WHITEPAPER

The Five Top Trends in Sustainable Construction

jaga CLIMATE DESIGNERS

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INTRODUCTION

Imagine it's 2075. Amid extreme weather events and terrible air quality, humans have adopted its habitats to withstand the inhospitable conditions outdoors. An architectural marvel of this era, known as "MOBY," offers humans safety and a livable indoor environment. This Modular Oxygen Bubble (MOBY), is a self-contained unit that can withstand various ecological shocks and an atmosphere free of noise, pollution, diseases and crowds. It provides optimal oxygen, CO_2 and uses minimal energy. Everything happens within your MOBY unit, and units are attached to one another to form MOBY communities, accommodating high populations of people. MOBY units are designed to be self-sufficient, with their own energy generation and waste management systems, making them a sustainable and resilient solution for future living.

The vision of MOBY and why we need to start designing for tomorrow today

As a leading advocate for sustainable design and construction, we at Jaga regularly look to "Dream a Future," and Jan Kriekels of Jaga, dreamed of MOBY in 2000—nearly a quarter of a century ago!

"I sought inspiration in the culture of the Incas," he said of the project. "They lived in the jungle but had a limited chance of survival due to wildlife, diseases and bacteria. So they started living above the treeline, in the pure air without bacteria and diseases. This old example shows so well that clean air is important for your health. The need for fresh air is certainly not new, but we now see that it is more relevant than ever."

The Tipping Point

Experts have emphasized that we're near a tipping point when it comes to sustainable building. No longer is it simply nice to have building materials, systems and approaches that limit our environmental impact, it's imperative. In December during COP28, The Buildings Breakthrough was launched, which is a global push for near-zero emission and resilient buildings by 2030. More than 27 countries have pledged their commitment, including the U.S. This global initiative is designed to "strengthen international collaboration to decarbonize the building sector and make clean technologies and sustainable solutions the most affordable, accessible and attractive option in all regions by 2030.

While several regions throughout North America have accelerated sustainable building policies, many continue to opt for business as usual. According to the Pacific Northwest National Laboratory, "Understanding the nature and extent of inefficiencies and negative impacts in the built environment helps drive the development of new approaches and technologies that can improve all aspects of a building's performance. Green buildings are needed on a global scale to help drastically reduce greenhouse gas emissions, conserve increasingly stretched energy resources, and contribute to improved human health."

> "The ultimate goal is to create more earth-friendly solutions that will enable future generations to enjoy a liveable planet."

Looking beyond legislation, we continue to see the rising cost of inaction. Within the U.S., climate-change extreme weather events have cost the US $612B in the last five years, according to the NOAA's National Centers for Environmental Information. In Canada, experts predict that costs could soar to $108B between 2022 and 2050, which is just the tip of the iceberg. Soaring insurance costs make it difficult for some Canadian homeowners to insure their properties.

Despite the threats associated with rising temperatures, we're also starting to see several promising trends in the building industry throughout North America. As Europeans, we have a unique vantage point: Because we import most of our non-renewable energy, costs are higher in comparison and we experience stricter regulatory policies. Because of this, several of the trends we've seen happening throughout North America began on our side of the pond many years ago.

Ultimately, this white paper aims to highlight new and innovative techniques for reducing the carbon footprint of our building projects. The ultimate goal is to create more earth-friendly solutions that will enable future generations to enjoy a liveable planet.

Trend #1
Mass Timber Buildings

TREND #1

Mass Timber Buildings

When the primary load-bearing structure is created from solid or engineered wood, it is considered "mass timber." These buildings typically have multi-layered solid wood panels, resulting in solid timber floors and walls typically ranging from 5-12 inches thick. According to the WoodWorks Innovation Network (WIN), there were more than 2,000 multi-family, commercial or institutional mass timber structures in progress or built as of December 2023.

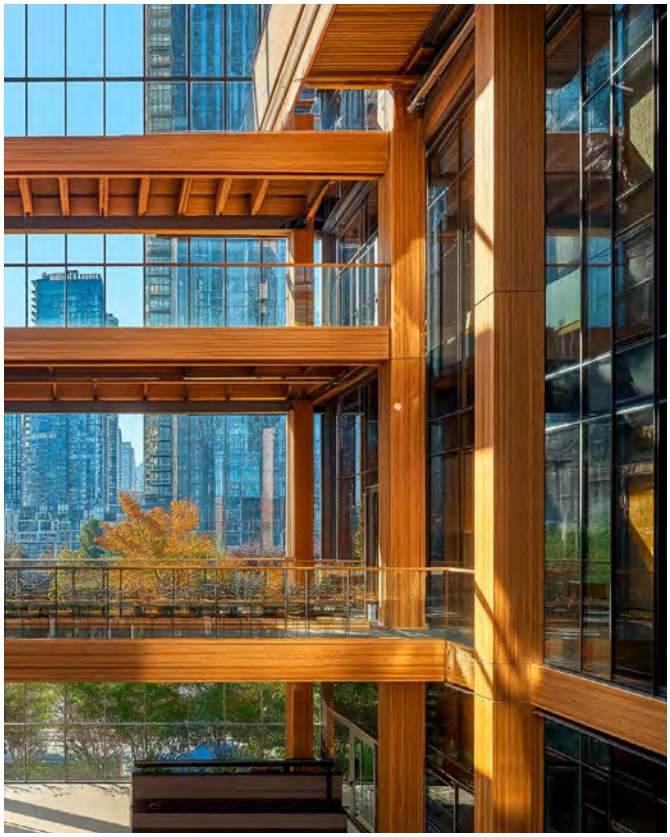
It's a building technique growing quickly in popularity, largely because of its ecological benefits, structural integrity, speed of construction and overall thermal performance. Wood is a natural resource compared to limestone, sand and other materials used to produce concrete.

> "Say the typical steel and concrete building has an emissions profile of 2,000 metric tons of CO_2,"

said Andrew Ruff, of Connecticut-based Gray Organschi Architecture in an article for YaleEnvironment 360.

"With mass timber you can easily invert so you are sequestering 2,000 tons of CO_2. Instead of adding to climate change you are mitigating climate change. That's the goal."

However, the environmental benefits go beyond the design. Because wood is a natural insulator, mass timber buildings also excel in energy efficiency. Where concrete absorbs heat, mass timber buildings allow only the air inside the building to be heated or cooled.

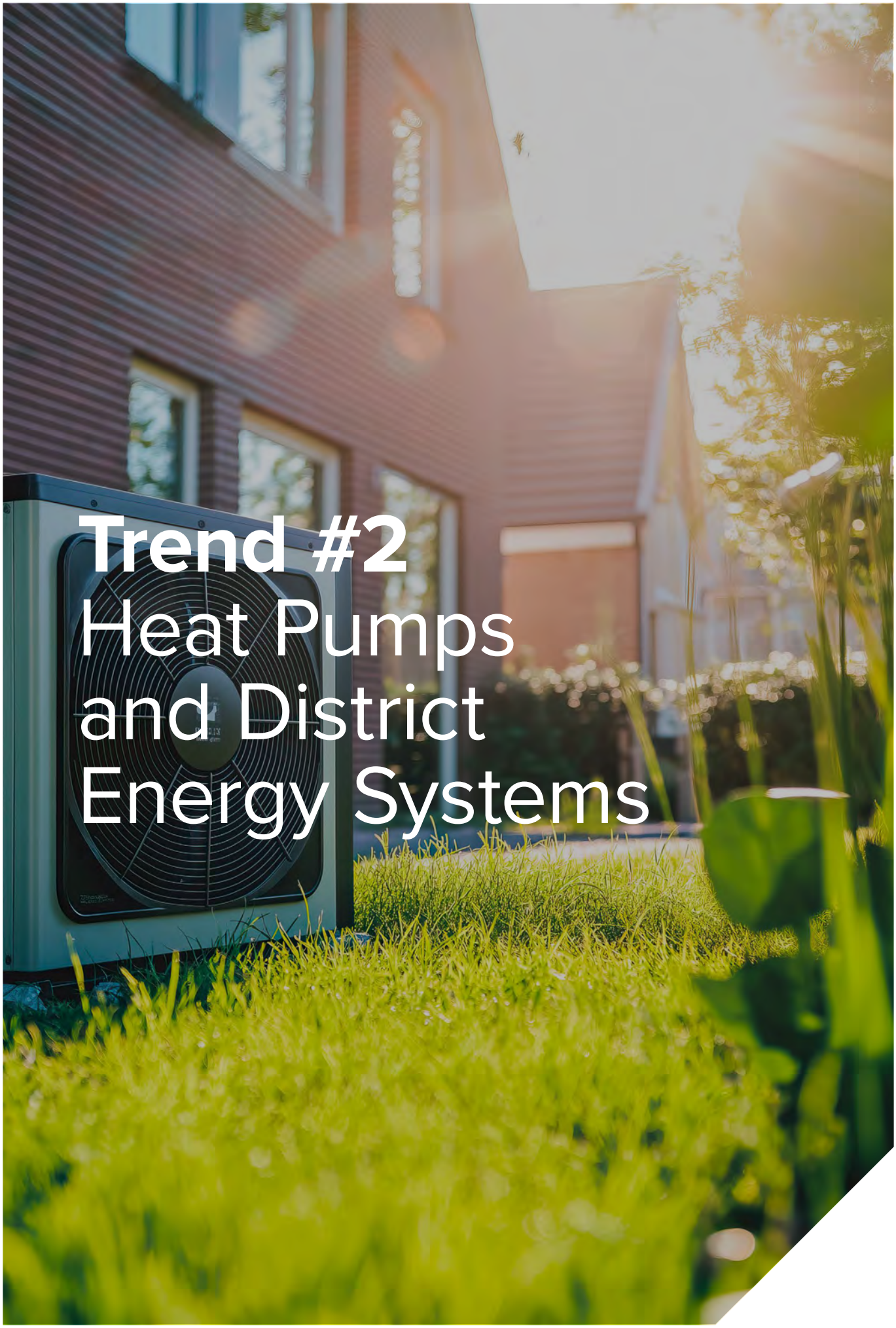


This makes it increasingly important to use heating and cooling systems that react quickly to maintain optimal temperatures, such as low-temperature hydronic systems. Otherwise, this efficiency (and cost-savings) is wasted.

Our Briza fan coil line is one of several hydronic options that offer ideal heating and cooling for mass timber construction. With three options based on the desired output, the Briza 12, 22 and 26 provide superior heating and cooling that reacts quickly, uses minimal energy and has become a go-to choice for maintaining optimal temperatures in a mass timber building.

A considerable advantage of using terminal hydronic fan coils is they can be “sill mounted” underneath windows, leaving the ceiling clean and uncluttered. When the building has a beautiful mass timber ceiling, you don’t want to clutter it up with sheet metal ductwork. Sill mounted fan coils are ideal for this, and the Briza 22 specifically has found itself in a sweet spot in terms of cooling capacity and size, as it’s able to provide up to 4 tons of cooling while being no more than 9” deep.

The Jaga Clima Canal range is the ideal solution for projects where mounting a fan coil in the ceiling or underneath windows is impossible. Again, keeping those beautiful ceilings clean, all the terminal heating and cooling equipment is now placed within or on top of the floor. With the Clima Canal 19 (7.5” tall) we can get 1 ton of cooling in 6ft length. Plenty of capacity for a hydronic fan coil in the floor making it a popular solution for mass timber. These are usually combined with “raised floor” or UFAD (underfloor air distribution” systems.



Trend #2
Heat Pumps and District Energy Systems

TREND #2

Heat Pumps and District Energy Systems

As more businesses and homeowners look to transition toward more sustainable energy solutions, we've seen heat pumps increasingly utilized in HVAC system design. Within North America, moves toward electrification and decarbonization have specifically contributed to this trend, as heat pumps are known for increasing energy efficiency and reducing greenhouse gas emissions.

One of the primary drivers is financial incentives offered by the federal government in the U.S., such as the 179D tax deduction for commercial buildings. This offers base tax deductions to commercial building owners and designers of buildings that meet certain energy efficiency standards. The deductions work on a sliding scale of $0.50 per square foot for energy savings of 25 percent and up to $1 per square foot for energy savings of 50 percent or greater.

How does a heat pump work?

Heat pumps use electricity to transfer heat from a cool space to a warm space: Similar to the way that cold air displaces warm air when you open a door in the winter. There are three types of heat pumps: air-to-air, air-to-water and geothermal. Each unit collects heat from the air, water or ground outside of the building to use indoors. With air-to-water heat pump technology, it leverages basic principles of refrigeration and heat exchange, absorbing heat from the air and then realizing it into the water circuit. This system is significantly more energy-efficient than traditional electric or other fuel-based heating systems, which brings the added benefit of reducing greenhouse gas emissions and lowering operational costs.

What are district energy systems?

In addition to heat pumps, we're seeing the growth of buildings using district energy systems. These are large, efficient energy hubs for heating and cooling from a single, central source. A central plant that generates hot water, steam or chilled water is at the heart of a district energy system. Powered by a variety of energy sources, this water is distributed through a network of insulated, underground pipes that distribute the energy to various buildings in the district. Energy goes to each building to warm or cool rooms, and Jaga's low-temperature solutions work great to emit hot and cold air in these systems.

Trend #3
Biophilic Design

TREND #3

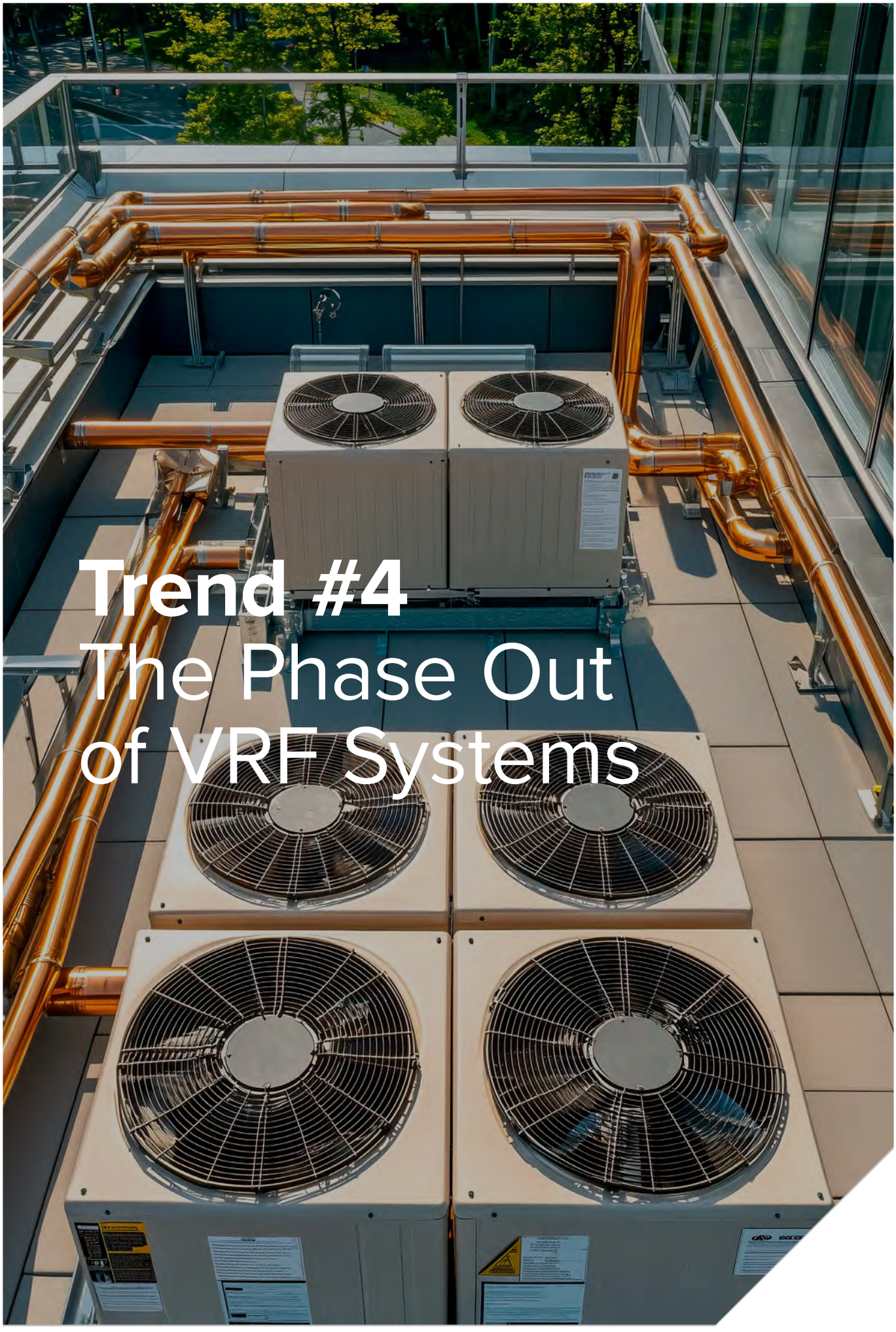
Biophilic Design

Coined by Harvard naturalist Dr. Edward O. Wilson, the term "biophilia" describes human tendency to interact or be closely associated with other forms of life in nature. However, as populations continue moving from rural to more urban environments and spending more than 90 percent of our time indoors, incorporating biophilic elements helps satisfy our need to affiliate with nature.

When used in an indoor environment, biophilia has been shown to improve productivity, by as much as six percent, and creativity by up to 15 percent. It can also improve the health and well-being of occupants by reducing stress and anxiety. In academia, biophilia has been shown to improve test scores. A study published in the Journal of Environment and Behavior found that students who studied in classrooms with views of nature (through glazing or a large window) demonstrated better attention spans and focus.

What does biophilic design look like? Some fascinating research suggests that you can break biophilic design into three categories: nature in space (using actual natural elements), natural analogs (artificial elements that mimic nature) and nature of the space (how humans interact and behave in a space). By creating visual connections to nature through large windows, bringing nature indoors with sustainable, organic elements and creating open spatial elements like large atriums or green spaces will all impact your heating and cooling considerations.

From our trench heating and cooling which rest perfectly in line with a finished floor which maximize window views to convectors and grilles that are made of organic materials such as wood, our solutions maximize the biophilic elements in modern buildings.



Trend #4
The Phase Out of VRF Systems

TREND #4

The Phase Out of VRF Systems

VRF systems use refrigerants, like R-410a, that are phased out globally due to their harmful impact on the ozone layer and potential health risks. For example, R-410a, when leaked, can accumulate in low-ventilation spaces, posing serious respiratory hazards or even suffocation risks. Additionally, these refrigerants contribute to global warming, prompting international regulations such as the Montreal Protocol and its Kigali Amendment to phase them out. Despite their widespread adoption due to perceived initial cost savings, the long-term environmental and health implications of VRF systems warrant careful consideration.

While VRF systems may appear cheaper initially than hydronic systems, their long-term costs are higher. Factors contributing to these costs include the expensive copper piping required for VRF systems, specialized labor needed for installation and maintenance, and proprietary controls that can lead to higher replacement costs. In contrast, hydronic systems use more affordable materials, have more flexible maintenance options, and can integrate components from various manufacturers, making them more cost-effective over their lifespan. Additionally, hydronic systems offer energy efficiency advantages, often consuming significantly less energy compared to VRF systems, further reducing operational costs.

Ultimately, you should look beyond the marketing claims of VRF systems, advocating for a comprehensive analysis that includes life-cycle costs, environmental impact, and health safety. Hydronic systems, with their safety, efficiency, and cost-effectiveness track record, present a robust alternative to VRF systems. This emphasis on reliable, unbiased information underscores the importance of making informed decisions in HVAC system selection, considering both immediate and long-term consequences for human health and environmental sustainability.

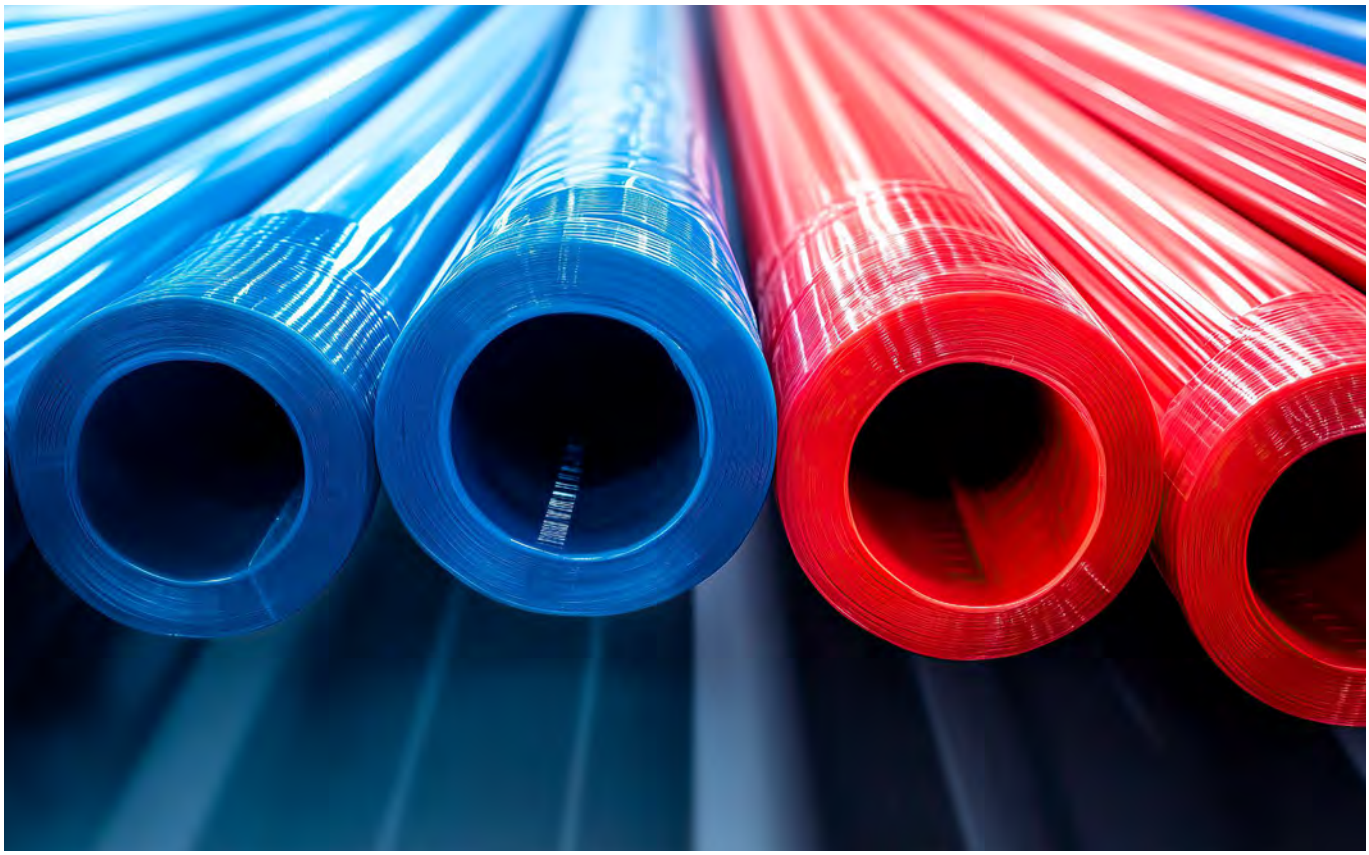
Trend #5
Evolution of Building Materials

TREND #5

Evolution of Building Materials

The advancement of materials used in building systems has led to significant improvements in the efficiency and sustainability of mechanical systems. One notable development is the increased use of PEX (cross linked polyethylene) pipe in plumbing, heating and cooling systems. PEX pipe is a durable, flexible plastic that can bend around corners and tight spaces without breaking, resembling a strong, bendable straw.

This characteristic greatly reduces installation time, making hydronic systems more viable. As nearly every building requires cooling, the decreasing cost and increased adoption of pre-insulated PEX pipe by installers have made hydronic cooling via chilled water fan coils much more cost-effective.



Unlike traditional copper pipes, which require welding and are prone to bursting in freezing temperatures, PEX pipes are resistant to freezing, cracking and leaking, providing a more reliable solution for builders. They are easy to install, versatile and also allow for effective metering. When used with fan coil units, PEX pipes offer ultimate flexibility, as a six-way valve enables the use of a two-pipe fan coil system where the entire coil can be used for heating or cooling.

We're also seeing the six-way control valve gain traction in mechanical designs. This valve is particularly advantageous in multi-use buildings where individualized heating and cooling spaces are desirable (e.g. residential apartments). With traditional two-pipe systems, the entire building must be either in heating or cooling mode, limiting occupants' control. However, six-way valves manage the changeover between heating and cooling, allowing each occupant to choose their preferred mode. This results in smaller fan coil units (FCUs) as a single coil receives all the hot or chilled water, reducing the number of valves required. Instead of needing multiple two-way valves, a single six-way valve is sufficient.

Additionally, if energy metering is required, a six-way valve only needs a single meter, whereas a four-pipe FCU system would require two meters. This streamlined approach not only simplifies installation and maintenance but also enhances the overall efficiency and sustainability of the building's HVAC system.

A Vision for the Future

As we navigate the complexities of the 21st century and confront the challenges posed by climate change, the vision of “Moby” encapsulates a profound aspiration for a more sustainable and resilient future. It illustrates the potential of human ingenuity and technological advancement to create sanctuaries where clean air, efficient energy use, and community integration are prioritized.

In the quest for sustainable building practices, the trends highlighted in this white paper—mass timber construction, heat pumps, district energy systems, biophilic design, the phasing out of VRF systems, and introducing PEX pipes—are not just innovations. They provide indications of progress, demonstrating a collective movement towards reducing our carbon footprint, conserving resources, and enhancing the livability of our built environments.

When we adopt strategies and practices such as these, we are not merely responding to the immediate environmental crises but also set the foundation for a resilient infrastructure capable of withstanding future ecological shocks. Our commitment to integrating these sustainable solutions into mainstream construction practices reflects a deep recognition of the necessity for a profound shift in how we design, build, and inhabit our spaces.

In embracing these advancements, we not only mitigate the impacts of climate change but also enhance the quality of life for future generations. The path forward is clear: through continued innovation, unwavering commitment, and collaborative effort, we can build a world that harmonizes human habitation with the natural environment, ensuring a livable planet for centuries to come.

At Jaga, we are committed to building more comfortable indoor environments while limiting our impact on the natural environment. This focus is core to everything we imagine, design and build.

From sustainable heating, cooling and ventilation products, our solutions are designed to work with environmentally friendly technology such as heat pumps and solar energy. Operating on the lowest water temperatures, our award-winning radiators not only provide outstanding heating and cooling, they enhance the space with while maximizing comfort.

For more information go to **jaga-canada.com**

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