

Design Report
Building Envelope Design Competition
Sustainable Buildings Manitoba

Manitoba WARM Window Team

March 2, 2026

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Design Report

Part 1 - Executive Summary

Buildings are significant contributors to Manitoba's overall greenhouse gas emissions (GHG). Windows, an integral part of occupied buildings contribute to as much as 30% of winter heat losses in a typical residential home. Our team is proposing a made in Manitoba solution that seeks to reduce those emissions and provide an occupied space that focuses on thermal comfort. Our proposed solution features the following key components:

1. **Insulated Panel Envelope** – The building enclosure is detailed to control all four layers; liquid, air, water vapour, and heat. The envelope consists of structural insulated panels (R-43.5) on the walls, and (R-55) on the roof. The panels provide a continuous wall and roof system and is based on Greenstone Insulated Panels that are 100% owned and manufactured in Brandon, MB. This insulated panel system provides exceptional R-Values using closed cell Graphite Polystyrene insulation. The panels have been used successfully in arctic climates. The wall and roof systems are detailed to address a water control layer, air control layer, vapour control layer and the thermal control layer. While this is an evolving product, it shows much promise for the future. Greenstone has an extensive library of tested details with attention to eliminating or minimizing thermal bridging. They have been an active and staunch support as a partner on this team. The systems are light, simple to install, leading to reduced labour and very efficient construction. In summary the insulated panel approach will result in:
 - a. High thermal control (panels up to R55)
 - b. Liquid water control layer
 - c. Air control layer
 - d. Water vapour control layer
 - e. Faster and reduced labour to install

2. **Self-Supported Balcony** - The self-supported (or stand-alone) balcony was determined to have the least thermal conductivity, improved thermal performance, improved thermal comfort when compared to other balcony options. The benefits of the self-supported balcony are as follows:
 - a. Significantly Reduced Thermal Bridging - Knife plate connections at discrete locations provide the required lateral stability with reduced thermal bridging compared to typical structurally cantilevered solutions.

- b. Improved thermal comfort for occupants due to reduced thermal bridging.
- c. Construction efficiency – Balcony can be prefabricated off-site, then installed after the envelope is complete.

3. **Manitoba WARM Windows** – Working with Hi-Tech Energy Windows (100% owned and manufactured in Winnipeg, Manitoba, 100% Metis owned) our team is proposing a new innovative heated window system, which keeps the interior glass surface at 20°C throughout the heating months, inspired by the double façade of Manitoba Hydro’s office tower. The WARM Window puts thermal comfort first and allows for a choice of larger windows for exceptional daylight and views for the occupant. The concept, if tested and proven, will result in:

- higher thermal comfort to the occupant,
- larger windows for daylight and views,
- reduced energy consumption,
- reduced demand peaks to Manitoba Hydro,
- smaller mechanical systems (i.e. a smaller furnace for the owner), and
- readily adaptable to current window manufacturing practices.

Manitoba WARM Window -Thermal Performance

Thermal performance was assessed based on the methodology of the Competition Brief Tier 3 base building. Our team’s design was able to achieve the following effective R-Value (hr-ft²-°F/Btu) results:

Aboveground Vertical Façade Wall/Windows	Clear Field with Thermal Bridging and Linear Interfaces	R24.7
Roof	Clear Field with Thermal Bridging and Linear Interfaces	R50.3

This is the result of careful consideration of innovative building component systems; the proposed building is anticipated to exceed the thermal performance by **14.9%** and **4.6%** for the wall and roof system respectively of the Competition Brief Tier 3 base building.

When the WARM Windows are energized the building envelope’s performance improves due to a change in heat loss regime through the WARM Window. This results in reductions to the size of the building mechanical system because the mechanical system does not need to account for the heat loss through the windows.

The advantage of the Manitoba WARM window is the ability to achieve high thermal performance and improved thermal comfort for occupants without compromising window size. Large windows and increased daylight are critical to occupant well-being especially in cold climate regions.

The Manitoba WARM Window concept would benefit from BETAC testing to validate assumptions and hypotheses.

The team incorporated these three key building system elements to develop a building that focuses on improved thermal performance, reduced thermal bridging, high overall U-value, continuity of the principal control layers, while enhancing occupant comfort, daylighting, and views. Our submission provides the thermal performance to achieve National Energy Code of Canada for Buildings (NECB) 2020 Tier 3 performance using these key building components in a unique way. The solution considers simplified constructability and emphasizes Manitoba content in manufactured materials, as described in this report.

Part 2 - Introduction

This submission focuses on three key elements of building design critical to the success of a high performing buildings with improved thermal comfort outcomes for building occupants. The three elements include a high performing roof and wall system, self-supported balconies, and the use of Manitoba WARM Windows.

Windows are the weak link in a building envelope during winter heat losses, yet windows are critical for daylighting and views, which is important to occupant health and well-being. Adequate daylight is crucial for occupant health, regulating circadian rhythm, improving quality of sleep, increasing daytime alertness, and enhancing mood.

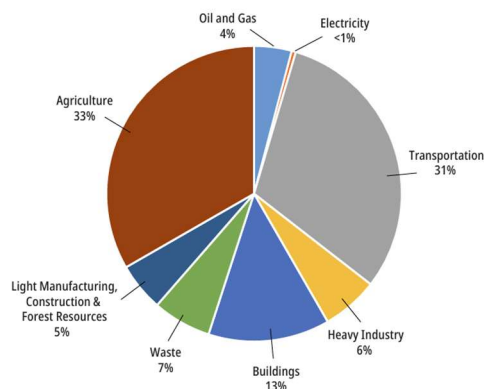
Balancing occupant need for daylight and optimizing window size for thermal performance is challenging, often resulting in reduced window sizes using conventional construction methods. With most walls in an average home (old and new) having an “R20” to “R40” range for the wall, and most windows significantly lower. Windows have always been the weak link in thermal building performance, with effective thermal resistance in the R10 to R15 range for the complete wall assembly.

Can a better window be made? Is the question motivating our team to find solutions. Our team investigated a solution to improve window performance, that could potentially change the way we handle windows in cold climates; for the purposes of this report, we’ve called our window solution the “Manitoba WARM Window”.

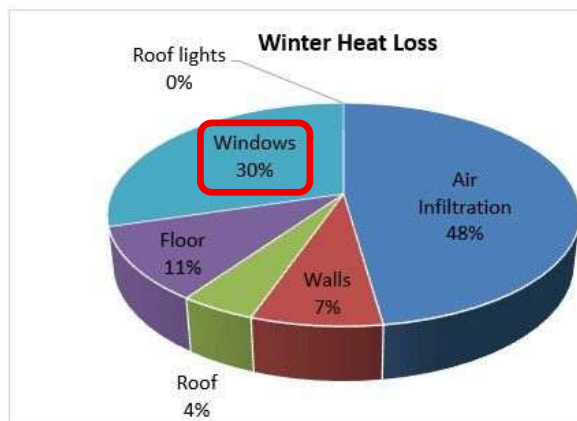
2.1 The Role of Windows in Manitoba’s CO₂e emissions

Buildings contribute 13% of Manitoba emissions (source: Manitoba’s Path to Net Zero, October 2025). Within the category of “Buildings”, windows assume a significant role, accounting for up to 30% of building heat loss (this number is dependant/varies with outdoor temperature, size, and quality of the windows). Windows have always been the weak link in an envelope design; with low winter thermal performance compared to other elements of a building envelope.

Figure 2 – Manitoba's Emissions by Economic Sector (2023)



Buildings contribute 13% of Manitoba's GHG emissions
 Source: Manitoba's Path to Net Zero, October 2025, by the Province of Manitoba



Windows can contribute 30% to Winter Heat loss
 Typical single dwelling home winter Heat Loss Pie-Chart – under winter design conditions

In Manitoba we have over 518,000 occupied private dwellings ([Stats Canada](#)), all assumed to have windows. Windows play a big role in the energy equation, not only to the homeowner, but to the entire energy grid. A better window improves occupant comfort and if implemented on a larger scale will reduce demand on the electrical grid (by reducing demand peaks) benefiting the environment through demand-side energy reduction.

While our team focused on the windows as the weakest link, we also addressed the use of a high performing building envelope and building mass with well-established, low-risk, high-performance products sourced locally that have not become mainstream practices in Multi Unit Residential Buildings (MURB). Our approach to each of these building elements are presented in this report.

Part 3 - Concept Description

The “Manitoba WARM Window” is a new window concept presented in this report. The term “Manitoba WARM Window” or “WARM Window” is used throughout this report to refer to the window concept presented below, and to differentiate it from other windows available commercially.

The remainder of our envelope design is using established and proven envelope systems that in combination with our three key concepts will provide superior envelope thermal performance. The key components of our building envelope submission are summarized in the following sections:

1. Manitoba WARM Windows (Part A)
2. Insulated Panels – by Greenstone Building Products (Part B)
3. Self-Supported Balcony (Part C)

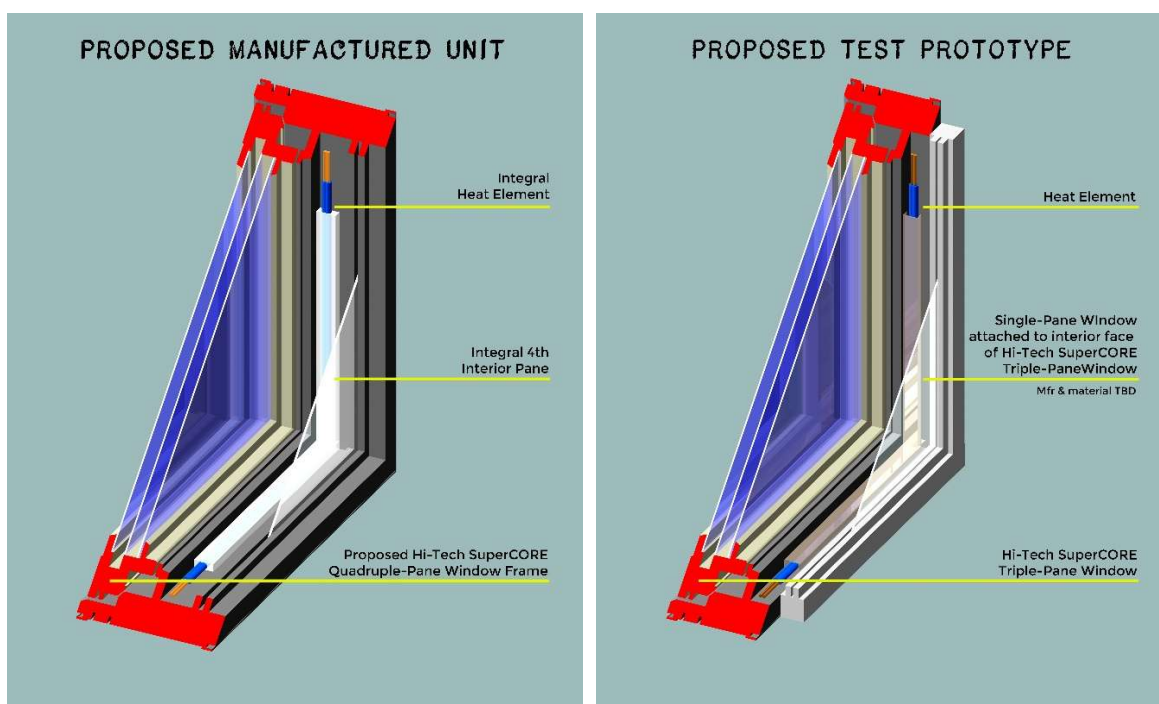
Our submission provides the construction details in Appendix A - Drawings. Please refer to Appendix A - Drawings for the following:

1. Manitoba WARM window, prototype and potential commercial versions (drawings W1 and W2)
2. Competition Apartment Floor Framing Plan, Roof Framing and Window Plan (drawing D1 to D3)
3. Building Envelope Details (drawings D4 to D5)
4. Bill of Materials (D6)
5. Standard Construction details for the Insulated Panels (D7 to D10)
6. Self-Supported Balcony Concept (drawing D11)
7. Elevations and Renderings (drawings D12 and D13)

Detailed thermal calculations, based on our envelope design, are presented in Appendix B- Thermal Calculations.

3.1 Part A - Manitoba WARM Window

The WARM Window concept consists of quadruple pane window system: a high-performance triple pane glass assembly on the exterior, and a single pane on the interior. A self-regulating heating element is located between the panes of the window, with the heating capacity to keep the interior glass surface at room temperature.



Manitoba WARM Window – Concept Plan

Heating element between exterior triple-pane and interior single pane.

Manitoba WARM Window – Mock-up Version

Could be used for testing the concept.

3.1.1 What is a “Manitoba WARM Window”?

The WARM Window concept is a window system that has two sets of glass within the window frame, with a simple heating element embedded in the interstitial space. Current construction practices have rough-in depths of 6” or more, which allow for larger window assemblies to be inserted. The WARM Window is shown in the figure above and consists of the following components:

1. **Exterior Glass and Frame** - The exterior triple pane system using argon gas fill and low-E glass. Teaming with Hi-Tech Energy Windows, they are proposing their Super-Core high-performance PVC frames (fibreglass could also be used) and triple pane

glass unit with an Energy Star Rating of R7.1. The base frame is based on a Hi-Tech Energy Window frame, (although this is easily adaptable to other systems).



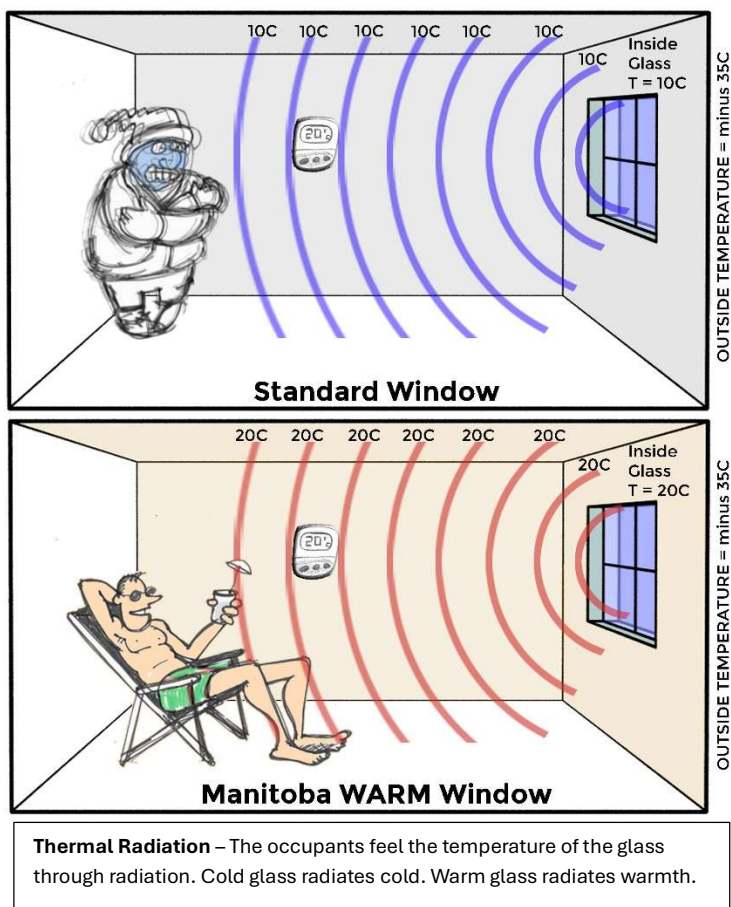
2. **Heating element** – an inexpensive self-regulating heating element, within a metal cover (to conduct the heat to the interstitial space) is embedded in the window, between the exterior window assembly and the interior single pane. The setpoint will be set thermostatically to maintain interior glass surface at 20°C. The heating element will have sufficient heating capacity to maintain the interior glass temperature at 20°C even on the on the coldest days of winter (-35°C).
3. **Interior glass** - the interior pane is mounted close to the interior wall. This glass could be removable to facilitate cleaning of glass surfaces or could be replaced with a screen in the summer. The glass may also be designed to be reversed for improved (low-E) reflectivity performance during summer months. These are details that will be worked out along with a window manufacturer after testing. Additional details will need to be considered for commercial manufacture.

3.1.2 How It Works:

While not proven or tested, the expected results of the WARM Window are as follows:

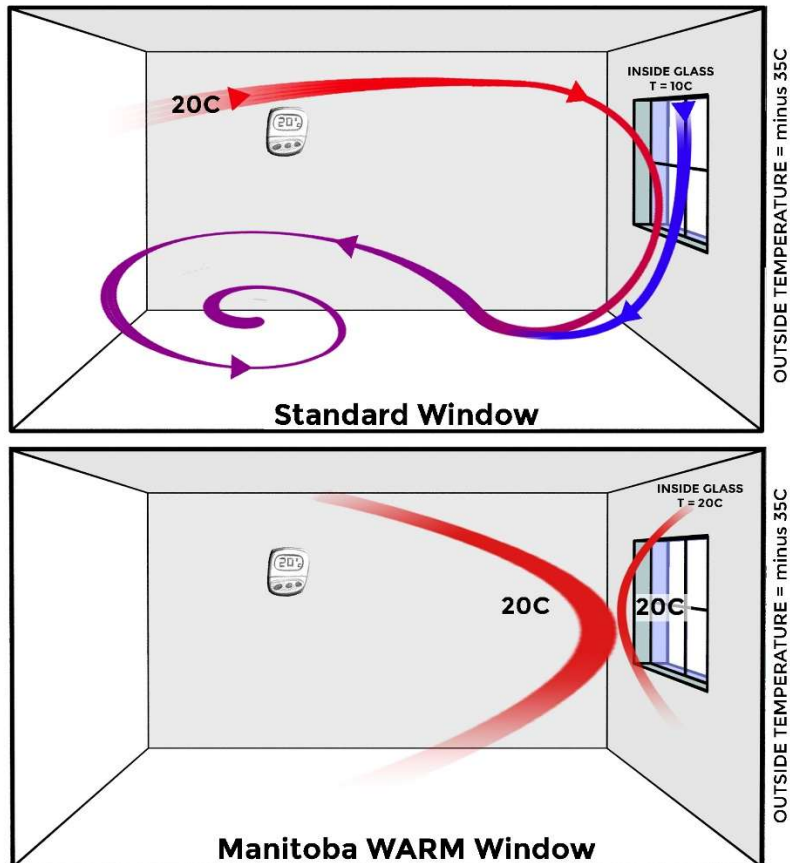
1. **WARM Window will improve occupant thermal comfort in cold weather, due to the radiation effect of the warm glass.** The heating element is self-regulating to maintain the temperature within the window assembly's interstitial space resulting in a consistent temperature on the interior glass surface. The WARM window will be designed to maintain the interior glass surface at 20°C as compared to current windows which can experience 10°C or colder when -35°C outside. The occupant

will emit less heat to the WARM window, instead of the cold surface (e.g. 10°C) of a traditional window. Radiation (i.e. radiant heat in the infrared light spectrum) is a little understood phenomenon: it is the exchange of energy between our skin and the difference in temperature of the surfaces our skin is exposed to. Radiation from the sun, a campfire, or cold basement walls (on a hot summer day) are examples of where we experience radiation. With a WARM Window (at 20°C) the occupant will feel a higher level of comfort compared to a traditional window (e.g. at 10°C). The occupant feels the temperature of the glass surface through radiation. As a result of the WARM Window, the room air temperature can be reduced, while maintaining thermal comfort, which will result in energy savings.



2. **Window heat loss is dealt-with at the source, without air-mixing.** On winter days, the air near the window is cooled causing air cool downward air currents. This air mixes with room air. With a WARM window, the glass surface is warm, reducing air mixing in the room space. The window heat loss is dealt with at the source, inside

the window interstitial space Heating the space will require less energy especially during typical peak energy demand in the mornings and evenings, resulting in smaller mechanical systems (furnace), and a corresponding reduction in electrical demand during known electrical demand peaks in the morning and evening.



Air Mixing – In winter, denser cool air at the window sinks toward the floor, drawing warmer room air with it. This mixed air stream lowers the room temperature. The WARM Window’s inside glass surface is warmer, lessening or eliminating this cooling effect. The WARM window heat loss is dealt with at the source, inside the window.

Stable Thermal Environment
= Small Temperature Swings
= Small Mechanical Systems
= Low Demand Peaks

3.1.3 Benefits of the WARM Window

The benefits of the WARM Window include:

1. **Reduced Peak Electrical Demand** - The WARM window helps stabilize temperatures within the residence, reducing the morning and evening demand peaks on the Manitoba Hydro Electrical Grid. The building mechanical systems will require little additional energy to warm the space during those ramp-up peak periods. The resulting effect is a reduced energy demand during peak demand periods, when projected on a larger scale will translate into significant costs savings for Manitoba Hydro and all Manitobans. (see Attachment 1 – Perspective: The impact of electrical peak demand reduction and the potential impact of WARM Windows on the Electrical Grid)
2. **Lower Room Temperature Setpoint** – Occupants will experience higher thermal comfort at a lower room air temperature setpoint. The occupant experiences thermal comfort from several phenomena which are radiation, air movement (convection), air temperature, clothing and metabolic rate. The control of the temperature of the radiant surfaces (windows, ceilings, floor) was a design principal incorporated in the Manitoba Hydro Office. Lower air temperature = energy savings.
3. **Smaller Mechanical Systems (furnace)** – In winter, the output of the furnace will be lower, as the windows are already taking care of the heat losses in the window (24/7). A smaller mechanical system translates into lower mechanical system initial cost.
4. **Improved Comfort to Occupants** – No cold windows when outdoor temperatures are cold e.g. -35°C. Warm interior window surface translates into improved thermal comfort for occupants.
5. **Higher R-Value** – Quadruple pane WARM Window will provide a higher R-Value than standard windows, resulting in lower overall energy consumption and electrical demand requirements.
6. **No Condensation or Frost on the Glass** – The WARM Window will keep the interior glass surfaces above the normal dewpoint of a residence, reducing the potential for moisture damage near the window frame due to frost or condensation.
7. **100% Manitoba Made Solution** – Proposed to be manufactured using a 100% Manitoba owned and operated manufacturing facility (Hi-Tech Energy Windows. Winnipeg. 100% Metis owned).

- 8. Readily Adaptable using Current Standard Window Manufacturing Practices** The system utilizes standard window extrusions and glazing elements combined to create the four-pane window for a mock-up: a standard triple pane window extrusion and glazing connected to a standard single pane (interior) window extrusion and glazing. A customized extrusion would likely be required for commercial production. This WARM Window could be produced by most window manufacturers in Manitoba.

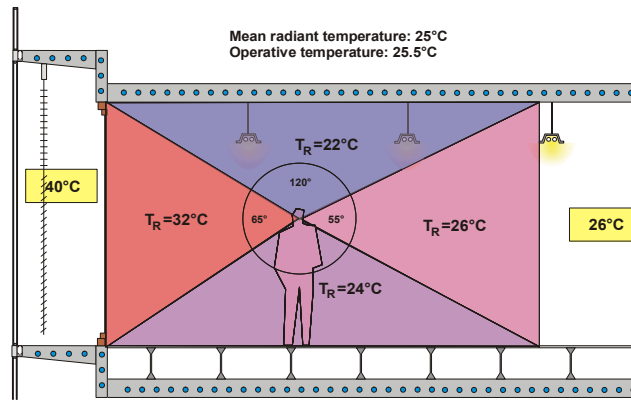
3.1.4 Inspiration for the Manitoba WARM Window Concept

The Manitoba WARM Window was inspired by the double façade system used in the Manitoba Hydro Office building. Alan Aftanas, Jeff Brooks and Neil Klassen were on the Earth Tech mechanical and electrical engineering design team, and part of the Integrated Design Process (IDP), working alongside the energy consultants, Transsolar KlimaEngineering GmbH, from Stuttgart Germany.

“As part of the Earth Tech mechanical and electrical design team I had the opportunity to meet with Transsolar in Germany and travel to see double façade buildings that they had done in Stuttgart, Frankfurt and Berlin. At that time, it was clear that's the double façade would work for Manitoba Hydro in a cold climate application. Over the last 14 years, since the Hydro Office opened, the warm interior glass concept has proven itself. Ever since that project was completed, I've always wondered why the double facade concept has not been scaled to a residential application.” Alan Aftanas, P.Eng,

February 25, 2026

The double façade of the Manitoba Hydro Office Tower has an exterior glazing system, then a 3-foot space, before an interior curtain wall (typical of store-front). The 3-foot interstitial space between the exterior glazing and the interior glass is heated with the concrete slab heating system. In the winter when temperatures are cold outdoors (say -35°C) the interior curtain wall is relatively warm, which affects the resultant temperature felt by the occupants. The figure below shows the mean radiant temperature of the occupant, in summer conditions, but is calculated in the same way for winter conditions.



Graphic from Manitoba Hydro Office Double Façade - The glass surface radiates to the occupants. Occupant feels the “resultant radiant temperature” of the (warm) interior window, ceiling and floor. This figure shows the resultant radiant temperature for summer conditions, but the calculation is done the same for winter. (image source: Transsolar KlimaEngineering GmbH)

3.2 Part B - Envelope based on Insulated Panels

The backbone of our proposed envelope system is based on structural insulated wall panels, 9.25” thick (R-43.5), and 11.5” thick roof panels (R-55). The panels along with the air/vapour-tight building (roof and wall) assembly systems are based on Greenstone Insulated Panels (100% Manitoba owned and manufactured in Brandon, MB). This system provides exceptional R-Values through a Graphite Polystyrene closed cell insulation and isolated steel studs for structural integrity.

The technology has been used and proven in arctic climates and is rapidly evolving with improved thermal resistance, and protection against water, air and vapour. This is an evolving product that shows much promise for future building application. Greenstone has a well-developed 215-page standard details manual, with attention to the details that eliminate or minimize thermal bridging and provided strong support as a partner on this team.

Details of the complete wall and roof assemblies are shown in sections A and B and in the corresponding materials list. Exterior finishes include cement fibre cladding (e.g. Cedral, Hardie Board, etc.) attached to strapping on a peel and stick membrane mounted to thermally isolated metal structural members embedded in the exterior face of the insulated panels as shown on drawing D10 (Standard Panel detail 103). The interior finishes such as gypsum drywall are attached directly onto the interior face of the insulated panels over a permeable membrane and fixed to thermally isolated steel stud members embedded in the foam panels, and the embedded studs seal taped as shown in our drawing in Appendix A - Drawings.

The insulated panels are well-suited to low-rise multi-story building applications and have been proven in far-north climate regimes. These panels can carry structural building live and dead loads. In our sample suite for this submission, we have included independent steel framing to support the floor loads however roof loads will be supported by the insulated wall panels.

The floor system is proposed as a 315 mm cross laminated timber (CLT) system that can be fabricated locally in Manitoba. The slabs will allow for long clear spans eliminating interior load bearing members. The thermal mass and passive heat gain of the building is enhanced when compared to a typical wood joist floor system. The steel framing while

supporting the floor loads also accommodates the discrete knife plate connections for lateral support of the self-supported balconies.

The Roof framing consists of insulated panels spanning prefabricated wood trusses. The insulated panel system accommodates roof overhangs of varying lengths, to permit shading for windows. For our submission we have included a standard 600mm overhang throughout except for above the balcony where the overhang extends to the outside edge of the balcony. The truss system is configured with the panels to minimize thermal bridging at these locations.

The exterior of the roof includes durable metal roofing mounted over strapping on a peel and stick membrane on the insulated panels.

Installation of the roof and wall panels, which can be done in any season, is simple and does not require specialized equipment. Greenstone also provides assembly support through training, videos and on-site documentation. Refer to Greenstone details for information.

Consideration for minimizing air infiltration issues in the suites ventilation and air exchange is important. We have employed the following strategies ventilation requirements:

- Kitchen exhaust - to a common exhaust service running in building common space and as a single penetration (i.e. no in-suite envelope penetration);
- Bathroom exhaust is proposed to connect to a central heat recovery ventilation (HRV) system and directed out through a building common space (i.e. no in-suite envelope penetration); and
- The multiple plumbing vent stacks should be connected to a common stack vent penetration in the common space (i.e. no in-suite penetration).

3.2.1 Benefits of Greenstone Insulated Panels

The 100% owned and manufactured in Brandon, Manitoba system is light, easy to install, leading to reduced labour and efficient construction. In summary the insulated panel approach will result in:

1. **High Thermal Performance** - The GS Insulated Panel has high effective R-Values in a single-step prefab system. The panels provide a tight envelope that is energy efficient by addressing thermal bridging and water, air, and vapour penetration.

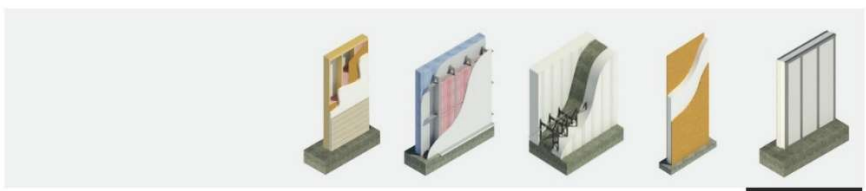
Greenstone claims that that Tier 4 of the NEBC 2020 can be easily achieved by using the GS Insulated Panel system.

2. **Airtight** - With proper detailing, GS Panel houses have come in as low as 0.20 ACH 50 PA, exceeding passive house standards.
3. **Proven Performance in Cold Climates** - Sample Greenstone projects are provided in Appendix D. Some of these projects are in the high arctic (Iqaluit, NU) and northern climates.
4. **Durable with Good Structure Integrity** - Each project is reviewed and stamped by an engineer, and the panels are custom designed custom for each build, ensuring ultimate structural integrity. (Fun fact: a GS Panel house stood through hurricane Dorian in the Bahamas in 2019).
5. **Accelerated Completion and Labour Savings** - The panels combine framing, insulation, and vapour barrier into one pre-fab step, increasing speed of construction and reducing labour costs. No stud framing required on interior walls. Drywall is applied directly on the insulated panels which have built-in metal studs at standard spacings. Similarly, the exterior walls have thermally isolated connections for Fibre Cement Siding. Panels are prefabricated specifically for the project, and are relatively light, improving construction speeds, and reduced heavy equipment required on site.
6. **Environmentally Responsible** - The graphite polystyrene insulation in Greenstone panels are manufactured (expanded) using atmospheric air, not toxic gases. This means these panels will never off-gas into the home, resulting in healthy air quality and consistent lifetime R-Values.
7. **Generational Housing** - The panels are made from hydrophobic non-organic materials that will never rot or mould. This ensures that when properly protected the building will last for generations.

R-VALUES								
Panel Thickness	5.5"		7.5"		9.25"		11.5"	
Core Material (<small>EPS: Expanded Polystyrene - Standard</small> <small>GPS: Graphite Polystyrene - Premium</small>)	EPS	GPS	EPS	GPS	EPS	GPS	EPS	GPS
EPS R-Value (tested at 24.02°C)	22.91	25.85	31.24	35.25	38.53	43.475	46.00	55.20
THERM Analysis of ICE Panel Assembly	22.18	•	30.24	•	37.3	•	44.53*	•

**estimated based on THERM Analysis of 5.5"-9.25" ICE Panels*

Greenstone Product Thermal Performance – R-Values for GPS Insulated Panels



	WOOD	STEEL STUD	ICF	SIPs	GS PANEL
Single Step Building Envelope	-	-	-	✓	✓
Visible Structural Integrity	✓	✓	-	✓	✓
No Thermal Bridging	-	-	✓	-	✓
Permanent R-Values (200+ Years)	-	-	✓	-	✓

Greenstone Product Literature – Envelope Comparison for the GS Insulated Panels



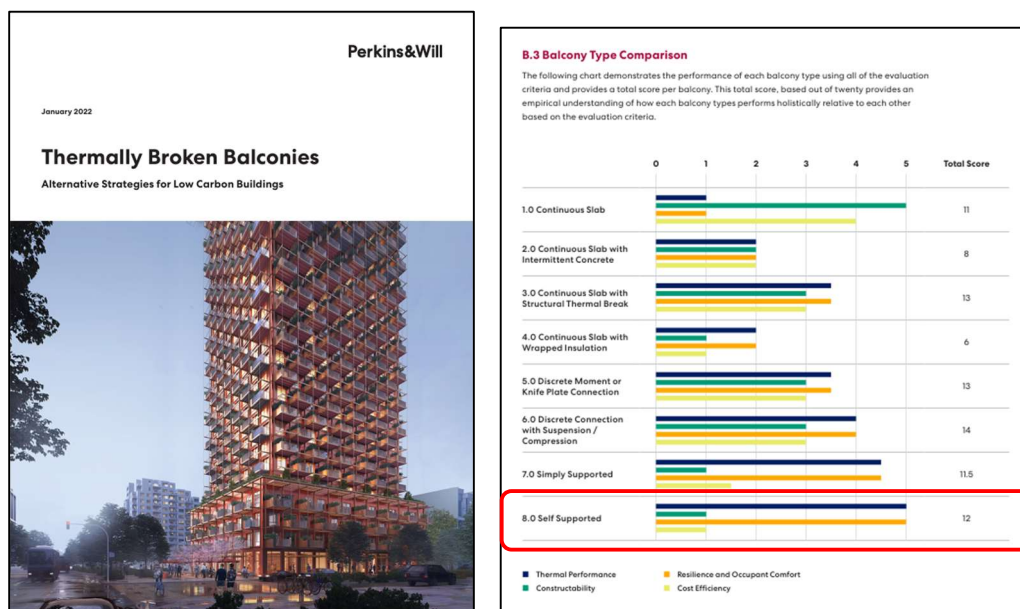
Greenstone Assembly Photos – Prefabricated panel assemblies add to construction speed and efficiency

3.3 Part C – Self-Supported Balcony

Balconies present a challenge for building performance related to the balcony-building connection. Thermal bridges include local areas of the building envelope with significantly higher thermal conductivity. Typical cantilevered balconies present some of the most critical thermal bridges resulting in high heat transfer out of the building, colder surface temperatures inside the building. These lead to high energy consumption, condensation that can lead to mould growth, premature structural integrity issues, and are least favourable for occupant comfort.

There are several alternative balcony connection solutions that are being used in Canada and around the world. These balcony solutions often utilize proprietary structural connectors with thermal breaks in a number of different balcony structural support systems. These discrete connections result in reduced thermal bridging at the balcony connection points and improve the efficiency and thermal performance of the overall building envelope. This means inside surface temperatures are not compromised or reduced at the connection locations and removes the risk of condensation and mould growth potential, results in consistent inside temperatures, and improved thermal comfort for occupants.

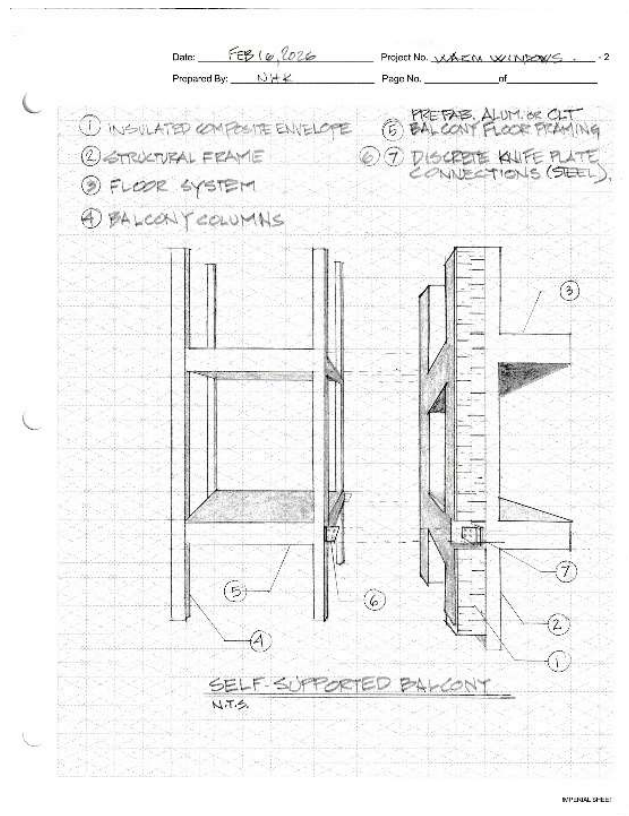
Having considered the myriad options and performance of each balcony system, we have settled on the self-supported balcony that demonstrates best *Thermal Performance* and best *Resilience and Occupant Comfort* when compared with other options. (See attached reference, Perkins and Will — Thermally Broken Balconies - Alternative Strategies for Low Carbon Buildings, January 2022).



Perkins&Will is proud to publish this report with support from RDH Building Science and funding from BC Housing through the Building Excellence Research & Education Grants Program.

Self-supported balconies work best for the low to mid-rise building type and are well suited to this case study building. The self-supported balcony is considered free standing, supported by external columns that are independent of the building structural system. Balcony foundations are independent or an extension of the building foundations. While noted as self-supported, some discrete connections to the building are used for lateral stability and loading.

This balcony system can be prefabricated offsite in steel, aluminum, heavy timber or CLT and then installed after the building envelope has been completed. Discrete knife plate connections at each floor level provide lateral stability and reduce the number of connection points and significantly reduce the thermal bridging normally associated with balcony connections, improving the overall building envelope efficiency.



Concept Drawing of a Self-Supported Balcony
and knife edge lateral support to the main structure

Part 4 - Results

4.1 Overview

This section summarizes the results of the Manitoba WARM Window Team's envelope design, as presented in this report.

4.2 Thermal Performance Analysis

A thermal performance analysis of the building envelope was carried out by our team based on the conceptual level of this system design. This thermal performance analysis included the assessment of the various clear field, linear interface, and point interface fields to minimize any thermal bridging of the building envelope. The team's approach of utilizing highly effective windows and doors, high R-Value wall and roof systems, along with the balancing of the window-to-wall ratio provides a building envelope which exceeds the requirements outlined in the competition brief. The important consideration of the window-to-wall ratio shows the influence of windows and doors can have on an extremely effective exterior wall panelling system. A further factor that has been minimized with the selected envelope system and self-supported balcony system is the minimal thermal bridging occurrences.

The thermal performance analysis of the roof and wall systems are provided in Appendix B – Thermal Performance Analysis Calculations. A summary of the results shown in the tables below indicate the proposed building achieved a 14.9% and a 4.6% improvement in the building thermal performance for the wall system and the roof system respectively.

Base Building Wall		Proposed Building Wall		Below Baseline
Opaque U-Value (Btu/hr-ft ² -°F)	0.048	Opaque U-Value (Btu/hr-ft ² -°F)	0.041	-14.9%
Effective R-Value (hr-ft ² -°F/Btu)	21.0	Effective R-Value (hr-ft ² -°F/Btu)	24.7	

Base Building Roof		Proposed Building Roof		Below Baseline
Opaque U-Value (Btu/hr-ft ² -°F)	0.021	Opaque U-Value (Btu/hr-ft ² -°F)	0.020	-4.6%
Effective R-Value (hr-ft ² -°F/Btu)	48.0	Effective R-Value (hr-ft ² -°F/Btu)	50.3	

4.3 Daylighting and Views

Windows, with their low thermal resistance (low R-Value), are a weak link in cold-climate envelope design. Designers must carefully balance the window-to-wall ratio, to achieve acceptable average Clear Field values on the vertical façades.

The “Manitoba WARM Window” changes the game, with high thermal performance and low energy requirements, thereby eliminating the normal thermal penalty for window size. This allows the window sizes to be increased, improving daylight penetration and views for the occupants. Our design team was able to provide large windows as shown in drawing D2, and still exceed the R21 Vertical Façade performance, to meet the 50% (Tier 3) savings over NECB 2020.

Our submission includes a ratio of 16.7% of window clear field to wall clear field. This can be increased but was limited for functionality of the bedroom spaces and furniture placement considerations. The ratio affords good daylight penetration into the occupied spaces. The building ceiling system is sloped to further optimize daylight penetration.

Additionally light penetration could be enhanced during the cooling season when the sun has a higher angle of inclination using either reflective light shelves or light-coloured wide slat Venetian blinds. The daylight penetration could be proved out with daylight modeling. Either option can bounce indirect visible light into the apartment. During the cooling season either option would minimize the impact of infrared light, which causes high solar heat gains within the space. The strategic location of the low-E window coatings of the Manitoba WARM windows will further reduce radiant heat losses during the heating season by placing the coating closer an interior portion of the glazing.

4.4 Climate Resiliency

Climate change requires us to adapt our approach to building to improve resilience against more frequent extreme weather events. Buildings are a significant source of energy consumption with provincial and national demand for heating and cooling expected to increase due to climate change. New construction needs to consider reducing energy consumption, reduce GHG emissions and target (and achieve) net zero goals.

Our proposed plan incorporates systemic changes to standard building envelope materials that improve energy efficiency and proposes an innovative approach to residential building windows adapted from proven commercial concepts.

We have integrated different building materials that consider the lifecycle assessments and improve the building's resilience to the escalating impacts of climate change, including elements such as the CLT flooring, and structural insulated panels, pre-fab self-supported balconies, careful consideration of window shading provided by roof overhangs and Manitoba WARM Windows.

The Manitoba WARM Windows provide improved thermal resistance and enhanced thermal comfort against these changing climate conditions. Additionally, they provide improved sound transmission for greater occupant comfort in increasingly denser and noisier urban settings. The greater thermal performance of these windows when implemented at scale also translates into reduced energy consumption.

The increasing potential for extreme weather events brought about by climate change will require buildings to be resilient and thermal autonomy to ride out these events. With the increased frequency and volatility of climate events Manitoba buildings are increasingly susceptible to lengthy power interruptions. These events have left communities across Manitoba without electrical services for hours or even days at a time. Our proposed building assemblies using Manitoba WARM Windows and the Greenstone insulated panels provide a high performing thermal envelope, larger windows, the associated passive (solar) heat, thermally massive CLT floor panels. Thermal resilience and building autonomy can be achieved to bridge power outages. The daily solar radiant heat absorbed by the slabs during the daylight hours is gradually released throughout the remainder of the day.

Climate change is also causing warming in Canada at a far faster rate than the global average. Our design considered reducing solar heat gain in summer months through various shading methods at the suite's fenestration. The elevation of the south facing windows in relation to the building eaves should consider the need to provide solar heat gain during the winter when the sun is at a low inclination (18 to 30 degrees) and shaded during the summer when the sunlight is striking the building at an inclination 45 to 60 degrees mid-day. This needs to be balanced with providing adequate natural light into the space. The use of a low albedo patio surface and orientation Venetian blinds and/or exterior light shelves is employed to help reflect visible light into the suite and reducing the need for electrical lighting.

The proposed cladding systems are proven products for durability:

- Exterior Cladding - The cladding is a cementitious exterior finish (such as Cedral or Hardie Board), known for low maintenance with proven durability to changing climate conditions.

- Roof Cladding - The proposed roof cladding is steel, also known for low maintenance product with proven durability to changing climate conditions when compared to other roof systems such as shingles or built-up systems.

4.5 Constructability

The Insulated Panel provide several constructability advantages over framed systems.

Accelerated Completion - the Insulated Panels combine framing, insulation, and vapour barrier into one pre-fab system, facilitating cold weather construction, reducing installation time, and reducing labour costs.

For the Insulated Panels each project is reviewed and stamped by an engineer, and the panels will be designed custom for the build, ensuring ultimate structural integrity, and simplified assembly.

Panels are relatively light, improving construction speeds, and reduced heavy equipment required on site.

No additional stud framing is required on interior walls. Drywall is applied directly on the insulated panes which have built-in metal studs at 16" O.C. (or other spacing, as required by the engineer).

The Manitoba WARM Window concept is easily adapted to virtually all existing window manufacturers and window types. The outer and inner glazing panes are mounted in standard window extrusions. The heating and thermostat components are added to existing extrusions.

Balcony constructability has also been considered, the vertical framing and balcony floor can both be prefabricated and easily installed floor by floor, during even during winter. The knife plate connections are preinstalled and easily bolted to secure the prefabricated balcony elements together. Materials for the vertical framework would consist of galvanized structural steel. The knife plate connections would also be steel but consideration can be given to stainless steel for reduced thermal conductivity. The balcony floor plate is envisioned as aluminum or CLT panels with an appropriate water protection membrane system.

4.6 Aesthetics

Overall building massing including form and shape are established by the competition. We have worked within that massing using materials, colour and texture to break up larger building face elements and applied a variety of materials to create interest while maintaining functionality, high durability and low maintenance of the materials.

The roof is proposed as a simple gable roof primarily to reduce the amount of potential thermal bridging in the wall/ roof envelope, introduced by roof load bearing elements such as trusses, particularly at the roof overhangs.

Our building envelope finish materials design includes fibre cement exterior panels, such as Cedral Fibre Cement Siding or Hardie Panel Siding, and metal roofing from a Manitoba company such as IroSTEEL in Winkler, among others. These products are available in many colours, styles and textures and offer tremendous flexibility to customize each MURB unit with an identity to suit the neighbourhood and with appropriate contextual sensitivity.

Our building envelope features large windows, made possible by the combination of the WARM window and exceptional thermal performance of the envelope.

Our renderings and elevations are shown on drawings D12 and D13 in Appendix A - Drawings. Our elevations and rendering are just one example of that of a multitude of combinations and aesthetic opportunities.

The ground level will be finished using stone to anchor the overall building mass.

The materials and overall look and feel are well suited to the context of typical residential neighbourhood. Lighting and landscape design would enhance and harmonize with the neighbouring homes and aesthetic.

4.7 Local Materials

Our building envelope is based on the following the following Manitoba owned companies, which would supply the key component:

- Windows – Hi-Tech Energy Windows, proudly 100% Winnipeg Owned and Operated (and 100% Metis owned). Manitoba manufacturing includes: most frames are extruded in Winnipeg, and the glass is cut and assembled in Winnipeg. Glass is formed in Canada.
- Insulated Panels – Greenstone Building Products, Brandon, Manitoba, 100% owned, operated and manufactured in Brandon.

- Self-Supported Balconies – There are many qualified manufacturers that can pre-fabricate the balconies and are 100% owned and operated in Manitoba (e.g. Bang-On Metal Fabrication Ltd.).
- Metal Roof Cladding – IroSTEEL Ltd., Winkler, Manitoba, 100% owned, operated and manufactured in Winkler.

The gypsum wallboard (i.e. drywall) is 100% manufactured in Winnipeg at a significant manufacturing facility, with gypsum supplied from Manitoba. The CentainTeed (formerly Westroc) manufacturing facility employs many Manitobans but is a US owned company.

While these manufacturers are named for the purposes of this competition, we have also determined that there are multiple manufacturers in most of these material categories that can supply similar products.

Part 5 – Conclusion

Our submission introduces a bold and innovative Manitoba WARM Window concept adapted from commercial use to a residential application.

The WARM Window allows the overall design to include plenty of glazing and not compromise the daylight and views for the occupant, while providing exceptional thermal comfort, and reduced energy consumption for the homeowner and to the Province. The WARM Window would benefit from BETAC testing to provide proof of concept and an opportunity to evolve the concept further.

The proposed balcony system virtually eliminates thermal bridging and the associated negative effects, in a simple constructible way that utilizes locally sourced manufacturing and supply.

The building envelope proposed achieves NECB 2020 Tier 3 performance using key building components in a unique way, sourced from 100% Manitoba owned, operated manufacturers. The products are practical, adaptable, durable, locally produced and facilitate accelerated construction methods.

Acknowledgments

The Manitoba WARM Window Team would like to acknowledge and thank the following contributors to this submission:

- Design report – by Alan Aftanas, Neil Klassen and Jeff Brooks
- Construction drawings, sections and balcony design – by Neil Klassen
- Thermal performance calculations – by Jeff Brooks
- Renderings and elevations – by Laurie Aftanas
- Poster boards – by Alan Aftanas
- WARM Window graphic art – by Chris Lipscombe
- Insulated Panel information and technical support – by Jena Kline and Weldon Loewen of Greenstone Building Products
- Window information and technical support – by Sean Kapusta, Hi-Tech Energy Windows

NOTE: The “Manitoba WARM Window” concept is the property of: Alan Aftanas, P.Eng. at AAftaPD@outlook.com

Attachment 1 – Perspective: The impact of Manitoba WARM Windows on electrical demand reduction and the potential impact to the Electrical Grid

The innovative concept of WARM Windows when applied to the broader provincial housing through both new construction and retrofits will reduce electrical grid demand peaks, leading to demand side reductions. Efficiency Manitoba and Manitoba Hydro's Integrated Resource Planning (IRP) groups would have the resources to examine and develop this perspective.

The capital cost of energy - Manitoba Hydro's (MH) recently constructed Keeyask Generating Station was built at a cost to Manitoban's of \$8.7 billion for 695 MW of green energy. That translates to \$12.5 million per MW of firm demand gained. This excludes, transmission line upgrades (BiPole 3) which cost another \$5 billion. Alternately, non-green-fossil-fuel energy can be generated at a lower cost, using Combustion Turbines ("currently estimated" at \$3 billion for 500 MW or \$6 million/MW).

Keeyask Generating Station – completed 2023



\$8.7 billion; 695 MW firm demand gained;
\$12.5 million/MW - paid by all Manitoban's.

Alternately, Efficiency Manitoba is working on reducing demand (source: Efficiency Manitoba 2024/25 Annual Report). Based on this report the apparent cost per MW of energy avoided is:

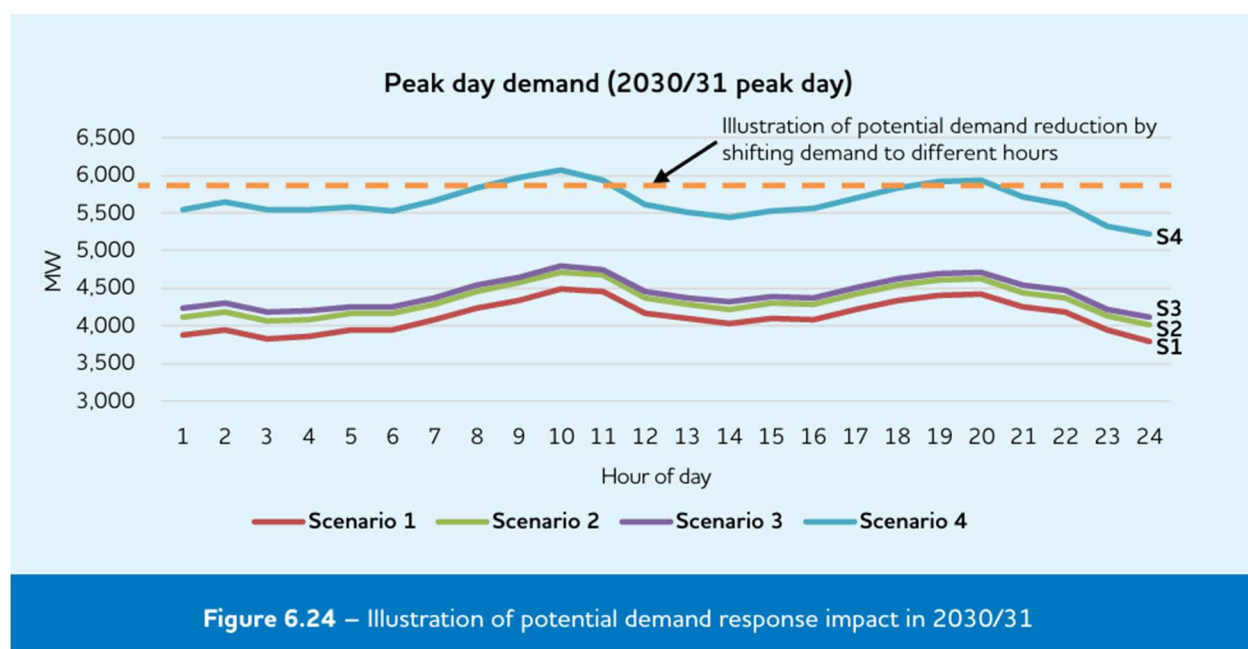


\$67.7 million; 51.2 MW of firm demand reduced;
\$1.32 million/MW – paid by all Manitoban's

From this we can see that demand side reduction efforts appear to be much more cost effective per MW than adding capacity. Efficiency Manitoba efforts, such as providing

consumers with financial incentives to install better windows will contribute to reducing the demand on the electrical grid at a much lower cost than building capacity (it's our money).

Morning and Evening Demand Peaks - The morning and evening demand peaks on the electrical grid contribute up to 500 MW of additional demand (see diagram below) driven by warming-up our house and hot showers in the morning and after work. The following diagram clearly shows the morning and afternoon demand peak, that in combination with the winter design peak (-39°C for 2 days is used for the natural gas system design) which only occurs a few days every few years, **is driving the sizing of the entire** MH Electrical and MH Natural Gas (NG) systems.



Morning and Afternoon Electrical Demand Peaks of 500 MW (appear to be about 6,000 MW to 5,500 MW for S4) source: page 76, 2023 Integrated Resource Plan, July 2023, Manitoba

Efficiency Manitoba is seeking ways to reduce demand.

Shaving the 500 MW morning/evening winter peak can be attributed to “Buildings” and business ramp-up heating and hot water usage (that is another morning/evening peak contributor that can be 100% avoided with very simple solutions). “Windows” are a significant contributor, representing up to 30% of the buildings heat loss (this number varies with outdoor temperature, size and quality of the windows).

We believe that the Manitoba WARM Window concept, if proven out, could have a role to play. By heating the windows all night (and all day), the amount of “ramp-up” energy is reduced in the morning and evening, reducing the morning/evening 500 MW peak.

Some simple calculations can demonstrate the role of windows in the Province of Manitoba CO₂e emissions:

$$\text{Manitoba CO}_2\text{e - Windows Role} = 21.3 \text{ MT/yr} \times 13\% \text{ (buildings)} \times 30\% \text{ windows} = 0.83 \text{ MT/yr}$$

or

$$\text{Manitoba CO}_2\text{e - Windows Role} = 13\% \text{ buildings} \times 30\% \text{ windows} = 3.9\% \text{ of all Manitoba's CO}_2\text{e emissions}$$

Refer to Manitoba's Path to Net Zero, October 2025, Province of Manitoba for basis of calculations.