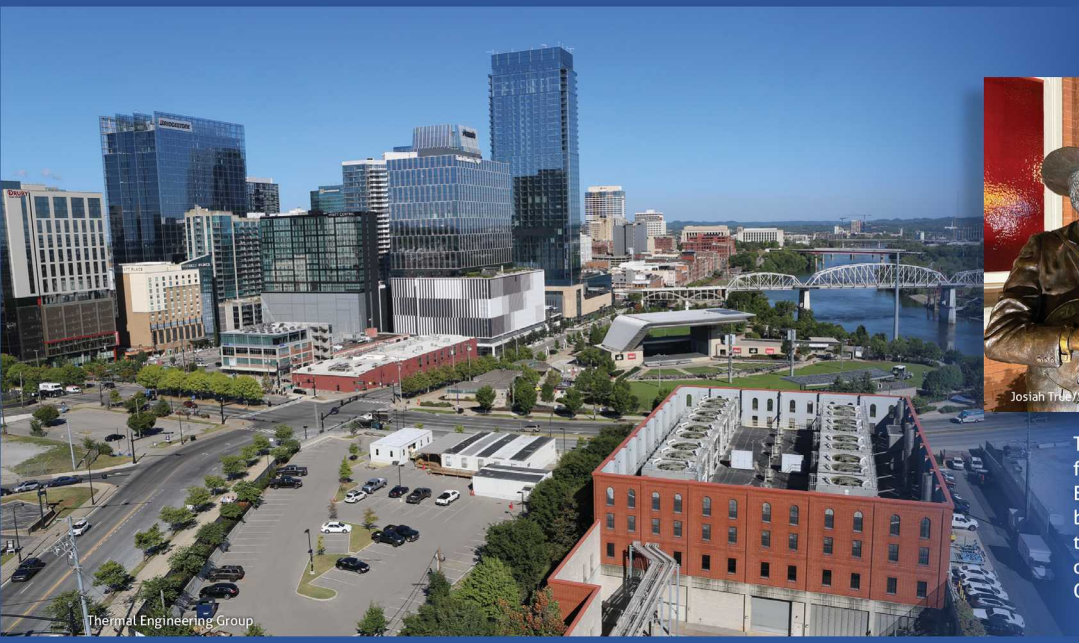
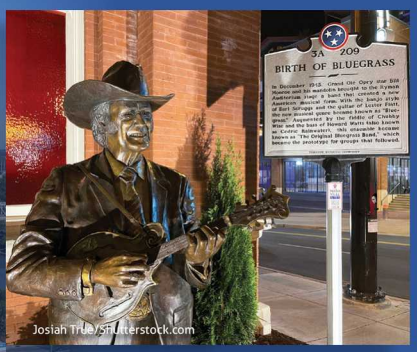
# Reinvention and revitalization in Music City, USA

## Metro Nashville District Energy System is helping sustain a long-running development boom

*By Brent Israelsen*




The view toward downtown, left, from the Metro Nashville District Energy System plant, whose client base is growing and which counts the historic Ryman Auditorium, original home of the Grand Ole Opry, among its legacy customers.

Along the west bank of the Cumberland River, in an inviting open space called "The Green," visitors and locals alike enjoy a quiet stroll past public art, neat landscaping and a new 6,800-seat amphitheater. Nearby, in sparkling new hotels and renovated buildings, they sip lattes and wine while perusing menus offering fare from around the globe.

The 10-acre scene was much different a couple of decades ago. The Green could have been called "The Grey," thanks to a waste incinerator that generated significant noise, debris and ash. And the nearby restaurants, shops and upscale lodging did not exist in what was then a somewhat blighted area just a short walk from Broadway, Nashville's famed "Honky Tonk Highway."

In both the then and now scenes, district energy has played first fiddle.

In 1972, Nashville became one of the first cities in the U.S. to build a cutting-edge waste-to-energy facility after a forward-leaning mayor, Beverly Briley, toured one in Europe. For the next 30 years, the Nashville Thermal Transfer Corporation's plant took in municipal waste, one garbage truck at a time, and converted it to energy to heat and cool nearly three dozen downtown buildings, including the Ryman Auditorium, original home of the Grand Ole Opry.

Despite producing energy, disposing of waste and helping to grow district energy in the city, the incinerator had its detractions, chief among them its location, which had made sense at the time but not as the downtown area modernized and expanded.

"Thermal killed our property values," said Michael W. Hayes, president of C.B. Ragland Company, a longtime landowner in Nashville. Today, C.B. Ragland is riding the wave of a development boom in the city that owes much of its success to a district energy system that has reinvented itself.

### FROM THE ASHES, MODERNIZATION AND EXPANSION

The old thermal transfer plant – already under fire for environmental, noise and traffic concerns – suffered a devastating blow in 2002 when a fire halted operations. By then, however, the city – officially known as the Metropolitan Government of Nashville and Davidson County, or "Metro" – was already moving to replace the incinerator with natural-gas fired boilers. The conflagration accelerated the transition, and Thermal's giant iconic red-striped stack came tumbling down.

In the plant's place, on a hill just two blocks to the south but a world away from


Gary Layda

Thermal Engineering Group

MNDES customers include the Schermerhorn Symphony Center and Nissan Stadium, home of the NFL's Tennessee Titans.

the prime real estate of SoBro (South of Broadway), rose a new energy generation plant and the headquarters of the newly minted Metro Nashville District Energy System (MNDES), which was built by Constellation Energy.

MNDES – managed through Metro Water Services but operated by Constellation, with administration and technical support provided by Thermal Engineering Group – steadily became an important player in the city's burgeoning development. Concurrent with construction of the new energy plant and continuing into its first few years of operations, MNDES concentrated on quickly upgrading infrastructure by:

- Replacing 600 feet of piping from the plant to the major piping tunnel at Broadway;
- Installing 26 chilled water division valves, replacing seven steam valves and adding three additional steam valves in order to isolate sections of the energy distribution system so repairs would be less disruptive;
- Replacing all fiberglass condensate lines with insulated carbon steel;
- Rehabilitating tunnels and problematic manholes;

## Vanderbilt pushes the net-zero envelope

Vanderbilt University is set to become carbon neutral this year after embarking on an aggressive array of initiatives, one of which was a decision to expand and fine-tune its district energy system.

Currently providing electricity, steam, hot water and chilled water to 14.5 million square feet of building space, the system is expected to grow another 1 million square feet over the next five or six years, said Randy Hurt, chief engineer for Vanderbilt, which is located about a mile from downtown Nashville.

Vanderbilt, Hurt said, decided to "stay the course" with district energy two years ago as it contemplated major capital projects that, so far, total at least $600 million.

A sizeable chunk of the capital will go toward district energy, mainly in adding chilling capacity, connecting new buildings, retrofitting existing buildings, expanding the hot water system from 5% of heating to 40%, and interconnecting the 14 separate chiller plants around campus, a move that will result in fewer chillers as well as an opportunity to improve efficiencies. The system's main cogeneration plant, which dates back 135 years, was converted from coal to natural gas in 2014. It has three turbines and three recovery steam generators, though one turbine is currently offline.

The cogeneration plant provides 20% of the campus's electricity, 90% of its heating and 100% of its steam needs, including those of Vanderbilt University Medical Center, the largest hospital in Tennessee.

After adding 17 buildings and 947,000 square feet to its system a few years ago, the university earned IDEA's District Energy Space Award in 2020.

In the coming years, its capital plans call for new residential towers, additional academic buildings, an enlarged football stadium and a new basketball training facility – all of which will be added to the district energy system.

- Replacing customer meters to improve billing accuracy and efficiency.

By 2010, MNDES – which in 2006 won IDEA's System of the Year Award – had added a few existing government buildings, while many private developers, still mindful of Thermal's history, took a wait-and-see approach. Among the exceptions was the new Schermerhorn Symphony Center, a world-class performance venue that chose district energy to minimize HVAC noise and for the ability to better control humidity and temperature levels to protect musical instruments. Viridian, a new high-rise luxury apartment tower, also hooked up.

## RAPID GROWTH, MISSED OPPORTUNITIES

Growth has continued to this day, with MNDES expanding its service by 21% in the past decade and now providing service to nearly 11 million square feet of space in 41 buildings downtown. Customers added to the system since 2013 include the Music City Center, a 2.1 million square foot convention facility; the Hyatt Place hotel; and, most recently, the Hyatt Centric hotel.

With sports arenas, music venues, office and residential towers, a place of worship, retail space and government buildings, the MNDES portfolio is as varied as that of any major district energy in North America.

Besides the Ryman, notable legacy customers include Metro, whose library and criminal justice center are on the system; the state of Tennessee, whose Capitol is among a dozen state buildings served; the Wildhorse Saloon, a 68,000 square foot dance hall and concert venue; the Renaissance Nashville hotel; St. Mary of the Seven Sorrows, downtown's oldest extant church; the 19,000-seat Bridgestone Arena, where the Nashville Predators of the National Hockey League play; and the 68,000-seat Nissan Stadium, home to the NFL's Tennessee Titans and the only facility MNDES serves on the east bank of the Cumberland.

"Nashville's district energy system is like the city of Nashville itself, realizing its greatest potential because of the diversity of those it serves," said Dan Coyle, who is president of Thermal Engineering Group and has been associated with the system since 1977.

**'WE'RE NOW SEEING AN INFLECTION POINT IN GROWTH, TECHNOLOGY AND GREENHOUSE GAS CONCERNS.'**

For all the success, though, Coyle and some Metro officials can't help but lament the ones that got away – potential customers lost in a recent building frenzy so rapid that the official travel bureau has trouble keeping its tourist maps updated.

"Our challenge has been keeping up and coordinating all the new construction that's underway," Coyle said. "Development happened so fast, we missed some opportunities."

For example, the Four Seasons Nashville, which just opened in SoBro, had already purchased all its HVAC equipment when its architects realized it could have hooked up to district energy, Coyle said.

## AN 'OPT-OUT' CHECKBOX FOR DISTRICT ENERGY

To keep up with development, Metro – which nearly divested itself of district

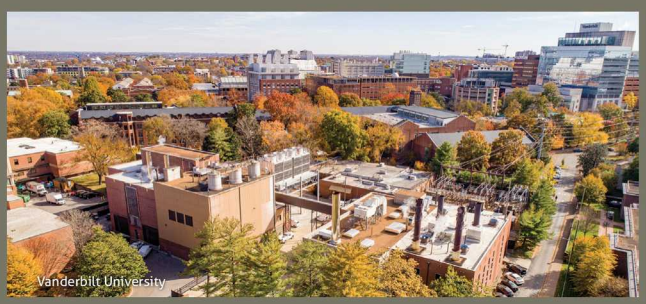
As plans for the new structures were presented, some architects proposed making each building independently net-zero by attaching solar panels. But the university opted to stick with district energy after Hurt and energy consultants made a convincing argument about economies of scale, especially as they relate to reducing carbon.

"Instead of making my finger net-zero, I'm trying to make the whole body net-zero," Hurt said. "Instead of making a building net-zero, I'm making the neighborhood net-zero."

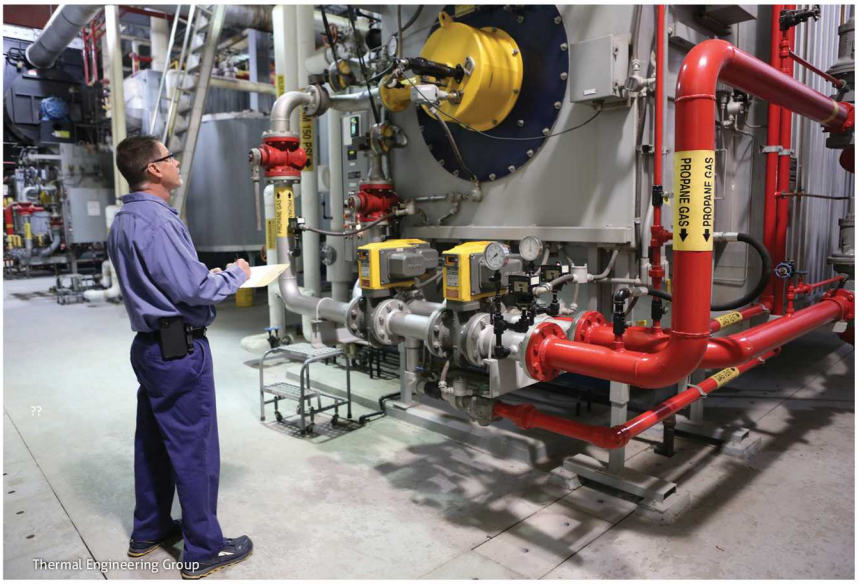
The strategy is part of the university's goal to become net-zero by 2050 – a goal it says it will achieve later this year. The reductions come largely from two photovoltaic projects totaling 60 MW in partnership with the Tennessee Valley Authority and Nashville Energy Services. These projects are expected to come online in the fall of 2023 and will offset 100% of the university's electricity demand, reducing the campus's total carbon footprint by 25%.

Other carbon reductions will come from energy efficiency and transportation improvement projects on campus and with a recent purchase of 121,000 metric tons of $CO_2$ equivalent offsets through Climate Vault, a Chicago-based non-profit that purchases carbon permits on the open market.

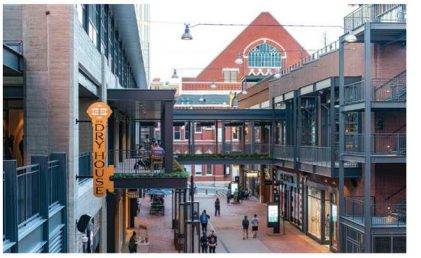
*— Brent Israelsen*




Vanderbilt University, winner of IDEA's District Energy Space Award in 2020, opted to double down on district energy for its economy-of-scale advantages.



Thermal Engineering Group





Nashville Convention & Visitors Corp.

The modernized system replaces one originally supported by a long-defunct waste-generation plant. Customers today include (from top right) Music City Center, the Fifth + Broad residential and retail area, and the 19,000-seat Bridgestone Arena.

energy three years ago over capital concerns that have since been allayed – is revamping the city's development-planning process and code to ensure that all developers know their energy options. MNDES also has enhanced efforts to communicate with developers to provide a detailed analysis of what tapping into district energy would cost.

Coyle noted that MNDES, drawing on an abundance of data from current customers, can return a report to a developer or architect in less than a week that explores considerations that include how much cooling and heating would be needed, the capital costs of hooking into district energy as opposed to installing their own of heating/cooling equipment, and the operating costs of both options.

"We are able to present to any potential customers specific historical load factor data from a highly diverse customer base with various functional space types, giving developers confidence in the demand-flow calculations," Coyle said. "This is a tremendous resource for anyone planning a new building downtown."

**IN FIVE TO 10 YEARS, NEW DEVELOPMENTS COULD MORE THAN DOUBLE THE NEARLY 11 MILLION SQUARE FEET CURRENTLY SERVED BY MNDES.**

It was just such an analysis that helped persuade a skeptical C.B. Ragland to choose district energy for the Hyatt Centric hotel. Hayes said his company examined the experiences of the Hyatt Place and other MNDES customers.

"We didn't take the decision lightly," Hayes said, noting that the company was motivated purely by financial considerations. "We've had a good experience. We're one year in now, and I believe our operating costs are below projections."

Hayes said he has directed his engineering staff to investigate retrofitting a renovated commercial building it owns kitty-corner from the Hyatt Centric.

To further avoid losing potential customers, the city recently added an "opt-out" checkbox to Metro's planning process that ensures developers know about district energy. It's a move that "will certainly put district energy in front of the design teams," said Freddie O'Connell, a Nashville Metro council member whose district includes virtually all of MNDES's customers. O'Connell said he sees district energy as a vehicle not only for accommodating growth but to meet Metro's goals of shrinking its carbon footprint 80% by 2050 while realizing long-term tax savings to residents.

"With district energy, you get to see efficiencies played out at scale. Costs are shaved. These are big wins," he said.

For MNDES, those efficiencies mean being able to buy electricity and natural gas at cheaper rates than are available to individual customers and that MNDES is better situated to modernize its equipment. Over the next several years, Coyle said, MNDES will replace a handful of its nine 2,600-ton chillers with state-of-the-art 3,600-ton machines that will boost capacity for the same amount of energy. The system is also looking to build about 4,000 tons of thermal storage that can be charged overnight when electricity rates are low and when the grid is less reliant on fossil fuels.

Even more aggressive greening measures are being contemplated for the other side of the river.

## REIMAGINED POSSIBILITIES FOR THE EAST BANK

Now hovering around 704,000, the population of Davidson County is expected to grow to 783,000 by 2030. To accommodate that growth, as well as downtown development activity currently averaging about $4 billion per year, Metro has embarked on an ambitious planning initiative called "Imagine East Bank," named after a neglected and underutilized 338-acre area across the river from downtown.

East Bank currently has a truck stop, sprawling parking lots and the Titans' badly aging open-air stadium, which MNDES serves with piping that runs beneath the nearby Woodland Bridge. The Titans plan to build a new, enclosed stadium slightly to the east of the current one, a $2.1 billion project that will require additional heating and cooling from MNDES.

The system may also be tapped for other projects in the Imagine East Bank initiative, which envisions transforming the area into a modern, mixed-use neighborhood that includes residential, commercial, green space, recreational, flood control and transportation improvements.

Adjacent to East Bank, in a zone known as River North, the software giant Oracle recently purchased 90 acres to build an 8,500-employee campus, and it has committed $175 million to public infrastructure upgrades, which could include connections to MNDES.

To meet the demand in both East Bank and River North, MNDES is drawing up plans to build "satellite" energy centers in both areas.

"Extending District Energy to the re-imagined East Bank will upgrade the infrastructure of these new resilient neighborhoods and enhance the quality of life for residents and visitors," said Adrienne Fancher, the Metro liaison to MNDES.

Each new center, Coyle said, would be constructed with its carbon footprint in mind, especially the one that would be connected to Oracle, which has aggressive net-zero greenhouse gas ambitions. To accomplish that, MNDES will be exploring higher-efficiency equipment and systems (such as hot water versus steam), wastewater heat recovery and geo-exchange to get as close to net-zero as possible. Other carbon emission reductions would likely come from Oracle's investment in renewable energy on the grid, Coyle said.

**System snapshot: Metro Nashville District Energy System**

| | Steam system | Chilled-water system |
|---|---|---|
| **Startup year** | Early 1970s<br>New plant 2003 | Early 1970s<br>New plant 2003 |
| **Number of buildings served** | 36 | 41 |
| **Total square footage served** | 8,867,898 | 10,685,279 |
| **Plant capacity** | 260,000 lb/hr | 23,400 tons |
| **Number of boilers/chillers** | 4 boilers | 9 chillers |
| **Fuel types** | Natural gas with propane backup | Electricity |
| **Distribution network length** | 23,686 ft – steam<br>24,615 ft – condensate | 24,566 ft CWS<br>24,566 ft CWR |
| **Piping type** | Direct-buried and tunnel installed insulated carbon steel | Direct-buried and tunnel installed insulated carbon steel as well as ductile iron |
| **Piping diameter range** | 20 to 3 inches | 42 to 4 inches |
| **System pressure** | 150 psig | 170 psig |
| **System temperatures** | 366 F | 42 F supply/53 F return |

Source: Metro Nashville District Energy System (MNDES)

## 'ANOTHER TOOL IN THE TOOLKIT FOR A SUSTAINABLE COMMUNITY'

In five to 10 years, the East Bank and River North developments could add an additional 10 million square feet of customer base, while new development downtown and on the south side could add another 3 million – more than doubling the nearly 11 million square feet currently served by MNDES.

"We're now seeing an inflection point in growth, technology and greenhouse gas concerns," Coyle said. "The system has provided reliable service at cost-effective rates for customers over a very long period of time, and it has the capacity to add new customers going forward."

As those customers are signed, MNDES will have to start similar greening initiatives like those it plans for the East Bank. "With our new master plan, we've got to move in the same direction downtown," Coyle said.

To that end, Metro Water Services, the agency under whose umbrella MNDES sits, is working closely with Mayor John Cooper's office to promote district energy and ensure its success.

"The ability to provide efficient and environmentally friendly heating and cooling services to Nashville buildings through district energy is another tool in the toolkit for a sustainable community," said Scott Potter, director of Metro Water Services.

The mayor's office agreed. "District energy will play a huge role in improving efficiency and decreasing greenhouse gases from the built infrastructure," said Kendra Abkowitz, chief sustainability and resilience officer for the mayor.

*Brent Israelsen is an associate editor for* District Energy *magazine.*