SETTING THE STANDARD:

Getting to zero carbon warehouses

The Wilkinson Project is an ambitious industrial development located on Wilkinson Avenue in Dartmouth, Nova Scotia. The plan calls for five multi-tenant warehouses totaling approximately 300,000 square feet. What makes the Wilkinson project unique is the focus its owner East Port Properties put on achieving energy-efficient, zero-carbon warehousing.

One of the first phases of the project was a 65,000-square-foot building located at 355 Wilkinson. In September 2019, it became the first warehouse to achieve the Zero Carbon Building – Design (ZCB-Design) certification under the Canada Green Building Council’s (CaGBC) Zero Carbon Building Standard. With this certification, the project is achieving East Port’s goals of re-inventing industrial-class real estate and lowering greenhouse gas emissions for future generations.

KEY INFORMATION

<table>
<thead>
<tr>
<th>Project Developer:</th>
<th>East Port Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainability Consultant:</td>
<td>East Port Properties</td>
</tr>
<tr>
<td>Prime Consultant Engineer:</td>
<td>Ruitenberg Inc.</td>
</tr>
<tr>
<td>Landscape Architect:</td>
<td>DesignPoint Engineering &amp; Surveying</td>
</tr>
<tr>
<td>Mechanical Engineer:</td>
<td>Barber Engineering Services</td>
</tr>
<tr>
<td>Structural Engineer:</td>
<td>Laurence Smith</td>
</tr>
<tr>
<td>Electrical Engineer:</td>
<td>MCW</td>
</tr>
<tr>
<td>Builder:</td>
<td>Lindsay Construction</td>
</tr>
<tr>
<td>Total Building Area:</td>
<td>6,020 m² (64,799 ft²)</td>
</tr>
<tr>
<td>Type:</td>
<td>Multi-tenant Warehouse</td>
</tr>
<tr>
<td>Climate Zone:</td>
<td>Zone 6</td>
</tr>
<tr>
<td>EUI:</td>
<td>50.0 kWh/m²/year</td>
</tr>
<tr>
<td>Peak Demand:</td>
<td>82.5 kW</td>
</tr>
<tr>
<td>Onsite Renewable Energy:</td>
<td>10.4%</td>
</tr>
<tr>
<td>Renewable Energy Utilization Rate:</td>
<td>47.9%¹</td>
</tr>
<tr>
<td>Embodied Carbon Intensity:</td>
<td>209.3 kg CO₂e/m²</td>
</tr>
</tbody>
</table>

¹ Renewable energy utilization rate refers to the percentage of renewable energy generated that is consumed onsite.
VISION

The next generation of zero carbon industrial assets

From the very start, developer and property manager East Port Properties intended its Wilkinson Avenue warehouse campus to be built to a next-generation standard. East Port has a long history of developing and managing high-performance buildings, including Leadership in Energy and Environmental Design® (LEED) certified buildings such as the first LEED-certified multi-tenant warehouse in Halifax, Nova Scotia, as well as the first LEED Gold® certified office building in St. John’s, Newfoundland.

East Port set its sights even higher with Wilkinson. They envisioned a warehouse campus that would offer tenants highly-efficiently buildings that take advantage of all of East Port’s expertise in multi-tenant real-estate to achieve zero-carbon and no-cost central heating. East Port looked to the CaGBC’s Zero Carbon Building (ZCB) pilot program to help guide their efforts with the first of the planned buildings, 355 and 495 Wilkinson.

With the ZCB Standard and armed with their deep knowledge of efficient industrial design, East Port set out to create a comfortable and leasable building. They wanted to provide tenants with low operational costs, including free central heating. Consideration for operational costs and tenant comfort overall compelled East Port to integrate non-standard warehouse features such as a better building envelope and efficient mechanical systems with integrated automation.

In addition, East Port wanted to make the project financially competitive. They were confident that any premium resulting from building to zero carbon would be offset by higher net rents, achieved through significantly lower heating energy bills and a more comfortable workspace for prospective tenants.

While this cost model is a win-win for project developers and tenants, there is always some element of risk with industrial buildings given owners face the additional challenge of an unknown tenant or an unknown use over the project life-cycle. East Port was fortunate to have FedEx, a company that wholly supported the project’s sustainability goals, as 355 Wilkinson’s first tenant.

“Awareness is always the first step toward understanding how to make things better. Our participation in the CaGBC’s Zero Carbon Building Pilot Program gave us a platform to show others that zero-carbon is possible in this asset class.”

Judy Wall,
President, East Port Properties
THE PROCESS

Create better warehouses to attract more engaged tenants

Typically, warehouses are built by the owner, with the cost of operations falling to the tenant. Traditionally, limited financial and design resources are spent on exploring energy-efficient shells, with focus placed instead on providing the lowest-cost product. However, that was not East Port Properties’ approach.

East Port adapted their experience and learnings from designing and managing highly-efficient industrial buildings. They knew specific key decisions would be critical to achieving a significant impact on building energy use, including ensuring better insulation values, installing efficient heating systems, and providing automated controls to help reduce dependence on human intervention to operate the system.

To achieve their ambitious goals, East Port worked in partnership with Efficiency Nova Scotia. This collaboration focused on designing a building that would keep tenants’ operating costs as low as possible. East Port challenged all the consultants, engineers, and builders to consider a different way of designing. They turned the design process on its head by working backward from the end-goal of generating onsite all the electricity required to power the heat pumps as well as offset the energy costs for the small amount of natural gas used on the coldest days of the year, thus eliminating central heating costs for tenants.

East Port knew that to achieve its goal of low heating costs and to retain the value of the asset, it was essential to have careful oversight over the building’s operation. An in-house electrical engineer was retained to record and monitor energy production once the warehouse was in operation. In addition, East Port established a process to engage tenants and assist them in lowering their costs so they could better take advantage of the building’s features and eliminate their central heating costs.

“We don’t just lease a box and walk away for five or ten years until renewal; we keep the engagement throughout the term because the goal of the owners is to have a sustainable asset that delivers everyday value to the tenants.”

Judy Wall,
President, East Port Properties
THE DESIGN

Integrated design based on operational data

Design excellence in multi-tenant industrial real-estate assets is not typically as high a priority as it is with commercial offices. Therefore, it’s not surprising that the result is often a low-cost “box” with minimal emphasis on quality in general, including external and internal aesthetics. This was not the case with 355 Wilkinson. This project excelled in design by including non-standard warehouse features that are desirable to tenants and provide a quality indoor environment.

The building was located in a low-density built area, fully exposed to sunlight. The project team chose a rectangular shape for the floor-plate to accommodate a flexible industrial future use, and to offer longer façades facing north-east and south-west.

To eliminate central heating costs, the project team focused on efficiency. Both insulation and airtightness were extensively addressed as critical components of the building’s overall performance. Other passive measures implemented in the design included the use of natural daylighting and passive solar gains through dedicated high windows in the external envelope. Mechanical systems were carefully sized, and onsite renewable energy utilized to offset the emissions from electricity use as well as the limited use of natural gas associated with the building’s operations. The project was able to take advantage of the ample roof space available for onsite photovoltaics (PV).

This design approach ensured that the 355 Wilkinson Avenue warehouse would become an exceptional industrial building, able to improve real estate value, introduce sustainability, and lower operational costs.

Figure 1 – The development site will include five multi-tenant warehouses totalling approximately 300,000 square feet. The first phase of the project was a 65,000-square-foot building (355 Wilkinson Avenue warehouse) and a smaller 58,900- square-foot building (495 Wilkinson Avenue warehouse). Both buildings were part of the CaGBC’s Zero Carbon Pilot Program and are now ZCB-Design certified.

Figure 2 – 355 Wilkinson Avenue warehouse.
BUILDING ENVELOPE

Superior performance from concrete panels

An industrial building requires a flexible layout to accommodate potential uses not known at the design stage. 355 Wilkinson kept a simple rectangular layout to ensure flexibility, and then East Port Properties paid particular attention to the design and quality of the envelope construction. The project team knew this would be critical to reducing heating demand and eliminating central heating costs.

High bay clerestory-type windows and skylights maximized natural daylighting, which helped to lower the lighting loads. Clerestory-type windows were located high on the walls to allow daylight to penetrate deep into the space.

The opaque elements of the envelope were chosen to ensure a well-insulated and air-tight construction. Insulated tilt-up concrete sandwich panels were used to provide continuous R-20 rigid insulation value and a durable concrete surface suitable for industrial use. East Port also upgraded the insulation value of the roof to R-40, compared to the National Energy Code for Buildings (2015), which only requires R-30.

In order to control air-infiltration from the external envelope, the project team gave special attention to construction joints and other possible areas of heat loss, such as the bay doors. The team specified insulated overhead doors with a continuous dock seal. Further infiltration reduction was achieved by using vertical-storing dock levelers with seals. This product is typically used in cold storage (or refrigerated) warehouses to keep the cold in and minimize the heat exchange with the external environment. East Port used this technique to keep cold drafts out of the building and minimize heating demand.

A challenge the team faced when measuring the thermal energy demand intensity (TEDI) was the building geometry, a single storey with a high ceiling and a wide footprint. This configuration resulted in a higher building envelope-to-floor-area ratio, which means there was more envelope for heat to escape through. In particular, the prescriptive air infiltration value used in the energy model was impacted by the wall height. This information was used to inform updates to the ZCB-Design Standard. Version 2 of ZCB-Design now allows teams to target a lower air infiltration value and requires air leakage testing prior to achieving ZCB-Performance.

A well-designed building envelope for an industrial building will not significantly improve its marketability in and of itself. However, it will provide significantly lower operating costs and a more comfortable indoor environment – two principle parameters to attract quality tenants in a competitive market.

Figure 3 – The south elevation of 355 Wilkinson Avenue, showing clerestory windows placed high for daylighting.
Figure 4 – An interior photo of 355 Wilkinson Avenue, showing daylight penetrating the space.

Figure 5 – Vertical-storing dock levelers help improve the building envelope performance.
HEATING, COOLING AND VENTILATION SYSTEM

Designing an efficient system

Creating an industrial building able to keep tenants’ operating costs low and also retain indoor comfort is a difficult goal for an industrial building with such a massive internal volume. 355 Wilkinson Avenue’s design team examined the warehouse’s heating, ventilation, and lighting operations closely and ensured automated controls were in place to reduce dependence on human intervention to operate the system. Hence, a digital control system monitors and controls the operations.

The project team also focused on the use of an energy-efficient ventilation system using heat recovery to improve further the building’s efficiency and comfort.

Industrial buildings are challenged by the frequent use of doors and the associated heat losses they cause. To ensure heat is provided only where and when needed, a digital control system manages heating through floor sensors and relays on the overhead doors. The system can stop in-floor heating circulators from running in areas with open bay doors. To compensate, additional heating is supplied by overhead unit heaters that are metered and billed directly to the tenant. In this way, the tenants become more aware of the cost implications of how they operate their premises.

The concrete tilt-up construction provides a significant opportunity for thermal storage in the envelope. An in-floor radiant heating system was used. It was decided to heat only the perimeter of the building because heat loss is not proportional over the slab. Heating the perimeter only also ensured that there was space to bolt down racking for the tenants. This central heating system consists of six air-to-water heat pumps with a peak-load condensing natural gas boiler to be used on the coldest days only. Together, they provide a constant floor temperature of 17°C. The water distribution in the system is managed by electronically commutated motors (ECM).

Figure 6 – In-floor radiant heating system is being installed prior to pouring the concrete floor.
ELECTRICAL SYSTEM

The Electrical System: Operate with motion

The 355 Wilkinson Avenue warehouse uses internet-based integrated controls to allow for real-time optimization of all building systems. The lighting system is motion-sensor controlled and uses high bay LED lighting fixtures to reduce electricity demand. Electricity use is sub-metered, enabling tenants to monitor and adjust their power usage.

RENEWABLE ENERGY

Renewable energy to provide zero carbon heating

The building was designed to achieve a zero-carbon balance by using both onsite and off-site renewable energy. Using onsite renewable energy reduces the peak demand from the electrical grid, decreases energy costs, and minimizes the environmental impacts from power generation facilities.

East Port Properties had to work within the restrictions of the local utility to determine how much excess energy they could return to the grid through net-metering. They installed roof-mounted photovoltaic (PV) panels at 35 degrees for maximum solar gain. The overall PV system was sized to offset the cost associated with the existing fuel sources and to provide the tenant zero (or near zero) central heating costs. As a result, 355 Wilkinson aims to generate 10 per cent of the building’s modelled energy. This exceeded the ZCB-Design v1 certification requirement for at least 5 per cent of total energy consumption to be met by renewable energy generated onsite. The project team chose to match the solar array size to the heating load as this is the most predictable load in a multi-tenant warehouse where prospective tenants have varying process energy needs.

Figure 7 – The roof-mounted solar photovoltaics are positioned at 35 degrees.
SUMMARY

To date, East Port has certified two Zero Carbon Building – Design warehouses, 355 and 495 Wilkinson. These are just the first of five warehouses planned for this campus. The knowledge and experience gained from East Port’s participation in the CaGBC’s ZCB pilot program will be applied to their next projects, giving them an opportunity to modify or fine-tune decisions on future buildings and bring even more innovative thinking to industrial spaces.

While East Port Properties is a small management company in a small market, they have made it their goal to develop valuable assets that embrace operational excellence. They are confident they have a winning business strategy, and CaGBC’s recent report, Making the Case for Building to Zero Carbon, also supports that there is a business case for zero carbon warehouses.

After 12 months of operations, East Port has reported that 355 Wilkinson’s actual performance is better than anticipated. The team has achieved the goal of no-cost central heating for tenants. They are also confident they will achieve ZCB-Performance certification in the near future. It is obvious from 355 Wilkinson’s performance that East Port has achieved its goal of developing the next generation of low-carbon warehouses.

KEY PERFORMANCE METRICS

- **EUI**: 81 ekWh/m²/year
- **Peak Demand**: 386 kW
- **Renewable Energy**: 825,014 kWh/year
- **Embodied Carbon**: 260 kg CO₂ eq/m²