

Design for Zero Energy Building

Lambton Shores Administration Building

Date Completed

April 19, 2021

Prepared for

**Skinner & Skinner Architects
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Prepared by

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1. OVERVIEW

Energy models were created for the Lambton Shores Administration Building project in order to assess the viability of a Net Zero Energy Building (NZEB). This report summarizes the energy modeling inputs and the results of the study.

1.1 PROJECT SCOPE AND METHODOLOGY

Project Name:

- Lambton Shores Administration Building

Project Goals:

- Achieve a Zero Net Energy (ZNE) Building as recognized by the New Buildings Institute
 - EUI Goal: Meet the Zero Energy Performance Index (zEPI) of 27.9 kBtu/ft² (87.9 kWh/m²) based on predicted EUI from energy model
 - PV Goal: Provide on-site renewal energy generation that generates at least as much energy as the building consumes over a period of one year

Energy Modeling Software and Notes:

- Software: eQuest v3.65, version 3.65, DOE 2.2
- All of the building components have been considered, including building envelope, lighting, plug loads, HVAC, and service water heating.
- The results shown herein are based on the output of the hourly energy simulation software and are reflective of the design parameters listed herein as well various modeling assumptions. While the work was performed with reasonable care and in accordance with the latest professional standards, the actual energy use of the building will vary based on factors such as weather, workmanship, depreciation of the thermal resistance of building materials, building operation, maintenance, etc.

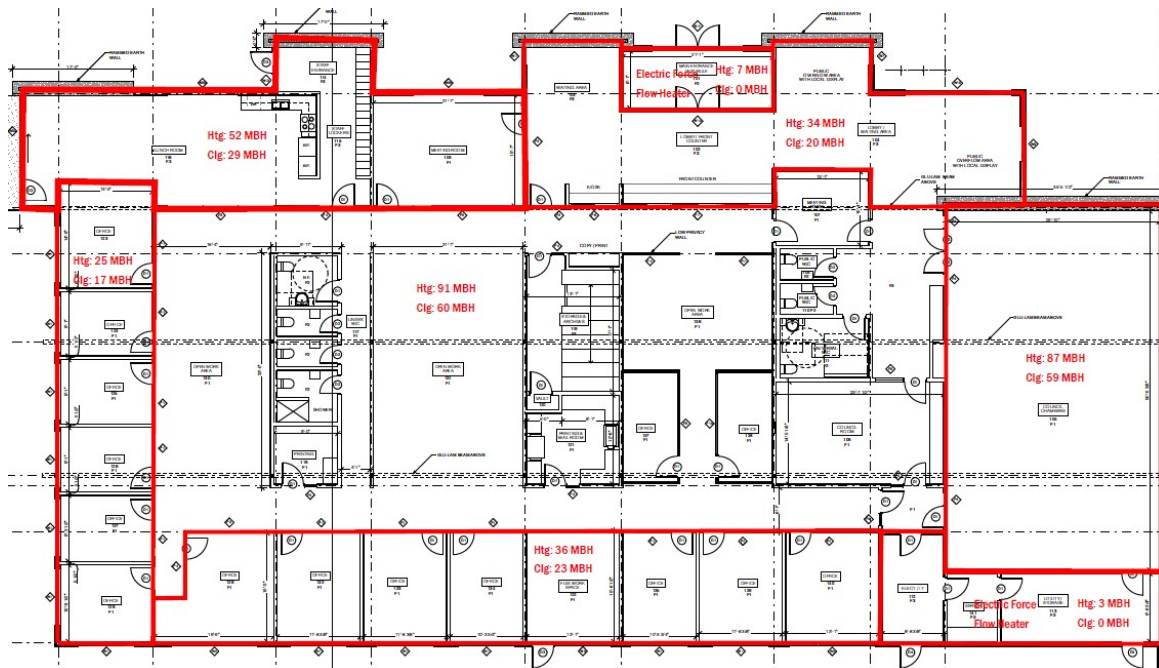
Design Documents Referenced:

- Architectural Drawings: Issued for Budgeting (April 16, 2020)

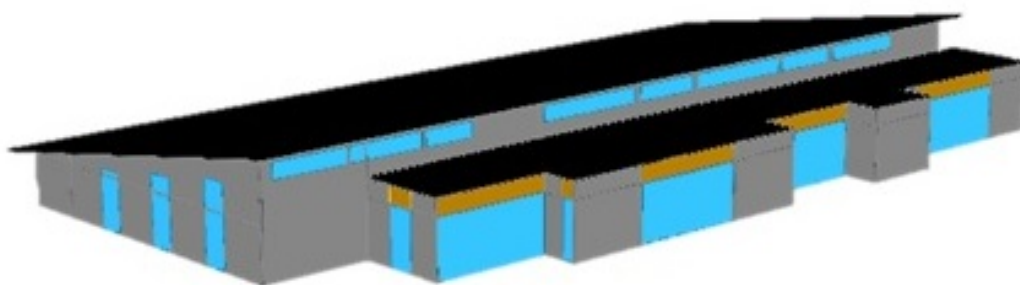
1.2 Building Parameters

Location	9575 Port Franks Road, Thedford, Ontario					
Weather File	London, Ontario					
Building Type	Office					
Site Orientation	Project North is 41 degrees clockwise from True North					
Modeled GFA	12,215 ft² (refer to Proposed Zoning Layout below)					
Building Storeys	1					
Utility Rates	Electricity: \$0.189/kWh (based on historical utility rates)					
Occupancy Schedules	Office Area: 25 people		Council Chamber: 75 people			
	Mon-Fri: 8:30 – 16:30		Mon,Wed,Fri: 17:00 - 20:00			
	Saturday: unoccupied		Saturday: unoccupied			
		Sunday: unoccupied		Sunday: unoccupied		
Fan Schedules	System	Mon-Fri	Saturday	Sunday		
	ERV	7:00 – 20:00	8:00 – 17:00	Off		
	Lobby	Cycle fans On/Off based on thermostat				
	Office Areas	Cycle fans On/Off based on thermostat				
	Council Chamber	Cycle fans On/Off based on thermostat				
	Vestibule, Utility, Elect/IT Room	Cycle fans On/Off based on thermostat				
Thermostat Setpoints	Location	Cooling Setpoint (°F)		Heating Setpoint (°F)		
		Day	Night	Day	Night	
	Occupied Space	75	80	70	64	
	Vestibule	n/a		65		
	IT	80		60		

Proposed Zoning Layout



Energy Model Elevations – As Viewed from the East



2. PROJECT DESIGN PARAMETERS

2.1 Plant Design

Domestic Hot Water Heating <i>Air-Source Heat Pump</i>	Hot Water Heater • Type: air-source heat pump • Efficiency: COP of 3 • Hot Water Temperature = 140°F • Location: Adjacent to IT room (use IT room as heat source) Load • Lavatory Fixtures: 8.35 LPM (max) • Kitchen Fixtures: 8.35 LPM (max) • Shower Fixtures: 7.6 LPM (max) • Schedule: based on NECB schedule for office building
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2.2 HVAC Design

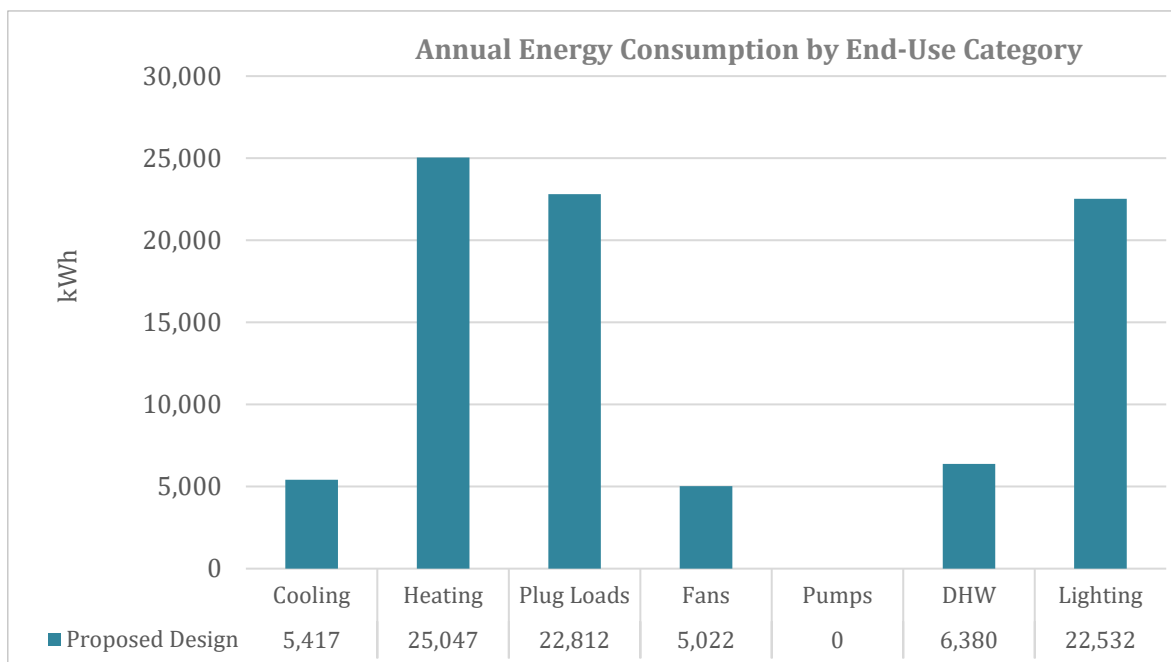
Lunch room, Lobby, Office area, Council chamber <i>VRF Heat Pump</i>	Heat Pump with variable refrigerant flow (heat recovery type) • Heating: VRF with COP of 4.1 (ARI conditions) • Cooling: VRF with EER of 12.7 (ARI conditions) • Ventilation: provided by ERV • Fan power: TSP = 0.5" @ 40% efficiency (0.147 W/cfm) • Controls: fans cycle ON/OFF based on call for heating/cooling
Building Ventilation <i>ERV with supply and exhaust ducts to each space</i>	ERV providing tempered ventilation • Heating: electric resistance heating, SAT 68°F • Cooling: air-cooled DX with EER = 10.9, SAT 68°F • Ventilation: 1,370 cfm (based on Ez = 1.0) with demand-control ventilation (council chambers & lunch/meeting room) • Energy Recovery: enthalpy heat exchanger with 70% sensible & 65% latent effectiveness • Fan Power: TSP = 2.25" (supply & return) @ 48% efficiency • Fan Control: variable volume (VFDs) • Controls: fans run continuously during occupied hours with variable air volume (based on DCV)
Vestibule, Utility room, IT room <i>Electric Force Flow Heater</i>	Force flow heaters • Heating: electric resistance heating • Fan power: TSP = 0.5" @ 40% efficiency (0.147 W/cfm) • Controls: fans cycle ON/OFF based on call for heating Ductless split AC units (applies to IT room only) • Cooling: DX, EER of 12 • Controls: fans cycle ON/OFF based on call for cooling

2.3 Enclosure and Electrical Design

Envelope <i>Not all construction assemblies listed</i>	Slab-on-Grade Assemblies <u>Floors</u>: CIP concrete, R-15 insulation for 4 feet along perimeter Above-Grade Assemblies <u>Walls</u>: 3.5" brick, 1" air space, 2" XPS (R-10), 5/8" sheathing, 4" wood stud @ 16" O.C. c/w 3.5" batt insulation (R-10), 5/8" gypsum - R-21 ft²hr°F/Btu (effective) <u>Roof</u>: roof membrane, ½" protection board, ¾" plywood, 24" truss @ 16" O.C. c/w R-35 insulation, ½" gypsum - R-38 ft²hr°F/Btu (effective) <u>Fixed Windows</u>: Triple Glazed, argon fill, low-e coating on #2/#4, PVC frames - U-0.16 Btu/ft²hr°F, SHGC = 0.47, Tvis = 0.60 (effective) <u>Window Wall</u>: Double Glazed, argon fill, low-e coating on #2, aluminum frames with 9 mm thermal break - U-0.40 Btu/ft²hr°F, SHGC = 0.36, Tvis = 0.60 (effective) - Window Area: 31% of total exterior gross wall area Infiltration 0.9 air-changes per hour @ 50 Pascals (use blower door testing)
Lighting <i>not all spaces are listed</i>	Interior Lighting - The building average lighting design power density is 0.66 W/ft² - Office space: 0.65 W/ft² - Meeting: 0.67 W/ft² - Council: 0.67 W/ft² Exterior Lighting - Not modeled (TBD)
Other Electrical Loads <i>not all spaces are listed</i>	Receptacle Loads - Building average receptacle power density is 0.47 W/ft² - Office space: 0.50 W/ft² - Lunch: 0.68 W/ft² - Council: 0.96 W/ft² IT Loads 500 Watts

3. ENERGY RESULTS

3.1 Energy Chart



3.2 Energy Metrics

	Proposed Design	OBC Design	Savings vs OBC
Annual Energy	87,211 kWh/yr	218,713 kWh/yr	60%
Annual EUI	76.8 kWh/m ² /yr	193 kWh/m ² /yr	60%
Annual GHG's	4,361 kg CO ₂ e/yr	29,989 kg CO ₂ e/yr	85%
Annual Cost	\$16,483/yr	\$17,421/yr	5.4%
Estimated Net-Zero Array Size	74 kW	185 kW	60%

3.3 Energy Requirements

The Lambton Shores Administration Building is pursuing NBI's a Zero Energy Building status which requires an EUI of 87.9 kWh/m²/yr.