WHITE PAPER

Improving energy efficiency
in the food and beverage industry

Opportunities to reduce energy use in food and beverage production

The food and beverage industry provides the nutrition essential to our daily lives and it will always be required. However, providing food for all 7 billion people on the planet consumes a lot of energy.

It has been estimated that the food industry consumes 30% of global energy and accounts for 20% of greenhouse gas emissions.[1] Demand for food is likely to increase because the global population is projected to grow to over 9 billion people by 2050.[2] This, combined with the challenges of reversing climate change, mean that it is becoming increasingly important to reduce both the emissions from and energy used in the food and beverage industry. This white paper takes a look at some of the ways to improve energy efficiency across the industry.

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Assessing energy use in the food and beverage industry
Because of the importance of food production to society, companies, governments and authorities around the world have assessed the amount of energy used in the industry, and which parts of the value chain consume the most energy. For example, in the EU, the food and beverage industry is one of the most energy-intensive industrial sectors. Looking more closely, it is estimated that processing alone accounts for 28% of the total energy use in the EU.[3] While globally, food processing and transport are estimated to account for about 40% of end-use energy demand.[4] As a result, leading organizations like the European Commission, as well as the UN and the OECD, are trying to drive energy efficiency measures throughout the industry.[5]

Energy assessments guide decision-making at all levels. At the government level, these assessments are industry-wide reviews which are used to inform energy efficiency policy and the development of new regulations. At the corporate level, the assessments are consultants' reports that give an overview of the business and its operations, and these are used to set sustainability goals and improvement targets. However, it's at the facility level where the real changes are made. This is where new regulations and company guidelines are put into practice. It's where the energy is used during food and beverage production. And it's where equipment and processes can be updated and improved to reduce actual energy consumption.

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Food processing in the EU accounts for 28% of total energy consumption.

At the facility level, too, energy assessments help support businesses in making better decisions and they are the first step in improving energy efficiency. With the right tools, customers can perform assessments themselves or they can ask an expert service partner for help. Energy assessments will provide the information and insights needed to identify the energy saving potential of the installed electrical equipment, including motors and drives.

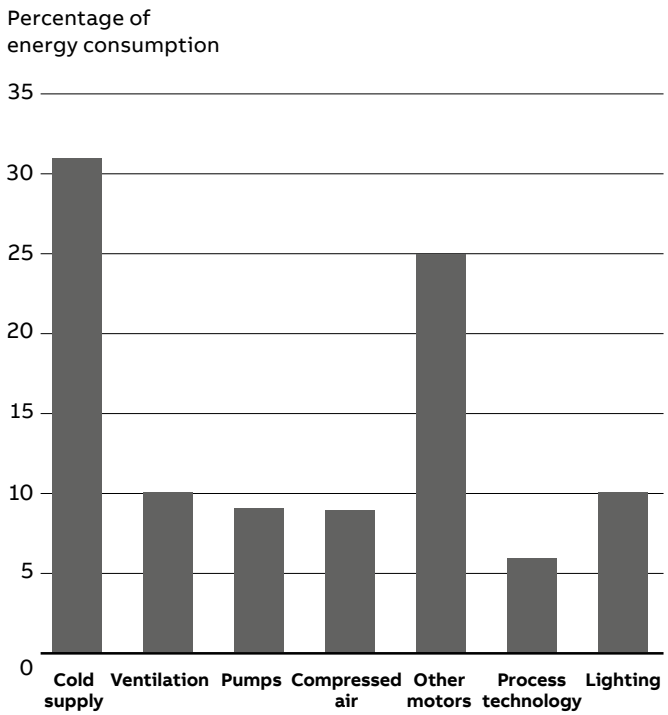
ABB offers expert Energy Appraisals as a service. In addition to our in-depth knowledge of motors, drives, and food and beverage processes, we can offer complete solutions to improve energy efficiency and reduce energy costs.

Identifying areas to improve

In the food and beverage industry the processes that consume the most energy vary by segment. In some segments fans and pumps are responsible for most of the energy use. For example, in the agriculture segment these are feeding and ventilation applications for animals, while in the dairy sector they are cooling and refrigeration. In other segments milling and mechanical processing use the most energy. For example, milling and centrifuges in sugar processing, and grain milling in the ingredients sector. And in confectionary, milling as well as conches, compressors and mixers use most of the energy.

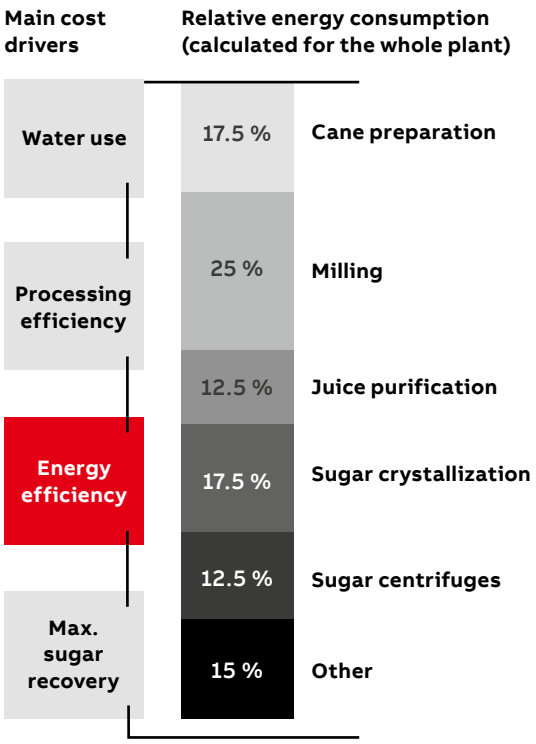
A sugarcane mill was using a steam turbine to run their crusher. When they replaced the turbine with a variable speed drive and electric motor they reduced energy use by over 40%.[8]

The processes that consume the most electricity in the food industry rely on motors.[6]



Most of these processes rely on electric motor systems, including steam systems, pumps and compressors, and heating, cooling and refrigeration systems. However, although electricity consumption in the industry is high, electric motor systems also offer opportunities to save energy, especially in processes that do not run full speed all the time.

Relative energy in sugarcane processing.[7]



Let's take a look at sugar processing to illustrate some of the potential savings that can be found. Sugar production is very energy intensive and therefore sugar factories often have their own power plants. These power plants generally operate on a cogeneration basis, producing both steam and electricity. The amount of energy used by each process step varies and, for example, sugarcane preparation and milling use around 40% of all the energy used in a plant. However, many older sugar factories use a large amount of steam from their co-generation boilers to power their processes, which is inefficient. Converting steam-driven processes to electrically driven ones can significantly improve energy efficiency. For example, an ABB customer was using a steam turbine to run their crusher. When they replaced the turbine with a variable speed drive and electric motor they reduced energy use by over 40%.

Ways to improve energy efficiency

Once inefficiencies have been identified, then the most effective solution or combination of solutions can be proposed. This is where domain expertise and knowledge of food and beverage applications is vital. In particular, it is important to understand how modernizing and upgrading individual components will affect the process as a whole. It's also useful to know what the state-of-the-art is and what new options are available.

There are several technologies on the market that have great potential for reducing energy consumption throughout the production chain, including digitally enabled services. In this section, we will take a look at some of the possibilities that these offer.

Optimize operations with variable speed drives
Many applications in the food and beverage industry are usually run at partial load, like fans, pumps, compressors and conveyor belts. However, these traditionally use mechanical control methods like valves, brakes and throttles to control their speed. In this kind of system, the motor is doing more work than necessary and energy is being lost through the mechanical speed control.

Variable speed drives (VSDs) offer a more efficient way of running applications at partial load because they can control the speed and torque of an electric motor directly. This eliminates the need for mechanical speed control and oversized motors. With direct control of a motor, it can be controlled to match the actual process demand, enabling applications to run with high efficiency at a range of different speeds. As a result, VSDs can significantly improve energy efficiency throughout whole production chains.

ABB offers VSDs and control software that, together with our application expertise, can be used to optimize various processes throughout the food and beverage industry, ensuring that motor-driven applications, such as compressors, pumps, extruders, conches and conveyors, do the right amount of work at the right time.

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Adding a variable speed drive to a fan, pump or compressor can typically reduce energy use by 25%.[9]

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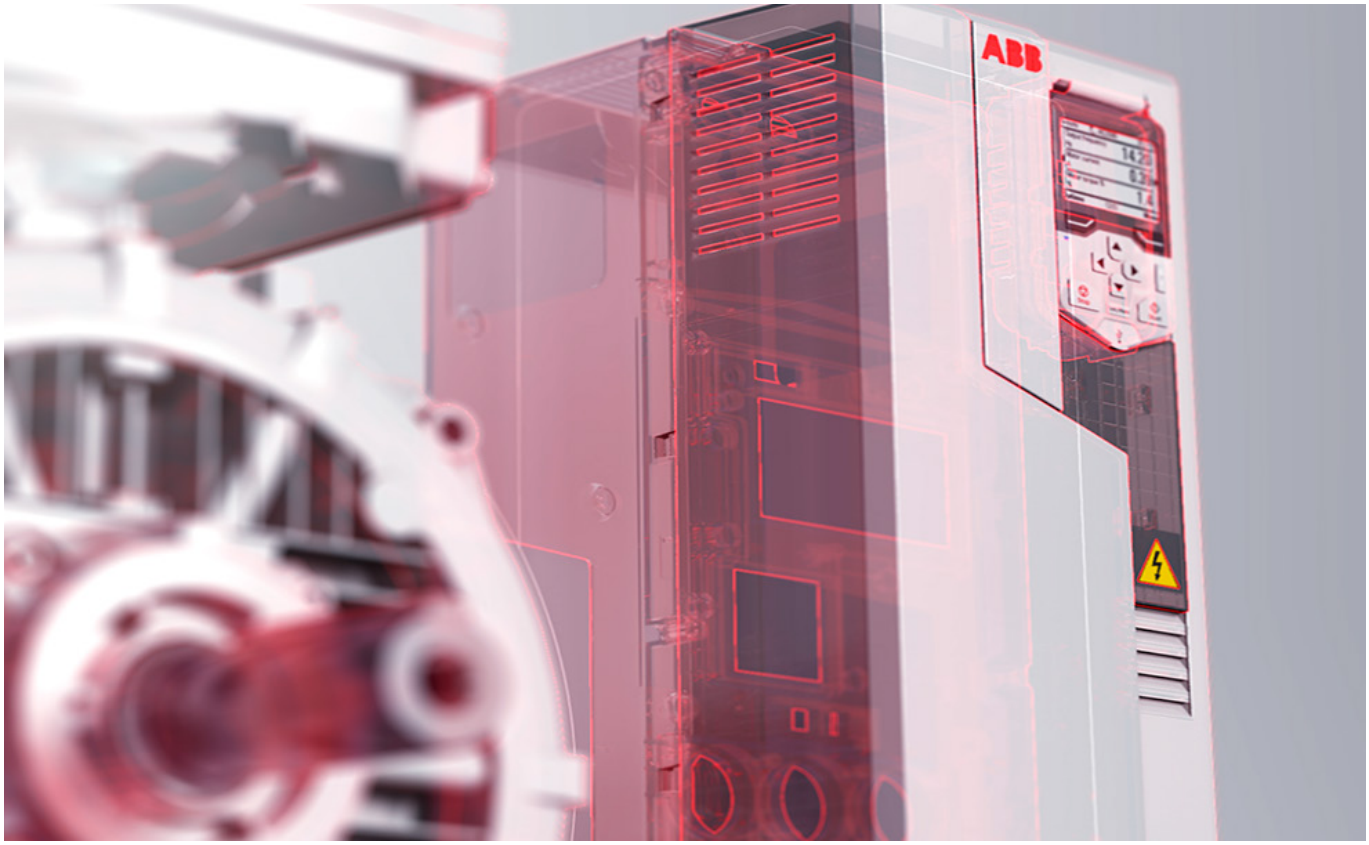
Globally, around 14% of food produced is lost before it reaches the consumer.[10]

Another benefit of VSDs is that they enable precise speed control and this capability can be used to prevent energy and food going to waste during production. This is because maintaining the right machine speed, e.g. in mixing, is very important in the food industry, and entire product batches can be ruined if the ingredients are mixed too fast or too slow. However, since VSDs can ensure the correct mixing speed, they can also help minimize food waste and the associated energy consumption during production. In addition, because food waste is also a major source of greenhouse gas emissions, reducing waste during production also improves a company's sustainability.



Modernize to more efficient motors
In addition to adding VSDs to improve the efficiency of existing applications, upgrading motors to more efficient models can also improve the overall efficiency of food and beverage applications. Currently, many motors in use in the food and beverage industry have IE3, IE2 or even IE 1 efficiency. However, motors with much better efficiency are available. For example, induction motors are available with up to IE4 efficiency and synchronous reluctance motors, like ABB's SynRM motors, are available with IE5 efficiency. Since each IE class delivers 20% lower losses, upgrading offers the potential for clear energy and cost savings. Furthermore, in some markets modernization is also supported by tax breaks, government grants and other financial incentives to encourage businesses to improve their energy efficiency.

Recover energy from processes with regenerative drives
Although VSDs can run applications at the optimum speed without the need for brakes, some applications in the food and beverage industry do require some form of braking. For example, in the sugar industry batch centrifuges are used to separate sugar crystals from molasses and these use repeated cycles of acceleration and deceleration. If traditional mechanical braking systems are used in a process like this, the kinetic energy of the rotating centrifuge is lost as heat as the brakes are applied. If electrical braking is used in conjunction with a VSD, the kinetic energy is dissipated through braking resistors, and again it is lost as heat.

However, using regenerative drives, it is possible to use electrical braking and recover the energy as electricity. The energy recovered by regenerative drives can either be used elsewhere in the plant, for example, in the acceleration phase of another centrifuge, or it can be fed back into the grid. By recovering energy that would otherwise be lost, regenerative drives can improve overall energy efficiency, as well as reducing or eliminating the need for cooling systems that handle the waste heat.

Reduce electrical energy consumption and CO_2 emissions with energy efficiency solutions and services
Plug and play digital solutions securely collect data from applications, providing deeper status insights and a true indication of the condition of the installed base. By collecting and analyzing information directly from your powertrain, cloud-based technologies are utilized to help understand and predict any potential downtime, enabling the scheduling of maintenance services at a time that is suitable.

Using ABB's domain expertise and digital solutions helps you make better decisions to identify potential energy savings and CO_2 emission reductions as well as to track and trace equipment to enable efficient operations, reduce waste, and comply with regulations.

Energy efficient solutions and services can also be implemented by modernizing motors and drives at the right time based on data and advanced analytics to determine optimal energy savings, minimize waste through circular service models, and improve financial returns for specific assets and applications.

CASE STUDY

Source: Campell's Australia

Campbell’s Australia reduces energy costs by 14% over 1 year

To help them meet their sustainability targets, Campbell's Australia's Shepparton plant in Victoria installed an ABB SynRM motor and drive package in their refrigeration plant. After 12 months, the investment had clearly reduced their energy costs by 14% and reduced their CO_2 emissions. Thanks to this success, Campbell's Shepparton have since added another three ABB SynRM variable speed drive packages to their facilities.

CASE STUDY

Source: Canal Sugar

New sugar factory designed for optimal efficiency

Canal Sugar is constructing a major new agro-industrial complex in Egypt. As part of their investment they selected variable speed drives from ABB to run 15 batch and 10 continuous centrifuges. Using these energy efficient and state-of-the-art systems, they aim to increase the number of cycles and raise output, while also reducing energy consumption by 25% per tonne of massecuite compared to traditional machines. ABB will also deliver a multidrive system that is customized for regenerative operation. This will further save energy by recovering energy generated by centrifuges in the braking stage of the cycle and transferring it the centrifuges that are accelerating.

Conclusion

Although the food and beverage industry relies on a lot of energy intensive processes, there are many opportunities to optimize energy efficiency. Technologies and solutions are available now which can significantly reduce energy consumption, and service partners like ABB can also provide expert advice and services to help businesses optimize their whole operations. Better still, energy savings also mean cost savings, so businesses can expect attractive Return On Investment (ROI) and payback times.

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(7) Based on ABB measurements and calculations.

(8) Based on ABB customer experience.

(9) For an example of the calculations involved, see “Program Insights: Variable frequency drives,” Consortium for Energy Efficiency, 2019, https://www.cee1.org/content/variable-frequency-drives

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