REPORT FOR:

T2K Office
Macdonald, MB
Energy Modelling Report for Upgraded TI Equipment

Submitted to:	BLDG Architecture Office Inc.
Attention:	Al Coppinger
Date:	2022-Feb-03
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Our File No.	2021-1409

Crosier Kilgour & Partners Ltd.™

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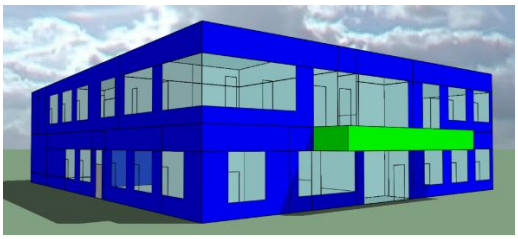
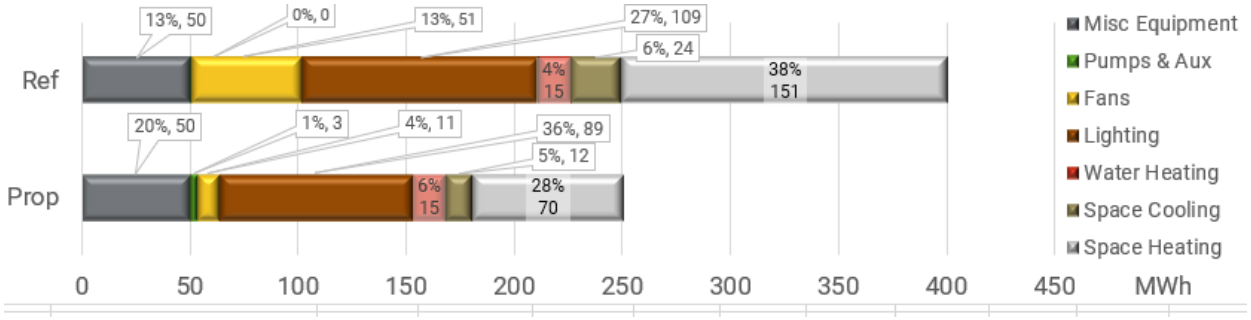
Project Summary

Location:	Macdonald, MB
Climate Zone:	Zone 7A
Conditioned Area:	1452 m^2



Modelling Software:	IES-VE
Energy Standard:	MECB 2013
Building Performance:	37.4% Better than code
Weather File:	Winnipeg, MB
Building Use:	Office
Constructions:	Steel with exterior Quik-Therm insulation
Mechanical:	Forced air furnaces
FDWR:	19.9%
Fenestration:	Dual pane low-e
Average LPD:	10.6 W/m^2
Certification Program:	Eff MB NBP 728

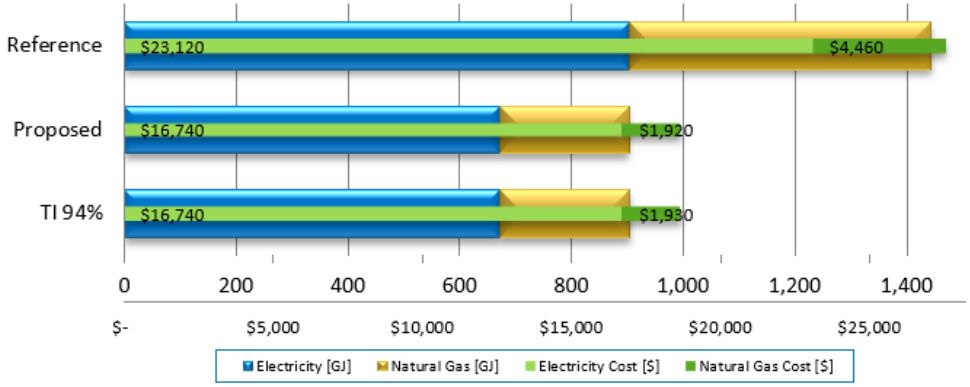
Energy Breakdown



Energy Use by Category

Total Energy Use:
Proposed: 251 MWh/y
Reference: 401 MWh/y

PASS
37% Better than energy code requirements



Parametric Analyses

Other Data

Thermal Energy Demand Intensity (TEDI)

Proposed	46	kWh/m^2y
Reference	79	kWh/m^2y

Energy Use Intensity (EUI)

Proposed	173	kWh/m^2y
Reference	276	kWh/m^2y

Key Takeaway

The building as designed will meet the requirements of the MECB 2013 and should qualify for the maximum incentive from the New Buildings Program.

1. Introduction

A computer model of the proposed T2K Office at 103 Progress Way in Macdonald, MB was created using the IES-VE software package based on the IFT drawing and specification package. The software was used to determine the energy performance of the proposed design compared to the Manitoba Energy Code for Buildings (MECB) 2013 reference building, with equipment in the tenant fit-up performance similar to that installed in the designed space. This report documents the significant model inputs and assumptions and indicates the potential energy performance of the project.

The initial building energy model shows the building would perform at 37% better than the MECB 2013. This energy analysis indicates the building could qualify for the maximum incentive available under the New Buildings Program Performance Path. An image of the shell from the IES-VE model is shown in Figure 1-1.

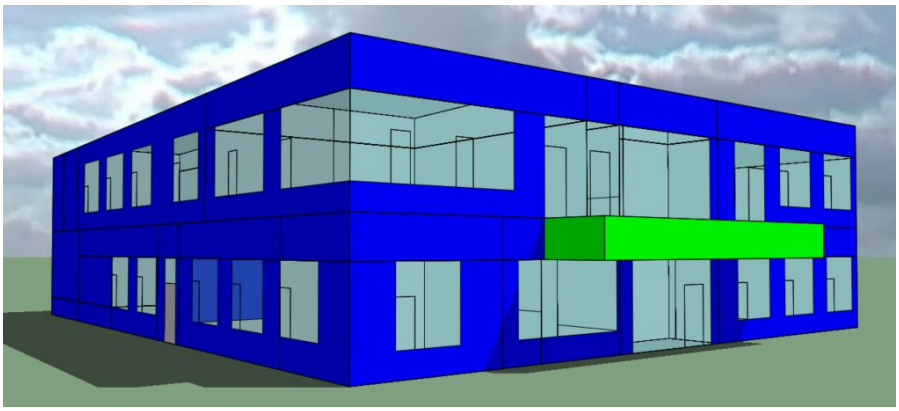


Figure 1-1: IES-VE Model Shell

1.1 Building Overview

The project is a new office building in Macdonald, Manitoba. The building provides eleven offices and a shop space. The building is a two storey slab-on-grade structure. A mechanical room is located on the second floor. The east side of the building is left unfinished for a future tenant. The heated area is just over 1,452 m^2. Heating is provided from three furnaces and three unit heaters, and cooling from three condensing units. The proposed ventilation system also makes use of ventilation heat recovery from exhaust air to preheat incoming fresh air to the furnaces.

1.2 Climate Zone

Climatic data for Winnipeg, MB is used for the energy model. The heating degree day value listed in Appendix C of the National Building Code for Winnipeg is 5670 (base 18°C). The climatic zone used for the project is Zone 7A. The hourly weather file used for the IES-VE energy model is for Winnipeg, MB.

1.3 Energy-saving Features

Energy-saving features analyzed for the building include the following:

- Good envelope and windows;
- Fenestration and Door to Wall ratio below MECB 2013 reference;
- Energy efficient lighting, exceeding MECB 2013 prescriptive requirements;

- Efficient mechanical systems;
- Ventilation air heat recovery.

1.4 Model Results

Table 1-1 includes a summary of the analyses as produced by the IES-VE model. Figure 1-2 shows the energy summary in graphical form.

Table 1-1: Energy Summary by End Use

Energy Summary by End Use	Energy Type	Proposed Energy [MJ]	Proposed Intensity [MJ/m²]	Reference Energy [MJ]	Reference Intensity [MJ/m²]	Energy Savings [MJ]
Lighting	Electricity	320,845	221	393,591	271	5.0%
Space Heating	Natural Gas	232,299	160	539,603	372	21.3%
Space Heating	Electricity	20,795	14	4,953	3	-1.1%
Space Cooling	Electricity	43,430	30	84,911	58	2.9%
Pumps & Aux	Electricity	11,246	8	698	0	-0.7%
Fans	Electricity	37,922	26	183,132	126	10.1%
Service Water Heating	Electricity	55,625	38	55,625	38	0.0%
Total Energy		**902,941**	**622**	**1,443,293**	**994**	**37.4%**
Energy Use Intensity (EUI)		173 kWh/m²y		276 kWh/m²y		
Thermal Energy Demand Intensity (TEDI)		46 kWh/m²y		79 kWh/m²y		42.3%

Energy and Cost Summary by Fuel	Proposed Energy [MJ]	Proposed Cost [$]	Reference Energy [MJ]	Reference Cost [$]	Percent Savings Energy	Percent Savings Cost
Electricity	670,642 186,300 kWh/y	16,740	903,690 251,000 kWh/y	23,125	25.8%	27.6%
Natural Gas	232,299 6,000 m³/y	1,922	539,603 13,900 m³/y	4,464	56.9%	57.0%
Total	**902,941** 250,817 ekWh/y	**$18,662**	**1,443,293** 400,915 ekWh/y	**$27,588**	**37.4%**	**32.4%**

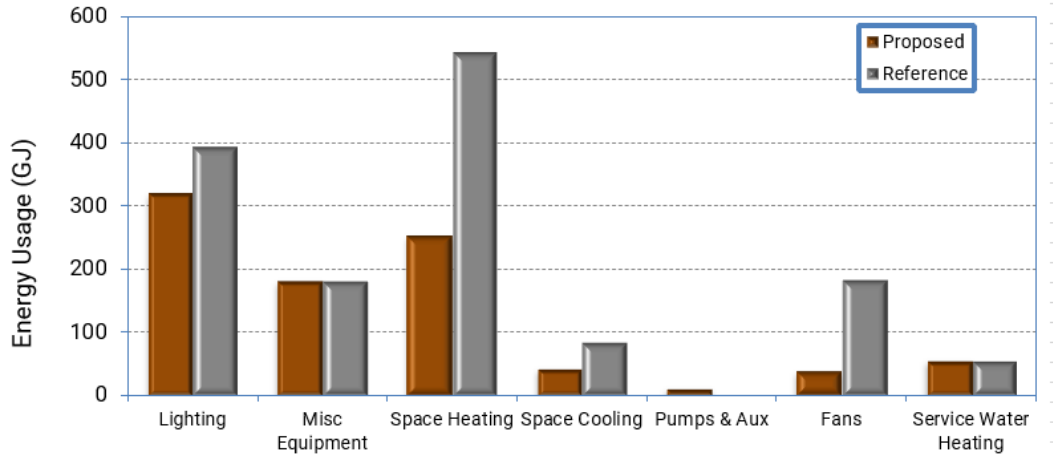


Figure 1-2: Energy by End Use Summary Comparison

1.5 Summary of Model Parameters

Table 2 summarizes the basic model assumptions for the building energy model.

Table 1-2: Model Parameters Summary

Item	Proposed Building	Reference Building	Comments
Walls	W10: U = 0.210 W/m^{2}K W11: U = 0.208 W/m^{2}K W12: U = 0.206 W/m^{2}K W14: U = 0.289 W/m^{2}K W15: U = 0.278 W/m^{2}K	U = 0.210 W/m^{2}K	
Roof	R10: U = 0.114 W/m^{2}K	U = 0.162 W/m^{2}K	
Floors	Heated: Ueff = 0.097 W/m^{2}K Unheated: Ueff = 0.077 W/m^{2}K	Heated: Ueff = 0.178 W/m^{2}K Unheated: Ueff = 0.125 W/m^{2}K	Ueff calculated using the ASHRAE F-factor method
Windows	Fixed: U = 1.74 W/m^{2}K Operable: U = 1.76 W/m^{2}K Curtain Wall: U = 2.16 W/m^{2}K	U = 2.0 W/m^{2}K	
Doors	Opaque: U = 2.10 W/m^{2}K Glass: U = 2.40 W/m^{2}K Overhead: U = 0.80 W/m^{2}K	U = 2.2 W/m^{2}K	
FDWR	19.9%	28.9%	
Lighting	As designed	Set to prescriptive levels	
Lighting Controls	As designed	Set to prescriptive	
Exterior Lighting	As designed	Per MECB section 4.2.3	
HVAC System Type	Natural Gas Furnaces with DX cooling Electric unit heaters	NECB System 3 Natural Gas Packaged Single Zone with Hydronic baseboard	Proposed model tenant fit-up similar to designed side
Heating Equipment Efficiency	Furnaces: 98% Boiler: 95%	RTU: 81% Boiler: 83%	
Cooling Equipment Efficiency	COP = 3.45 - 4.19	COP = 3.16 - 3.45	
Ventilation	Heat recovery ventilation 44% effective sensible	Ventilation equal to proposed No heat recovery	
Service Water Heating System	Electric tank	Electric tank	
Water Flow Rates	1.5 L/min	Equal to Proposed	

2. Zoning

Generally all rooms are treated as separate spaces, with some similar spaces combined (such as adjacent offices) to simplify the model. Attention was also paid to the mechanical system design when determining building zones. Figure 2-1 shows the thermal zones in the energy model.

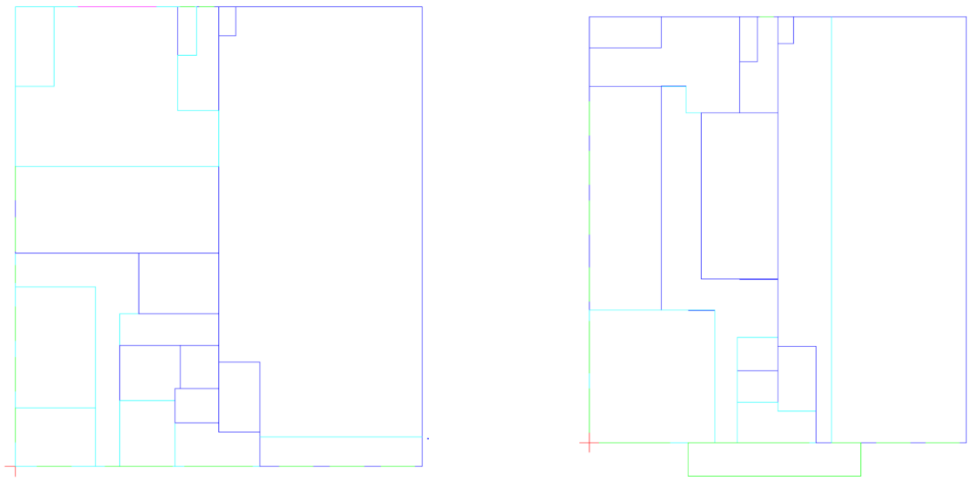


Figure 2-1: Main and Second Floor Zoning Diagrams

2.1 Space Functions and Schedules

The space is modelled using the MECB 'A' and MECB 'C' schedules. The default MECB 2013 receptacle power and lighting power density are used for the reference model in all zones. The proposed building model also uses the prescriptive receptacle power density, while lighting power density is a based on the actual number and type of luminaires in the lighting design. In certain spaces where the final lighting design is incomplete such as the tenant fit-up area, the prescriptive lighting power density is used for the proposed model as well. Occupant density used in both models was determined from the occupant density for the ASHRAE 62.1 analysis included on the mechanical drawings. The undeveloped tenant fit-up areas are assumed as a retail space on the main floor and office space on the second floor to better represent the likely end use, and use the software default occupancy density and ASHRAE 62.1 outdoor air rates for these space types.

3. Envelope

The opaque envelope consists of five wall types, one roof type, and two slab-on-grade floors. Three types of window are modelled, as well as three door types.

3.1 Above Ground Envelope Assemblies

All wall and roof dimensions for the modelled building were entered as indicated in the architectural drawings.

Each exterior construction assembly was modelled using the layer by layer approach in IES-VE. Generally, thermal bridging was not significant in the envelope construction assemblies. In the case of assemblies containing structural elements which interrupt the insulation layer, the clear field U-value was set based on the NBC, and the insulation layers of the proposed model construction in IES-VE were adjusted to achieve the appropriate overall U-value. A summary of the exterior construction assemblies used in the model is given in Table 3-1.

Wall thermal resistance values take advantage of test results for Quik-Therm insulation. An effective R value of 4.18 h-ft^2-°F/BTU per inch is used.

Table 3-1: Above Ground Opaque Building Assembly U-values

	Assembly Description	U-Value Source	Proposed U-Value [W/(m²-K)]	Reference U-Value [W/(m²-K)]
W10	Metal siding; Rsi 4.40 Quik-therm insulation; Vapour barrier OSB sheathing; Steel studs @ 400 o/c; Gypsum board	IES material library, NBC	0.200	0.210
W11	Face brick; Air space; Rsi 4.40 Quik-therm insulation; Vapour barrier; OSB sheathing; Steel studs @ 400 o/c; Gypsum board	IES material library, NBC	0.200	0.210
W12	Metal siding; Ext grade gypsum board; Rsi 4.40 Quik-therm insulation; two layers FR gypsum board; Steel studs @ 400 o/c; FR Gypsum board	IES material library, NBC	0.198	0.210
W14	Metal siding; Rsi 2.96 Quik-therm insulation; Vapour barrier; Concrete masonry wall; Gypsum board	IES material library, NBC	0.277	0.210
W15	Face brick; Rsi 2.96 Quik-therm insulation; Vapour barrier; Concrete masonry wall; Gypsum board	IES material library, NBC	0.268	0.210
R1	Standing seam metal roof system; Underlayment; Vapour retarder; Rsi 8.82 Quik-therm insulation; Steel decking; Gypsum sheathing; Steel trusses	IES material library, NBC	0.111	0.138

3.2 Windows and Doors

The windows proposed for the project are fiberglass frame windows with double glazing for fixed panes, and double glazing for operable sections. Both include one low-e coating and argon gas fill. A small portion of aluminum frame curtain wall is also included, as well as both hollow metal insulated and glass doors. Manufacturer performance information was not available so ASHRAE Fundamentals values have been used. The hollow metal doors are modelled with 44mm thick polyurethane insulation. The glass doors and curtain wall are both treated as aluminum frame with thermal break, double glazed with 13mm argon gas fill and one low-e coating as per the project specifications.

The FDWR is 19.9% in the proposed model and 28.9% in the reference model. The reference model FDWR is calculated from on the heating degree day value of 5670 included in Appendix C of the NBC for Winnipeg, MB.

Window and door U-Values for the proposed building energy model are listed in Table 3-2. Reference model windows are modelled with U=2.0 W/m²-K and doors use U=2.2 W/m²-K.

Table 3-2: Window and Door U-values

Assembly Description	U-Value Source	Proposed U-Value [W/(m^2-K)]	Shading Coefficient	Visible Transmit-tance
Fixed Windows	ASHRAE Fundamentals	1.74	0.62	0.66
Operable Windows	ASHRAE Fundamentals	1.76	0.57	0.60
Curtain Wall	ASHRAE Fundamentals	2.16	0.64	0.68
Glass Doors	ASHRAE Fundamentals	2.40	0.64	0.67
Hollow Metal Insulated Doors	ASHRAE Fundamentals	2.10	0.01	0.01
Overhead Door	ASHRAE Fundamentals	0.80	0.01	0.01

3.3 Underground Assemblies

Underground assembly effective U-values for both the reference and proposed building energy models are determined using the ASHRAE F-factor adjustment method within the software. Underground wall assemblies are modelled using the layer-by-layer approach.

3.3.1 Proposed Slab

- Assembly: 6” concrete slab, 4” x 24” rigid exterior insulation (R19), 2” rigid insulation under-slab (R10)
- F-Factor:
  - Unheated F-Factor: F2=0.28 per ASHRAE Table A6.3.1-1
  - Heated F-Factor: F2=0.50 per ASHRAE Table A6.3.1-2
- Conductivity:
  - Unheated Ueff = 0.077 W/m^2-K
  - Heated Ueff = 0.097 W/m^2-K

3.3.2 Reference Slab

- Assembly: The prescriptive requirement of U=0.757 W/m^2-K under the floor perimeter is treated as R-7.5 exterior and R-7.5 under slab perimeter
- F-Factor:
  - Unheated F-Factor: F2=0.65 per ASHRAE Table A6.3.1-1
  - Heated F-Factor: F2=0.64 per ASHRAE Table A6.3.1-2
- Conductivity:
  - Unheated Ueff = 0.125 W/m^2-K
  - Heated Ueff = 0.178 W/m^2-K

4. Lighting

4.1 Lighting Power Density

The lighting power density is determined from the lighting quantities indicated on the drawings and power used from the lighting schedule. The reference building lighting power density is set according to the applicable MECB 2013 space type. In the case of the undeveloped tenant fit-up area and where the luminaire power was not indicated on the drawings, the proposed lighting power density was treated as compliance neutral and equal to that for the MECB 2013 reference.

4.2 Lighting Controls

Occupancy controls required according to the MECB are included in this preliminary model by reducing the lighting power density as appropriate for each space. Daylighting controls as required by the energy code are included in the energy model. Lighting controls included in the design are incorporated in the energy model.

Additional details on lighting power density and controls for each space are included in Appendix B.

4.3 Exterior Lighting

A site lighting analysis based on NECB section 4.2.3 has been conducted for MECB compliance but the associated energy savings are not included in the results of this report per the New Buildings Program guidelines. The exterior lighting power allowance and that of the proposed building is indicated in Table 4-1. Lighting energy is determined by multiplying the lighting power by an average annual usage of 11 hours per day (one half hour after sunset to one half hour before sunrise) to determine annual energy use. The resulting annual energy use for the reference building is 17,400 MJ and the proposed building 10,670 MJ.

Table 4-1: Exterior Lighting Power Allowance

Location ID	Location Category	Amount	Power Allowance (W)	Installed Power (W)
Entrances	Building Other doors [66 W/m door width]	28.9 m	78	196
Facade	Facade [8.2 W/m]	137.6 m	1128	542
Zone 2	Basic Site Allowance [600 W less facade]		0	-
Total			**1206**	**738**

5. Heating, Ventilation, and Air Conditioning

The mechanical design information for the developed west side of the building is included in the drawing package. The mechanical system which serves the developed main and second floor office areas consists of three natural gas forced air furnaces with DX cooling which receive fresh air from two heat recovery ventilators. Electric force flow heaters are included at the office entries. The main floor also includes a shop area which is heated by a gas fired unit heater in addition to in-floor radiant heating served by a natural gas fired condensing boiler. Outdoor air for both proposed and reference is modelled based on the ASHRAE 62.1 analysis with some adjustments made for minor inconsistencies related to the rough-in office areas.

The east side of the building are tenant fit-up areas which have electric unit heaters included on the drawings but are assumed as a retail space on the main floor and office space on the second floor to better represent the likely end use. These areas are modelled with NECB System 3 for both proposed and reference models to treat them as compliance neutral since they are not yet developed, and a parametric analysis has been included to show the energy impact if these areas were outfitted with mechanical equipment equivalent to that specified in the proposed design.

5.1 Proposed Model HVAC Equipment

Central system equipment in the building includes two ventilation air heat recovery units and a central boiler which provides for the shop in-floor radiant heating system. Parameters used in the energy model for this equipment are listed in Table 5-1.

Table 5-1: Proposed Model Central HVAC Parameters

System Name	System Type	Equipment	Fan ESP	Efficiency/ Effectiveness
HRV-1	Heat Recovery Ventilator	Nuair NU500FP	125 Pa	Sensible: 44%
HRV-2	Heat Recovery Ventilator	Nuair NU500FP	125 Pa	Sensible: 44%
B-1	Condensing Gas Boiler	Camus Valiant VT0080	-	95%

System level equipment includes three packaged single zone systems which represent the gas fired furnaces with DX cooling coils that serve the developed office areas supplying tempered air to zone level VAV terminal units. Separate systems are used for the vestibule. Parameters used for system and zone level equipment are listed in table 5-2.

Table 5-2: Proposed Model HVAC Parameters

System Name	System Type	Schedule	Fan SP	Equipment	Heating	Cooling	Outdoor Air
Offices F-1/-2/-3 C-1/-2/-3	Packaged Single Zone	NECB A	250 Pa	Lennox EL296UH070XE36B Lennox 14ACX-036	Gas Furnace: 98%	COP 4.19	431 L/s HRV-1/-2
Tenant Fit-Up Similar to Designed side	Packaged Single Zone	NECB A NECB C	250 Pa	NECB 2011 Warm Air Furnace	Gas Furnace: 98%	COP 4.19	1421 L/s HRV
Shop GUH-1	Unit Heater	Constant 15C	250 Pa	Reznor UDAP75	Gas Furnace: 82%	None	None
Mechanical EUH-1	Unit Heater	Constant 15C	250 Pa	Ouellet OAS15036AM	Electric: 100%	None	None
Vestibules EFFH-1	Unit Heater	Constant 15C	250 Pa	Ouellet OAWH01502-TAV	Electric: 100%	None	None

5.2 Reference Model HVAC Equipment

The reference model central HVAC equipment is listed in Table 5-3, which includes the NECB 2011 atmospheric boiler which serves the hydronic baseboard heaters.

Table 5-1: Proposed Model Central HVAC Parameters

System Name	System Type	Equipment	Fan ESP	Efficiency/ Effectiveness
NECB	Non Condensing Boiler	NECB 2011 Boiler		83%

The reference model systems are NECB System 3 and modelled as packaged single zone systems with hydronic baseboard heating and Dx cooling. Ventilation air heat recovery is not included since the quantity of outdoor air does not meet criteria for sufficient heat content in the exhaust stream.

Table 5-3: Reference Model HVAC Parameters

System Name	System Type	Schedule	Fan SP	Heating	Cooling	Outdoor Air
Offices	Packaged Single Zone	NECB A	250 Pa	Gas Furnace: 81%	COP: 3.22	431 L/s No HRV
Tenant Fit-Up	Packaged Single Zone	NECB A NECB C	250 Pa	Gas Furnace: 81%	COP: 3.16	1421 L/s No HRV
Shop	Packaged Single Zone	Constant 15C	250 Pa	Gas Furnace: 81%	None	None
Mechanical	Packaged Single Zone	Constant 15C	250 Pa	Electric: 100%	None	None
Vestibules	Packaged Single Zone	Constant 15C	250 Pa	Electric: 100%	None	None

6. Hot Water

6.1 Water Heating Equipment

The hot water design for the building includes a central electric domestic water heater. The water heater has an efficiency of 100% and a recovery rate of 79.5 L/hr. The reference service hot water system is modelled with the same flow rate and heating capacity as the proposed.

6.1.1 Proposed

- Equipment: Rheem Marathon
- Type: Electric
- Capacity: 189 L
- Efficiency: 100%

6.1.2 Reference

- Equipment: MECB 2013 Domestic Hot Water Tank
- Type: Gas
- Capacity: 189 L
- Efficiency: 100%

6.2 Water Heating Loads

6.2.1 Hot Water Demand

- Domestic hot water loads are modelled the same in the reference building as in the proposed building per MECB sentence 8.4.4.3.1. The hot water demand is estimated based on an assumed total population of 60 people and typical office use.
- Schedule: MECB ‘A’
- 1.5 L / occupant per ASHRAE Applications Chapter 50 Table 7
- 60 occupants
- Peak Demand: 1.5 L/min

7. Parametric Analyses

Table 7-1 includes a summary of the energy results of the parametric analyses as produced by the IES-VE model. Comparisons are made to the MECB 2013 reference building energy model. Figure 7-1 shows the energy and cost impacts in graphical form. The Present Value analysis includes the anticipated energy savings over the lifetime of the particular upgrade, but does not include added maintenance costs. Lifetimes used in the PV analysis vary depending on the nature of the change. A discount rate of 2% is assumed for the difference between the anticipated general inflation rate and utility rate increases. Additional analyses may be performed as required.

Table 7-1: Parametric Energy Analysis Summary

	Energy Use						
	Elec. [GJ]	Natural Gas [GJ]	Total [GJ]	Cost [$]	Energy Saving [%]	Cost Saving [%]	Present Value [$]
Reference	904	540	1,443	$27,590	-	-	-
Tenant Improvement	671	232	903	$18,660	37.4%	32.4%	-
Tenant Improve 94%	671	233	904	$18,670	37.4%	32.3%	-$200

7.1 Tenant Improvement 94%

This analysis is the same as Tenant Improvement above but decreases the efficiency of all furnaces from 98% to 94%.

- Proposed furnace efficiency: 98%
- Trade-off furnace efficiency: 94%
- PV analysis lifetime: 15 years
- Energy Impact: decrease of 0%
- Cost Impact: increase of $10/y in energy costs

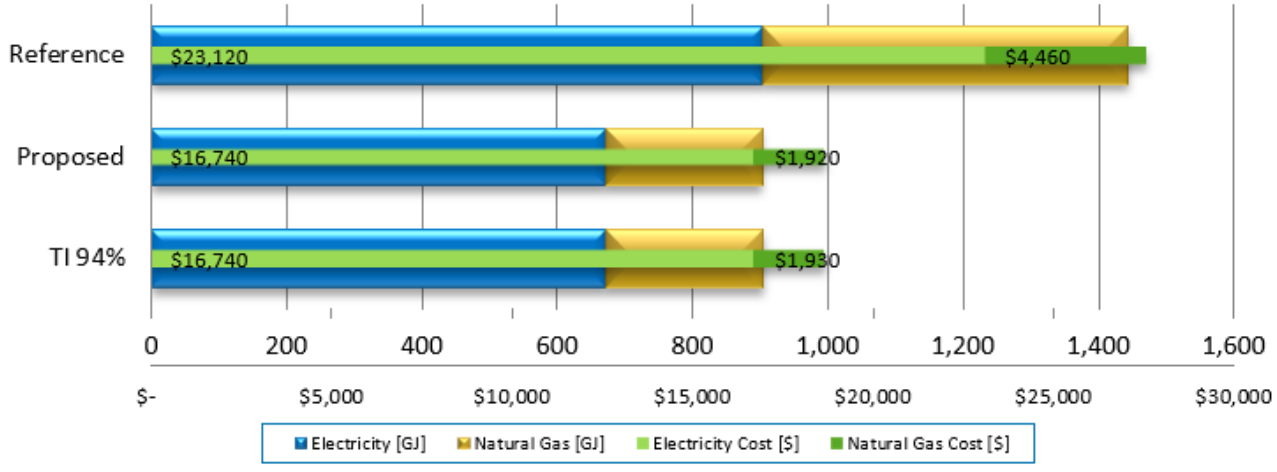


Figure 7-1: Parametric Energy and Cost Comparisons

8. Discussion and Recommendations

The building will meet the requirements of the MECB 2013 as designed and is expected to qualify for the maximum level of incentive available from Efficiency Manitoba's New Buildings Program.

The parametric analyses included can be used to assess the value of potential modifications to the design. If the upgrades analyzed can be performed for less than the net present value of the energy savings and incentive, or if the potential energy costs are less than the capital savings from the proposed modification, then the option should be considered.

The cost and energy impact of a lower furnace efficiency is negligible for this project.

9. Other

9.1 Utility Rates

It is assumed that electricity for this building will be provided by Manitoba Hydro and natural gas by Manitoba Hydro. Energy rates have been entered as indicated in Table 9-1. Electricity rates used are those in effect as of 2020-Dec-1 and natural gas as of 2021-May-1.

Table 9-1: Utility Rates

Electricity	Manitoba Hydro Rate as of 2020-Dec-1
Energy charge:	
First 11,000 kWh	$0.09263/kWh
Next 8500 kWh	$0.06849/kWh
Balance of kWh	$0.04328/kWh
Demand charge:	
First 50 kVA of monthly recorded demand	No charge
Balance of recorded demand	$11.08/kVA
Natural Gas	**Manitoba Hydro Small Rate as of 2021-May-1**
Primary Gas	$0.1012/$m^3$
Supplemental Gas	$0.1384/$m^3$
Transportation to Centra	$0.0452/$m^3$
Distribution to Customer	$0.0744/$m^3$
Total Rebundled Sales Rate	**$0.2241/$m^3$**

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Report for: T2K Office
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Appendix A Envelope Thermal Calculations

Effective Thermal Resistance Calculator

Isothermal-Planes and Parallel-Path Flow Method

Assembly No.	W10	Description	Exterior and interior insulated steel stud wall with steel siding
Structure Type	Steel		
Orientation of Assembly	Wall	interior air film R_{si}	0.12
Adjacent to	Exterior	exterior air film R_{si}	0.03

Catagory	Material	Custom Thickness (mm)	Listed Thickness of Material (mm)	Thermal Resistance (Rsi), (m² K)/W per mm	Thermal Resistance (Rsi), (m² K)/W of Material
Cladding_Materials	Metal or vinyl siding over sheathing: Hollow-backed		0	0.00000	0.11
Insulating_Materials	Quiktherm Rigid Insulation		152	0.02900	4.40
Sheathing_Materials	Plywood - generic softwood (11mm)		11	0.00000	0.10
Structural_Materials	Steel stud, galvanized sheet	152		0.00002	0.00
Air_Cavities	Wall air cavity 90 mm		90	0.00000	0.18
Interior_Finish_Materials	Gypsum board	12.5		0.00610	0.08

Assembly Thickness:		U-value:		R-value:	
328	mm	0.201	W/m^2K	4.97	m^2K/W

Effective Thermal Resistance Calculator

Isothermal-Planes and Parallel-Path Flow Method

Assembly No.	W11	Description	Exterior and interior insulated steel stud wall with brick
Structure Type	Steel		
Orientation of Assembly	Wall	interior air film R_{si}	0.12
Adjacent to	Exterior	exterior air film R_{si}	0.03

Catagory	Material	Custom Thickness (mm)	Listed Thickness of Material (mm)	Thermal Resistance (Rsi), (m² K)/W per mm	Thermal Resistance (Rsi), (m² K)/W of Material
Cladding_Materials	Brick: fired clay (2400 kg/m2)		100	0.00070	0.07
Air_Cavities	Wall air cavity 13 mm		13	0.00000	0.16
Insulating_Materials	Quiktherm Rigid Insulation		152	0.02900	4.40
Sheathing_Materials	Plywood - generic softwood (11mm)		11	0.00000	0.10
Structural_Materials	Steel stud, galvanized sheet	152		0.00002	0.00
Air_Cavities	Wall air cavity 90 mm		90	0.00000	0.18
Interior_Finish_Materials	Gypsum board		0	0.00610	0.00

Assembly Thickness:		U-value:		R-value:	
428	mm	0.200	W/m^2K	5.01	m^2K/W

Report for: T2K Office
Upgraded TI Initial Energy Model
Submitted to: Al Coppinger
Date: 2022-Feb-03
Our File No. 2021-1409

Effective Thermal Resistance Calculator

Isothermal-Planes and Parallel-Path Flow Method

Assembly No.	W12	Description	Exterior and interior insulated steel stud wall with steel siding (Fire Rated)
Structure Type	Steel		
Orientation of Assembly	Wall	interior air film R_{si}	0.12
Adjacent to	Exterior	exterior air film R_{si}	0.03

Catagory	Material	Custom Thickness (mm)	Listed Thickness of Material (mm)	Thermal Resistance (Rsi), (m² K)/W per mm	Thermal Resistance (Rsi), (m² K)/W of Material
Cladding_Materials	Metal or vinyl siding over sheathing: Hollow-backed		0	0.00000	0.11
Sheathing_Materials	Gypsum sheathing		12.7	0.00630	0.08
Insulating_Materials	Quiktherm Rigid Insulation		152	0.02900	4.40
Sheathing_Materials	Gypsum sheathing	13.8		0.00630	0.09
Structural_Materials	Steel stud, galvanized sheet	152		0.00002	0.00
Air_Cavities	Wall air cavity 90 mm		90	0.00000	0.18
Interior_Finish_Materials	Gypsum board	13.8		0.00610	0.08

Assembly Thickness: **344** mm

U-value: **0.198** W/m^2K

R-value: **5.05** m^2K/W

Effective Thermal Resistance Calculator

Isothermal-Planes and Parallel-Path Flow Method

Assembly No.	W14	Description	CMU wall with steel siding
Structure Type	Concrete		
Orientation of Assembly	Wall	interior air film R_{si}	0.12
Adjacent to	Exterior	exterior air film R_{si}	0.03

Catagory	Material	Custom Thickness (mm)	Listed Thickness of Material (mm)	Thermal Resistance (Rsi), (m² K)/W per mm	Thermal Resistance (Rsi), (m² K)/W of Material
Cladding_Materials	Metal or vinyl siding over sheathing: Hollow-backed		0	0.00000	0.11
Insulating_Materials	Quiktherm Rigid Insulation	102		0.02900	2.96
Concrete_Blocks	LW Conc Block: no insulation in cores (190mm)		190	0.00000	0.32
Interior_Finish_Materials	Gypsum board	12.5		0.00610	0.08

Assembly Thickness: **305** mm

U-value: **0.277** W/m^2K

R-value: **3.61** m^2K/W

Effective Thermal Resistance Calculator

Isothermal-Planes and Parallel-Path Flow Method

Assembly No.	W15	Description	CMU wall with brick
Structure Type	Concrete		
Orientation of Assembly	Wall	interior air film R_{si}	0.12
Adjacent to	Exterior	exterior air film R_{si}	0.03

Catagory	Material	Custom Thickness (mm)	Listed Thickness of Material (mm)	Thermal Resistance (Rsi), (m² K)/W per mm	Thermal Resistance (Rsi), (m² K)/W of Material
Cladding_Materials	Brick: fired clay (2400 kg/m2)		100	0.00070	0.07
Air_Cavities	Wall air cavity 13 mm		13	0.00000	0.16
Insulating_Materials	Quiktherm Rigid Insulation	102		0.02900	2.96
Concrete_Blocks	LW Conc Block: no insulation in cores (190mm)		190	0.00000	0.32
Interior_Finish_Materials	Gypsum board	12.5		0.00610	0.08

Assembly Thickness: **418** mm

U-value: **0.268** W/m^2K

R-value: **3.73** m^2K/W

Appendix B Interior Space Loads

Room Name	NECB Space Type	Area (m2)	NECB Table LPD	Occ Factor	P C Factor	Adj Ref LPD	Occ Inst?	Adj Inst LPD	Equip Power Density	Occupancy
Elev Shaft		0.0								0.0
112 Unit A Shop	Workshop	347.0	17.1	1	1	17.1	1	1.4	10	0.0
101 Stair 1	Stairway	11.4	7.4	1	1	7.4		16.5	0	0.6
114 Stair 2	Stairway	18.9	7.4	1	1	7.4		6.5	0	0.0
120 Unit B Future Tenant	Retail - sales area	703.5	18.1	1	1	18.1		18.1	2.5	35.2
111 UTR	Washroom	6.7	10.5	0.9	1	9.5	1	6.2	1	0.3
113 Service WC	Washroom	12.3	10.5	0.9	1	9.5	1	6.0	1	0.6
215 UTR	Washroom	6.3	10.5	0.9	1	9.5	1	13.2	1	3.1
102 Reception	Office open plan	14.4	11	1	0.9	9.9		8.9	7.5	2.9
220 Future Tenant	Office open plan	707.4	11	1	0.9	9.9		11.0	7.5	0.0
105 Office 1	Office enclosed	18.4	11.9	0.9	0.9	9.6	1	8.8	7.5	3.7
106/107 Office 2/3	Office enclosed	38.3	11.9	0.9	0.9	9.6	1	8.5	7.5	0.0
108 Office 4	Office enclosed	19.2	11.9	0.9	0.9	9.6	1	6.8	7.5	0.0
208 Office	Office enclosed	19.3	11.9	0.9	0.9	9.6	1	6.7	7.5	2.9
209/210/211 Office	Office enclosed	55.0	11.9	0.9	0.9	9.6	1	7.1	7.5	16.5
212/213/214 Office	Office enclosed	58.4	11.9	0.9	0.9	9.6	1	6.7	7.5	0.0
218 Corridor and Future Offices	Office enclosed	44.5	11.9	0.9	0.9	9.6		11.9	7.5	22.3
203 Flex	Lounge/recreation area	16.9	9.4	0.9	1	8.5		3.3	1	0.8
100 Elevator Lobby	Lobby for elevator	13.1	6.9	1	1	6.9		2.1	1	0.7
200 Elevator Lobby	Lobby for elevator	13.1	6.9	1	1	6.9		3.8	1	0.0
110 Coffee	Food preparation area	12.4	10.7	1	1	10.7		2.3	10	0.0
204 Kitchen	Food preparation area	7.8	10.7	1	1	10.7		1.8	10	0.0
217 Mechanical	Electrical/Mechanical area	10.4	13.4	1	1	13.4	1	7.9	1	0.5
103/104 Corridor	Corridor/transition area < 2.4 m wide	35.8	8.4	1	1	8.4		5.3	0	0.0
202 Corridor	Corridor/transition area < 2.4 m wide	10.9	8.4	1	1	8.4		5.1	0	0.0
205 Corridor	Corridor/transition area < 2.4 m wide	34.0	8.4	1	1	8.4		2.9	0	0.0
109 Meeting Room	Conference area/meeting/multi-purpose	13.1	13.2	0.9	1	11.9		11.0	1	0.0
206 MPR	Conference area/meeting/multi-purpose	76.8	13.2	0.9	1	11.9		4.2	1	0.0