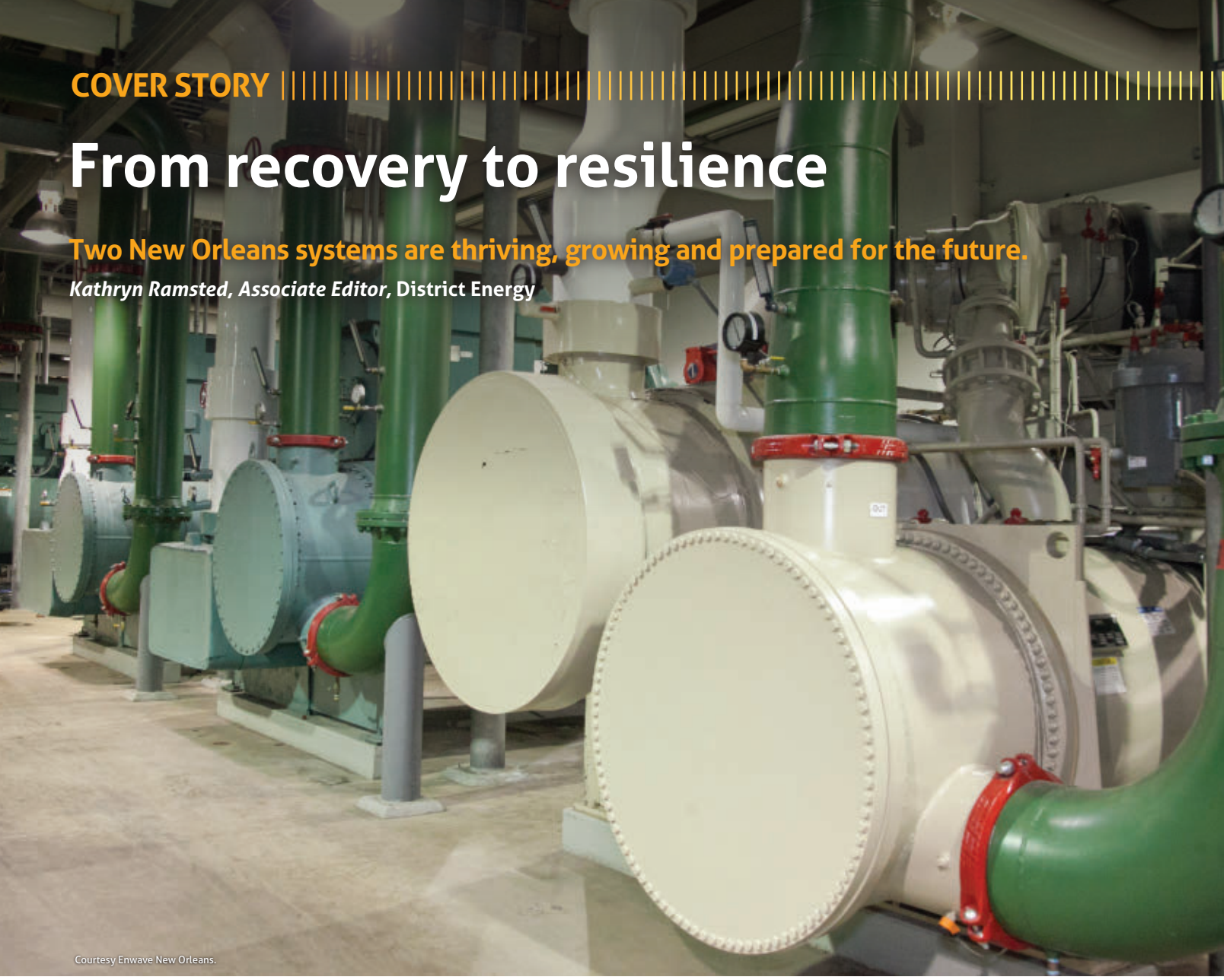
From recovery to resilience

Two New Orleans systems are thriving, growing and prepared for the future.

Kathryn Ramsted, Associate Editor, District Energy



Enwave New Orleans' chiller plant.

Editor's note: *IDEA's CampusEnergy2019 conference takes place Feb. 26-March 1 in New Orleans, La. Here* District Energy *profiles two systems in our host city: Enwave New Orleans and Tulane University.*

In 2018, New Orleans, La., marked the 300th anniversary of its founding. A year of events honored the city's rich history and culture and celebrated its resilience. New Orleans' response to 2005's Hurricane Katrina is recognized as a shining example of that resilience, in the wake of a storm that was one of the deadliest and costliest in U.S. history. In the words of former Mayor Mitchell Landrieu, the city has not only come back from that disaster but is rebuilding "better and stronger than before."[1] Guided by its 2015 resiliency plan, New Orleans continues taking action to shape its future for coming generations.

Two district energy networks in the city, along with the buildings they serve, endured the wrath of Katrina. Enwave New Orleans and the system on Tulane University's uptown campus have, like their city, moved from recovery to resilience. They are looking ahead – thriving, growing and ready for tomorrow.

ENWAVE NEW ORLEANS

For nearly 20 years, Enwave New Orleans has been providing thermal energy to mission-critical hospitals and health care facilities in the city's BioDistrict medical corridor. The company's first customers were five medical complexes supplied with chilled-water service from Enwave's district cooling plant and steam from a plant the company leased from Louisiana State University (LSU) Health. Today Enwave serves customers not only in the BioDistrict but also in the adjacent central business district. The company is a subsidiary of Brookfield Asset Management.

Enwave's district cooling plant, housed beneath a 600-car parking garage at the corner of Gravier and Claiborne, is capable of providing up to 32,000 tons of cooling capacity at full buildout, including 52,000 ton-hr of ice thermal storage. It is currently connected to 31 customer buildings representing 5.6 million sq ft of space. This system has been operating with 99.99 percent reliability since it began service in 2000.

About a quarter-mile away is Enwave New Orleans' new steam plant, opened in 2014. Its three 70,000-lb/hr natural gas-fired boilers produce steam for distribution to 22 buildings totaling 4.1 million sq ft for space heating, domestic hot water, laundry and sterilization use. The company constructed the $28 million facility to replace the leased plant after Hurricane Katrina.

SURVIVING KATRINA

When Katrina hit, Enwave's chiller plant survived the high winds, storm surge and levee breaches intact. It had been designed to withstand extreme storms above the 500-year flood plan. The building and rooftop cooling towers had been hardened, and 8 MW of backup generation was in place to keep the plant running for several days off the grid. That turned out to be unnecessary, however, as all 11 of Enwave's customers at the time – all in the BioDistrict – were under water in the disastrous flooding that submerged 80 percent of the city.


Courtesy Enwave New Orleans.

The reverse osmosis system and piping at Enwave New Orleans' steam plant.


Courtesy Enwave New Orleans.

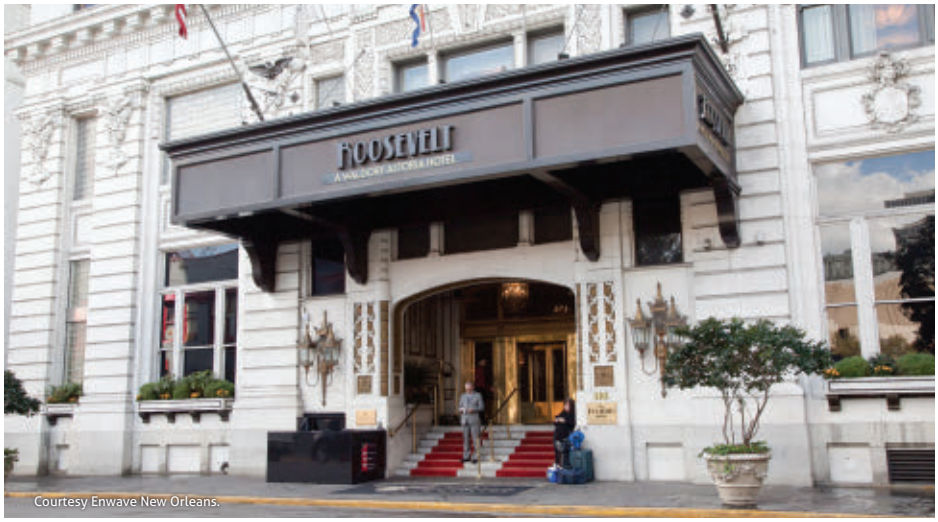
The $1.1 billion University Medical Center New Orleans, a Level 1 trauma hospital and Enwave customer, opened Aug. 1, 2015.

While the chiller plant had fared well in the storm, the old LSU steam plant was rendered inoperable for several weeks. It had been built at grade with critical equipment on the ground level, vulnerable to flooding. After Katrina, Enwave reinvested in the plant, replacing boilers and pumps to get it up and running again. An opportunity to build a modern, resilient new boiler plant soon presented itself, however.

A key Enwave customer building, Charity Hospital, never recovered from the hurricane (and stands abandoned to this day). Its owner, LSU Health, was moving ahead with plans to replace it with a new $1.1 billion Level 1 trauma hospital: the University Medical Center New Orleans. To serve this facility, Enwave

KEY ENWAVE NEW ORLEANS CUSTOMERS INCLUDE:

- LSU Health Sciences Center
- University Medical Center New Orleans
- Tulane University Health Sciences Campus
- City of New Orleans
- Louisiana Cancer Research Center
- Delgado Community College School of Nursing
- The Roosevelt, A Waldorf Astoria Hotel
- The Troubadour Hotel
- The Orpheum Theater
- The Pythian Apartments
- St. Joseph's Church



Courtesy Enwave New Orleans.

The Roosevelt, A Waldorf Astoria Hotel, was Enwave's first customer in the city's central business district.

agreed to build a new storm-hardened boiler plant that could reliably deliver steam service to the medical center for up to seven days in the event of electric, natural gas or water utility failures.

The new steam plant was designed to withstand flooding and 150 mph Category 5 hurricane winds. It contains N+1 redundancy on all steam-generating equipment and increased storage of water (150,000 gal) and fuel oil (40,000 gal). All essential equipment – boilers, feedwater pumps, water softener system – is positioned 20 ft above sea level on the second floor; the control room is on the third. The plant also has a bunk room for system operators should they need to overnight at the plant in an emergency. (For steam plant details, see "Never Again: New Orleans system ready for the next Katrina" in Third Quarter 2015 *District Energy*.)

EXTENDING DISTRIBUTION

The steam plant was not Enwave New Orleans' only new development. One byproduct of the storm was extension of the company's heating and cooling services beyond the BioDistrict, into New Orleans' central business district. This came about when owners of the flood-damaged Fairmont Hotel were renovating their property as The Roosevelt, A Waldorf Astoria Hotel. They wanted to put a five-star spa where the cooling equipment was located and contacted Enwave in search of a solution. The company offered to extend chilled-water distribution to the hotel, not only freeing up space for the spa but also eliminating rooftop cooling towers to make room for a pool.

Since the connection of this first downtown customer, others have followed. Like The Roosevelt, a number have been motivated by the ability to convert cooling equipment space into profit centers instead: The Troubadour Hotel now features the Monkey Board bar and eatery on its rooftop; and the Orpheum Theater and Pythian Apartments have added a bar and artisanal food market, respectively, where chillers once stood.

ONGOING RELIABILITY IMPROVEMENTS

Enwave has made numerous other post-Katrina improvements as well. To ensure delivery of reliable service in future disasters to its Level 1 trauma center customer and others, the company conducted an analysis of all risk points in its systems. One such point was the loss of water pressure from the local utility at the cooling plant during the hurricane, which made it difficult to get water to the cooling towers up on the sixth floor. The company has since put in its own well, drawing water from an aquifer 720 ft below the plant

System snapshot: Enwave New Orleans

	Steam system	Chilled-water system
Startup year	2000 – Enwave system established (leasing LSU plant) 2014 – New steam plant built	2000
Number of buildings served	22	31
Total square footage served	4.1 million sq ft	5.6 million sq ft
Plant capacity	210,000 lb/hr steam, 450 kW emergency diesel generator	32,000 tons chilled water including 52,000 ton-hr ice thermal storage, 8 MW backup electric generation
Number of boilers/chillers	3 boilers	11 chillers
Fuel types	Natural gas/diesel	Electricity
Distribution network length	1.4 miles	1.8 miles
Piping type	Direct-buried steel, direct-buried preinsulated steel, steel in above-ground walkway	Direct-buried epoxy-coated steel, direct-buried preinsulated steel, preinsulated ductile iron, high-density polyethylene
Piping diameter range	To 16 inches	To 30 inches
System pressure	175 psig	75 psig
System temperatures	377 F supply, 180 F condensate return	36 F supply/54 F return

Source: Enwave New Orleans.

and precluding future issues with utility pressure problems.

In 2016, Enwave installed the largest reverse osmosis (RO) system in the city at its cooling plant. The system filters the brackish well water, with its salt and other impurities, and sends it on to a holding tank for use in the cooling towers. In 2017, the company extended piping from this well-RO system down the street to its boiler plant to better secure the reliability of the water supply there too. Also at the cooling plant, another two external diesel storage tanks have been added for fueling the backup generator, bringing total storage capacity to 104,000 gal. This helps ensure continuity of service to the University Medical Center, and other customers, for seven days (up from five) in the event of a utility failure.

Enwave has also made some important cultural and operational changes to prepare for potential future disasters, natural or manmade. The company has developed its most comprehensive emergency plans yet, with multiple levels of contingency – and measures added based on hard-won experience gained from living through Katrina. This includes, for example, yearly tabletop drills with customers, equipping all employees and customers with two-way radios (with shared frequencies) and identifying the employees who own boats in case they need to be called upon to transport people or fuel to the plants.

Whether for times of crisis or everyday operations, the company is continually working to improve system performance. One current focus is the automation of plant maintenance records and log readings – creating a cloud-based system that is instantaneously accessible by employees and customers so any issues can be quickly spotted and addressed. At the chiller plant, a bleach-injection system was recently installed to prevent biological contamination in the piping and cooling towers, enhancing equipment reliability.

Improvements are always made with Enwave's customers in mind and in continual, close collaboration with them. Given the critical work they do – in cancer research labs and Level 1 trauma patient care, for example – failure of any energy systems, no matter how brief, is never acceptable. To help system operators see firsthand the critical nature of their work, many have toured the medical facilities they serve.

Enwave New Orleans has been able to share its emergency-preparedness and storm planning experience with its sister plants, including Enwave Houston. In turn, it too benefits from the depth of expertise found across Enwave's portfolio of nine North American district energy systems.

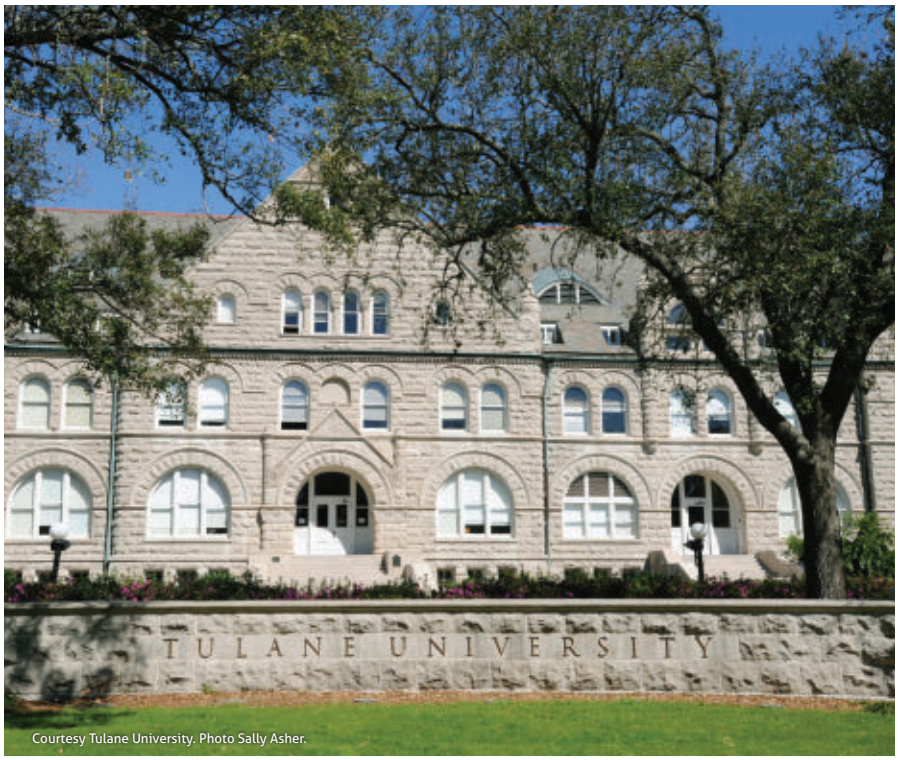
Looking ahead, the New Orleans system is seeking opportunities to expand its network in the central business district, which will depend on the city's plans to redevelop blighted buildings in the area. In the meantime, the company will continue to provide thermal energy with exceptional reliability to its mission-critical medical corridor and downtown customers.

TULANE UNIVERSITY

Tulane University, established in 1834, is one of the country's leading research universities with a total student body of around 14,000. The institution is New Orleans' largest private employer. Its health sciences campus, an acclaimed teaching, research and medical complex located downtown, is an Enwave heating and cooling customer. The university's main location, its 110-acre uptown campus across from Audubon Park, is served by Tulane's own central heating and cooling systems.

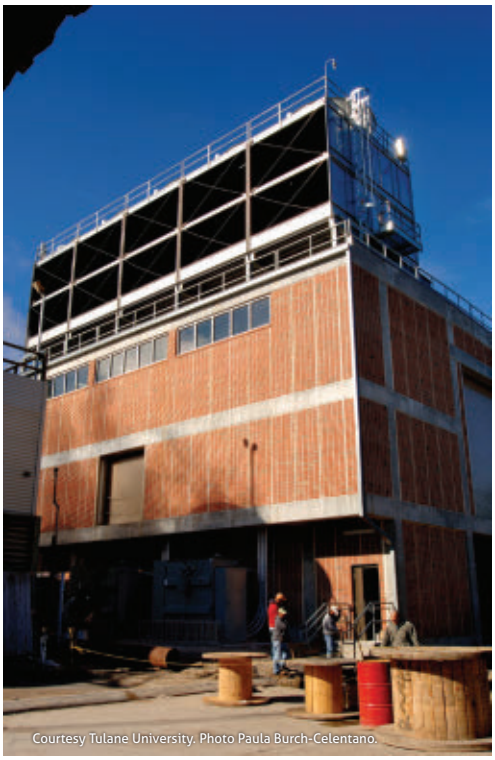
Dotted by large, mature oak trees, the picturesque uptown campus has been supplied with steam since 1929 when the original power plant was built. Campus chilled-water service was added in 1957. The central plant and its three satellites now produce up to 156,500 lb/hr of steam and 19,550 tons of chilled water. The facility also cogenerates 5 MW of electricity for campus use, meeting around one-third of total campus power demand. Seventy-two buildings account-

Tulane's 110-acre uptown campus is known for its majestic oak trees. The university has formal tree policies and procedures for monitoring their care and keeping.



Courtesy Tulane University. Photo Sally Asher.

Built in 1894, Tulane's landmark Gibson Hall is the oldest building on the uptown campus. It currently houses university administration and undergraduate admissions.


Courtesy Tulane University. Photo Paula Burch-Celentano.

Tulane University's expanded central plant opened in 2007.

ing for 4.7 million sq ft are connected to the uptown heating and cooling distribution networks.

In the days preceding Aug. 29, 2005, when Hurricane Katrina struck New Orleans, Tulane students had been moving into their residence halls for the new school year. But soon all were evacuated in anticipation of the storm slamming the Gulf Coast. Initially, Katrina's impact on the university's main uptown campus seemed minimal, with some buildings damaged, trees down and some roofing tiles missing. Tulane President Scott Cowen at that point figured the university could likely reopen within a couple of weeks; but then the levees gave way, and both the uptown and downtown campuses were inundated with floodwaters.[2] The school ultimately reported more than $650 million in total damages and losses.[3]

With the levee breaches, Tulane's central plant took in around 12-18 inches of water. Built 1.5-2.5 ft above street level, it is not typically prone to flooding from heavy New Orleans rains. Equipment on the ground floor of the plant, raised on pads, was spared from damage – except for the switchgear supplying power to the plant as well as other electrical equipment used in cogenera-

System snapshot: Tulane University

	Steam/combined heat and power system	Chilled-water system
Startup year	1929	1957
Number of buildings served	72	72
Total square footage served	4,725,948 sq ft	4,725,948 sq ft
Plant capacity	Central plant: 102,500 lb/hr steam, 5 MW electricity Satellite plants (3): 54,000 lb/hr steam	Central plant: 11,850 tons chilled water Satellite plants (3): 7,700 tons chilled water
Number of boilers/chillers	2 boilers, 1 heat recovery steam generator	5 chillers
Fuel types	Natural gas	Steam, electric
Distribution network length	7.8 miles	3.9 miles
Piping type	Direct-buried, insulated carbon steel	Direct-buried, insulated carbon steel
Piping diameter range	2 to 36 inches	1 to 24 inches
System pressure	150 psig	120 psig
System temperatures	365 F supply, 160 F condensate return	42 F supply/58 F return

Source: Tulane University.

tion. Water eventually got to the electrical equipment, raised 4 inches off the floor, but not before power to it was turned off. The plant would be without electricity for around three months, brought back up in December.

President Cowen proved to be a dynamic force in getting the institution up and running just five months later in time for spring semester. Restoring and upgrading campus energy systems was a critical part of making that happen. Prior to Katrina, a study done with Johnson Controls had shown that the central plant would need to expand in order to serve the future cooling and heating demands of the growing university.[4] New construction projects were already planned for the uptown campus – including the Wall Residential College freshman honors community and the Lavin-Bernick Center for University Life, a hub for student organizations with dining options, a bookstore and other student resources.

To accommodate this and future growth in the aftermath of Katrina, Tulane's central plant was expanded by 8,000 sq ft and outfitted with a new 4,500-ton chiller that was 20 percent to 30 percent more efficient than the facility's existing four chillers. Electrical equipment was raised to the second floor to prevent problems with any future flooding. (Johnson Controls also worked with Tulane on campus restoration, energy conservation and these energy system expansion/improvement projects.)

Opened in December 2007, Tulane's central plant expansion was built above grade and storm-hardened to withstand Category 5 hurricane force. It contains a new operational command center for use in future emergencies and a small warehouse facility for shipping and receiving added on the first floor. Other improvements made as part of the project include replacement of malfunctioning steam traps; repair of insulation in segments of the steam distribution piping; and the campuswide optimization of building heating and cooling systems (including converting chilled-water systems to variable flow).

While much of the construction at Tulane following Katrina has focused on renovating flood-damaged facilities, the growth of the uptown campus has continued with numerous new building projects. Among those more recently completed – and served by campus heating and cooling systems – are Weatherhead Hall (a dorm on which construction was originally to have started the very day Katrina came ashore); the Greenbaum House residence hall; Yulman Stadium, the new home of Green Wave football; Mussafer Hall; and the Goldring/Woldenberg Complex. Set to open in 2019 is The Commons, a new $55 million 77,000-sq-ft dining hall and commons space.

"CROSS INTO THE POSSIBILITIES OF THE FUTURE"

In the wake of Hurricane Katrina, Enwave New Orleans and Tulane University moved quickly to recover and, where necessary, rebuild their district energy systems. Not stopping there, these systems have gone on to make further improvements and connect major new buildings to their networks. Both are more prepared than ever to face future emergencies.

The same can be said of the city of New Orleans. In the 13-plus years since Katrina, it has faced new challenges – among them, the BP oil spill, rising sea levels and coastal erosion.

But as the city's resiliency plan resolutely states, New Orleans "must move beyond the devastation of the past and cross into the possibilities of the future."[5] With the historic commitment of the city and its residents, New Orleans is already well on its way.

Author's note: District Energy *wishes to thank Steve Martins, Enwave New Orleans; Adolfo Girau, Tulane University; and their colleagues; for their contributions to this article.*

End notes

1 City of New Orleans, "Resilient New Orleans: Strategic actions to shape our future city" (https://tinyurl.com/yav2h9z4).

2 Tulane University, "The Aftermath of Hurricane Katrina Memorial Website" (https://tinyurl.com/yde6mp65).

3 Tulane University, "Remembering Katrina 10 Years Later" (https://tinyurl.com/y9gg5owl).

4 Johnson Controls, *Case Study: Tulane University, New Orleans, Louisiana* (https://tinyurl.com/y9mj9ty2).

5 City of New Orleans, "Resilient New Orleans," p. 5 (https://tinyurl.com/yav2h9z4).