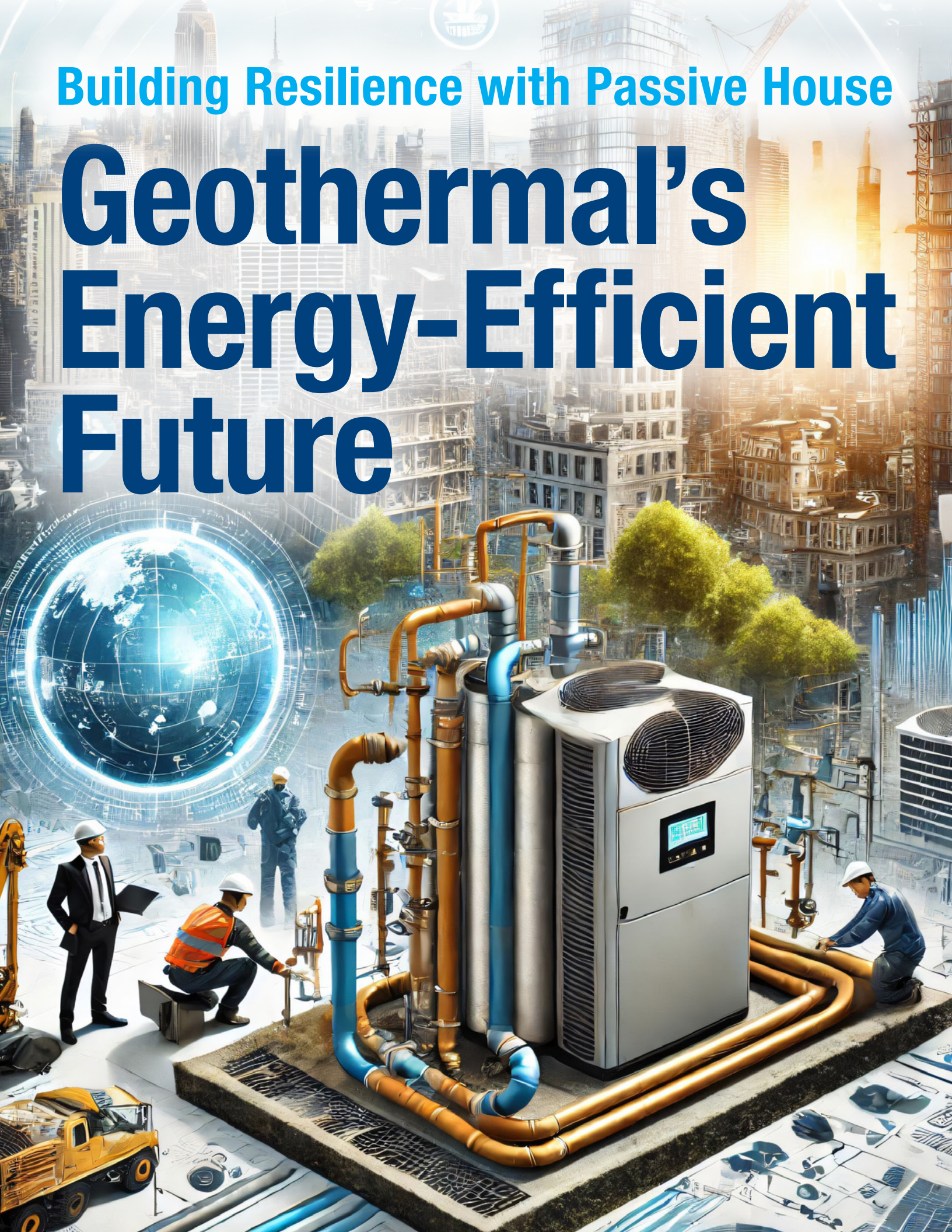
Building Resilience with Passive House

Geothermal's Energy-Efficient Future



In the heart of Brooklyn, an ambitious new project called Alafia is rising as a beacon of resilience, health, and sustainability. This wellness-oriented development, part of New York State's Vital Brooklyn initiative, is set to transform over 25 acres of decommissioned public land into a thriving community hub. Ice Air's Geothermal Heat Pumps are playing a critical step in aligning with Passive House standards used on this development.

With the guidance of Dattner Architects, Alafia is not just another urban revitalization project—it's actually a blueprint for addressing chronic social, economic, and health disparities. Central to its design is the adherence to **Passive House standards**[1], emphasizing high-performance, energy-efficient building practices, particularly in its HVAC systems.

Some of the key features for Alafia included:

- 2,400+ Affordable Apartments with housing for seniors, individuals with disabilities, and the homeless.
- Pedestrian-Friendly Neighborhood with everything within a 15-minute walk to support a healthy, car-free lifestyle.
- 11.3 Acres of Green Space featuring a fitness loop, play zones, urban agriculture, and vibrant courtyards.

"The Passive House standard is an important standard, but it hasn't been used extensively in New York yet," says Christopher Kolb, PE, Vice President at Cosentini Associates, the engineering firm on the project. "But that's changing. It's becoming one of the most important standards guiding projects seeking to reach sustainable elements throughout the site to reduce energy consumption for all residential buildings. The standard will not only reduce energy use, but improve indoor air quality and provide a better, healthier environment for residents while delivering buildings that stay cooler in summer and warmer in winter."

Geothermal Innovation: Ice Air's Heat Pumps as the HVAC Solution

Heating, ventilation, and air conditioning (HVAC) systems are a significant element in any building's energy footprint. For Alafia, the choice to utilize Ice Air's Geothermal Heat Pumps marks a critical step in aligning with Passive House standards. These heat pumps harness the renewable energy beneath the Earth's surface to provide both heating and cooling—an efficient, eco-friendly alternative to conventional systems.

Ice Air was not the basis of design, but Kolb noted that after doing the diligence and reviewing several manufacturers, Ice Air was selected for the project.

"From Ice Air's perspective, geothermal heat pump projects may involve more coordination with contractors during the installation phase (due to drilling, piping, etc.)," says Tom Glass, Ice Air's Director of Sales and Marketing, "as well as the need for detailed customization based on soil and climate conditions. There is also likely to be a longer lifecycle for the equipment, making performance reliability even more critical, something Ice Air excels at since we developed this technology."

For example, Glass points out that customization was necessary to adjust for the site's specific needs, such as making the units easier to install and ensuring compatibility with the Building Management System[2] being used. Modifying the design ensured optimal energy performance in a multifamily residential setting.

Ice Air's geothermal heat pumps are uniquely suited to meet the needs of Passive House projects, offering an energy-efficient solution[3] that reduces operational costs while ensuring reliable performance year-round. These systems take advantage of the relatively stable temperatures underground, which range from 50°F to 60°F just a few feet below the surface, to transfer heat during colder months and dissipate it during warmer ones.

"This closed-loop geothermal system (see SIDE BAR) operates with a low energy requirement, drastically reducing the carbon footprint compared to traditional HVAC systems" Glass points out. "By tapping into this constant energy source, Alafia's buildings can maintain the temperature balance necessary for Passive House compliance while utilizing a system that is durable, sustainable, and virtually unaffected by external weather fluctuations." [4]

Alafia's residents will benefit from consistent comfort, regardless of outside conditions, while supporting New York's larger goal of reducing its carbon footprint and meeting aggressive climate goals

Adaptability to New York's Environmental Conditions

New York presents a unique set of environmental challenges, from freezing winters to hot, humid summers. For this reason, the adaptability of Ice Air's Geothermal Heat Pumps was a critical factor in their selection for Alafia. These systems provide reliable heating even in extreme cold, something essential for New York's climate, where temperatures frequently dip below freezing.

"Geothermal heat pumps are becoming more common in New York due to a renewable energy push," Glass says alluding to Local Law 97[5], "but they were rare in urban areas and affordable housing. Ice Air developed this new technology to meet site-specific conditions such as available land, soil quality and the New York and other challenging climates."

A closed-loop geothermal system operates with a low energy requirement, drastically reducing the carbon footprint compared to traditional HVAC systems.

1. The Passive House Standard, also known as the Passivhaus standard, has several requirements that a building must meet to be considered a Passive House. These include the following: Space heating. The energy demand for space heating must be no more than 15 kWh/m2 of living space per year, or 10 W/m2 at peak demand. Primary energy. The total energy needed for all domestic applications must be no more than 60 kWh/m2 of living space per year. Airtightness. Passive buildings must be very airtight, with no more than 0.6 air changes per hour at 50 pascals of pressure. Thermal comfort. Living areas must be comfortable all year round, with no more than 10 percent of the hours in a given year exceeding 25°C. Passive House design and construction is based on five principles: super-insulated envelopes, airtight construction, high-performance glazing, thermal-bridge-free detailing, and heat recovery ventilation.

2. Additionally, the BMS will tie the use of DC Motors and VFD (variable frequency drive) Pumps, Advanced Energy Metering including extensive placement of energy meters and electrical submeters for analysis & minimizing parasitic power consumption and the flow meters for every water closet so that the building can immediately fix any water leakage (part of Passive House requirements).

3. The site of the project has its own micro-grid, and additional on-site green energy generation is provided by the rooftop solar panel arrays as well as a fuel cell coupled with a biodigester, powered by waste from on-site urban farms.

4. This project uses a centralized ERV (energy recovery ventilator) and everything in the building has to go back to that ERV except for the dryer exhaust. Every 9 holes, drilled 499 feet down, are circuited together underground with horizontal piping and they come up with 2 pipes: supply and return. 90 wells drilled in total for this job with 6-inch open holes, using Cement-Bentonite to keep the holes open. Bentonite product is displaced with the thermal grout which is used to transfer heat between the inside of the pipes and the ground. The Closed-loop system is used so very little maintenance needed and long lifespan.

5. Buildings account for approximately two-thirds of greenhouse gas emissions in New York City, and both Mayor Adams as well as prior mayors have pledged to address these emissions as part of their plans to make the city carbon neutral by 2050. Local Law 97 is one of the most ambitious plans for reducing emissions in the nation. Local Law 97 was included in the Climate Mobilization Act, passed by the City Council in April 2019 as part of the Mayor's New York City Green New Deal.

"The owner did not want the bore holes to be located below the foundation of the building, so there was a need to limit the HVAC load in the building to adapt to the number of bores that could fit around the site," Glass says. "In other words, there were trade-offs between the sizing of the storage tank and the amount of equipment (including heat pumps) needed in the mechanical room."

But the tradeoffs always favored of energy and comfort.

In the summer months, for example, the geothermal system excels at keeping indoor spaces cool without the excessive energy use typically associated with traditional air conditioning units.

"The efficiency of Ice Air geothermal technology meant that Alafia's residents will benefit from consistent comfort, regardless of outside conditions, while supporting New York's larger goal of reducing its carbon footprint and meeting aggressive climate goals" he added.

Supporting Long-Term Sustainability and Wellness

The decision to integrate Ice Air's geothermal heat pumps at Alafia isn't just about immediate energy savings—it's a long-term investment in the sustainability and health of the community. By prioritizing renewable energy sources like geothermal, Alafia is reducing its dependency on fossil fuels, cutting emissions, and lowering energy costs for residents – something that fits perfectly with New York's aggressive climate objectives.

By integrating affordable housing with open space and fitness opportunities, healthy food retail, urban agriculture, social enterprises focused on economic empowerment, access to healthcare, and community-wide programming, the social determinants of health to improve the greater wellbeing of Brooklyn residents is addressed.

Sustainability and wellness are key pieces of the New York State Energy Research and Development Authority (NYSERDA) work across New York's economy and energy systems. Since its founding in 1975, NYSERDA's mission, vision, and programs are continually evolving to improve the lives of New Yorkers. When ready, the building will be eligible for NYSERDA incentives that offset installation costs for the rooftop solar panels. The project is also expected to qualify for Solar and Geothermal Tax Credits that will generate $670,000 USD in equity.

State financing for the first phase included $38.1 million in permanent tax-exempt bonds, Federal Low-Income Housing Tax Credits that will generate $117.8 million in equity, $174.9 million in subsidy from New York State Homes and Community Renewal, and $450,000 from NYSERDA.

Ice Air's Contribution to Sustainable Development

Ice Air's commitment to providing sustainable, energy-efficient solutions aligned perfectly with Alafia's objectives. The geothermal heat pumps selected for the project not only met the energy performance requirements set by Passive House standards but also contributed to a broader vision of environmental stewardship and community wellness.

Their low operational costs, ease of maintenance, and longevity made them ideal for large-scale developments like Alafia. Moreover, by reducing utility bills, these systems played a direct role in addressing economic disparities, one of the core goals of the Vital Brooklyn initiative.

A Model for Future Developments

As Alafia moves through its phased redevelopment, it stands as a model for future resilient developments, demonstrating how design, technology, and social responsibility can intersect to create healthier, more sustainable communities. The integration of Passive House standards and innovative HVAC solutions like Ice Air's Geothermal Heat Pumps ensures that Alafia will not only meet the needs of its current residents but will also serve as a sustainable, energy-efficient solution for future generations.

"This project showcases how energy-efficient technology, when thoughtfully applied, can become the backbone of urban resilience—offering not just a solution to environmental challenges, but a pathway to better health and economic equity for all," says Ric Nadel, President and CEO of Ice Air. "And Alafia's adoption of Passive House standards, particularly in its HVAC systems, sets a new precedent for sustainable urban design in New York. Alafia demonstrates the potential for resilient, wellness-focused communities in even the most challenging urban landscapes."

Understanding "The Loop" in Geothermal Systems: A Guide for Developers Embracing Passive House Standards

As the demand for sustainable buildings grows, developers and building owners are increasingly encountering terms like "the loop" in relation to geothermal systems. For those working to meet the rigorous requirements of Passive House standards, particularly in New York where this concept is relatively new, gaining a basic understanding the technology behind geothermal loops and heat pumps is essential to help them achieve their efficiency goals.

Geothermal energy systems are not just about tapping into renewable energy sources—they represent a highly efficient, cost-effective solution for heating and cooling buildings while minimizing environmental impact. Alafia is setting a standard for the use of this technology, and the following points will help "unpack" what the loop means, how it works with heat pumps, and why it's an ideal fit for projects.

What Is "The Loop" in a Geothermal System?

At the heart of any geothermal system is what's known as "the loop," a closed circuit of piping buried in the ground, which circulates a glycol-water mixture. This loop is responsible for transferring heat between the ground and the building, using relatively stable temperatures found a few feet below the Earth's surface. In the winter, the loop absorbs heat from the ground and delivers it to the building; in the summer, it removes excess heat from the building and dissipates it back into the earth.

There are typically two types of loops developers should consider:

- **Closed-Loop Systems**: The most common type, these systems continuously circulate the same fluid through underground pipes to exchange heat with the ground.
- **Open-Loop Systems**: Less common, these systems use groundwater from a well or another source, exchanging heat before returning the water to the earth.

For Developers and Owners, Understanding the Efficiency of the Loop is Crucial.

Because the ground maintains a constant temperature (usually around 50°F to 60°F in New York), geothermal systems are more efficient than conventional air-source systems, which must work harder to deal with fluctuating outdoor temperatures.

One key consideration when geothermal systems are designed is whether the loop will be "heating-dominant" or "cooling-dominant." This **balance** is critical to ensuring that the system performs efficiently throughout the year.

In developments like those following Passive House standards, heat pump water heaters are commonly used in conjunction with geothermal loops. The heat from the wastewater system is fed into the heat pump, which further reduces the amount of energy needed to heat the building's domestic water supply. This process not only makes the geothermal loop more efficient, but also helps reduce the overall load on the building's electrical system.

By sizing the geothermal loop and the wastewater heat recovery system properly, developers can ensure that the system can cover the building's space heating, cooling, and domestic hot water needs throughout the year without excessive energy consumption or high operational costs.

Why Developers Should Consider Geothermal Loops and Heat Pumps

For developers and building owners, the upfront costs of geothermal systems may seem daunting. However, the long-term benefits make these systems a smart investment, especially when paired with Passive House standards.

- **Energy Savings**: Geothermal systems significantly reduce the amount of energy required to heat and cool a building, resulting in lower utility bills. This is especially true in larger developments where the energy savings multiply over time.
- **Reduced Carbon Footprint**: By utilizing renewable energy stored underground, geothermal systems help buildings reduce their reliance on fossil fuels, aligning with New York's aggressive carbon reduction goals.
- **Increased Property Value**: Buildings with geothermal systems are highly attractive to environmentally conscious tenants and buyers, who value lower operational costs and sustainable living.
- **Operational Reliability**: Geothermal systems have fewer moving parts than traditional HVAC systems, which translates to lower maintenance costs and increased reliability.

The Future of Sustainable Building is the Loop

As New York continues to adopt and expand upon Passive House standards, understanding the role of geothermal loops and heat pumps becomes increasingly important for developers and building owners. These systems, when properly sized and balanced, offer unparalleled energy efficiency, reduced operational costs, and long-term sustainability. By integrating innovative solutions like wastewater heat recovery, geothermal systems can provide heating, cooling, and domestic hot water with minimal environmental impact.

In embracing geothermal technology and Passive House principles, developers are not just building more sustainable structures—they are investing in the future of urban living, where energy efficiency, comfort, and resilience coexist harmoniously.

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