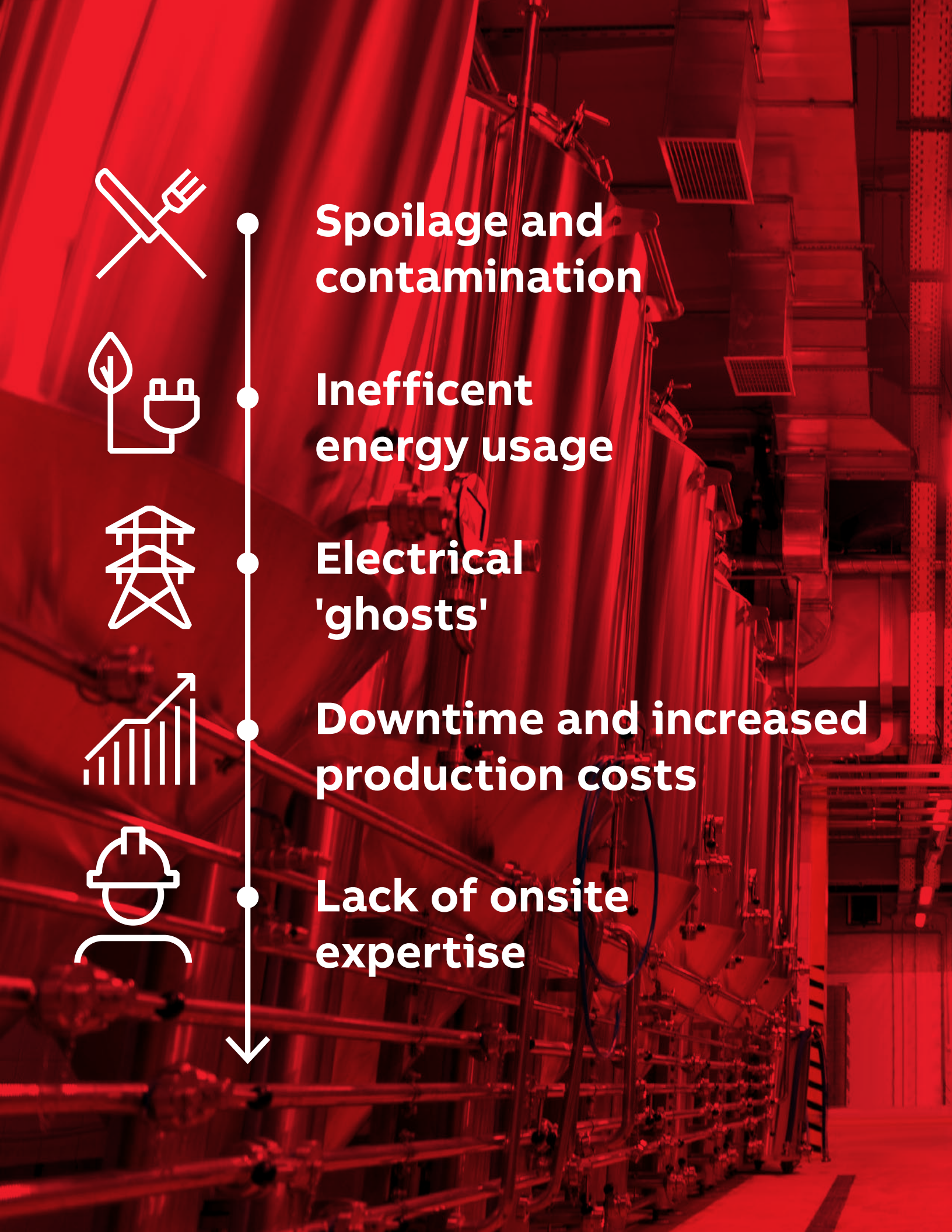
# Five enemies of productivity in food and beverage manufacturing


Spoilage and contamination
Inefficent energy usage
Electrical 'ghosts'
Downtime and increased production costs
Lack of onsite expertise

The food and beverage industry is under constant pressure to adapt and evolve to meet consumer expectations. Adjusting production requires unprecedented flexibility and efficiency to provide multiple flavors, and varying product sizes, ingredients, and packages, to meet these expectations. All of this must be done while maintaining productivity, quality, and safety. To that end, it's imperative that food and beverage manufacturers identify and develop proactive plans to eliminate impediments to productivity. Spoilage and contamination, unsuitable environments, inefficient electrical usage, electrical ghosts, and lack of onsite expertise all play a role, but there are proactive measures you can take to eliminate them from your operations.

# 1 Spoilage and contamination

In the food and beverage industry, spoilage and contamination can be caused by a multitude of things, including cavitation and unsuitable environments.

Having to scrap a batch of product is enough to put anyone responsible for operations in a sour mood. Production lines come to a screeching halt, product gets unceremoniously dumped, and the painstaking cleaning process begins. Then, when you're finally ready to start production, how can you be sure the same thing won't happen again? Or, worse yet, what happens if a bad batch gets through and is distributed to customers? The outcome can have massive consequences for the community as well as the company. Even when you catch it before it goes out, over time, spoilage, contamination, and the production backlogs they create put a crimp in productivity – and the company's bottom line.

What if, instead of just reacting to a bad situation, you could be proactive and head problems off as soon as, or even before, they occur? The first thing you'd need to do is determine the causes.

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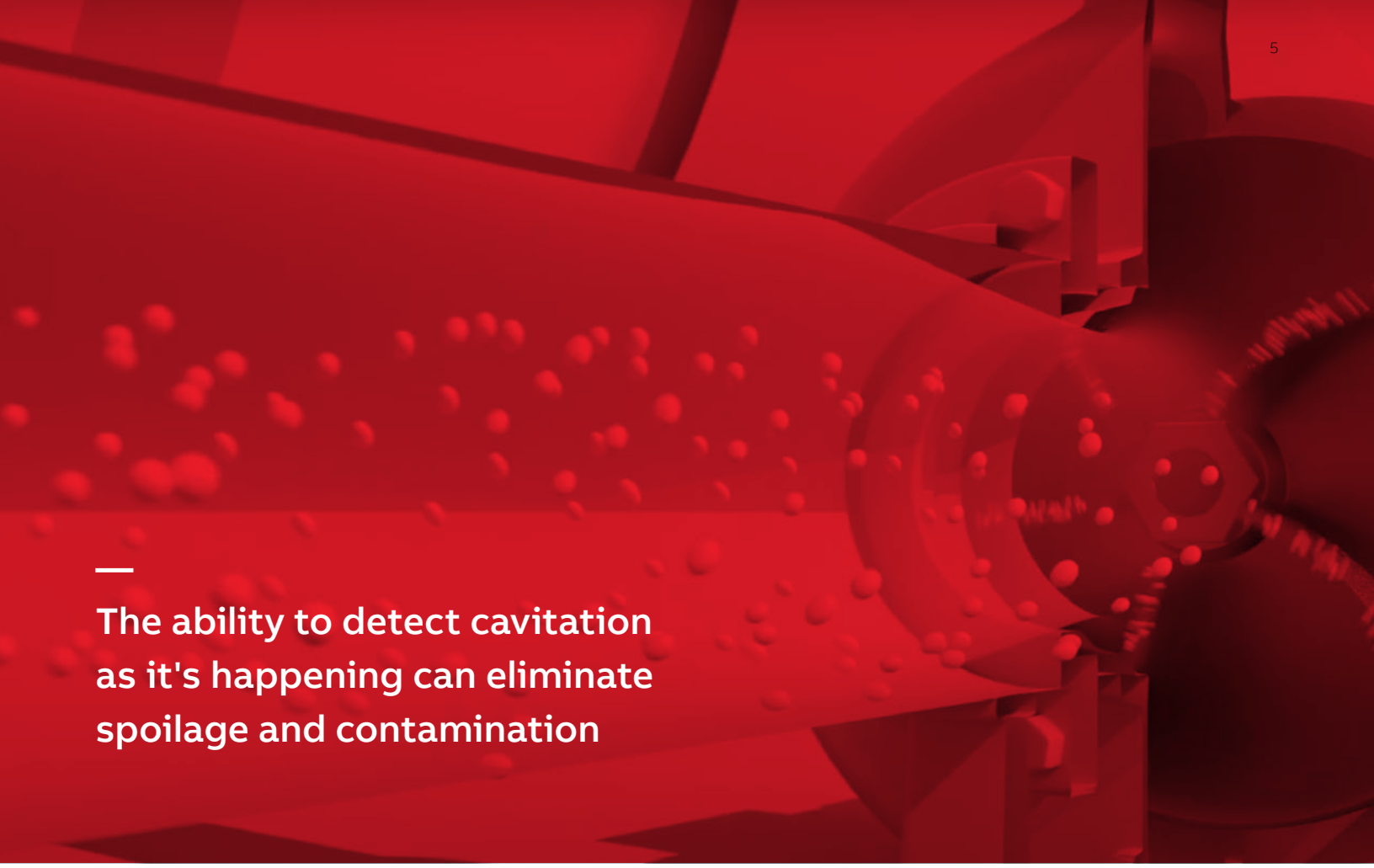
01 Impeller damage caused by the effects of cavitation

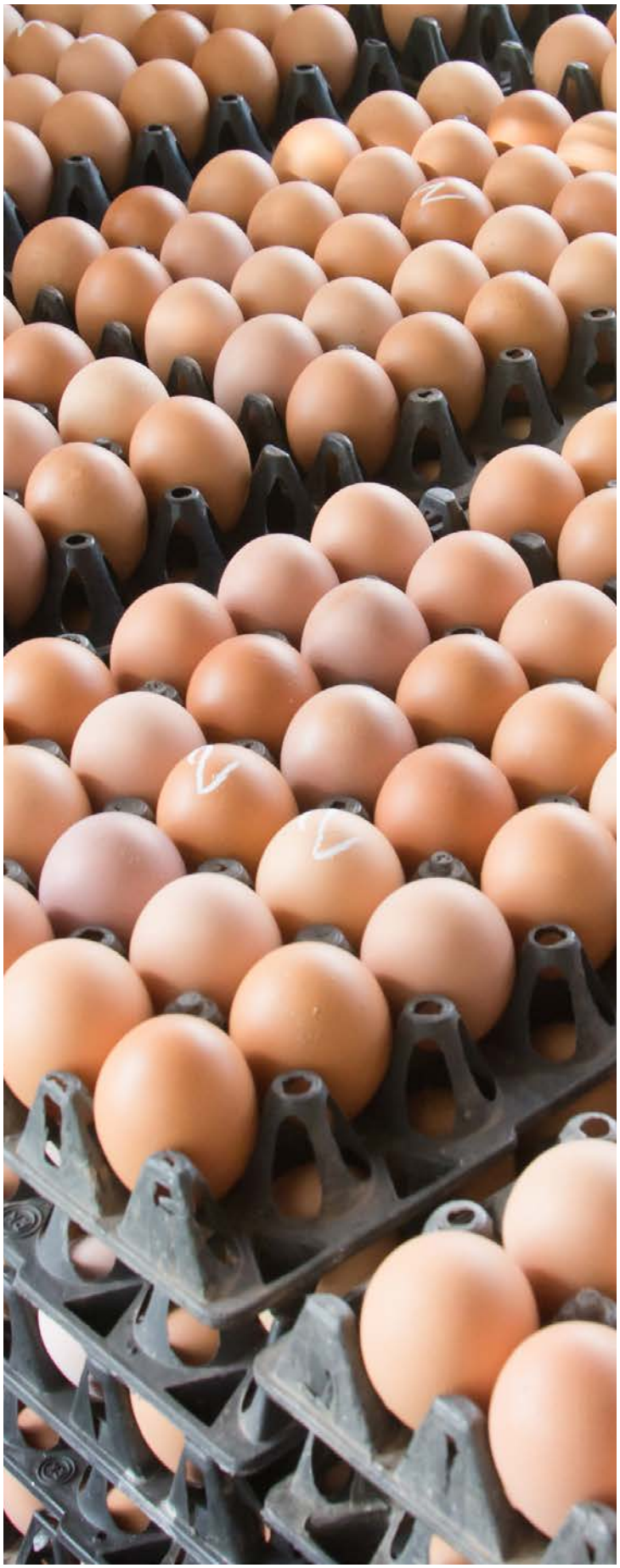


## The ability to detect cavitation as it's happening can eliminate spoilage and contamination

**Cavitation**
As you know, reliable pump operation is essential for both product quality and productivity. Cavitation is one of the most troublesome issues that can occur in various fluid handling systems used in the food and beverage industry. It's triggered by a pressure drop in the liquid moving in either the pipe or the centrifugal pump, causing bubbles to form. As the pressure continues to fluctuate, the density of the liquid changes, resulting in cavitation. Eventually the bubbles collapse. The subsequent rapid implosions can cause serious mechanical damage to the pump's impellers and seals, and if vapor lock occurs, it can even burn up motors.

For the food and beverage industry, the problems associated with cavitation are not limited to loss of production and increased maintenance costs. As a bigger problem, it can also cause shock waves in the liquid that lead to the formation of bubbles or foam when pumping fluids, resulting in poor product quality, including contamination from metal flakes from the pump, and lost revenue.

Step one to correcting this problem is being able to detect it when it's beginning. Once detected, the speed of the impeller must be slowed down to stop the cavitation. To manage this challenge efficiently, ABB's ACS580 drive provides innovative, built-in cavitation detection and control functionality as an ideal way to ensure high productivity and quality. When cavitation occurs, the speed of the impeller is automatically adjusted. As a result, pump efficiency and productivity improve as the cavitation is eliminated, and adverse wear and tear on the mechanical equipment is avoided. Because external sensors aren't needed, and cavitation was addressed before it caused problems, there are clear savings in initial product cost as well as maintenance expenses. Above all, cavitation detection and control functionality will help provide consumers with high quality products and ensure uncompromised and effortless food production.



## Spoilage and contamination

### Unsuitable environments

Another major contributor to spoilage and contamination is unsuitable environments, including ventilation and temperature. Many food and beverage facilities rely on environmental control as part of their process. If that environmental control fails, the consequences can be severe, from the health and productivity of livestock to spoiled product that must be scrapped.

**Livestock health**

Environmental control that contributes to the health and comfort of livestock, such as chickens, is critical to farmers. 65 to 75 degrees is perfect for egg production, for example, but as temperatures begin to creep into the 80s, egg size may be reduced, shell quality may suffer, and the chickens will lay eggs less often. Anything hotter than 90 leads to discomfort, reduced appetite, and agitation, and 100 degrees is where the chickens' health begins to suffer.

Birds in a chicken house depend on adequate air velocity or cool conditions to allow them to maintain their ideal body temperature, resulting in optimum productivity. So how do you keep them cool enough to optimize production without expending additional energy? ABB variable frequency drives (VFDs) can help to better manage air flow, automate the hours of system operation, and improve performance, all while minimizing maintenance needs.

When air extractors perform better, fewer are needed, which allows farmers to eliminate excess equipment and minimize maintenance. Not only does this process improvement move more air through the facility to keep the chickens cool, it also helps reduce CO2 and ammonia, which benefits the health of the birds, and provides greater water savings through improved inlet cooling system evaporation. Overall, when VFDs are used, it translates into greater bird comfort with constant air flow, and can save 25 percent or more in energy costs, and even more when applied to partial loads.

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**Refrigeration**

Everyone knows that food safety is paramount, and bacteria that flourish in certain environments can create a substantial risk. According to the FDA[1], 'Pathogenic bacterial growth and toxin formation resulting from time and temperature abuse of food can cause consumer illness.' No one wants this, which is why environmental control is critical to food and beverage production and storage. It's vital that refrigeration systems, which are one of the largest energy users in a food and beverage facility, reliably meet the required parameters to avoid these risks.

Although refrigeration sounds straightforward, there are many sub-systems, such as heat exchangers, evaporators, and compressors, that each need to function optimally. In addition, system connectivity is critical. Information needs to be shared to ensure that the entire system is working in sync and at peak.

ABB solutions allow food and beverage facilities to monitor and control their systems to optimize energy use and reduce cost. VFDs can be used to slow down or speed up motors depending on demand, resulting in substantial energy savings. They also enable the system to be flexible enough to adjust based on production, environmental changes, energy fluctuations, and external factors, such as power outages.

Because refrigeration is so critical, generators play a vital role as a backup power source, adding complexity to the system. ABB ultra-low harmonic VFDs create a stable, generator-friendly environment to maintain the appropriate temperature, minimizing the risk of spoilage.

# Inefficient energy usage

The food industry consumes approximately 30% of all global energy.[2] Uncontrolled usage doesn't only waste energy. It can also cause undue wear and tear on equipment and, in some municipalities, result in penalties on utility bills.

When you control energy usage, you can also optimize the efficiency of your processes. With energy costs skyrocketing, this is an ideal place to look for productivity improvements that also provide cost savings.

**Identify and eliminate waste**

To find impactful ways to eliminate wasted energy, you must first identify applications with high energy use. In the food and beverage industry, the processes that consume the most energy vary by segment. For example, in agriculture, feeding and ventilation applications are the big users, while in the dairy sector it's cooling and refrigeration, and in sugar processing, it's milling and centrifuge applications.

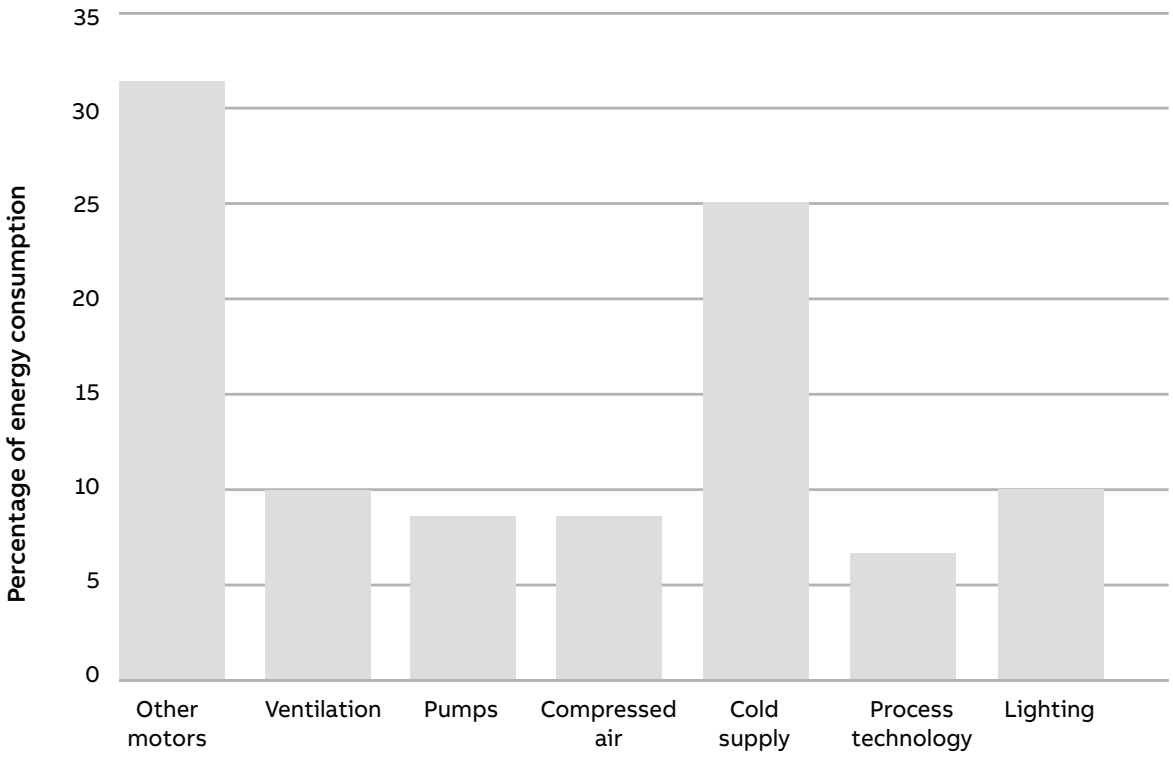
Motors operating in food processing facilities often run 24/7 even though the load can vary significantly throughout the day. Many of these applications, like fans, pumps, compressors, and conveyors are typically run at partial load and have traditionally used mechanical control methods like valves, brakes, and throttles to control their speed. Also, when a motor is slowed down, excess electrical energy is run through a braking resistor which dissipates the energy as heat. In these types of systems, the motor is doing more work than necessary, and energy is being lost through mechanical speed control.

**Adding a variable frequency drive to a fan, pump, or compressor can typically reduce energy use by 25%.[3]**

VFDs control the speed and torque of an electric motor directly, so the motor is controlled to match the actual process demand. This enables applications to run with high efficiency at a range of different speeds and eliminates the need for mechanical speed control and oversized motors. Because the speed of an electric motor is tied to the power it consumes, even a modest speed reduction yields significant energy savings.

ABB offers VFDs and control software that, together with our application expertise, can be used to optimize various processes throughout the food and beverage industry. These solutions ensure that motor-driven applications, such as compressors, pumps, extruders, and conveyors, do the right amount of work at the right time. For example, adding a variable frequency drive to a fan, pump, or compressor can typically reduce energy use by 25%. Food and beverage facilities can leverage ABB VFDs to significantly improve energy efficiency throughout their entire production chain, resulting in improved overall productivity and profitability. ABB also provides drives with regenerative capabilities, which absorb and store excess electrical energy to use elsewhere, or can even be fed back to the grid, reversing the meter flow and reducing costs. In addition, cost-effective plant-wide condition monitoring and smart sensors can work together with the energy monitoring capabilities of VFDs to collect a wealth of data to help analyze and address energy use.

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



# 3 Electrical 'ghosts'

As food and beverage manufacturing becomes more automated, electrical equipment becomes increasingly prevalent on the plant floor.

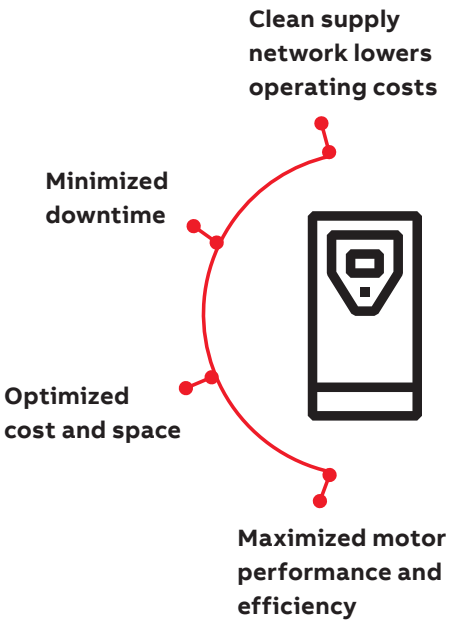
Most electrical office and test equipment in your facility, including VFDs, are non-linear loads, which cause harmonic distortion and other side effects. Increased harmonics produce what seem like 'electrical ghosts' on the plant floor. For example, transformers and motors can suddenly overheat, sensitive electronic equipment can operate erratically or fail, breakers can randomly trip, and generators and fuses can blow. The resulting downtime and quality issues decrease productivity and affect overall product output. To top it off, it wastes energy, adding unnecessary cost to your process. In some areas, it can also show up as power factor penalties on utility bills. In the short term, these issues can make life miserable. In the long term, they can shorten the life of equipment.

Manufacturers often try to address these issues by oversizing transformers and motors, which takes up precious space, adds unwarranted cost, and limits future expansion. They may also locate VFDs closer to motors to minimize long motor leads, which adds complexity to the system design, especially in washdown areas.

ABB's ultra-low harmonic (ULH) product knowledge – through four product generations – combined with valuable customer feedback has yielded an industry leading ULH technology that addresses power quality issues while improving energy efficiency and alleviating electrical disruptions that negatively impact manufacturing facilities. The result is a stable electrical system that performs as expected to provide continuous operation. ABB's ULH drives also enable food and beverage manufactures to meet the most stringent recommendations of IEEE519.

The common theme with harmonics is that, left unchecked, they cost you money. By using ABB's ULH solution, you can achieve near unity power factor to reduce both OPEX and CAPEX costs, avoid penalties, and increase the productivity and life of expensive manufacturing equipment. The ULH design also maintains full motor voltage and provides ride-through for momentary power losses and sags, performs flying starts, and compensates for long motor leads and insufficient transformer voltage.

ABB's ULH solution is easy to use and fast to install (three wires in; three wires out), has a small footprint, and leverages a common communication platform to provide an all-compatible experience. This proven design incorporates 20 years of ABB's ultra-low harmonic industry experience to yield an industry leading solution, making it ideal for improving productivity in the food and beverage industry.



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ABB's ULH solution enables you to achieve near unity power factor, reducing both OPEX and CAPEX costs.

# 4 Downtime and increased production costs

Every minute a line is down adds cost and reduces productivity.

When individual applications within a system are not well synchronized, the entire process can become extremely inefficient. In the short term, this can cause a multitude of unappealing consequences throughout the facility. In the long term, it can limit the ability of manufacturers to move at the speed of consumer demand.

The power of an automation solution is that it does the hard work for you. Technology has enabled intelligent assessment and coordination of your applications to drive highly efficient solutions for productivity on the plant floor. Unfortunately, many food and beverage facilities are not using technology to its fullest.

Maximizing uptime drives increased productivity in food and beverage facilities. By integrating solutions, providing increased visibility across operations, and implementing predictive maintenance, facilities can reduce downtime, improve reliability, and reduce operational costs.

**Integration and Communication**

When processes are run independently of each other with little coordination, timing issues cause production delays. For example, when one application must wait for the arrival of product from another upstream application, production is stalled, and product quality may suffer. This can be caused by a lack of integration and coordination between applications, as well as a lack of visibility to data from the entire system. Either way, it reduces efficiency, system reliability, and in the end, productivity.

With synchronized applications and continuous communication, processes can be coordinated to eliminate unproductive lag time.

ABB is uniquely positioned to deliver superior, end-to-end, scalable, automation solutions to the food and beverage industry. As a global market leader, ABB provides solutions that include VFDs, motors, programmable automation controllers (PACs), communications, and services, that enable your facility to perform optimally.

In addition to having the right products, you need the right information at the right time. If you don't know what's happening in your system, it's hard to proactively manage productivity. Good data that you can turn into actionable information can make all the difference.

Because the food and beverage industry is heavily regulated to protect consumers, information is paramount. Facilities need to have the ability to track and trace everything throughout the supply chain to help mitigate the risk of compromised product that leads to recalls. This same data can be used to improve processes and increase productivity.

ABB Ability provides visibility to the entire system, whether it's one facility or multiple locations. It allows you to evaluate environmental effects, such as temperature, as well as operating conditions, such as loading levels. With Ability, you can visualize, in real time, the impact on your processes, as well as on the equipment. This allows you to make corrections and immediately visualize the impact on your system. Ultimately, you can adjust your system to efficiently produce high-quality products and extend the life of your equipment.

**Predictive Maintenance**

Most food and beverage facilities have a scheduled maintenance strategy that helps keep the system up and running. While this is a good baseline, it's not necessarily the most cost-effective strategy and it doesn't catch everything. What if you could detect an issue, such as overheating, or determine the health of individual components, such as IGBTs, filters, or capacitors, before they cause downtime?

ABB can help you prepare for success by moving from preventive to predictive maintenance. This means, in addition to regular maintenance, you can evaluate what's happening in real time to address issues before your system goes down, taking with it your facilities' productivity.

# Lack of onsite expertise

Running lean has understandably become the mantra of most manufacturers. Gone are the days when facilities had a full staff onsite to manage equipment.

Food and beverage facilities are no different. It makes sense. The focus needs to be on the core competency of producing quality products. However, as food and beverage facilities become increasingly automated, having access to expertise to ensure processes are efficient, maintained, and repaired when needed is imperative. Without it, operational downtime can quickly eat away at the company's bottom line.

It's critical to have the right expertise no matter what stage the facility is in. When designing a process, ABB is a trusted partner with the industry and application expertise, tools, and resources you need to ensure success. That means not only helping you design your system to operate in the most efficient way, but also providing local and remote application support to address issues as they occur.

Even before you buy a PAC, HMI, VFD, or motor, ABB's experts are on hand to offer technical advice from dimensioning to potential energy saving. Once you've decided on the right products, ABB and its partners can help with installation and commissioning.

They are also on hand throughout the operations and maintenance phases of the product's life cycle, providing preventive maintenance programs as well as other services tailored to your needs. No matter where your facilities are located, our wide channel partner network and global service is always local. You choose the services that fit your needs, from classroom training to customized service contracts.

Having access to that expertise is just as important once your system is up and running. When your system is down, you need support right away! The longer it takes to get it back up and running, the more it impacts your bottom line. Not only does it put you behind, creating lost revenue, but you may have to deal with product spoilage and cleaning shutdowns as well. Add to that the cost of maintenance engineers working to get the system back up and the extra costs if it happens in the middle of the night.

ABB provides a variety of technical support options to reduce operational downtime. In addition to the 24/7/365 technical phone support that comes with every VFD, ABB offers Mobile Connect, a modern remote diagnostics service that allows you to commission and troubleshoot drives quicker, more easily, and avoid the unnecessary costs and delays of an on-site visit.

# Summary

With constant pressure to adapt and evolve to meet consumer demand, food and beverage facilities can benefit from partnering with ABB to better understand and address the things, like spoilage and contamination, energy efficiency, and electrical ghosts, that get in the way of productivity.

By leveraging ABB's expertise to address these issues, food and beverage facilities can better integrate their systems to improve processes, get the information they need, minimize downtime, and optimize productivity.

ABB helps you improve productivity so that you can move at the speed of consumer demand.

**References**
(1) Time and Temperature Controls during Unrefrigerated Processing
(2) Food and Agriculture Organization of the United Nations,
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(3) 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
(6) Monforti-Ferrario, F. Energy Use in the EU Food Sector: State of Play and Opportunities for Improvement; European Union;
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It's critical to have the right expertise no matter what stage the facility is in.

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