PACKAGING OEM

MARCH 2025

ENERGY EFFICIENCY IN PACKAGING MACHINES: A GROWING PRIORITY

INSIDE:

- Megatrends: Climate and cost concerns
- Tools to offset energy-intensive components
- The application of energy

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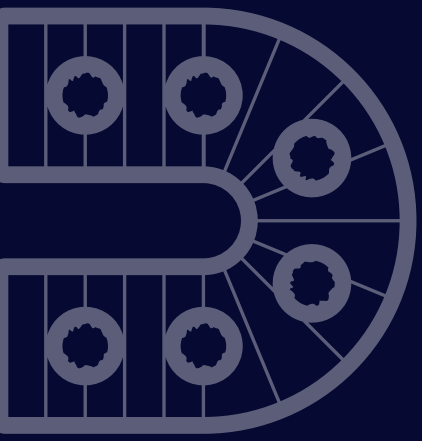

INTRODUCTION

As manufacturers focus on sustainable best practices within their organizations, there's a new pressure on packaging OEMs to deliver energy-efficient machines. This, however, is an area that many OEMs have not historically focused on. Instead, they have prioritized cost, speed, flexibility, and technology. But as the manufacturing C-suite examines plant floor operations as part of the big picture in a sustainability strategy, they are asking equipment suppliers to come to the table with solutions.

In this report, *Packaging OEM* looks at the megatrends driving the need for energy efficiency in machinery, practical ways to measure energy consumption, the technologies that can be integrated into equipment to monitor energy usage, and real-world applications that highlight how to optimize energy usage while simultaneously cutting costs.

EXECUTIVE SUMMARY

Manufacturers want data on electricity, gas, and water consumption. This is not just for tracking but for actively reducing energy waste. Traditionally, manufacturers may have manually recorded energy usage leading to delays in analysis and decision-making. By automating this process, companies can avoid peak consumption costs and optimize their energy use on the processing and packaging line in real time.

To provide more energy monitoring in machines, OEMs are now working to integrate sensors and data visualization tools into equipment, with an eye on incorporating machine learning and artificial intelligence in the future. A challenge arises when customers use equipment from multiple OEMs, each with different monitoring capabilities. To address this, interoperability and centralized data collection are becoming crucial as organizations need solutions that consolidate information from various machines into a unified system.

The journey toward energy efficiency is ongoing, with many OEMs still prioritizing overall equipment effectiveness (OEE) over energy optimization. However, energy management is becoming a crucial factor in manufacturing productivity. Companies that effectively integrate energy monitoring and optimization into their processes will not only reduce costs but also enhance sustainability and compliance with global energy regulations.

As the industry adopts a more energy-conscious attitude, OEMs and manufacturers must continue to innovate, ensuring that energy efficiency becomes an integral part of machine design and factory operations.

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MEGA TRENDS: CLIMATE AND COST CONCERNS

When manufacturing products, carbon dioxide and other greenhouse gases (GHGs) are produced. These GHGs trap heat in the atmosphere and warm the planet.

According to the Congressional Budget Office (CBO), the United States emitted about 6.4 billion metric tons (BMT) of greenhouse gases in 2021, more than any other country – except China. CBO estimates that the manufacturing sector was responsible for 12% of U.S. greenhouse gas emissions in 2021. According to the CBO report, about 75% of those emissions came from burning fuel to create heat, and the rest were by-products of industrial processes that transform materials into products.

With a growing concern over how greenhouse gas emissions impact the planet, many manufacturers are looking at their role and responsibilities as they balance productivity with environmental impact.

The Capgemini Research Institute took a look at this dynamic in its report Sustainable operations – a comprehensive guide for manufacturers. The company surveyed close to 1,000 sustainability leaders at major manufacturers in industries ranging from aerospace and defense, automotive, industrial and capital goods, to high-tech, consumer products, pharmaceuticals, and medical device manufacturing.

> "OUR RESEARCH SHOWED THAT THROUGH SUSTAINABILITY INITIATIVES, OVER 80% OF ORGANIZATIONS ENHANCED BRAND REPUTATION AND BETTER [ENVIRONMENT, SOCIAL, AND GOVERNANCE] RATINGS, AND OVER 50% IMPROVED EFFICIENCY AND PRODUCTIVITY, REDUCED PACKAGING COSTS, AND INCREASED SALES. **HOWEVER, ONLY A FEW ORGANIZATIONS ARE ACTUALLY ON TRACK TO BECOME SUSTAINABLE MANUFACTURERS AND A MERE 11% OF SUSTAINABILITY INITIATIVES ARE EVER SCALED ACROSS THE ORGANIZATION.** FINALLY, TECHNOLOGIES - ESPECIALLY AUTOMATION, AI/ MACHINE LEARNING, AND DATA ANALYTICS ARE CRITICAL TO ACCELERATING [THE] SUSTAINABILITY AGENDA."
>
> *– THE CAPGEMINI RESEARCH INSTITUTE*

And while most manufacturers are acting as good corporate citizens, they are also looking to sustainability initiatives to reduce energy costs. Multinationals, for example, are taking a hard look at ways to lower energy consumption because energy costs are much higher in Europe.

According to Cipher, which reports on climate and technology news, industrial power prices have risen much more in Europe compared to the U.S. And these high energy prices could be holding back Europe's manufacturing industry.

Now, the question is: How can OEMs help manufacturers meet energy goals?

PACTEON'S POWER STICKER

The Pacteon Group is on a mission to be a leader in energy-friendly machines. Awareness is the first step. And that starts with a sticker!

Pacteon's four companies — ESS Technologies, Schneider Packaging Equipment Company, Phoenix, and Descon — provide cartoners, case packers, conveyors, palletizers, and wrappers. In response to customer inquiries for energy efficient equipment, the group has built a way to measure energy usage on existing equipment.

Enter the Pacteon "power sticker." Similar to an Energy Star sticker that a consumer would see on household appliances, the Pacteon sticker is a visual representation of the overall annual cost to operate the machine. Pacteon's portable energy monitoring system plugs into the power feed on existing machines and outputs the kilowatt hours and the total cubic feet per minute (CFM) of air consumption.

They then use those values and take the national average of energy cost, as in dollars per kilowatt hours for the electrical, and convert that to dollars, showing the estimated average yearly cost to run the machine.

Pacteon has made the commitment to calculate power consumption for end users as an additional resource.

"We believe we're leading this charge as we haven't seen any other competitor doing this from an OEM standpoint," said Jamie Barber, director of product development at Schneider Packaging Equipment, a Pacteon company. "But if we can work toward that standard energy sticker across industrial equipment, our end users can then start looking at a baseline and understand which machines are more efficient than others. Today the challenge for our end users is that they don't have a good sense of which [machines] are using the most energy and which ones are using the least. So, if we can all work together on a standardized approach to using the same calculations for energy consumption, I think we can really provide them a holistic view of their facility. Then they can start looking at what is costing them more money."

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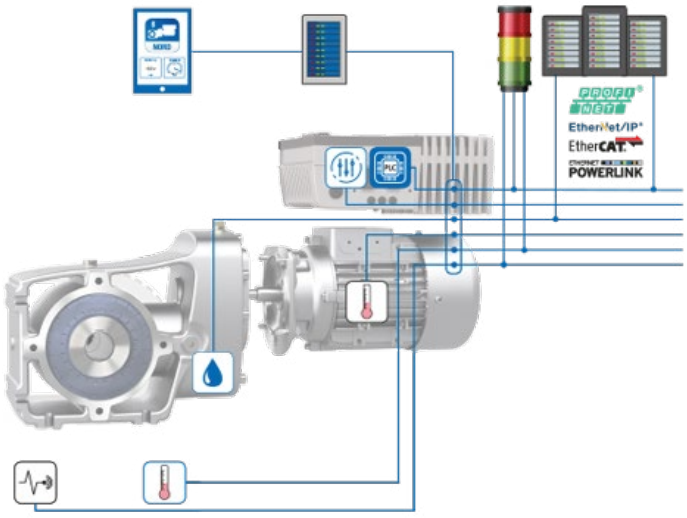

NORD DRIVESYSTEMS designs and manufactures gear boxes, electric motors, and electronic control products for hundreds of industries worldwide with modular designs that deliver more than 20,000,000 standard configurations. When you need quality, versatility, and high efficiency, NORD has you covered with complete drive solutions for primary and secondary packaging, end-of-line packaging, and higher-level applications.

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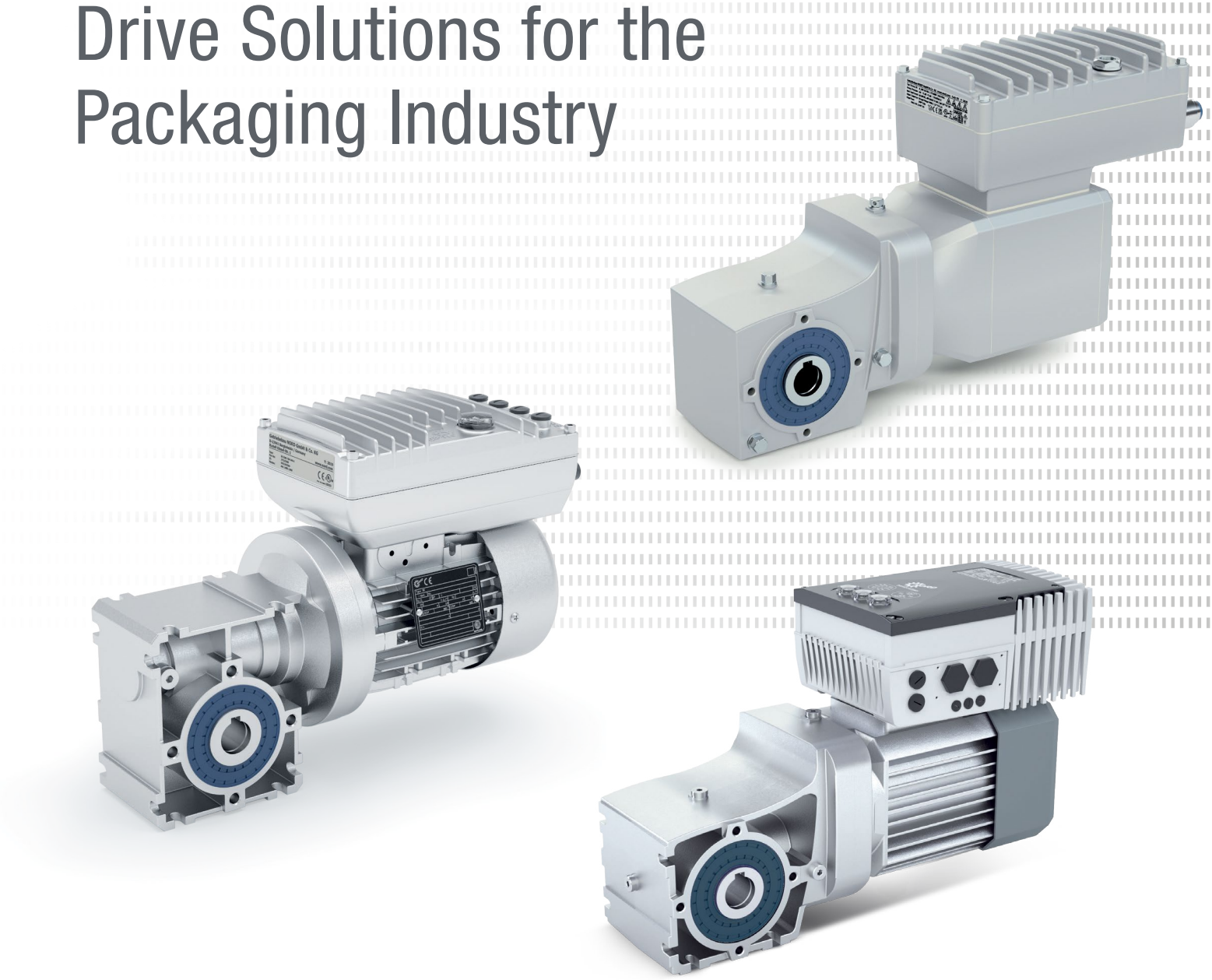

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End users can also use the energy monitoring option as a strategic tool to ensure the machine is not wasting energy — such as implementing strategic idle time management that turns off the machine when products are not running.

It can also provide insight into other options for adhesive technologies that use lower heat output in glue tanks, for example, or switching out a venturi vacuum generator that uses costly compressed air for electric pumps instead.

> **"VENTURI IS A CHEAPER OPTION FOR INITIAL COST BUT MAY BE COSTING YOU MORE IN ENERGY CONSUMPTION OVER THE LIFE OF THE MACHINE BECAUSE OF THE COMPRESSOR USAGE. AN OPTION FOR THAT IS TO EVALUATE IT AND LOOK AT ELECTRIC PUMPS VS. VENTURI PUMPS."**
>
> *– JAMIE BARBER, DIRECTOR OF PRODUCTDEVELOPMENT AT SCHNEIDER PACKAGING EQUIPMENT, A PACTEON COMPANY.*

TOOLS TO OFFSET ENERGY-INTENSIVE COMPONENTS

When it comes to the biggest energy consumption culprits, compressed air, steam, and electromechanical systems are high on the list. Figuring out upfront cost vs. long-term cost can determine the best option.

To help, Festo has identified 12 action items addressing energy efficiency as outlined in the following infographic.

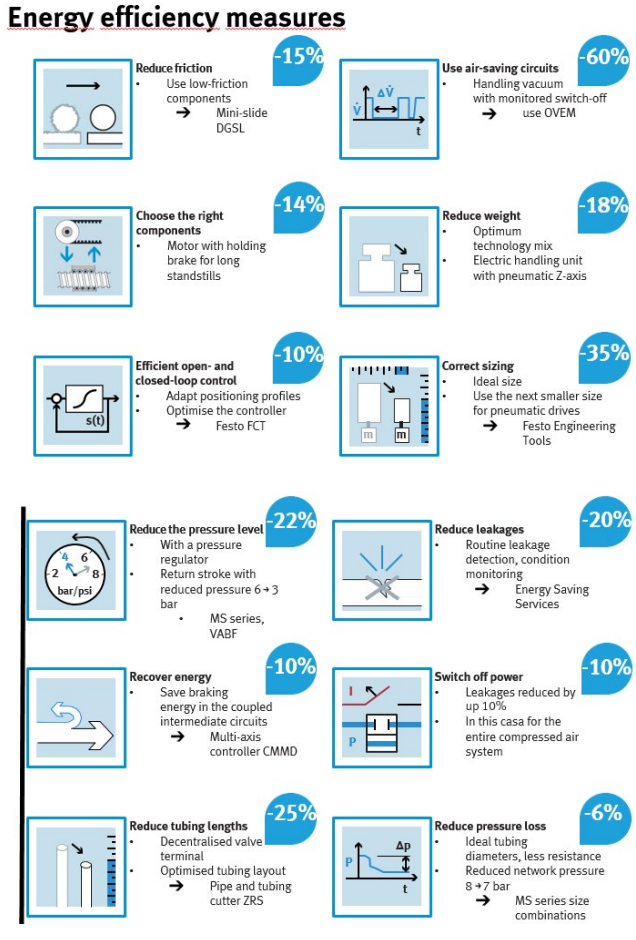

Image credit: Festo

The company also provides an online tool that can be used to compare the electrical system vs. the pneumatic system.

The CO2 and TCO Guide allows users to compare the performance and efficiency of pneumatic and electric drive solutions. By entering specific parameters such as drive type, load, stroke and energy costs, it can quickly and easily determine which solution is best suited to the application. After entering the required data, Festo provides a detailed comparison of CO2 emissions and total cost of ownership (TOC) to help make informed decisions that will optimize the system in terms of performance and sustainability.

"You know you have to move so much weight in so many seconds, and you can simulate all of this and try out using bigger valves, smaller valves, bigger tubing and see how it affects your system to make sure you are using the right components in the right place," said John Narup, senior applications engineer at Festo. "Ten years ago, everybody used what they used because it worked…but it wasn't always efficient."

Investing in energy-efficient motion control is a good option, but everything needs to be measured and monitored to predict future states. And that is where artificial intelligence (AI) can help.

INTELLIGENT ON/OFF

During a recent visit to a customer site, Narup was asked about ways to turn the air off on a machine when it goes into an idle state. His suggested solution: Festo's MSE6 family of products that regulate the compressed air supply when the system is at a standstill to prevent waste caused by leakage.

Positioned on the inlet to the machine level, the energy efficiency module incorporates a bus network communicating back to the PLC and monitors the flow rate and the pressure of the system. It also has an on/off valve so it can be opened and closed.

"It can be programmed by the PLC to have minimum flow because you don't want to turn off the machine every time there's a dip in the flow rate," Narup said. "So, you can put like a floor, that, if it falls below this much consumption, the machine is in fact not running and give it time. If it doesn't come back above that level for two minutes, it shuts the valve off because then you assume the machine is off."

The system can help set a baseline when the machine is first set up to see the amount of pressure that comes in and how it fluctuates when the actuators move around, using that information to compare over time as seals and valves start to wear. "So, you can get an idea when it might be time to start looking at doing maintenance and changing out certain components," said Narup.

For more predictive maintenance, the Festo AX system collects real-time data and uses AI to analyze and predict when specific parts will need to be replaced, while monitoring product quality and even the use of energy. "With Festo AX you can reduce downtimes by 25%, cut waste by 20% and reduce leakages by up to 65%," the company said.

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TOP THREE REASONS TO SPECIFY A MINIATURE BALL SCREW FOR YOUR LINEAR MOTION APPLICATION

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1. PRECISION, ACCURACY, AND REPEATABILITY

An accurate shot is throwing a dart and hitting the bull's-eye. In contrast, precision refers to how often the system can hit its intended target. A system's accuracy is the difference between where it actually is and where the controller thinks it is. The repeatability of a system is determined by the difference in its position when it returns to the same location in the same conditions, with the same motion profile and direction. In many cases, one-way repeatability differs greatly from bidirectional repeatability due to backlash and "slop" within system mechanics.

Miniature ball-screw actuators are known for their high precision and accuracy. Lead screws on the other hand, generate greater amounts of friction which requires greater torque and a larger motor.

2. EFFICIENCY AND SPEED

When efficiency and speed are critical, especially in short-stroke applications, choosing rolling element ball-screw drives — which have less friction and thus reduced power consumption — will achieve greater efficiency compared to gliding element lead-screw drives. Lead screws have higher friction, making them less efficient than ball screws. As a result, lead screws are more suitable for simple transfer applications where speed is not as critical.

When it comes to speed, the choice of ball-screw size is crucial. Smaller diameter ball screws require less drive power to achieve higher rotational speeds, making them well-suited for applications that require rapid linear motion. Design engineers may choose a smaller ball screw for applications that demand high-speed operation because the reduced mass and inertia of a 6 mm ball screw, for example, allows for faster acceleration, deceleration, and higher speed operation.

3. LOAD CAPACITY

Another reason that design engineers might specify a miniature metric ball screw is its load-carrying capacity. Ball-screw assemblies can support higher axial loads than lead-screw actuators of the same diameter and lead. This makes them ideal for applications that require high force, efficiency, and precision. As the diameter of the ball screw increases, so does its axial load-bearing capacity.

Ultimately, the optimal selection of a linear actuator is determined by the unique requirements of each application.

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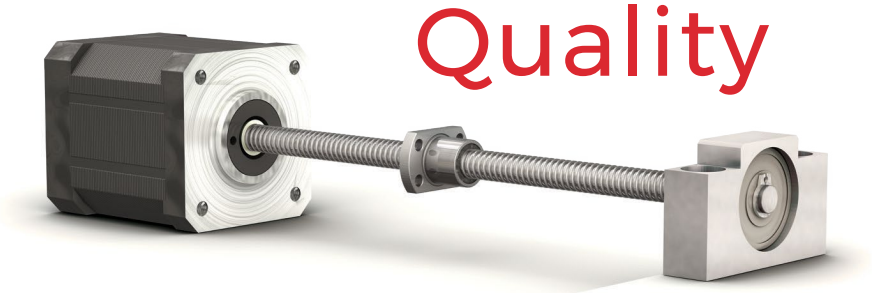

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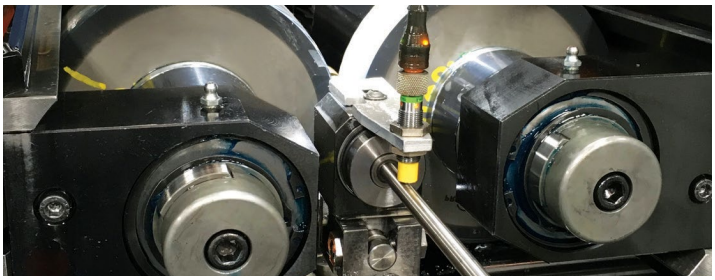

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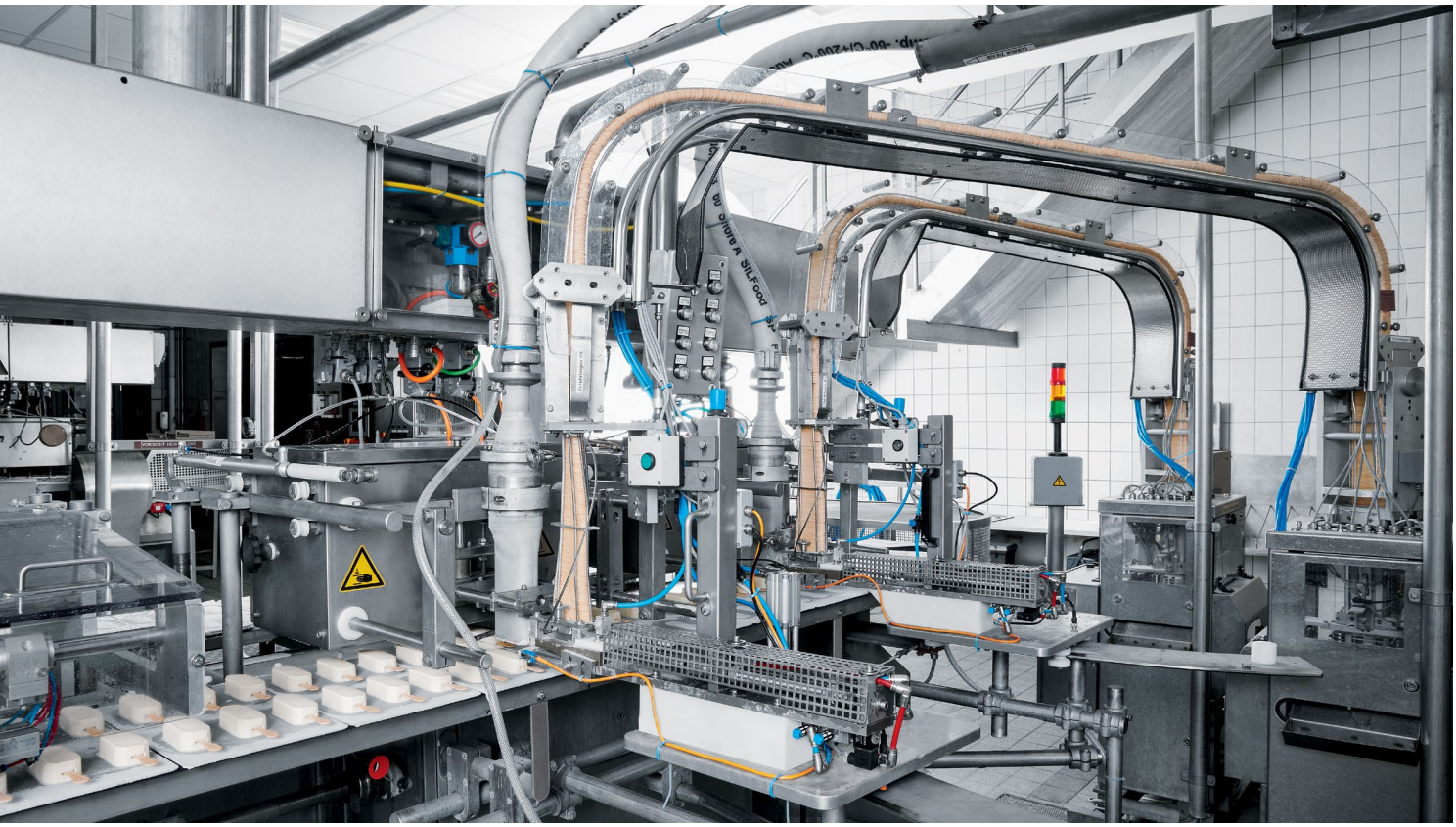

At the Unilever plant in Heppenheim, Germany, Festo's MSE6-E2M module was deployed to reduce the compressed air consumption of a plant manufacturing Magnum ice creams. Image credit: Festo

UNILEVER REDUCES COMPRESSED AIR CONSUMPTION

The Unilever plant in Heppenheim, Germany is one of the main Unilever production locations for ice cream products including Magnum, Feast, Viennetta and Carte d'Or. Just one of the five Magnum production lines in Heppenheim produces more than 20,000 ice creams on a stick per hour. This requires a lot of energy.

To reduce the compressed air consumption of the pneumatic components, the ability to visualize and measure the compressed air consumption was of huge importance to Unilever. Previously, the consumption on the individual production lines had not been determined. "Until then we were just unaware," says Alexander Hemmerich, an automation engineer at the Unilever plant in Heppenheim. "Air is not visible, so it is not immediately obvious if consumption is too high."

Hemmerich and his team took the decisive step towards lowering compressed air consumption with the introduction of the energy efficiency module MSE6-E2M from Festo. "The energy efficiency module gave us the opportunity to see the amount of compressed air we were using during operation of a line," Hemmerich said. "In addition, we were able to determine how the compressed air requirement developed when we switched off individual consumers. We were thus able to locate leaks and eliminate unnecessary consumption."

As Narup noted, one of the core functions of the MSE6-E2M is the automatic shut-off of the compressed air in stand-by mode, which made it possible to establish how quickly the system empties. The energy efficiency module MSE6-E2M immediately reports an unusually quick drop in pressure to the system controller. At the same time, the automatic pressure shut-off function prevents further compressed air consumption while the system is not in operation.

Thanks to the new condition monitoring for the pneumatic components on the Magnum machine, Hemmerich now has continuous process-relevant data. The MSE6-E2M regularly exchanges important measurement parameters, such as flow, pressure, and consumption, with the machine's controller. And, it is easy to operate via the control panel. "We've been able to reduce compressed air consumption on the Magnum production system step by step with the energy efficiency module from Festo. We did not have to add any additional communication or power cables when converting our existing systems."

According to Unilever, on the Magnum line, the costs for compressed air consumption were reduced by more than $650 per year.

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THE APPLICATION OF ENERGY

Examining the equipment for energy waste is one way to address the issue of energy efficiency. But the application is just as important.

> **"THERE ARE CERTAIN PROCESSES THAT ARE BY THEIR VERY NATURE ENERGY-INTENSIVE, BUT I THINK IT CAN BE USEFUL TO THINK ABOUT APPLICATIONS WHERE THERE'S THE MOST SAVINGS POTENTIAL."**
>
> *– JEREMY MCCULLOUGH, SENIOR PRODUCT APPLICATION ENGINEER FOR SEW EURODRIVE*

One such application is motion control.

"An example that comes to mind is the braking resistor. You'll find one in or on nearly every electrical panel that contains a variable frequency drive. These are used to burn off regenerative energy, in the form of heat, during deceleration or downward travel," McCullough explained. "Applications that are cycling very quickly, or those that move vertically — such as hoists and lifts — can make heavy use of these. The problem is that any energy which flows into these resistors essentially becomes 'lost,' which is usually a bad thing, especially if you have a climate-controlled environment, because you then have to remove the heat which is generated. If you can hold on to that energy to then use later, or send it back into the grid, then that turns into direct savings."

Because SEW Eurodrive makes all of the components going from the motor to the gearbox to the variable frequency drive (VFD) to the motion controller, they are able to take a holistic approach regarding energy consumption. There are optimizations which can be made every step of the way, and often it's not just the components which are used, but rather the way in which they are used.

McCullough offers this example: Say that a customer has been using a certain sized motor on one of their conveyors for many years, and they want to update to something that's more efficient. So, they approach their supplier, who then says that there's now a NEMA 'premium efficiency' version of that exact same motor. Great! But is that the most optimal solution? Not always, because sometimes the difference between a standard and premium efficiency motor is only a few percentage points. Furthermore, efficiency numbers are very dependent on how much a motor is loaded. A motor running at 25% of its rated load is much less efficient than one running at 100% of its rated load.

This illustration helps to explain why:

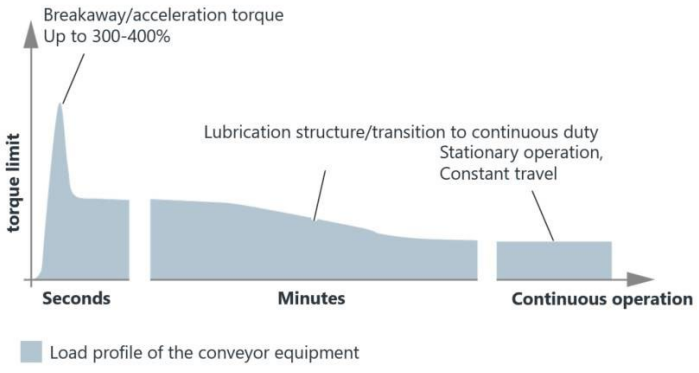

Image Credit: SEW Eurodrive

When you first start the conveyor up, you need enough torque to overcome any static friction and also to accelerate the load to the desired speed. Once that speed is reached, the torque settles down some. Then, after the lubrication of the gearbox and the mechanical components warms up, there's a further reduction in torque, after which it basically remains stable for as long as the conveyor is running.

The problem is that the peak torque requirement determines the size of the motor, so what you end up getting is something like this:

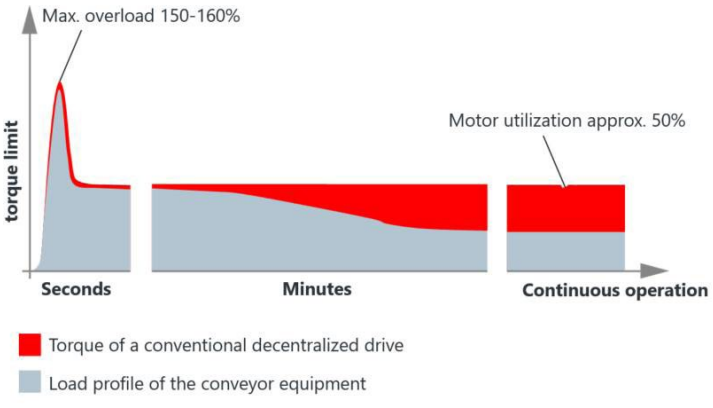

Image Credit: SEW Eurodrive

In this case, the motor can deliver the initial torque, but during continuous operation it ends up being underutilized. To solve this problem, SEW Eurodrive would recommend using a permanent magnet servomotor. "But we wouldn't size it based on horsepower alone, as would typically be done with a standard AC motor," McCullough said. "Instead, we would size it based on the torque requirements of the continuous operation and then use the higher overload capability of the servomotor to meet the demands of the initial acceleration phase."

What you ultimately end up with is a smaller motor that's much more efficient. "However, this strategy also requires proper sizing of the VFD, because it must be able to deliver the proper amount of current," McCullough explained.

These examples are for a conveyor, but the concepts can be applied to many other types of machines, McCullough said. In general, SEW Eurodrive has different strategies for energy efficiency that would be used on a per-application basis. "What works in one situation may not work in another. This is a big reason why we have such a large product portfolio — it's so that we can tailor a solution to best address a particular application."

CONCLUSION

Energy efficient machines may be an afterthought, but they are an important part of a manufacturer's sustainability strategy. Implementing technology that lowers power usage not only reduces a company's carbon footprint, but also contributes to cost savings, and even enhanced machine performance.

*Packaging OEMs can take several strategic steps to convince manufacturers to invest in energy-efficient machines, including:

1 Demonstrate cost savings

- Provide ROI calculations showing reduced energy costs over time.
- Offer case studies or real-world data proving savings in similar operations.

2 Highlight sustainability benefits

- Emphasize compliance with environmental regulations and corporate sustainability goals.
- Show how energy-efficient machines contribute to reduced carbon footprints.

3 Offer incentives and financing options

- Partner with energy companies or government programs to offer rebates or incentives.
- Provide leasing or financing plans to reduce upfront investment concerns.

4 Showcase performance and productivity gains

- Demonstrate how energy-efficient technologies improve machine uptime and reduce maintenance costs.
- Highlight advanced features such as predictive maintenance and smart energy management.

5 Use smart data and monitoring

- Integrate IoT-based energy monitoring tools that provide real-time energy consumption insights.
- Offer remote diagnostics to optimize energy use and reduce waste.

6 Provide modular and upgradeable solutions

- Design machines with energy-efficient components that can be retrofitted onto existing systems.
- Show how scalability allows gradual adoption without full system replacement.

7 Educate and train customers

- Host webinars, training sessions, or in-person demos to showcase the benefits of energy-efficient packaging solutions.
- Provide technical support and resources to ensure seamless integration.

*(*This list was generated with the help of Generative AI.)*

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