BUILDING A SUSTAINABLE FUTURE

Solving modern building challenges with hydronic systems

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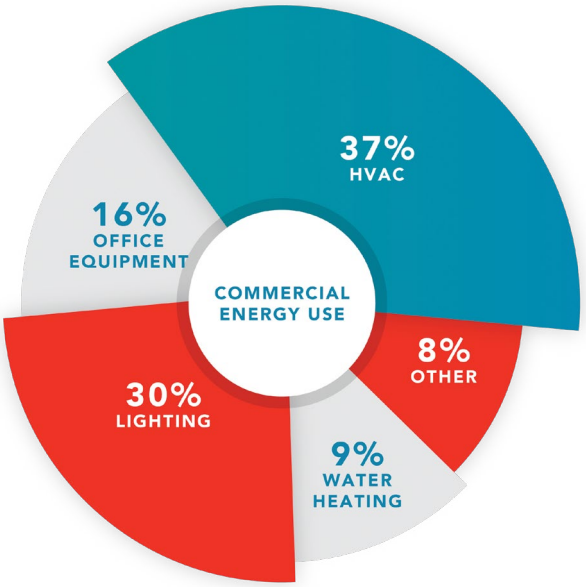
THE COMMERCIAL BUILDING INDUSTRY IS KEY TO A GREENER FUTURE

Carbon reduction in building design is critical to reducing energy consumption and ensuring a more sustainable future. **In the United States, direct combustion of fossil fuels accounts for at least 34% of all energy used in commercial buildings.**

Not only do HVAC systems account for nearly half of the energy used in commercial buildings, according to the U.S. Environmental Protection Agency (EPA), they also fall in the top five sources of greenhouse gas emissions.

These statistics are enough to warrant immediate and drastic action by the commercial building industry but there are other factors pushing the industry to switch to more eco-friendly heating and cooling systems.

A wave of new building codes, policies and regulations are driving change and creating new challenges for the existing commercial building market to overcome. At the same time, this presents a rare opportunity for the commercial building industry to rethink how it does business by investing in smarter, better systems that reduce greenhouse gas emissions while achieving maximum return on investment.



A net zero energy building is designed and built to consume as little energy as possible. **Net zero buildings combine energy efficiency and renewable energy generation to consume only as much energy as can be produced onsite.** Simply put, it means the building is producing as much – or more – energy as it uses. *(Source: energy.gov)*

National Renewable Energy Laboratory
Golden, Colorado
Bell & Gossett rep: McNevin Co.

More than 55 Bell & Gossett products, including e-1510 centrifugal pumps and gasketed plate and frame heat exchangers (GPX) make up the hydronic system that achieve's NREL's lofty performance goals of LEED plantinum cerification, 50% better than ASHRAE 90.1 standards and power use effectiveness (PUE) of 1.06.

THE RACE TO NET ZERO: SPURRING CHANGE THROUGH LEGISLATION

Over the past decade, regulatory pressures have increased the speed at which efforts to achieve "net zero" carbon emissions are happening. Growing concern around climate change, along with the declining cost and improved performance of renewable energy technology, has prompted many states to create clean energy programs and policies.

According to the Clean Energy States Alliance (CESA), there are currently 21 states, along with the District of Columbia and Puerto Rico, that have adopted policies to move to either all-renewable or zero-emission electricity supplies.

Case in point, New York City and Boston, two of the largest commercial building markets in the U.S., have adopted new requirements for building emissions. **New York's Local Law 97 mandates cutting emissions 80% by 2050, with numerous benchmarks set along the way. The first benchmarks must meet new energy requirements by 2024, with more restrictive 40% reduction demands by 2030.** Meanwhile, Boston's Building Emissions Reduction and Disclosure Ordinance (BERDO) aims for net zero by 2050. *(source: Rocky Mountain Institute)*

In the Race to Zero, many state and county governments are offering financial incentives in the form of grants, loans, rebates and tax credits to encourage renewable energy development.

At the federal level, the Inflation Reduction Act became law in August 2022. The landmark legislation incentivizes a major shift toward cleaner energy. **This includes nearly $370 billion in clean energy and climate investments over the next 10 years to help reduce the nation's carbon emissions by roughly 40% by 2030,** putting the U.S. within reach of international commitments.

Faced with such aggressive emissions and energy efficiency requirements, building owners and developers must consider the overall environmental impact of their buildings and the costs required to bring them into compliance.

When it comes to shrinking carbon footprint and maximizing ROI, water is a winner. Based on tried-and-true principles with more than a century of success, hydronics is a proven heating and cooling solution. With rising energy prices and new legislation driving growing demand for more efficient buildings, modern hydronics presents a viable solution to reduce HVAC systems' negative impact on the environment and promote more sustainable energy sources.

Eighty Seven Park
Miami
Bell & Gossett rep:
George A. Israel Co.

THE FIRST STEP: MODERNIZING HVAC SYSTEMS

Commercial building operations account for 28% of carbon emissions globally. HVAC systems contribute the largest portion of those CO2 emissions, so it is no surprise there is a focus on reducing the carbon footprint of commercial building stock.

In the movement to reduce energy usage, HVAC system design is at the forefront of change to achieve net zero goals. With heating and cooling among the largest costs in commercial buildings, HVAC system selection is an important component in both new construction and retrofit projects to keep costs in line and realize energy-efficiency targets.

As the industry continues the shift to sustainable building practices that maximize building performance while minimizing environmental impact, the type of HVAC system is an important factor in realizing energy-efficiency targets. When HVAC systems are designed with energy efficiency in mind, they can use less electricity and produce fewer greenhouse gas emissions.

In an effort to move the industry forward, the U.S. Department of Energy (DOE) launched a new national initiative in 2021 to advance clean heating and cooling systems in buildings, making it easier to afford and install high performance heat pump solutions. **As part of its E3 initiative, the DOE is working closely with stakeholders nationwide over the next 10 years to transform the heating and cooling marketplace, making affordable, clean and efficient solutions easily available across the United States.** That includes a strong emphasis on systems that can deploy effective hydronic heating and cooling technologies that already exist on the marketplace today like water source and geothermal heat pump systems, heat pump water heaters, and the implementation of hydronic thermal storage strategies to further enhance savings potential.

ACHIEVING NET ZERO

According to the EPA, net zero means consuming only as much energy as produced, achieving a sustainable balance between water availability and demand. A net zero building only uses the energy it needs. Anything extra, including the energy it produces itself, is sent back into the grid to help power other buildings, which, in turn, increases their efficiency. In short, net zero buildings:

- Produce as much energy as they consume
- Use efficient and automated building systems
- Focus on efficiency and functionality together
- Integrate renewable energy systems, including solar and geothermal

Energy plant installation
Northwest Georgia
Bell & Gossett rep:
James M. Pleasants

Albany High School
Albany, New York
Bell & Gossett rep:
Frank P. Langley

WATER – THE LIFEBLOOD OF A BUILDING

While hydronic systems as a room comfort technology have been in use in some form or another for well over a century, it is also the HVAC technology of the future because it enables engineers, architects and building owners to adapt to changing demands.

Specifically, hydronic systems operate on a closed-loop, meaning that the same water is constantly being recirculated and heated again. This makes it an extremely efficient water conservation strategy because it reuses water and typically lasts the lifetime of a unit, such as HVAC.

Water also is considered technology agnostic – no matter what type of technology exists in the market today or in the future, water will always be a great source, adaptable to all technology. Modern hydronic heating and cooling systems can easily accommodate a wide variety of current and future energy sources. **As interest in renewable energy sources like solar and geothermal grows, building owners and designers are recognizing that hydronics provide the ideal distribution system that enables these alternative technologies to perform.** Moreover, hydronic system efficiency is already well-documented in thousands of real-world applications, making it an extremely convenient option.

Wilshire Grand Center
Los Angeles
Bell & Gossett rep: Dawson Co.

WHAT IS A NET ZERO WATER BUILDING?

The Federal Energy Management Program describes a net zero water building as one where the amount of alternative water used and water returned to the original water source is equal to the building's total water consumption. Using water as a transmission tool in heating and cooling is an idea that is timeless because it is safe, and leveraging the chemical properties of water will continue to be a medium of choice for heating and cooling in the future.

POISED FOR EXPONENTIAL GROWTH

From multidwelling units, to office buildings, to industrial spaces, hydronics are applicable in a wide variety of buildings across the commercial building sector. As building owners consider a more efficient option for their new or existing HVAC systems, along with considering the overall size of the building, designers must also consider the size of the HVAC system itself. For instance, cooling or heating a large industrial or warehouse space can be costly. Hydronic systems, however, are ideal in large building spaces that require 50 to 100 tons of cooling capacity or more, and where water needs to be pumped efficiently across very long distances.

What's more, in structures like multifamily buildings or high-rises where the level of heating and cooling is unbalanced due to the number of stories and tenants, hydronic systems are a high-efficiency system of choice. Radiant heating and cooling systems use a fraction of the energy of a forced-air system, as demonstrated in Xylem's HVAC solution for the Wilshire Grand, the tallest building on the West Coast. Ancillary HVAC equipment like air separators and expansion tanks that increase and decrease pressure in hydronic systems in response to changes in building temperature, further demonstrate the efficacy and versatility of hydronics.

With the advent of new hydronic products and technology, the HVAC industry is anticipating opportunity for rapid market growth. **According to Research and Markets, the global hydronic systems market is expected to grow $1.3 billion by 2025.** Propelling that market growth is the growing need for energy-efficient cooling and heating systems and an increase in construction activities worldwide.

ADVANCING THE COMMERCIAL BUILDING INDUSTRY'S FOCUS

Sustainability
A focus among nearly all industries, steps toward sustainability have grown within reach thanks to green technology and other advancements in hydronic HVAC systems.

Decarbonization
Grid-connected, energy-efficient radiant heating and cooling systems and heat pump water heaters (HPWHs) can play a key role in building decarbonization, which eliminates emissions at the building as well as at the generation source.

Water reuse
Besides using less energy, hydronic systems have the ability to store thermal energy (hot water) for later use. Water in a hydronic system can draw the heat or chill out of a room and carry that energy back to the system for storage and later use, reducing energy consumption and costs.

Increased demand for healthy buildings
In the wake of the COVID-19 pandemic, the health of commercial buildings has emerged as critically important. Indoor air quality can have a big impact on people's health. Traditional HVAC systems distribute air through a system of ducts and vents. Doing so circulates air pollutants. Because hydronic radiant heating systems use pumps to move water, instead of fans or blowers to push air, harmful air contaminants like dust and mold are not circulated throughout a building, promoting safer air quality.

Ellipse Tower
New Jersey
Bell & Gossett rep:
Wallace Eannace Associates

REALIZING THE POTENTIAL OF HYDRONIC HVAC SYSTEMS

In addition to contributing to global warming in a major way, the rising need for HVAC systems in the developing world is adding strain to already overburdened electrical grids. **Reducing wasted HVAC energy consumption is an important element in the push for greater sustainability in the commercial building sector. It is also a solution to significantly reduce operating costs.**

All of these factors are driving the increasing demand for modern HVAC systems that can effectively increase comfort and maintain air quality while reducing overall energy consumption. As such, hydronics is poised to play a key role in building sustainable heating and cooling systems that save money, are less reliant on fossil fuels and are significantly less harmful to the environment.

Willis Tower
Chicago
Bell & Gossett rep:
Bornquist Inc.

TEXAS HEALTH HOSPITAL MANSFIELD

Designing HVAC systems for hospitals poses many challenges. Not only must the equipment run 24 hours a day, seven days a week, but it must also maintain accurate temperature and humidity control to keep patients comfortable and vital medical equipment functioning properly.

Hydronics provides solutions to address all of these factors, from meeting the demand for comfort and energy efficiency to improving indoor air quality and environmental impact.

To ensure occupant comfort and enhance the building's indoor air quality at Texas Health Hospital Mansfield, a 38-acre health care campus with a 59-bed acute care hospital, the design included a primary and secondary heating water system, chilled water system, condenser system, domestic water and domestic hot water return pumps.

Bell & Gossett representative Oslin Nation provided HVAC and plumbing equipment for the project, including Bell & Gossett pumps, tanks and ancillary equipment for their HVAC, domestic plumbing and wastewater systems. This equipment ensures the facility, which opened in December 2020, will be able to run efficiently and effectively into the foreseeable future.

Hydronic equipment that ensures reliability for years to come is essential for Texas Health Hospital Mansfield, which is designed for future expansion to accommodate the rapidly growing population in Mansfield and surrounding communities.

Texas Health Mansfield
Mansfield
Bell & Gossett rep:
Oslin Nation Co.

ADVANTAGES OF HYDRONICS

Using water as a temperature regulation method is a natural choice. There is no carbon footprint involved in the creation of water, and there is no inherent danger in exposure to water in the event of a system failure.

Considerable benefits of hydronic HVAC systems include lower energy usage and cost, wider range of maintenance flexibility and longer system life expectancy.

Energy efficient
Water needs less energy to heat since it absorbs heat better and retains heat for longer. Compared to forced-air heating systems, a hydronic heating system is about 25% more efficient.

Lowest lifecycle costs
Hydronic systems have long been regarded as more expensive to install, but that's no longer true. Today's advanced hydronic systems include application of technologies like integrated and single pipe systems that dramatically reduce piping, along with the use of variable speed pumps and fans. As a result, commercial building owners can expect significantly lower lifecycle costs.

Low maintenance and operating costs
Hydronic systems are generally easier to maintain. Their piping runs don't require brazing or special soldering, plumbers and pipe installers can handle the job, and there's no oil or refrigerant to deal with. Additionally, hydronic systems offer a much wider range of flexibility for components, operation and maintenance, both in terms of parts and service.

Adaptable
Hydronic systems provide the most adaptable, efficient delivery of heating and cooling regardless of the source and are compatible with a variety of refrigerant-based, thermal and electric heating and cooling sources. A single system can supply space heating, domestic hot water and specialty loads such as pool heating.

St. Regis
Chicago
Bell & Gossett rep:
Bornquist Inc.

Space-saving
State-of-the-art commercial hydronics systems have the ability to control heating and cooling systems remotely via mobile devices with a far smaller footprint than previously possible. In fact, modern hydronic systems occupy about one-eighth of the space of ducted air systems. That translates to more useable building space.

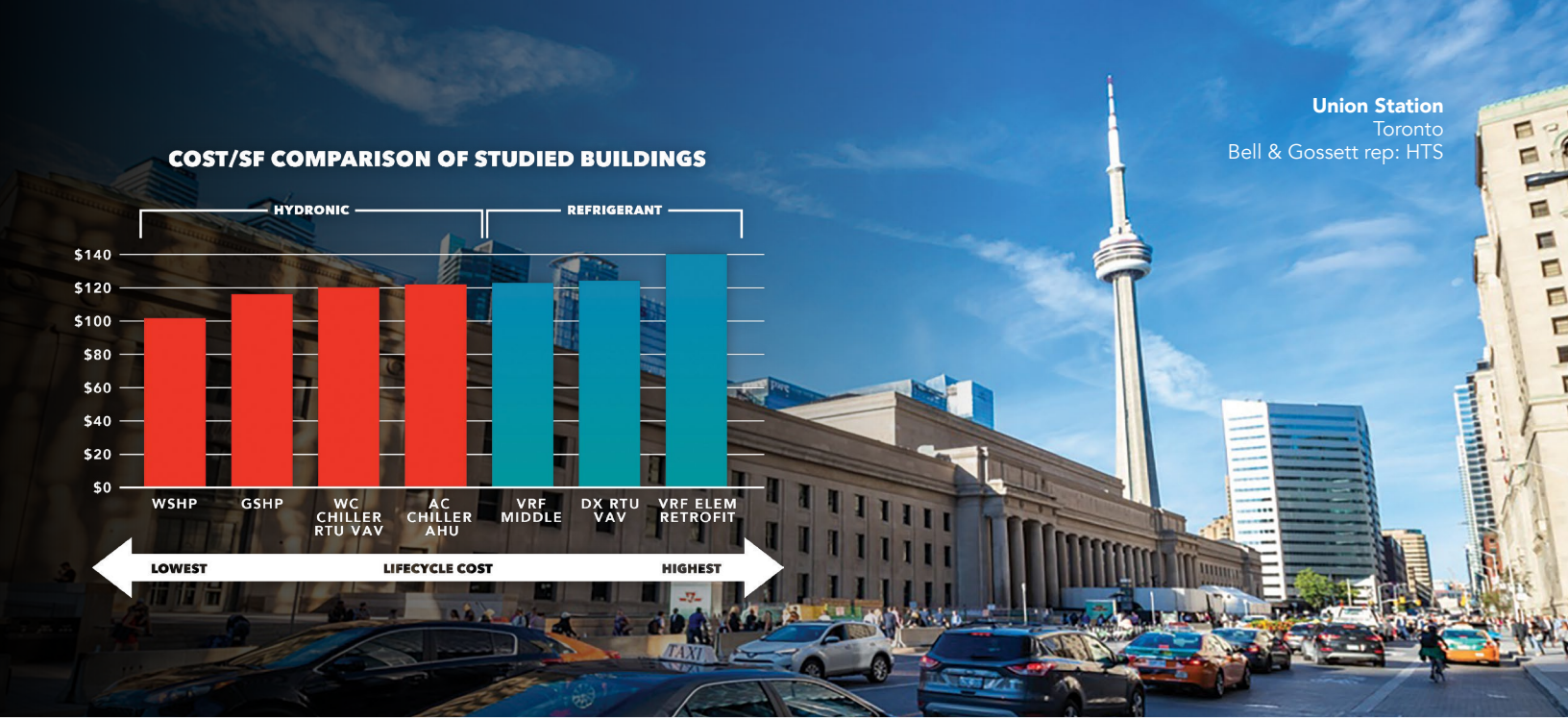
Comfort and safety
Hydronic systems distribute heat evenly for greater comfort throughout the building. Equipping hydronic HVAC systems with a range of hydronic comfort control products like thermostatic valves and thermostatic operators for individual rooms allow for even more accurate control, further enhancing occupant comfort. Unlike forced air technology, hydronic heating systems don't push dust, mold or other allergens around the building.

Versatile
Hydronic systems are designed with universal components that can be installed and serviced by any HVAC technician. Component manufacturers can be changed and new technologies installed without impacting the other system components. Conversely, VRF systems are proprietary, requiring specialized technicians for installation and maintenance throughout the life of the system.

Sustainable
Hydronic systems can draw on the natural thermal storage capabilities of water. Thermal storage can result in the reduction of operating costs by producing and storing the energy during periods of low energy supply cost (off-peak/night time) and utilizing the stored energy during periods of high energy supply cost (peak/day time).

Future-proof flexibility
With the HVAC market moving toward heating and cooling using renewable-sourced electricity, gas-fired boilers could be phased out within the next 15 years. Hydronic heat pump systems can be a complete opportunity to offer an all-electric comfort system. Electric heat pumps can be directly swapped with conventional gas boilers, which means there is no need for costly retrofitting beyond the heat pump installation.

Shinola Hotel
Detroit
Bell & Gossett rep:
R.L. Deppmann Co.



Union Station
Toronto
Bell & Gossett rep: HTS

THE EFFICACY OF HYDRONICS VS. OTHER HVAC SYSTEMS

Upfront costs and energy consumption are primary drivers when selecting a commercial HVAC system in new and retrofit projects. A study commissioned by Xylem underscores the importance of evaluating total lifecycle cost in the selection process to adequately identify pros and cons of the various system types.

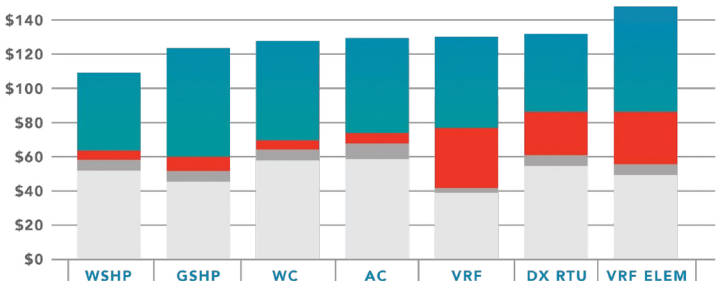
The Xylem study evaluated HVAC systems in a number of South Carolina school buildings, hydronic systems outperformed all other systems, in terms of lower energy use, cost and life expectancy, by as much as 24%.

To compare and contrast HVAC systems according to their 30-year lifecycle cost analysis (LCCA), the study analyzed seven elementary and middle schools located in South Carolina Climate Zone 3A, a humid, warm climate. The cost analysis included upfront installed cost, replacement cost allocations and ongoing energy and maintenance cost of the following system types:

- Variable refrigerant flow heat pumps (VRF)
- Water source heat pumps (WSHP)
- Ground source heat pumps (GSHP)
- Direct expansion rooftop units (DX RTU)
- Water cooled chillers (WCC)
- Air-cooled chillers (ACC)

The findings of the study revealed that the schools with WSHP, GSHP and WCC systems displayed energy use levels that were 30%, 41% and 25% better than the national median for elementary and middle schools, respectively. The replacement cost allocation also acknowledged that the tested hydronic systems operate effectively for approximately 25 years, as opposed to the 15-year replacement estimation for VRF systems.

COST/SF COMPARISON OF STUDIED BUILDINGS



	WSHP	GSHP	WC CHILLER RTU VAV	AC CHILLER AHU	VRF MIDDLE	DX RTU VAV	VRF ELEM RETROFIT
INSTALL $/SF	$35	$50	$45	$42	$42	$31	$42
REPLACEMENT ALLOCATION	$8.89	$12.70	$9.42	$8.79	$32.72	$24.15	$32.72
30 YR. MAINT. $/SF	$5.33	$5.33	$4.72	$10.35	$4.69	$6.81	$10.04
30 YR. ENERGY $/SF	$61.34	$55.15	$67.75	$69.26	$52.34	$71.29	$60.28

Ritz Carlton Residences
Miami
Bell & Gossett rep:
George A. Israel Co.

VRF systems generally have a shorter life expectancy than hydronic systems. **Hydronic systems have been known to last 20 to 25 years, while VRF systems could need replacing as soon as 10 or 15 years after installation.** The compressor in a VRF system is forced to work harder during heating cycles, reducing the life of the compressor.

At lower temperatures, hydronic systems are more reliable than VRF systems. That's because a VRF system might require a supplementary heat source in cold climates, such as electric heat, which could negate the energy efficiency of the system. Without another heat source, the VRF compressor can be set to run at maximum capacity for the morning warm-up, but that takes more electricity, potentially negating any efficiency benefits, including reduced energy costs.

A study by the Hydronic Industry Alliance (HIA) evaluated a VRF system and hydronic system installed in the same building, addressing similar loads.

The HIA found that, over a three-year period, the VRF system had an energy consumption 57% higher than the hydronic system in year one, 84% higher in year two and 61% higher in year three.

ASHRAE HEADQUARTERS

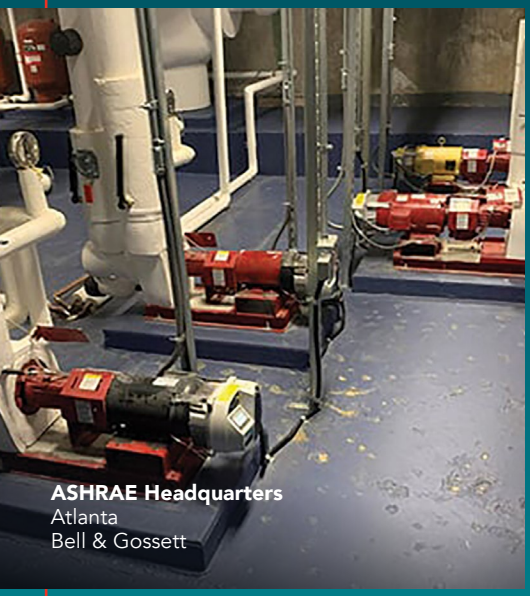
Among the goals ASHRAE set for its new, renovated headquarters is to be a showcase for the latest HVAC&R equipment, providing a destination venue for industry visitors to experience state-of-the-art technology installed and "in action" in a built environment.

Bell & Gossett helped with the retrofit of ASHRAE's headquarters into a next-generation workspace, implementing cutting-edge hydronic equipment and products.

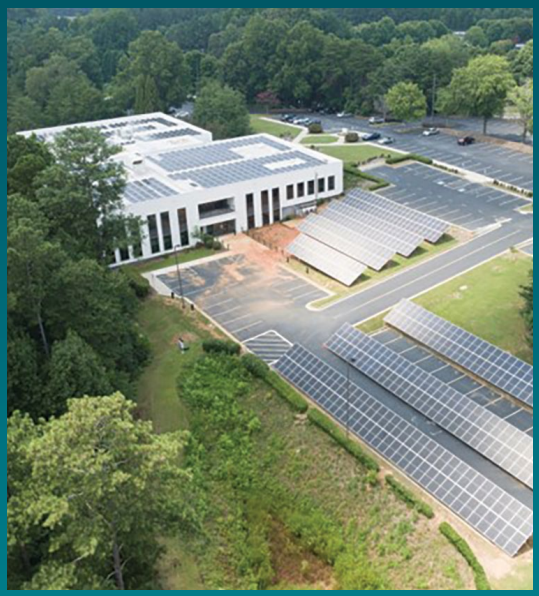
In order to achieve superior efficiency while delivering a healthy and comfortable environment, a focus on right-sizing equipment to reduce energy usage without affecting occupant comfort was applied.

With an ever-greater focus on sustainable and energy-efficient building design, right-sizing the components of a building's HVAC system offers a significant opportunity to achieve project performance goals. Utilizing detailed analysis of the building's heating and cooling loads while applying energy code standards helped ensure the proper equipment was selected for the system, maximizing efficiency and minimizing operating costs.

Bell & Gossett provided highly efficient, DOE-compliant pumps to the ASHRAE headquarters building, successfully and cost-effectively transforming an existing older building stock into a high-performance workplace.



ASHRAE Headquarters
Atlanta
Bell & Gossett



TAKING SUSTAINABILITY A STEP FURTHER

Future-proofing buildings, or specific systems within them, breaks down to extending their lifecycle and usefulness. **Longer lasting equipment that continues to meet the changing needs of occupants reduces costs and improves ROI.** Future-proofing focuses on flexibility to handle changing standards and occupant needs, scalability for expansion and the ability to maintain equipment efficiency.

Knowing that hydronics is a reliable energy source that outperforms other HVAC systems is key to addressing decarbonization challenges. Any future-proofing strategy requires consistent energy to make commercial buildings more self-reliant, i.e., can a building store energy during the day that can be used to heat the building at night? In general, those are approaches that have lasting security in commercial buildings.

Google East Coast Headquarters
Manhattan
Bell & Gossett rep:
Wallace Eannace Associates

Globe Life Field
Dallas
Bell & Gossett rep:
Oslin Nation Co.

HOW BELL & GOSSETT IS PRIORITIZING SUSTAINABILITY

Bell & Gossett has been a leader in hydronics and education since the 1950s. Sustainability is a story of its entire product lifecycle, beginning with the product development process, which focuses on energy efficiency and construction materials.

In order to best serve its customers and provide a sustainable future, Bell & Gossett's parent company, Xylem, is focusing on strengthening its own resiliency. The organization is working to minimize the carbon footprint in the manufacturing of its products, the operation of its products and their end of life.

Over the past few years, Xylem has been consistently planning and investing in its facilities to further reduce overall energy and water consumption, as well as in reducing the waste it generates and disposes in landfills. The company is making significant progress, from identifying high-emitting activities to engaging employees across the organization to adopt a more energy-water-waste efficient mindset.

Xylem is currently focused on:

- Consistent lowering in the volume of water it uses in its operations
- Growing its recycle and reuse
- Relevant increase in the renewable electricity it procures or generates for its operations
- Reduction in the amount of waste as a means of reaching its 2025 sustainability goals

In addition to responsible water use practices in its facilities, Xylem's commitment to watershed stewardship is reflected in its operations in water-stressed areas. Several activities in the company's operations in those areas have been implemented to reduce its water usage.

Xylem won a Global Water Award in 2021 and was named "Net Zero Champion" at the 2022 Global Water Awards. These are achievements through committed activities and not theoretical discussion.

Bell & Gossett's Little Red Schoolhouse
Morton Grove, Illinois

XYLEM'S 2025 SUSTAINABILITY GOALS FOR OPERATIONS AND SAFETY

- 100% renewable energy at major facilities*
- 100% process water recycling at major facilities*
- Achieve zero waste to landfill from processes at major facilities*
- Reduce injury frequency rate** to an incident rate of 0.5 or below
- Develop 1.5°C science-based targets for GHG reduction (Scope 1, 2, 3)

THE NEED FOR EDUCATION

While the technology is promising, widespread adoption of hydronic HVAC systems isn't without challenges. Most importantly, building owners need more education to dispel the misconception that refrigerant-based systems like VRF are better solutions than hydronics.

Although veterans in the HVAC industry already know the benefits of hydronic systems, there is a growing need to educate new industry professionals on hydronics as a solution to address new regulations around reducing greenhouse gas emissions. To address this challenge, Bell & Gossett's Little Red Schoolhouse, the company's training center for professionals dedicated to the plumbing and hydronic HVAC industries, is introducing new modules focused on thermal storage and electrification in 2023. With a focus on sustainability, Little Red Schoolhouse training programs demonstrate how hydronics can provide benefits that will guide engineers, contractors and other hydronic HVAC and plumbing professionals into a sustainably responsible future.

QUANTIFYING THE BENEFITS OF HYDRONICS

Another obstacle is the heavy push from VRF manufacturers around decarbonization and electrification. In recent years, the number of VRF manufacturers in North America has grown significantly. As a result of this increased presence, marketing efforts to position VRF as a better alternative to traditional hydronics-based solutions have become common.

While solutions to address decarbonization in commercial buildings are still evolving, there are limitations to the solutions that do exist, such as that of electric technology. Adapting existing commercial buildings accordingly with energy-efficient options is a feasible place to start. **The Center for Climate and Energy Solutions reported emission reductions of 17.3% and 11.4% in the residential and commercial sectors, respectively, since a 2005 peak, due to improvements in energy efficiency.** Qualifying the importance of implementing changes in these sectors begins with understanding the net lifetime savings that come from investing in efforts toward greater energy efficiency.

Harvard District Energy Facility
Boston
Bell & Gossett rep: FIA

AN OPPORTUNITY FOR SUSTAINABLE CHANGE

The global push for net zero energy buildings is rapidly driving demand for high-efficiency heating and cooling solutions. The legislative, cultural and economic incentives that encourage beneficial electrification and decarbonization, and the accompanying demand for low-energy and net zero buildings, collectively represent one of the greatest opportunities for the U.S. hydronics market in decades.

Whether it's designing an optimized system from the ground up or supplying intelligent pumps capable of adjusting performance to handle any challenging environment, hydronic solutions ensure reliability while protecting people and buildings and safeguarding valuable resources for the future. It is now in the hands of commercial building designers and industry leaders to take meaningful action toward driving sustainable change.