SPRING / 22

VOLUME 35 / ISSUE 1

gastechnology

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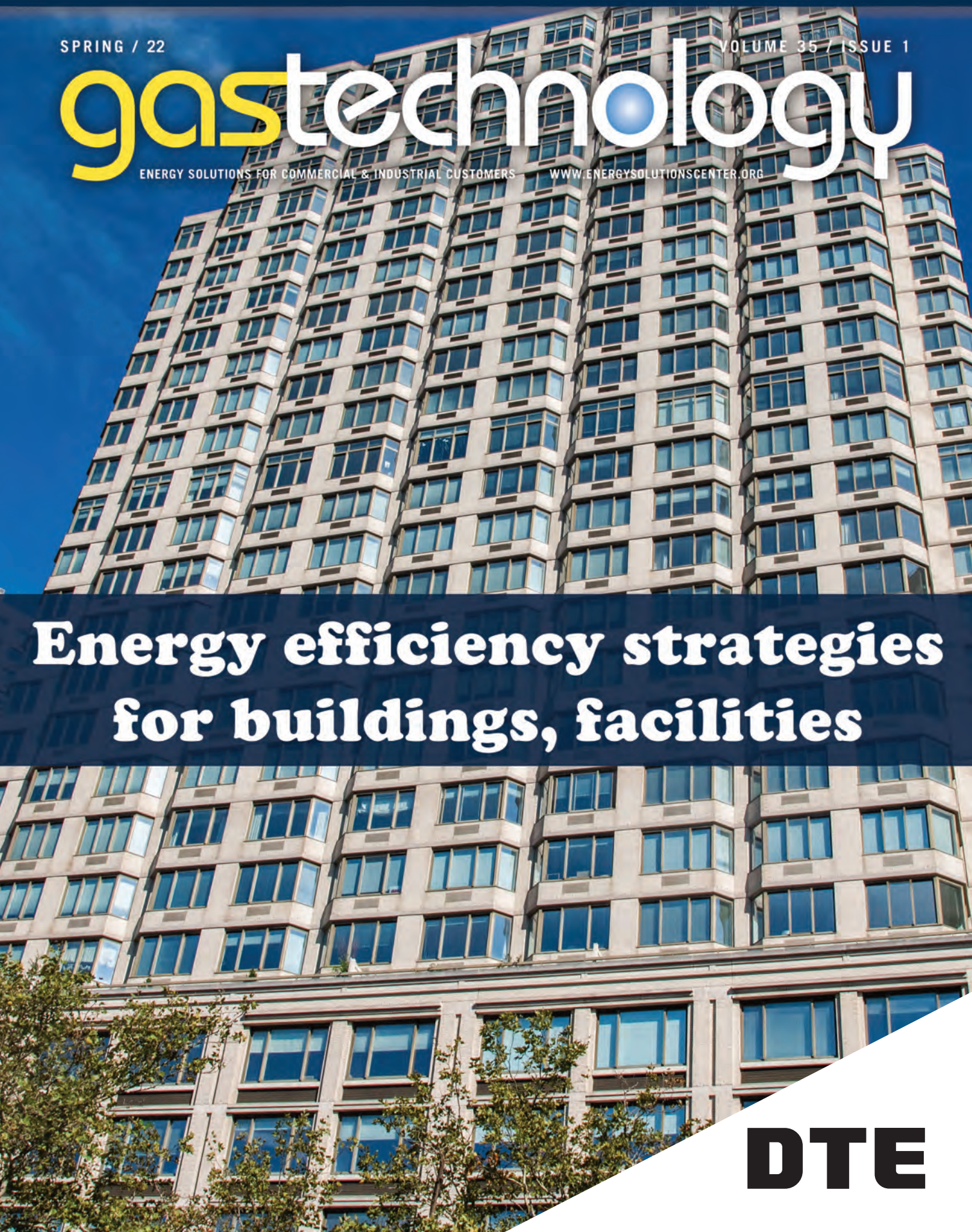

Energy efficiency strategies for buildings, facilities

DTE

on the cover

CarbonQuest has developed a distributed on-site CCUS they call Building Carbon Capture and Storage™ (BCCS™) to capture carbon dioxide (CO2) emissions. Courtesy: CarbonQuest

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Gas Technology is a trademark of Energy Solutions Center Inc. and is published in cooperation with CFE Media, LLC.

Gas Technology is an educational supplement from:
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Washington, DC 20001
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Downers Grove, IL 60515
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Printed in the USA

Energy Solutions Center websites:

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inside

VRF NATURAL GAS HEAT PUMPS CHOSEN FOR CHARTER SCHOOL SYSTEM

Variable refrigerant flow (VRF) natural gas heat pumps are used in two campuses at a charter school system in Georgia.

VARIABLE REFRIGERANT FLOW (VRF) IS AN HVAC TECHNOLOGY THAT USES REFRIGERANT AS THE COOLING AND HEATING MEDIUM. It is conditioned by one or more condensing units (which may be outdoors or indoors, water or air cooled), and is circulated within the building to multiple indoor units. This allows the user to vary cooling in specific areas or switch to heating mode without additional equipment while still being efficient.

While VRF systems had used electricity in the past, some companies are turning to natural gas to power their systems. The reasons for this are that natural gas is typically greener than electricity, overall energy efficiency is higher, and customers save money with gas heat pumps.

FIGURE 1: Front Entrance of the Dublin City Schools Middle School Campus. Dr. Fred Williams, the Superintendent of the Dublin City School System in Dublin, Georgia, oversees five campuses. Courtesy: Dublin City Schools and Clay Consulting

Saving energy and money is becoming more important for not only companies, but for other institutions. For example, one charter school system in Georgia decided VRF was the way to go for what has become a larger project as they go from success to success.

VRF natural gas units installed in gifted school

Dublin City Schools (DCS) in Dublin, Georgia, is a charter school system educating more than 2,400 students at five campuses located throughout the greater Dublin region, which is more than 100 miles Southeast of Atlanta.

The school district earned "Exemplary Board" status by the Georgia School Boards Association three times since 2015 and boasts a greater than 90% graduation rate. In addition to the above accolades, the school district has made recent decisions to chart a path to improve its overall building energy efficiency and to reduce its carbon footprint through HVAC system retrofits utilizing natural gas heat pump (GHP) HVAC systems.

Superintendent Dr. Fred Williams and the school board made the decision to install five 14-ton YANMAR VRF GHP systems at the DCS Gifted Academy campus in 2019. The configuration included two 2-pipe systems and three 3-pipe systems totaling 70 tons of installed capacity. VRF heat-pump systems are increasingly being designed in buildings throughout the U.S. They provide increased energy efficiency along with improved tenant comfort with multi-zone configurations and individual zone temperature control.

Benefits of the VRF system

VRF systems have a smaller footprint than conventional HVAC systems and are designed to modulate to meet the heating and

FIGURE 2: Dublin City Schools is in the process of installing 266 tons of VRF GHP systems at the Middle School Campus. The success of the first project in 2019 was a determining factor in this decision. Courtesy: Dublin City Schools and Clay Consulting

cooling load requirements of each zone and to maintain temperature control. YANMAR natural GHPs take advantage of the highly efficient natural gas delivery system and low-cost natural gas to provide lower operating costs, reduce CO_2 emissions, and deliver cost effective solutions for a wide range of cooling and heating applications.

Williams said, "We were looking for a more reliable HVAC system that could meet high efficiency levels and provide student comfort for a productive teaching-learning environment. Student performance is a critical metric for our school district. At the same time, operating costs and energy environmental stewardship were key factors and important to us."

The GHP system reduces electricity use and electric peak demand by using outside air and transferring heat either to or from the conditioned space supplemented with low-cost natural gas energy. Heating and cooling efficiencies are greater than 100%.

Johnny Bayto, DCS maintenance director, said, "Our previous HVAC system, a geo-thermal electric heat pump system, was approaching end-of-life and had continual maintenance issues. The leaks in the underground piping configuration proved to be a source of high maintenance costs. We have been very pleased with these systems, and their operations."

The YANMAR system tracks system conditions and provides maintenance alerts via remote monitoring adaptors preventing reduced down time.

Results of the installation and future projects

The DCS Gifted Academy GHPs have provided lower energy costs for the School District and a high level of performance.

Williams said, "One of the hurdles we faced was overcoming the capital costs needed for the project. The City of Dublin assisted through an intergovernmental agreement and provided project financing with a five-year term. The project financing, the per ton rebate, and the energy cost savings all added up to quick payback numbers and life-cycle costs savings that were very attractive."

City of Dublin Natural Gas, the municipal gas provider and Member of the Municipal Gas Authority of Georgia (Gas Authority), accessed financing through a combination of reserves and Gas Authority financing for this project and a recent project on another DCS campus currently in phase II installation.

Michael Clay, former Dublin Utilities Director and now acting consultant for the City of Dublin said, "The financing proved to be an important part of the success of these projects."

The gifted academy was a successful GHP project for DCS in 2019. In 2020, DCS decided to replace geo-thermal heat pumps at Dublin Middle School, which required 266 tons of installed capacity. DCS decided to go with 19 3-pipe systems. The 3-pipe system provides simultaneous heating and cooling operation optimizing comfort level within each zone.

Michael Edge, Middle Georgia Mechanical Heating & Air (and installation sub-contractor for both projects) said, "The VRF GHP system provides high level performance. The installations for the gifted academy and phase I for the middle school have gone extremely well. We've had no call-back issues with the gifted academy which has been in operation for over two years. The phase I installation for the middle school, even with COVID restrictions has gone well. During those periods where the students were restricted from gathering due to COVID, we were able to get our crews in to the facilities to continue installation work."

Middle Georgia Mechanical Heating & Air, a YANMAR dealer, promotes the VRF GHP system throughout Central and East Georgia and is approaching 400 tons of installations. "One critical element with VRF is the site evaluation," Edge said. "This allowed us to better understand desired comfort requirements and to better map out the multiple zones to maximize student and teacher comfort levels."

The middle school project obtained financing and utilized rebates provided by the City of Dublin Natural Gas and the Gas Authority. Phase II is estimated to be completed by mid-2022 completing the installation of all nineteen units. Natural gas heat pumps, by utilizing the efficient natural gas grid (over 90% efficiency) and efficient GHP systems (over 100%) offer an effective pathway to reducing carbon emissions and maintaining affordable energy costs while optimizing occupant comfort levels.

Dublin City Schools is in the planning process of expanding natural gas VRF GHP installations at a third campus. Looking back at the first two projects, several factors were critical in choosing to look at expanding GHP installations. Initial education on the benefits of VRF systems and, specifically, natural gas heat pump VRF systems. Secondly, a trained HVAC contractor that understands the system and stands behind the system performance.

Having experienced the systems and their performance in meeting space conditioning expectations all played a role in making GHP VRF systems a solid choice. The benefits they provide from an energy as well as a financial standpoint are making them attractive to users. **GT**

FIGURE 3: City of Dublin Natural Gas is the natural gas provider for the Dublin City Schools. The City's financing program proved instrumental to the overall project success. Courtesy: Dublin City Schools and Clay Consulting

MORE info

DUBLIN CITY SCHOOLS
https://www.dcs.irish/en-US

GAS HEAT PUMPS
www.gasheatpumps.com

YANMAR ENERGY SYSTEMS
www.yanmarenergysystems.com

CHP success stories

Combined heat and power (CHP) systems play a key role throughout the United States as a key source of power for facilities and several examples of how they improve a facility's overall performance are highlighted.

COMBINED HEAT AND POWER (CHP) SYSTEMS PLAY A KEY ROLE THROUGHOUT THE UNITED STATES AS A KEY SOURCE OF POWER FOR FACILITIES. These systems generate electricity and usable thermal energy from onsite generator sets. Typically, CHP systems are used at facilities with high heat load requirements. Most CHP installations run on natural gas and power part or all of a facility's operations. Facilities with CHP systems save money over buying power from the grid and gas for heating.

CHP is used in many unexpected places and is providing flexibility and power generation to industries that might not be considered for CHP at first glance.

Taking flight at Johnson Space Center

NASA's Lyndon B. Johnson Space Center (JSC) has served as a hub of human spaceflight activity for more than sixty years. The combined heat and power plant (CHP) supports mission control to the International Space Station and training center for the world's leading space explorers – with adaptability and flexible scale, while meeting JSC's electric and steam requirements, and half the chilled water requirements. JSC is home to the nation's astronaut corps, the International Space Station mission operations, the Orion Program and a host of future space developments.

Funding for The Johnson Space Center (JSC) CHP plant was provided through the DOE's Energy Savings Performance Contracting (ESPC) partnership with Energy Systems Group. In this $47 million project, utility savings are used to cover the project and maintenance costs over a 22-year period. Since operations and maintenance (O&M) for new equipment is included, there will be no increase to the current facilities contract. The ESPC also provides that all ESCO installed equipment have at least 10 years of remaining operational life at the end of the contract term of 22 years.

JSC's CHP plant, operating in parallel with the utility, powers 70% of the site base electric load. The waste heat from generators is converted into steam. This provides 100% site steam load, and between 40 and 60% peak chilled water load. This is possible because of the existing steam turbine chillers in the JSC plant. Further, in the event of utility power disruptions, the CHP plant provides the potential for island microgrid operation of critical mission operations. The CHP plant produces nearly 12 MW of electricity via two 5.7 MW combustion turbines and one 500 kW steam turbine.

(LEFT) In 2017, Tate & Lyle installed a CHP system at its Loudon facility, which generates electricity and steam to power and heat the facility, resulting in a year over year reduction of around 35% in greenhouse gas emissions at the site. Courtesy: Tate & Lyle

Utilizing waste heat from the combustion turbines, the two heat recovery steam generators produce ~50,000 lbs./hour of high-pressure steam. This steam is used for heating as well as generating chilled water through existing steam turbine-driven chillers.

Whereas traditional utility power provides on average 36% efficient electric, ESG claims that NASA JSC's CHP plant allows for approximately 85% efficient operations. This CHP system allows JSC to meet federally mandated energy reduction metrics.

Start early planning of any CHP project and get the local gas utility involved to avoid potential timing issues with energy supply and connection to local gas distribution systems.

Consider hiring specialty consultants that can perform a Life Cycle Cost analysis that looks at capital costs, energy costs, and maintenance costs all over the life of the expected system.

Bringing CHP to a food ingredient processing plant

Tate & Lyle has been a long-time user of CHP at many of its industrial locations. Two of its corn wet mills in Loudon, Tenn. And Lafayette South, Ind., have been awarded the U.S. Environmental Protection Agency's (EPA's) Energy Star certification, having met strict energy efficiency performance levels set by the EPA. It is the only corn refining plants in the U.S. to earn this accolade. Energy Star was introduced by EPA in 1992 as a voluntary, market-based partnership to reduce greenhouse gas (GHG) emissions through energy efficiency.

"This reflects the dedication and hard work of our operations team, especially our technicians who are committed to running these mills as efficiently as possible," said Nick Waibel, global energy lead at Tate & Lyle.

Demanding corn milling processes

Tate and Lyle, a global provider of food and beverage ingredients processes around 2% of the U.S. annual corn crop in several plants. The company takes shelled corn (maize), separates the kernels into their core components (starch, oil, protein and fiber) and processes them to create a range of products such as specialty sweeteners and bulk ingredients, which are distributed globally.

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Tate & Lyle, encouraged by the return on investment (ROI) they received switching to natural gas-based CHP at a facility in Loudon, TN, completed a similar upgrade at their Lafayette South food ingredient processing plant in Indiana. It chose to replace its aging coal boiler with a similar configuration as Loudon: two Siemens Energy SGT-700s and two Rentech Heat Recovery Steam Generators (HRSG).

"Natural gas fired cogeneration brings clearer energy online and helps us move away from the use of coal boilers," said Nick Waibel, global energy lead at Tate & Lyle. "We have set a goal of eliminating coal from all our sites by 2025. Our Decatur, Ill., facility, is also in the midst of replacing coal boilers with natural gas."

The energy units are designed for high output/efficiency and lower emissions with a wide fuel range capability. Due to high process heat needs these sites are s well suited to CHP. The system also includes a third-generation dual fuel dry low emissions (DLE) combustion system which keeps NOx emission levels low.

"In these dynamic times, we had to ensure our investment will serve us in the near term and the long term. It's good to know our turbines can make the transition to hydrogen when that supply comes online in the future."

The results of this plant upgrade were positive: Improved grid resiliency, greater process efficiency, carbon emissions slashed by more than 30% and a GHG emissions drop of around 40%. By replacing aging coal boilers, generating electricity on-site and recovering heat, overall energy efficiency has been boosted while substantially reducing energy costs and cutting water usage by 5%. The plant manager also reports greater process efficiency and power resiliency.

"We take our responsibility to the environment seriously and are committed to doing more to care for the planet, including lowering our greenhouse gas emissions by using cleaner energy," said Travis Montoya, Lafayette South plant manager for Tate & Lyle.

Far from being projects executed at specific plants, this represents a company-wide target by the company for 2030 to deliver: a 30% reduction in CO2 emissions, all its waste to be beneficially used, a 15% drop in water use and the elimination of coal from its operations. Getting rid of the coal boilers at Loudon and Lafayette is a major step in achieving the latter goal.

"The Lafayette South plant project not only helps meet our sustainability goals in reducing greenhouse gas emissions and water use, it's also a project that saves us money as a company, so it was really a win-win for us," Waibel said. "Eliminating coal and going into a clean-burning fuel is the right next step for our plant."

CHP benefits everywhere

Regardless of the facility's size or needs, CHP has many potential benefits for manufacturers. Their ability to provide flexibility and power generation to facilities will make them better suited for the future as companies look to leave a small energy footprint.GT

MORE info

JOHNSON SPACE CENTER
www.nasa.gov

TATE & LYLE
www.tateandlyle.com

UNDERSTANDING CHP
www.understandingchp.com

Improving hot water heating efficiency at hotel resort

Tankless water heaters were used at the Pan Pacific Hotel in British Columbia to improve overall hot water heating efficiency and reduce maintenance needs.

THE PAN PACIFIC HOTEL IN WHISTLER, BRITISH COLUMBIA, CANADA, is a luxury ski resort designed to provide a comfortable environment for its guests in the snowy mountains. With everything from hot tubs, pools, fully equipped kitchens and more, keeping the hot water flowing is critical to maintaining the image of comfort for its guests.

When Pan Pacific's hot water efficiency systems started failing due to age, the management consulted with Rinnai on solving their current issue. They were looking for a product to enhance their customer offering. Rinnai specializes in tankless water heaters and recommended them for the project. Based on that recommendation, Pan Pacific installed two TRW03CUiN Rinnai three-rack tankless rack systems for the hotel.

Rob Peters, business development for Rinnai Canada, said the project was time-sensitive because the destination prides itself on luxury and comfort.

"Pan Pacific are an international brand who require first class service whistler is a premier destination where people expect lots of hot water combine those two things and the margin for error is minimal," Peters said.

MORE info

RINNAI CORPORATION
www.rinnai.com

PAN PACIFIC WHISTLER MOUNTAINSIDE RESORT
https://www.panpacific.com/en/hotels-and-resorts/pp-whistler-mountainside.html

Project results

Because of the nature of the hotel business, Rinnai had to install the tankless heaters while being as unobtrusive as possible. While repairs are normal, it could not come at the impact of the guests or cause any issues during their stay.

During the installation, new pumps were sourced to provide a better flow curve than the old system produced, cutting down on potential downtime. The facility was not designed for easy equipment replacement in the mechanical room and the rack system was able to be disassembled and reassembled allowing it to be moved through tight spaces on its way to the mechanical room. Tankless water heaters have a smaller footprint compared to their traditional counterparts, which provided additional flexibility during the installation process.

The installation was completed on time and has a 96% efficiency rating. The tankless water heaters have worked excellently without major issues or repairs. And if tankless unit were to go offline, there is ample redundancy with other units to keep hot water flowing.

Due to the installation's success, Pan Pacific has undertaken additional installations of a three-rack system at a neighboring hotel and Demand Duos tankless systems from Rinnai in two other lodges. Pan Pacific is happy with a system that has worked well for them to date in an environment that always demands efficiency to keep the image of comfort and safety that is a guiding principle for any hotel or resort. GT

Photos of the before (left) and after (right) of the installation process performed by Rinnai at the Pan Pacific Whistler Mountainside Resort in Whistler, British Columbia, Canada. Courtesy: Pan Pacific

Improving industrial equipment efficiency

Industrial equipment manufacturers (IEMs) build a specific type of industrial equipment repeatedly without much customization. Improvements can be challenging, but it can result in major savings and better efficiency for companies.

INDUSTRIAL EQUIPMENT MANUFACTURERS (IEMS) BUILD A SPECIFIC TYPE OF INDUSTRIAL EQUIPMENT REPEATEDLY WITHOUT MUCH CUSTOMIZATION, such as packaging machinery, metal and plastic forming equipment, testing machines, and other equipment managed by controllers. They are often designed once and do not require many modifications afterwards.

While this can be comforting to a manufacturer that does not require specialization, it can make improvements a challenge. In many cases, manufacturers or customers don't look at an IEM unless there's a problem. Why would they? They're designed to constantly run without a break and handle simple tasks.

If companies put in the time and effort, though, they can see a greater return on investment (ROI) from a financial standpoint and can prevent breakdowns and downtime that will have a lasting and negative impact on the bottom line.

Replacing catalytic oxidizers with regenerative thermal ones

Novolex is a packaging manufacturer that deals in paper, plastic and sustainable materials for the food, retail, health and industrial markets. They have 62 manufacturing facilities and administrative offices in North America and Europe, including two plastic recycling facilities and specialize in the food and beverage industry. They recently replaced two catalytic oxidizers with a regenerative thermal oxidizer (RTO).

An RTO works on the principle that the heat energy of the exhaust gases can be transferred to a solid media (in this case a ceramic material) and subsequently transferred to the incoming gases. In this way, the incoming gases and volatile organic compounds (VOCs) can be heated to full oxidation temperature while adding little energy.

The RTO is designed with a combustion chamber section, which operates at about 1500ºF, located between two heat storage sections. The exhaust gases from the combustion chamber travel through one of the heat storage sections at a time wherein they are cooled to about 170 to 230ºF. As the gases flow through the media the heat generated during combustion is transferred to the ceramic media. Then a valve system causes the gas flow to reverse so that the incoming fume stream will pass through the other heat storage section. In this way, the incoming fume stream will be heated to 95% of the combustion chamber temperature.

For the selected RTO technology, all energy savings are calculated as compared to the existing recuperative catalytic oxidizer (RCO) system for achieving the same destruction efficiency level for VOC reduction. While the new RTO will be nominally rated to handle 75,000 scfm of process air, the energy calcs are based on existing 71,226 scfm of flow. The annual therm savings of installed RTO vs baseline is projected to be 509,934 therms/year.

Improving production at an automotive plant

Nahanni Steel Products Inc. is an automotive parts manufacturer. At its Brampton, Ontario facility, conventional thermostats kept the plant at a constant temperature, resulting in energy waste during unoccupied times. Today, new smart temperature controls optimize energy use, provide fault detection, and improve zone temperature control, while providing greater visibility into how the plant uses energy. The project cost a little over $13,000 and is expected to achieve a payback of less than two years and reduce heating costs by 40%.

What prompted this project was an Enbridge Gas site visit that identified the energy conservation opportunity.

During the site inspection, the team spotted exhaust coming from a rooftop unit (RTU) during the summer. It turns out that a thermostat had been hit by a forklift and this damage was causing the RTU to fire during the off-season. The RTU would have continued to waste heat all summer had this gone unnoticed. If a smart system were in place, this anomaly would have triggered a fault notification, allowing for the issue to be resolved right away.

Saving money during unoccupied times

The new system provides greater visibility into the plant's heating consumption and adjusts start times automatically. "We now have clear data and 40% lower heating costs," said Sebastian Zupanec, general manager at Nahanni Steel. "If you can't see energy waste, you can't save it. This project has uncovered many opportunities for future energy savings."

Today, temperatures can be scheduled to be reduced during unoccupied times so that Nahanni Steel isn't paying to heat an empty space. Even better, the HVAC system can be controlled off-site using a smartphone.

"We had a conversation about deeper savings. [Zupanec] has a strong desire to understand the building better and reduce its energy consumption. We decided on a site visit," said Per Polderman, an Energy Solutions Advisor for Enbridge Gas. "Based on Nahanni Steel's operating schedule—the building is unoccupied 75% of the time—I suggested temperature setbacks during the unoccupied times." The greater the unoccupied times, the greater the potential for energy savings. Built-in logic optimizes the system based on how long it takes to heat the building. If a shift starts at 7 a.m. it will adjust to come on at 6:40 a.m. The system is also zone-controlled and scalable, should the company wish to automate lighting or ventilation later.

Financial incentives also influenced Zupanec's decision to proceed with the project. "They're always beneficial to our return on investment (ROI)," he said. "We could have waited, but the incentive allowed us to complete the project sooner."

The results of this project have also created a desire for Nahanni Steel to be smarter and more proactive. This is a constant for many companies who are realizing there is a wealth of information that can improve operations.

"While off-the-shelf big-box store thermostats can provide similar savings, they don't provide the data our customers desire. The data enables the customer to dig deeper," Polderman said. "Fault detection allows the customer to correct issues before they cause serious problems with continuity, energy waste and occupant comfort."

"The customer now has full remote control of HVAC equipment, which provides peace of mind and prevents people from changing parameters. Overall, smart technology helps with employee retention, continuity, energy conservation and future planning."

The project is also an investment in Nahanni Steel's personnel. "It's important for us to put systems in place that create better comfort for our staff," Zupanec said. "It's hard for any company to find and keep great people. It's an added benefit that we're saving money."

Industrial equipment manufacturers facing new normal

The demand and expectation to be efficient from a production and energy standpoint is the new normal. A good way to do this is improving IEM on the plant floor.

"Companies like Nahanni Steel supply larger manufacturers, who are starting to lean on their suppliers to reduce their scope 3 emissions and become more sustainable," Polderman said. "Nahanni Steel is required to report their emissions because it becomes part of the manufacturers' overall product footprint.

"Temperature setbacks during unoccupied times and ventilation optimization or filtration are the low-hanging fruits to reduce the amount of natural gas consumed by HVAC equipment."

Benefits of IEM improvements

When it comes to IEM, the new normal can be a challenge when dealing with old equipment that is prone to breaking down or is too embedded in operations to shut down. While it might be inconvenient, the alternative of constant and unexpected downtime is not acceptable anymore. As shown in the examples, taking the time to thoroughly examine what is and isn't working can improve operations and save a company more than money long-term. GT

Reducing building carbon emissions

Cities such as New York are forcing buildings to reduce CO_2 emissions, which has allowed some entrepreneurs to develop building decarbonization solutions to reduce emissions in a smart, efficient way.

FOR THE PAST SEVERAL YEARS, MANY COUNTRIES AND CITIES HAVE PUT FORTH A CONCERTED EFFORT TO REDUCE CARBON DIOXIDE (CO_2) EMISSIONS ANY WAY THEY CAN. This has come in the form of many initiatives such as better light bulbs, cleaner vehicles, cleaner factories and more. On their own, it might not seem like much, but the effort can result in a cleaner environment for people while creating a more sustainable environment.

Buildings are no stranger to the decarbonization initiative. While they might not produce the same level of toxic chemicals as, say, a factory might, they still emit a great deal of CO_2. Cities, in particular, are working to reduce their overall emissions. For many years, cities used tax breaks and incentives to encourage buildings to reduce CO_2 emissions.

While that has worked to a certain extent, the results have not been as strong as some cities would like. Now, cities such as New York are getting rid of the carrot and going with the stick. If buildings can't reduce their CO_2 emissions, they will be taxed.

Local Law 97, enacted by New York City, says most buildings over 25,000-sq-ft will be required to meet new energy efficiency and greenhouse gas emissions limits by 2024, with stricter limits coming into effect in 2030 and 2035. The law's goal is to reduce emissions 40% by 2030 and 80% by 2050. Other cities such as Philadelphia, Chicago, Boston and more are following suit.

Reducing carbon footprints

On paper, reducing a building's CO_2 emissions might seem like an easy thing to do, but it's not quite that simple. More than 70% of buildings in New York City use natural gas, which emits plenty of CO_2, according to Shane Johnson, CEO of CarbonQuest. Making the shift isn't simple and requires a more concentrated effort, which is where CarbonQuest is hoping to make their mark.

CarbonQuest, which was created in 2019 by a group of entrepreneurs at the intersection of energy, decarbonization and buildings. Based in the Pacific Northwest and New York City, the company is focused on providing urban building owners advanced technologies and solutions that enable acceleration of global carbon reduction.

While CarbonQuest itself is new, the team has collectively built several technology firms in the renewable energy, telecommunications and financial technology industries. The new challenge – reducing CO_2 emissions in buildings – is a tall order, but Johnson said they're ready and eager to tackle it head-on by capturing carbon in buildings.

Building carbon capture system

Carbon Capture, Utilization and Storage (CCUS) refers to a range of technologies that capture CO_2 emissions and utilize the CO_2 in circular carbon economy applications that store the CO_2 in high permanence applications so the CO_2 doesn't enter the atmosphere. While not a new concept, CarbonQuest has developed a distributed on-site CCUS they call Building Carbon Capture and StorageTM (BCCSTM).

Johnson outlined the system as a four-step process:

- The CO_2, along with the nitrogen, water vapor and oxygen, are diverted into a system that condenses out and removes the water vapor. Separation and purification. The oxygen and nitrogen are separated from the CO_2 and sent up the building's flue and chimney while the CO_2 is sent along to be liquefied.

- CO_2 liquefaction. The CO_2 gas is compressed and cooled to convert it to a liquid they call SustainableCO_2.

FIGURE 1: CarbonQuest has developed a distributed on-site CCUS they call Building Carbon Capture and Storage™ (BCCS™)to capture carbon dioxide (CO_2) emissions. Courtesy: CarbonQuest

FIGURE 2: CarbonQuest installed their CCUS in a 377,000-sq-ft multi-family unit in Manhattan with a goal to reduce CO_2 emissions by 25% and provide a 5-year return on investment (ROI). Courtesy: CarbonQuest

- Storage and transfer. The liquid CO_2 is stored in a tank system where it can be sold and transferred to a utilization off-tanker when the tank is full.

CarbonQuest's Carbon intelligent software autonomously manages the operations of the system ensuring continuous and safe operations of the system. Their Carbon Management SystemTM (CMSTM) provides their customers and their network operations a real time view into the systems operations and performance. As a part of the process, they manage the entire offtake process, including the sales and tracking of the SustainableCO_2.

Johnson said, "As a starting point, we've targeted the concrete manufacturing industry in the mixing and curing process for our SustainableCO_2 offtake partners where they use less cement in the process. By mixing the CO_2 with the cement, its permanently sequestered in the concrete products where they are sold as sustainable products back into the construction industry, completing the local circular carbon economy."

There are many other ways CO_2 can be utilized. Johnson mentioned utility companies using captured CO_2 for wastewater treatment facilities rather than carbonic acid, which is what the facilities typically use. CO_2 is less toxic and cleaner and it comes at a lower cost to the utility.

"We very much believe in carbon to value," Johnson said. "There is a growing carbon tech market out there and one of the big questions is how we will use all the CO_2. If we all believe the problem is as significant as it is, continuing to innovate in a multi-technology approach is how we're gonna get there."

From the customer's viewpoint, Johnson said it was important the project's installation have a small footprint, which serves as a nice parallel to the company's goal.

"It's hard to reduce on-site emissions," Johnson said. "For us, we're relying on the overall infrastructure. We take pride in not being very disruptive to their operations. We can locate systems in garages, on rooftops and setbacks or wherever space is available in or adjacent of the building."

Johnson described a 377,000-sq-ft multi-family building in Manhattan and how their Building Carbon Capture System takes up only 600 sq ft, which is a drop in the bucket by comparison. The goal for the multi-family project, Johnson said, is to reduce emissions by 25% so the owners wouldn't be hit by the carbon taxes and provide a 5-year return on investment (ROI).

"We're trying to make a scalable platform that links into the building," Johnson said. Not only is minimizing the system size critical to being able to apply the technology, but modularity and flexibility of the design is also crucial as it allows us to place our standardized modules very flexibly within available building space. We offer a range of product sizes that allows us to cover the broad set of building sizes and meet a wide range of carbon reduction goals."

The system itself, in addition to being small, is also designed to be smart. "We couple our Building Carbon Capture System hardware with intelligent software to continuously optimize the system operations," Johnson said. "The carbon capture control system makes all the hardware pieces interact as efficiently and effectively as possible to get the best results. Each building receives a Carbon Gateway that interfaces between the site system and our cloud Carbon Management System which measures and reports each building and the customer's combined building portfolio carbon performance over the life of the system operations.

The multi-family unit in Manhattan is one of more than 50,000 buildings in New York City that are subject to LL97 and need to reduce their CO_2 emissions. More than 80% are multi-family with commercial, hotels and manufacturing making up the rest of the pie.

For many of these facilities, Johnson said it's about doing something now. "Why wait for a 100% green grid when we can dramatically reduce emissions now? 95% of the buildings that exist today will be standing 50 years from now. When these buildings and the surrounding utility infrastructure were built from ground up to use natural gas, it's very challenging and costly to convert them to electricity. These buildings need an alternative to decarbonize now. And we're seeing a significant interest our approach."

Conclusion

Johnson believes CarbonQuest's work can serve as a model for an industry he believes is ready to explode. While it's early days yet, Johnson believes there is a great deal of potential for the future of the industry and its long-term potential.

"We have to go from 1 project a month, to one a week, to one a day and then 10 a day to make a significant difference. If we did 10 day that would only be 2500 systems or 5% of NYC buildings," Asparro said. "We have to continue to innovate and drive costs down and performance and efficiency up on our journey to opening up scale global market applications. We need to continue to educate, create awareness and influence policy to maximize our mission potential. We are one of many innovative companies seeking to make a significant contribution to decarbonization and looking for customers and partners who want to join us on our quest for decarbonization." **GT**

MORE info

CARBON QUEST
www.carbonquest.com

LOCAL LAW 97
https://www1.nyc.gov/site/sustainablebuildings/ll97/local-law-97.page

VIDEO PRESENTATION FROM ESC CONFERENCE
https://www.youtube.com/watch?v=kh7mhA3Yt-o

Improving the efficiency of steam traps

A look at how a facility in suburban Chicago improved energy efficiency and reduced natural gas costs by identifying potential energy and money savings.

INTERNATIONAL-MATEX TANK TERMINALS (IMTT) IS AN INDUSTRY LEADER IN THE HANDLING AND STORAGE OF BULK LIQUID PRODUCTS. Founded in 1939, the company has largely been a family-driven enterprise and, after a series of acquisitions in the early 21st Century, were acquired in November 2020 for $2.65 billion by Riverstone Holdings LLC.

Headquartered in New Orleans, the company owns and operates 19 terminals in the United States and Eastern Canada with an emphasis on terminals that handle petroleum, biofuels, commodity/specialty chemicals and more for customers including refiners, commodities traders, and chemical manufacturers and distributers. The company continues to look for ways to improve their production and operations.

Their Lemont, Ill., facility, located in about 30 miles Southwest of Chicago, is a high-production facility involved in blending and packaging antifreeze to storing petroleum products.

In 2019, Matt Burbach, terminal manager at IMTT, identified some major operational efficiency improvements that could save money in the long term. He was able to identify key natural gas-saving opportunities. Working with a Nicor Gas-approved contractor, Burbach learned the Nicor Gas Energy Efficiency Program had offerings that could benefit the facility. The program team partnered with Burbach and the contractor to provide support, working toward IMTT Lemont's goals to be more sustainable, conserve energy and save money.

As steam lines cool slightly, they build condensation, which is supposed to be removed by steam traps. The hottest steam is dry steam, and it is important to remove as much condensation as possible to make the heating process more efficient. Burbach noted the facility was using a lot of steam during the heating process. However, looking around the facility, there were many steam traps that were not working properly.

Burbach, along with the Nicor Gas Energy Efficiency Program team, identified and replaced 147 steam traps, which was almost half of the traps within the facility. Not only was IMTT able to improve its heating operations, they are saving around $300,000 a year in natural gas costs and annual energy savings of 660,000 therms.

How IMTT created a successful plan

Burbach knew being able to provide a solid case for investing company resources into energy efficiency upgrades would be important and presenting the Nicor Gas incentives was key to obtaining project approval.

"You have to do the legwork and provide them with savings opportunities they can validate," Burbach said. "I let them know Nicor Gas was helping us improve our bottom line. We spent the money that we needed to spend and got paid back in the end."

The program team and the contractor worked together to calculate and verify potential energy and money savings. Nicor Gas provided $43,000 in incentives for the project.

Improving energy efficiency

IMTT applied steam traps to its ac fault system and found another efficiency opportunity in its calcium chloride system. Calcium chloride – salt water – can be burnt. The pipelines that run in between tanks to production areas were steam traced. It was an open, 120-lb. steam which is about 370°F. The product, however, had a burn point of 235°F. By regulating the supply down to five pounds and 230°F, they would not reach a point that would burn the products. This allowed IMTT to trap the trace and eliminate the open atmosphere venting of their energy.

Burbach noted the ease of the process has led their team to explore three custom projects. They are looking at installing insulation jackets on exposed valves in the boiler house. In addition, they also will be installing economizers on a 400-HP and 600-HP boiler.

IMTT also is looking into pipe insulation and other potential energy-saving projects, as well.

"If we're able to reduce and improve our cost, it helps everyone in the long run," Burbach said. "It contributes to reducing the entire supply chain and the bills of our end users. These programs help us do our part to positively impact the big picture. From easing global warming to reducing our carbon footprint, we're in it to try to do what's right for our environment." **GT**

MORE info

INTERNATIONAL-MATEX TANK TERMINALS (IMTT)
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