FOOD ENGINEERING
THE MAGAZINE FOR OPERATIONS AND MANUFACTURING MANAGEMENT

OCTOBER 2024
Vol. 96, No. 10

The State of Food Manufacturing in 2024

Upgrade Chilling Equipment to Industrial Heat Pumps

New Platforms and Tools Move Companies Closer to AI Strategies

Do Your Packaging Machines Speak the Same Language?

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BREAKING DOWN FOOD ENGINEERING'S 2024 STATE OF FOOD MANUFACTURING

FOOD ENGINEERING's 45th State of Food Manufacturing webinar breaks down the results of this year's survey of food and beverage manufacturers. Each we partner with Clear Seas Research to poll the industry about staffing, automation, supply chain and more.

Last year's survey revealed an increase in demand for products, but supply chain and labor issues are preventing food manufacturers from a corresponding increase in revenue. Are we starting to see change, or is it more of the same? Join the editorial staff of FE and Refrigerated & Frozen Foods as we share how business is doing, what's affecting business, and where companies are spending money, if at all.

Webinar attendees will learn:

- Major trends in staffing, automation, and supply chain management impacting food and beverage manufacturing
- Insights from the 2024 survey on how demand changes and operational challenges are affecting revenue
- How food manufacturers are allocating budgets and resources in response to industry challenges
- Comparisons of this year's data with previous years to identify progress and ongoing issues

SPEAKERS:

Derrick Teal
Editor-in-Chief
Food Engineering

Kelley Rodriguez
Editor-in-Chief
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FOOD ENGINEERING

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Upgrade Chilling Equipment to Industrial Heat Pumps

Industrial heat pumps provide chilling and freezing, and reclaim the heat energy lost in chilling to save money on heating water for cooking and cleaning—but is retrofitting possible?

New Asset Management Platforms and Remote Service Tools Move Food Companies Closer to AI Strategies

New remote service tools and robust asset management platforms enable food and beverage companies to envision AI-based strategies and facilitate product innovation across the enterprise.

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Derrick Teal I Editor-in-Chief

Offering Dietary and Weight Loss Help for Type 2 Diabetes

ACCORDING TO THE CDC, more than 38 million Americans have diabetes, and about 90% to 95% of them have type 2 diabetes. Being overweight is one of the known risk factors for type 2 diabetes, as is being inactive and being 45 or older. As many of us know, it becomes more difficult to lose weight as we get older. And if you already have type 2 diabetes, losing weight can be even more difficult.

During last month's webinar about FOOD ENGINEERING's Top 100 Food and Beverage Companies, I was joined by Refrigerated & Frozen Foods Editor-in-Chief Kelley Rodriguez to talk about trends that are having an impact or will be having an impact on food and beverage manufacturers. In her view, that will be users of GLP-1.

GLP-1 (glucagon-like peptide 1) is a class of type 2 diabetes drugs that improves blood sugar control and may also help with weight loss. With about 1 in 10 Americans having diabetes, most of them with type 2, it stands to reason that GLP-1 drugs are going to become popular with many trying to lose weight.

To that end, Nestlé launched in September a new brand of frozen meals designed to provide dietary support to GLP-1 users and consumers focused on weight management. Called Vital Pursuit, the line offers 14 varieties that include at least 20g of protein and contain essential nutrients such as vitamin A, vitamin C, potassium, calcium or iron. The meals are made with quality proteins, vegetables and whole grains.

"People taking these medications not only have a decreased appetite, but they must adjust their diets with a sharper focus on smaller portions, while also prioritizing beneficial nutrients for their health," says Marlene Schmidt, registered dietitian and senior health & wellness manager at Nestlé. "To complement these eating habits, we're striving to take the guesswork out of mealtime with thoughtfully portioned, nutritious, accessible options."

The company plans to release a ready-to-drink beverage with 30g of protein and no added sugar in 2025. **FE**

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COLLABORATION FOR INNOVATION:

PROVISUR'S CUSTOMER-CENTRIC VISION.

Provisur is a leading industrial food processing equipment manufacturer headquartered in Chicago, Illinois, with a global network of sales and service locations. Each of Provisur's Business Units – Slicing, Further Processing, Separation and DMC (Defrosting, Marinating, Cooking) – contributes to the company's customer-centric vision and world-class service, ensuring that Provisur remains at the cutting-edge of present and future food-processing innovation.

We asked the president and the leading experts from each Business Unit to explain how customer collaboration shapes the company strategy.

Thank you so much for talking to us today. First, could you explain the main pillars of Provisur's customer collaboration strategy?

Brian Perkins: Our Innovation and Ingenuity Centers are crucial. This is where we invite our customers to test our equipment and create solutions that boost their business. We have two centers, one in Mokena, Illinois, and one in Plailly, France. Customers can come in and test and collaborate with our staff to determine the exact solutions they need. Provisur staff, consisting of highly experienced application experts and food scientists, are on hand to support them. The centers, equipped with the latest food processing technologies, are places of true collaboration. These facilities are a perfect illustration of how we help our customers push boundaries.

How does the collaborative process between Provisur and its customers play out?

Brian Sandberg: When a customer comes to us with their issues we listen and interview them at length to determine exactly where the opportunity for improvement lies. Voice of customer is extremely important – it tells us what type of solutions are needed, and how we need to structure the subsequent innovation process.Our customers know what issues they face, so our job is to listen very carefully. What is the product? What performance is required? What other parameters are necessary? One example of this is the need to adapt bacon lines because belly size has grown.

Frédéric Cecilia: Our customers are constantly faced with a changing marketplace or changes in raw material - we help them adapt to all present and future challenges that come their way. Reducing labor costs, optimizing energy savings, ensuring more product with less footprint – these are all ways in which we support our customers.

Could you give us some examples of customer collaboration leading to upgrades and innovations?

Jim Lewis: In Further Processing, the Formax® NovaMax® 400 is our newly introduced mid-size former. It is a prime example of figuring out what our processors may need from a size perspective, that maximizes throughput and weight control for a wide range of products - meat, poultry, protein alternatives, pet food, treats and more - a truly versatile piece of equipment.

How has customer collaboration shaped DMC technology?

Frédéric Cecilia: In DMC, we collaborate with customers on their processes all the time. Customers come to Lutetia because they know we are the experts in the defrosting and marinating technologies. So, while the collaboration doesn't necessarily result in a new piece of equipment, it provides the Lutetia team with additional application expertise.

What about the Slicing and Separation units?

Brian Sandberg: We recently developed the Formax® SX550, which is our largest capacity slicer. We developed this product as a direct result of customer collaboration. Some of our customers want to run large amounts of product, resulting in the highest possible yields, and this machine will help customers achieve that.

David Schumacher: The STS was a product developed through customer feedback. The belt separator was the one type of Separation equipment we did not offer and there was a need for it in the market. It helped round out our product offering and provide our customers with the option to choose the best type of Separation technology based on their application. ■

For more information, visit Provisur at **provisur.com** or contact us at **info@provisur.com**

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Jim Lewis
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Dave Schumacher
General Manager Separation BU

Fred Cecilia
Sales Director DMC BU

Waste Not, Want Not: Turning Food Waste into New Revenue Streams

The founder and managing director of Changing Tastes, shares his thoughts on sustainability and the food industry, as well as finding ways to transform would-be food waste into valuable new offerings.

Image by GettyImages / FYMStudio

THE NEED TO REDUCE THE FOOD SECTOR'S CARBON FOOTPRINT, is becoming increasingly urgent. Depending on the source, the industry is responsible for between 14% and 50% of all greenhouse gas emissions.

The food industry has continued to focus attention on food waste as a significant environmental problem. The statistics are quite stark: More than 1/3 of all food is wasted. That means about 1/3 of the carbon emitted and water consumed is wasted, as well.

Despite what may seem like obvious culprits, that amount of waste isn't because we don't clean our plates or throw away food that's seen better days. Rather, most of that loss occurs in or near the fields where it's grown.

Arlin Wasserman

The inability to harvest crops when they're ripe and issues with storage are big sources of food waste. So is our preference for eating some, but not all, of what we grow. For instance, orange juice and lemonade remain popular beverages, but we don't go around snacking on the peels, which contain most of the flavor and nutritional value.

In this FOOD ENGINEERING podcast, Arlin Wasserman, founder and managing director of Changing Tastes, discusses his experience in sustainability and the food industry, finding ways to transform what would-be food waste into valuable new offerings, and the marketing and consumer acceptance of upcycled products.

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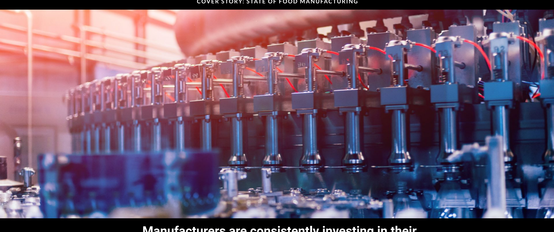


Manufacturers are consistently investing in their manufacturing processes as costs are finally starting to come down, albeit slowly.

BY DERRICK TEAL

Photo courtesy of Getty Images / Romaset

BETWEEN OUR 47TH ANNUAL PLANT CONSTRUCTION SURVEY AND OUR 2024 TOP 100 FOOD AND BEVERAGE COMPANIES, we've been able to put together a mostly complete picture of what's going on with the food and beverage industry regarding how it's spending money. Through the reports of members of the AEC industry, we've seen that many companies are currently holding off on larger projects as they await the results of next month's election. Through the financial reports of manufacturers, we've seen that many took a hit in terms of overall sales, but continued to grow revenue based on initiatives aimed at improving efficiency and cutting waste, among others. Now with our 45th State of Food Manufacturing, we'll see how food and beverage manufacturers have been achieving those efficiency and waste-cutting goals, and our picture will be complete. FOOD ENGINEERING partnered with research firm myCLEARopinion Insights Hub to get the answers we were looking for. And, simply put, manufacturers have been compensating for lower-than-expected sales—despite a need for increased throughput—by investing in their production processes to improve revenue.

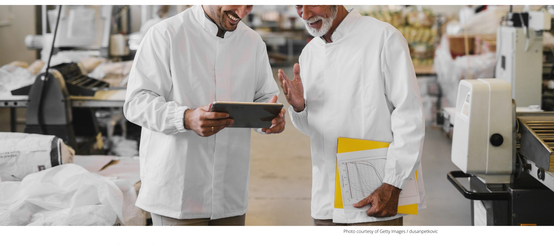


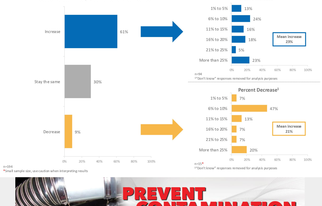
Photo courtesy of Getty Images / dusanpetkovic

Throughput Expectations

We'll start with throughput expectations which, much like the previous year, are expected to increase. Three in five manufacturers expect their location's gross throughput to increase at an average of 23%, up from last year's expected increase of 18%. This data is significant because financial data used to create FE's Top 100 indicates that more than a few manufacturers experienced a decline in sales for fiscal year 2023 compared to the year prior. How is it possible that manufacturers needed to increase throughput despite a decline in sales? Well, some of those reported declines in sales were relatively marginal. A few examples would include Tyson Foods, which went from $53 million to $52 million, Archer Daniels Midland went from $47 million to $46 million, and CHS dropped from $37 million to $35 million. Companies like Tyson, in particular, closed processing locations to prevent that sales decline from impacting yearly revenue. Closing those plants, however, meant that other plants had to pick up the slack. This would lead to investing in those other plants in order to improve their throughput.

Location Gross Throughput

Three-in-five of manufacturer respondents expect their location's gross throughput to increase in 2024, at an average of 23%. *Just under one-third of respondents expect their throughput to remain unchanged.*



Another reason for the need to improve throughput is more straightforward: increased sales and demand. While quite a few manufacturers did experience slower sales or sales declines, many others saw the trend of increasing sales continue. Increased sales was relatively unchanged, with 36% expecting that to generate the need for more throughput compared to 35% expecting that to be the case last year.

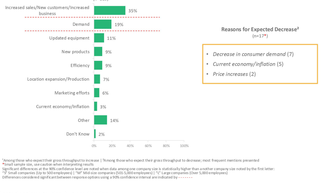
Demand, though still high, dropped 5% between last year and this year, the study shows. Various manufacturers and accounting firms state that consumers are still buying, however they've become more sensitive to price, and therefore more open to finding other purchase options. "According to the results of our latest U.S. Consumer Pulse Survey," write the authors of the report from McKinsey & Company, "they're worried about rising prices and job security, yet they're optimistic and still spending. They're switching to less expensive brands to save money, but they're also willing to splurge on certain goods and services."

The Hershey Company's consumer insights team did its own survey, and came to the same conclusion. Its survey also found that consumers are more apt to buy in bulk, share experiences with friends and relatives, and that wellness continues to be a high priority for many.

Albeit another small change in percentage, it's still significant to note that updated equipment supplanted new products as a reason for additional throughput, followed by an uptick in efficiency increases.

Reasons for Expected Change in Location Gross Throughput

The expected increase in gross throughput is primarily driven by increased sales/customers/business, followed by increased demand. Those who expect to see a decrease cite decreased consumer demand, the economy/inflation, and price increases negatively impacting their customer base.



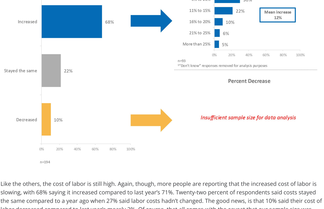
Costs Continue to Rise, but are Slowing

As reported in our Top 100, although inflation has cooled, it's still much higher than it was pre-pandemic and is one of the reasons that consumers have been switching to less expensive brands. The increased cost of food for consumers, though, is the result of manufacturers having to continue to pay to cover their own costs. Our survey found that 68% of respondents said their total cost per product increased at an average of 12%. The reported cost increase is down from the reported 75% last year, but the average of that increase remained the same at 12%. On the positive side, 10% reported a cost decrease, which is up from 8% reporting a decrease the previous year.

Seventy four percent of survey takers reported a material cost increase, which is down from 80%. 21% reported that their costs stayed the same, which is up from 17%. Those reporting a decrease in material costs were more than last year, but the sample size from both years is too small to make an accurate analysis. Regardless, the fact that costs appear to be rising at a slower rate is reflective of the economy as a whole as the pain caused by inflation continues to ease.

Total Cost Per Product

The majority of manufacturer respondents in 2024 indicate their total cost per product has increased since the previous year. The increase is 12% on average.



Like the others, the cost of labor is still high. Again, though, more people are reporting that the increased cost of labor is slowing, with 68% saying it increased compared to last year's 71%. Twenty-two percent of respondents said costs stayed the same compared to a year ago when 27% said labor costs hadn't changed. The good news, is that 10% said their cost of labor decreased compared to last year's measly 2%. Of course, that all comes with the caveat that our sample size was too small to do a complete data analysis.

Everyone Onboard with Automation?

I took a little bit of grief last year for my stance that the industry wasn't incorporating automation as much as it was talking about it. Given the results of this year's survey, it looks as though companies still aren't quite walking the talk.

Respondents continue to believe the biggest trend that changes manufacturing operations is automation/robotics/AI. However, that number dropped from last year's 38% down to this year's 27%. Respondents went even further to say that customer demand has more of an impact on operational change (19%) than new equipment (16%). The idea of a customer's choice in products having an effect on operations was at 10% last year. Maybe that's to be expected since, as we saw earlier, consumers are more willing to try new brands based on cost and manufacturers have to adapt.

Trends That Change Manufacturing Operations

Automation/Robotics/AI is the top trend that manufacturer respondents expect to change manufacturing operations in the next 5 years, followed by current customer demand/new products.

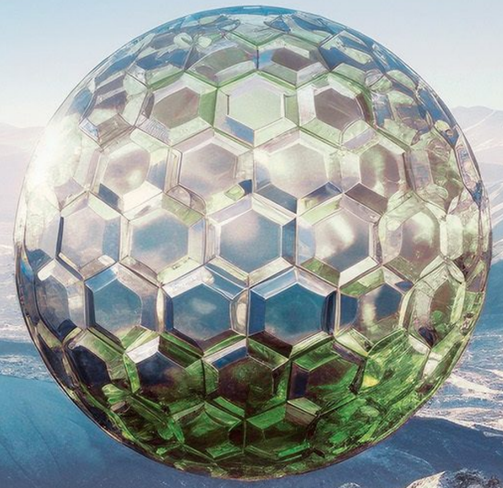
None of this is to say that manufacturers aren't investing in automation. Clearly, they are. The best indicator for this is by looking at budgets and how those dollars are allocated. Approximately 25% of budgets are set aside for the purchase of equipment, which includes machines for production, packaging, software, etc. Nearly 70% of respondents said that less than $1 million is being set aside for said purchases.

Meanwhile, 50% of respondents said that their budgets have increased, with a mean increase of 23%, while 40% said their budgets have stayed the same, and 10% said their budgets actually decreased. These numbers are nearly identical to what respondents to last year's survey said, suggesting the people responsible for purchasing have consistency in expected finances to work with.

This, of course, is a brief look at some of the highlights of this year's study. There was a lot more information covered, including more on labor costs and how the AEC community has seen budgets being affected. The full survey is available for download from myClearOpinion. We'll also be expanding on these topics and adding more like the ones listed above during our State of Food Manufacturing webinar taking place on October 22, 2024. FE

NEXT ARTICLE

A **New Dimension** of Temperature Control



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Temperature Control

Atmosphere Application

Service & Systems Support

Two heat pumps installed by GEA at a food processing facility move heat from cold rooms to equipment needing hot water. *Image courtesy of GEA Refrigeration Technologies*

BY WAYNE LAIS

What's wrong with this picture? You spend money to purchase natural gas to run your boiler(s) to create steam and hot water to supply your food production process. Then you spend more money to chill and freeze your product. Yet, the heat removed from your product most likely goes into the atmosphere. Maybe it's time to think of your refrigeration plant with its compressors as a heat source, a "heat pump." After all, it removes the heat from your product—but why throw the heat away when you could be reusing or charming it to cook product or clean the facility? When it's hot every week necessarily replace your boiler, it will save you the cost of half of it—and save energy in the process. This makes your operation more "green," which is how you want your customers to think of your product(s) and company.

But should you consider a retrofit for your existing facility or wait until you move to a new greenfield site? The solution needs to be considered and assessed based on the individual case, says Joseph Miller, sales director, industrial refrigeration for Danfoss Climate Solutions. "Certainly, if the existing plant has a refrigeration system, the likelihood of seeing the payoff is much better than if a talent, and an evaluation on how to reclaim and boost the required heat source is worth doing. The efficiency (coefficient of performance, or COP) of heat pumps is significantly higher than boiler-based equipment, making them ideal for decarbonization, with a relatively short payback period."

"For processors seeking to lower their carbon footprints, heat pump retrofits absolutely make sense—particularly as effective and sustainable alternatives to traditional fossil fuel-fired boilers, which are being phased out in carbon footprint management at Other Industrial Sectors Equipment. Even if a plant operator may not be able to completely decommission their existing boiler, they could potentially leverage a heat pump in a "base-loading" scenario—i.e., using the boiler only when needed during high peak loads to significantly lower its overall base load, adds Kosar.

"No to retrofitting!" answers Gorman Robledo, GEA North America heat pump sales manager, who has actually seen more retrofits than new installations. But, according to Robledo, management needs to be committed to investigating and implementing the changes that must be required. Adopting this technology will mean thinking outside the box, and a processor shouldn't look at heat pumps in the same way as a boiler, refrigeration compressor or an air compressor as the path is different. Decarbonizing is an approach that can take up to seven years to see a ROI—not that it can't happen sooner, says Robledo. Sometimes it can, if the stars align and the payoff often includes re-piping, new valves, heat exchangers and carts. Boilers will need to be retained if steam is needed for cooking processes.

It's important to consider for both options—new and retrofit—the specific needs of the site, budget and timeline of the project, says Tierra Herrera, Grainger US LLC key account and product engineer. For existing facilities, retrofitting with heat pumps can offer efficiency improvements and cost savings, though it may require careful planning to overcome challenges such as space constraints and the need for integration with existing systems. For new facilities, seamless integration and efficiency. Heat pumps can be more energy-efficient than boilers, especially in moderate to high ambient temperatures. However, it's important to review every case on its own.

Ideal for large capacity heat pumps, the 6-cylinder semi-hermetic BOCK HGX34/ 2/22 T achieves water temperatures up to 90°C/194°F and offers a wide operating range and high efficiency. Its design and features **promote reduced size, system complexity, and the number of components required for large industrial heat pumps, refrigeration and district heating systems. *Photo courtesy of Bock*

A Special Note on Refrigerants

Refrigerants are typically grouped into chemical families such as hydrocarbons (HC), and hydrofluorocarbons such as hydrocarbons and propane and synthetic, which includes hydrofluorocarbons (HFCs)—and alternative synthetic refrigerants hydrofluoroolefins (HFOs) and hydrochlorofluoroolefins (HCFOs). HFCs are being phased out in the U.S. by the EPA as part of its Significant New Alternatives Policy program, and in Europe by the F-Gas Regulation. Hydrocarbons, HFCs, HFOs are also considered fluorinated greenhouse gases (F-gases) and are also not F-gas with the same issues as HFCs, and both are said to have trifluoromethanesulfonyl (TFM) formulation risks. HFOs/HCFOs have become increasingly popular because of their high COP, but because of their breakdown into TFA, they have raised environmental health concerns by various groups, though neither the U.S. EPA nor the United Nations Environment Program (UNEP) suggest there is a problem.[1]

According to Nick Ernst, P.E., manager of refrigeration engineering for Gray, when deciding between refrigerating a heat pump at an existing brownfield site or installing a new system in a facility, several factors should be considered to access the return on investment (ROI):

Retrofit considerations: Retrofitting a heat pump can be cost-effective if the existing infrastructure is sound. It allows for incremental improvements, minimizing downtime and disruption. However, challenges may include space constraints, system compatibility issues and the need to update ancillary equipment.

New facility design: Designing a new system from the ground up allows for optimal integration, tailored to specific operational needs, energy efficiency goals and future scalability. This approach can incorporate the latest technology, ensuring the facility meets modern food processing demands. Cost implications of new facility design and construction, along with potential land acquisition, also play pivotal roles in the decision.

Design considerations: Key steps in designing heat pump systems include assessing heating and cooling requirements, planning integration with existing systems, evaluating heat transfer between heating and cooling needs, optimizing energy efficiency, ensuring safety and compliance and planning for scalability.

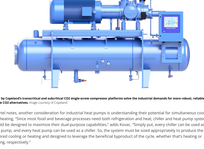
Application benefiting from heat pumps: Heat pumps are beneficial in food and beverage applications like dairy processing, meat and poultry processing and breweries, where they recover and reuse energy for simultaneous heating and cooling. Not all applications allow for full energy recovery due to heating and cooling demand, system efficiency requirements and space allocations.

Boiler alternative: Heat pumps can reduce or sometimes eliminate the need for traditional boilers with certain considerations, but they will often lead to lowering energy consumption, greenhouse gas (GHG) emissions, and operating costs when properly designed.

"The choice between retrofitting and building new depends on specific circumstances. Retrofitting may be cost-effective, but a new design offers greater flexibility, efficiency and growth potential," says Ernst. "Integrating heat pumps can lead to significant energy savings and improved operational efficiency."

In terms of efficiency, three compressor types are used in heat pumps—piston, screw and centrifugal—and by nature, piston-type compressors typically have the highest COP, says Robledo. Piston-type heat pumps coupled with ammonia will deliver highest possible COP compared to any other type of compressor and refrigerant.

Screw-type compressors always have a lower COP compared to piston-based machines—due to their physics—but they cover large capacity volumes where piston-based devices are limited, adds Robledo. For a large-capacity plant, processors may need a greater number of piston units versus screw-type compressors, but can opt to go with screw-based machines to reduce the number of units and probably CAPEX as well—but will sacrifice COP.



GEA Systems North America LLC has been selected to supply a GEA Refrigeration heat pump to a Canada-based global dairy processor and distributor of cheese, dairy products and grocery items. *Image courtesy GEA Systems North America*

Processors will need to ask the experts on the type of refrigerant and compressors to be used. While ammonia is the most often used in food facilities, special needs may require other combinations of machines and refrigerants.

Integration of Heating and Cooling Systems

Integration is the operative word in connecting heat pumps with existing systems. "Plant operators must ensure that heat pump retrofits integrate seamlessly with existing processes and infrastructure, without impeding productivity or operational efficiencies," says Kosar. "One way to do that is to install a buffer tank or thermal energy storage (TES), which is essentially a large water repository that can be heated by the heat pump and used when needed."

Water side management is also essential, says GEA's Robledo. The use of TES is essential, and there's a science to sizing the tank, integration and primary-secondary loop design. Typically, a heat pump does need the TES as part of the system as hot water can be drawn on demand directly from the heat pump, which is a recipe for disaster. Another important note: One thing that hurts a heat pump is a phenomenon called internal condensation, which is when the vapor gas condenses into liquid before reaching—or inside—the compressor. Should a compressor run with liquid, it will break. There are rules to avoid such a situation, but full integration will prevent problems.

Vilter by Cryotech's transcritical and adaptive CO2 single-screw compressor platform solve the industrial demands for more robust, reliable and simple CO2 alternatives. *Image courtesy of Cryotech*

As ESG looms, another consideration for industrial heat pumps is understanding their potential for simultaneous cooling and heating. "Since most food and beverage processors need both refrigeration and heat, chiller and heat pump systems should be designed to maximize their dual-purpose capabilities," adds Kosar. "Simply put, every chiller can be used as a heat pump, and every heat pump can be used as a chiller. So, the system must be sized appropriately to produce the requested cooling or heating and designed to leverage the beneficial byproduct of the cycle, whether that's heating or cooling, respectively."

Benefits from an Integrated Heat Pump System

Benefits of an integrated heat pump system include operational efficiency where waste heat from processes like refrigeration, air compression or other processes can be reused for heating elsewhere in the facility, reducing the need for additional heat sources and lowering overall energy consumption. This integration can result in significant cost reduction in equipment footprint, yet potentially leads to challenges such as flow issues for the facility. Heat pumps are often more energy efficient than traditional boilers, leading to reductions in energy use and costs when applied correctly. Lower utility needs for the site can provide potential reduction of energy or piping costs, or even elimination in some cases, and offer environmental benefits such as lower greenhouse gas emissions, aiding in achieving sustainability targets.

Compared to a traditional boiler, an industrial heat pump typically has three to five times higher COP, depending on the operating conditions and specifications, which significantly boosts energy efficiency. These efficiencies may equate directly to long-term, cumulative energy savings, which could significantly lower the total cost of ownership (TCO) throughout the lifecycle—all while cutting GHG emissions by reducing reliance on boilers.

There is a visible and tractable trend of combining the refrigeration and heating COP, says Danfoss' Miller. "The general efficiency (COP) of heat pumps is higher than the theoretical C.O. depending on the use, heat source temperatures and refrigerants, it could range between 2.5 to 7.0 or higher, while fossil fuel-based burners are merely reaching 0.9. The combined system COP (refrigeration combined with heating) could help the individual COP reach higher levels."

Compatible with the new European F-Gas regulations, the Mediterra dairy milk cooler uses carbon dioxide (CO2) as the refrigerant. The EPC RO range of cold cooling tanks is available for clients ordering with 1 or 2 sheets and with capacities ranging from 1,200 liters to 30,000 liters. *Image courtesy of Mediterra*

Lower operational costs from enhanced efficiency results in lower lifetime operational costs, adds Hallendorffer. Fewer moving parts and streamlined systems can also reduce maintenance needs. However, the initial investment may result in higher upfront costs that can be offset by long-term savings in energy and maintenance. Return on investment calculations can be provided to assess a variety of system and product strategies to fully optimize the site footprint when considering the building size. Each refrigeration system has its own advantages and regulatory considerations, and these can vary greatly by refrigerant type.

An integrated heat pump system can provide significant operational benefits, including energy savings, reduced maintenance costs and a lower total cost of ownership compared to conventional systems, says Gorman's Herrera. "Real-world installations demonstrate that heat pump systems can deliver substantial benefits, particularly in terms of efficiency and sustainability, making them a viable option for modern food processing facilities. In Sweden can be found examples of industrial heat pumps that have achieved significant energy savings, with substantial cost reductions and reduced carbon emissions compared to traditional heating and cooling systems. Also Nestlé has implemented heat pump systems in several of its facilities because of substantial energy savings and reduced operational costs of the integration of a heat pump system. In the U.S., Cargill has adopted heat pump technology across various locations to optimize energy use for their industrial processes. It's an option that has started to grow in the U.S. industry."

Real-World Examples, according to Hallendorffer include:

- Dairy plants: Recover heat for pasteurization and cleaning, cutting energy use and costs.
- Breweries: Manage heating and cooling efficiently, lowering energy costs.
- Meat processing plants: Recover heat for hot water, eliminating the need for separate boilers.

Five Reasons to Switch to Natural Refrigerants

Natural refrigerants refer to water, ammonia, CO_2 and hydrocarbons such as butane and propane, etc. Synthetic refrigerants typically include fluorine within the molecular structure.

1. Cost-efficiency: Businesses can achieve significant savings through improved energy efficiency, lower operational costs and reduced need for future retrofits, making natural refrigerants a smart financial investment.

2. Sustainability credentials: Adopting natural refrigerants enhances a company's sustainability profile, boosts brand reputation, and meets consumer and shareholder expectations for environmental responsibility.

3. Regulatory compliance: Switching to natural refrigerants helps companies stay ahead of regulatory changes, avoiding potential fines and operational disruptions while ensuring long-term compliance.

4. Enhanced food safety and quality: Optimal temperature control extends product shelf life, reduces spoilage and ensures compliance with stringent food safety regulations, guaranteeing the highest quality for consumers.

5. Proven technology: Companies benefit from reliable, proven technology that ensures efficient and effective cooling solutions, backed by industry leaders like Grainger.

– Tania Herrera, Grainger US LLC Key Account and Product Engineer

Maintenance and Related Costs

A heat pump has a compressor and rotating equipment, so maintenance is important to protect the investment, says GEA's Robledo; compressors need proper care. GEA has redesigned and revamped both its piston and screw compressors to protect them from adverse conditions that may occur, especially with condensation.

"Conventional boiler systems have been the norm in many places, with parts and or service more readily available compared to heat pumps," says Danfoss' Miller. "More technician training on heat pumps is needed to fully take advantage of heat pumps on a large scale. But, heat pumps do require less maintenance than conventional boilers. However, in many cases, older components used in refrigeration systems are already upgraded to the same rating of heat pumps, and that will start equalizing the costs by simplifying maintenance."

Commonly used in HVAC systems, air-source heat pumps can be used in food processing facilities to provide heating and cooling. Auxiliary equipment heating options in combination with water or geothermal energy, for example, They can save natural refrigerants such as NH_3, CO_2, propane and propane (R290) or R1234ze. *Photo courtesy of Danfoss*

"In terms of preventative maintenance schedules and costs, an industrial heat pump and refrigeration system would have similar maintenance requirements and schedules," says Danfoss' Miller. "Regarding the lifecycle and expected lifetime, durability of the filter single-screw compressor platform can expect significant reductions in unplanned maintenance and lost production time. Some customers have reported experiencing more than 50,000 hours of runtime without an unplanned maintenance event."

Heat Pump Maintenance Costs vs. Conventional Refrigeration and Boiler Systems

Maintenance costs comparison:

a. Heat pump system: Heat pumps typically incur lower maintenance costs due to their simpler, integrated design. They operate by transferring heat rather than generating it, which reduces fewer components and subject to wear and tear. Modern heat pumps often have advanced controls and monitoring systems that help predict and prevent issues before they become serious.

b. Conventional refrigeration and boiler system: Traditional systems, which separate refrigeration and heating, usually have higher maintenance requirements. Boilers need regular inspections, cleaning and parts replacement to ensure safe operation. Refrigeration systems also require ongoing maintenance to address issues like refrigerant leaks and compressor wear.

Lifecycle of equipment:

a. Heat pump system: Heat pumps generally have a long lifecycle, often lasting 15-20 years with proper maintenance. Their efficiency and fewer mechanical parts contribute to their extended lifespan, leading to a lower total cost of ownership.

b. Conventional systems: Boilers typically last around 10-15 years due to the harsh operating conditions, and refrigeration systems may have a similar life expectancy though components like compressors might need earlier replacement.

Cost analysis:

a. Initial costs: Heat pump systems have higher upfront costs due to advanced technology and integration. However, this cost difference is often offset by lower operational and maintenance costs over time. As technology is advanced, costs are trending down.

b. Payback period: The payback period for heat pump systems ranges from years to 10 years, with significant cost savings continuing thereafter. This is very system-specific and requires careful evaluation to ensure all aspects of cost are considered.

c. Long-term savings: Over their lifespan, heat pumps usually have a lower total cost of ownership compared to conventional systems due to reduced energy consumption and maintenance costs.

Advantages and disadvantages:

a. Heat pumps: Advantages are more energy-efficient, offer environmental benefits with low-GWP (global warming potential) refrigerants, and provide precise temperature control, enhancing product quality in food processing.

b. Disadvantages: Higher initial investment and installation complexity can be barriers. Performance can also be affected by ambient temperatures, requiring supplemental heating in extremely cold climates. In recent years, cold-climate technologies have significantly advanced which will allow for fewer break-ins/outs.

Heat pump systems present notable long-term benefits over conventional refrigeration and boiler systems, including lower maintenance costs, extended equipment lifespan, and significant energy savings. Despite higher initial costs and installation complexity, their operational efficiencies and environmental advantages make them an appealing choice for food processors.

– Nick Ernst, P.E., Manager, Refrigeration Engineering at Gray

"Heat pump systems generally offer lower maintenance costs, longer-term energy savings and environmental benefits compared to conventional refrigeration and boiler systems," says Gorman's Herrera. They can have higher initial costs and may require specialized maintenance. Conventional systems might be cheaper to install and simpler to maintain but tend to have higher ongoing costs and a greater environmental impact. To evaluate the best option, it's important to consider factors such as the local weather, energy prices, if there's any incentive available (which there usually are) and the specific needs of the facility.

The lifecycle of a heat pump is about 20 years, the same level as refrigeration systems, adds Miller. The payback period needs to be evaluated on a case-by-case basis. In general, the higher the COP of the particular application, the faster the payback period.

For more on maintenance, see the box, "Heat Pump Maintenance Costs vs. Conventional Refrigeration and Boiler Systems." **FE**

RESOURCES:

"Industrial Heat Pumps are the Past, Present and Future," By Wayne Borkowman, FE, May 2024

"GEA to Supply RedGenium Heat Pump to Canadian Dairy Processor," FE, July 2024

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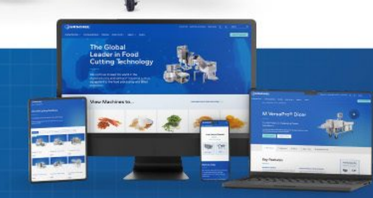

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DO YOUR PACKAGING MACHINES Speak the Same Language?

PackML transforms the concept of individual machines in a packaging line to a single unified machine with consistent parts for packaging making line changes and maintenance faster and easier.

PackML makes this range system an individual machine, yet the operator can command the machine's functions and coordinate with other processes and downstream in the same line, as the entire line behaves as one machine. Image courtesy of Rockwell Automation, Inc.

By Kendal Lutz

PACKML (PACKAGING MACHINE LANGUAGE) is an industrial technical standard intended to make the control of packaging machines and packaging lines—in fact, any discrete machine process built using the language—easier to understand and program. PackML's main goals are to let one machine communicate with another about its status to provide a coordinated flow of product on the line and bring to the user a common look and feel and operational consistency to machines that make up a packaging line.

The word "consistency" is key for the operator mean, says Mark Lewis, special projects team manager, Beckhoff Automation LLC. "PackML is a predefined strategy for software consistency. There are many ways to program a machine so there are controls engineers. And engineers often neglect to provide documentation or even comment their code, which leaves the operator in the dark when it comes to troubleshooting or even to fine-tune machine operation. Implementing a PackML ISA88 as the orchestration layer avoids that confusion."

Think of it the building a house, says Lewis. You have specific building codes for framing—what size lumber you have to use, where, how far apart it's placed, etc. That ensures the house is structurally sound, but it also means the teams doing finish work can install drywall, lighting, cabinets or anything else without having to fix the an angle of how it was framed. They know the studs are all at 16 inches on center.

In the same way, you always need inside and state control in the machine controller, adds Lewis. PackML provides that standard, but the benefit is that it's tested, documented and accepted—not just in packaging but across many, many industries. At the end of the day, easier, and even an imperfect standard, allows operators and engineers to become familiar with how to deal with the machine on a least playing field.

To demonstrate a consistent look and feel on a packaging line, the early PackML demonstration showed four packaging machines running in a line, each with a different brand programmable controller (PLC) and user interface (HMI). The HMI on each machine had a similar look and set of controls, but only that, at operation time, the machine in the line could call up the HMI/controls belonging to another machine, thus making it easier to make a change on a single machine without having to be physically present at the machine.

With the data about machine and line status passed on through PackML, key performance indicators are also available—such as OEE, uptime and downtime, etc. Data can also be passed along to maintenance so repairs can be scheduled rather than putting out fires.

With many packaging lines are up to run consistently, PackML makes it easy to access any particular line at a single machine or to check in on any one particular machine within that line. Image courtesy of Organizetics.

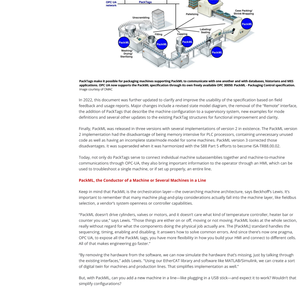
Early History

The Organization for Machine Automation and Control (OMAC) was created in 1994 to provide machine builders a forum to standardize on software and communication protocols for packaging manufacturing performance. By 2011 OMAC's PackML Working Group began a period of dynamic evolution. Manufacturers such as Procter & Gamble, Nestlé, Frito Foods and Kellogg drove the effort for better international acceptance.

When the ISA88 batch specification was first developed, it did not include discrete automation and packaging equipment. Since PackML is a standard implementation of ISA88 and ISA95 it adapts those standards to encompass manufacturing machinery. Generally packaging machine standards, The Part 1 standard was to be called the "Modular Concepts for Automated Control Systems" and would define methods for developing a library of automation control components that could be supported by automation vendors for all types of manufacturing.

Dave Chappell of Procter & Gamble was appointed to serve as the Part 1 Working Group chair. Chappell's role provide standard terminology, command and control functionality, a way to describe and identify each modular component, a way to describe and exchange component definitions and a method for intercommunications between components," says Chappell.

By the end of 2011 the ISA 88 committee approved the document, ANSI/ISA-TR88.00.02-2015 Machine and Unit States: An implementation example of ANSI/ISA-88.00.01. Known as TR88 or PackML, it was developed by the OMAC Packaging Working Group and provides a "common information model for machine control and packaging line implementation. PackML also defines a set of data tags called "PackTags," which serve to standardize internal machine automation and communication with other machines or systems.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REGULATORY **WATCH**

Photo courtesy of Getty Images Plus / fcafotodigital / E+ Collection

FDA Releases Sampling Results of Retail Dairy-Free Dark Chocolate and Chocolate-Containing Products for Milk Allergen

The sampling was conducted to better understand the extent to which these products potentially contain unintended milk at levels that may be hazardous to people with milk allergy.

THE U.S. FOOD AND DRUG ADMINISTRATION, in cooperation with the Pennsylvania Department of Agriculture (PDA) and the Michigan State Department of Agriculture and Rural Development (MDARD), has released results from its retail sampling of dark chocolate and chocolate-containing products labeled as "dairy free" that were collected and tested for unintended milk in 2022 and 2023. The sampling was conducted to better understand the extent to which these products potentially contain unintended milk at levels that may be hazardous to people with milk allergy.

This sampling initiative was part of the FDA's continued efforts to protect consumers with food allergies and is a continuation of a similar effort by the FDA implemented in FY 2018-2019. Unlike the earlier assignment, which focused on chocolate bars and chocolate chips, this recent effort included testing for milk in additional chocolate-containing products, such as chocolate chip cookies, chocolate syrups and chocolate baking powders that were labeled as "dairy free." In 2022 and 2023, PDA and MDARD collected 210 samples at retail in the states of Pennsylvania and Michigan, respectively. The testing found that 13 of the 210 samples tested were positive for milk. These 13 samples were made by three different food manufacturing firms. Twelve of these 13 samples contained less than 80 parts per million (ppm) of milk, with one sample testing at 1,083 ppm. Additionally, the 13 products found to contain milk had labeling with milk allergen advisory statements, such as, "...made in a facility that also processes milk."

In response to the findings, two manufacturers removed the "dairy free" claim from their chocolate products. The third manufacturer likewise agreed to remove the "dairy free" claim from its products, if the cause of the presence of milk could not be determined and eliminated pending completion of a root cause analysis. Preliminary investigations, based on inspections by state agencies, have implicated the supplier of dark chocolate as the likely source of milk in these products rather than inadequate sanitation or other practices at the manufacturer. The FDA and state agencies will follow-up with these manufacturers and assess their ongoing compliance.

The FDA does not define the terms "dairy free" or "milk free." Such claims are voluntary and, when used, must be truthful and not misleading, the agency says. Consumers with milk allergy who choose to eat dairy-free dark chocolate or chocolate-containing products can contact the manufacturers and inquire about how the product is made, including whether the product is made on equipment dedicated to making dairy-free chocolate, whether the ingredients used are free of milk, and whether the manufacturer tests its products with "dairy free" claims for the presence of milk.

The agency says it will continue to monitor dark chocolate and chocolate-containing products labeled as "dairy free" for the presence of milk because it can cause serious health consequences to consumers with milk allergy. **FE**

NEXT ARTICLE

Must See PRODUCTS

PACK EXPO **PLANT PRODUCTS**

A compilation of the newest food engineering technology and plant products featured at PACK EXPO 2024.

RYCHIGER - BOOTH #S-2153

Compact Cartoner with Multiple Configurations

RYCHIGER's VRC-60 is a compact cartoner for food and beverage. It is available in multiple configurations, including fully automated and semi-automated loading options. The cartoner has a product feed and removal station with an indexed rotary table in between. It can be fitted with a single-lane or multi-lane product feed. The robot also grips grouped products and packs them into cartons at high speeds if required by the packing pattern. Labeling and barcode units, as well as other quality control features like weighing technologies or a camera, can be added as well.

TEXWRAP - BOOTH #S-3636

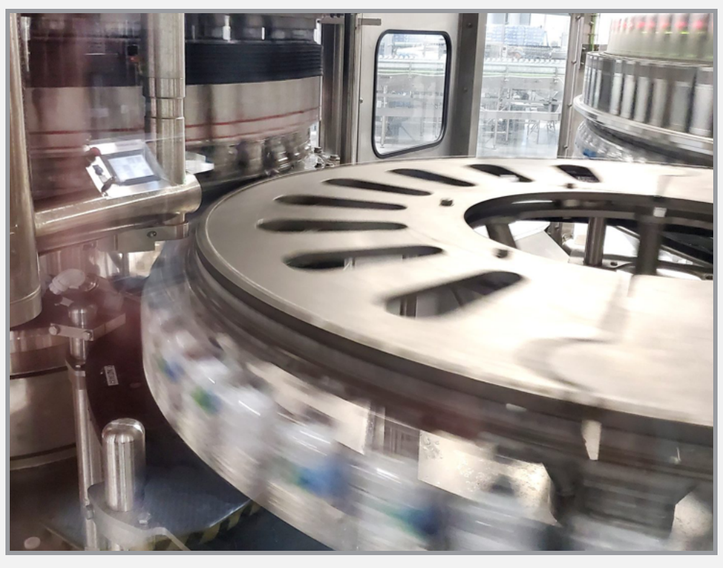
Dual Roll Bundler Offer Workhorse Productivity

Texwrap, a ProMach brand, will be demonstrating its updated DX-130 Dual Roll Bundler. At just more than 5-ft. wide by 10-ft. long, the machine offers workhorse productivity in a compact footprint. Bundles supported by the DX-130 can range from 4x6x7 inches to 12x24x20 inches and can be run at up to 25 cycles per minute. This dual roll bundler runs an inline intermittent motion system ideal for wrapping trays of products. Wrapped trays are then conveyed through a tunnel for tight protection and unity for transport.

LOMA SYSTEMS - BOOTH #S-3916

Metal Detector Series for Uptime and Productivity

Loma Systems is displaying its IQ4 FLEX Conveyor, IQ4 Pipeline, IQ4 Waferthin and the IQ4 Vertical Fall. The IQ4 Metal Detector series contains features designed to enhance uptime and productivity; notably, its variable frequency technology allows for detection capabilities across a wide array of product conditions. The user-friendly touchscreen interface, complete with intuitive icon-driven menus, is designed to make setup quick and easy. Additionally, with ingress ratings of up to IP69K, these detectors can be used in both high-care and low-care environments.



VACUUM BARRIER CORPORATION - BOOTH #C-2516

High-speed Liquid Nitrogen Dosing System

An advanced dosing system designed for fast, precise delivery of low-pressure liquid nitrogen in beverage applications, Vacuum Barrier Corporation's NITRODOSE G3 SERVODOSER allows manufacturers to adapt to their production needs without downtime. The seamlessly integrated system can handle up to 2,000 containers per minute (CPM) while offering accurate dosing control. The NITRODOSE system is used for non-carbonated beverages in plastic bottles or aluminum cans, where it adds rigidity to enhance structural integrity and durability.

FORTRESS TECHNOLOGY - BOOTH #S-1758

Hygienic X-ray Inspection System

Fortress Technology's Icon X-ray was created with a hygienic design to support sanitation processes and increase plant productivity. The high-speed x-ray system inspects and rejects packaged chilled, baked and confectionery products using the company's proprietary IA+ algorithm. This is intended to provide high-quality processing and detection to adapt to variable-density products that present with metal, ceramic, glass and high-density plastic contaminants. The Icon X-ray features internal cameras to monitor product status and immediately address operational bottlenecks.

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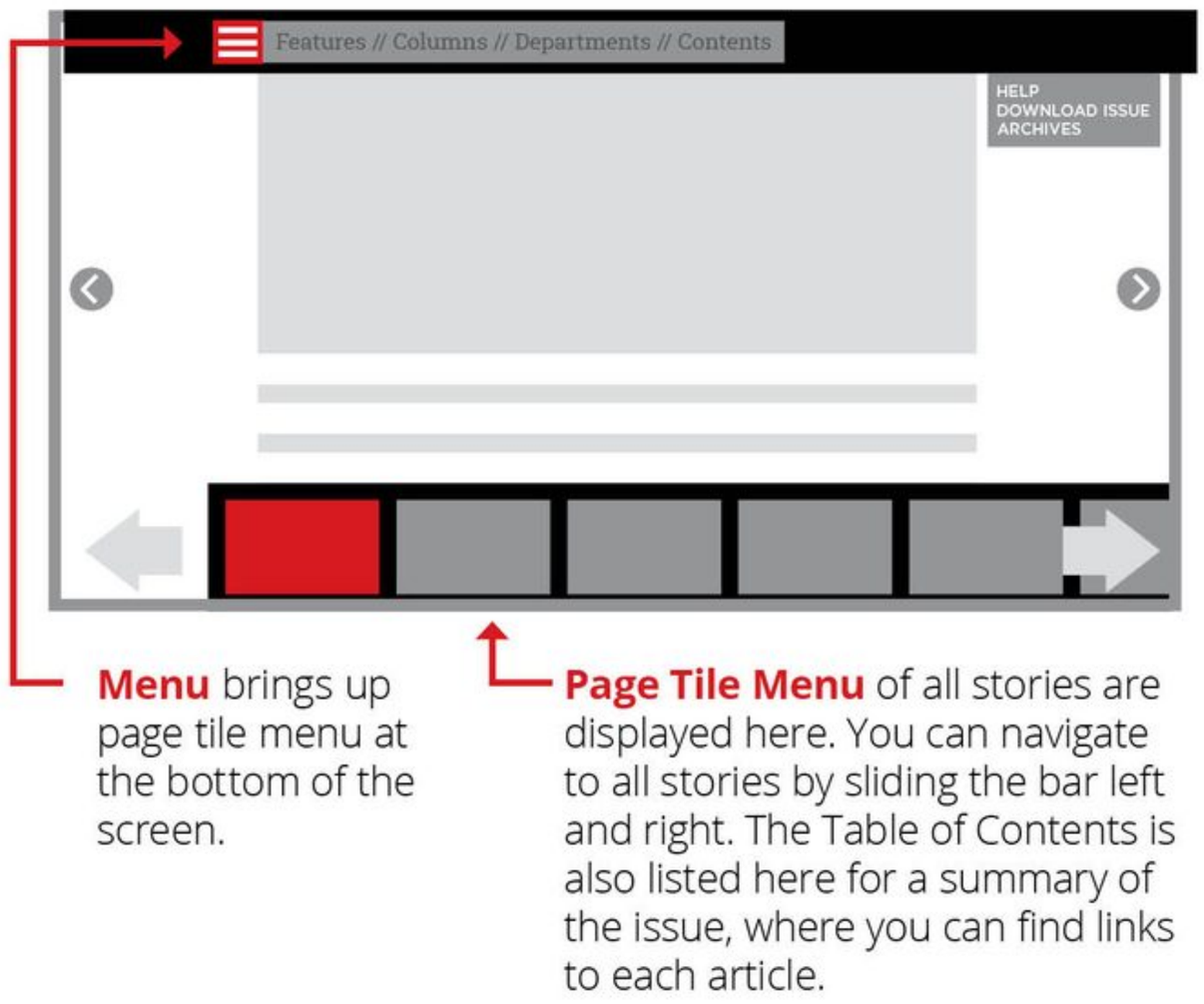

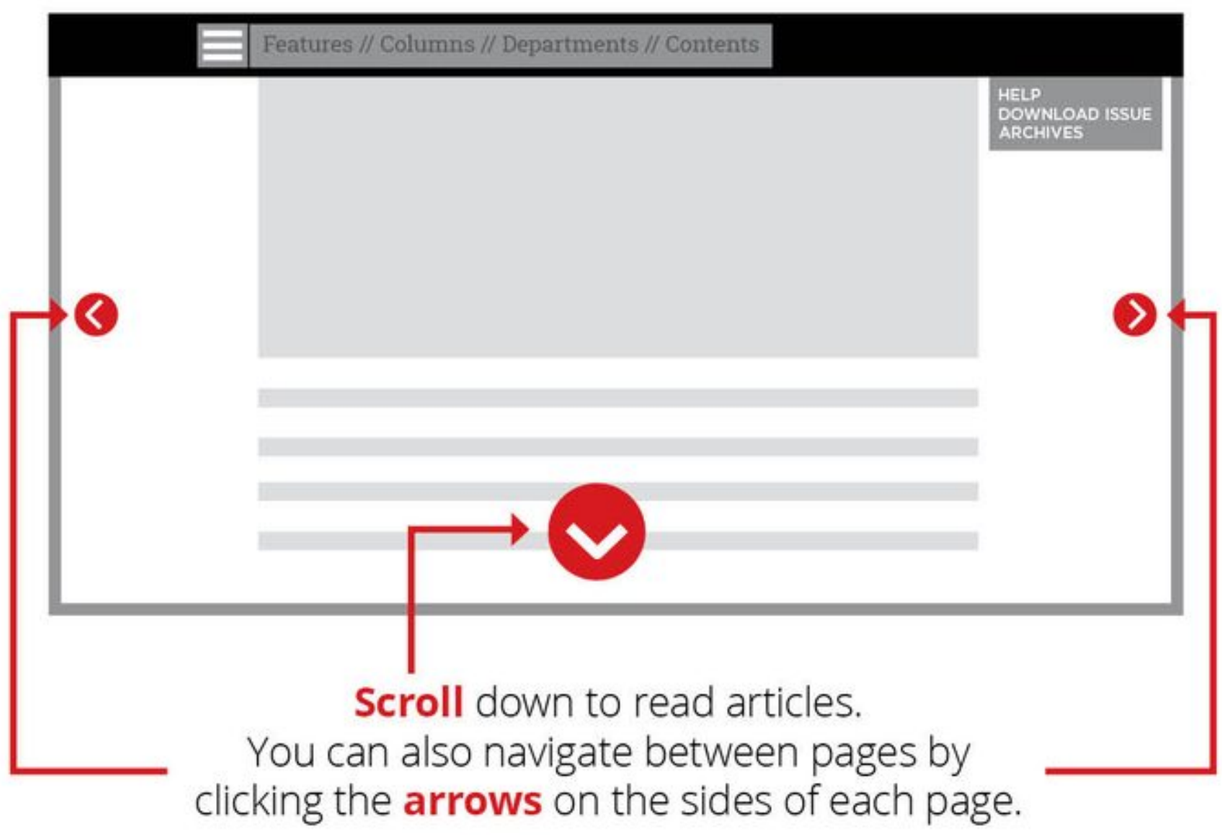

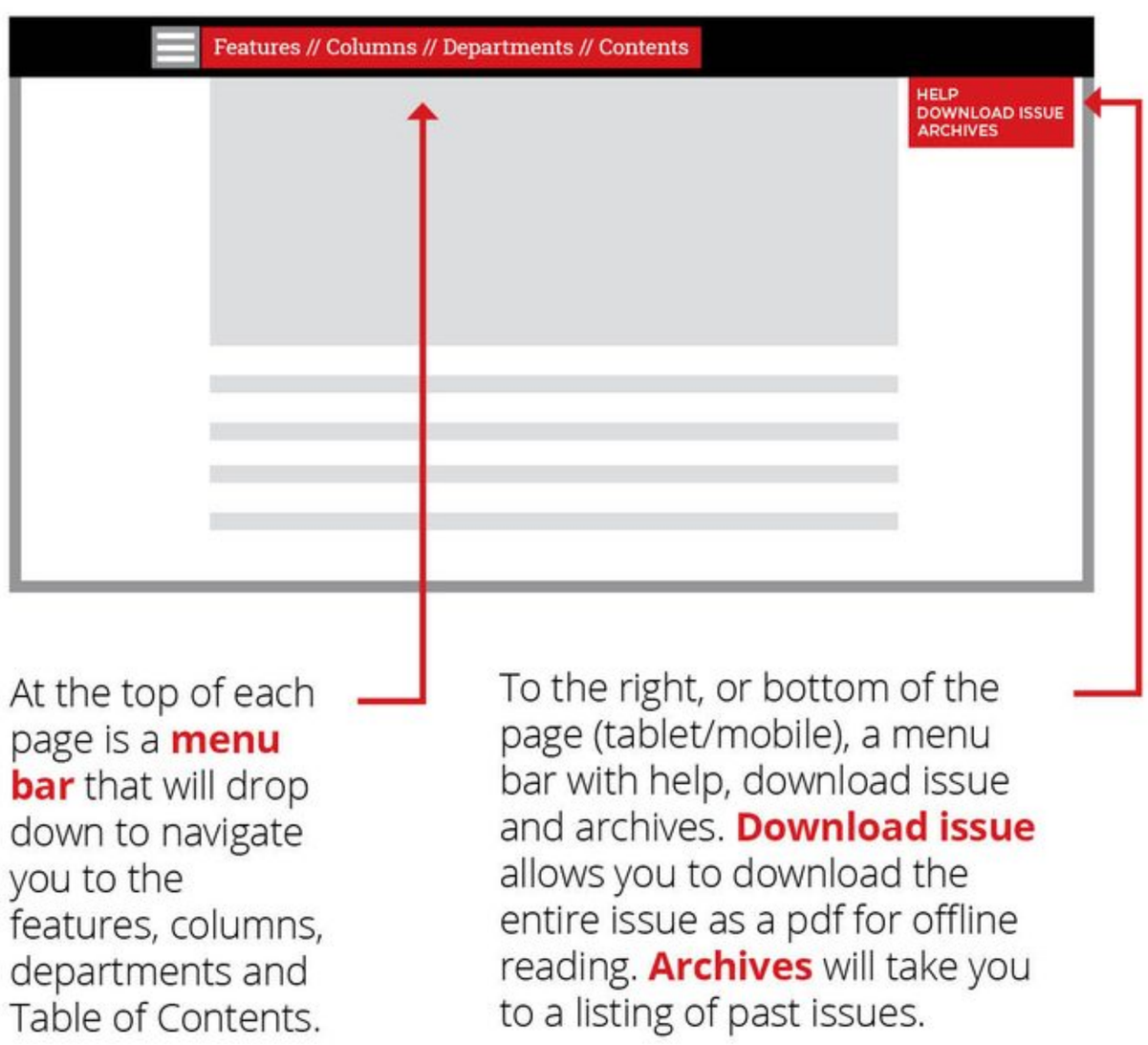

Zoom

To zoom on **desktop view**, use your browser's zoom commands.

Zoom In: Control + on PC
Command + on Mac

Zoom Out: Control – on PC
Command – on Mac

To zoom on **tablet and mobile views**, pinch your screen.