# **Commercial Clean Heating & Cooling**

A Program of Sustainable Westchester

# **CASE STUDIES**



A Program of Sustainable Westchester

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### **SOMERS CROSSING TOWNHOMES**

Program	New Construction Program
Funding Entity	NYSERDA
Sector	Multifamily, New Construction
Energy Conservation Measures Implemented	Geothermal/Ground Source Heat Pump, hybrid hot water heaters that heat water with free byproduct heat from geothermal, LED lighting Solution Provider
Annual Cost Savings	A comparable 2500 sq ft structure would have annual utility bills averaging \$3,600+, while this project averages \$960 per year
Owner	Boniello Development
Solution Provider	Johnson Controls
Location	Somers, NY
No. of Units/ Square Footage	66 units, 2000-3000 sq ft each



#### **Project Background**

Inspired by the increasing demand of people who want to downsize but not reduce quality, Boniello Development began designing Somers Crossing as a premium product on Route 100 in Somers. Additionally they took a bet on the idea that, "sustainability sells." There was some debate as to whether we should use geothermal at all, but we believed customers would make their purchase decisions on more than just "the numbers." There is a perceivable thoughtfulness in Somers Crossing when you see the attention to detail. The overall package of a zero compromise condo (Built to the same quality as a typical, 4000-5000 sq ft homes), along with a focus on sustainability created a unique product that the town and the customers love. 66 units are being built over 4 years and currently about  $\frac{1}{2}$  these units have completed construction and  $\frac{3}{4}$  sold already.

### **Project Highlights**

The system uses a DX system that runs a compressor with puron as the refrigerant to condition the ground heat at 55F to upto 150F for heating and can also decompress the air to use it as an air conditioner. A traditional Forced Air system then circulates this conditioned air across the entire building. The system requires drilling 100 ft deep in the ground and the installation comes with a warranty of 20 years. The GSHP system cost \$12,000 per ton compared to the propane system that costs \$7500/ton and came with a 26% federal tax credit incentive to the customer that brings the cost down to \$9000/ton + \$1500/ton incentive from NYSERDA to the installer/developer and a break even period of less than 2 years. A comparable 2500 sq ft structure would have annual utility bills averaging \$3,600+, while this project on the other hand averages \$960 per year. This will lead to an expected 152.46 metric tons CO2 reduction per year.



# **AUTUMN GARDENS HOUSING COMPLEX**

Program	Commercial Clean Heating & Cooling
Funding Entity	HUD Project Improvement funds, NYSERDA
Sector	Multifamily (Affordable Housing), Retrofit
Energy Conservation Measures Implemented	Geothermal/Ground Source Heat Pump
Annual Energy and Cost Savings	40.7 % energy savings; \$35,000
Owner	Lockport Housing Authority
Solution Provider	Buffalo Geothermal Heating (BGH)
Location	788 E High St, Lockport, NY 14094
No.of Units/ Square Footage	9 buildings, 72 units



### **Project Background and Highlights**

The Autumn Gardens Housing Complex consists of 9 building low-income housing complex with 72 housing units. Its 40 years old electricity-powered heating system was converted to a geothermal system between September 2015 and May 2016. A total of 171 WaterFurnace heat pumps were installed in the complex by BGH, and the geothermal portion of the project cost \$800,000. NYSERDA provided a \$68,400 grant upon project completion, plus an additional \$25,200 after the system delivered 40.7% energy savings during its first year and 75% energy savings for just heating. Based on BGH's projections, the system will save \$35,000 annually and \$1.6 million over a 30 year period.



## **MINERVA PLACE CONDOMINIUM**

Program	Multifamily Performance Program (Low Rise New Con- struction Pilot)
Funding Entity	NYSERDA, White Plains Affordable Housing Fund, NYS Affordable Housing Corporation grants to homebuyers
Sector	Multifamily (Affordable Housing), New Construction
Energy Conservation Measures Implemented	Geothermal/Ground Source Heat Pump
Annual Cost Savings ; Annual Cost Savings	57,487 kWh, 45% less energy usage ; 37% reduction in annual cost
Owner	Community Housing Innovations, Inc.
Solution Provider	Buffalo Geothermal Heating (BGH)
Location	5 Minerva Place, White Plains NY 10601
No.of Units/ Square Footage	14 units, 3-story, 15,0698 sq ft



### **Project Background**

The featured project is a multifamily housing development located in White Plains, NY that was completed in 2007. The building utilizes geothermal heat pumps for heating, and has no natural gas or oil service. As such, the building is fully electrified. The aim of the project was to achieve a 20% performance target under NYSERDA's Multifamily Performance program and the inspiration came from a Geoexchange system installed in 2008. This project enables the building to achieve an ENERGY STAR label.

### **Project Highlights**

Minerva Place Condominiums were the first project in White Plains to use geothermal heat pumps for heating and cooling. A closed loop system with water and 20% glycol was used with holes drilled about 450' deep. Analysis was done by TRC of actual performance. TRC calculated the total in-unit annual estimated energy usage of the building as 70,058 kWh, based on the actual usage of a sample of 4 units for a year (from Nov-09 to Oct-10). The energy usage from the 4 units was compared to the building model and RECS. The RECS tool was used to estimate the performance of buildings relative to HUDs database of residential buildings. It was found that the annual proposed electricity consumption was 127,544 kWh, as simulated by the final proposed building model. This was 57,487 kWh higher than actual usage, and the actual building is using about 45% less energy than the modeled building. The building scored a 98 on the RECS tool, which means it performs better than 99% of buildings in HUDs database. The total project cost was \$4,050,000.



# **BEACH GREEN DUNES II**

Sector	Mixed-use (Affordable Housing), New Construction
Energy Conservation Measures Implemented	Geothermal/Ground Source Heat Pump, Solar Panels, Passive House Design
Annual Cost Savings	10% less in opperating costs
Owner	L+M Development Partners, Inc.
Solution Provider	ZBF Geothermal
Location	4519 Rockaway Beach Boulevard, Queens, NY 11691
No.of Units/ Square Footage	127 units, 8-story, 121,000 sq ft



#### **Project Background and Highlights**

Beach Green Dunes Phase II located in the Edgemere neighborhood of Queens is a 100 % Affordable Housing Development featuring geo-thermal energy generation, passive house standards and resilient design. The building includes approximately 50 accessory residential surface parking spaces (both covered and uncovered) on the ground floor along with approximately 2,495 SF dry flood proofed commercial space. The project has 127 rental apartments located on the second through the eighth floors affordable to households whose income does not exceed 100% of Area Median Income. The project is L+M's first building designed and built to Passive House standards. In addition the site's subterranean conditions provide the opportunity to use geothermal technologies to heat and cool the building. The building also includes photovoltaic panels on the roof and on a steel trellis covering the surface parking area. The closed-loop geothermal system has 36 bore wells 450' deep. Installed under the parking lot and the playground, it has vertical stack heat pumps with ECM fans and has remote monitoring of loop field temperatures. The system was projected to have a return on investment within one year due to the cost savings of not installing other mechanical equipment. The operating costs were estimated to be 10% less than natural gas for heating and a one-bedroom apartment was estimated to use only \$15 of electricity to cool the apartment over the summer. The project was also awarded a \$100,000 PSEG Long Island rebate.



# **LILLIAN PARK**

Sector	Mixed-use, New Construction
Energy Conservation Measures Implemented	Geothermal/Ground Source Heat Pump
Annual Cost Savings	\$36,000 operational cost savings
Owner	Shiplake Properties
Solution Provider	Diverso Energy
Location	44 Lillian St, Toronto, ON M4S 0B7
No. of Units/Floors/Square Footage	600 units, 26-story, 500,000 sq ft



### **Project Background**

For commercial and multifamily buildings, the third- party utility model provides a low-risk heating and cooling solution for real estate developers. Diverso Energy, an Ontar-io-based geothermal utility company uses such a model; it designs, builds, pays for, owns, and operates the geothermal system. One of their projects is the installation of a geothermal system in Lillian Park, a 26-story, 600-unit property 500,000 sq ft in size which opened in 2020.

### **Project Highlights**

The project had a net construction savings of \$450,000 by eliminating the cooling tower, heating boilers and reducing the size of the rooftop mechanical penthouse. In addition,the geothermal system has led to operational cost savings of \$36,000 in its first year, based on Diverso's financial projections. When including gas, electricity, maintenance and repairs, water, chemicals, capital reserve avoidance, it is approximately \$350,000 annually.



# **MILLENNIUM TOWER**

Sector	Mixed-use, New Construction
Energy Conservation Measures Implemented	Geothermal/Ground Source Heat Pump, 932 water-to- air ground source heat pumps, closed-loop geothermal system
Annual Energy Savings	22% reduction in energy consumption compared to a base case
Owner	Millennium Partners
Solution Provider	ClimateMaster
No. of Units/Floors/Square Footage	234 units, 35-story, 400,000 sq ft
Location	30 West Street, New York, NY, 10004



### **Project Background and Highlights**

Real estate developers, Millennium Partners, chose to install ground source heat pumps in their 35-story condominium building with a 234-unit condominium building, 400,000 sq. ft in size. This system played a large part in the Millennium Tower obtaining LEEDTM Gold Certification. The heat pump manufacturer, Climate Master, used a non-ozone-depleting refrigerant for their heat pumps, making them an environmentally friendly option.



# **WALL CENTRE CENTRAL PARK**

Sector	Mixed-use, New Construction
Energy Conservation Measures Implemented	Geothermal/Ground Source Heat Pump, Wastewater Heat Recovery System
Annual Energy Savings	Natural Gas use reduction: 23,400 therms
Owner	Wall Financial Corporation
Solution Provider	Geo-NII
Location	Vancouver, British Columbia
No. of Units	Phase One: 728 units Phase Two: 332 units



### **Project Background and Highlights**

Wall Centre Central Park (Wall Centre) is a mixed-use residential development in Vancouver, British Columbia. Phase One of the project was completed and opened to the public in 2017 and Phase Two was completed in 2018. Each phase incorporates a wastewater heat recovery system from SHARC Energy Systems, sized to provide approximately 30% of the water heating load at high efficiencies. Wall Centre Phase 2 implements a Piranha system, commissioned in July 2018. It consists of two Piranha T10 modules operating in parallel, for 20 tons' total heat output. Each module houses a specialized heat pump, serving as a batch-reactor type wastewater heat recovery unit. Each pass of domestic water through the heat pump is designed to increase its temperature by 9°F. between Jan. 1st, 2019 and Oct. 31st, 2019, a Carbon dioxide reduction of 126 tonnes CO2e/yr was achieved which is equivalent to planting 5,520 trees.



# **GARMENT STREET CONDOS**

Sector	Mixed-use High Rise, New Construction
Energy Conservation Measures Implemented	Geothermal/Ground Source Heat Pump
Owner	Momentum Developments
Solution Provider	Diverso Energy
Location	120 Victoria Street South, Kitchener, ON
No. of Units/Floors/Square Footage	300 units, 26- story, 300,000 sq ft



### **Project Background and Highlights**

This building is in the middle of the technology district and includes the new Google building built by Momentum Development and the Zehr Group. The developer wanted to provide a low carbon innovative building to align with the high tech neighborhood but also had budget restraints as it was a condominium. Utilizing the energy as a service business model offered by Diverso Energy they were able to accomplish both. The building has a rooftop pool which also doubles as a heat dump for the geothermal system making it more effective long-term. The borefield which consists of over 100 holes to a depth of 600 ft was installed pre-construction under the building footprint. Currently in Ontario there are no tax credits or incentives available but the developer was able to reduce their construction costs by over \$300,000 thanks to the elimination of heating boilers and cooling towers. The rooftop amenity space which includes an outdoor pool offers a far better experience for the occupants by eliminating noisy equipment from the roof. This feature along with the extra sustainability provided a great value for the sales and marketing team.



# **THE PLANT CONDOS**

Sector	Mixed-use High Rise, New Construction
Energy Conservation Measures Implemented	Geothermal/GSHP, reduced window / wall ratio to improve envelope performance, green roofs provide additional insulation value and stormwater management, mixed use building enables load-sharing efficiencies
Annual Energy Savings; Annual Cost Savings	Electricity and gas savings approximately 35cents /sf , water - \$7,000, capital reserve for displaced equipment (cooling tower)- \$25,000, maintenance savings from displaced equipment-\$25,000, chemicals from displaced cooling tower- \$7,000
Owner	Windmill Developments and Curated Properties
Solution Provider	Diverso Energy
Location	41 Dovercourt Road, Queen West area, Toronto, Canada
No. of Units/Floors/Square Footage	10 -story; 74 units; 100,000 sf (25,000 sf retail + 75,000 sf residential)



### **Project Background**

A residential condo located at a former industrial property, the redevelopment was planned as a mixed-use development to include 25% non-residential uses. This project created employment opportunities in the area and was designed as a complete community, or a vertical village in the Queen West area of Toronto. The 25,000 sf commercial podium contains storefront retail at grade and office space on the second floor which provides a base for the 8 stories of residential above, with 74 units in the upper 75,000 sf. The development was completed in 2020.

### **Project Highlights**

Diverso Energy was the Geothermal Utility Firm who designed, built, owns and operates the geothermal system. The project used the One Planet Living Framework to guide the design in order to achieve a positive social and environmental impact. There was a strong focus on urban agriculture and local food to encourage health, well-being and to build community. The building features large balconies for private gardens, green roofs on the upper roof and podium roof. The amenity space provides a communal kitchen for social gatherings focused on food, a greenhouse south wall to start seedlings and communal container gardens on the podium roof for herbs and vegetables. The building name references both this focus on growing as well as its historical use as a factory. There was no capital outlay and the building shows positive cash flow from year one.



### **SIANO BUILDING**

Program	NYS Clean Heat Statewide HP Program Incentives
Funding Entity	NYSERDA
Sector	Mixed-use, New Construction
Energy Conservation Measures Implemented	Geothermal/Ground Source Heat Pump
Annual Cost Savings	\$66,000 cost savings compared to conventional systems
Owner	Matthew and Chris Siano
Solution Provider	Buffalo Geothermal Heating (BGH)
Location	363 Grant Street, Buffalo, NY
No. of Units/Floors/Square Footage	Retail space + 11 apartments, 12600 sq ft



**Project Background and Highlights** 

Completed in 2017, the Siano Building is a \$2.3 million project that converted a vacant lot into a 12,600 sq. ft mixeduse building featuring retail space and 11 apartments. As NYSERDA's approved contractor, BGH was able to use NYSERDA's GSHP Rebate program to help offset costs and get a rebate of \$38,000. The building exclusively uses geothermal heat pumps for heating, cooling, as well as domestic hot water. By utilizing available rebates and the 10% tax credit, the overall cost of installing the GSHP was several thousand dollars less than a conventional system, dispelling the notion that these systems always have much higher upfront costs over their traditional counterparts. In total, rebates and tax credits covered nearly 30% of the overall system cost—with the savings achieved, this project has a payback period of zero.

Based on cost analysis by BGH, the project is a cheaper alternative to traditional natural gas heating systems. Additionally, infrastructure expenses were much lower (less \$12,000) since GHSP systems do not require gas lines, cooling towers, furnace exhausts, etc. The building owners will continue to see significant annual savings in their operating and maintenance costs for both the heating/cooling and hot water systems since boilers and cooling towers are not required.



# **ZERO PLACE**

Program	New Construction Program
Funding Entity	NYSERDA
Sector	Mixed-use, New Construction
Energy Conservation Measures Implemented	Geothermal/Ground Source Heat Pump, Solar Panels
Annual Cost Savings	NYSERDA rebate: \$109,000
Owner	David Shepler, Anthony Aebi, Luis Martinez, and Keith Libolt
Solution Provider	Buffalo Geothermal, Matrix New World
Location	87 N. Chestnut St New Paltz, NY 12561
No. of Units/Floors/Square Footage	46 units, 15,000 sq ft



### **Project Background and Highlights**

The building was selected as a winner in New York State's inaugural Buildings of Excellence Competition for the design, construction and operation of a zero-carbon-emitting multifamily building. It is designed to achieve LEED certification and net-zero-energy performance is scheduled to complete construction by late 2020. It will include 5 affordable housing units and over 8,000 square feet of retail space. The building combines a geothermal system for all heating, cooling and hot water with a 246-kW solar system and high-performance building envelope to achieve net-zero energy.



## **MAMARONECK SELF STORAGE**

Program	New Construction Program
Funding Entity	NYSERDA
Sector	Commercial, New Construction
Energy Conservation Measures Implemented	VRF/Air Source Heat Pump, high-performance spray foam insulation; energy recovery ventilation system; interior and exterior LED lighting on motion sensors; an 8 kw solar shingle system
Annual Energy Savings, Annual Cost Savings	52% more energy efficient than baseline construction; \$35,000
Owner	Chris Murphy and Sean Murphy
Location	426 Waverly Avenue, Mamaroneck, NY
No. of Units/Floors/Square Footage	285 units, 4-story, 40,000 sq ft



### **Project Background**

In 2014, Chris and Sean Murphy, owners of Murphy Brothers Contracting in Mamaroneck, started the design and build of a multi-story self-storage facility that would meet the increased demand for storage space in their community. Today, Mamaroneck Self Storage is a 40,000 sq. ft. all-electric self-storage facility with nearly 30,000 sq. ft. of rentable storage space and 285 mixed units throughout four-stories. It was constructed as a green facility because they believe that by reducing their energy usage, they can provide their community with a more sustainable environmentally friendly operation.

### **Project Highlights**

The main goal of the project was energy efficiency and sustainability in order to meet the rigorous standards of NYSERDA's New Construction Program. The construction boasts energy-saving features that include: high- performance spray foam insulation; high-efficiency HVAC equipment with variable frequency flow Daikin heat pumps for heating/cooling and a 65% efficient ERV system; interior and exterior LED light on motion sensors and an 8.5 kW solar shingle system. According to NYSERDA, these features make Mamaroneck Self Storage 52% more energy efficient over standard baseline construction, with an annual operating cost savings of \$35,000. The energy-saving measures also earned a \$60,000+ rebate from NYSERDA and a sales tax incentive from Westchester County.

"As general contractors, we understand why developers are reluctant to invest in energy-saving upgrades.", said Chris Murphy. "However, monthly energy bills don't lie. Energy-efficiency is just that, it's money-saving, and what developer doesn't want to save money. It just makes sense!" Chris Murphy is also a Board member of the New York Self Storage Association.



## **PROPERTY MANAGEMENT HEADQUARTERS**

Program	Clean Heating and Cooling Communities
Funding Entity	NYSERDA
Sector	Commercial, Retrofit
Energy Conservation Measures Implemented	Variable Refrigerant Flow/Air Source Heat Pump, com- bined with a high-efficiency ERV system
Annual Energy Savings; Annual Cost Savings	60-70% energy savings every year; \$500,000 over 2 years
Owner	Gibraltar Management Comp
Solution Provider	Blend Air Mechanical Corp
Location	150 White Plains, Tarrytown, NY
No. of Units/Floors/Square Footage	4-story, 71,000 sq ft

### **Project Background and Highlights**



Fujitsu's air-source VRF heat pump system was selected to replace the building's 47-year-old natural gas-fired rooftop units that are inefficient by today's standards. The VRF system provides simultaneous heating and cooling throughout the building while the ERV system recovers energy from exhaust air and transfers it to the incoming fresh air. By the end of Phase Two, the building will have 109 heating and cooling zones compared to 48 zones in the previous system. The new heat pump system will provide annual electricity and natural gas savings over the original system of 224,000 kWh and 38,800 therms respectively. This leads to a \$62,000 annual cost reduction including a reduced annual maintenance cost from \$49,000 to < \$15,000. However \$500,000 approx in energy savings over 2019-2020 have been achieved beyond expectation. The cost to upgrade the original system to a heat pump system versus a standard code minimum system is 9.6% higher. As a result, the simple payback for upgrading from a code minimum system to heat pumps is just 3 years. Based on the results of the analysis, the project was fasttracked by the customer.



## **WESTWOOD GARDENS**

Sector	Retail Commercial, New Construction
Energy Conservation Measures Implemented	Geothermal/Ground Source Heat Pump
Annual Cost Savings	\$250,000
Owner	CollecDev
Solution Provider	Diverso Energy
Location	8868 Yonge Street, Toronto, ON
No. of Units/Floors/Square Footage	420 units, 2 buildings 16-story each, 330,000 sq ft



### **Project Background and Highlights**

The project covered 2 buildings each 16 stories, 420 units with a common parkade and main floor retail of size 330,000 sq ft. "Diverso partnered with Eolectric in Montreal in order to introduce a unique proposition that unlocks the potential of geothermal to be more widely adopted," says Maurice Wager, President of Collecdev development company. Eolectric has a background in renewables, financing expertise and access to capital. With Eolectric's backing, Diverso developed a utility model under which they build, own, maintain and operate a building's geothermal system for 30 years, after which the condo owners can choose to buy it. This reduces capital costs, eliminates the developer's budget and technical challenges, and also helps the condo owners corporation manage their annual budget.

By law, condo owner corporations must use owner maintenance fees to pay operating costs and also carry reserves for long-term capital upgrades. This can be problematic with gas heating. Gas is traded on the global commodities market and prices can be volatile, often spiking when the economy weakens and employment becomes unstable. Buyers liked the clean energy system, electric car chargers, biking facilities, and nearby trails. Westwood meets the Toronto Green Standard Tier Two (equivalent to LEED<sup>™</sup> Gold).



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### **KENSINGTON HIGH SCHOOL FOR THE CREATIVE AND PERFORMING ARTS**

Sector	P-12 Schools, New Construction
Energy Conservation Measures Implemented	Geothermal/Ground Source Heat Pump
Annual Energy Savings; Annual Cost Savings	46% energy savings, 64% water savings
Owner	School District of Philadelphia
Solution Provider	Geo-NII
Location	1901 N Front St, Philadelphia, PA 19122
Square Footage	Gross Area: 88,450 sq ft. Conditioned Space: 79,695 sq ft



#### **Project Background**

A former industrial site known for recreational drug dealing and as a dump- ing ground inhabited by vagrants and unwanted pets did not seem to be an ideal place to locate a new high school. But when activist student group Youth United for Change championed the idea for smaller, greener high schools to reduce the dropout rate, the School District of Philadelphia divided its underperforming 2,000-student high school into four smaller schools. Kensington High School for the Creative and Performing Arts helped revitalize the derelict site and the surrounding community while using less energy than any other school in the district.

#### **Project Highlights**

This new construction high school has a Geothermal Water Source Heat Pump, which is a high performance (EER >30.0) and low-maintenance system. The system uses a Variable water flow system for efficient energy consumption and ERV for indoor air quality. There is no boiler system nor any of the mechanical components that accompany older HVAC systems. There are also no outdoor components on the roof. This is a modular operation, meaning that systems run only in rooms that are occupied. Temperature and humidity control are improved by implementing these "green technologies."

The ventilation system is a CO2 demand-based, air-to-air heat recovery system. It recovers 70% of heating/cooling from the exhaust. The energy management system monitors room temperatures via a web-based system that is easy to view and control. The 2011-12 annual EUI recorded was 39.74 kBtu/ft2 (Natural Gas 1.62 kBtu/ft2, Electricity 38.12 kBtu/ft2) that resulted in 46% of energy savings over standard 90.1-2004 design buildings. Other factors that helped this construction gain LEEDTM Platinum status are the energy-efficient lighting, including daylight harvesting, low-flow water fixtures, rainwater collection and a greywater system, and green roofs.

Maintenance costs for geothermal systems are lower than conventional systems due to no boiler, cooling tower or centrifugal chiller. All equipment is within the thermal envelope of the building. The developers who came into the project with zero knowledge of sustainable design bought into what the plan said it would deliver and came out converts of sustainable design. The school faculty has embraced the building's sustainability, using it not only as a "teaching tool" for science classes but also for art, photography, broadcasting, and performance.



# WHITE PLAINS HIGH SCHOOL

Program	Clean Heating and Cooling Communities
Funding Entity	NYSERDA
Sector	P-12 Schools, Retrofit
Energy Conservation Measures Implemented	Air-Source Heat Pump, with Demand Control Ventilation and Unit Ventilators with electronic expansion valves and Variable Refrigerant Volume
Owner	White Plains High School
Location	550 North Street White Plains, New York 10605
Square Footage	12,000 sq ft



#### **Project Background**

White Plains High School, located on a beautiful 75-acre campus in NY, offers almost 400 courses to 9-12th grade students. The B-Wing, one of two original structures on campus, was constructed in the 1950s leveraging the common architectural design methods of the era. The original design posed some challenges when it came to updating the HVAC system. A like-for-like replacement of the current UVs to avoid- downtime, added expense associated with designing a new solution, and to use the existing hot water system.

### **Project Highlights**

UV continues to be a great application in educational spaces because of the ability to provide individual control of heating and cooling and direct integration of fresh air into the classroom. They eliminated the need for condenser airflow and were used with factory installed EEVs, utilizing remote Daikin VRV IV heat pump condensing units. UVs have the ability to bring in up to 100% outside air directly into the classroom, and without the need for condenser airflow the existing louver opening was sufficient. The VRV condensers were placed outside on ground level where there is ample space and airflow to reject heat in cooling mode. The UV were also able to use the existing hot water heating system during the cold New York winters.

The solutions include DCV, a feature which increases operating efficiency for the school and translates into dollars saved for the District. EEVs in the system modulate the precise amount of refrigerant to each zone, meeting the requested set point in a more gradual and efficient manner. The demand control ventilation feature is continuously monitoring CO2 levels in the classrooms and bringing in fresh air accordingly, optimizing the volume of outside air supplied to the space and reducing energy waste. The single air filter in each unit removes particulate from raw outside air before it is conditioned and supplied to the classrooms.

The outcomes: The absence of ductwork removes potential audible distractions such as rattling, humming and buzzing. The outdoor air processing capability bolsters indoor air quality, creating better learning environments for teachers and students alike. Daikin VRV IV condensing units also played a large part in providing an environment that promotes productivity. The VRV IV's compact footprint provided multiple options for placement, and the best choice was ground level where there would be short, non-invasive refrigerant pipe runs.



# LADY BIRD JOHNSON MIDDLE SCHOOL

Sector	P-12 Schools, Retrofit
Energy Conservation Measures Implemented	Geothermal/Ground Source Heat Pump, 2,988 solar pho- tovoltaic panels, Wind turbine generating 2.4kW electrical capacity, ENERGY STAR rated kitchen, high-efficiency glazing and wall/roof insulation, LED lighting, water cistern for recycling and irrigation
Annual Energy Savings	Net-zero energy use
Owner	Irving Independent School District
Solution Provider	Geo-NII
Location	3601 W Pioneer Dr, Irving, TX 75061
Square Footage	152,250 sq ft

### **Project Background and Highlights**



The Lady Bird Johnson Middle School is the first net zero energy school in the State of Texas, and its campus is the largest net zero educational facility in the country. This is the eighth middle school for Irving ISD and serves approximately 900 students, sixth through eighth grade. The state-of-the-art facility is designed to provide as much energy on-site as it uses over the course of a year through energy-efficient construction and renewable energy systems. The school is designated LEED<sup>™</sup> Gold.

The Geothermal Heat Pump alone is responsible for 30% of energy use reduction in the building. The project drilled 468 Geothermal Bores approximately 250 feet deep in a closed loop system and is responsible for reducing HVAC energy use.

Other sustainable systems in the design and construction of this middle school include a solar array (brings over 41% energy savings), north clerestory, solar shading, wind energy, recycling, light shelves, a water cistern, and LED lighting. Educating the students about these systems was visibly built into the design to create a learning opportunity.



# **MICHIGAN STATE UNIVERSITY FRATERNITY HOUSE**

Sector	Higher Education, New Construction
Energy Conservation Measures Implemented	Air Source Heat Pump
Annual Energy Savings, Annual Cost Savings	50% reduction in annual utility bills
Owner	Michigan State University
Solution Provider	Bogden Plumbing and Heating
No. of Units/Floors/Square Footage	342 N Harrison Rd, East Lansing, MI 48823





### **Project Background and Highlights**

Through a partnership with Sigma Alpha Epsilon Financial & Housing Corporation, an over \$2,000,000 renovation was scheduled to begin in March 2016 and was completed in 2017. As part of a massive building renovation, the Sigma Alpha Epsilon fraternity house has more than doubled in size to accommodate 36 dorm rooms from 16 dorm rooms previously. Fujitsu air source heat pumps were installed to provide heating and cooling to the entire building as some parts of the building did not have air conditioning previously. A total of 61 indoor units were installed and, despite the building square footage more than doubling, the annual utility costs decreased by 50%.



# **ST. PATRICK'S CATHEDRAL**

Sector	House of Worship, Retrofit
Energy Conservation Measures Implemented	Geothermal/Ground Source Heat Pump
Annual Energy Savings	Over 30% reduction in energy consumption
Solution Provider	PW Grosser
Location	5th Ave, New York, NY 10022, NY
Square Footage	76,000 sq ft



### **Project Background**

Construction on St. Patrick's Cathedral began in 1858, but it didn't open its doors to worshippers until 1879. Since then, it's remained a New York City landmark, bringing in over 5 million visitors through its doors each year. The cathedral is rightly proud of its traditions and history, so over the course of the last century, the exterior of the church has remained largely unchanged. But underneath the old-world facade lies an ultra-modern heating and cooling system that few of the cathedral's millions of visitors would guess is there. Prior to 2017, the cathedral's heat was provided by oil-powered steam radiators, but after 60 years, it was time for a replacement. The church decided to look towards the future by switching to a geothermal heating and cooling system. They hoped to serve as an example to other historic buildings across the country, proving that eco-friendly initiatives don't mean compromising the building's look and feel.

### **Project Highlights**

PW Grosser designed a state-of-the-art geothermal heating and cooling system for St. Patrick's Cathedral in New York City, the largest Gothic Catholic cathedral in the country. Engineered as part of the \$177 million restoration project of this 138-year-old landmark, the system replaces a more conventional HVAC system that dated back to the 1980s. Early feasibility studies determined that installing a conventional HVAC system would have posed many challenges for preserving the integrity of this historic building. Plans required substantial excavation and rock removal which would have impacted the building's architecture. The geothermal system, however, is ecologically sound, takes up just 40% of the space of a conventional HVAC system, and uses the building's existing structure. Additionally, the geothermal plant will reduce the building's energy consumption by more than 30 percent and reduce CO2 emissions by approximately 94,000 kilograms. The St. Patrick's project highlights the tremendous utility of geothermal systems for restoration projects. Aside from the long-term financial and environmental gains, the systems are able to be built out of sight, without interfering with visual aesthetics that are crucial to preservation projects.



## **HUGUENOT MEMORIAL CHURCH**

Funding Entity	Mostly donations (70%) and PCUSA loan (30%)
Sector	House of Worship, Retrofit
Energy Conservation Measures Implemented	Geothermal/Ground Source Heat Pump
Annual Energy Savings; Annual Cost Savings	50% reduction in utility costs; 13.5 years payback
Owner	Presbyterian Church
Solution Provider	DJH Mechanical Associates, LTD
Location	901 Pelhamdale Ave, Pelham, NY 10803
Square Footage	35,000 sq ft



### **Project Background**

Originally a coal-fired furnace was used in the chapel. It was converted to oil -fired in the 1930's. A small task force started the "thinking" part of a Sustainable Huguenot in April of 2009. The next year was dedicated to study the actual condition and uses of the building, refine goals and define an overall approach to the building, including the HVAC system. In May of 2010 a report was submitted to the Session (the Church board) that recommended additional improvements and overhauling to the HVAC system. By May of 2011 they were able to recommend that a geothermal system best met the needs of the church and launched the Capital Campaign to raise the money for the project through donations. Professional design services were engaged to design the project, going to bid in the fall of 2011.

### **Project Highlights**

Geothermal heating and cooling was the best choice for HMC because it offered the lowest ongoing operating costs of all possible HVAC solutions examined. This significantly improved the church's long-term financial future; energy costs counted for at least 13% of the church budget and were reduced by more than half by switching to geothermal. A closed-loop vertical geothermal system on the west side of the church was installed. A field of small vertical wells were drilled to a depth up to 360 ft and fitted with pipes. Construction started on the exterior with the drilling of 27 wells in the parking lot during April of 2012. They stopped all programming in the church, except worship, for the entire summer to facilitate the installation of the system and other upgrades. They achieved the NY mandated "heat on" date for schools of Oct. 15, 2012. Further commissioning and final completion of all systems and controls was achieved by the end of the year. Previously the fuel cost was close to \$140,000 per year. The new fuel cost is \$70,000 annually. The geothermal conversion project included complete envelope sealing, addition of a thin glass storm window (with aluminium frame) and insulation for the buildings. The church now has all 34,000 sq ft fully conditioned, 365 days a year and expects additional programming. Now they can run nursery school, summer camp, gym, sanctuary for prayer and host summer weddings.



# **JACOB BURNS MEDIA ART CENTER**

Program	New Construction Program
Eurodian Entity	
Funding Entity	NISERDA
Sector	Non-profit, New Construction
Energy Conservation Measures Implemented	Geothermal heat pump, solar roof panels
Annual Energy Savings, Annual Cost Savings	30% energy cost savings
Owner	Stephen Apkon. Managing Director: Dominic Balletta
Solution Provider	OLA Consulting Engineers
Location	405 Manville Rd, Pleasantville, NY 10570
Square Footage	28,000 sq ft

### **Project Highlights**

This new 28,000 square foot Media Center houses the Jacob Burns Film Center's management and fundraising offices on the top floor, a master classroom and several smaller classrooms on the main level with the Center Studio. The Center Studio is a flexible, two-story space for events or exhibits. Other facilities include animation studios, an editing suite, sound effects recording studio, and a production studio. The building achieved a LEEDTM Gold Rating by the US Green Building Council.

The design of this building includes a saw tooth roof to maximize daylight on the office floor, a vertical well closed loop geothermal heat pump system with 37 borewells inside the parking lot, photovoltaic solar-electric power generation, daylight controlled lighting, heat recovery systems, and a radiant floor system that combine to achieve over a 30% energy cost savings compared to the LEED baseline building. The water conservation features in the design utilized ultra-low flow toilets, waterless urinals, and ultra-low flow lavatory faucets to achieve over a 50% water usage savings compared to the LEED baseline. On the sloped south façades of the sawtooth features are photovoltaic solar electric generating panels totaling over 13 kW of generation which supplies 7% of the electric demands of the building.







### GLOSSARY

ASHP	Air Source Heat Pump
DCV	Demand Controlled Ventilation
DX	Direct Exchange
EEV	Electronic Expansion Valves
ERV	Enthalpy Recovery Ventilation
GSHP	GroundSource Heat Pump
HP	Heat Pump
HUD	U.S. Department of Housing and Urban Development
HVAC	Heating Ventilation and Air Conditioning
LEED	Leadership in Energy and Environmental Design
LED	Light Emitting Diode
NYSERDA	New York State Energy Research and Development Authority
PSEG	Public Service Enterprise Group
RECS	Residential Energy Consumption Survey Tool
TRC	Technical Resource Manual
UV	Unit Ventilators
VRF	Variable Refrigerant Flow
VRV	Variable Refrigerant Volume