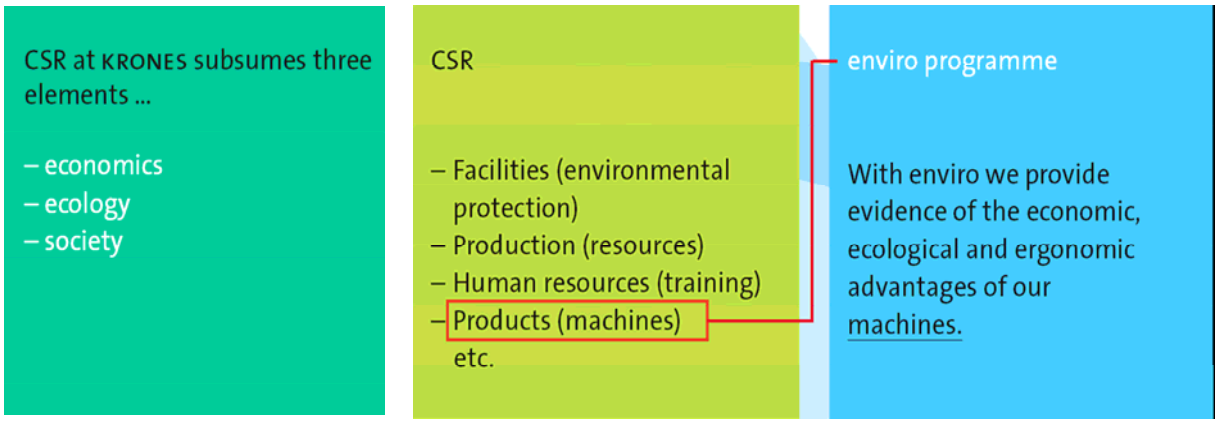

Fig. 1 Extent of the Krones Enviro programme

The introduction of the Enviro passport for Krones' machines is the first step towards implementing the extensive programme. The passport serves to provide precise details of consumption data and thus the costs in actual operation. The certificate is attested in co-operation with the Technical Supervisory Association TÜV SÜD Industrie Service GmbH (***Fig. 2***).

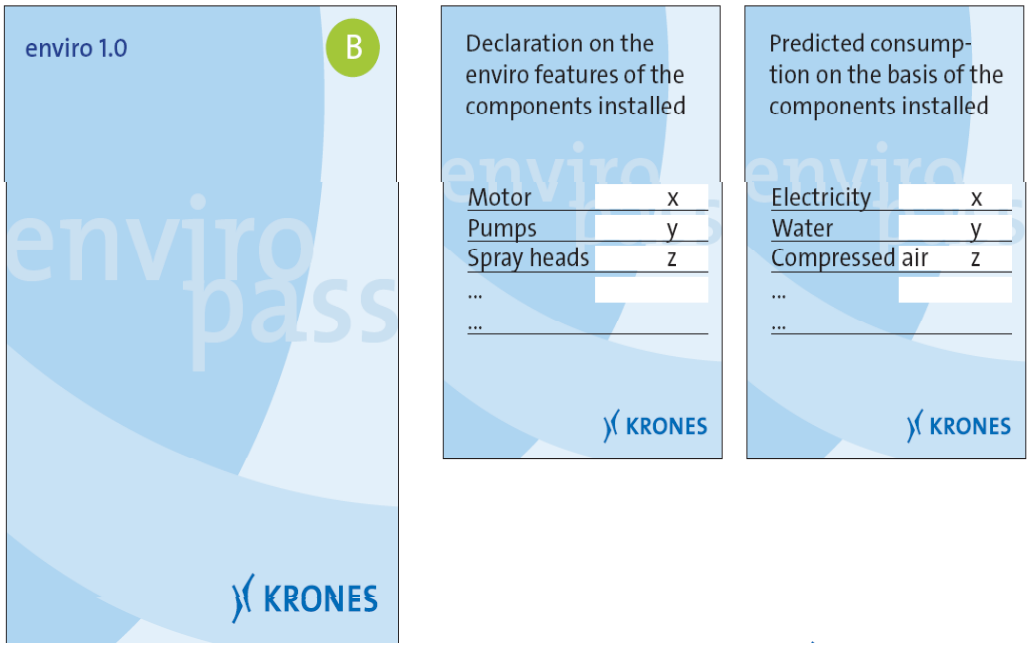

Fig. 2 Example of the Enviro passport for a Krones machine

An important consideration is the energy mix itself. Considering the traditional energy supply and environmental situation, the main question for the future will be what part can be replaced by renewable energy. One solution is the use of solar-thermal process heat in breweries.

Many Possibilities, One Solution – The Sun

In principle, many forms of renewable energy are suitable for generating heat in a brewery. However, systems based on biomass, such as alcohol, oil or gas are in turn dependent on the availability of raw materials. Therefore, the possibility of heavy price fluctuations cannot be excluded. Hydro power is a promising way to generate electricity but it is also extremely location dependent. Specifically, the brewery would already have to be located on a suitable body of flowing water or be built there. The same applies to geothermal power. In this case, the required temperature level is present at a suitable drilling depth, which is to say at a corresponding pumping depth. Another promising alternative, currently for breweries, is wind energy. This includes not only the direct generating of electricity but also storing energy as compressed air. The compressed air can then be saved effectively or used directly in many places in the brewery.

On the other hand, if the goal is to provide process heat, the current method of choice is solar heating. The sun provides up to 15 000 times more energy per year than the entire population of the world can use and will continue to do so for at least four billion years to come. There is no bill from the sun for use of this energy, no greenhouse gases are produced while generating it and it is highly reliable, since it is completely independent of political and economic interests. Furthermore, generating solar heat is largely a fully mature technology that is comparatively economical. It works reliably for years and can easily be integrated into an existing brewery process, since it can be combined with fossil fuel firing.

Financially Practical In Most Cases

Different regions are more or less suited for use of solar energy depending on their input of solar radiation. In most cases, however, using the sun to supply long-term energy is financially practical. To ensure this, the remaining energy requirement of the brewery should be reduced to the point where solar systems can be operated effectively for complementary coverage of heating needs. For example in Germany it is possible to save about 50 litres of oil per year for every m² of solar collector surface and in Namibia, savings would possibly be about 130 litres per annum.

The first step is a comprehensive analysis of the incoming and outgoing flow of energy and materials in a brewery. This analysis determines where and if energy can be saved and residual energy can be derived. The next step is to optimise all heating needs for maximum efficiency. Finally, the renewably operated brewery stands or falls by making the most efficient use possible of the primary energy used. Krones has achieved the necessary system efficiency through some innovations over the last few years, even to the point of being able to operate the brewhouse with regenerative energies. Current technological development is also moving in this direction in other areas of the brewery. One example is the patented and highly effective VarioTherm heating system for bottle washing machines. A saving of fuel costs from 5–30% is possible (***Fig. 3***).

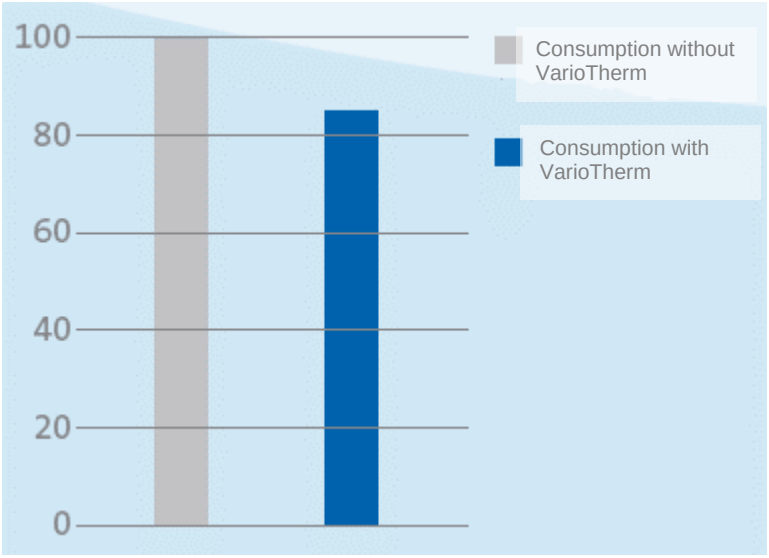

Fig. 3 Energy saving by using the VarioTherm heating system for bottle washing machines

Comprehensive analysis results, together with meteorological data for the location, served as the basis for a computer simulation to determine the necessary collector surfaces, design of the process water circuit and suitable heat consumers.

Solar Collectors with Double-Surface Output

A basic principle in designing an effective solar process heat generating system is to use the most modern collector technology available. Extremely high-output CPC vacuum tube collectors will be built into the brewery sector. Light is absorbed on the coated interior of the glass tubes in these tube collectors. The CPC mirror is shaped so that all radiation is directed to the absorber. This means that even diffuse incoming radiation (*e.g.* radiation received under cloudy conditions) is effectively converted into heat.

Water is used as the heat transfer medium. In this process, the collectors do not first heat a heat transfer medium that then circulates the process water through heat exchangers. Instead, the process water flows directly through the collector and is heated to at least 120°C in the process.

Determining the Solar Energy Available in a Location

The benefits of this type of solar heating system are quantified here based on the example of a brewery in Namibia. According to meteorological records, 2100kWh/m^2/year of annual solar radiation may be expected there. With a collector field of 800m^2, at least 1000MWh/year are available to generate process water with a temperature of 120°C. In this scenario, 1000MWh/year means a savings of ±182000 litres of oil or 131000m^3 of natural gas. Together with this energy savings, the annual CO_2 emissions are reduced by ±340t (***Fig. 4***).

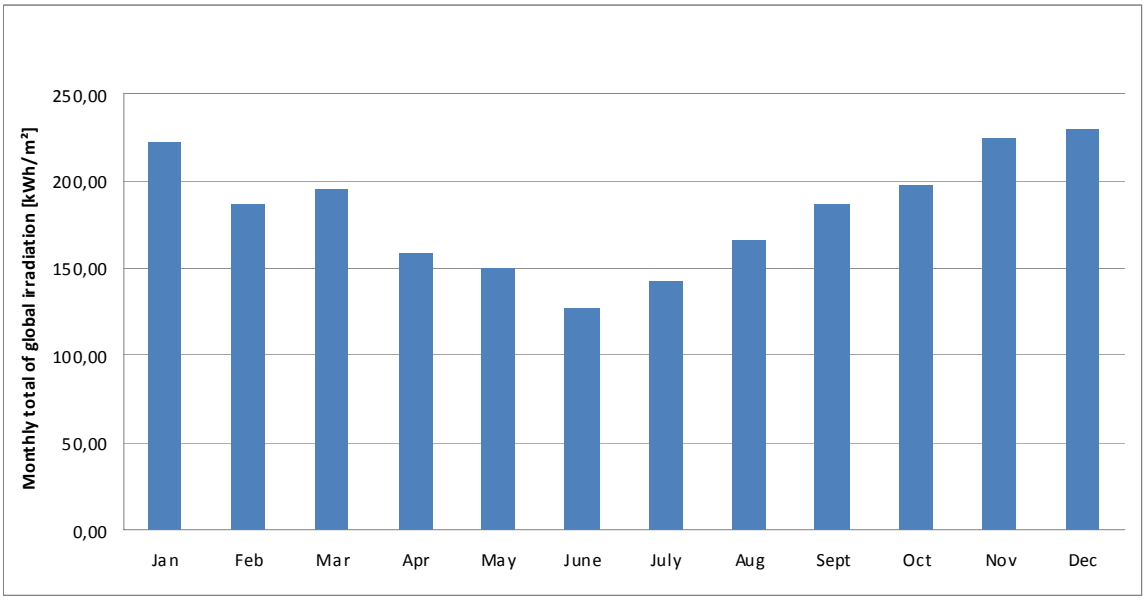

Fig. 4 Monthly usable solar energy in Namibia

This 1000MWh/year of solar energy can be made available to a wide range of heat consumers in the brewery. Water that has been heated to at least 120°C is stored in an insulated tank. Consumers are integrated into the process water circuit, which is created through modular cascades. The hottest water is sent to the consumer with the highest thermal need first. The discharge from this consumer leads to other high or low temperature applications. This cascade connection can theoretically be replicated any number of times, making the concept highly flexible for brewery application.

Energy consumption totals show that if a mash tun, lautering wort heater or bottle washing machine were integrated, ±600kWh/year would remain from the 1000MWh/year produced per 800m² of solar collector surface. Process heat, therefore, could be supplied to other consumers as well. Heating the CIP system from 15° to 85°C requires 3.6MWh monthly; heating from 65° to 85°C requires ±3.9MWh/year. Other potential consumers are the bottle supply water generator, flash pasteuriser or crate washer and heating for the building.

Calculating Energy Costs

As an additional consideration, the solar heating system keeps energy costs at a nearly constant level that can be calculated long term. The oil and natural gas markets are quite a different matter. The cost of crude oil has long flirted with the US$100/bbl mark. The trend is similar for natural gas prices, since they are linked to oil. In addition, it is a foregone conclusion that energy costs will continue to increase over the coming decades.

At the same time, there has been an intensified effort worldwide to contribute to the breakthrough needed to achieve sustainable climate protection. Common approaches include discharges connected with CO_2 emissions.

CONCLUSIONS

Investing in a solar heating system, to capture process heat, yields a continuous profit over an extended period of time. As businesses that remain attached to a specific location, breweries are particularly well poised to benefit from such a system. To this may be added the possibility of financial aid from governments, lower environmental costs and an enhanced image in an area that is influencing consumer buying decisions to an ever greater extent.

The first brewery in Germany using solar heating has been built up: the Privatbrauerei Hofmühl in Eichstätt runs a solar power plant with 27CPC vacuum tube collectors. It will be expanded to 433 solar collectors with a total collector surface of 1400m^2. Altogether solar heating energy will replace almost 30% of the heating oil currently required to generate heat (***Fig. 5***).

Fig. 5 Picture of the solar power plant Hofmühl

The first practical experience of this project is presented. The data from August until September 2008 showed solar peak of 3.6 kWh/m²/d, the average daily solar radiation was 2.1kWh/m²/d. An average collector field efficiency rate of 58% was calculated for this period. With a total collector surface of 1400m² a solar energy yield of 157500kWh from August to September 2008 was achievable. This is a saving of primary energy of 19700 litres of oil or 20280m³ of natural gas and avoidance of 54t of CO_2 emissions. These figures prove that the system is leading to success (***Fig. 6***).

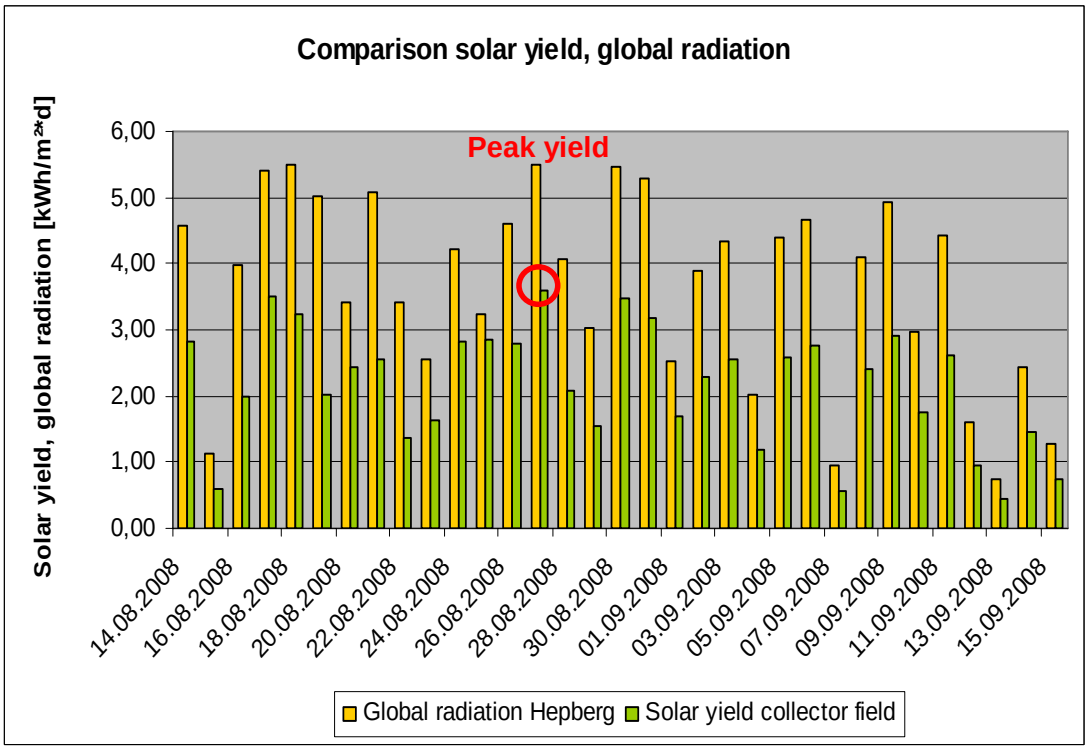

Fig.6 Yield data of solar power plant Hofmühl

Generating solar process heat is a decision with a secure future and leads to sustainable production.