Technical Article

Utility savings concepts for the food & beverage industry

Innovative instrumentation, comprehensive energy management and robust energy reduction strategies benefit food & beverage processors by providing lower operational cost savings, increased brand perception and achievement of sustainability goals.

Endress+Hauser
People for Process Automation

Executive summary

As process manufacturers push for sustainability and environmental stewardship, companies are looking for ways to increase their operational efficiency, reduce waste and do more with less. While primary focus is often placed on reducing emissions, cutting incoming utility consumption is a frequently overlooked key area for increasing efficiency, with the dual benefit of decreased environmental burden and reduced production costs (Figure 1).

Utility usage is directly correlated with carbon footprint and inversely proportional to profits, incentivizing companies to minimize consumption. Because product margins are typically slim in the food & beverage industry, even slight expense reductions can have substantial impacts on overall profits.

Reducing energy consumption and increasing operational efficiency can be executed in three primary phases:
1. Identify areas for process improvement or optimization. This sometimes requires retrofits, but it is often achievable simply by using already-installed equipment more efficiently. Opportunities for improvement are revealed by accurately measuring process values and applying energy performance indicators in the right locations.
2. Adjust operations according to optimization insights.
3. Measure and track energy and emissions data, then align this information with progress reporting on efficiency goals.

Utilities are a necessary expenditure, but there are almost always opportunities for savings. These savings can help companies reduce operational costs and meet ambitious environmental stewardship targets. However, proper energy management requires accurate data capture and appropriate analysis.

Food and beverage industry impact

Bakeries, dairies, breweries and companies that produce ready-to-eat foods account for a large portion of total utility usage among the food & beverage sector. Given this large impact, other participants in the industry frequently look to these key players when adopting their own operational strategies and sustainability goals.

Many critical operational procedures rely on processes with heavy utility usage and energy consumption, such as shock freezing, pasteurization, sterilization, preservation, heating, cooling, cooking and cleaning. There are often many opportunities for savings present in the steam, boiler, compressed air, water heating and cooling utilities that power these processes, and identifying opportunities for consumption reduction is paramount.

Process engineers are often tasked with spearheading reduction efforts, but determining where to begin can be difficult. As they strive to achieve organizational objectives—such as “reduce energy consumption and emissions by 20% by 2030,” for example—frequently asked questions include:
- Where do we start, and which opportunities have the greatest ROI potential?

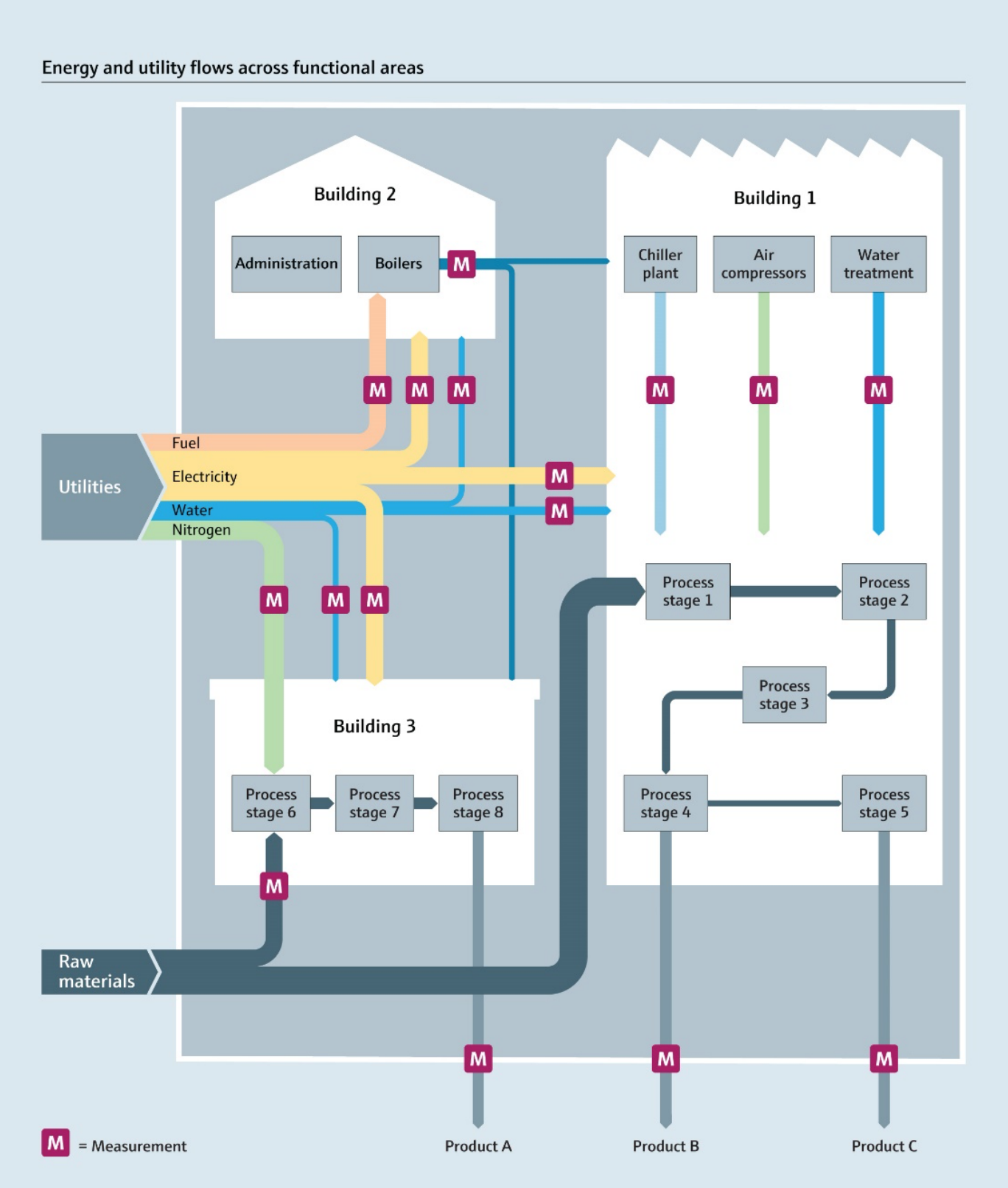

Figure 1: Utilities are a significant part of every food & beverage facility, so optimizing their efficiency is essential to achieving goals related to cost and energy savings.

- In our plant, we use a lot of steam, water, compressed air and heat, but exactly which processes consume these utilities, and in what amounts?
- We need to align with industry standards and regulations, but which standards align with our goals? In what areas can we lead the industry?
- I know we must measure energy consumption and efficiency as we make improvements, but where should we place instrumentation to best measure these components and identify opportunities for reduction? How much will these measurements cost, and what are the potential savings?
- How do we best create and record emissions data, track our carbon footprint and show progress toward goals?
- Who can help me with these improvements?

To answer these questions and create realistic targets, reliable instrumentation for monitoring plant processes and utility consumption is required around a facility. This information empowers plant personnel to establish baselines, monitor process efficiency, identify opportunities for savings and optimize operations.

Five utility savings concepts

Comprehensive utility monitoring and optimization can regularly reduce energy consumption by 5 to 15%, but this requires instituting the right energy performance indicators (EnPIs) and making appropriate process operational tweaks. All reduction opportunities depend on instrumentation that can objectively quantify energy flows, energy consumption and process data, with related systems presenting this data in terms of EnPIs.

Beginning with existing assets and operations, facilities should institute the following five steps to optimize energy usage and reduce utility consumption.

1. **Look for process areas to optimize by analyzing key instrument data.**
   Optimization efforts begin with creating context throughout entire plant operations by installing the right instruments in suitable locations. These instruments generate data, which can then be aggregated and pieced together to create actionable information.

   To ensure detailed and accurate information, teams should:
   - Leverage the knowledge of expert consults to help establish what should be measured and where measurement should be applied.
   - Examine a facility holistically to identify strategic measurements that provide high-quality data. This information can then be leveraged for plant insights.
   - Implement advanced monitoring and onboard diagnostics in the process using capable instruments, such as Endress+Hauser's Heartbeat Technology-enabled sensors. These types of efforts help progress plant digitalization strategies by providing troubleshooting, verification and predictive maintenance data.

   When analyzed appropriately, the resultant insights from data collected over time tell a story, providing personnel with a detailed understanding of their operations.

2. **Decide where optimization is possible among existing processes, and then adjust operations according to insights.**
   Installing instrumentation to measure process and utility flow, temperature, pressure and other variables is critical for energy management systems, but these systems are not complete without a means to visualize measured values and energy data, typically provided by some type of human machine interface (HMI). This is the basis for detailed evaluation.

   Once measurements are made and pieced together in context, process experts can delve deeper into the data to identify opportunities for utility consumption reduction. Key targets are areas where energy inputs can be reduced without compromising output product quality or plant safety.

3. **Track changes using energy management software (EMS), which provides recommendations for continued improvement, and then aligns these efforts with progress reporting on efficiency goals.**
   The correct information leads to actionable insights for efficiency enhancements, but the journey does not end here. Data collection must be continuous, informing efficiency gains and supporting compliance reporting.

   Additionally, the right software tools are needed to ease procedures for moving operational data to shareable reports, which in turn can be used to communicate wins throughout a company and demonstrate regulatory compliance. EMS solutions on the market today typically provide access to entire plant monitoring systems via an internal intranet or the internet. The best software packages, including those from Endress+Hauser, incorporate:
   - Web-based secure local or remote access
   - Simple operation and easy-to-use interfaces with drop-down menus
   - Automatic data import from data loggers, SCADA systems, production systems and building management systems
   - Simple integration into existing operating data recording systems
   - Modular application design for simple customization
   - Simulation and calculation using multivariate mathematical functions

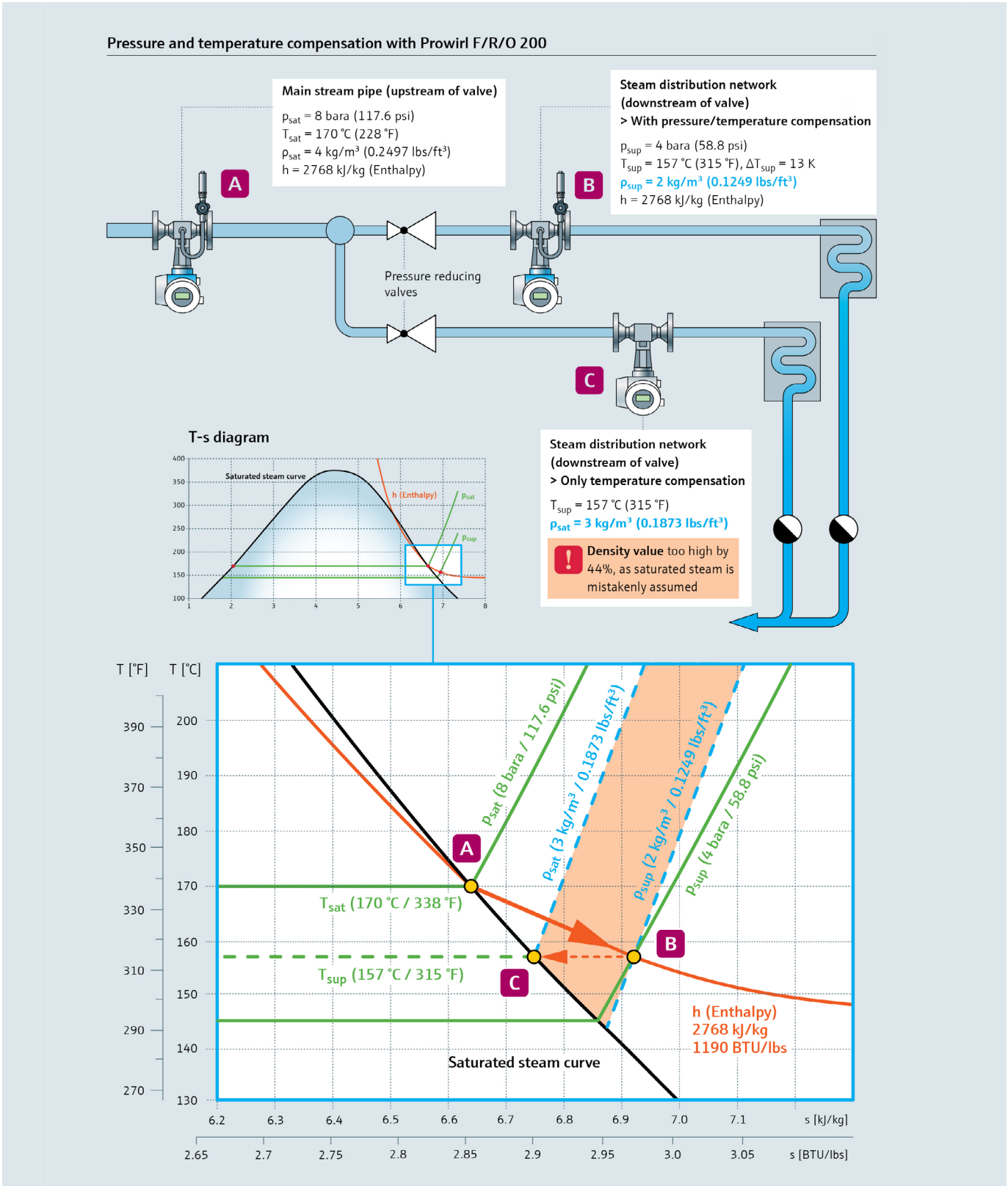

Figure 2: Prowirl F 200 measures steam quality directly in the pipe, including both dryness fraction and steam type. This provides accurate navigation of the enthalpy-entropy chart (Mollier diagram) and flow measurement. Basic measurement compensation—e.g., purely temperature-based compensation of superheated steam downstream of a pressure-reducing valve—would produce extreme errors, but Prowirl F 200's combined temperature and pressure compensation helps avoid this and other inaccuracies.

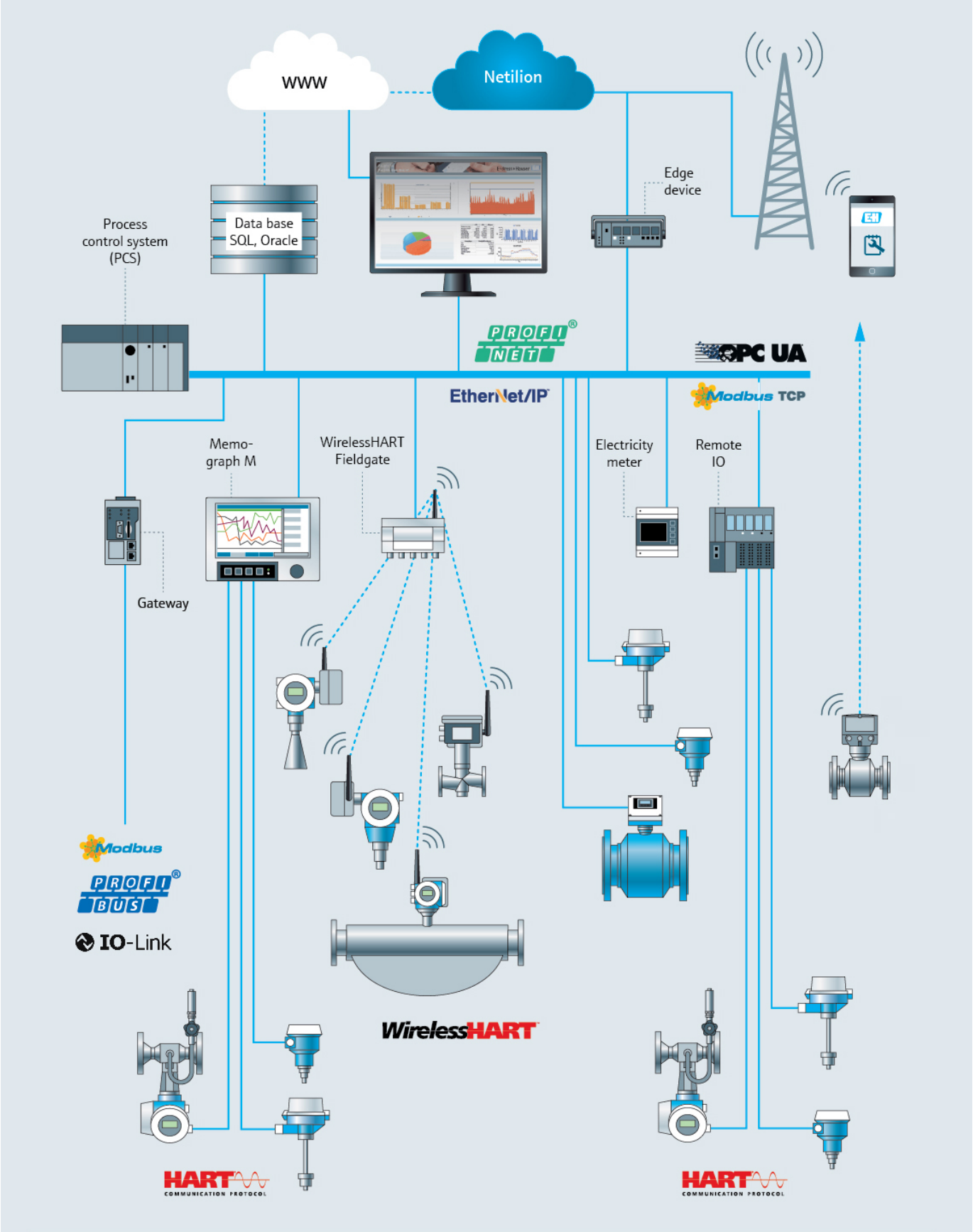

Figure 3: Endress+Hauser has an industry-leading portfolio, helping companies manage their utilities reliably and save energy.

- Energy analysis
- Energy consumption monitoring
- Efficiency assessment
- Target/actual energy data comparison
- Peak values identification
- Cost analysis
- Simple creation of diagrams and displays, with symbol libraries available
- Ability to create and monitor budget plans
- Cost comparison functionality
- Profitability calculations in terms of return on investment
- Deviation analysis
- Email notifications and warnings
- Limit value adjustment
- Notification prioritization
- Reporting
- Tailored reports via SQL Server Reporting Services
- Cumulative curve calculation and comparative displays
- Automatic report creation and sharing capabilities

There are tremendous opportunities for utility efficiency gains with existing equipment and instrumentation. However, modern instrumentation advancements can help food & beverage processors take their game to the next level.

4. **Lean on newer, advanced technologies to upgrade where it makes sense.**
In the past, instruments were typically limited in what they could measure, in addition to the information they could transmit, with only one or two 4-20mA analog outputs for communication with a host system. However, today's instrumentation is capable of sensing and reporting a host of secondary process variables and internal diagnostics—leveraging Heartbeat Technology and digital communication protocols—which improves both process and instrument insights.

Let's explore some key instrumentation for monitoring food & beverage utilities.

- Proline Prowirl F 200 is a versatile vortex flowmeter featuring active pressure and temperature compensated output in both mass and volumetric flow. Additionally, it provides wet steam detection and compensation for optimal accuracy (Figure 2). Factory calibration ensures accuracy out-of-the-box along with high plant availability, even for low flow rates of gas, steam and liquids. Rated for use in hazardous areas, Prowirl F 200 ensures operational safety in a wide range of conditions, and Heartbeat Technology provides process and instrument health diagnostic data to host systems. This flowmeter is ideally suited for steam, compressed air and boiler utility measurement applications.
- iTHERM TH13/TM131 modular temperature sensors provide unparalleled response times, vibration-resistance, Bluetooth-initiated and tool-free calibration capabilities, and hazardous area approvals. With installation options in new or existing thermowells, TH13/TM131 are well suited for a host of applications, including steam, compressed air and boiler measurement applications.
- Cerabar PMP21 is a compact pressure instrument, featuring a piezo-resistive sensor capable of measuring absolute or gauge pressure between 400mbar and 400bar. PMP21 is designed to withstand harsh conditions with high quality materials—such as 316L—and it provides ingress protection grades up to IP68. High reference accuracy of 0.3%, along with high long-term stability and repeatability, ensure accurate process monitoring and utility baseline measurements in compressed air, boiler and cooling applications.
- Proline t-mass F 300 thermal mass flowmeter provides unprecedented measurement stability for nitrogen and natural gas, compensating for changing process conditions in real time, including temperature, pressure, flow direction and gas type. Its compact transmitter is easy to access, featuring remote display and improved connectivity options. Additionally, onboard Heartbeat Technology enables accurate measurement and reliable verification. T-mass F 300 is of high value in boiler measurement applications, helping maintain tight control of incoming gas streams.
- Steam and water analysis systems (SWAS) are also essential for Food & Beverage operations, optimizing energy consumption, protecting equipment, achieving water quality requirements and streamlining operations. These systems are often comprised of pH, ORP, dissolved oxygen, conductivity, turbidity and TOC instruments, depending on process requirements. Endress+Hauser's space-saving SWAS Compact saves up to 70% of energy compared to a conventional SWAS system. The company's SWAS solutions provide bundled high-tech sensors for critical measurement parameters, saving on operating costs through very low cooling and sample water consumption.

The right combination of instruments to accurately monitor utility usage and reduce energy consumption varies by facility configuration and requirements, so seeking SME support can significantly ease the decision-making procedure.

5. **Implement energy-saving process flows in the facility, taking advantage of waste to pre-condition incoming utilities, such as waste heat recycling.**
Energy loss is often high in boilers due to inefficient combustion and buildup in the tubes. In addition to rudimentary maintenance mitigations, recycling heat waste from production facilities back to the boiler location is becoming increasingly common.

This strategy can result in reduced energy consumption when creating process heat. Depending on the building and applications, these heat recovery investments can pay off quickly.

Optimizing energy consumption yields end-user benefits

Getting started can be overwhelming, but reliable instrumentation selection and installation lays the foundation for effective energy management system rollouts. Endress+Hauser can ease the journey from first steps to final refinements by providing end users with high-quality instrumentation, system components, software solutions and expert consulting and support (Figure 3).

Conclusion

As with all process improvements, informed decision-making for utilities begins with data from accurate and reliable measurements. These elements create the foundation for developing high-level energy management strategies to increase operational efficiency and reduce production costs. Additionally, implementing these measures helps establish process manufacturers as sustainability leaders, elevating brand perception among consumers and industry peers, improving employee recruitment and retention, and trailblazing energy-efficient practices for a sustainable future.

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