Advancing Thermal Resilience in Multi Unit Residential Buildings (TRiM)

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1 Context
1.1 INTRODUCTION

Sustained indoor overheating during heat events can result in physiological heat stress, particularly where occupants are unable to recover overnight in cooler spaces. In Vancouver, overheating in multi-unit residential buildings (MURBs) has become an increasing concern as rising summer temperatures, and recent extreme heat events have revealed limitations in maintaining safe indoor thermal conditions. As such, the study isolates building passive thermal response under extreme heat, rather than assessing full resilience under compound or infrastructure failure events such as power outages and / or smoke events.

The Thermal Resilience in MURBs (TRiM) study was initiated by the City of Vancouver to develop an evidence-based framework advancing thermal resilience in new MURB construction. The study evaluates design and construction approaches to reduce overheating risk under current and extreme heat events.

The study integrates literature review, climate scenario assessments, overheating risk modelling, energy modelling, costing analysis of measures, constructability assessment, and implementation considerations to:

- Assess passive design strategies that improve indoor thermal safety and reduce overheating risk.
- Examine performance indicators related to occupant thermal comfort and overheating risk.
- Evaluate the effectiveness, feasibility, and cost implications of passive design strategies under both current and projected future climate scenarios.

The outcomes are intended to provide evidence-based guidance that supports practical implementation and informed policy dialogue, without introducing new regulatory requirements.

1 Context

1.2 CLIMATE, POLICY AND HEALTH CONTEXT

The TRiM study builds on City of Vancouver policy priorities and growing evidence that overheating risk in multi-unit residential buildings is increasing as climate conditions change. Recent extreme heat events have demonstrated that even high-performing, energy-efficient buildings can experience elevated indoor temperatures, highlighting the need to better understand how building design and policy frameworks interact to support thermal safety.

The City of Vancouver's Climate Change Adaptation Strategy[1] identifies extreme heat as one of the city's top climate hazards, emphasizing indoor thermal safety and resident protection during heat events. TRiM explores how new MURBs can be designed to better protect occupant health, support long-term livability, while aligning with the City's climate and emissions objectives.

At the regulatory level, recent updates to the Vancouver Building By-law (VBBL)[2] and the BC Building Code[3] reflect growing recognition of overheating risk.

The VBBL includes summer design temperature considerations under Section 9.33, requires cooling systems to maintain an indoor temperature of 26°C or lower in at least one living space within each dwelling unit at the outdoor summer design temperature. City of Vancouver Energy Modelling Guidelines[4] require overheating analysis for projects with mechanical cooling disabled through the simulation and reporting of the associated overheating hours relative to ASHRAE 55 adaptive comfort limits. Together, these provisions indicate a growing regulatory focus on overheating risk in residential buildings.

The Vancouver Indoor HEAT Study[5] documented indoor temperatures exceeding 35°C in uncooled suites during extreme heat events. Public-health reporting from Vancouver Coastal Health[7] and the BC Extreme Heat Death Review Panel[8] highlights the disproportionate impacts of extreme heat on seniors, renters, and low-income populations, reinforcing the need to consider indoor thermal conditions as a public health priority.

Rather than prescribing specific design solutions, TRiM applies the recently developed NRC health-based overheating risk assessment framework to evaluate how passive and systems-based approaches perform under current and projected climate conditions. The study assesses the effectiveness, feasibility, and limitations of these approaches to inform future design practice and policy discussions related to thermal resilience in new MURBs.

References

[1] Climate Change Adaptation Strategy | City of Vancouver
[2] Vancouver Building By-law (2025) – 9.33.3.1 Indoor Design Temperatures
[3] BC Building Code (2024) – 9.33.3.1 Indoor Design Temperatures
[4] CoV Energy Modelling Guidelines v3.0
[5] Indoor HEAT Study (Webpage / Summary – Dec 2024)
[6] Extreme Heat Death Review Panel Report
[7] Protecting Population Health in a Climate Emergency (VCH)
[8] Vancouver heat wave: Rentals and A/C – CityNews
[9] B.C. heat domes: New report out from VCH – Vancouver Is Awesome
[10] Global News (July 2023)

LIVED EXPERIENCE — THE HUMAN IMPACT OF OVERHEATING

Recent research and lived-experience underscore the human consequences of inadequate thermal protection. The 2021 extreme heat event resulted in 619 deaths across British Columbia[6], with most occurring in residential buildings.

Nearly half (47%) of households reported experiencing at least one symptom of heat-related illness in the summer of 2023 and described impacts to daily lives.

Beyond codes and policies, Vancouver residents are already living the realities of overheating. Their experiences illustrate how equity, affordability, and health intersect with design decisions.

"I tried to put reflective film on my patio windows, and the strata told me to take it down."

— Vancouver Indoor HEAT Study (2021–2023)[5]

"Moving somewhere that allows A/C would easily be $1,000 more a month."

— Vancouver Indoor HEAT Study (2021–2023)[5]

"I had to save up for a portable A/C. That meant less cash flow for groceries."

— Vancouver Indoor HEAT Study (2021–2023)[5]

CityNews Vancouver (Aug. 2023)[8]:

Advocates call for rules to keep renters cool during heat waves, as many still live in apartments without air conditioning.

Vancouver Is Awesome (Aug. 2023)[9]:

75 % of Vancouver-area residents without A/C face dangerous indoor temperatures.

Global News (Jul. 2023)[10]:

Advocates call for rules to keep renters cool during heat waves, as many still live in apartments without air conditioning.

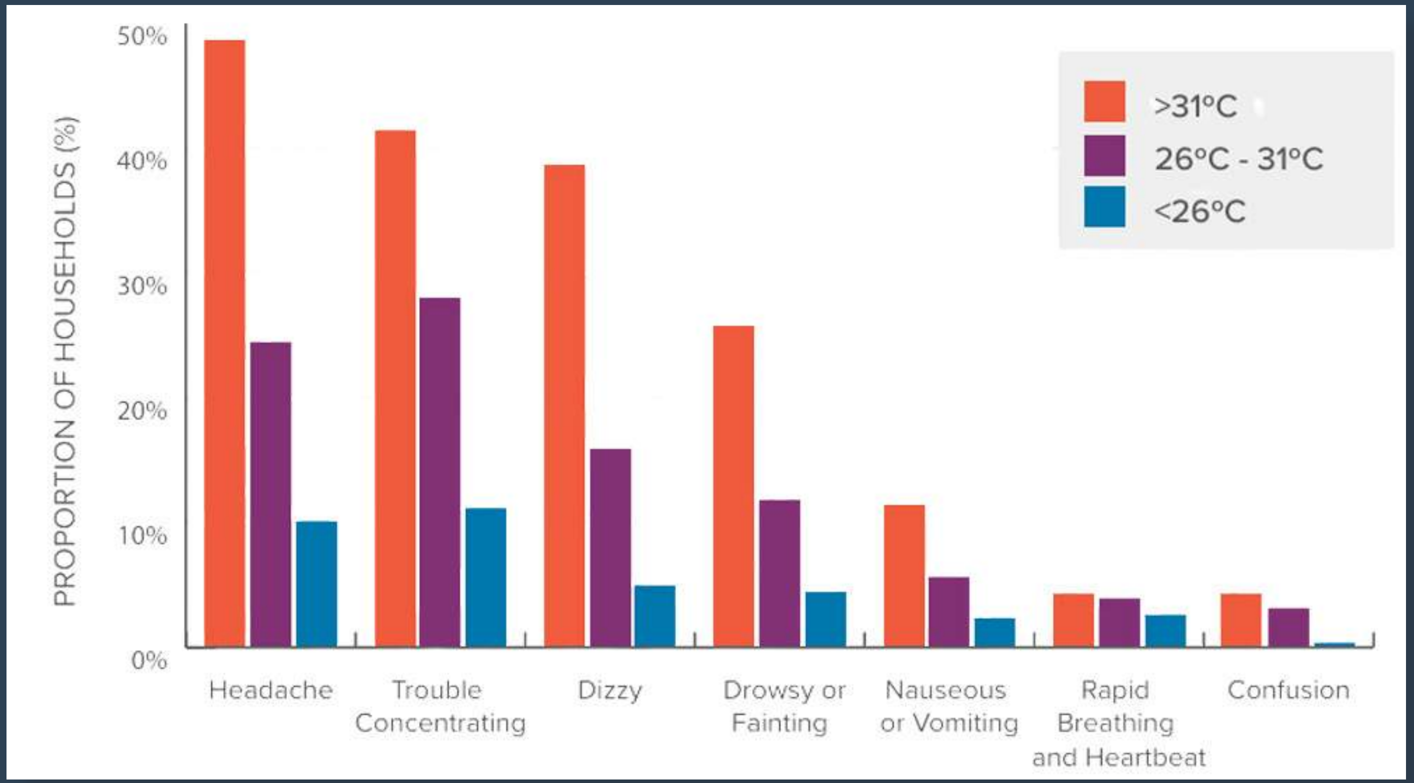


Figure 1. Reported heat-related health symptoms by indoor temperature range. From page 7 of Indoor HEAT Study for Webpage - Dec 2024

2 Study Approach
2.1 STUDY APPROACH OVERVIEW

The Thermal Resilience in MURBs (TRiM) study was structured to evaluate practical, industry-relevant passive design strategies to reduce overheating risk in new multi-unit residential buildings. The approach integrates technical analysis with real-world considerations, including constructability, cost, and market availability.

The study was delivered through a structured process, with study inputs defined early and held constant across all technical analyses to ensure consistency and comparability of results.

- Project Initiation and Management - Study scope, objectives, and workplan established.
- Direction Setting - Archetypes, baseline assumptions, climate files, passive measures, and performance metrics defined and screened
- Study Definition - Passive measure bundles and modelling parameters established.
- Technical Studies - Overheating modelling, energy modelling, cost analysis, and market availability and constructability assessment completed.
- Results & Refinement - Performance compared across bundles, metrics evaluated, and key findings identified.
- Draft Reporting - Findings consolidated and reviewed with stakeholders and Advisory Group
- Final Reporting - Study outputs finalized and presented to the City of Vancouver.

Overheating risk assessment, energy modelling, costing analysis, and market availability and constructability review were undertaken using consistent parameters across all scenarios. This approach ensured that results reflect differences in design strategies rather than variations in modelling assumptions.

Figure 2: TRiM study methodology flow diagram

2 Study Approach
2.2 ADVISORY GROUP ENGAGEMENT

An Advisory Group was engaged during the direction-setting phase to review study framing, assumptions, and prioritization prior to technical studies. The group included representatives from building design, engineering, public health, research, and policy. The Advisory Group provided structured input; responsibility for technical analysis and interpretation remained with the project team.

Advisory Group Session #1
Reviewed study scope, archetype definitions, and climate file selection, supporting confirmation of baseline assumptions

Advisory Group Session #2
Workshop session to review the longlist of passive measures, test guiding principles, and inform bundle development and performance metric selection.

Advisory Group Session #3
Reviewed study findings following completion of technical studies and provided contextual feedback prior to finalization of the report.

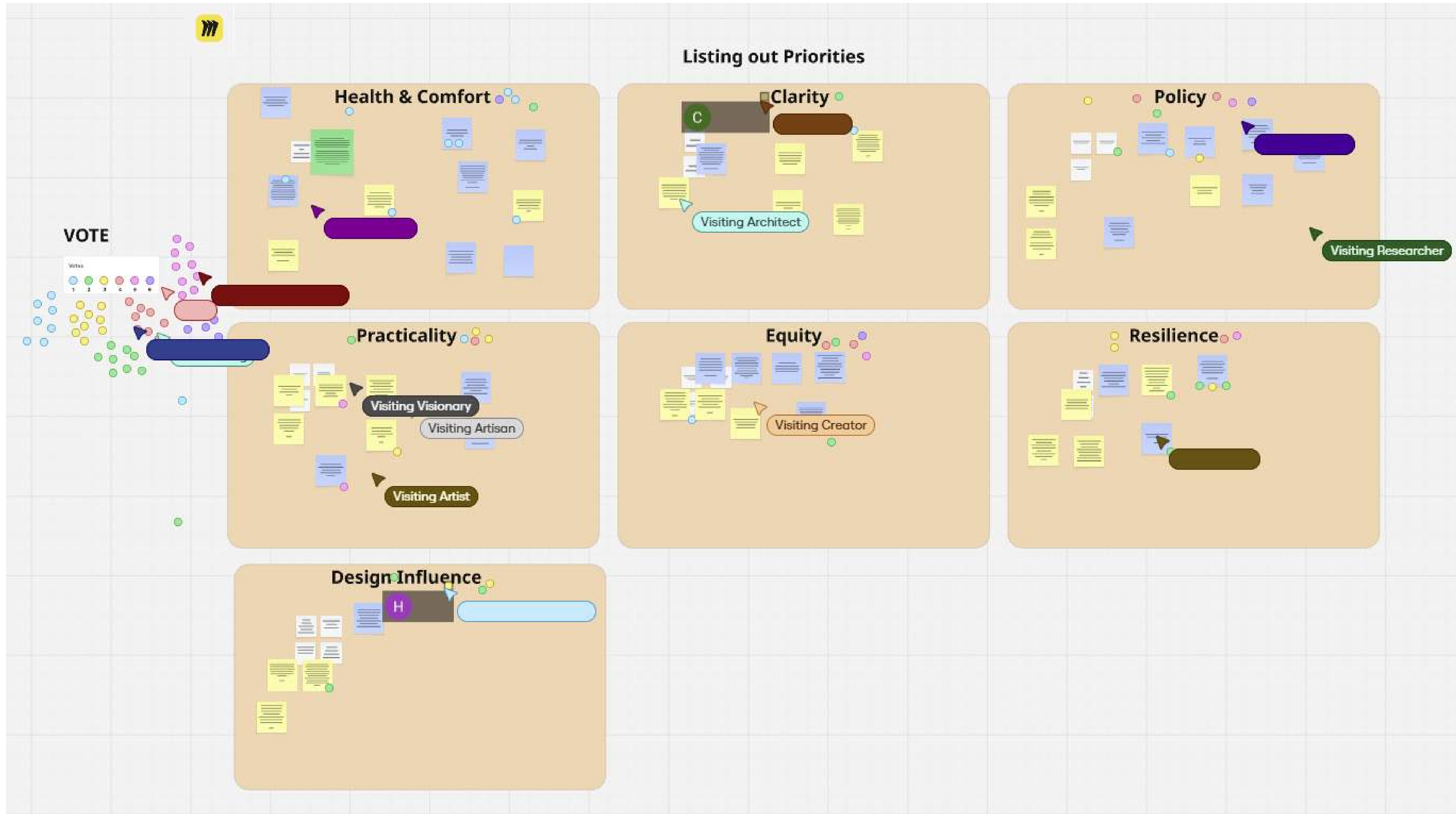


Figure 3. Excerpt from Advisory Group Workshop #2

2 Study Approach

2.3 BASIS FOR STRATEGY DEVELOPMENT AND EVALUATION

2.3.1 Literature and Precedent Review

A literature and precedent review was undertaken during the direction setting phase to inform passive design strategies and evaluation of overheating performance metrics. The review considered Canadian and international guidance addressing:

- Overheating risk and occupant health
- Passive and prescriptive design approaches
- Regulatory and performance-based frameworks
- Analytical methods for assessing overheating and thermal comfort
- Sources included materials referenced in the RFP, research identified in the project proposal, and additional guidance identified by the project team and Advisory Group members.
- The review informed development of a longlist of passive measures and candidate performance metrics and supported assessment of the relative strengths and limitations of comfort-based and physiology-based evaluation approaches.

The review was broad in scope but not exhaustive.

Other jurisdictions are actively evolving their approaches to overheating assessment in response to a warming climate, with increasing focus on physiological health impacts. A review of European regulatory approaches by Attia et al. (2023) provides context for current methods, summarized in the adjacent section.

A summary of referenced materials is provided in **Appendix J: Literature and Precedent Review.**

INTERNATIONAL OVERHEATING ASSESSMENT APPROACHES (EUROPE)

Research across European jurisdictions shows a range of methods used to evaluate overheating risk in residential buildings. A comparative review of overheating assessment approaches across 26 European countries identified substantial variation in temperature thresholds, exceedance criteria, and modelling assumptions used in national regulations.

Most European frameworks rely on thermal comfort–based indicators, typically derived from adaptive comfort models such as EN 16798-1 or assessment methodologies such as CIBSE TM59. These approaches evaluate overheating using temperature thresholds and allowable hours of exceedance.

While these methods provide indicators of occupant thermal comfort, they are not intended to evaluate health risks associated with extreme indoor heat exposure. Emerging Canadian work, including the NRC overheating framework, explores the use of health-based indicators to assess overheating risk.

Country/Region	Standard or Method	Metric Type	Example Indicator
United Kingdom	CIBSE TM59	Adaptive comfort + fixed threshold	Living areas assessed using adaptive comfort limits; bedrooms limited to 26 °C night-time threshold
France	RE2020 (DH indicator)	Degree-hours	Degree-hours above comfort temperature during summer period
Germany	DIN 4108-2	Temperature exceedance	Hours above 26 °C / 28 °C operative temperature
Netherlands	TOjuli indicator	Weighted temperature exceedance	Hourly temperature exceedance weighted against comfort threshold
European Union	EN 16798-1	Adaptive comfort model	Indoor temperature relative to running mean outdoor temperature

Reference

Attia et al. (2023). Overheating calculation methods, criteria and indicators in European regulation for residential buildings. Energy and Buildings.

2 Study Approach
2.4 STUDY PARAMETERS AND ASSUMPTIONS

To ensure consistency and comparability across all technical studies and scenarios, core study parameters were established during the direction setting phase and confirmed prior to technical studies.

2.4.1 Archetype Definitions

The study evaluates three representative new multi-unit residential building (MURB) typologies reflecting a range typical in current Vancouver market practice:

- 6-storey mid-rise
- 12-storey high-rise
- 35-storey high-rise

Archetypes were derived from recent local projects and adjusted based on Project Team and Advisory Group input to reflect common market design characteristics. A selection of three MURB typologies was selected to capture variations in typical envelope and construction techniques.

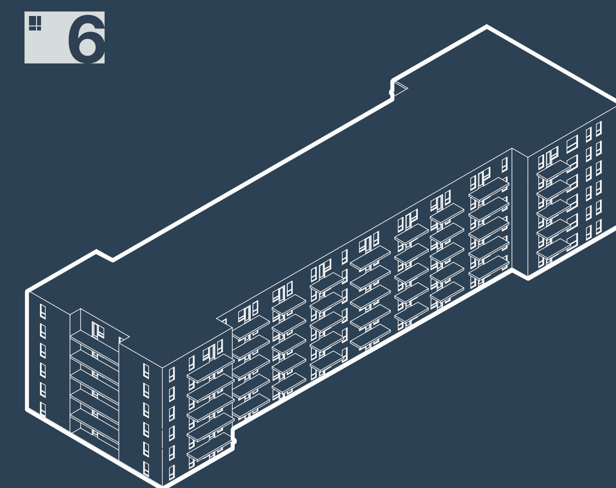
2.4.2 Baseline Envelope & Systems Assumptions

Baseline Archetype conditions reflect Vancouver Building By-law (VBBL) minimum requirements, including energy & operational carbon limits, and common market practice for new MURBs. Baseline parameters include archetype-specific:

- Window-to-wall ratios
- Glazing thermal performance
- Defined enclosure assemblies
- Mechanical system configurations for space heating and cooling
- Generic orientation assumed for each archetype

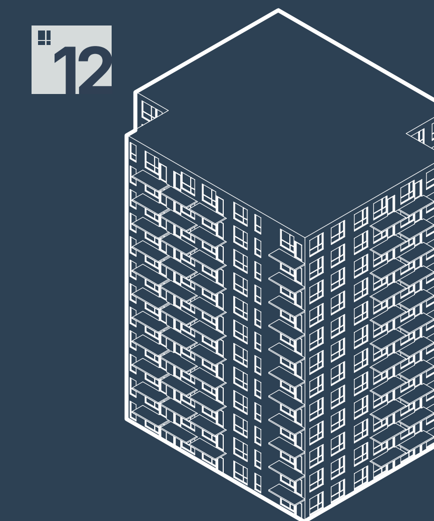
Detailed elevations were created for each archetype to capture realistic window size, type, and placement, avoiding reliance on simplified generic WWR assumptions in the study (Refer to **Appendix D: Summary of Archetype Architectural Inputs**).

ARCHETYPE DEFINITIONS



Mid-Rise 6 Storeys

- R-10 (4” exterior wood stud)
- Max 25% WWR
- U-27, SHGC - 0.30
- PTAC (partial cooling) + Electric baseboards
- ERV 75% Efficiency



High-Rise 12 Storeys

- R-7 (Hybrid steel stud + Window wall)
- Max 40% WWR
- U-32, SHGC - 0.30
- VRF (full cooling)
- ERV 75% Efficiency

High-Rise 35 Storeys

- R-5 (100% Window wall)
- Max 40% WWR
- U-32, SHGC - 0.30
- Hydronic FCUs (full cooling)
- ERV 75% Efficiency

See Appendix I: Energy Modelling Inputs and Process for a more detailed modeling input table, outlining archetype modelling parameters including enclosure, mechanical and electrical performance.

The fully developed energy models reflecting the archetypes also include below grade areas, below grade parking and a podium (for the 35 storey). This is outside the scope of overheating study but included in energy models for a more realistic assessment of the overall energy metrics.

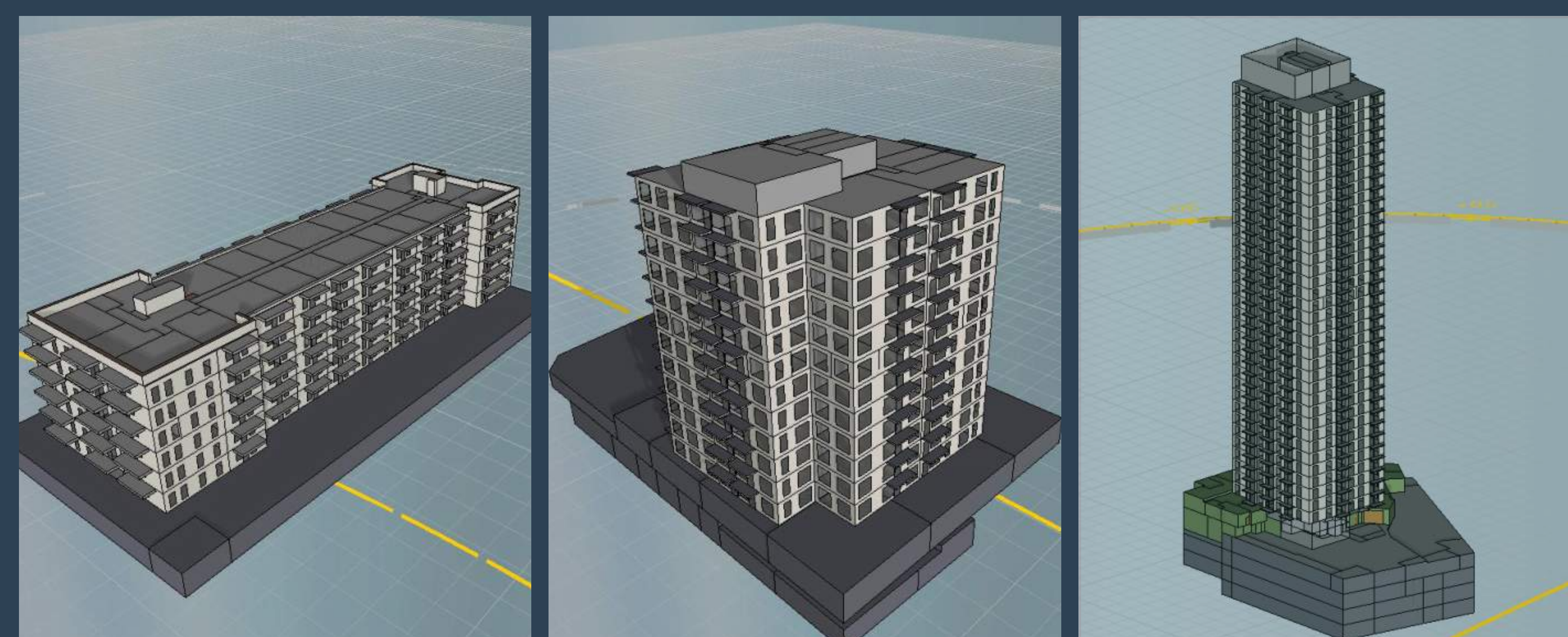


Figure 4. Renders from energy models

2 Study Approach
2.5 TRiM ANALYTICAL FRAMEWORK

The TRiM study applies a structured analytical framework to evaluate passive design strategies for reducing overheating risk in multi-unit residential buildings. The framework integrates guiding principles, passive measure screening, bundle development, and performance metric selection within a consistent modelling approach.

Guiding Principles

- Passive First (PF)
- Passive Survivability (PS)
- Passive and/or Performance Pathways (PPM)
- Balanced & Practical Metrics (BPM)
- Future Climate Ready (FCR)

Further detail on passive strategy screening and performance metric evaluation is provided in **Appendix F and Appendix G.**

This framework was applied consistently across all archetypes and climate scenarios within the defined study scope.

Shortlisted Passive Measures

Shortlisted Metrics

Passive Strategies Longlist to Shortlist

- **Window-Wall Ratio (WWR)**
- **SHGC**
- SHGC Orientation
- U-value - insulation
- U-value - airtightness
- Hybrid / Passive Cooling
- **Ventilation - Operable Window Control, manual / automate**
- HRV with Bypass/Boost
- **Active Cooling (Targeted Refuge)**
- **Exterior Shades - operable**
- **Exterior Shades - fixed**
- Insulation integrated within wall/roof/floor assemblies
- Mechanical Ventilation
- Thermal Bridging
- Natural Ventilation / Stack Effect
- High-Mass Envelope Assemblies
- Fan
- Heat loss Form Factor
- Ventilative Cooling
- Night-Time ventilation
- Thermochromic glazing
- **Electrochromic glazing**
- Form based Adjustments
- Thermally Activated Building Systems (TABS)
- Interior shading (Operable)
- Reflective Roof
- Green Infrastructure
- Phase Change Materials
- Enhanced Filtration and Zoning

Performance Metrics Longlist to Shortlist

- Overheating Severity
- **SETH – Standard Effective Temperature for Heat / Survivability**
- **Overheating Hours (OH)/ Hours of Exceedance (HE)**
- PMV / PPD
- OEF – Overheating Escalation Factor
- AWD – Ambient Warmness Degree
- Thermal Autonomy (TA)
- CEDI – Cooling Energy Demand Intensity
- Peak Load
- Standard Effective Temperature (SET)

6 12 35

Key Priorities

Solar heat gain control

Access to natural ventilation

Thermal envelope control

Shortlisted passive measures were combined into representative strategy bundles to evaluate integrated performance across archetypes.

Baseline

- Window-Wall Ratio (WWR)
- Ventilation - Operable Window Control, manual

Bundle 1

- Reduced Window-Wall Ratio (WWR)
- Increased Ventilation - Operable Window Control, manual

Bundle 2

- Reduced Window-Wall Ratio (WWR)
- Increased Ventilation - Operable Window Control, manual
- Exterior Shades - Operable
- Exterior Shades - Fixed

Bundle 3

- Window-Wall Ratio (WWR)
- Increased Ventilation - Operable Window Control, manual
- Exterior Shades - Electrochromic glazing

Bundle 4

- Window-Wall Ratio (WWR)
- Increased Ventilation - Operable Window Control, manual
- SHGC

2 Study Approach
2.6 PASSIVE MEASURE SCREENING AND SHORTLISTING

2.6.1 Guiding Principles for Strategy Selection

The guiding principles form the foundation of the TRiM analytical framework (Section 2.5).

The guiding principles were developed prior to Advisory Group Session #2 and were used to structure workshop discussion and prioritization of passive measure and candidate performance metrics.

The guiding principles were:

- Passive First – Prioritize passive design strategies when screening individual measures and developing bundles.
- Passive Survivability – Prioritize measures that support habitable indoor conditions during extreme heat events and potential power outages.
- Passive and/or Performance – Allow compliance through minimum prescriptive safeguards, performance-based outcomes, or a combination of both, depending on project context and regulatory intent.
- Future Climate Ready – Evaluate measures and bundles under both current and projected future climate conditions.
- Balanced and Practical Metrics – Consider candidate metrics that are technically robust while remaining practical for modelling workflows.

2.6.2 Evaluation Framework and Rubric

A qualitative scoring rubric was developed to support structured comparison of both passive measures and performance metrics against the guiding principle.

The rubric was used to:

- Screen the longlist of passive measures
- Support prioritization and bundle formation
- Evaluate candidate performance metrics
- Structure Advisory Group workshop discussion

Rubric outputs supported internal comparison and prioritization but did not function as an automated selection mechanism. Final decisions regarding which measures and metrics advanced to technical study were informed by rubric results, professional judgement, constructability considerations, modelling feasibility, and alignment with study objectives.

2.6.3 Strategy Screening and Shortlisting

An initial longlist of passive measures was developed during the direction setting phase. Measures were identified at a conceptual level and focused primarily on building form, enclosure performance, solar control, and natural ventilation strategies.

The full longlist of passive measures and the screening matrix used to develop the shortlist are provided in **Appendix F: Passive Strategy Longlist, Shortlist, and Evaluation Rubric.**

Mechanical-only cooling strategies were not advanced beyond the longlist to maintain alignment with the study's Passive First and Passive Survivability guiding principles.

The outcome was a condensed shortlist of passive strategies advanced for bundle development and technical study.

2 Study Approach
2.7 PASSIVE MEASURE BUNDLES

2.7.1 Bundle Formation

Shortlisted passive measures were grouped into four defined bundles. The original intent of the study was to evaluate three to six passive strategies. However, project team experience and findings in the literature review indicated that individual passive strategies alone would be insufficient to effectively mitigate overheating passively. As a result, bundled measures were included for technical studies. Each bundle was designed to include strategies that collectively address the following key priorities:

1. Solar heat gain control
2. Access to natural ventilation through openable window
3. Thermal envelope control

Each bundle combined multiple strategies intended to represent coherent passive design pathways rather than isolated individual measures.

Bundle development was further informed by:

- Alignment with guiding principles
- Potential impact on overheating risk
- Compatibility of measures when combined
- Practicality within typical MURB design frameworks
- Bundles were finalized prior to commencement of detailed modelling.

The bundle configurations are summarized in the adjacent table and form the basis for subsequent modelling and performance evaluation.

BUNDLES DESCRIPTION

	6	12	35
Baseline	WWR: 25% SHGC - 0.30 Controlled opening window	WWR: 40% SHGC - 0.30 Controlled opening window	WWR: 40% SHGC - 0.30 Controlled opening window
Bundle 1	WWR reduced to 20% Free opening window (bedroom and living room)		
Bundle 2	WWR reduced to 20%	WWR reduced to 30%	WWR reduced to 30%
	External fixed shading to South facade / Openable on East and West facades Free opening window (bedroom and living room)		
Bundle 3	WWR reduced to 20%	WWR reduced to 30%	WWR reduced to 30%
	Electrochromic glazing on East/South/West facades Free opening window (bedroom and living room)		
Bundle 4	WWR reduced to 20%	WWR reduced to 30%	WWR reduced to 30%
	Reduced SHGC to 0.20 Free opening window (bedroom and living room)		

Figure 5. Description of passive measures in each bundle

OPENABLE WINDOW DEFINITION AND APPROACH

Windows provide daylight, ventilation, and view, but may introduce fall hazards where glazing extends close to finished floor level.

For Group C multi-unit residential buildings, openable windows are governed by fall-protection provisions in Part 3 of the BC Building Code 2024 (BCBC). Openable windows must be protected by either a guard not less than 1,070 mm in height, or by a limiting device that restricts the clear opening to no more than 100 mm. This is typically achieved through a window opening control device (WOCD) in accordance with ASTM F2090 .

Exceptions apply where openings are located above 1,070 mm from the finished floor, or where the sill height exceeds 1,800 mm on one side, reducing the potential fall hazard.

Sill height must be considered relative to the effective finished floor level, including adjacent elements that may function as footholds. This condition is typically resolved through detailed sill design to discourage climbing while maintaining daylight, view, and ventilation performance

The typical openable-window assemblies developed for this study, set out in **Figure 6,** illustrate Ryder Architecture's standard responses to these provisions.

Window operation must also meet accessibility requirements under BCBC Section 3.8 and CSA B651, including reach range, one-handed operation, and maximum operating force. These requirements must be coordinated with sill height and hardware selection during design development.

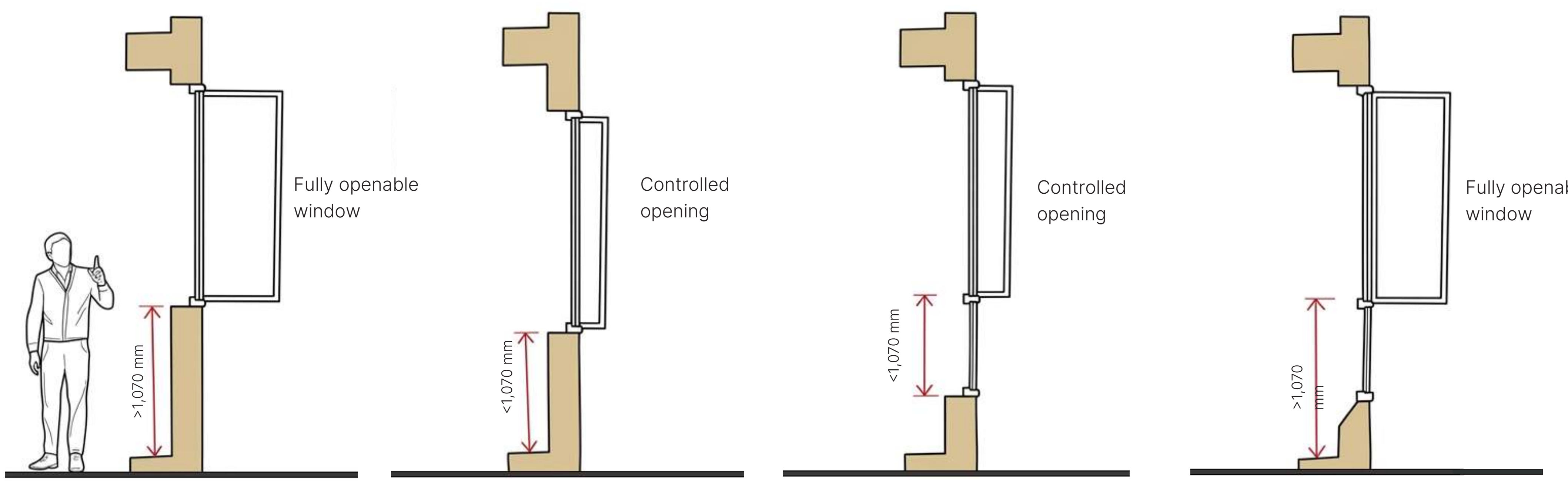
Openable windows support passive cooling but may be restricted during wildfire smoke events, reducing ventilation effectiveness.

These requirements should be considered early in design to ensure coordinated, code-compliant window assemblies.

Reference

[1] British Columbia Building Code (BCBC) 2024

Figure 6. VBBL Window Operability Options



Minimum window sill height for a non-restricted openable window

Controlled opening required at sills under 1,070 mm

Where window sill can act as a stepable foothold, the gap between the sill and window opening must be greater than 1,070 mm, otherwise a restricted window must be used.

A sloped sill is not considered a stepable foothold. Height of unrestricted window is minimum 1,070 mm.

2 Study Approach
2.9 PERFORMANCE METRIC SELECTION

2.9.1 Overheating Metric Identification

Performance metric selection was completed as part of the TRiM analytical framework (Section 2.5). Candidate overheating performance metrics were reviewed during the direction setting phase to evaluate overheating risk using building performance modelling from an occupant-focused perspective. Metric identification occurred in parallel with passive measure screening and bundle development to establish how overheating risk would be evaluated within the study.

Candidate metrics were informed by the literature review, City priorities, project team experience, and Advisory Group input.

These included both comfort-based and physiology-based approaches **Appendix G: Performance Metrics and Evaluation Rubric.** Candidate metrics were assessed against the guiding principles using the evaluation rubric described in Section 2.6.

Based on this review, the NRC overheating risk indicators were selected as the primary framework for evaluating overheating risk within the study. The NRC approach evaluates overheating through multiple dimensions - including event frequency, duration, severity, and intensity - providing a more comprehensive representation of occupant health risk than single-threshold comfort metrics alone. The NRC framework was therefore adopted as the primary overheating performance evaluation method for the TRiM modelling analysis.

NRC OVERHEATING RISK ASSESSMENT

Typically used overheating indicators (e.g. overheating hours, percent of time above 26°C, or adaptive comfort thresholds) primarily reflect thermal comfort or discomfort. This includes the current VBBL Overheating Hours metric (**refer to Section 2.9.2**). While these approaches are useful for assessing comfort, they do not represent cumulative physiological response to sustained heat exposure and therefore provide limited insight into potential health risk during extreme heat events.

In contrast, the NRC overheating risk assessment evaluates overheating based on cumulative physiological strain, linking indoor conditions to dehydration and core body temperature response rather than perceived discomfort alone (**refer to Section 2.9.3**).

VBBL Overheating Hours

- Indicate perceived comfort or discomfort
- Based on temperature thresholds
- Do not capture cumulative physiological stress

NRC Overheating Metric:

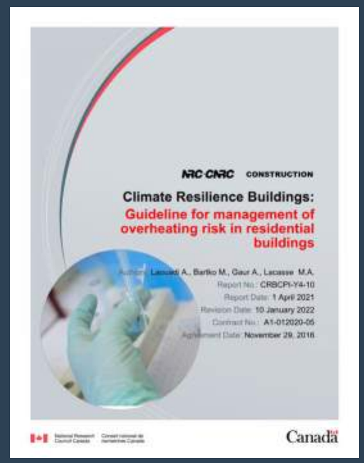
- Based on physiological response (dehydration and core body temperature)
- Evaluates cumulative heat exposure over time - (not just peak temperature exceedance)
- Accounts for daytime and nighttime conditions (living spaces and bedrooms)
- Captures duration, severity, and intensity of overheating events (DUR / SETH / INT)
- Capture limited overnight recovery during heat events
- Designed to assess health risk during extreme heat

NRC Metric Evaluates Health Impact

References

Laouadi, A., Bartko, M., & Lacasse, M. A. (2020). A new methodology of evaluation of overheating in buildings. Energy & Buildings, 226, 110360.

Laouadi, A., Bartko, M., Gaur, A., & Lacasse, M. A. (2021). Climate resilience buildings: guideline for management of overheating risk in residential buildings. National Research Council Canada.



2 Study Approach
2.9 PERFORMANCE METRIC SELECTION

2.9.2 The VBBL Overheating Metric

The VBBL overheating compliance method uses overheating hours (OH) as the primary performance metric. The OH metric quantifies the number of hours during which indoor air temperature exceeds an upper temperature threshold, reported on a monthly basis from May through October[1]. These thresholds are derived from the ASHRAE 55 adaptive comfort model (80% acceptability limits) and indicate risk for thermal discomfort within a suite. See Table 1.

This metric has been used in Vancouver since 2018 so there is familiarity with this methodology. However, local practitioners have indicated that this method doesn't provide information about whether the number of hours exceeding the thermal comfort threshold temperatures present any health risks, and thus make it difficult to understand the risk reduction potential of passive cooling designs in the building envelope.

The method applies to buildings with or without mechanical cooling and uses dry-bulb air temperature as a proxy for operative temperature. Overheating hours are calculated from energy simulations conducted with mechanical cooling systems disabled, referred to as passive overheating hours, in order to isolate the passive thermal performance of the building. The analysis is conducted using future climate weather data (NRC TMY, GW +2.0°C scenario) to assess resilience under projected warming conditions.

The VBBL method is based on a single-zone thermal modelling approach, where temperatures are averaged across the suite to represent overall indoor conditions. The OH metric is used as one of the selected overheating performance metrics evaluated in the TRiM study.

Month	VBBL Temperature (°C) Threshold Overheating Hours
May	25.5 °C
June	26.5 °C
July	27.5 °C
August	28.4 °C
September	26.5 °C
October	25.2 °C

Table 1: VBBL Monthly Overheating Hours Threshold (°C)

References

[1] CoV Energy Modelling Guidelines v3.0 Table 2

2 Study Approach

2.9 PERFORMANCE METRIC SELECTION

2.9.3 The NRC Overheating Risk Framework

The National Research Council (NRC) overheating methodology[1] was selected due to its physiological basis and its ability to evaluate cumulative heat stress associated with overheating illness, rather than isolated comfort-based temperature exceedances.
The NRC metric evaluates overheating using three complementary indicators:

- DUR (Duration) – the number of consecutive days during which cumulative heat stress exceeds a defined minimum threshold. Prolonged exposure increases dehydration risk and reduces the body's ability to recover.
- SETH (Severity) – the total accumulated heat stress during the overheating event, expressed in degree-hours. This represents the overall heat burden experienced during the event.
- INT (Intensity) – the average intensity of the overheating event, calculated as total severity divided by its duration. Higher intensity events correlate more strongly with increased core body temperature.

Together, these indicators capture different dimensions of overheating risk. While DUR and SETH are correlated with dehydration-related health effects resulting from cumulative heat exposure, INT is correlated with increases in core body temperature and associated cardiovascular symptoms. Together, the three indicators evaluate different physiological responses to overheating.

The framework accounts for both daytime exposure in living spaces and nighttime exposure in bedrooms, recognizing that inadequate overnight recovery can compound daytime heat stress and increase overall health risk. The methodology also differentiates between younger and older adults, acknowledging that vulnerability to heat varies across populations.

Vancouver and BC-specific overheating health-risk thresholds corresponding to older adults in residential buildings were applied following the NRC modelling methodology. These thresholds were applied consistently across all archetypes, climate files, and passive bundle scenarios.

The NRC metric was used within the study as a comparative analytical tool to evaluate the effectiveness of passive strategies and to test the analytical framework. It was not applied as a regulatory compliance requirement.

2.9.4 Simplified SET Implementation

The study applied a simplified Standard Effective Temperature (SET) approach, using indoor dry-bulb temperature instead of full SET calculation. NRC provided the threshold for the simplified SET dry-bulb temperature limits to work with.

The use of dry-bulb temperature instead of full SET would enable simpler implementation as not all energy modelling tools and platforms directly report on SET without additional post processing.

This approach enabled simpler implementation and transparent post-processing of overheating indicators across modelling platforms while maintaining consistency with NRC temperature-calibrated limits.

Detailed calculation methodology and references are provided in **Appendix H: NRC Overheating Risk Metric Calculation Methodology**.

Reference

[1] Laouadi, A., Bartko, M., Gaur, A., & Lacasse, M.A. (2021). Climate resilience buildings: guidline for management of overheating risk in residential buildings. National Resarch Council Canada.

HOW THE NRC OVERHEATING RISK METRIC WORKS

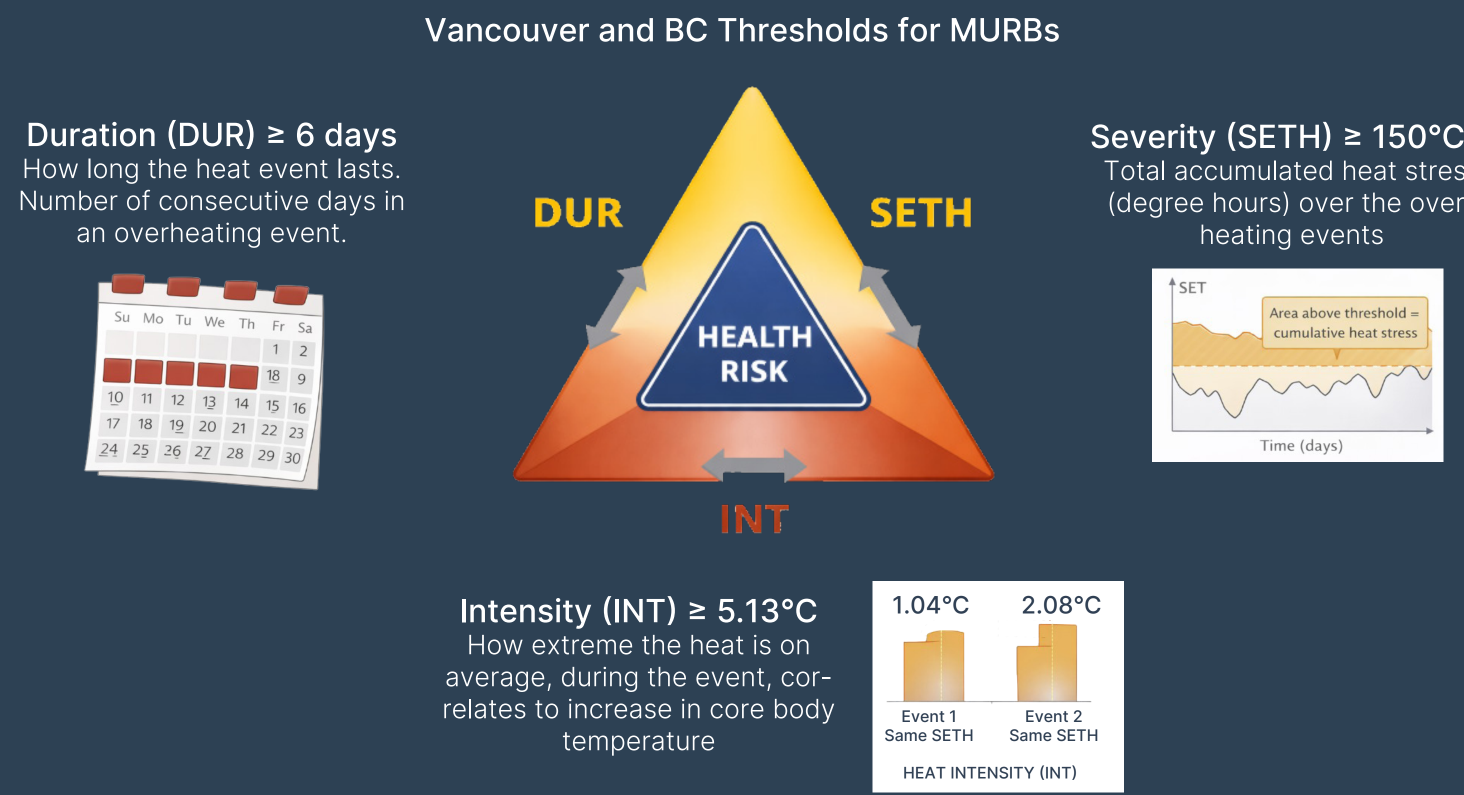


Figure 7. Overheating event VS overheating health risk event

Definition of an Overheating Health-Risk Event

Three indicators characterize an overheating health-risk event:

1. **DUR (Duration)**
   Number of consecutive overheating days.
2. **SETH (Severity)**
   Total cumulative heat stress during the event (°C·h).
3. **INT (Intensity)**
   Average event intensity (°C).

For Vancouver (older adults), a health-risk overheating event occurs when any of the following thresholds are exceeded:

- **DUR ≥ 6 days**
- **SETH ≥ 150 °C·h**
- **INT ≥ 5.13 °C**

These thresholds are derived from NRC physiological modelling linking cumulative heat exposure to dehydration and core body temperature rise for older adults in residential buildings under Vancouver and BC climate conditions.

NRC notes that these thresholds are climate-dependent and would require recalibration for regions with substantially different temperature and humidity conditions.

2.10 CLIMATE FILE SELECTION

During the direction setting phase, the project team reviewed Vancouver future-shifted climate files available at time of study, including all PCIC, NRC Typical Meteorological Year (TMY) and NRC Extreme Meteorological Year (EMY), and Extreme Weather Files (EWF), including files with Urban Heat Island (UHI) effects. All files are listed in **Appendix E - Climate File Scenarios.**

Climate file selection focused on identifying two primary climate scenarios for use in the study - a typical future-shifted annual condition for overheating analysis, and an extreme heat event ("heat dome") condition for sensitivity testing. A third climate file was included to maintain alignment with current VBBL requirements for energy and greenhouse gas emissions performance limits. The following files were used in the TRiM study:

Climate File Used in Study	Reference	Role in Study
NRC Global Warming +1.0°C (2014 – 2044)	Current time period climate file, required for use in current VBBL energy compliance modelling.	Represents alignment with current VBBL. Used for full year energy modelling analysis.
NRC Global Warming +2.0°C (2034 – 2064)	Future-shifted climate file with higher average temperatures and more frequent warm periods.	Represents alignment with current VBBL. Used for overheating analysis May-October.
NRC Extreme Weather File (EWF) with Urban Heat Island (UHI) for Vancouver*	Research climate file representing a prolonged high-intensity heat event with elevated daytime temperatures and limited nighttime cooling; includes Urban Heat Island effects.	Represents extreme/ stress-test condition for overheating analysis. Closely aligned with the Vancouver 2021 heat dome event. Used for overheating analysis May-October.

**Climate file provided by NRC, not yet publicly available. Events of similar severity to 2021 are expected to occur more frequently[1,2]*

A key limitation of commonly used Vancouver climate files is that they are derived from the YVR airport weather station, which does not capture Urban Heat Island (UHI) effects present in dense urban areas. As a result, these files may underestimate peak temperatures and reduced nighttime cooling.

The 2021 BC extreme heat event was characterized by multiple consecutive days exceeding 30°C, combined with elevated nighttime temperatures that limited thermal recovery. While the current VBBL reference climate file (GW +2.0°C) includes isolated high-temperature days, it does not represent sustained multi-day extreme heat conditions of this type.

To address this limitation, the NRC Extreme Weather File (EWF) incorporating UHI effects was selected. The file represents an extreme temperature profile and was reviewed against hourly data from the 2021 event to confirm alignment with observed intensity and duration. The EWF with UHI was used as the primary climate condition for overheating analysis, enabling evaluation of overheating risk and passive mitigation performance under sustained extreme heat conditions.

This selection is supported by emerging NRC climate-file research[3,4] that incorporates urban heat island effects into building simulation weather data, allowing overheating analysis to better reflect urban exposure conditions than conventional weather reference files.

Figure 8 shows the range of minimum and maximum temperatures over the year and average point for the three selected climate files.

Figure 9 shows how many hours are within high temperature ranges for the three selected files.

Figure 10 shows how the selected climate files compare during an extreme heat event week. This shows how the temperature does not drop at night with the heat dome equivalent file which is a very important distinction for increased health risks.

References

[1] Canada's Changing Climate Report; Government of Canada, (2019)

[2] IPCC Sixth Assessment Report; Cambridge University Press, (2021)

[3] Building Reference Year Climate Datasets for 564 Reference Locations in Canada." National Research Council Canada, (2022).

[4] Climate data for building simulations with urban heat island effects and nature-based solutions. Sci Data 11, 731 (2024)

Figure 8. Annual Outdoor Temperature Range per Study Climate File

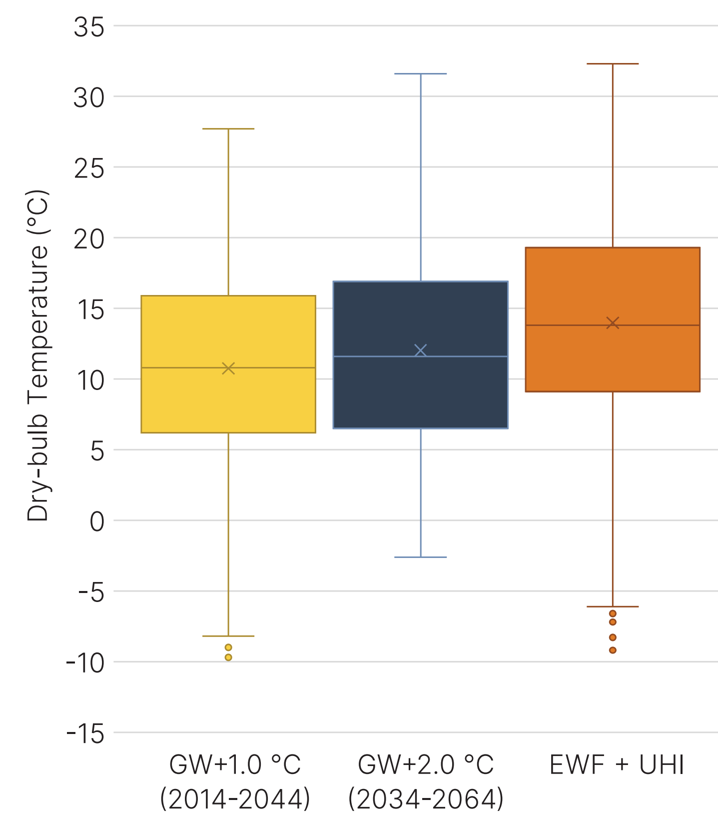


Figure 9. Number of Hours Within High Temperature Bins per Study Climate File

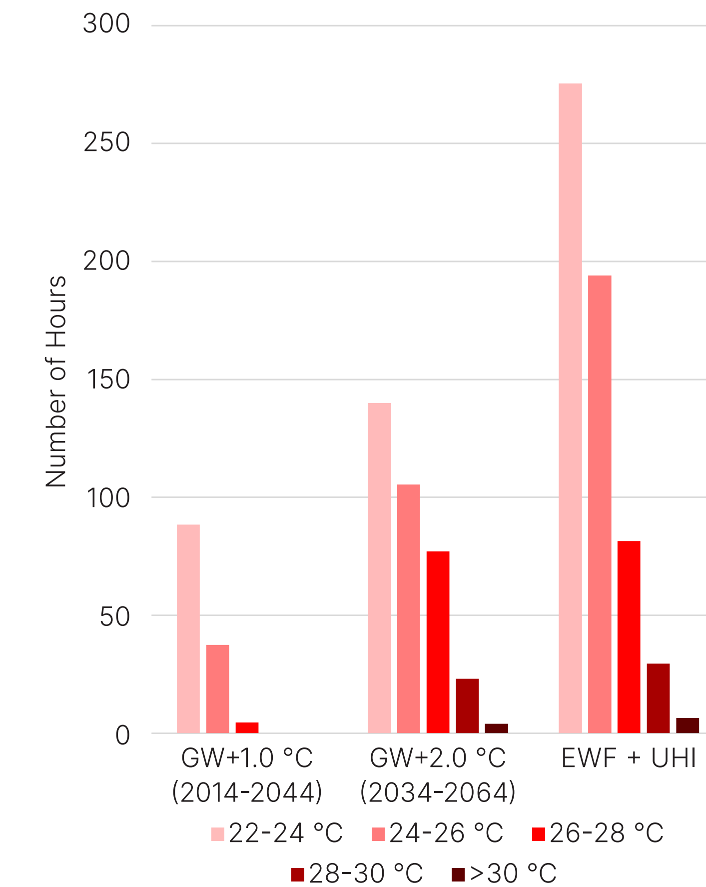
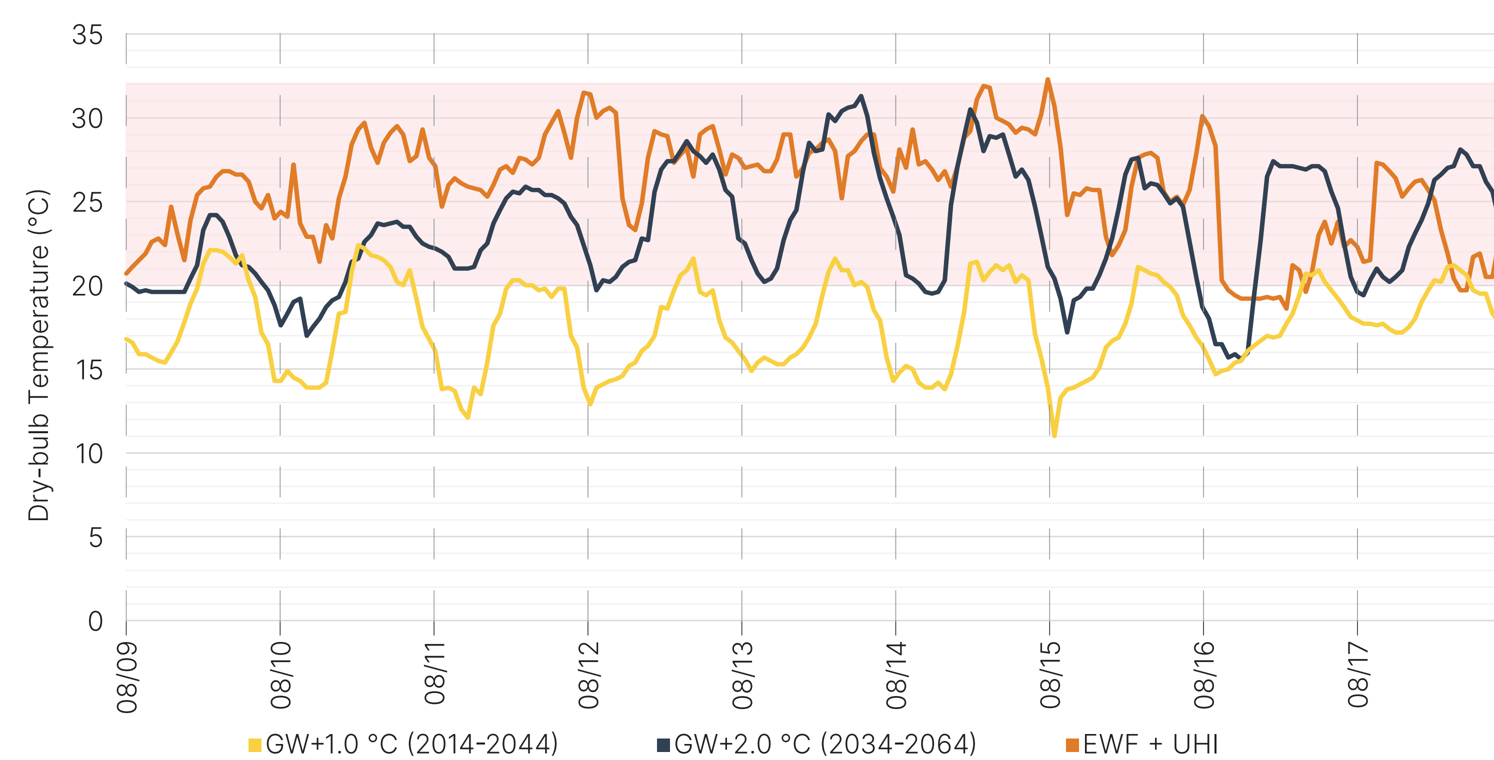


Figure 10. Temperature Profile Comparison During a Week of Extreme Heat Event per Study Climate File



2 Study Approach

2.11 OVERHEATING AND ENERGY MODELLING

Following bundle formation and performance metric selection, technical studies were undertaken including overheating and energy modelling.

An analytical modelling framework was developed to support the comparative evaluation of overheating risk, thermal resilience, and the impact of passive bundles on overall energy performance. The modelling process was structured to ensure consistent inputs, scenarios, and outputs across baseline and bundle cases, enabling direct comparative analysis.

The modelling approach was developed to:

- Assess the relative performance of selected passive bundles under both current and future climate conditions.
- Evaluate the methodology and application of the NRC overheating performance metrics within the modelling process, relative to the Overheating Hours (OH) metric currently used in the Vancouver Building By-law (VBBL).
- Report on energy performance metrics to understand the impacts and potential unintended consequences of passive measures on overall building energy use, cost, and performance.

The objective of the modelling was not to establish overheating compliance thresholds or to optimize building designs, but rather to support comparative analysis of passive strategies, using a health-risk based thermal safety method (NRC Overheating Risk Framework).

All simulations were conducted using IES Virtual Environment (IESVE). Two modelling approaches were applied across all archetypes:

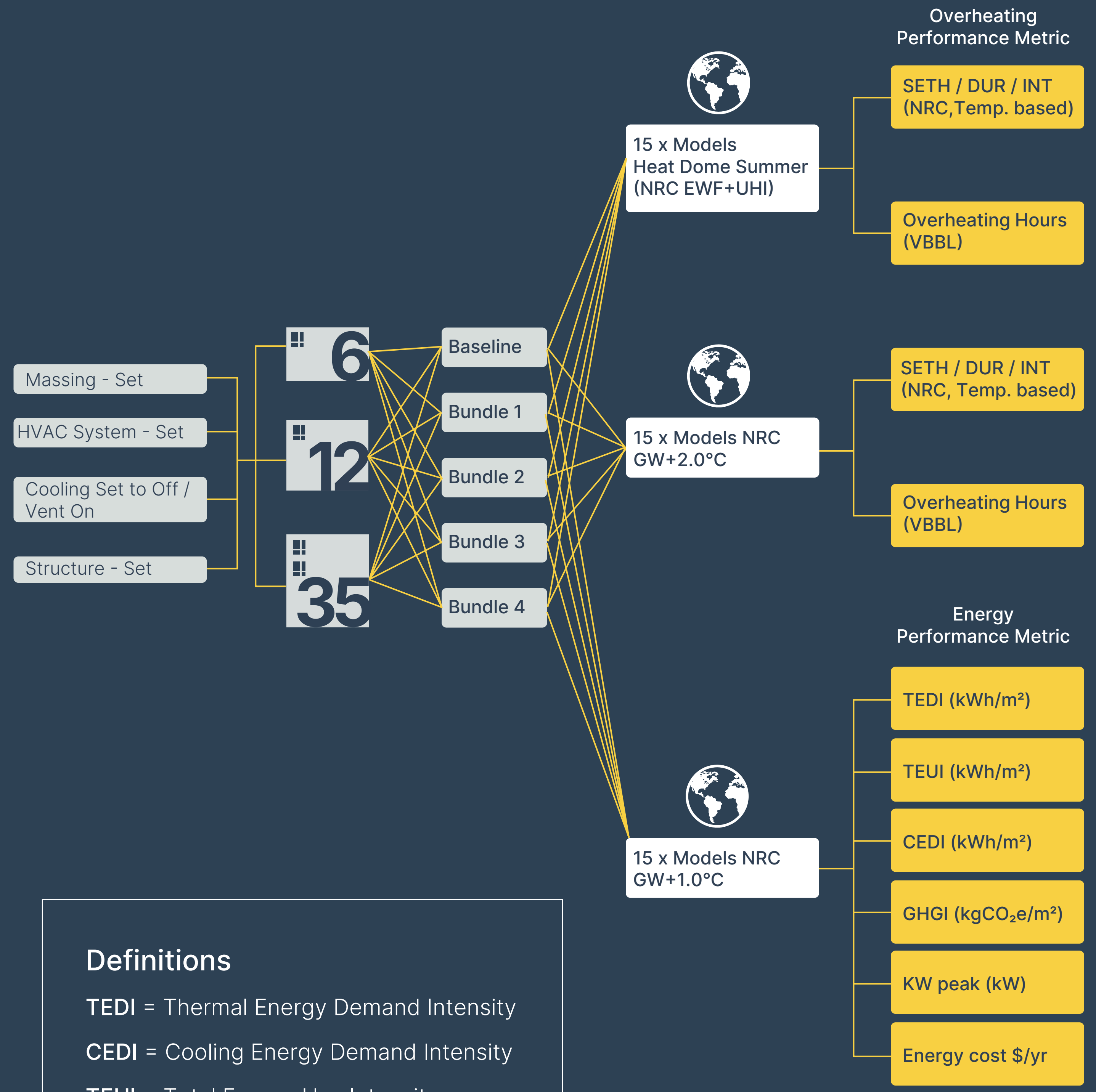
- Single-zone suite thermal modelling, consistent with the current VBBL overheating assessment methodology.
- Multi-zone suite modelling, used to differentiate daytime and nighttime exposure in accordance with the NRC overheating framework.

Hourly simulation outputs were exported and post-processed to derive overheating indicators in accordance with both the NRC methodology and the Overheating Hours (OH) metric. Vancouver-specific thresholds were applied.

The detailed calculation methodology is provided in **Appendix H: NRC Overheating Risk Metric Calculation Methodology.**

Energy performance outputs were generated in parallel to support integrated evaluation of overheating and energy outcomes. These included CEDI, TEDI, TEUI, energy cost, greenhouse gas intensity, and peak electrical demand.

OVERHEATING AND ENERGY MODELLING FRAMEWORK



Definitions

TEDI = Thermal Energy Demand Intensity

CEDI = Cooling Energy Demand Intensity

TEUI = Total Energy Use Intensity

GHGI = Greenhouse Gas Intensity

Figure 11: Overheating and energy modelling framework

2 Study Approach
2.12 COSTING AND MARKET AVAILABILITY

2.12.1 Costing Methodology

Cost analysis was undertaken to evaluate incremental hard construction cost impacts associated with the defined passive measure bundles relative to the established baseline condition.

The costing framework was structured as follows:

- Baseline archetype specifications were defined based on typical current Vancouver MURB practice across structure, enclosure, mechanical, and electrical systems.
- Only components modified within each bundle were costed incrementally relative to baseline.
- Costing focused exclusively on hard construction costs.

The following were excluded:

- Soft costs (consulting, design, permitting)
- Contingencies
- Lifecycle cost considerations
- Replacement cycles or long-term maintenance impacts

Pricing reflects point-in-time cost conditions and is intended to contextualize comparative decision-making rather than establish full project budgeting assumptions.

2.12.2 Trade Engagement and Industry Input

Peak Construction Group engaged members of its existing trade network to obtain indicative pricing for components associated with the passive measures. Where feasible, multiple supplier inputs were sought to support validation. The number of suppliers consulted varied depending on measure type and availability of comparable products.

2.12.3 Market Availability

Market availability refers to whether passive strategies, systems, and materials are commercially available within the construction market.

The analysis focused on:

- Current product availability
- Supply presence within the regional market

Market availability was informed through contractor and trade input obtained during the trade engagement process described in Section 2.12.2.

The study did not evaluate broader market readiness or implementation feasibility considerations such as industry capacity, workforce training requirements, regulatory pathways, or adoption barriers. These topics fall outside the scope of this phase of work and would require further investigation in future studies.

2 Study Approach
2.13 STUDY BOUNDARIES AND LIMITATIONS

The TRiM study is a comparative technical assessment of passive overheating mitigation strategies in new multi-unit residential buildings (MURBs) within the Vancouver context. The study is undertaken within defined analytical boundaries to support consistent modelling, comparison, and interpretation of results.

2.13.1 Building Scope

The study:

- Focuses exclusively on new MURB construction
- Does not evaluate retrofit strategies for existing buildings
- Does not assess other building typologies

Archetypes reflect typical current market practice and were not optimized prior to bundle application.

Overheating evaluation was conducted under passive-only conditions. Natural ventilation was represented through openable window assumptions and not explicitly evaluated for airflow effectiveness.

Mechanical cooling systems were defined within baseline archetypes but were disabled during overheating modelling to isolate passive thermal response.

The study does not evaluate optimized active cooling strategies or hybrid mechanical-passive system design.

2.13.2 Performance Metric Application

The NRC overheating methodology was applied as a comparative analytical tool to evaluate cumulative physiological heat stress under defined climate scenarios.

A simplified implementation of SETH was used for comparative purposes, based on indoor dry-bulb temperature as a proxy. This approach supports consistent comparison across scenarios but does not represent the full range of physiological inputs captured within the complete SET framework.

2.13.3 Climate Scope

Climate evaluation included projected mid-century warming scenarios and an extreme heat stress-test condition incorporating urban heat island effects.

The study does not model compound or infrastructure failure scenarios, including:

- Power outages
- Wildfire smoke events
- Loss of ventilation or mechanical system functionality

As such, the study isolates passive building response to sustained high outdoor temperatures, rather than full resilience under emergency or disruption conditions.

2.13.4 Costing and Market Scope

Costing based on 2025 market conditions (reflecting current pricing at time of study) reflects incremental hard construction costs and excludes:

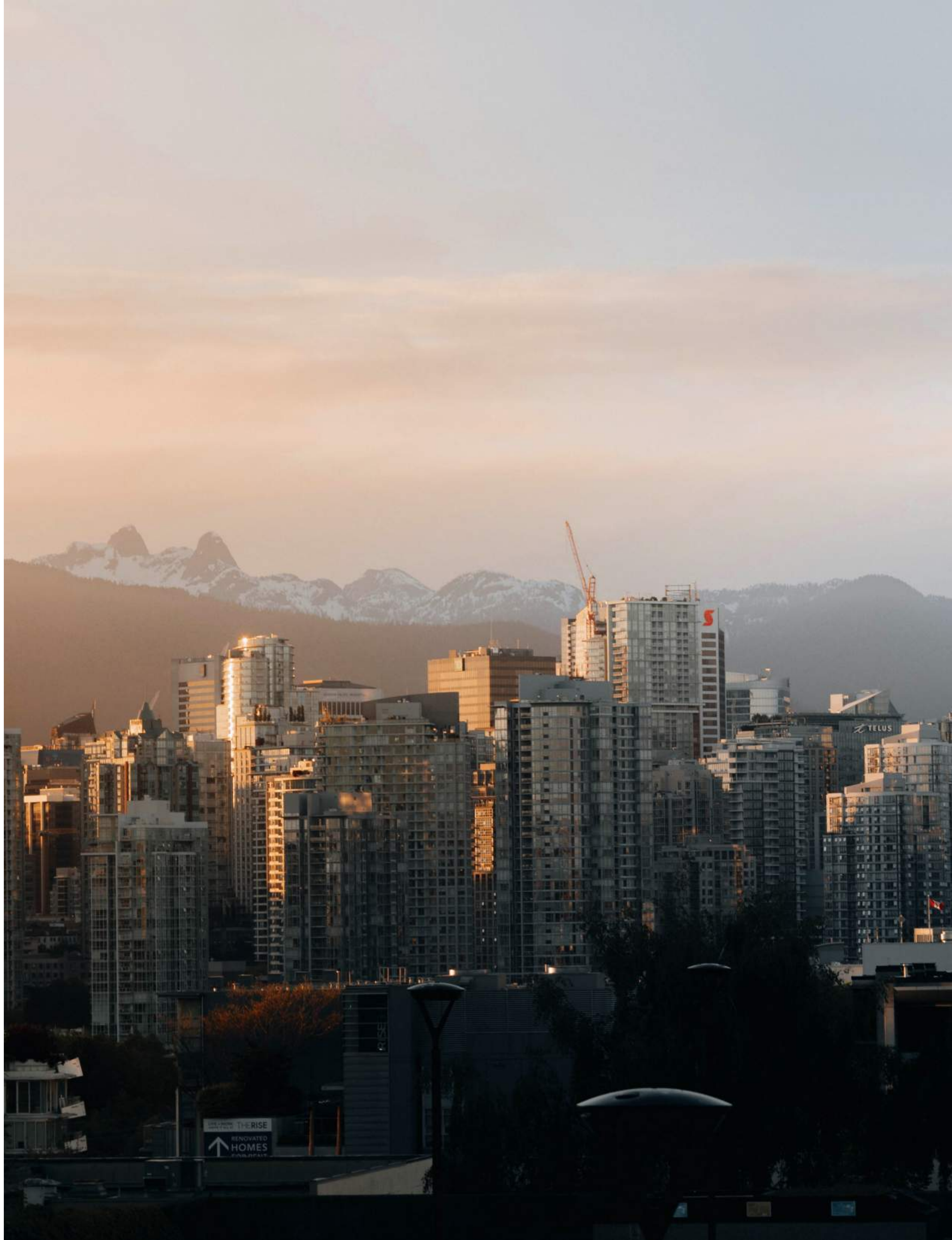
- Soft costs
- Lifecycle cost impacts
- Replacement cycles
- Financing considerations

Market assessment was limited to current product availability. Market readiness, adoption barriers, and workforce considerations were not evaluated.

2.13.5 Population Assumptions

The study applies the NRC metric thresholds calibrated for older adults. Archetypes were not modelled to represent specific vulnerable population subgroups, behavioral adaptation strategies, or assisted cooling interventions.

Overall, the study provides a structured, comparative evaluation of passive design strategies and overheating risk under defined assumptions. Findings should be interpreted within the boundaries described above.



3 Technical Findings

This section presents the results of the overheating, energy, and costing analyses described in Section 2. The analysis evaluates the performance of passive design strategies across representative multi-unit residential building (MURB) archetypes under current and future climate scenarios.

Findings are presented across the following areas:

- conventional overheating hours used in current policy evaluation
- overheating performance using the NRC overheating risk framework
- impacts on building energy performance
- cost and implementation considerations associated with the passive design strategies

Detailed descriptions of the passive design measures included in each bundle are provided in "Figure 5. Description of passive measures in each bundle" on page 9.

TECHNICAL STUDY

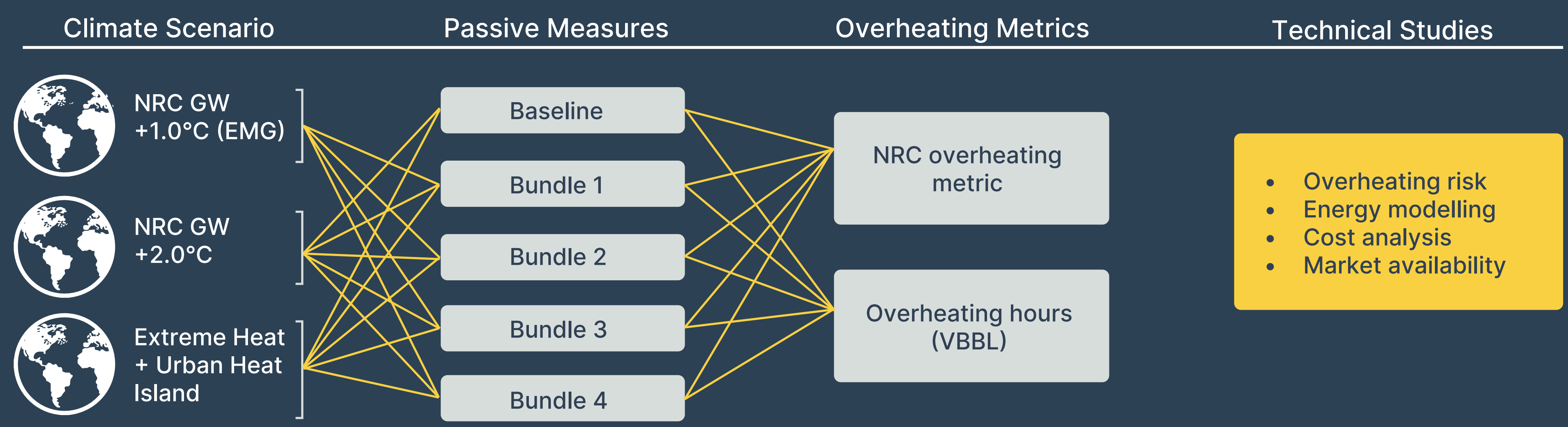


Figure 12: Technical Study Evaluation Parameters

The TRiM study evaluated passive overheating mitigation strategies through a structured modelling framework combining climate scenarios, passive design bundles, and health-based overheating metrics.

Key elements of the analytical framework included:

- **Climate scenarios:** Current and future conditions, including an NRC +2.0 °C scenario and extreme heat event ("heat dome") conditions.
- **Passive strategy bundles**: Baseline and four passive design bundles representing combinations of high impact strategies including combinations of solar control, envelope performance, and natural ventilation.
- **Performance metrics**: Evaluation using the NRC overheating risk indicators alongside the VBBL Overheating Hours (OH) metric.
- **Technical studies**: Integrated modelling outputs were used to evaluate energy performance, cost implications, and market readiness.
- **Archetype modelling**: Three representative multi-unit residential building archetypes were modelled.
- **Energy performance outputs**: CEDI, TEDI, TEUI, greenhouse gas intensity, peak electrical demand, and energy cost.

3 Technical Findings

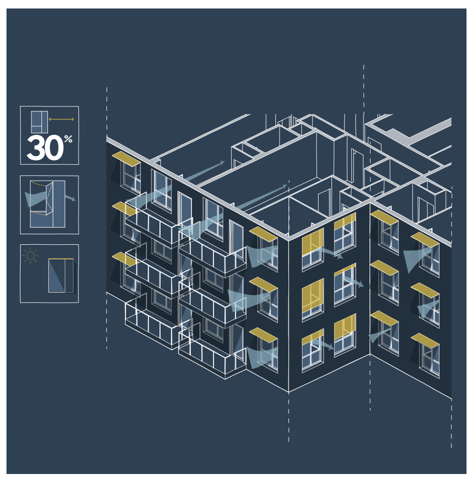
This section consolidates the outcomes of the technical studies undertaken for TRiM, bringing together results across overheating performance, energy modelling, cost implications, and constructability considerations. The intent is to present a coordinated view of how the design scenarios perform across these lenses, highlighting key comparisons and trade-offs to support interpretation of the results and the recommendations presented in Section 4.

3.1 OVERVIEW OF MODELLING RESULTS PER ARCHETYPE & BUNDLE

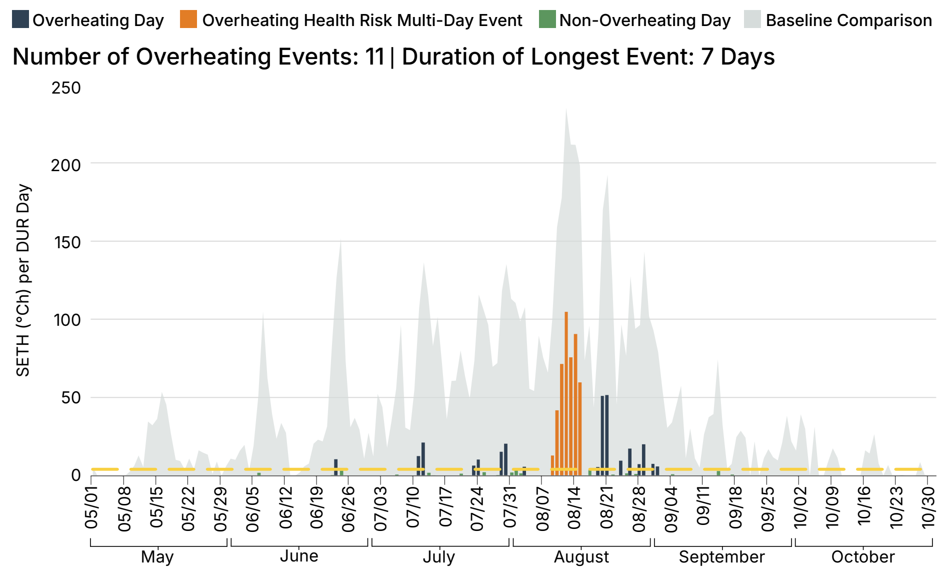
Summary results of the overheating risk assessment, energy model performance, and cost analysis are provided for each baseline and studied passive bundle scenario and can be referenced in **Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle.** This page provides an overview of the performance metrics reported in Appendix A, along with brief explanations to orient the reader to how the results are presented and interpreted.

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

12 STOREY MURB — BUNDLE 2



Number of Overheating Events: 11 | Duration of Longest Event: 7 Days



Overheating Evaluation

Bundle #2 reduces cumulative heat exposure and limits prolonged overheating conditions compared to the baseline:

- The longest overheating event is reduced from **97 days to 7 days**
- The severity (SETH) of the worst event is reduced by approximately **94%**, from **7,294°Ch to 457°Ch**
- Intensity (INT) remains below the health risk threshold

Remaining health risk events are shorter and lower in cumulative severity, with values approaching the health risk thresholds.

Number of Health Risk Events: 1 | Severity of Worst Health Risk Event: 457 (°Ch)

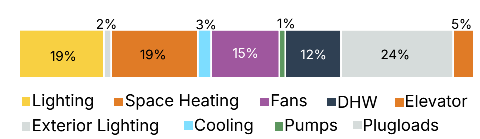
Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	23-06	23-06	1	11	0.4	NO
2	11-07	12-07	2	34	0.7	NO
3	23-07	24-07	2	17	0.3	NO
4	29-07	30-07	2	36	0.7	NO
5	03-08	03-08	1	6	0.2	NO
6	09-08	15-08	7	457	2.7	YES
7	19-08	21-08	3	108	1.5	NO
8	24-08	24-08	1	10	0.4	NO
9	26-08	26-08	1	17	0.7	NO
10	28-08	29-08	2	27	0.6	NO
11	31-08	01-09	2	13	0.3	NO

Building Energy Performance

Energy performance represents the Bundle #2 whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

Bundle #2 meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	23.8	kWh/m²
CEDI	5.7	kWh/m²
TEUI	70.0	kWh/m²
GHGI	0.8	kgCO²e/m²
Energy Use	807	MWh
Peak Electricity	257	kW
Energy Cost	$104,895	$/Year
Energy Cost (MFA)	$9.1	$/m²/Year



Incremental Cost

Incremental cost represents the change in façade cost for Bundle #2 relative to the baseline. Cost input is provided by Peak Construction and trades.

Cost Metric	Baseline	Bundle 2
Façade Cost ($/m² façade area)	$1,125	$1,237
Incremental Façade Cost ($ vs baseline)	n/a	$35,462
Incremental Façade Cost (% vs baseline)	n/a	10.0%

49

*Detailed results for suites in each building are included for reference in **Appendix K: Detailed Overheating Analysis Results***

BUILDING ENERGY PERFORMANCE

Building energy performance is modelled per VBBL using GW+1°C, to verify impact on building energy performance and compliance.

- **Cooling Energy Demand Intensity (CEDI)** - Annual building cooling load, as kWh/m²
- **Thermal Energy Demand Intensity (TEDI)** - Annual envelope and ventilation heating load, as kWh/m². Reported TEDI includes corridor pressurisation adjustment
- **Greenhouse Gas Intensity (GHGI)** - Building operational carbon emissions, as $kgCO_2e/m^2$
- **Energy Consumption** - Including full building above and below grade consumption, as MWh and as TEUI. Reported TEUI excludes corridor pressurisation adjustment
- **Peak Electricity** - Modelled annual peak, annual electrical peak, as kW
- **Energy Cost** - Reported as $/Year and $/m²/Year, per MFA (Modelled Floor Area)

INCREMENTAL COST

- **Façade Cost ($/m²)** - Unit facade cost
- **Incremental Façade Cost ($ vs baseline)**. Absolute difference of façade cost between the bundle and the baseline.
- **Incremental Façade Cost (% vs baseline).** Percentage difference in façade cost relative to the baseline.

OVERHEATING EVALUATION

- Overheating results are presented for the worst-case orientation for each archetype, as identified in the baseline scenario. The same suite and orientation are used consistently for comparison across all passive bundle scenarios.
- All overheating results are based on the Extreme Weather File (EWF) + Urban Heat Island (UHI) scenario (**refer to Section 2.10.1 – Climate File Selection**). Results for all orientations are included in **Appendix K: Detailed Overheating Analysis Results**.
- Results include the number of overheating events and those exceeding the threshold for classification as a health risk event.
- For each overheating event, the NRC indicators DUR (Duration), SETH (Severity), and INT (Intensity) are reported. Events that exceed health risk thresholds are highlighted in orange.

3 Technical Findings

3.2 VBBL OVERHEATING HOURS

3.2.1 Impact of Passive Design Bundles - VBBL Overheating Hours (OH)

Peak indoor temperature and overheating hours per VBBL overheating methodology were summarised for each scenario.

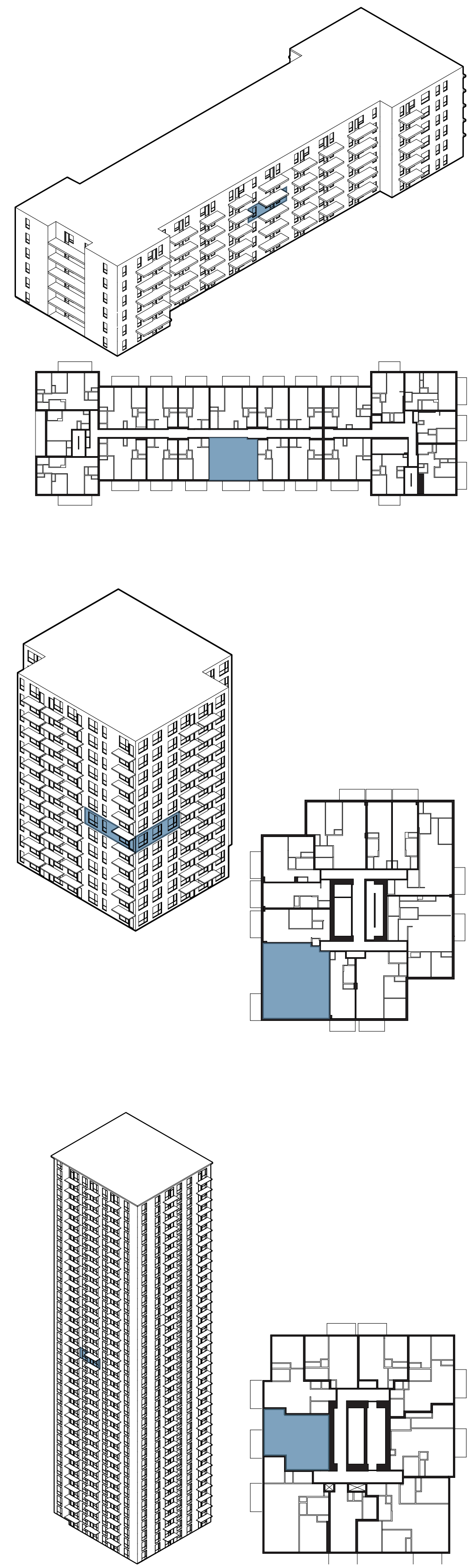
Across all archetypes, the passive design bundles significantly reduce the number of overheating hours relative to the baseline condition. Bundles 1 and 2 generally demonstrate the strongest performance, while Bundle 3 is the least effective in reducing overheating hours.

Despite these improvements, no scenario fully eliminates overheating hours. Results indicate that overheating conditions occur primarily during the summer months, particularly June through August, and to a lesser degree in May and October. In the baseline scenario, overheating conditions begin earlier in the season, starting in May and extending through October.

For the same suites, the overheating hours per VBBL are summarized for each archetype under the two climate scenarios.

The overheating hours are shown per month. Each hour exceeding the threshold based on VBBL EMG v3.0 is reported for the baseline and each passive strategy bundle.

The results show that across the archetypes, overheating hours are reduced by 81%–86% or the bundles in an extreme heat + UHI scenario, and 85%-90% in a future shifted GW+2°C scenario. The reporting clearly shows that the highest number of overheating hours occurs during July and August. During August, the passive bundles reduce the number of hours by 73%-80%.



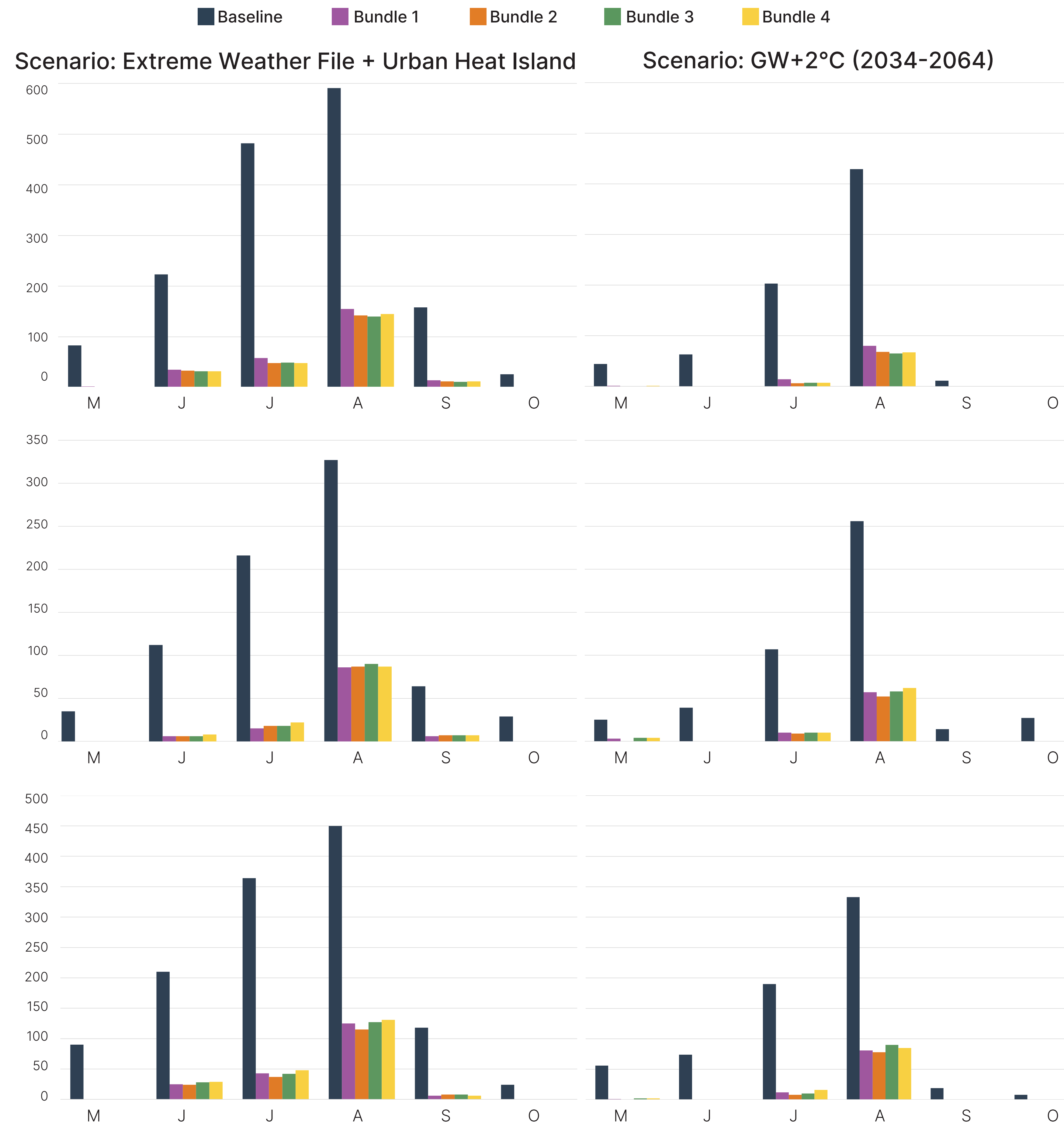


Figure 13: Summary Overheating Hours per Archetype and Climate Scenario - EWF+HUI (left) and GW+2°C (right)

3 Technical Findings

3.3 NRC OVERHEATING METRIC

The NRC overheating risk analysis indicates that the number of overheating and health-risk events decreases across all passive design bundles and archetypes. However, event count alone is not sufficient to evaluate overheating risk. The NRC framework assesses overheating using a combination of indicators (duration (DUR), severity (SETH), and intensity (INT) which together provide a more comprehensive measure of thermal exposure.

Figures on the following pages present results for the worst-performing suite on a typical floor, within each archetype and bundle scenario across the NRC indicators.

A representative mid-floor suite was selected for each archetype to evaluate the relative performance of the passive design strategies and selected overheating metrics under consistent building conditions. As the TRiM study was intended to compare passive design approaches rather than optimised building design, the analysis focused on the worst-case orientation on a representative floor, rather than the worst-case suite within the building. Top-floor suites often experience higher overheating risk, however, the critical suite and orientation are project-specific.

Performance patterns are similar between baseline and bundle scenarios under both the Extreme Weather File (EWF) + Urban Heat Island (UHI) and the Global Warming +2°C (2034-2064) climate scenarios. Under both climate file scenarios, several indicators approach the NRC threshold values, indicating that passive strategies substantially reduce overheating health risk.

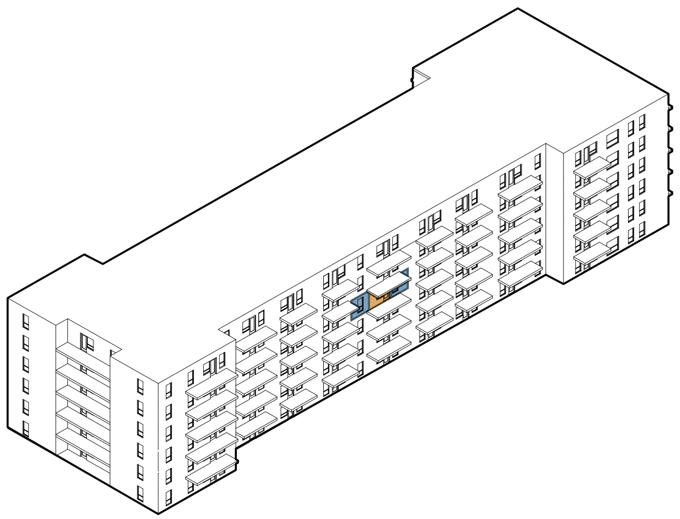
Across the archetypes, the passive design bundles significantly improve the duration and severity indicators (DUR and SETH). The bundles perform at broadly similar levels, reflecting the combined impact of reducing solar heat gains and enabling passive ventilation strategies. In contrast, baseline scenarios consistently perform worse across all archetypes, largely due to limited openable window area in the baseline configuration, which restricts the ability of suites to purge accumulated heat through natural ventilation.

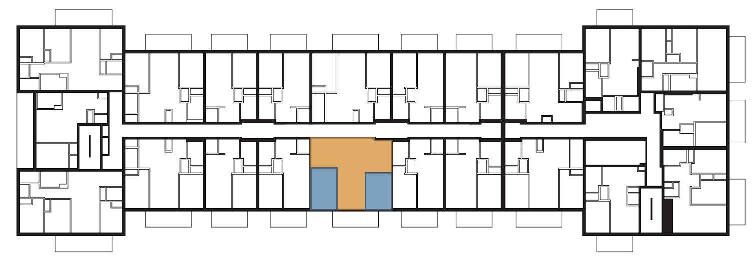
Requiring openable windows in the primary living spaces by code would also improve passive cooling performance. Modelling tested one scenario to quantify the impact of increased operability (e.g., allowing patio doors to open) on overheating risk outcomes, refer to **Appendix K: Detailed Overheating Analysis Results.** This condition is currently not permitted under the VBBL Energy Modelling Guidelines (EMG v3.0) for overheating simulations.

3 Technical Findings

3.3 NRC OVERHEATING METRIC

3.3.1 Impact of Passive Design Bundles - 6 Storey



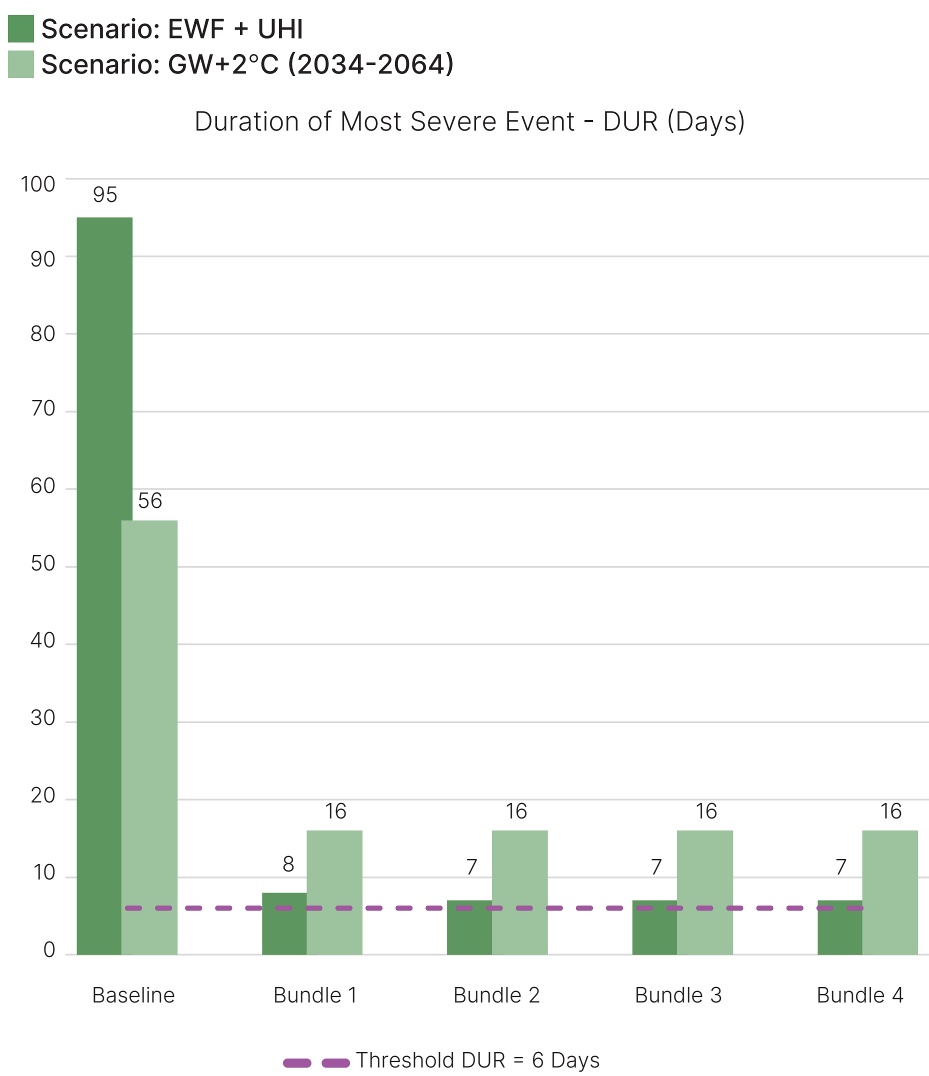


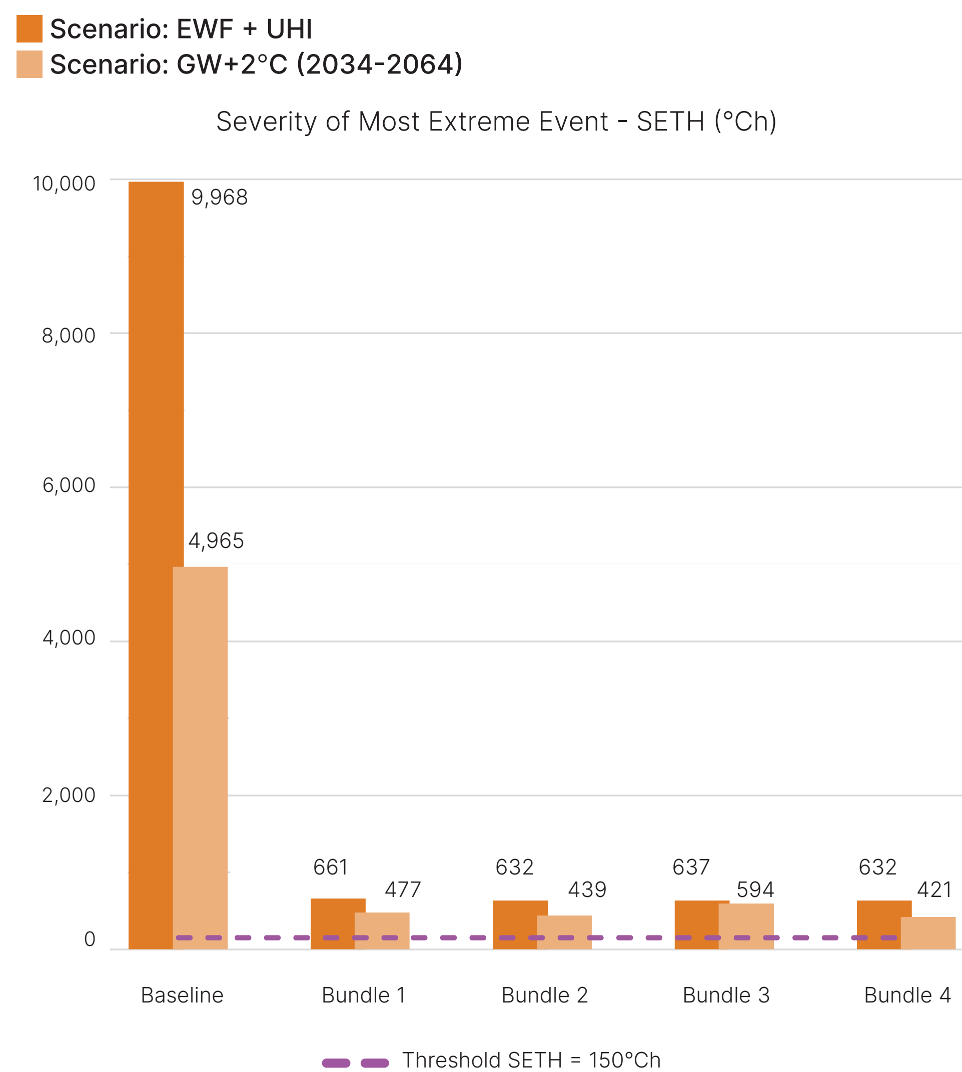
Results shown here represent a West-facing two-bedroom suite in the 6-storey archetype. As noted in the introduction of Section 3.3, the analysis focused on the worst-case orientation on a representative floor, rather than the worst-case suite within the building. Passive strategies are evaluated using the NRC overheating risk metric under two climate scenarios. The threshold lines indicate when a health risk event is reached.

The passive strategies reduce the duration (DUR) of the worst-case health risk event by 93% for the extreme heat dome summer scenario and by 71% for the GW+2 °C scenario. All bundles reduce the duration of the worst health risk event to a similar degree.

The severity (SETH) is reduced by 93% for the extreme heat dome summer and by 88% for the GW+2°C scenario. For the 6-storey archetype, Bundles 2, 3, and 4 perform similarly and better than Bundle 1, due to the addition of direct solar control strategies in combination with reduced window-to-wall ratio (WWR).

The intensity (INT) remains below the health risk threshold for all studied scenarios. All bundles reduce the average intensity of the worst-case overheating event compared to the baseline. This indicates that, under the climate scenarios evaluated, overheating risk is primarily associated with prolonged and cumulative heat exposure, rather than exceptionally high indoor temperatures.





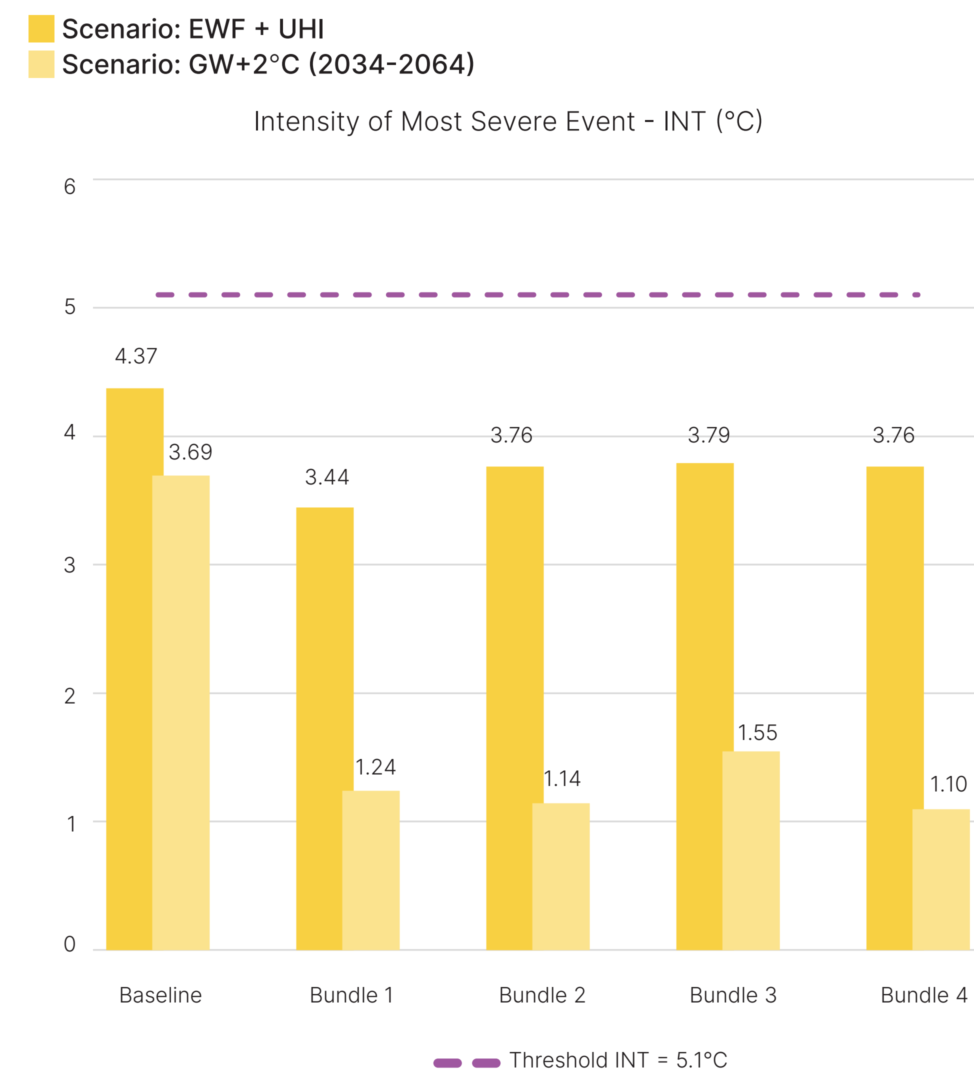
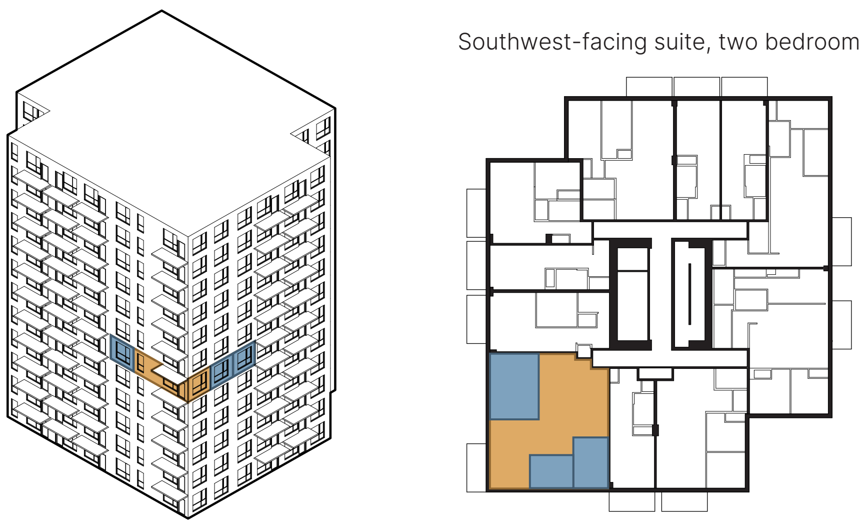


Figure 14: Summary of NRC Overheating Risk Assessment (DUR, SETH, INT) for 6 storey, Baseline vs Bundles

3.3.2 impact of Passive Design Bundles - 12 Storey



Results shown here represent a southwest-facing three-bedroom suite in the 12-storey archetype. As noted in the introduction of Section 3.3, the analysis focused on the worst-case orientation on a representative floor, rather than the worst-case suite within the building. Passive strategies are evaluated using the NRC overheating risk metric under two climate scenarios. Passive strategies are evaluated using the NRC overheating risk metric under the two climate scenarios. The threshold lines indicate when a health risk event is reached.

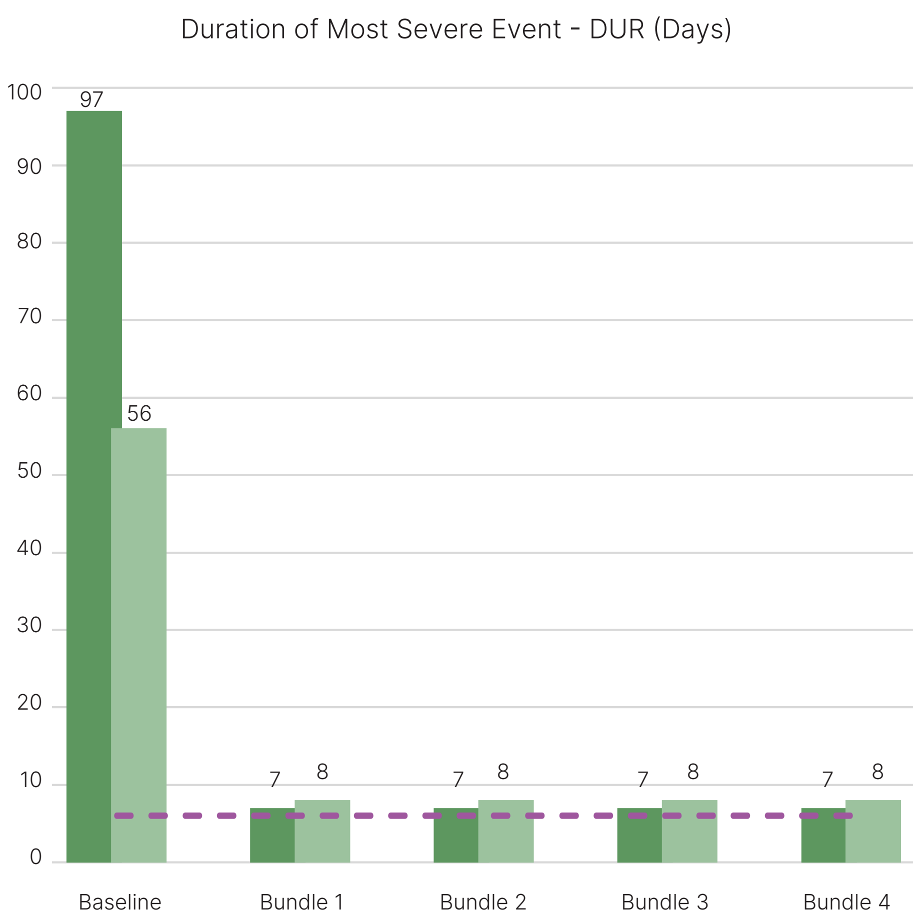
The passive strategies reduce the duration (DUR) of the worst-case health risk event by 93% for the extreme heat dome summer and by 86% for the GW+2 °C scenario. All bundles reduce the duration of the worst health risk event to a similar degree, bringing results close to the health risk threshold.

The severity (SETH) is reduced by 94% for the extreme heat dome summer and by 95% for the GW+2 °C scenario. All bundles perform similarly relative to the baseline in both climate scenarios.

Under the GW+2 °C scenario, the resulting severity (SETH) remains close to the health risk threshold and may potentially be mitigated through adaptive measures such as portable fans or other occupant-level interventions, without relying on active mechanical cooling.

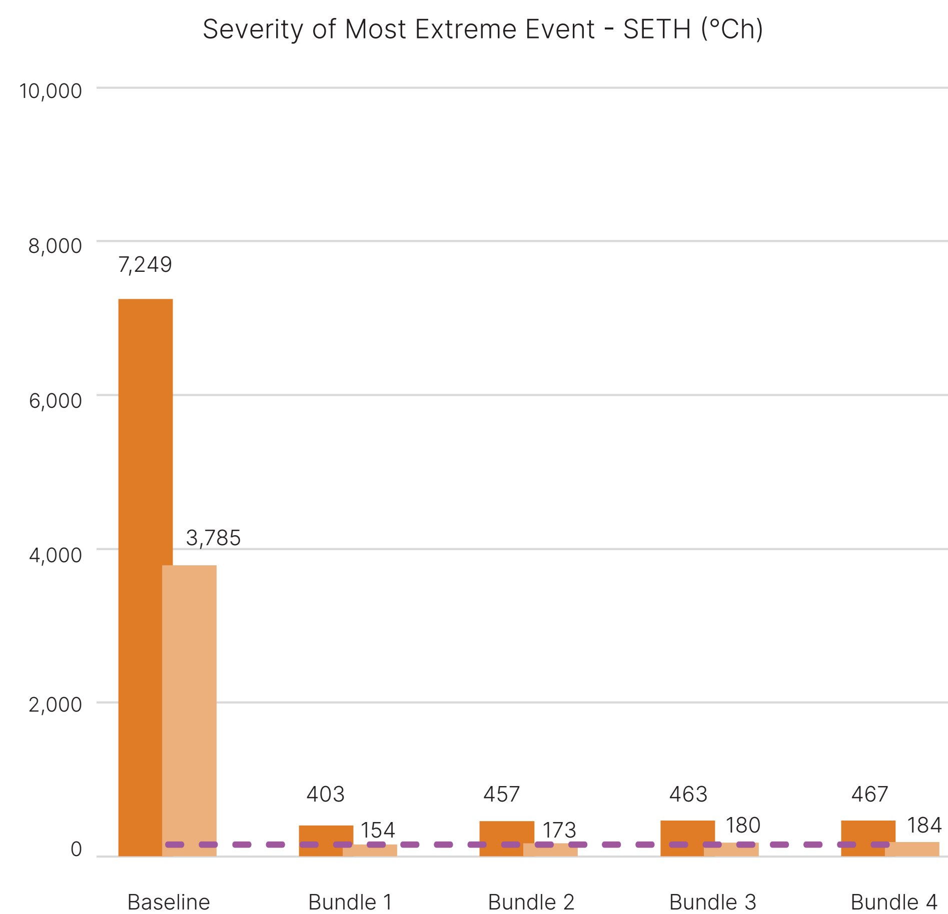
The intensity (INT) remains below the health risk threshold for all studied scenarios. All bundles reduce the average intensity of the worst-case overheating event compared to the baseline. This indicates that, under the climate scenarios evaluated, overheating risk is primarily associated with prolonged and cumulative heat exposure, rather than exceptionally high indoor temperatures.

Scenario: EWF + UHI
Scenario: GW+2°C (2034-2064)



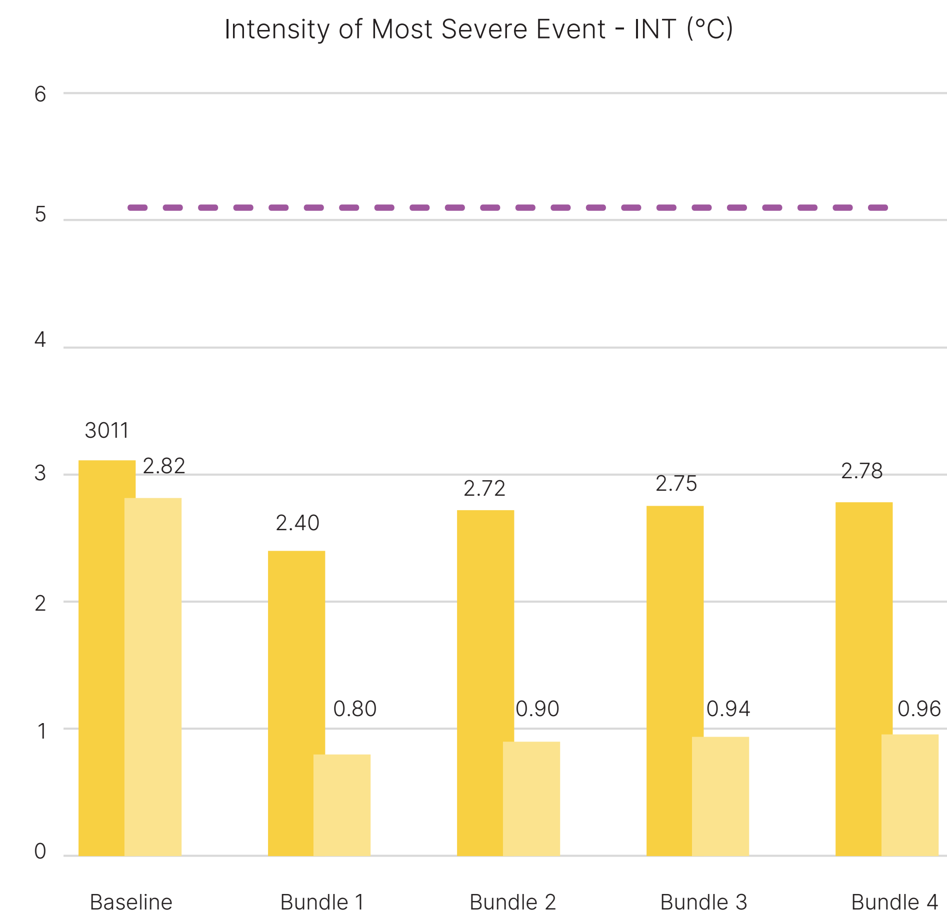
Threshold DUR = 6 Days

Scenario: EWF + UHI
Scenario: GW+2°C (2034-2064)



Threshold SETH = 150°Ch

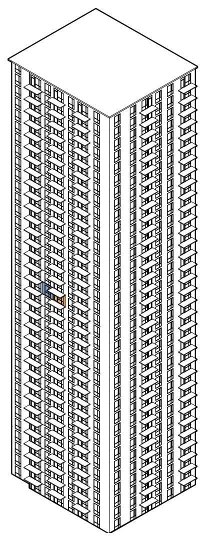
Scenario: EWF + UHI
Scenario: GW+2°C (2034-2064)



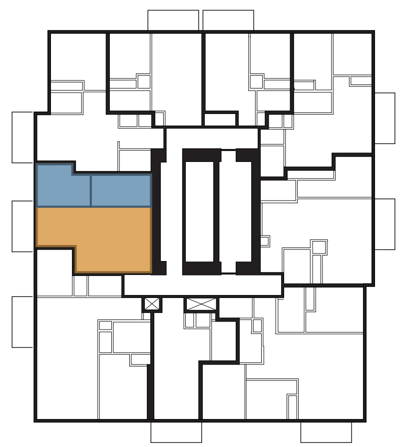
Threshold INT = 5.1°C

Figure 15: Summary of NRC Overheating Risk Assessment (DUR, SETH, INT) for 12 storey, Baseline vs Bundles

3.3.3 Impact of Passive Design Bundles - 35 Storey



West-facing suite, two bedroom

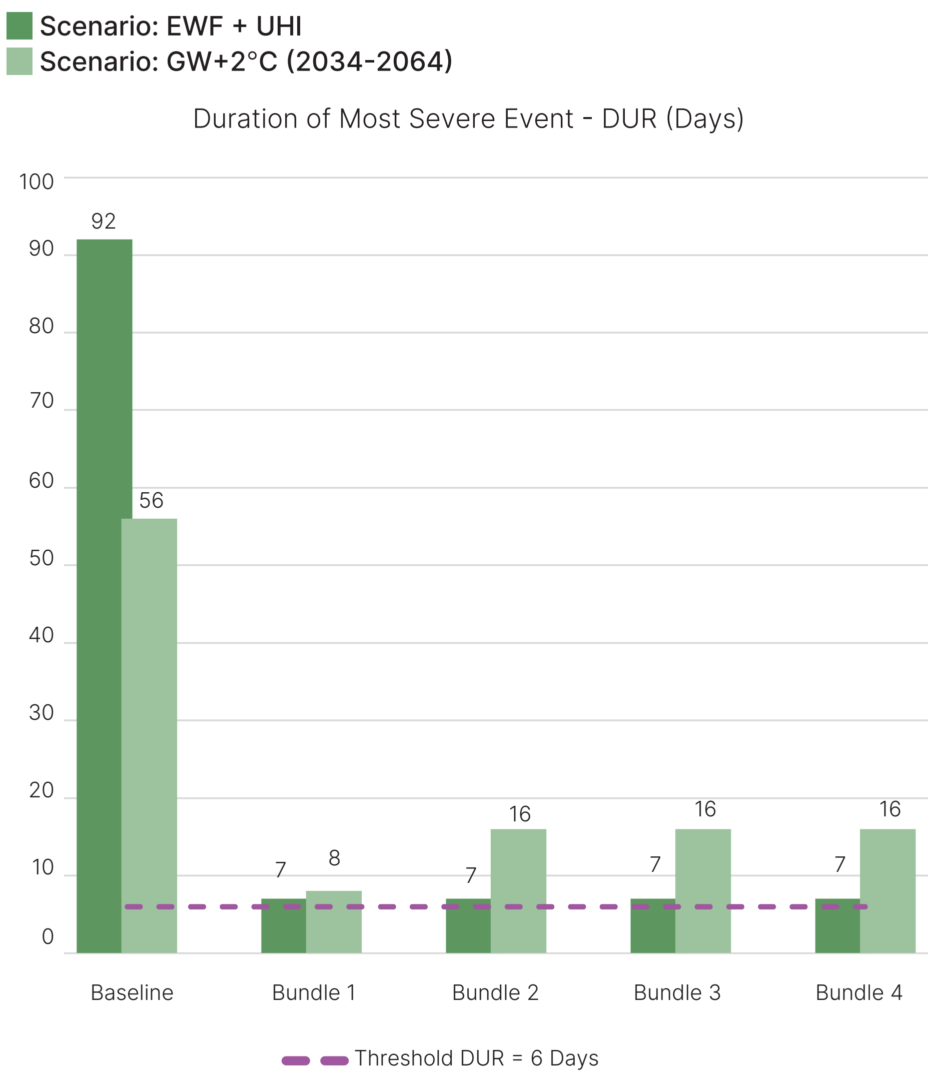


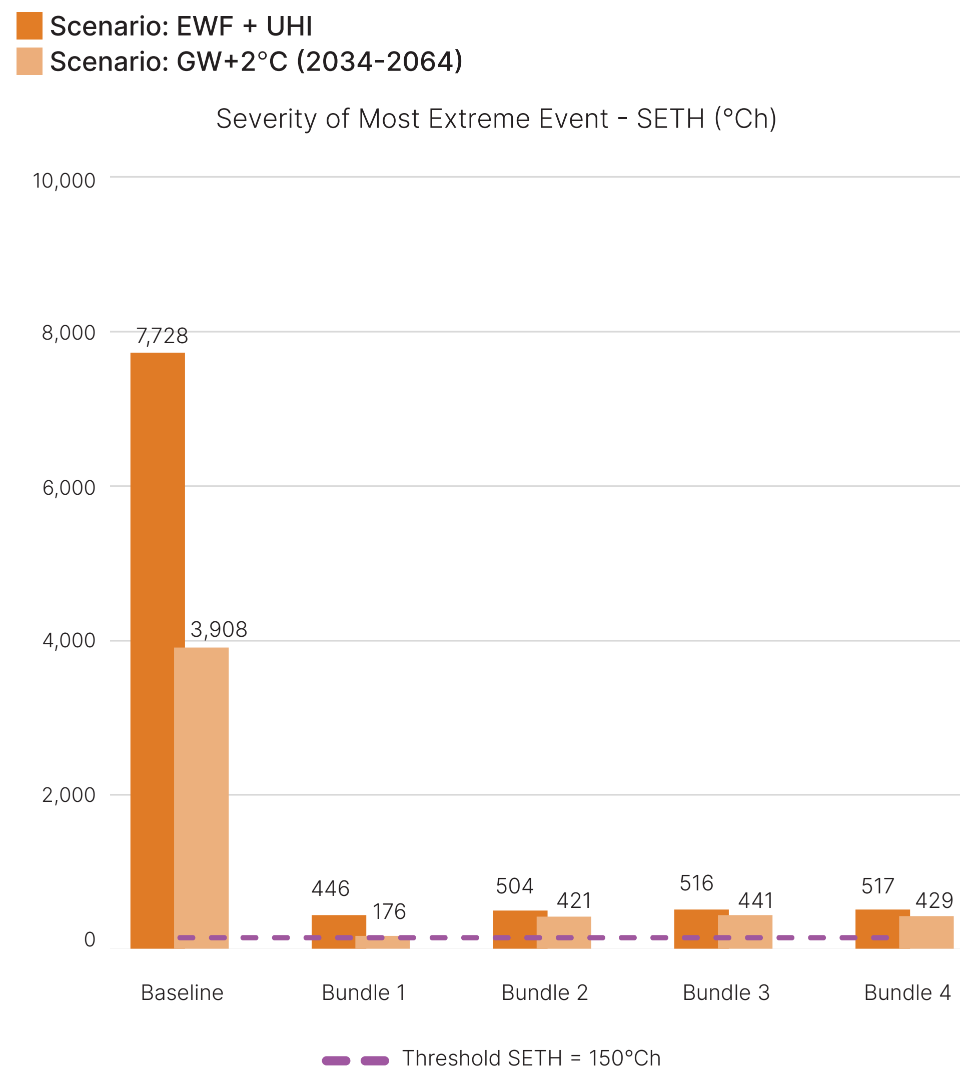
Results shown here represent a west-facing two-bedroom suite in the 35-storey archetype. As noted in the introduction of Section 3.3, the analysis focused on the worst-case orientation on a representative floor, rather than the worst-case suite within the building. Passive strategies are evaluated using the NRC overheating risk metric under the two climate scenarios. The threshold lines indicate when a health risk event is reached.

The passive strategies reduce the duration (DUR) of the worst-case health risk event by 92% for the extreme heat dome summer and by 71% for the GW+2 °C scenario, bringing results close to the maximum threshold. Bundle 1 performs best among the bundles for the 35-storey archetype, indicating that reducing window-to-wall ratio (WWR) is more effective than adding exterior shading while maintaining a larger WWR. However, the addition of solar control strategies with a larger WWR, in combination with openable windows, still performs significantly better than the baseline condition.

The severity (SETH) is reduced by 93% for the extreme heat dome summer and by 89% for the GW+2°C scenario. Bundle 1 approaches the risk threshold and may potentially be mitigated through adaptive measures such as portable fans. Bundles 2, 3, and 4 indicate that additional strategies would be required to fully eliminate health risk during the hottest summer conditions.

The intensity (INT) remains below the health risk threshold for all studied scenarios. All bundles reduce the average intensity of the worst-case overheating event compared to the baseline. This indicates that, under the climate scenarios evaluated, overheating risk is primarily associated with prolonged and cumulative heat exposure, rather than exceptionally high indoor temperatures.





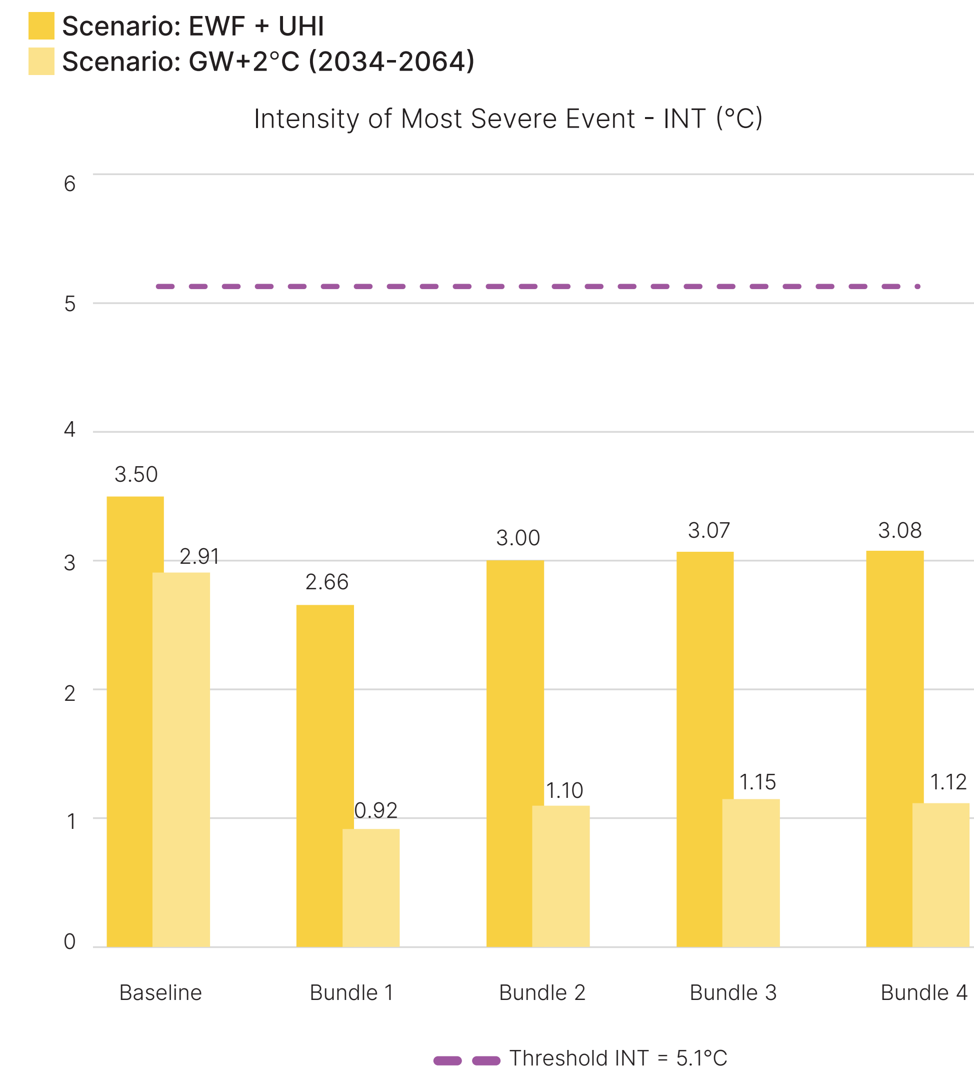


Figure 16: Summary of NRC Overheating Risk Assessment (DUR, SETH, INT) for 35 storey, Baseline vs Bundles

3 Technical Findings

3.4 VBBL ENERGY PERFORMANCE METRIC

In addition to overheating performance, the modelling assessed the impact of the passive design bundles on building energy performance, including CEDI, TEDI, TEUI, GHGI, peak building load and estimated energy cost.

VBBL provides several compliance paths for MURBs under Part 10, Section 10.2.2.5.

For the purposes of the TRiM study, the energy performance thresholds referenced are based on Table 10.2.2.5.A. Alternative compliance paths (including those removing greenhouse gas intensity (GHGI) limits or Low Carbon Energy Systems) were not evaluated.

These thresholds are used for comparison and discussion purposes only. The selection of compliance path does not influence the overheating risk analysis, which is assessed independently of energy compliance requirements.

VBBL does currently not have a compliance threshold for cooling energy demand intensity (CEDI)- its a reporting only metric.

Table 2: VBBL Energy Compliance Requirements for MURBs (Path 10.2.2.5.A)

VBBL Table 10.2.2.5 A	TEDI Thermal Energy Demand Intensity (kWh/m²)	TEUI Total Energy Use Intensity (kWh/m²)	GHGI Greenhouse Gas Intensity (kgCO_2e/m²)
Residential < 6 Stories	25	120	3
Residential > 6 Stories	30	120	3

All energy performance metrics are modelled with NRC GW +1 °C scenario as required by VBBL for compliance.

Detailed energy performance metrics for each archetype are provided in **Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle.**

Corridor pressurisation adjustment is accounted for in all reported TEDI numbers. The adjustment is not included in the reported TEUI or GHGI metrics.

3 Technical Findings

3.4 VBBL ENERGY PERFORMANCE METRIC

3.4.1 Energy Performance Metric Comparisons - CEDI

The following summarises the CEDI results (Figure 17) for all archetypes and bundles.

All bundles reduce CEDI relative to the baseline, with some nuances:

- The 6-storey archetype has a more efficient starting point (lower WWR and better wall R-value), resulting in smaller CEDI reductions relative to the baseline compared to the other archetypes.
- Bundle #1 (WWR reduction) shows a larger impact on the 12- and 35-storey archetypes, where the baseline condition has a higher WWR than the 6-storey archetype.
- Bundle #2 (reduced WWR /exterior shading) is the most effective strategy across all bundles in reducing overall cooling demand.
- Bundle #3 (reduced WWR/electrochromic glazing) is very similar to Bundle #4 (reduced WWR/lower SHGC) in all archetypes.

3.4.2 Energy Performance Metric Comparisons - TEDI

The following summarises the TEDI results (Figure 18) for all archetypes and bundles.

The 6-storey archetype is the most efficient due to its lower WWR and better exterior wall thermal performance.

The 35-storey baseline condition is already close to meeting the TEDI threshold due to the thermal performance characteristics of the window-wall façade system.

- Bundle #1 (reduced WWR) results in a reduction in TEDI, primarily due to reduced heat loss through glazing.
- Bundle #2, #3 and #4 performs similarly across all archetypes, leading to TEDI reductions in 6- and 12-storey relative to baseline. This means that reduced WWR in combination with solar control reduce both CEDI and TEDI.
- For the 35-storey archetype, Bundles #2, and #4 increase TEDI above the compliance threshold, indicating that additional measures to reduce heating demand would be required to maintain energy compliance.

Reducing solar gains can have the unintended consequence of increasing TEDI, as solar gains contribute to passive heating during colder periods.

Figure 17: Total Cooling Demand (CEDI) - kWh/m²

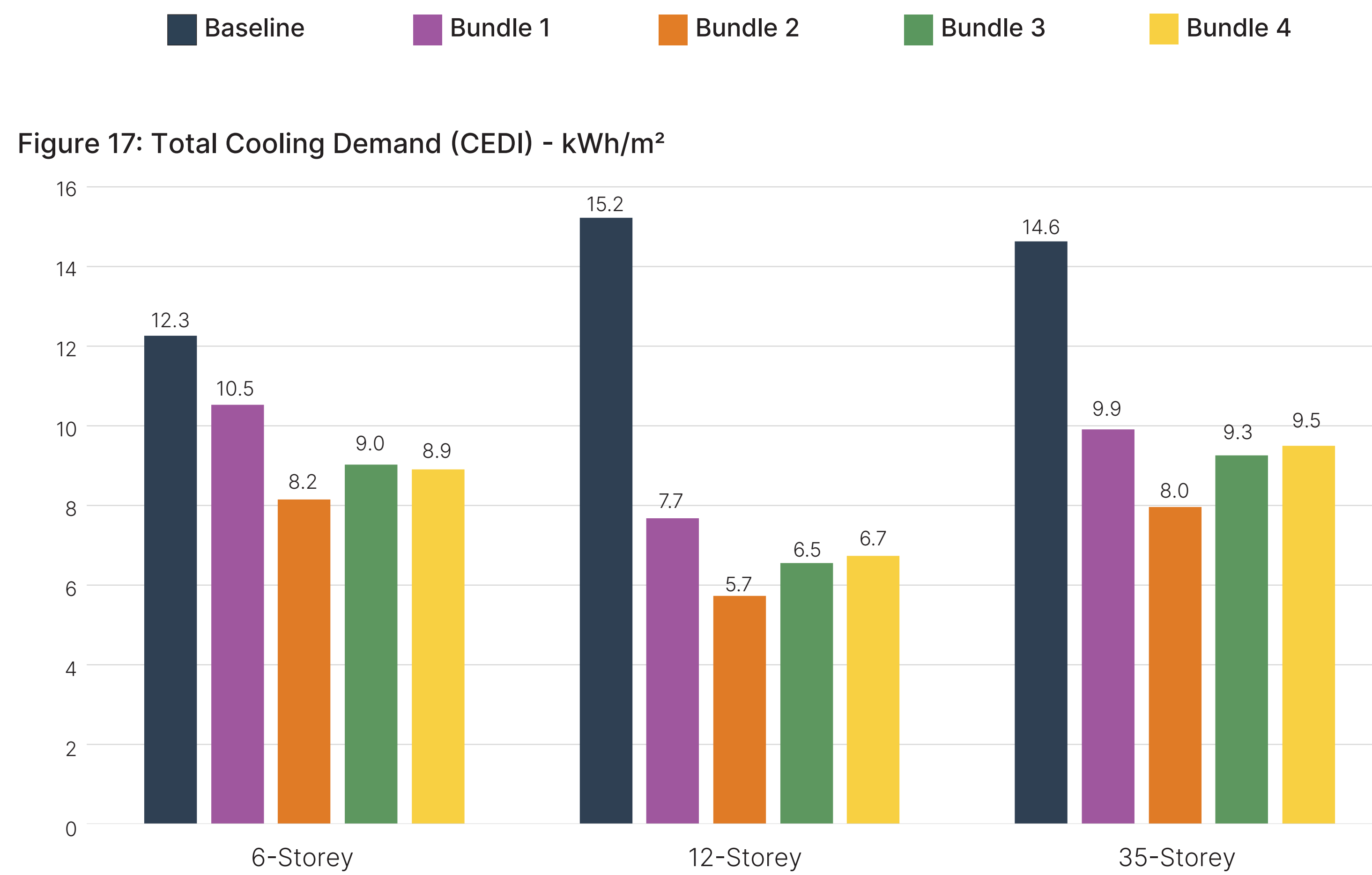
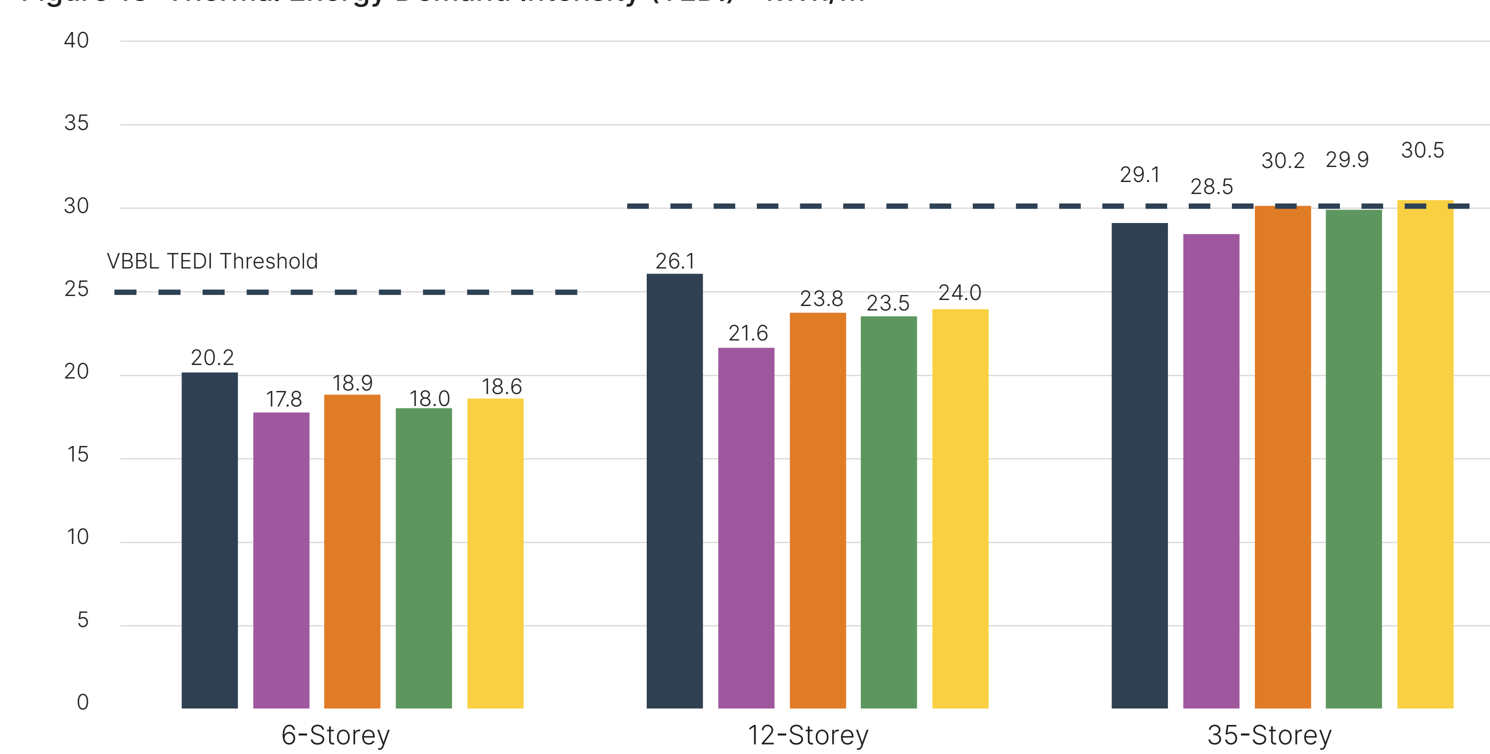


Figure 18: Thermal Energy Demand Intensity (TEDI) - kWh/m²



*TEDI results include corridor pressurisation adjustment per VBBL

3.4 VBBL ENERGY PERFORMANCE METRIC

3.4.3 Energy Performance Metric Comparisons - TEUI and GHGI

The following summarises the TEUI and GHGI results (Figure 19) for all archetypes and bundles.

- The passive bundles have minimal impact on overall energy consumption and do not risk compliance with the TEUI requirement.
- Cooling energy is reduced by the passive measures, while heating energy on the bundles with solar control increases, resulting in a balancing effect on overall energy use.
- The energy differential from the passive bundles is more pronounced in the 12- and 35-storey archetypes, as these systems include full mechanical cooling, which also affects fan and pump energy.

All buildings are fully electric and meet the GHGI requirement, with very similar performance ranging between 0.8 - 0.9 $kgCO_2e/m^2$. The GHGI values are not significantly affected by the passive strategies.

3.4.4 Energy Performance Metric Comparisons - Energy Cost

Energy cost is presented for each archetype both as total annual energy cost (Table 3 and 4 and as energy cost savings relative to Baseline (Figure 20).

- Energy cost is evaluated using the GW+1°C (current) climate scenario, and life-cycle projections were not undertaken.
- Total annual energy cost is reduced between 1.6% - 4.1% across the archetypes. Note that this is modelled with full cooling and does not factor in openable windows.
- Evaluating the GW+2°C scenario would likely show larger reductions in energy cost, as cooling energy demand is expected to increase by approximately 30% under a GW+2°C scenario compared to GW+1°C.

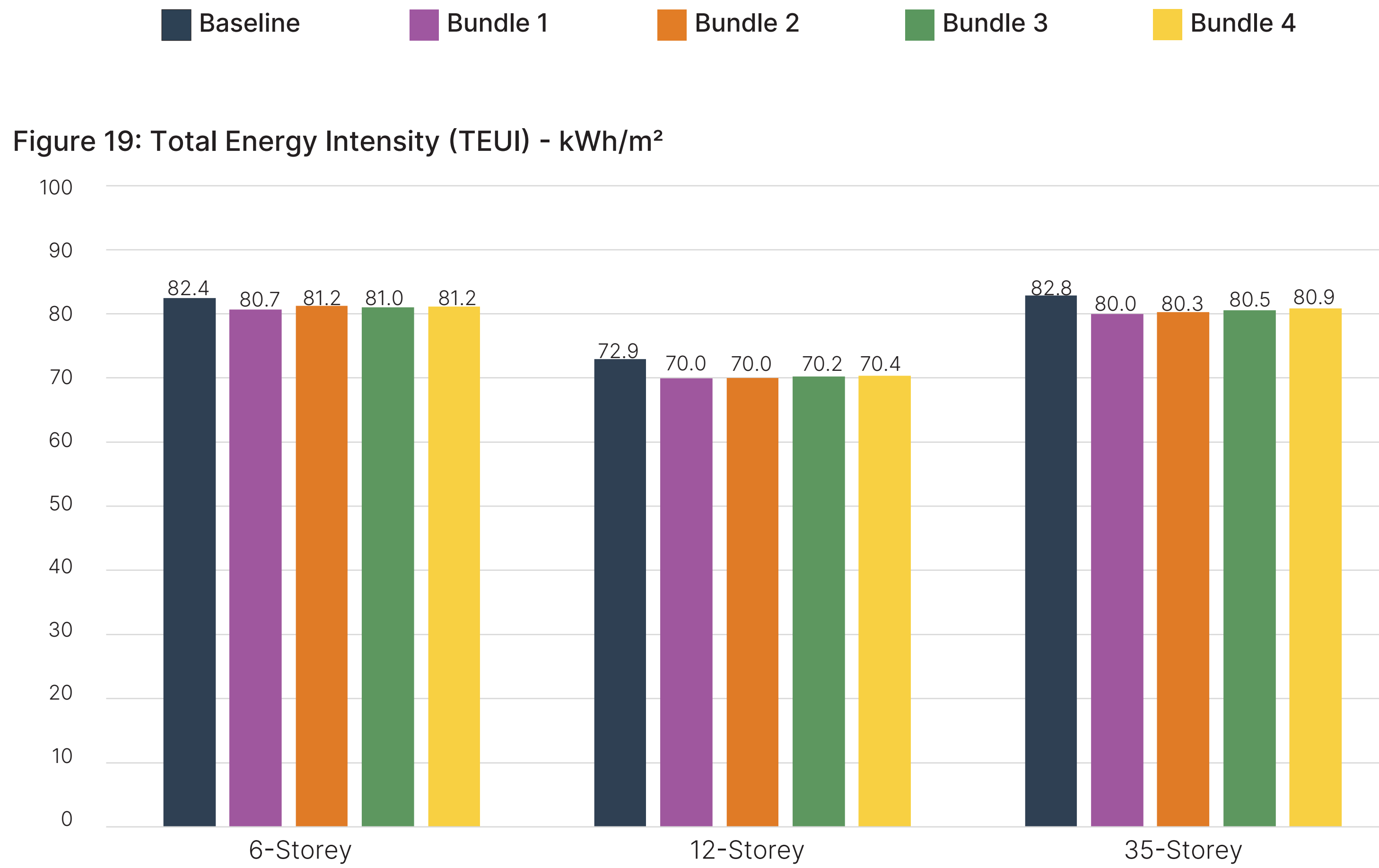
Table 3: Annual Building Energy Cost - Total

Building Energy Cost ($/Year)	Baseline	Bundle #1	Bundle #2	Bundle #3	Bundle #4
6-Storey	$120,796	$118,165	$119,027	$118,729	$118,894
12-Storey	$109,241	$104,789	$104,895	$105,191	$105,392
35-Storey	$332,877	$321,444	$322,512	$323,662	$324,954

Table 4: Annual Energy Cost - Average per Suite (1-3 Bedrooms)

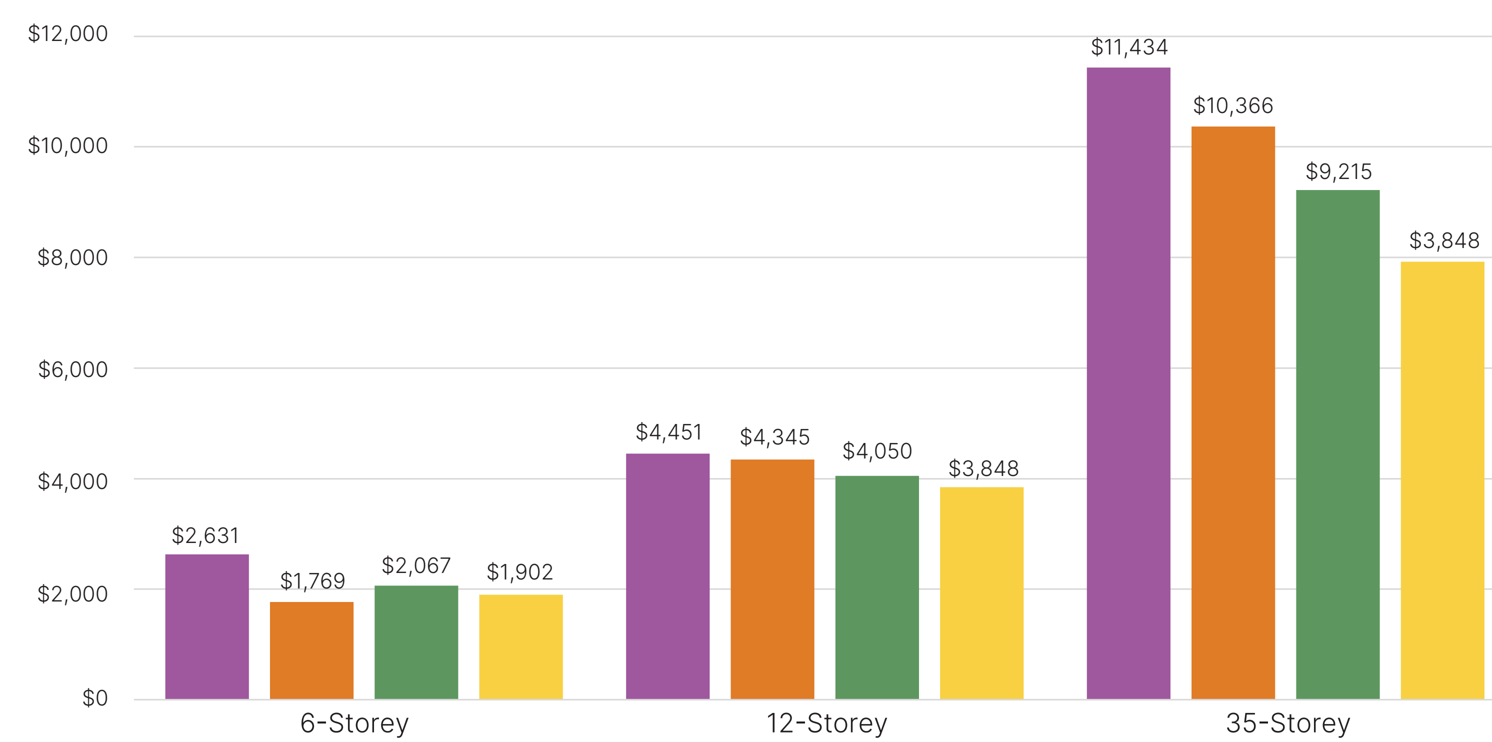
Building Energy Cost ($/Year)	Baseline	Bundle #1	Bundle #2	Bundle #3	Bundle #4
6-Storey	$915	$895	$902	$899	$901
12-Storey	$828	$794	$795	$797	$798
35-Storey	$1,057	$1,020	$1,024	$1,027	$1,032

Figure 19: Total Energy Intensity (TEUI) - kWh/m²



*TEUI results exclude corridor pressurisation adjustment per VBBL

Figure 20: Building Annual Energy Cost Savings (2026 Rates) - $/year



3.5 COST ANALYSIS

Cost implications were developed through trade input from Peak Construction Group and their trade contractor network, enabling comparison of incremental façade costs relative to the TRiM baseline. Detailed cost calculations and assumptions are provided in **Appendix B: Cost Analysis and Comparison.**

The costing analysis focuses on façade elements affected by the passive strategies. Components unrelated to the façade (e.g., structure, mechanical systems, interiors) were held constant to isolate the impact of envelope design changes.

Variations in façade cost between archetypes reflect differences in façade area and exposure (e.g., larger west-facing façades), which influence the extent of shading and glazing systems required.

Across the archetypes, façade cost impacts differ by strategy. Bundle 1 results in small cost reductions (–0.3% to –2.3%), while Bundle 2 increases façade costs (10% to 36%). Bundle 3 results in increases of 53% to 104%, and Bundle 4 results in minimal cost changes (0.3% to 0.5%).

3.5.1 Total Project Cost Context (Altus Benchmarking)

Façade cost impacts were translated to total project cost using Altus Group (2025) benchmark data for representative multi-unit residential buildings in the Vancouver market.

Altus benchmark data provides indicative cost distributions, enabling façade cost changes to be scaled to total project cost.

Based on these benchmarks, façade systems represent a limited proportion of total construction cost. As a result, changes in façade cost are proportionally moderated when translated to total project cost.

Bundle 1 and Bundle 4 remain negligible (<1%), Bundle 2 ranges from approximately 2% to 7%, and Bundle 3 ranges from approximately 10% to 21% of total project cost.

Table 5: Cost Summary by Archetype and Bundle

Archetype	Bundle	Façade Cost ($/m²)	Δ Cost ($ vs Baseline)	Δ Cost (% vs Baseline)	Δ Cost (% of Total Project, Altus 2025)
6 Storey	Baseline	461	—	0.0%	—
	Bundle 1	459	(945)	-0.3%	-0.10%
	Bundle 2	626	103,249	35.9%	7.20%
	Bundle 3	941	299,347	104.1%	20.80%
	Bundle 4	463	1,398	0.5%	0.10%
12 Storey	Baseline	1,125	—	0.0%	—
	Bundle 1	1,104	(6,362)	-1.8%	-0.40%
	Bundle 2	1,237	35,462	10.0%	2.00%
	Bundle 3	1,719	187,189	52.9%	10.60%
	Bundle 4	1,129	1,248	0.4%	0.10%
35 Storey	Baseline	1,114	—	0.0%	—
	Bundle 1	1,089	(7,525)	-2.3%	-0.5%
	Bundle 2	1,238	36,414	11.1%	2.2%
	Bundle 3	1,759	189,018	57.8%	11.6%
	Bundle 4	1,120	1,640	0.5%	0

Total project cost impacts are derived using Altus Group (2025) benchmark cost data for representative multi-unit residential buildings in the Vancouver market. Full costing methodology and detailed results are provided in **Appendix B: Cost Analysis and Comparison.**

Bundle 1 – Reduced Window-to-Wall Ratio / Fully Openable Window

- Façade cost reductions of approximately 0.3% to 2.3% are observed across all archetypes.
- Total project cost impact is negligible.

Bundle 2 – Reduced Window-to-Wall Ratio / External Shading Devices / Fully Openable Window

- Façade cost increases of approximately 10% to 36% are observed.
- This reflects the extent of external shading devices required across different building forms.
- Total project cost impact is approximately 2% to 7%.

Bundle 3 – Reduced Window-to-Wall Ratio / Electrochromic Glazing / Fully Openable Window

- Façade cost increases of approximately 53% to 104% are observed across all archetypes.
- Total project cost impact is approximately 10% to 21%.

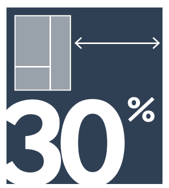
Bundle 4 – Reduced Window-to-Wall Ratio / Low SHGC Glazing / Fully Openable Window

- Façade cost increases of approximately 0.3% to 0.5% are observed.
- Total project cost impact is negligible.

Detailed descriptions of the passive design measures inc luded in each bundle are provided in “Figure 5. Description of passive measures in each bundle” on page 9.

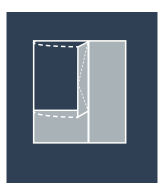
3 Technical Findings
3.6 CONSTRUCTABILITY AND MARKET AVAILABILITY

Constructability and market availability considerations were reviewed through Peak Construction Group and their trade contractor network. The review assessed supplier availability, façade integration requirements, and installation considerations for each passive strategy bundle. A summary of the findings is provided in **Appendix C: Constructability and Market Availability Methodology and Inputs.**



Reduced Window-to-Wall Ratio (WWR) (all bundles)

Reducing glazing area does not introduce constructability constraints across the archetypes and can be accommodated within conventional punched-window or window-wall façade systems.



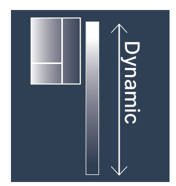
Openable Windows (all bundles)

All bundles assume fully openable windows to support increased passive cooling strategies. Openable window systems are readily available in residential construction; however, larger openable units may increase cost depending on window dimensions, opening direction, and hardware requirements.

In typical Vancouver MURB construction, openable window configurations most commonly include sliding and casement (side-hinged) systems, with tilt-and-turn and top-hung systems used less frequently due to cost, hardware complexity, and constructability considerations.

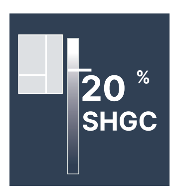
Exterior Shading Systems (Bundle 2)

Fixed exterior shading devices for south façades are readily available and commonly used. Operable exterior shading systems (e.g., roller shades or operable mesh screens) are less common in Canadian residential construction, although multiple suppliers are available in the BC market. Integration requires coordination with façade systems, including structural attachment, envelope penetrations, and installation sequencing considerations, particularly for taller buildings.



Dynamic Glazing (Bundle 3)

Electrochromic glazing products are commercially available but not widely used in Canadian residential construction. Local supply is limited, with products typically manufactured in the United States or Asia. Integration requires electrical connections, maintenance planning, and consideration of product lifespan (typically 15–25 years).



Low SHGC Glazing (Bundle 4)

Glazing systems capable of achieving SHGC values near 0.20 are available through multiple low-emissivity coating configurations. Achieving lower SHGC values may require tinted glazing, and high-rise applications may require higher glass strength, which may influence cost.

Table 6: Market Availability and Constructability Issues

<table>
<tr><th>Measures</th><th>Archetype 1
Mid-Rise 6 Storeys</th><th>Archetype 2
High-Rise 12 Storeys</th><th>Archetype 3
High-Rise 35 Storeys</th></tr>
<tr><td>WWR reduction</td><td colspan="3">• No constructability issues</td></tr>
<tr><td>Openable (bedroom & living room)</td><td colspan="3">• Extra large openable windows could cost more depending on L x W and opening direction</td></tr>
<tr><td>External fixed shading to S façade</td><td>• Fixed : Available and common
• Assume attachment to wall not windows</td><td colspan="2">• Fixed : Available
• Could attach to windows or cladding
• Attachment to window all - OK</td></tr>
<tr><td rowspan="2">Openable shade on the E / W</td><td colspan="3">• Openable: Can be roller shades or operable mesh screen. Not widely used in Canada
• Envelope penetrations need to be coordinated
• Typical sizes 4”- 16”</td></tr>
<tr><td>• Structural coordination depending on size</td><td colspan="2">• Structural requirements
• Vertically installed with WW
• Horizontally installed after WW complete with swing stage $$</td></tr>
<tr><td>Electrochromic glazing on E/S/W facades</td><td colspan="3">• Exterior grade dual pane product exists but is not commonly used.
• Electrical connections to come from unit electrical panel
• Limited local product. Manufactured mostly USA or Asia
• Product life span 15-25 years
• Maintenance and operational costs for use passed to tenant or owner.</td></tr>
<tr><td>Reduced SHGC 0.20</td><td colspan="3">• Products exist in the market to achieve SHGC 0.20
• Typically Low E Triple Silver
• May require some level or tinting to achieve.
• Pricing can increase on high-rise due to glass strength requirements</td></tr>
</table>

4 Results and Discussion

4.1 OVERHEATING RISK —TRiM CONTEXT

The TRiM study evaluates overheating risk in representative new multi-unit residential building archetypes under current and extreme heat conditions, using defined baseline configurations and passive design scenarios. The following sections discusses the results and puts forward suggested next steps.

Recent extreme heat events in British Columbia demonstrate the scale of this risk, including significant heat-related mortality during the 2021 heat dome[1], while prolonged periods of elevated temperatures[2] with limited nighttime cooling also contribute to cumulative heat exposure as the climate warms.

Overheating is considered as a health risk associated with cumulative heat exposure[3], not solely as a matter of thermal discomfort. Overheating events are characterized by sustained high daytime and nighttime temperatures, limiting physiological recovery and driving cumulative heat stress.

Overheating health risks are not captured by comfort-based metrics alone. In the TRiM study, overheating is evaluated using both comfort-based and physiological health-risk-based metrics to capture differences between temperature exceedance and cumulative heat exposure.

References

[1] Heat-related deaths in B.C.: Knowledge update

[2] Canada's Changing Climate Report. Government of Canada.

[3] Heat and health in the WHO European Region: Updated evidence for effective prevention

KEY TAKEAWAYS

- Overheating risk is driven by sustained exposure and limited nighttime recovery, rather than peak temperature
- Overheating risk represents a physiological health concern associated with cumulative heat exposure to MURB residents
- Overheating risk is not limited to extreme heat events and can occur during prolonged periods of elevated temperatures

4 Results and Discussion

4.2 EVALUATION OF OVERHEATING METRICS

Overheating was evaluated using two complementary approaches: the VBBL overheating hours metric and the NRC overheating risk framework. These metrics assess different aspects of overheating:

- VBBL overheating hours (OH) represent the number of hours above a comfort threshold, based on a single-zone model that averages conditions across the suite.
- The NRC overheating risk method evaluates duration (DUR), cumulative severity (SETH), and intensity (INT) to assess both dehydration-related heat exposure and increases in core body temperatures. It distinguishes between living areas and bedrooms to capture differences between daytime exposure and nighttime recovery.

The VBBL overheating hours metric records temperature exceedance above a comfort threshold and provides a simple and widely understood indicator of thermal discomfort. However, it does not capture the duration, persistence, or cumulative severity of heat exposure once thresholds are exceeded. As a result, it does not distinguish between short-duration exceedances and sustained multi-day conditions that may pose a risk to human health. **Reductions in overheating hours do not necessarily indicate that overheating risk has been mitigated.**

The VBBL approach is also based on single-zone thermal modelling, which averages performance across a suite and does not reflect variation between spaces or the persistence of overheating conditions over time. This limits its ability to represent real-world exposure and assess health risk.

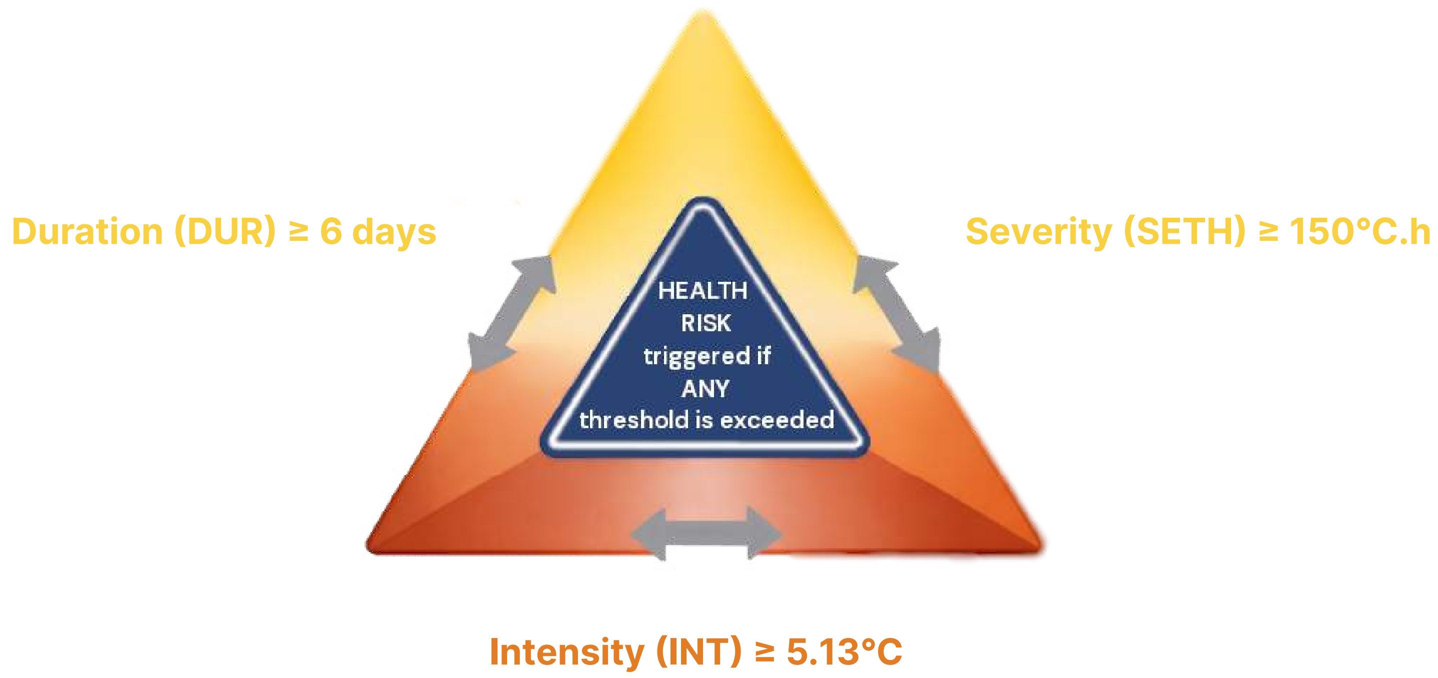


Figure 19: NRC Overheating Risk Framework and Thresholds (Vancouver & BC Application)

KEY TAKEAWAY

- To better represent occupant health risk during prolonged heat events, the study recommends transitioning from reliance on comfort-based overheating-hour metrics towards use of the NRC Overheating Risk Framework (DUR/SETH/INT), which better captures cumulative physiological exposure, nighttime recovery, and heat-health risk.

COMFORT VS. PHYSIOLOGICAL METRICS

Comfort-Based Metrics (VBBL Overheating Hours)

- Indicate thermal discomfort (temperature exceedance)
- Do not capture duration or multi-day accumulation
- Do not reflect ability for nighttime recovery
- Understate risk during prolonged or intense heat events
- Does not identify risk to health

Physiological Health-Risk-Based Metrics (NRC — DUR / SETH / INT)

- Capture duration (DUR) and cumulative severity (SETH)
- Account for nighttime recovery and multi-day accumulation
- Distinguishes between living areas, separates bedrooms from living areas
- Differentiates overheating event from a health risk event
- Identifies risk to health

References

[Climate resilience of buildings: overheating in buildings: development of framework for overheating risk analysis - NRC Publications Archive - Canada.ca]

[Laouadi, A., Bartko, M., & Lacasse, M. A. (2020). A new methodology of evaluation of overheating in buildings]

[Heat and health in the WHO European Region: updated evidence for effective prevention]

4 Results and Discussion

4.3 PASSIVE DESIGN FINDINGS

Passive design strategies reduced overheating risk across all archetypes showing a significant improvement across all overheating metrics.

VBBL overheating hours were reduced by 80-86% under the extreme heat scenario.

Across all archetypes, passive design bundles achieved similar reductions in DUR and SETH. Duration (DUR) decreased by approximately 90–97% under extreme heat scenarios, with comparable reductions in cumulative severity (SETH) (refer to Section 3). The intensity (INT) remains below the health-risk threshold for all studied scenarios. This indicates that, under the climate scenarios evaluated, overheating risk is primarily associated with prolonged and cumulative heat exposure, rather than exceptionally high indoor temperatures.

Baseline configurations exhibited a significantly higher risk due to limited openable window area and reduced user ability to open windows and release heat. Increasing access to natural ventilation and reducing solar gains improved performance across all archetypes.

Multiple passive design pathways achieved comparable reductions in overheating risk, allowing flexibility within typical residential constraints. Performance was driven by a combination of reduced solar gains and improved ventilation, including access to openable windows in each living space.

Passive measures reduce both peak cooling demand and duration of system operation, supporting overall system performance.

CURRENT REGULATORY RESPONSE (2025 VBBL REQUIREMENTS)

- Requires cooling to maintain ≤26°C in one living space
- Focuses on peak indoor temperature
- Does not require openable windows in living room
- Does not address duration (DUR) or cumulative exposure (SETH) to indoor overheating
- Typically results in mechanical cooling–led design

MECHANICAL VS PASSIVE RESPONSE

Mechanical Cooling (Reactive)	Passive Strategies (Proactive)
Responds to elevated indoor temperature	Limit solar gains and internal heat buildup
Maintains comfort conditions	Enable heat dissipation and nighttime recovery through use of fresh air
Does not reduce heat gains or cumulative exposure	Reduce duration (DUR) and cumulative severity (SETH) in exposure to heat
Requires sustained operation under prolonged heat events	Lower overall cooling demand
	Reduce dependence on mechanical system

KEY TAKEAWAYS

- Passive design bundles substantially reduce overheating hours by approximately 80-86% under the extreme heat scenario.
- NRC Overheating Risk Analysis showed substantial reductions in overheating duration (DUR) and cumulative severity (SETH), indicating materially lower prolonged heat exposure for residents.
- Multiple passive design pathways evaluated in the study achieved comparable reductions in overheating risk across archetypes.
- Current code-compliant baseline envelope designs did not eliminate overheating risk under future and extreme heat conditions.
- Risk Reduction to overheating was primarily driven by solar heat gain reduction and improved passive ventilation effectiveness.
- While passive strategies substantially improved thermal resilience, additional targeted measures may still be required under the most extreme future heat scenarios.

4 Results and Discussion

4.4 CLIMATE MODELLING CONSIDERATIONS

Multiple climate datasets were applied to assess overheating risk under both typical and extreme conditions, aligned with the climate file selection described in Section 2.10. Three climate files were used:

- a current reference file (NRC Global Warming +1.0°C) to align with VBBL compliance modelling,
- a future-shifted file (NRC Global Warming +2.0°C) to represent future conditions aligned with VBBL requirements,
- an NRC Extreme Weather File (EWF) incorporating Urban Heat Island (UHI) effects to represent prolonged heat events with elevated nighttime temperatures.

The EWF with UHI was used as the primary condition for overheating analysis, enabling evaluation of passive strategies under sustained and cumulative heat exposure.

4.4.1 Current Modelling Practice

Standard climate datasets used for energy and overheating modelling are typically derived from historical weather records (e.g., CWEC and TMY files), representing normalized conditions over a 30-year period. These datasets are suitable for assessing average performance but do not capture prolonged multi-day heat events or the cumulative effects of sustained high temperatures.

Typical and future-shifted climate files primarily reflect average conditions and underrepresent extended periods of elevated temperatures and limited nighttime cooling. As a result, they may not fully capture overheating risks associated with consecutive hot days and reduced thermal recovery.

Commonly used Vancouver climate files are derived from airport weather stations and do not capture Urban Heat Island (UHI) effects present in dense urban areas, resulting in underrepresentation of elevated nighttime temperatures and reduced thermal recovery.

Typical modelling approaches therefore do not explicitly account for the combined effects of extreme heat and UHI conditions.

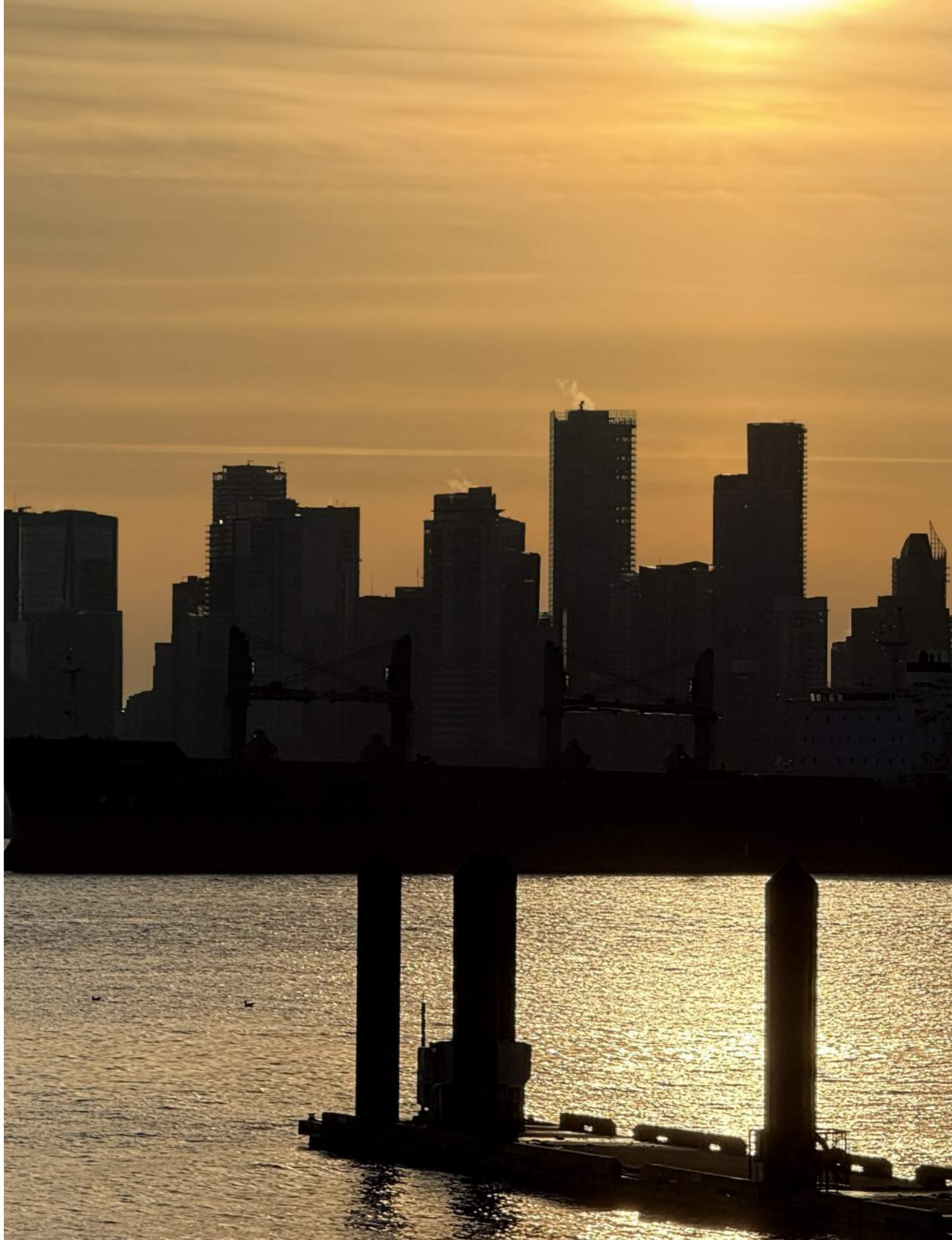
4.4.2 TRiM Climate File Application

To address these limitations, the use of NRC extreme heat (EWF) scenario with urban heat island (UHI) effects were considered in TRiM (refer to Section 2.10), which incorporates elevated nighttime temperatures and localized heat retention. This dataset is not publicly available and is not integrated into commonly used modelling tools, limiting its application in typical project delivery.

The use of an extreme heat scenario with UHI enables improved representation of prolonged and cumulative heat exposure. Where these conditions are not explicitly represented, overheating risk may be underestimated, and results may not fully capture the intensity and persistence of overheating in dense urban settings.

KEY TAKEAWAYS

- Standard climate files and typical modelling workflows underestimate overheating risk during prolonged heat events and Urban Heat Island (UHI) conditions.
- Extreme heat and UHI conditions materially increased cumulative overheating exposure and reduced ability for nighttime recovery across all archetypes.
- Evaluation of thermal resilience should include extreme heat event and UHI scenarios in addition to typical weather-year analysis.



4 Results and Discussion

4.5 NATURAL VENTILATION CONSIDERATIONS

One of the key passive strategies evaluated through the study bundles (Section 2.7) was natural ventilation, with archetypes modelled using fully openable windows (Section 2.8).

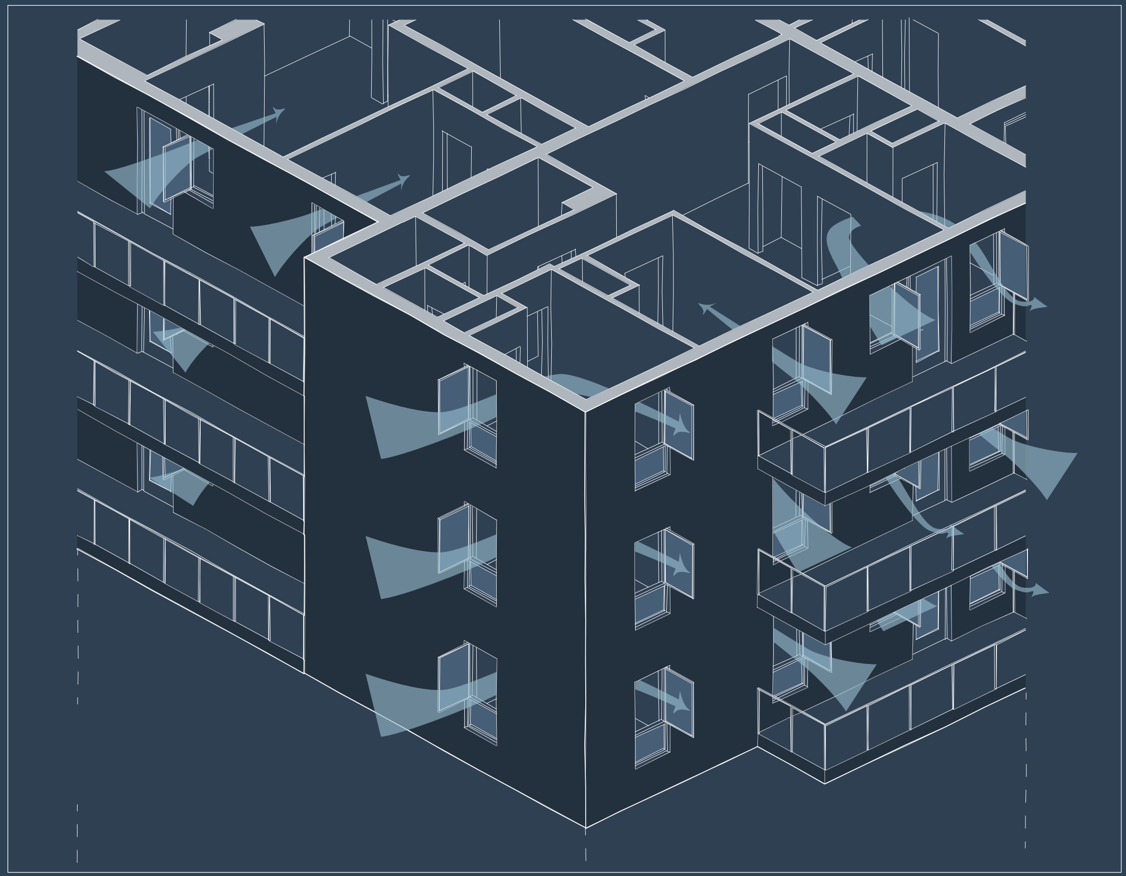
Increasing window operability and ventilation capacity significantly reduces overheating exposure across all archetypes and bundle scenarios, contributing to reductions in overheating hours (OH), duration (DUR) and cumulative severity (SETH). This approach differs from current Vancouver Building By-law (VBBL) requirements, which do not require openable windows in each room and limits window opening area.

Application in practice is influenced by several considerations:

- Occupant behaviour: Performance depends on when and how windows are used, including the ability to enable nighttime heat purge. Occupant education may be required to support effective use.
- Safety and regulatory constraints: All openable windows in the modelled scenarios comply with applicable code requirements (Section 2.7). Window restrictors, fall protection requirements, and building code provisions can limit opening area and reduce ventilation capacity.
- Building design and layout: Effectiveness varies with façade configuration, window placement, and cross-ventilation potential
- External environmental conditions: Air quality events (e.g., wildfire smoke) may temporarily limit use of natural ventilation. Overheating risk and associated health impacts occur independently of these events, and ventilation remains a primary strategy under typical conditions.
- Market and delivery considerations: Perceived risk, maintenance requirements, and market acceptance may influence adoption
- Acoustic constraints**:** Noise in dense urban environments may limit window use, particularly during nighttime periods.
- Integration with mechanical systems: Performance depends on coordination with mechanical systems and controls, particularly in mixed-mode operation.

The City of Vancouver Energy Modelling Guidelines v3.0 require patio doors to be modelled as closed. During the TRiM study, this assumption was identified as not representative of typical occupant behaviour. Patio door ventilation was therefore reviewed following the main study to assess its impact on natural ventilation performance. Results indicate a significant influence on overheating outcomes and warrant further evaluation (refer to Patio Door Modelling sensitivity review, **Appendix K: Detailed Overheating Analysis Results, p. 17).**

OPENABLE WINDOW CONSIDERATIONS



Rendering showing fully openable windows in the bedrooms and living rooms

KEY TAKEAWAYS

- Fully openable windows and nighttime ventilation materially reduced overheating risk across all archetypes evaluated.
- Ventilation effectiveness will vary based on occupant operation, building layout, and external conditions including smoke and noise.
- Thermal resilience strategies should include openable windows in all primary occupied spaces to support passive ventilation during prolonged heat events.

4 Results and Discussion

4.6 MARKET AVAILABILITY AND READINESS

The passive measures evaluated in this study are generally available within the current construction market, including openable windows, shading systems, and glazing configurations. Exterior shading systems remain less common in typical residential construction and represent an emerging market condition.

Market readiness, not availability, constrains implementation.

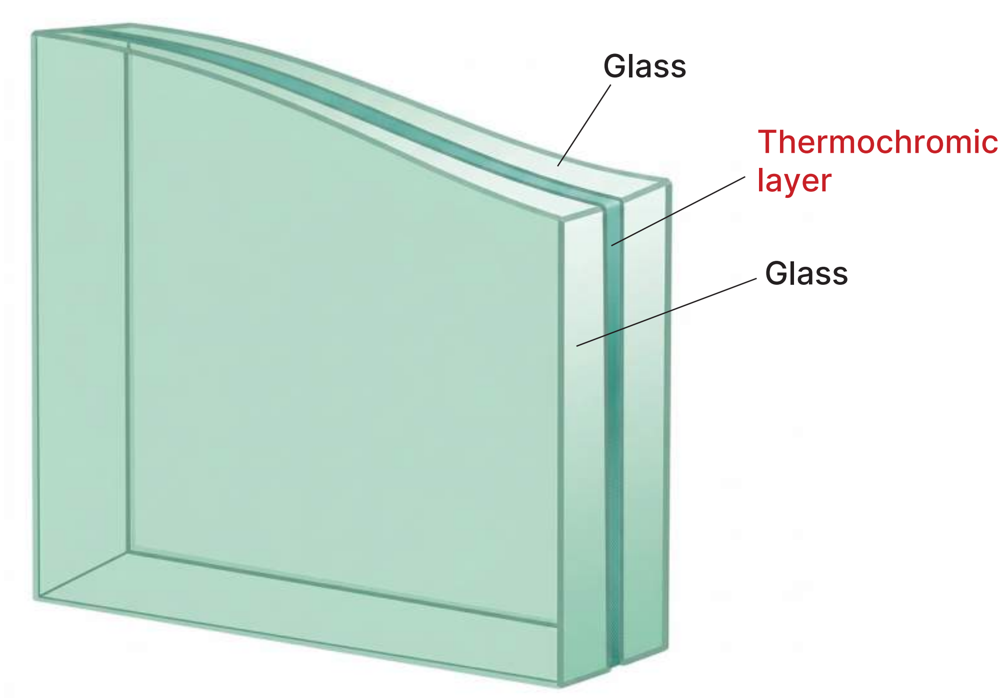
Cost impact varies by measure and is generally limited relative to overall project cost (refer to Section 4.7). Adoption is influenced by capital cost, financing conditions, and perceived delivery risk.

Industry feedback indicates that project viability is increasingly constrained by cost escalation, financing conditions, and regulatory complexity. Implementation of additional performance requirements, including those identified in the TRiM study, must be considered alongside overall project feasibility.

Design decisions are driven by project viability and constructability. Measures that introduce additional cost, coordination, or perceived risk are less likely to be implemented, regardless of performance benefit.

KEY TAKEAWAYS

- Most passive overheating mitigation measures evaluated in the study are already available within current construction practice.
- Implementation of passive measures is influenced more by project cost, coordination, and delivery considerations than by availability of the measures themselves.



Thermochromic layer becomes darker as the layer heats up from solar energy, the darker it becomes, the more solar heat gains are reduced.

Figure 18. Simple thermochromic window build up

EMERGING TECHNOLOGY NOTE – THERMOCHROMIC GLAZING

Thermochromic glazing was identified during industry consultation as an emerging façade technology that may provide passive solar heat gain reduction. The technology uses a photo-thermochromic interlayer laminated within the glazing unit that darkens in response to solar radiation and temperature and returns to a clearer state under lower solar loads.

The system operates passively and does not require electrical power, wiring, or controls. Thermochromic glazing may reduce solar heat gain during peak summer conditions without requiring active systems.

Industry input indicates the technology can be incorporated into conventional insulated glazing units (IGUs), including laminated double- or triple-pane assemblies suitable for high-rise applications and compatible with typical vinyl or aluminum window framing systems.

Thermochromic glazing was not included in the modelling analysis undertaken in the TRiM study, and cost, durability, and performance data remain limited relative to other façade strategies considered in this report.

4 Results and Discussion

4.7 COST AND IMPLEMENTATION CONSTRAINTS

Implementation of passive strategies is driven by cost, constructability, and integration within typical project delivery.

Overheating risk, particularly in terms of cumulative exposure and health impact, is not yet a primary design driver in typical project delivery and is not consistently required within current regulatory frameworks.

Cost impact varies by measure (refer to Section 3.5). Façade cost changes were contextualized at the total project level using benchmark cost distributions (refer to Section 3.5.1). Reduced window-to-wall ratio results in small façade cost savings (–0.3% to –2.3%) with negligible impact on total project cost. Lower SHGC glazing results in minimal façade cost increases (0.3% to 0.5%), offset by reduced glazing area.

External shading devices increase façade costs (10% to 36%), depending on exposure and glazing ratios, with controlled impacts on total project cost. Electrochromic glazing results in the highest cost increases (53% to 104%) due to higher unit costs and additional system requirements.

Measures affecting façade design, solar control, or glazing specification require early integration and are less likely to be adopted where they introduce additional cost, complexity, or perceived risk.

Several passive strategies have negligible impact on total project cost, yet adoption remains inconsistent. This reflects a gap between technical feasibility and current design drivers with project delivery. Industry feedback indicates that cost pressures, financing conditions, and the layering of requirements affect project viability.

KEY TAKEAWAYS

- Reduced glazing area, lower SHGC glazing, and openable windows had minimal impact on total project cost.
- External shading and electrochromic glazing introduced higher cost and delivery complexity.

4 Results and Discussion

4.8 UNCERTAINTY AND SYSTEM IMPLICATIONS

Results depend on modelling assumptions, including openable windows and occupant behaviour. Compound conditions (e.g., smoke events, outages) were not part of the study and performance will vary where these conditions are present.

Ventilation performance depends on building configuration, window availability, and occupant use, introducing variability between modelled and actual conditions.

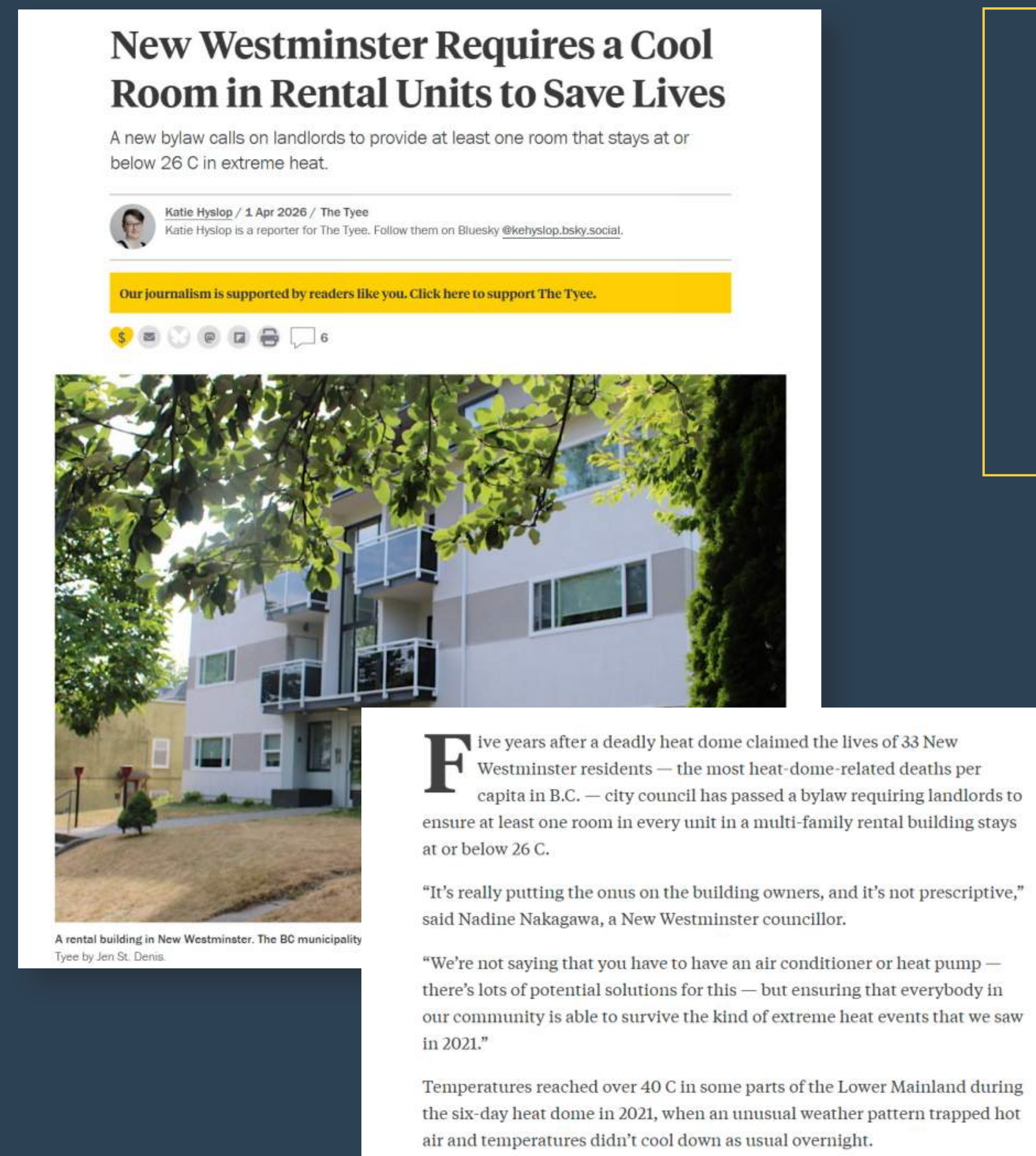
Passive strategies demonstrate a substantial reduction in overheating risk, transforming conditions from near-continuous summer exposure under baseline conditions to limited periods of elevated risk under extreme heat scenarios. While some residual overheating may occur during peak events, this is significantly reduced in both duration and severity. In some cases, results approach defined health risk thresholds, indicating that targeted additional measure, short of full mechanical cooling, may be sufficient to achieve acceptable performance in certain scenarios.

Passive measures address the primary drivers of overheating, with mechanical systems supporting residual and peak conditions.

If overheating is not addressed at the design stage, retrofit becomes more complex and costly. Early integration of passive strategies during concept and schematic design reduces long-term risk and improves performance while reducing operating costs under future conditions.

EMERGING REGULATORY CONTEXT – OVERHEATING

- Regulatory focus in BC is expanding to include overheating in existing buildings
- New Westminster has introduced maximum indoor temperature requirements for existing buildings
- Future obligations may apply where overheating is not addressed at design stage
- Early integration of passive strategies reduces exposure and retrofit risk



New Westminster Requires a Cool Room in Rental Units to Save Lives

A new bylaw calls on landlords to provide at least one room that stays at or below 26 C in extreme heat.

Katie Hyslop / 1 Apr 2026 / The Tyee
Katie Hyslop is a reporter for The Tyee. Follow them on Bluesky @kehyslop.bsky.social.

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A rental building in New Westminster. The BC municipality
Tyee by Jen St. Denis.

Five years after a deadly heat dome claimed the lives of 33 New Westminster residents — the most heat-dome-related deaths per capita in B.C. — city council has passed a bylaw requiring landlords to ensure at least one room in every unit in a multi-family rental building stays at or below 26 C.

"It's really putting the onus on the building owners, and it's not prescriptive," said Nadine Nakagawa, a New Westminster councillor.

"We're not saying that you have to have an air conditioner or heat pump — there's lots of potential solutions for this — but ensuring that everybody in our community is able to survive the kind of extreme heat events that we saw in 2021."

Temperatures reached over 40 C in some parts of the Lower Mainland during the six-day heat dome in 2021, when an unusual weather pattern trapped hot air and temperatures didn't cool down as usual overnight.

KEY TAKEAWAYS

- Passive strategies alone may not fully address overheating risk under all extreme heat scenarios.
- Residual overheating risk may still require targeted mechanical cooling in some conditions.
- Delayed action increases future retrofit complexity, cost, and regulatory risk.

Reference

New Westminster Requires a Cool Room in Rental Units to Save Lives — The Tyee, April 1, 2026

4 Results and Discussion

4.9 RECOMMENDED FURTHER STUDY

The study establishes a framework for evaluating overheating risk and passive mitigation strategies in multi-unit residential buildings.

Further work is required to support implementation in design, delivery, and regulatory contexts:

Technical Development

- Design guidance for integrating passive strategies within typical MURB delivery
- Refinement of modelling approaches, including requirement for multi-zone thermal models, and review of occupant interaction and behaviour
- Development of modelling post-processing tools for wider and consistent industry use of NRC overheating health risk framework
- Development and broader access to climate datasets representing prolonged heat events and Urban Heat Island (UHI) conditions

Implementation and validation

- Pilot projects to test passive strategies in real-world developments
- Monitoring of completed buildings to assess ventilation performance, occupant behaviour, and indoor conditions
- Design occupant guidance for window operation and shading
- Implementation of the NRC Overheating Risk Framework (DUR/SETH/INT) for overheating assessment

System-level considerations

- Analysis of integrated passive and mechanical system performance, including constrained ventilation scenarios, to quantify impacts on overheating risk and system demand
- Review of openable window design, including opening area and restrictors
- Assessment of retrofit pathways for existing buildings
- Review of regulatory approaches supporting implementation of the NRC Overheating Risk Framework
- Assessment of how cost, financing, and delivery conditions influence adoption, including cumulative impacts on project viability, housing delivery, and affordability (e.g. energy, carbon, overheating, seismic)
- Assessment of the impact of passive design strategies on unit design, marketability, and project economics (e.g. window-to-wall ratio and façade design)
- Evaluation of how requirements can be coordinated to support feasible implementation within current market conditions

If overheating is not addressed at the design stage, retrofit becomes more complex and costly. Early integration of passive strategies reduces long-term risk and improves performance under both current and future conditions.

KEY TAKEAWAYS

- Develop design guidance, modelling approaches, and representative climate datasets to support implementation.
- Transition to health-based overheating assessment using the NRC overheating risk framework (DUR / SETH / INT).
- Validate ventilation performance and occupant behaviour.
- Integrate passive strategies early in design to reduce retrofit complexity and long-term risk.
- Coordinate overheating requirements with broader sustainability regulations to support project viability, cost, and housing delivery.

5 Final Recommendations

5.0 SUMMARY OF KEY TAKEAWAYS

The TRiM study demonstrates that passive design strategies can substantially reduce overheating risk in new multi-unit residential buildings. However, achieving long-term thermal resilience will require improved health-based assessment methods, more representative climate modelling, practical implementation guidance, and coordinated policy development.

OVERHEATING RISK

- Overheating risk is driven by sustained exposure and limited nighttime recovery, rather than peak temperature.
- Overheating risk represents a physiological health concern associated with cumulative heat exposure to MURB residents.
- Overheating risk is not limited to extreme heat events and can occur during prolonged periods of elevated temperatures.

OVERHEATING METRICS

- To better represent occupant health risk during prolonged heat events, the study recommends transitioning from reliance on comfort-based overheating-hour metrics towards use of the NRC Overheating Risk Framework (DUR/SETH/INT), which better captures cumulative physiological exposure, nighttime recovery, and heat-health risk.

CLIMATE MODELLING CONSIDERATIONS

- Standard climate files and typical modelling workflows underestimate overheating risk during prolonged heat events and Urban Heat Island (UHI) conditions.
- Extreme heat and UHI conditions materially increased cumulative overheating exposure and reduced ability for nighttime recovery across all archetypes.
- Evaluation of thermal resilience should include extreme heat event and UHI scenarios in addition to typical weather-year analysis.

PASSIVE DESIGN FINDINGS

- Passive design bundles substantially reduce overheating hours by approximately 80-86% under the extreme heat scenario.
- NRC Overheating Risk Analysis showed substantial reductions in overheating duration (DUR) and cumulative severity (SETH), indicating materially lower prolonged heat exposure for residents.
- Multiple passive design pathways evaluated in the study achieved comparable reductions in overheating risk across archetypes.
- Risk Reduction to overheating was primarily driven by solar heat gain reduction and improved passive ventilation effectiveness.
- While passive strategies substantially improved thermal resilience, additional targeted measures may still be required under the most extreme future heat scenarios.

NATURAL VENTILATION CONSIDERATIONS

- Fully openable windows and nighttime ventilation materially reduced overheating risk across all archetypes evaluated.
- Ventilation effectiveness will vary based on occupant operation, building layout, and external conditions including smoke and noise.
- Thermal resilience strategies should include openable windows in all primary occupied spaces to support passive ventilation during prolonged heat events.

COST AND IMPLEMENTATION CONSTRAINTS

- Reduced glazing area, lower SHGC glazing, and openable windows had minimal impact on total project cost.
- External shading and electrochromic glazing introduced higher cost and delivery complexity.

MARKET AVAILABILITY AND READINESS

- Most passive overheating mitigation measures evaluated in the study are already available within current construction practice.
- Implementation of passive measures is influenced more by project cost, coordination, and delivery considerations than by availability of the measures themselves.

UNCERTAINTY AND SYSTEM IMPLICATIONS

- Passive strategies alone may not fully address overheating risk under all extreme heat scenarios.
- Residual overheating risk may still require targeted mechanical cooling in some conditions.
- Delayed action increases future retrofit complexity, cost, and regulatory risk.

RECOMMENDED FURTHER STUDY

- Develop design guidance, modelling approaches, and representative climate datasets to support implementation.
- Transition to health-based overheating assessment using the NRC overheating risk framework (DUR / SETH / INT).
- Validate ventilation performance and occupant behaviour.
- Integrate passive strategies early in design to reduce retrofit complexity and long-term risk.
- Coordinate overheating requirements with broader sustainability regulations to support project viability, cost, and housing delivery.

RECOMMENDED ACTIONS

ASSESSMENT

- Adopt the NRC physiological overheating framework (DUR/SETH/INT) as the primary methodology for evaluating overheating risk in new residential buildings.

MODELLING

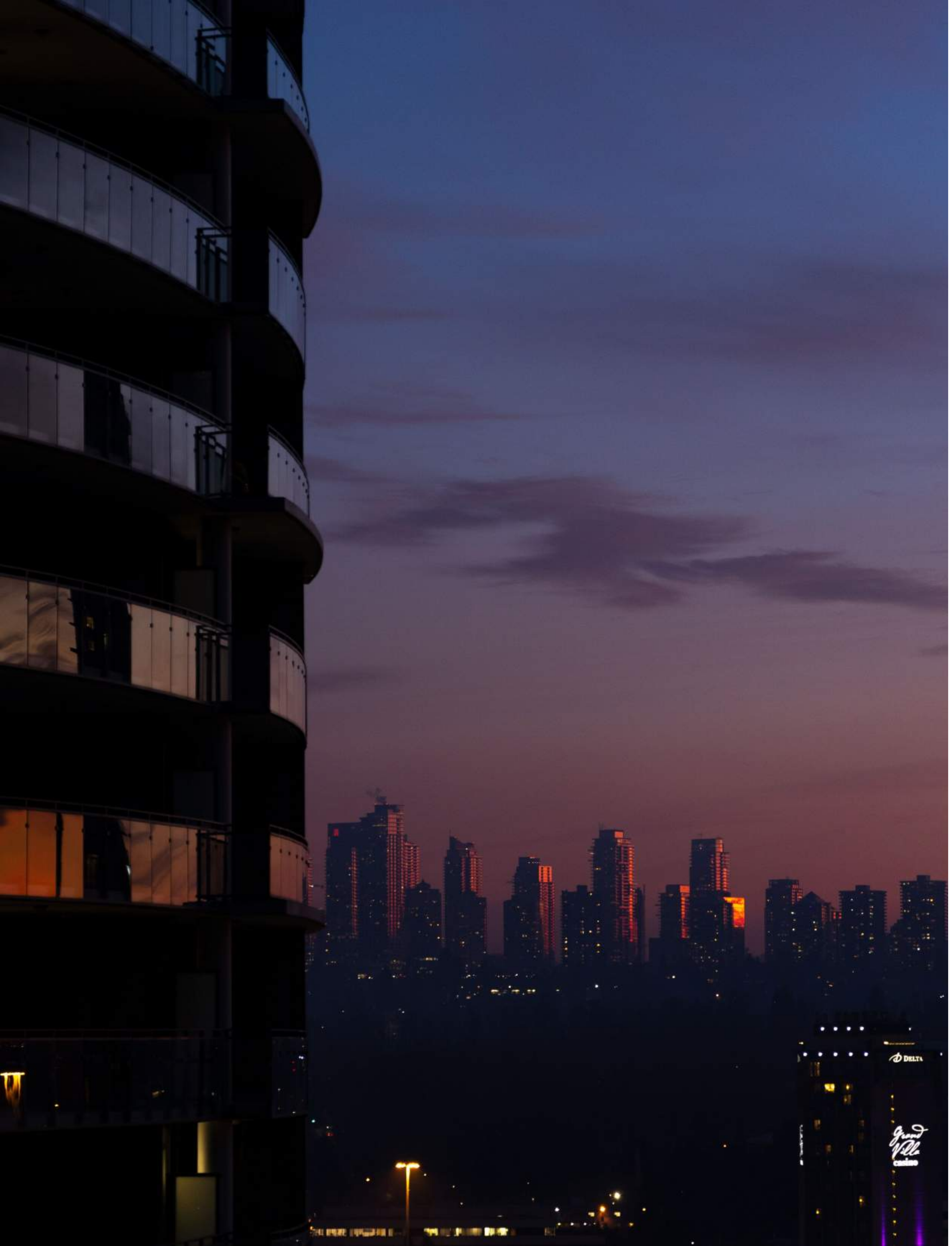
- Update overheating modelling approaches to better represent natural ventilation, occupant behaviour, prolonged heat events, and Urban Heat Island (UHI) conditions using representative future climate datasets.

DESIGN & IMPLEMENTATION

- Develop practical design guidance, modelling tools, and implementation resources to support wider adoption of passive overheating mitigation strategies.

POLICY

- Implement future overheating requirements through coordinated policy updates that balance thermal resilience with construction cost, market readiness, and housing delivery.



APPENDICES

Results and Supporting Analysis

Supporting Appendices

Appendices

APPENDIX A — SUMMARY OF OVERHEATING, ENERGY, AND COST BY ARCHETYPE AND BUNDLE

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

This appendix presents summary results of the overheating evaluation, energy performance, and incremental cost for each archetype baseline and associated passive bundle scenarios.

Overheating Evaluation

Overall, overheating risk is substantially reduced across all passive bundle scenarios compared to the baseline. With the NRC overheating risk assessment framework, the number of overheating and health risk events along does not represent performance as it does not capture duration or cumulative exposure. The indicators - duration (DUR), severity (SETH), and intensity (INT) - provide a complete representation of each event.

Across all passive bundles, health risk events are shorter and significantly less severe, with values in most cases approaching the health risk thresholds. These results indicate that overheating risk is largely mitigated through passive measures, with only limited residual risk remaining.

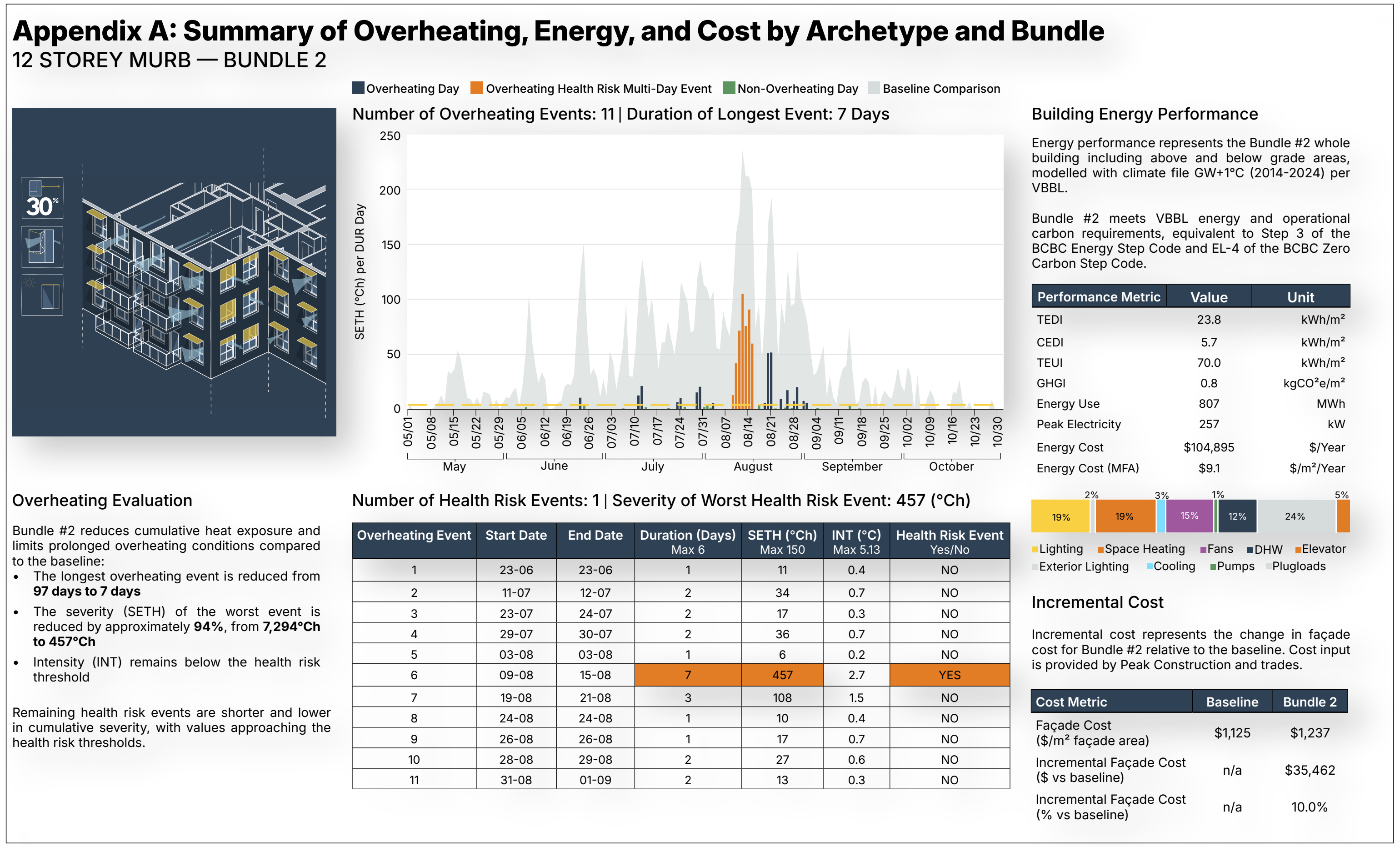
Energy Performance

All studied scenarios meet VBBL energy and operational carbon requirements for the selected compliance pathway (refer to Section 3.4 - VBBL Energy Performance Metrics), equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Incremental Cost

Incremental costs represent the change in construction relative to the TRiM baseline enclosure. Values are Class D estimates based on indicative trade input, and reflect intended for comparative analysis only. Costs exclude soft costs, lifecycle impacts, and financing considerations.

Further interpretation and discussion of these results are provided in Section 4 - Results and Discussion.



Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

12 STOREY MURB — BUNDLE 2

Overheating Day | Overheating Health Risk Multi-Day Event | Non-Overheating Day | Baseline Comparison

Number of Overheating Events: 11 | Duration of Longest Event: 7 Days

Overheating Evaluation

Bundle #2 reduces cumulative heat exposure and limits prolonged overheating conditions compared to the baseline:

- The longest overheating event is reduced from **97 days to 7 days**
- The severity (SETH) of the worst event is reduced by approximately **94%**, from **7,294°Ch to 457°Ch**
- Intensity (INT) remains below the health risk threshold

Remaining health risk events are shorter and lower in cumulative severity, with values approaching the health risk thresholds.

Number of Health Risk Events: 1 | Severity of Worst Health Risk Event: 457 (°Ch)

Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	23-06	23-06	1	11	0.4	NO
2	11-07	12-07	2	34	0.7	NO
3	23-07	24-07	2	17	0.3	NO
4	29-07	30-07	2	36	0.7	NO
5	03-08	03-08	1	6	0.2	NO
6	09-08	15-08	7	457	2.7	YES
7	19-08	21-08	3	108	1.5	NO
8	24-08	24-08	1	10	0.4	NO
9	26-08	26-08	1	17	0.7	NO
10	28-08	29-08	2	27	0.6	NO
11	31-08	01-09	2	13	0.3	NO

Building Energy Performance

Energy performance represents the Bundle #2 whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

Bundle #2 meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	23.8	kWh/m²
CEDI	5.7	kWh/m²
TEUI	70.0	kWh/m²
GHGI	0.8	kgCO²e/m²
Energy Use	807	MWh
Peak Electricity	257	kW
Energy Cost	$104,895	$/Year
Energy Cost (MFA)	$9.1	$/m²/Year

Incremental Cost

Incremental cost represents the change in façade cost for Bundle #2 relative to the baseline. Cost input is provided by Peak Construction and trades.

Cost Metric	Baseline	Bundle 2
Façade Cost ($/m² façade area)	$1,125	$1,237
Incremental Façade Cost ($ vs baseline)	n/a	$35,462
Incremental Façade Cost (% vs baseline)	n/a	10.0%

Detailed results for suites in each building are included for reference in ***Appendix K: Detailed Overheating Analysis Results***

BUILDING ENERGY PERFORMANCE

Building energy performance is modelled per VBBL using GW+1°C, to verify impact on building energy performance and compliance.

- **Cooling Energy Demand Intensity (CEDI)** - Annual building cooling load, as kWh/m²
- **Thermal Energy Demand Intensity (TEDI)** - Annual envelope and ventilation heating load, as kWh/m². Reported TEDI includes corridor pressurisation adjustment
- **Greenhouse Gas Intensity (GHGI)** - Building operational carbon emissions, as kgCO_2e/m²
- **Energy Consumption** - Including full building above and below grade consumption, as MWh and as TEUI. Reported TEUI excludes corridor pressurisation adjustment
- **Peak Electricty** - Modelled annual peak, annual electrical peak, as kW
- **Energy Cost** - Reported as $/Year and $/m²/Year, per MFA (Modelled Floor Area)

INCREMENTAL COST

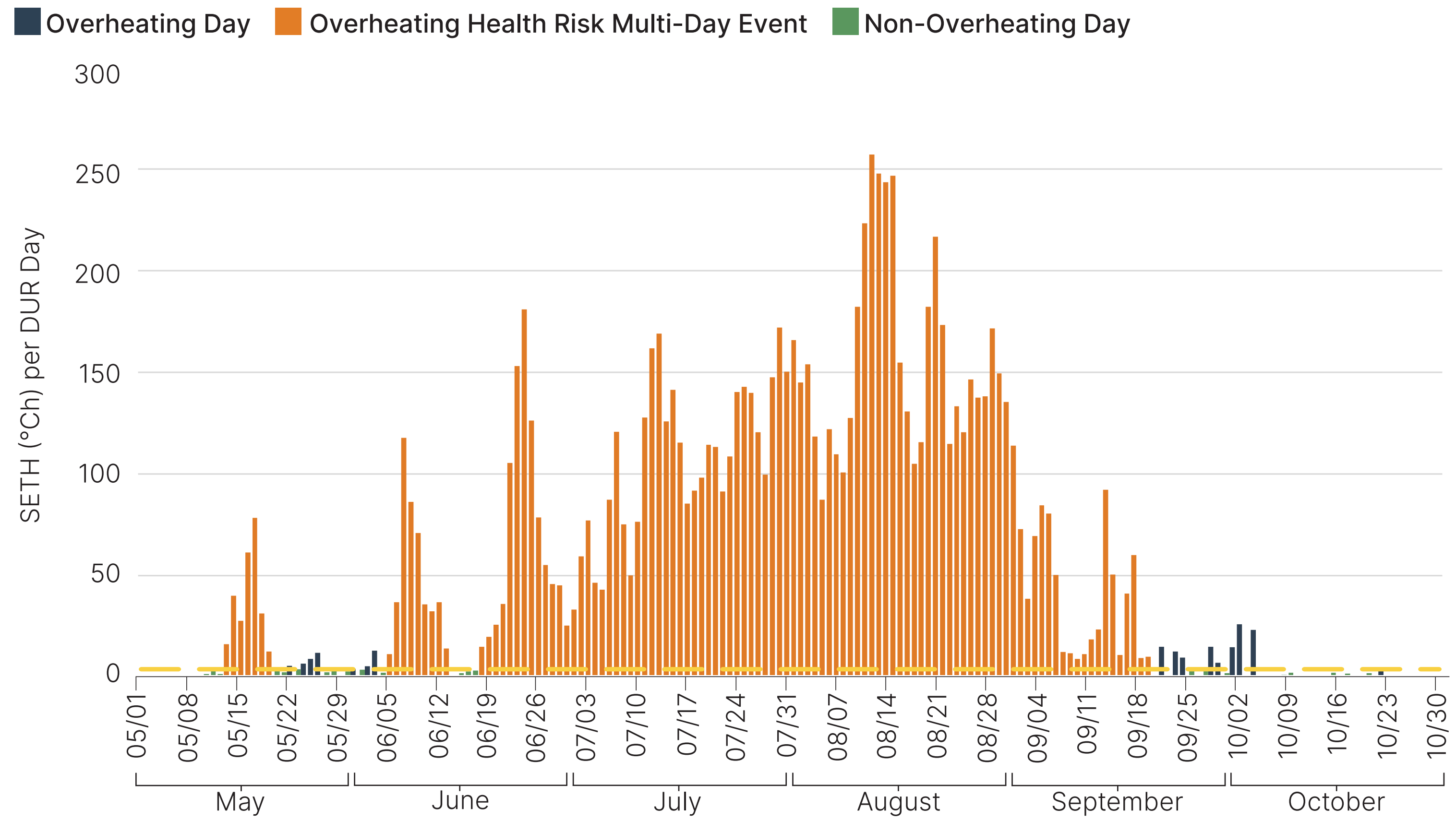
- **Façade Cost ($/m²)** - Unit facade cost
- **Incremental Façade Cost ($ vs baseline)**. Absolute difference of façade cost between the bundle and the baseline.
- **Incremental Façade Cost (% vs baseline).** Percentage difference in façade cost relative to the baseline.

OVERHEATING EVALUATION

- Overheating results are presented for the worst-case orientation for each archetype, as identified in the baseline scenario. The same suite and orientation are used consistently for comparison across all passive bundle scenarios.
- All overheating results are based on the Extreme Weather File (EWF) + Urban Heat Island (UHI) scenario (**refer to Section 2.10.1 – Climate File Selectio**n). Results for all orientations are included in **Appendix K: Detailed Overheating Analysis Results**.
- Results include the number of overheating events and those exceeding the threshold for classification as a health risk event.
- For each overheating event, the NRC indicators DUR (Duration), SETH (Severity), and INT (Intensity) are reported. Events that exceed health risk thresholds are highlighted in orange.

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

6 STOREY MURB — BASELINE



Number of Overheating Events: 13 | Duration of Longest Health Risk Event: 95 Days

Number of Health Risk Events: 3 | Severity of Worst Health Risk Event: 9,968 (°Ch)

Overheating Evaluation

The overheating evaluation presents results for a west-facing two-bedroom suite representing the worst-case orientation.

The baseline shows the following:

- 13 overheating events
- 3 health risk events
- The longest overheating health risk event has a duration (DUR) of 95 days
- The most severe health risk event (SETH) is 9,968°Ch
- The intensity (INT) of the worst health risk event is 4.4°C

The results show a continuous overheating health risk event spanning the majority of the summer period.

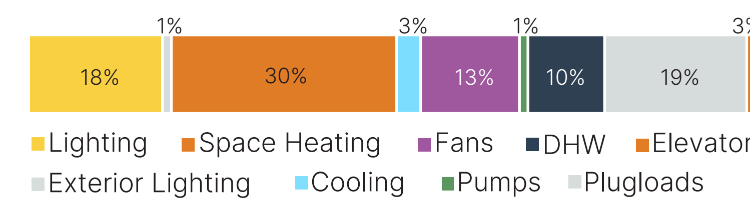
Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	13-05	19-05	7	268	1.6	YES
2	22-05	22-05	1	6	0.2	NO
3	24-05	26-05	3	28	0.4	NO
4	31-05	31-05	1	4	0.2	NO
5	02-06	03-06	2	18	0.4	NO
6	05-06	13-06	9	442	2.0	YES
7	18-06	20-09	95	9968	4.4	YES
8	22-09	22-09	1	15	0.6	NO
9	24-09	25-09	2	22	0.5	NO
10	29-09	30-09	2	22	0.5	NO
11	02-10	03-10	2	41	0.8	NO
12	05-10	05-10	1	23	1.0	NO
13	23-10	23-10	1	5	0.2	NO

Building Energy Performance

Energy performance represents the baseline whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

The baseline meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	20.2	kWh/m²
CEDI	12.3	kWh/m²
TEUI	82.4	kWh/m²
GHGI	0.9	kgCO²e/m²
Energy Use	929	MWh
Peak Electricity	432	kW
Energy Cost	$120,796	$/Year
Energy Cost (MFA)	$10.7	$/m²/Year



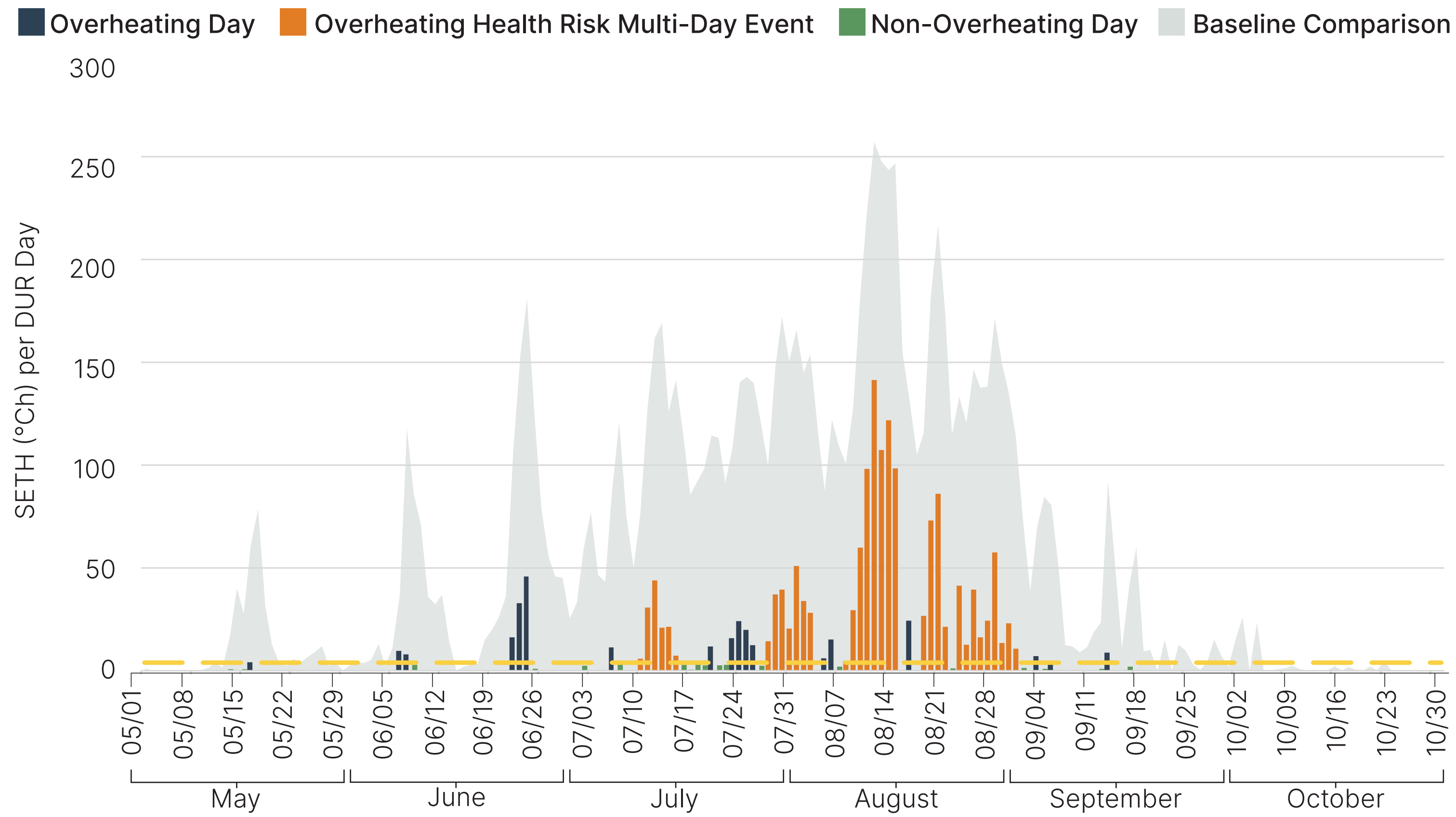
Incremental Cost

The incremental cost represents the baseline residential floors. Cost is provided by Peak Construction and trades.

Cost Metric	Baseline
Façade Cost ($/m² façade area)	$461
Incremental Façade Cost ($ vs baseline)	n/a
Incremental Façade Cost (% vs baseline)	n/a

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

6 STOREY MURB — BUNDLE 1



Number of Overheating Events: 16 | Duration of Longest Health Risk Event: 9 Days
Number of Health Risk Events: 5 | Severity of Worst Health Risk Event: 661 (°Ch)

Overheating Evaluation

Bundle #1 reduces cumulative heat exposure and limits prolonged overheating conditions compared to the baseline:

- The longest overheating health risk event is reduced from **95 days to 9 days**
- The severity (SETH) of the worst health risk event is reduced by approximately **93%**, from **9,968°Ch to 661°Ch**
- Intensity (INT) remains below the health risk threshold

Remaining health risk events are shorter and lower in cumulative severity, with values approaching the health risk thresholds.

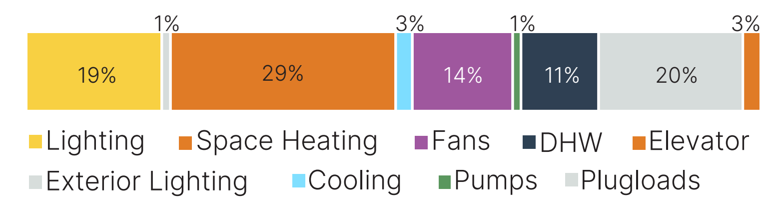
Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	16-05	16-05	1	4	0.2	NO
2	06-06	07-06	2	18	0.4	NO
3	22-06	24-06	3	95	1.3	NO
4	06-07	06-07	1	11	0.5	NO
5	10-07	15-07	6	130	0.9	YES
6	20-07	20-07	1	12	0.5	NO
7	23-07	26-07	4	72	0.8	NO
8	28-07	03-08	7	224	1.3	YES
9	05-08	06-08	2	21	0.4	NO
10	08-08	15-08	8	661	3.4	YES
11	17-08	17-08	1	24	1.0	NO
12	19-08	22-08	4	207	2.2	YES
13	24-08	01-09	9	238	1.1	YES
14	04-09	04-09	1	7	0.3	NO
15	06-09	06-09	1	5	0.2	NO
16	14-09	14-09	1	9	0.4	NO

Building Energy Performance

Energy performance represents the Bundle #1 whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

Bundle #1 meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	17.8	kWh/m²
CEDI	10.5	kWh/m²
TEUI	80.7	kWh/m²
GHGI	0.9	kgCO²e/m²
Energy Use	909	MWh
Peak Electricity	428	kW
Energy Cost	$118,165	$/Year
Energy Cost (MFA)	$10.5	$/m²/Year



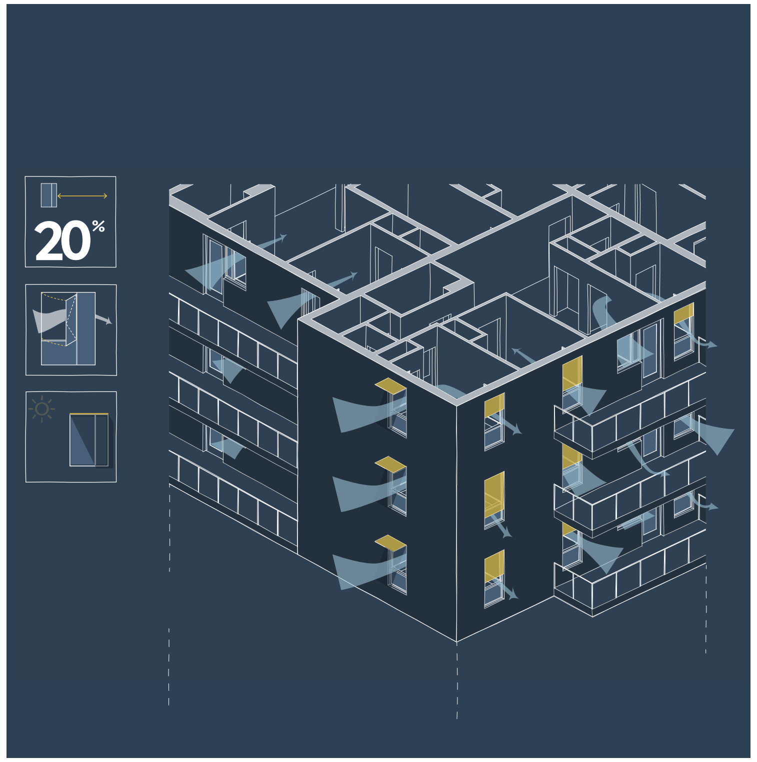
Incremental Cost

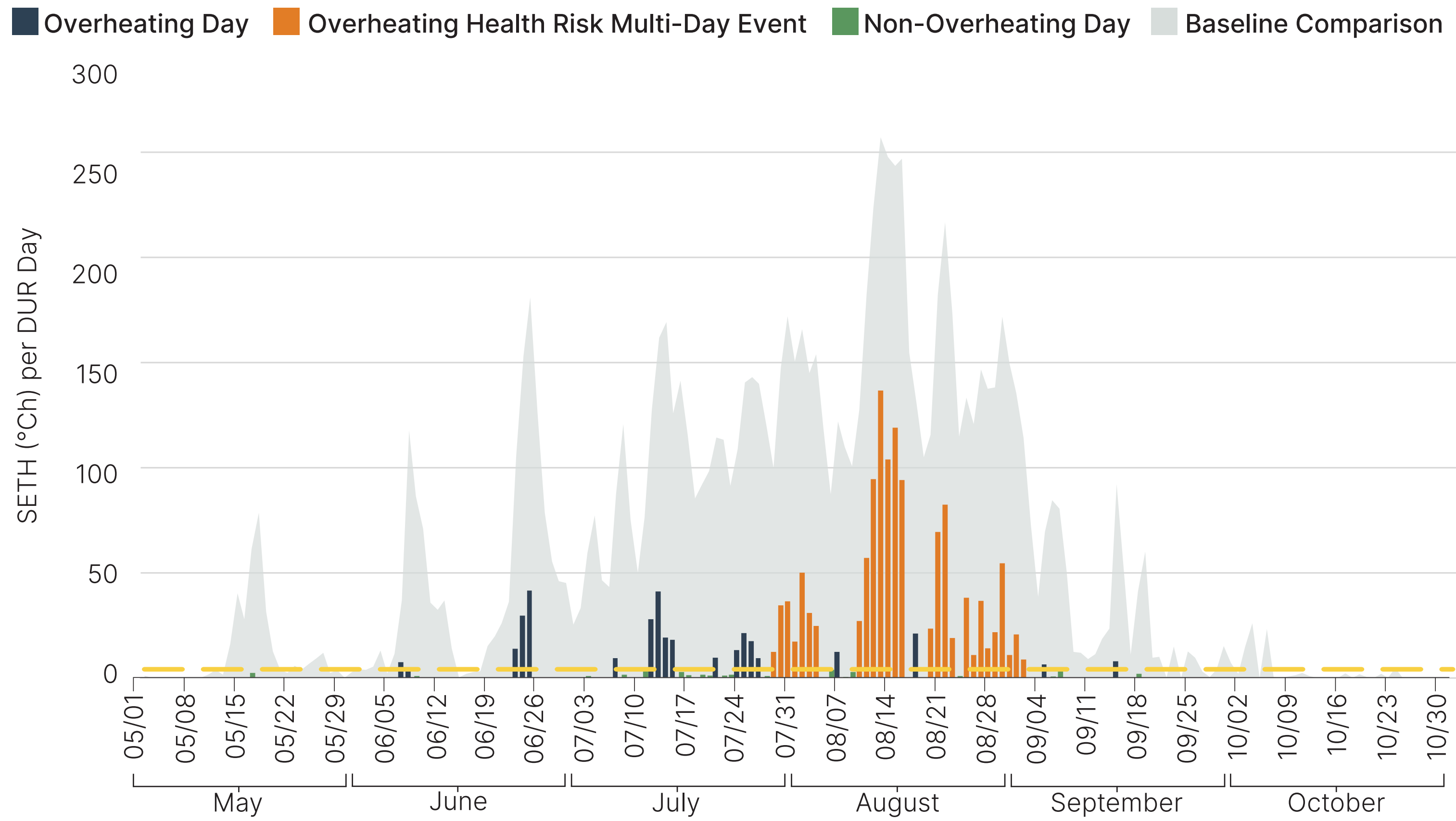
Incremental cost represents the change in façade cost for Bundle #1 relative to the baseline. Cost input is provided by Peak Construction and trades.

Cost Metric	Baseline	Bundle 1
Façade Cost ($/m² façade area)	$461	$459
Incremental Façade Cost ($ vs baseline)	N/A	-$945
Incremental Façade Cost (% vs baseline)	N/A	-0.3%

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

6 STOREY MURB — BUNDLE 2



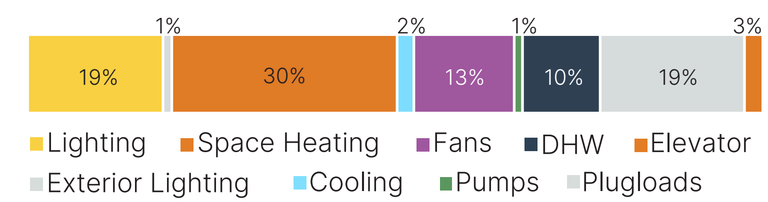


Building Energy Performance

Energy performance represents the Bundle #2 whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

Bundle #2 meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	18.9	kWh/m²
CEDI	8.2	kWh/m²
TEUI	81.2	kWh/m²
GHGI	0.9	kgCO²e/m²
Energy Use	916	MWh
Peak Electricity	257	kW
Energy Cost	$119,027	$/Year
Energy Cost (MFA)	$10.6	$/m²/Year



Number of Overheating Events: 14 | Duration of Longest Health Risk Event: 9 Days

Number of Health Risk Events: 4 | Severity of Worst Health Risk Event: 632 (°Ch)

Overheating Evaluation

Bundle #2 reduces cumulative heat exposure and limits prolonged overheating conditions compared to the baseline:

- The longest overheating health risk event is reduced from **95 days to 9 days**
- The severity (SETH) of the worst health risk event is reduced by approximately **94%,** from **9,968°Ch to 632°Ch**
- Intensity (INT) remains below the health risk threshold

Remaining health risk events are shorter and lower in cumulative severity, with values approaching the health risk thresholds.

Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	06-06	07-06	2	12	0.2	NO
2	22-06	24-06	3	85	1.2	NO
3	06-07	06-07	1	9	0.4	NO
4	11-07	14-07	4	106	1.1	NO
5	20-07	20-07	1	10	0.4	NO
6	23-07	26-07	4	61	0.6	NO
7	28-07	03-08	7	206	1.2	YES
8	06-08	06-08	1	12	0.5	NO
9	09-08	15-08	7	632	3.8	YES
10	17-08	17-08	1	21	0.9	NO
11	19-08	22-08	4	194	2.0	YES
12	24-08	01-09	9	216	1.0	YES
13	04-09	04-09	1	6	0.3	NO
14	14-09	14-09	1	8	0.3	NO

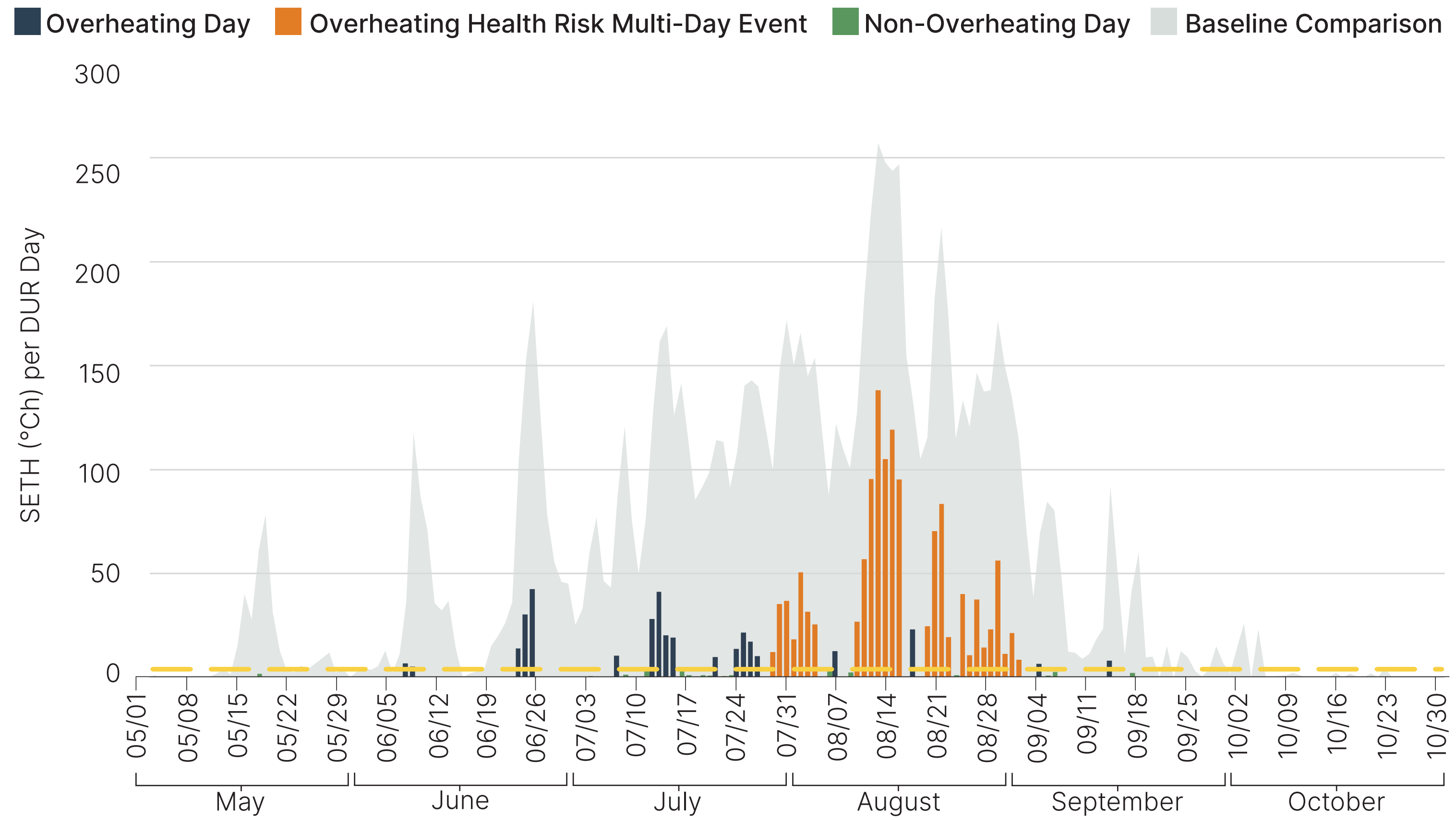
Incremental Cost

Incremental cost represents the change in façade cost for Bundle #2 relative to the baseline. Cost input is provided by Peak Construction and trades.

Cost Metric	Baseline	Bundle 2
Façade Cost ($/m² façade area)	$461	$626
Incremental Façade Cost ($ vs baseline)	N/A	$103,249
Incremental Façade Cost (% vs baseline)	N/A	35.9%

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

6 STOREY MURB — BUNDLE 3

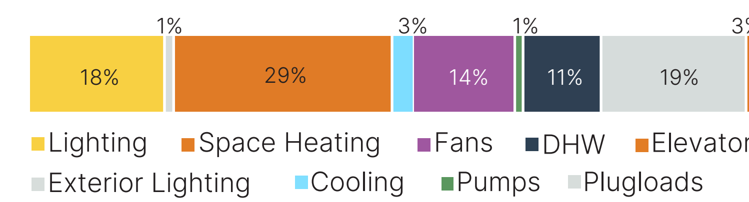


Building Energy Performance

Energy performance represents the Bundle #3 whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

Bundle #3 meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	18.0	kWh/m²
CEDI	9.0	kWh/m²
TEUI	81.0	kWh/m²
GHGI	0.9	kgCO²e/m²
Energy Use	913	MWh
Peak Electricity	427	kW
Energy Cost	$118,729	$/Year
Energy Cost (MFA)	$10.5	$/m²/Year



Number of Overheating Events: 14 | Duration of Longest Health Risk Event: 9 Days

Number of Health Risk Events: 4 | Severity of Worst Health Risk Event: 637 (°Ch)

Overheating Evaluation

Bundle #3 reduces cumulative heat exposure and limits prolonged overheating conditions compared to the baseline:

- The longest overheating health risk event is reduced from **95 days to 9 days**
- The severity (SETH) of the worst health risk event is reduced by approximately **94%**, from **9,968°Ch to 637°Ch**
- Intensity (INT) remains below the health risk threshold

Remaining health risk events are shorter and lower in cumulative severity, with values approaching the health risk thresholds.

Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	06-06	07-06	2	12	0.3	NO
2	22-06	24-06	3	87	1.2	NO
3	06-07	06-07	1	11	0.4	NO
4	11-07	14-07	4	109	1.1	NO
5	20-07	20-07	1	10	0.4	NO
6	23-07	26-07	4	63	0.7	NO
7	28-07	03-08	7	210	1.3	YES
8	06-08	06-08	1	13	0.5	NO
9	09-08	15-08	7	637	3.8	YES
10	17-08	17-08	1	23	1.0	NO
11	19-08	22-08	4	198	2.1	YES
12	24-08	01-09	9	223	1.0	YES
13	04-09	04-09	1	7	0.3	NO
14	14-09	14-09	1	8	0.3	NO

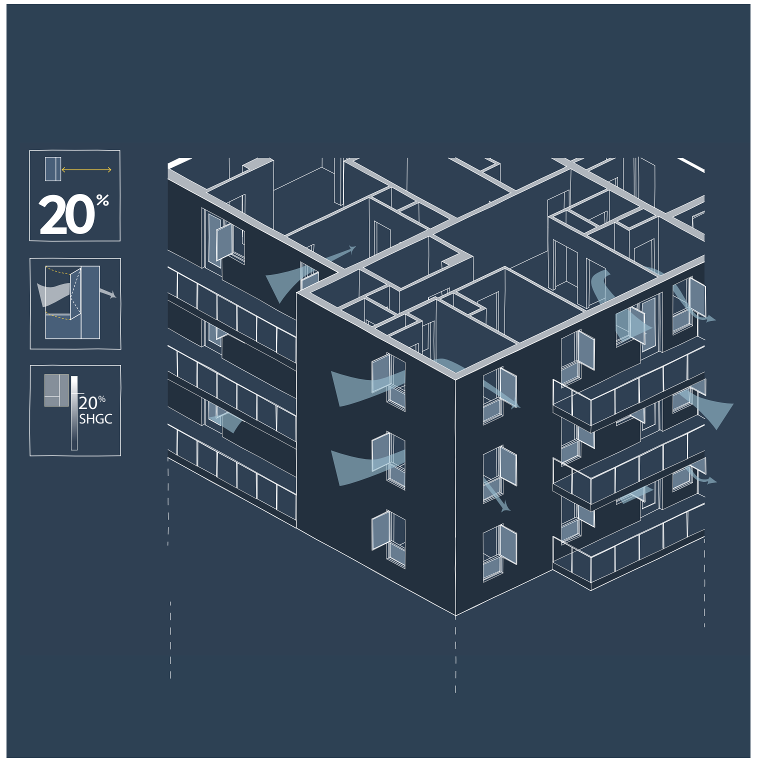
Incremental Cost

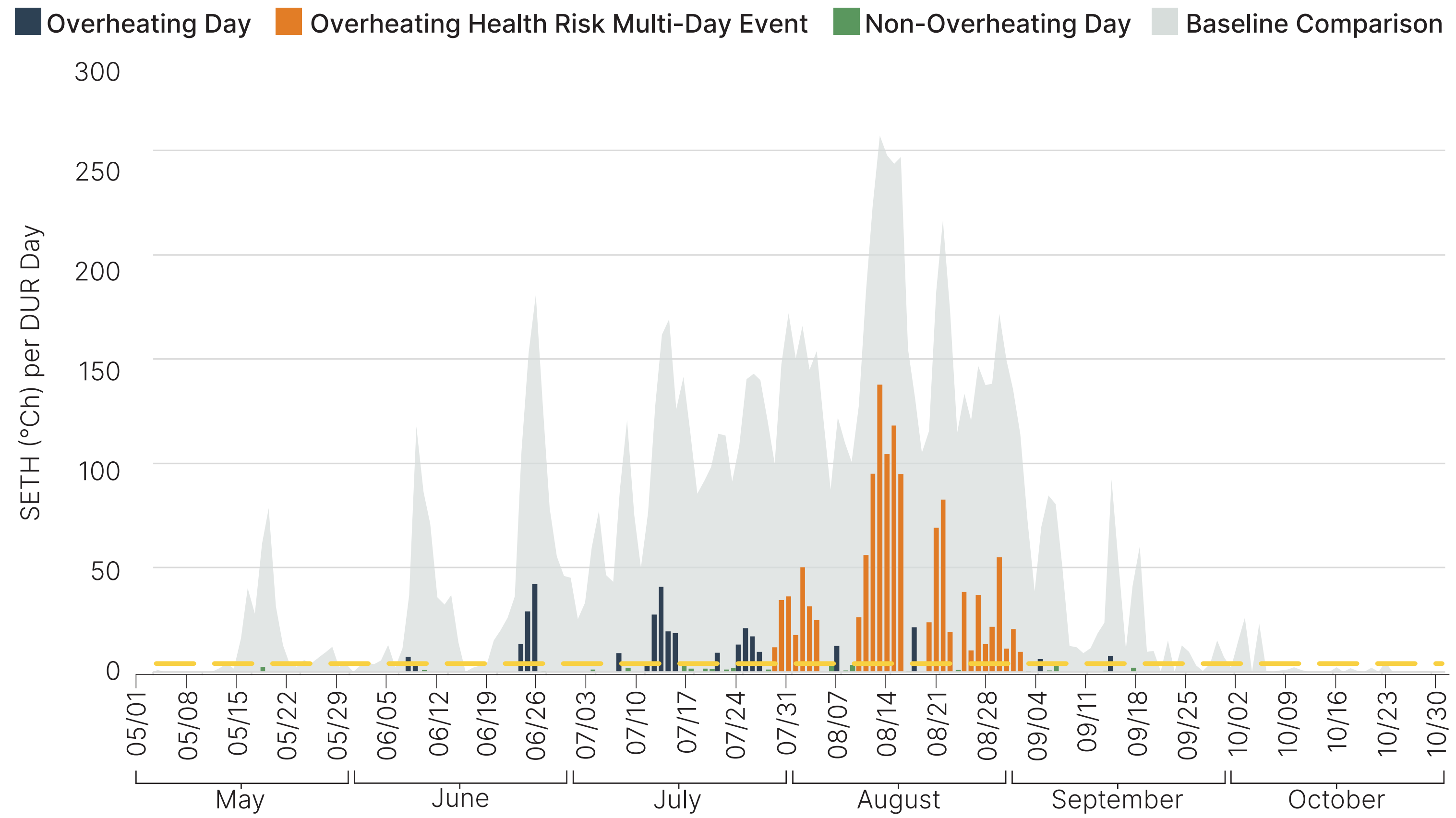
Incremental cost represents the change in façade cost for Bundle #3 relative to the baseline. Cost input is provided by Peak Construction and trades.

Cost Metric	Baseline	Bundle 3
Façade Cost ($/m² façade area)	$461	$941
Incremental Façade Cost ($ vs baseline)	N/A	$299,347
Incremental Façade Cost (% vs baseline)	N/A	104.1%

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

6 STOREY MURB — BUNDLE 4





Number of Overheating Events: 14 | Duration of Longest Health Risk Event: 9 Days

Number of Health Risk Events: 4 | Severity of Worst Health Risk Event: 632 (°Ch)

Overheating Evaluation

Bundle #4 reduces cumulative heat exposure and limits prolonged overheating conditions compared to the baseline:

- The longest overheating health risk event is reduced from **95 days to 9 days**
- The severity (SETH) of the worst health risk event is reduced by approximately **94%**, from **9,968°Ch to 632°Ch**
- Intensity (INT) remains below the health risk threshold

Remaining health risk events are shorter and lower in cumulative severity, with values approaching the health risk thresholds.

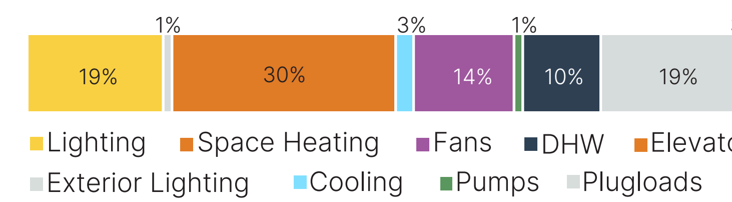
Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	06-06	07-06	2	12	0.2	NO
2	22-06	24-06	3	84	1.2	NO
3	06-07	06-07	1	9	0.4	NO
4	10-07	14-07	5	110	0.9	NO
5	20-07	20-07	1	9	0.4	NO
6	23-07	26-07	4	61	0.6	NO
7	28-07	03-08	7	206	1.2	YES
8	06-08	06-08	1	12	0.5	NO
9	09-08	15-08	7	632	3.8	YES
10	17-08	17-08	1	21	0.9	NO
11	19-08	22-08	4	195	2.0	YES
12	24-08	01-09	9	216	1.0	YES
13	04-09	04-09	1	6	0.3	NO
14	14-09	14-09	1	8	0.3	NO

Building Energy Performance

Energy performance represents the Bundle #4 whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

Bundle #4 meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	18.6	kWh/m²
CEDI	8.9	kWh/m²
TEUI	81.2	kWh/m²
GHGI	0.9	kgCO²e/m²
Energy Use	915	MWh
Peak Electricity	426	kW
Energy Cost	$118,894	$/Year
Energy Cost (MFA)	$10.5	$/m²/Year



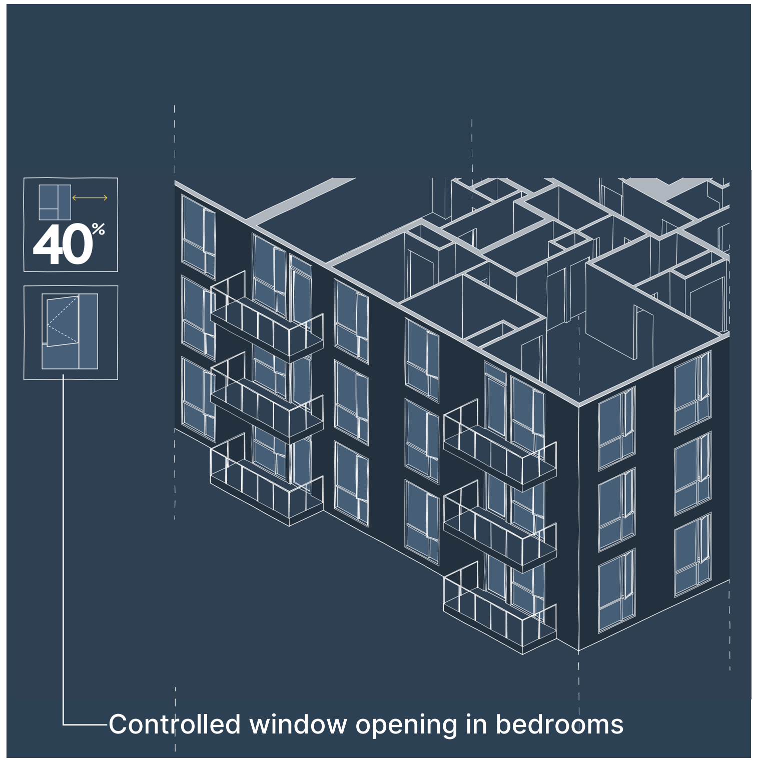
Incremental Cost

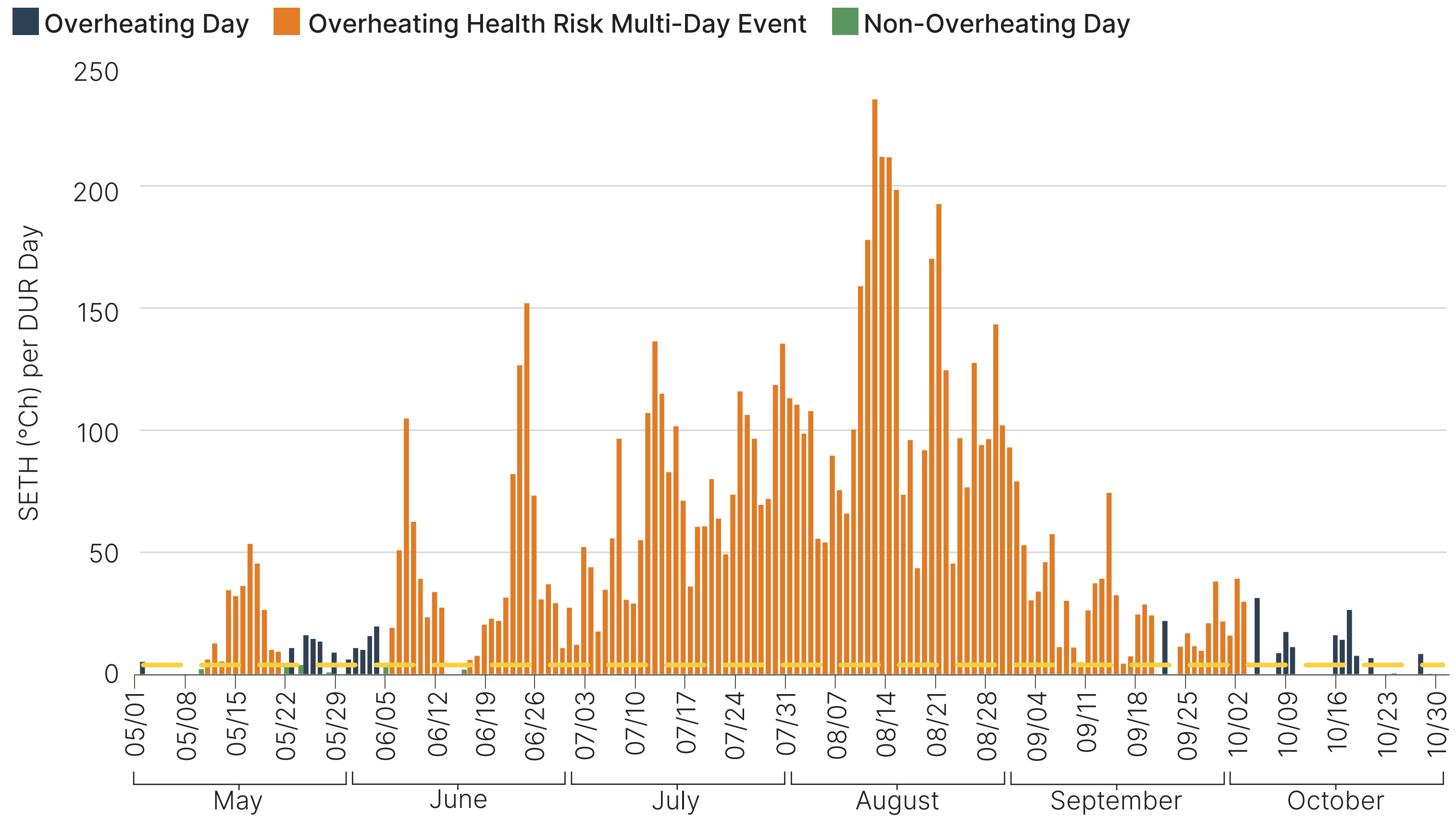
Incremental cost represents the change in façade cost for Bundle #4 relative to the baseline. Cost input is provided by Peak Construction and trades.

Cost Metric	Baseline	Bundle 4
Façade Cost ($/m² façade area)	$461	$463
Incremental Façade Cost ($ vs baseline)	N/A	$1,398
Incremental Façade Cost (% vs baseline)	N/A	0.5%

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

12 STOREY MURB — BASELINE





Number of Overheating Events: 12 | Duration of Longest Health Risk Event: 97 Days

Number of Health Risk Events: 4 | Severity of Worst Health Risk Event: 7,249 (°Ch)

Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	01-05	01-05	1	5	0.2	NO
2	10-05	20-05	11	273	1.0	YES
3	22-05	22-05	1	11	0.5	NO
4	24-05	26-05	3	44	0.6	NO
5	28-05	28-05	1	9	0.4	NO
6	30-05	03-06	5	63	0.5	NO
7	05-06	12-06	8	361	1.9	YES
8	16-06	20-09	97	7249	3.1	YES
9	22-09	22-09	1	22	0.9	NO
10	24-09	03-10	10	216	0.9	YES
11	05-10	05-10	1	31	1.3	NO
12	08-10	10-10	3	38	0.5	NO
13	16-10	19-10	4	65	0.7	NO
14	21-10	21-10	1	7	0.3	NO
15	28-10	28-10	1	9	0.4	NO

Overheating Evaluation

The overheating evaluation presents results for a southwest-facing three-bedroom suite representing the worst-case orientation.

The baseline shows the following:

- 15 overheating events
- 4 health risk events
- The longest overheating health risk event has a duration (DUR) of 97 days
- The most severe health risk event (SETH) is 7,249°Ch
- The intensity (INT) of the worst health risk event is 3.1°C, which is below the health risk threshold

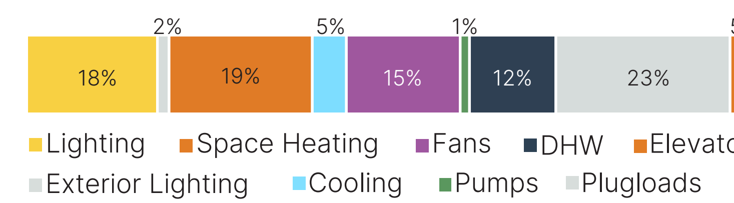
The results show a continuous overheating health risk event spanning the majority of the summer period.

Building Energy Performance

Energy performance represents the baseline whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

The baseline meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	26	kWh/m²
CEDI	15	kWh/m²
TEUI	73	kWh/m²
GHGI	0.8	kgCO²e/m²
Energy Use	840	MWh
Peak Electricity	268	kW
Energy Cost	$109,241	$/Year
Energy Cost (MFA)	$9.5	$/m²/Year



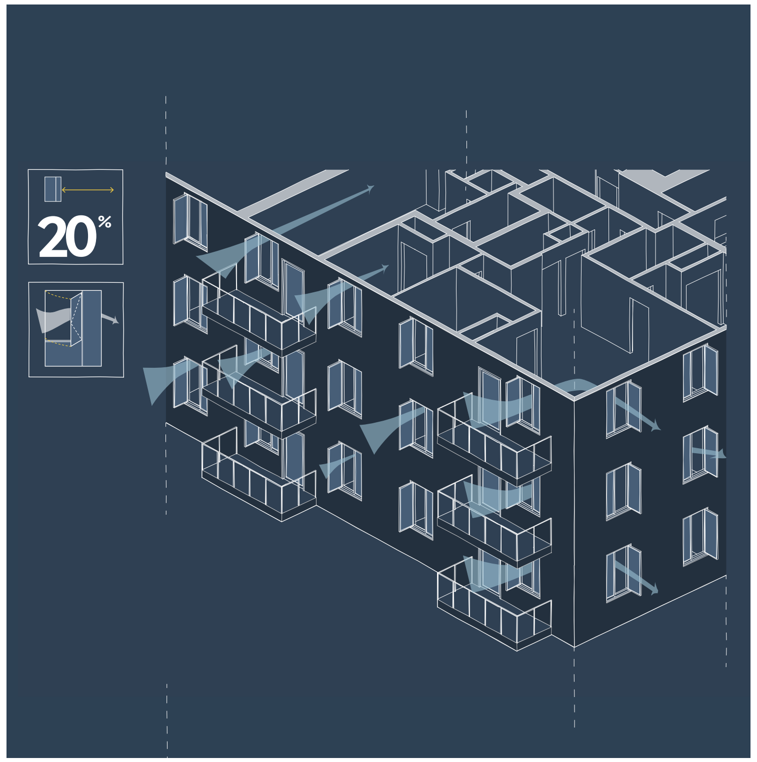
Incremental Cost

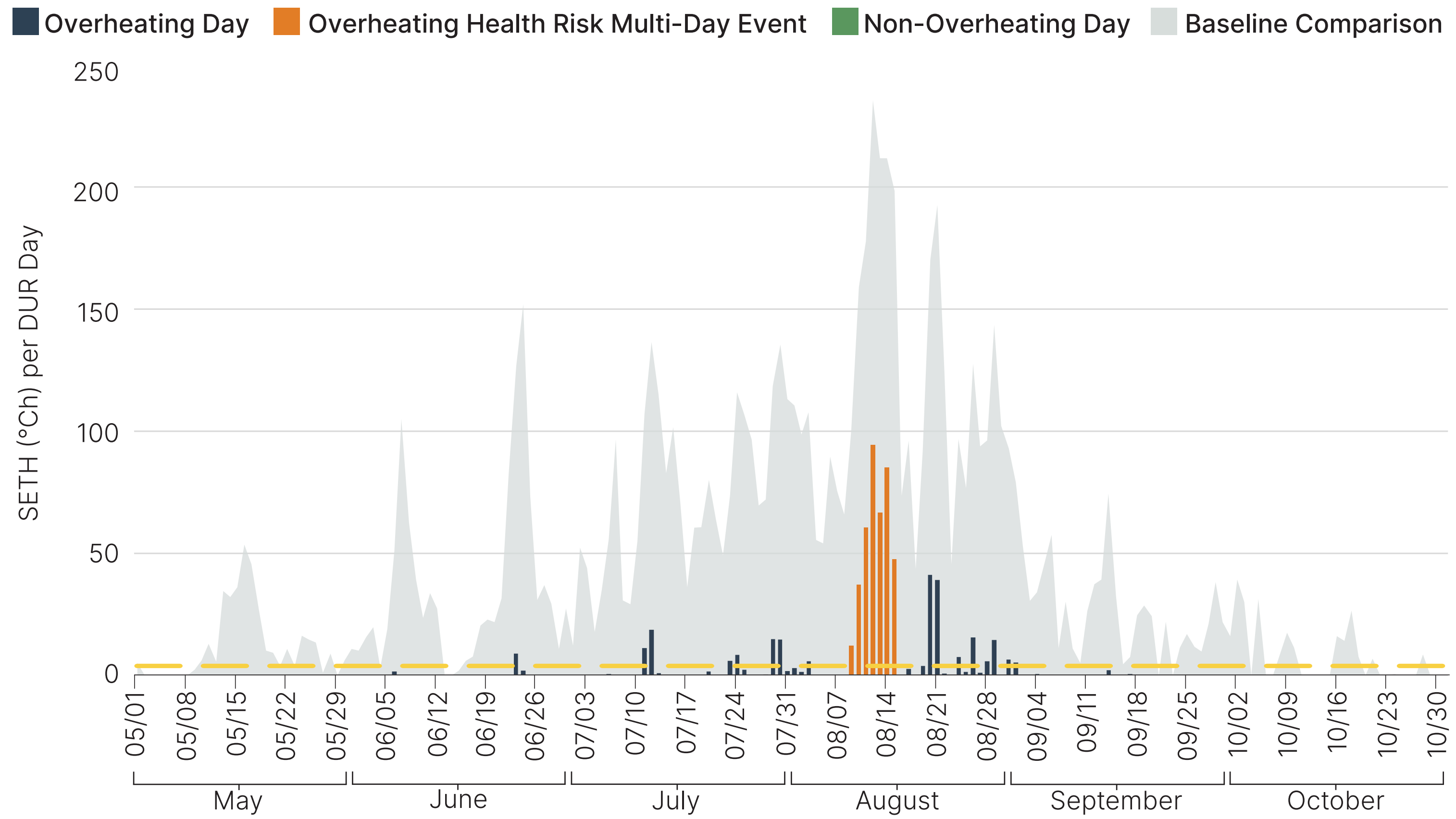
The incremental cost represents the baseline residential floors. Cost is provided by Peak Construction and trades.

Cost Metric	Baseline
Façade Cost ($/m² façade area)	$1,125
Incremental Façade Cost ($ vs baseline)	n/a
Incremental Façade Cost (% vs baseline)	n/a

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

12 STOREY MURB — BUNDLE 1





Overheating Evaluation

Bundle #1 reduces cumulative heat exposure and limits prolonged overheating conditions compared to the baseline:

- The longest overheating health risk event is reduced from **97 days to 7 days**
- The severity (SETH) of the worst health risk event is reduced by approximately **95%**, from **7,294°Ch to 403°Ch**
- Intensity (INT) remains below the health risk threshold

Remaining health risk events are shorter and lower in cumulative severity, with values approaching the health risk thresholds.

Number of Overheating Events: 11 | Duration of Longest Health Risk Event: 7 Days

Number of Health Risk Events: 1 | Severity of Worst Health Risk Event: 403 (°Ch)

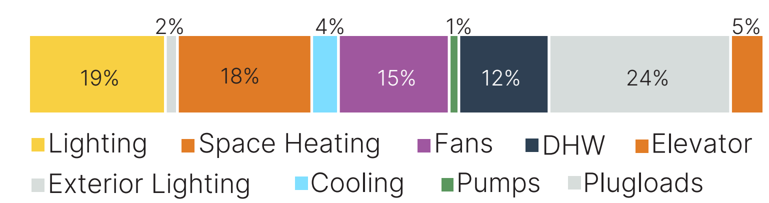
Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	23-06	23-06	1	9	0.4	NO
2	11-07	12-07	2	30	0.6	NO
3	23-07	24-07	2	14	0.3	NO
4	29-07	30-07	2	30	0.6	NO
5	03-08	03-08	1	6	0.2	NO
6	09-08	15-08	7	403	2.4	YES
7	20-08	21-08	2	80	1.7	NO
8	24-08	24-08	1	7	0.3	NO
9	26-08	26-08	1	16	0.6	NO
10	28-08	29-08	2	20	0.4	NO
11	31-08	01-09	2	12	0.2	NO

Building Energy Performance

Energy performance represents the Bundle #1 whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

Bundle #1 meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	22	kWh/m²
CEDI	8	kWh/m²
TEUI	70	kWh/m²
GHGI	0.8	kgCO²e/m²
Energy Use	806	MWh
Peak Electricity	254	kW
Energy Cost	$104,789	$/Year
Energy Cost (MFA)	$9.1	$/m²/Year



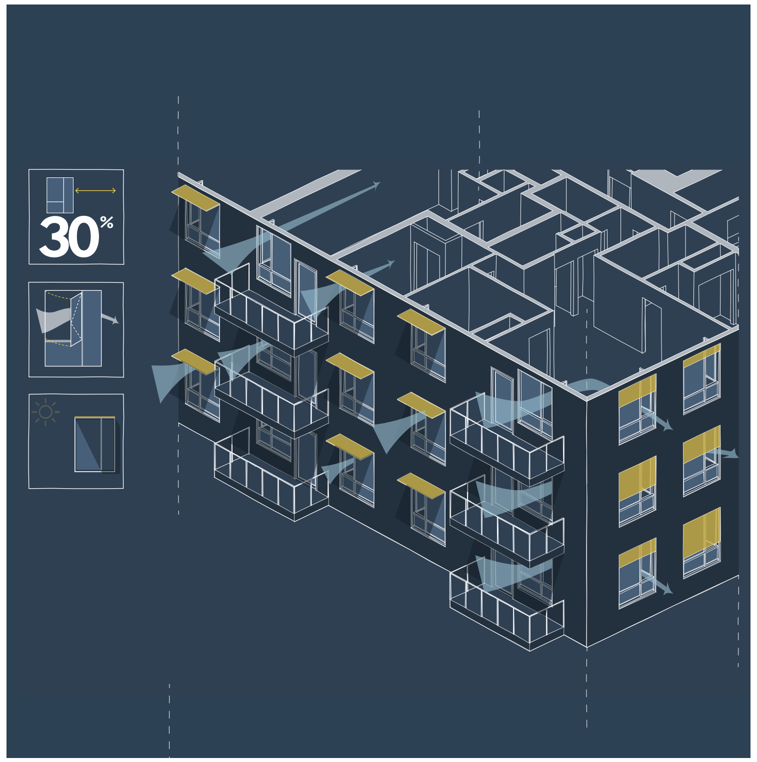
Incremental Cost

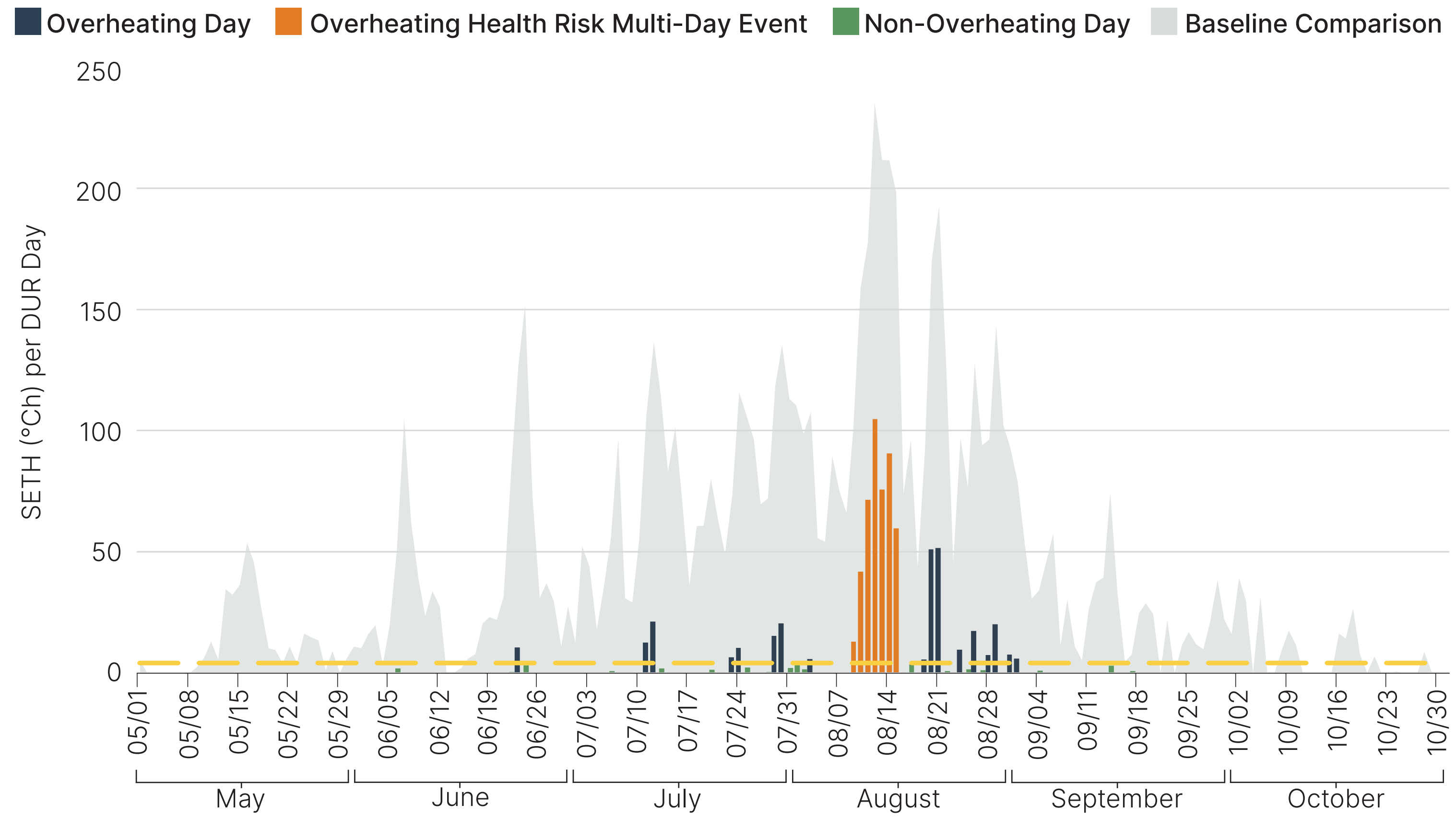
Incremental cost represents the change in façade cost for Bundle #1 relative to the baseline. Cost input is provided by Peak Construction and trades.

Cost Metric	Baseline	Bundle 1
Façade Cost ($/m² façade area)	$1,125	$1,104
Incremental Façade Cost ($ vs baseline)	n/a	-$6,362
Incremental Façade Cost (% vs baseline)	n/a	-1.8%

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

12 STOREY MURB — BUNDLE 2





Number of Overheating Events: 11 | Duration of Longest Health Risk Event: 7 Days

Number of Health Risk Events: 1 | Severity of Worst Health Risk Event: 457 (°Ch)

Overheating Evaluation

Bundle #2 reduces cumulative heat exposure and limits prolonged overheating conditions compared to the baseline:

- The longest overheating health risk event is reduced from **97 days to 7 days**
- The severity (SETH) of the worst health risk event is reduced by approximately **94%**, from **7,294°Ch to 457°Ch**
- Intensity (INT) remains below the health risk threshold

Remaining health risk events are shorter and lower in cumulative severity, with values approaching the health risk thresholds.

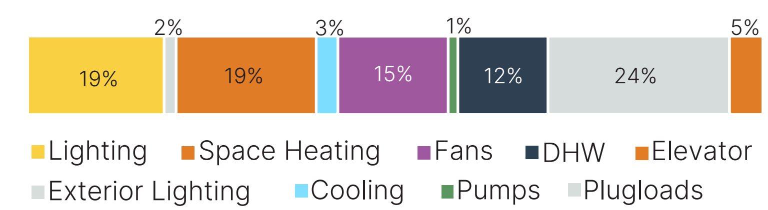
Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	23-06	23-06	1	11	0.4	NO
2	11-07	12-07	2	34	0.7	NO
3	23-07	24-07	2	17	0.3	NO
4	29-07	30-07	2	36	0.7	NO
5	03-08	03-08	1	6	0.2	NO
6	09-08	15-08	7	457	2.7	YES
7	19-08	21-08	3	108	1.5	NO
8	24-08	24-08	1	10	0.4	NO
9	26-08	26-08	1	17	0.7	NO
10	28-08	29-08	2	27	0.6	NO
11	31-08	01-09	2	13	0.3	NO

Building Energy Performance

Energy performance represents the Bundle #2 whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

Bundle #2 meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	23.8	kWh/m²
CEDI	5.7	kWh/m²
TEUI	70.0	kWh/m²
GHGI	0.8	kgCO²e/m²
Energy Use	807	MWh
Peak Electricity	257	kW
Energy Cost	$104,895	$/Year
Energy Cost (MFA)	$9.1	$/m²/Year



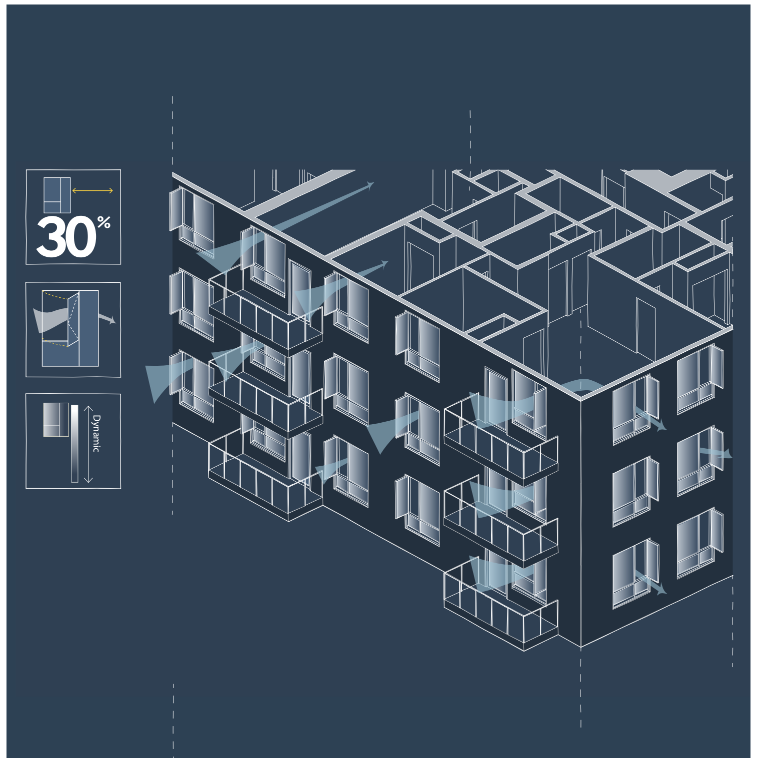
Incremental Cost

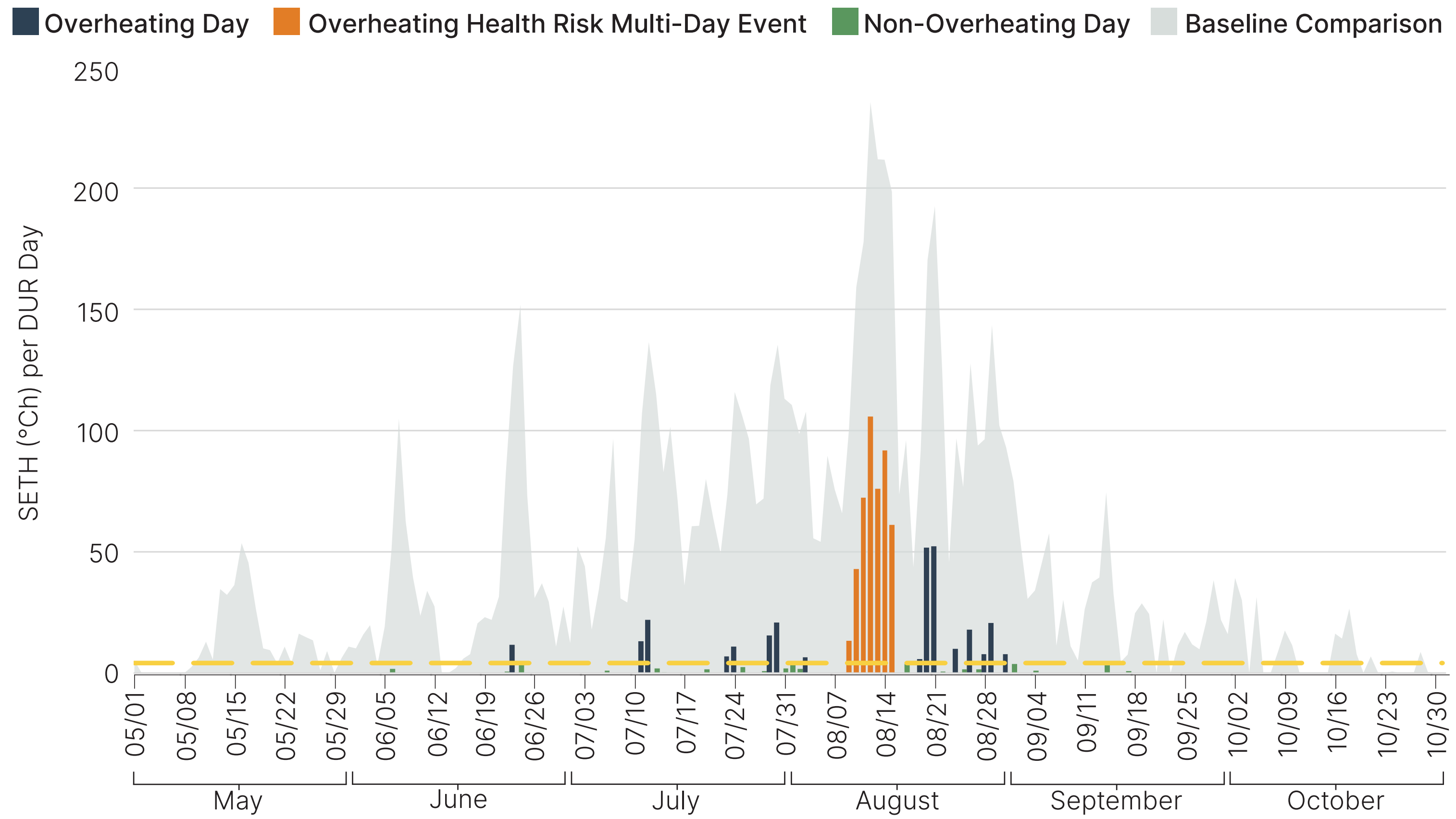
Incremental cost represents the change in façade cost for Bundle #2 relative to the baseline. Cost input is provided by Peak Construction and trades.

Cost Metric	Baseline	Bundle 2
Façade Cost ($/m² façade area)	$1,125	$1,237
Incremental Façade Cost ($ vs baseline)	n/a	$35,462
Incremental Façade Cost (% vs baseline)	n/a	10.0%

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

12 STOREY MURB — BUNDLE 3





Overheating Evaluation

Bundle #3 reduces cumulative heat exposure and limits prolonged overheating conditions compared to the baseline:

- The longest overheating health risk event is reduced from **97 days to 7 days**
- The severity (SETH) of the worst health risk event is reduced by approximately **94%**, from **7,294°Ch to 463°Ch**
- Intensity (INT) remains below the health risk threshold

Remaining health risk events are shorter and lower in cumulative severity, with values approaching the health risk thresholds.

Number of Overheating Events: 11 | Duration of Longest Health Risk Event: 7 Days

Number of Health Risk Events: 1 | Severity of Worst Health Risk Event: 463 (°Ch)

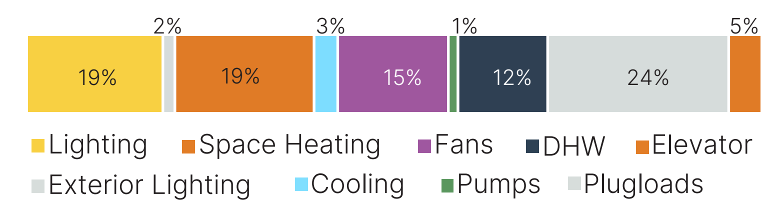
Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	23-06	23-06	1	11	0.5	NO
2	11-07	12-07	2	35	0.7	NO
3	23-07	24-07	2	18	0.4	NO
4	29-07	30-07	2	36	0.8	NO
5	03-08	03-08	1	6	0.3	NO
6	09-08	15-08	7	463	2.8	YES
7	19-08	21-08	3	110	1.5	NO
8	24-08	24-08	1	10	0.4	NO
9	26-08	26-08	1	18	0.7	NO
10	28-08	29-08	2	28	0.6	NO
11	31-08	31-08	1	8	0.3	NO

Building Energy Performance

Energy performance represents the Bundle #3 whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

Bundle #3 meets VBBL energy and operational carbon requirements, equivalent of Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	23.5	kWh/m²
CEDI	6.5	kWh/m²
TEUI	70.2	kWh/m²
GHGI	0.8	kgCO²e/m²
Energy Use	809	MWh
Peak Electricity	257	kW
Energy Cost	$105,191	$/Year
Energy Cost (MFA)	$9.1	$/m²/Year



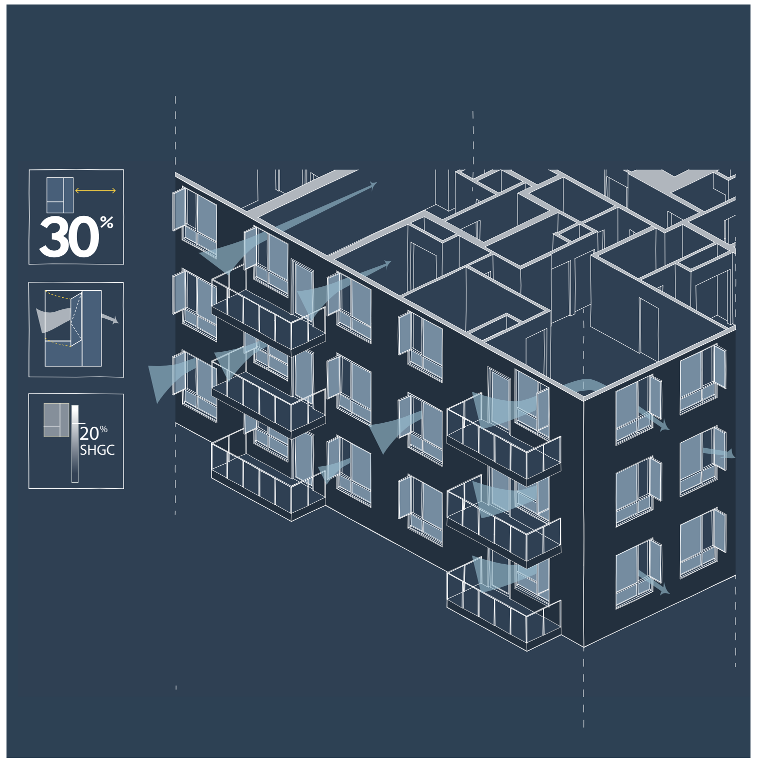
Incremental Cost

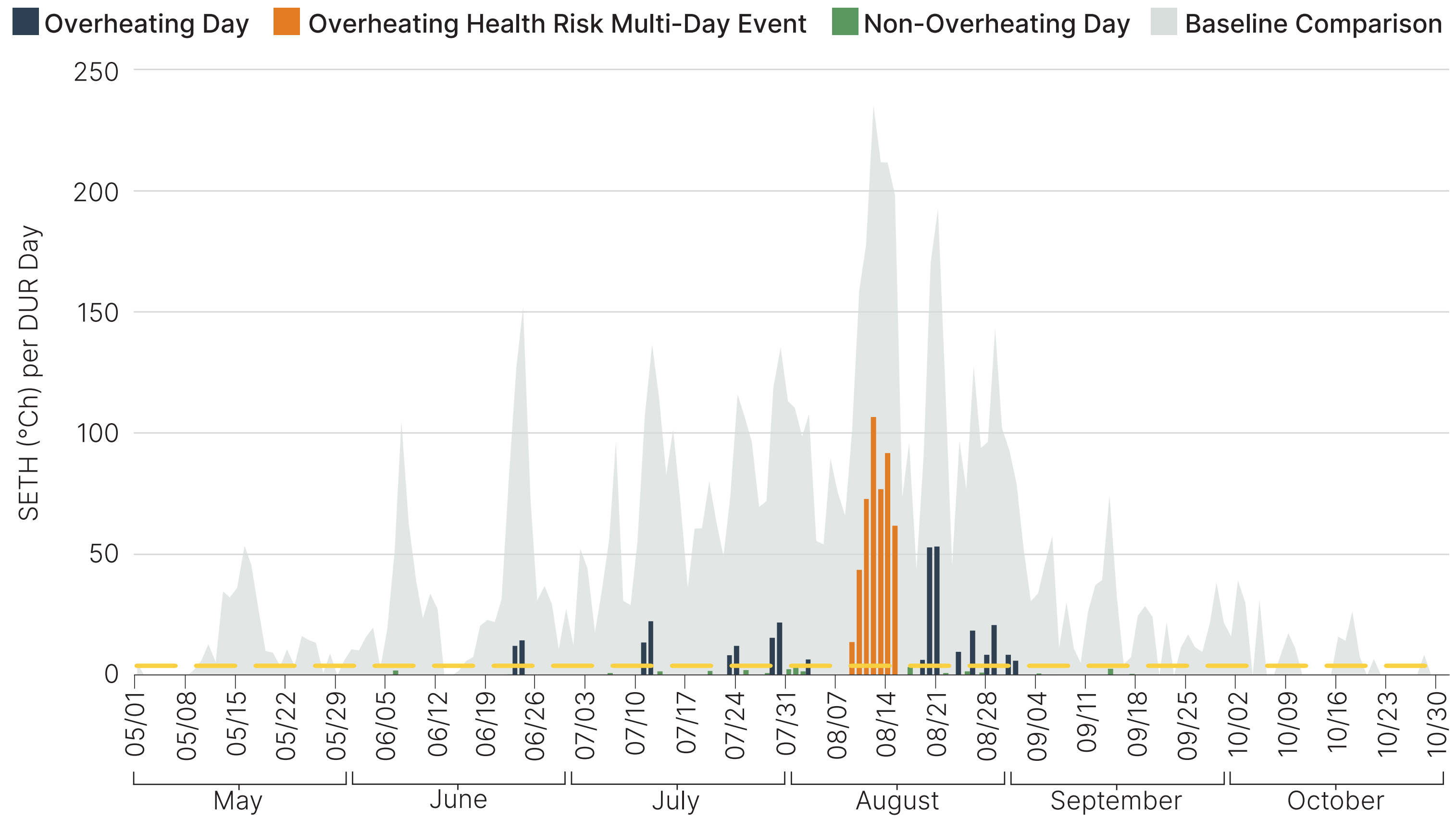
Incremental cost represents the change in façade cost for Bundle #3 relative to the baseline. Cost input is provided by Peak Construction and trades.

Cost Metric	Baseline	Bundle 3
Façade Cost ($/m² façade area)	$1,125	$1,719
Incremental Façade Cost ($ vs baseline)	n/a	$187,189
Incremental Façade Cost (% vs baseline)	n/a	52.9%

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

12 STOREY MURB — BUNDLE 4



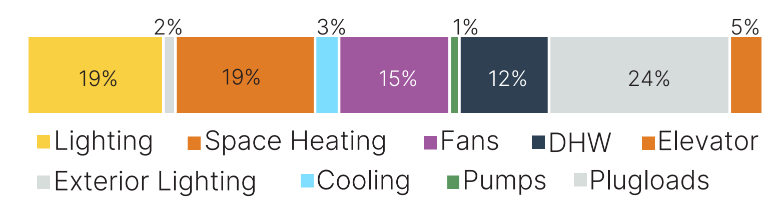


Building Energy Performance

Energy performance represents the Bundle #4 whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

Bundle #4 meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	24.0	kWh/m²
CEDI	6.7	kWh/m²
TEUI	70.4	kWh/m²
GHGI	0.8	kgCO²e/m²
Energy Use	811	MWh
Peak Electricity	257	kW
Energy Cost	$105,392	$/Year
Energy Cost (MFA)	$9.1	$/m²/Year



Number of Overheating Events: 11 | Duration of Longest Health Risk Event: 7 Days

Number of Health Risk Events: 1 | Severity of Worst Health Risk Event: 467 (°Ch)

Overheating Evaluation

Bundle #4 reduces cumulative heat exposure and limits prolonged overheating conditions compared to the baseline:

- The longest overheating health risk event is reduced from **97 days to 7 days**
- The severity (SETH) of the worst health risk event is reduced by approximately **94%**, from **7,294°Ch to 467°Ch**
- Intensity (INT) remains below the health risk threshold

Remaining health risk events are shorter and lower in cumulative severity, with values approaching the health risk thresholds.

Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	23-06	24-06	2	27	0.6	NO
2	11-07	12-07	2	36	0.8	NO
3	23-07	24-07	2	21	0.4	NO
4	29-07	30-07	2	37	0.8	NO
5	03-08	03-08	1	7	0.3	NO
6	09-08	15-08	7	467	2.8	YES
7	19-08	21-08	3	112	1.6	NO
8	24-08	24-08	1	10	0.4	NO
9	26-08	26-08	1	19	0.8	NO
10	28-08	29-08	2	29	0.6	NO
11	31-08	01-09	2	15	0.3	NO

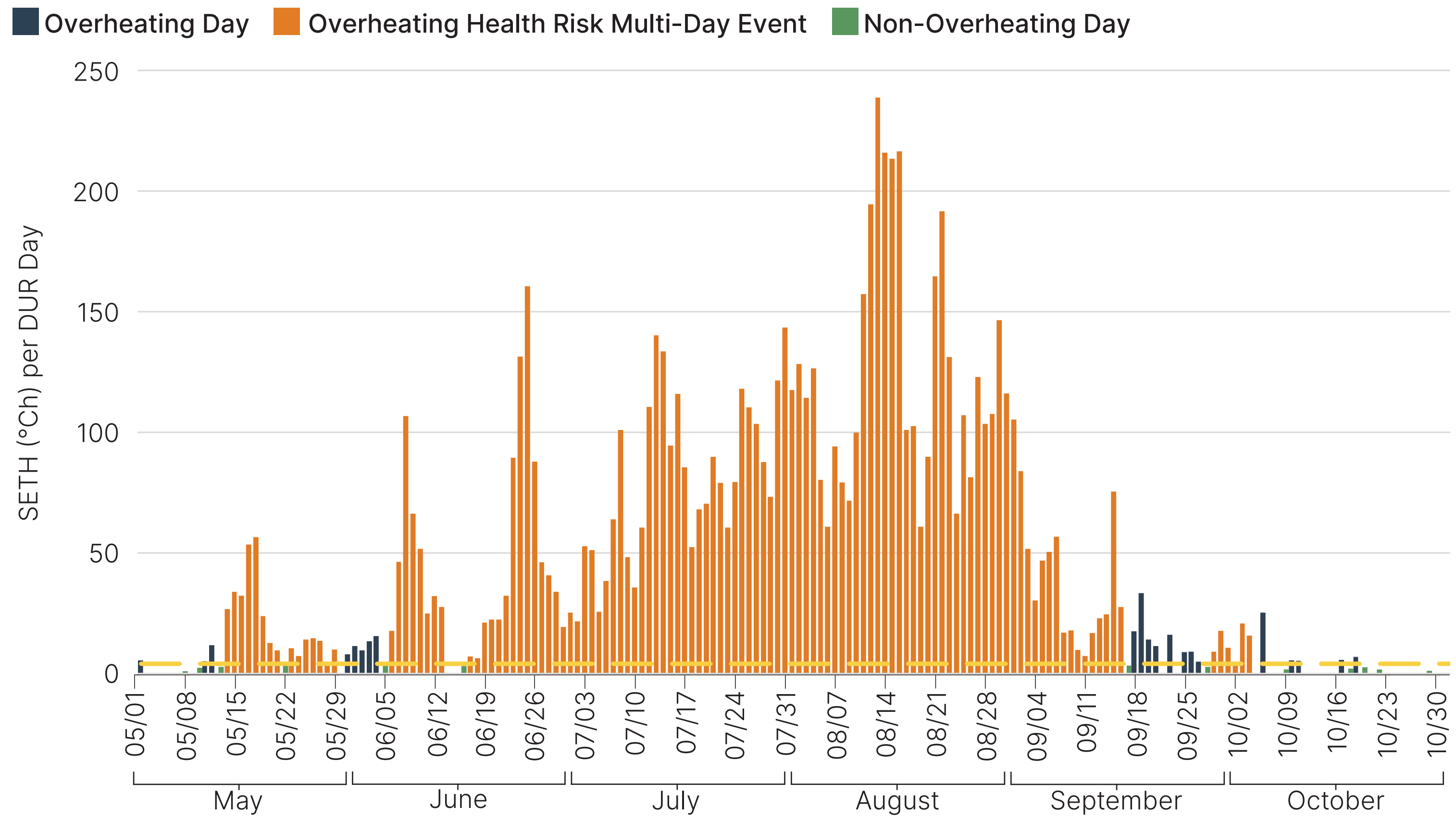
Incremental Cost

Incremental cost represents the change in façade cost for Bundle #4 relative to the baseline. Cost input is provided by Peak Construction and trades.

Cost Metric	Baseline	Bundle 4
Façade Cost ($/m² façade area)	$1,125	$1,129
Incremental Façade Cost ($ vs baseline)	n/a	$1,248
Incremental Façade Cost (% vs baseline)	n/a	0.4%

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

35 STOREY MURB — BASELINE



Number of Overheating Events: 15 | Duration of Longest Health Risk Event: 92 Days

Number of Health Risk Events: 5 | Severity of Worst Health Risk Event: 7,728 (°Ch)

Overheating Evaluation

The overheating evaluation presents results for a west-facing two-bedroom suite representing the worst-case orientation.

The baseline shows the following:

- 14 overheating events
- 5 health risk events
- The longest overheating health risk event has a duration (DUR) of 92 days
- The most severe health risk event (SETH) is 7,728°Ch
- The intensity (INT) of the worst health risk event is 3.5°C

The results show a continuous overheating health risk event spanning the majority of the summer period.

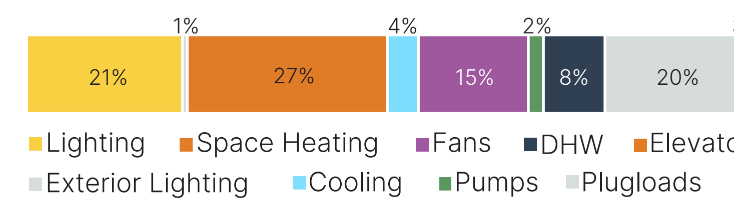
Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	01-05	01-05	1	6	0.2	NO
2	10-05	11-05	2	17	0.4	NO
3	13-05	20-05	8	249	1.3	YES
4	22-05	28-05	7	74	0.4	YES
5	30-05	03-06	5	58	0.5	NO
6	05-06	12-06	8	373	1.9	YES
7	16-06	15-09	92	7728	3.5	YES
8	17-09	20-09	4	76	0.8	NO
9	22-09	22-09	1	16	0.7	NO
10	24-09	26-09	3	23	0.3	NO
11	28-09	03-10	6	79	0.5	YES
12	05-10	05-10	1	25	1.1	NO
13	09-10	10-10	2	11	0.2	NO
14	16-10	16-10	1	6	0.2	NO
15	18-10	18-10	1	7	0.3	NO

Building Energy Performance

Energy performance represents the baseline whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

The baseline meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	29	kWh/m²
CEDI	15	kWh/m²
TEUI	83	kWh/m²
GHGI	0.9	kgCO²e/m²
Energy Use	2,561	MWh
Peak Electricity	1,141	kW
Energy Cost	$332,877	$/Year
Energy Cost (MFA)	$10.8	$/m²/Year



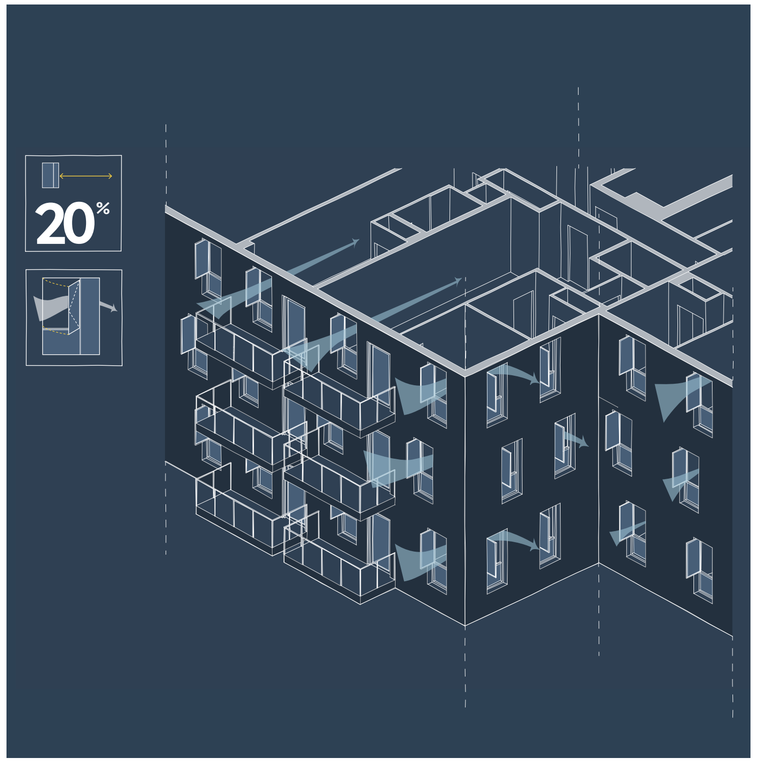
Incremental Cost

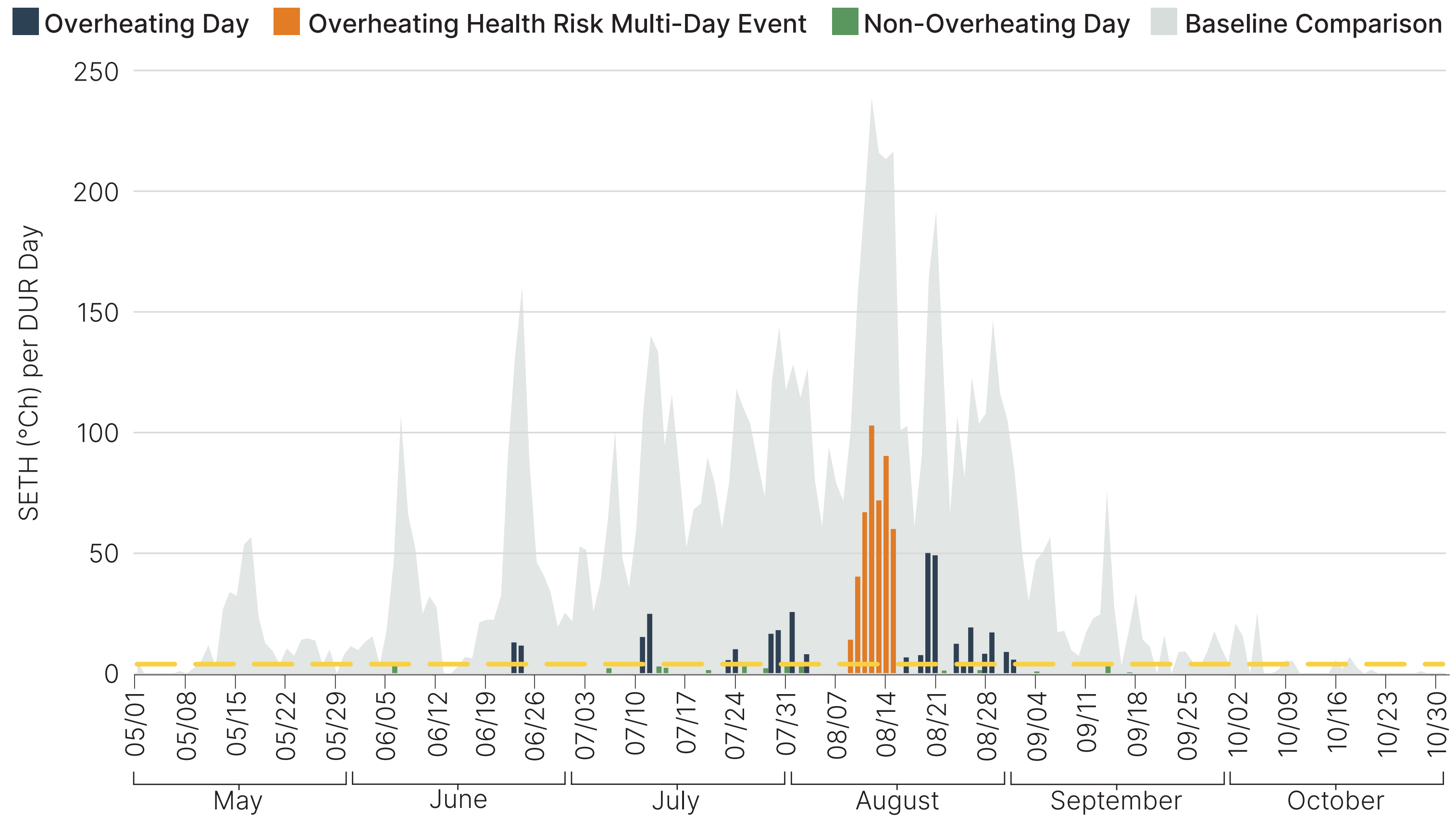
The incremental cost represents the baseline residential floors. Cost is provided by Peak Construction and trades.

Cost Metric	Baseline
Façade Cost ($/m² façade area)	$1,114
Incremental Façade Cost ($ vs baseline)	n/a
Incremental Façade Cost (% vs baseline)	n/a

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

35 STOREY MURB — BUNDLE 1





Number of Overheating Events: 12 | Duration of Longest Health Risk Event: 7 Days

Number of Health Risk Events: 1 | Severity of Worst Health Risk Event: 446 (°Ch)

Overheating Evaluation

Bundle #1 reduces cumulative heat exposure and limits prolonged overheating conditions compared to the baseline:

- The longest overheating health risk event is reduced from **92 days to 7 days**
- The severity (SETH) of the worst health risk event is reduced by approximately **94%**, from **7,728°Ch to 446°Ch**
- Intensity (INT) remains below the health risk threshold

Remaining health risk events are shorter and lower in cumulative severity, with values approaching the health risk thresholds.

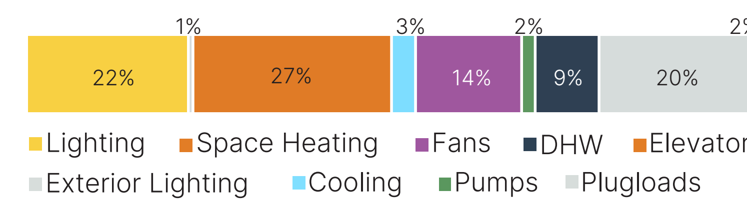
Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	23-06	24-06	2	25	0.5	NO
2	11-07	12-07	2	40	0.8	NO
3	23-07	24-07	2	16	0.3	NO
4	29-07	30-07	2	34	0.7	NO
5	01-08	01-08	1	26	1.1	NO
6	03-08	03-08	1	8	0.3	NO
7	09-08	15-08	7	446	2.7	YES
8	17-08	17-08	1	7	0.3	NO
9	19-08	21-08	3	107	1.5	NO
10	24-08	26-08	3	36	0.5	NO
11	28-08	29-08	2	25	0.5	NO
12	31-08	01-09	2	15	0.3	NO

Building Energy Performance

Energy performance represents the Bundle #1 whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

Bundle #1 meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	28	kWh/m²
CEDI	10	kWh/m²
TEUI	80	kWh/m²
GHGI	0.9	kgCO²e/m²
Energy Use	2,473	MWh
Peak Electricity	1,151	kW
Energy Cost	$321,444	$/Year
Energy Cost (MFA)	$10.4	$/m²/Year



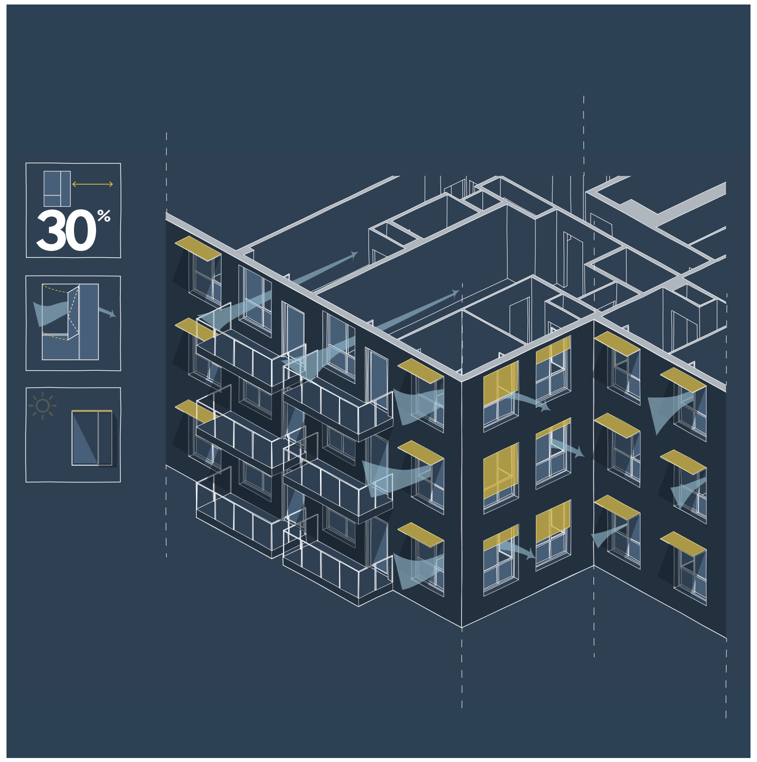
Incremental Cost

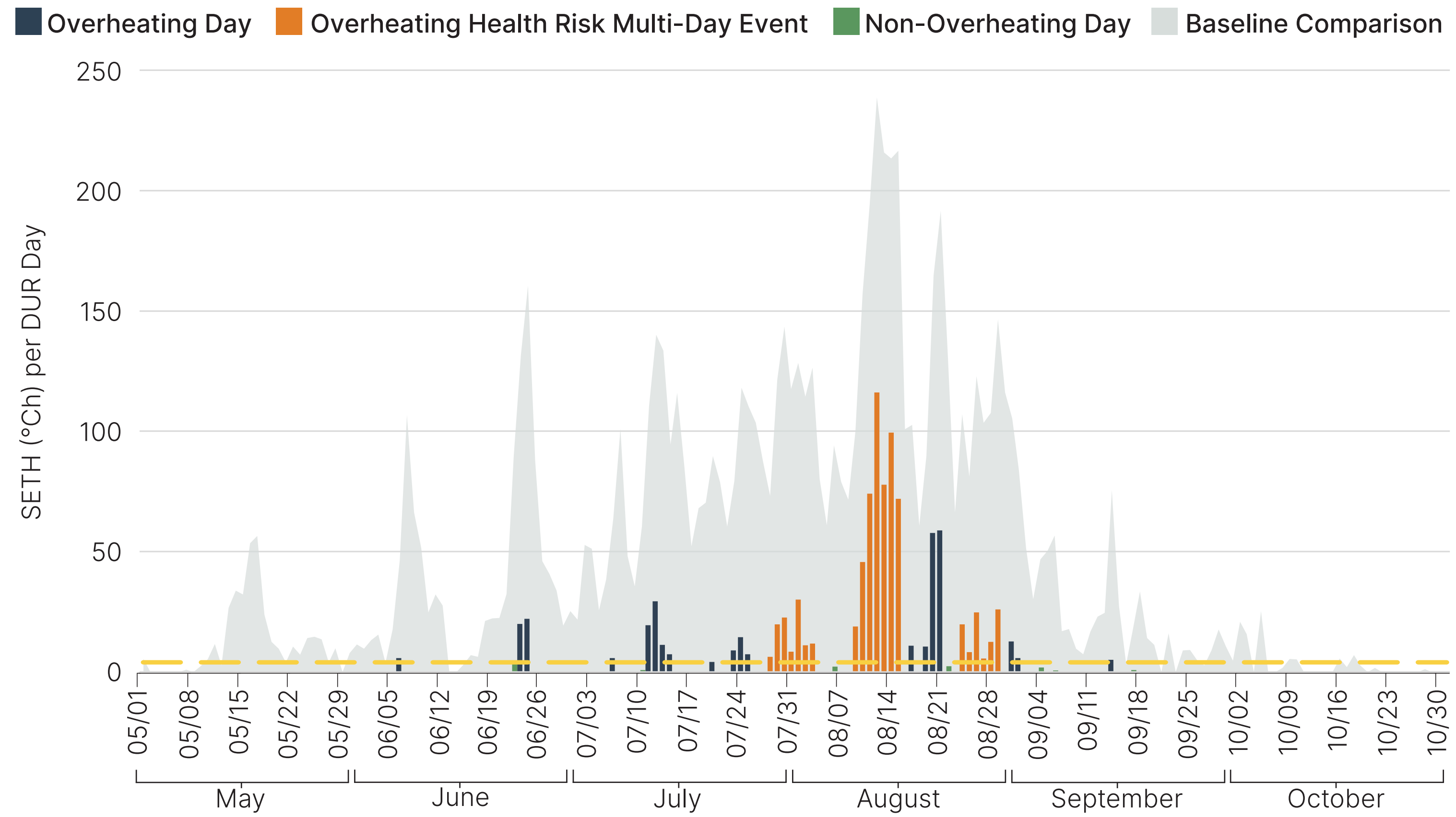
Incremental cost represents the change in façade cost for Bundle #1 relative to the baseline. Cost input is provided by Peak Construction and trades.

Cost Metric	Baseline	Bundle 1
Façade Cost ($/m² façade area)	$1,114	$1,089
Incremental Façade Cost ($ vs baseline)	n/a	-$7,525
Incremental Façade Cost (% vs baseline)	n/a	-2.3%

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

35 STOREY MURB — BUNDLE 2





Overheating Evaluation

Bundle #2 reduces cumulative heat exposure and limits prolonged overheating conditions compared to the baseline:

- The longest overheating health risk event is reduced from **92 days to 7 days**
- The severity (SETH) of the worst health risk event is reduced by approximately **94%**, from **7,728°Ch to 504°Ch**
- Intensity (INT) remains below the health risk threshold

Remaining health risk events are shorter and lower in cumulative severity, with values approaching the health risk thresholds.

Number of Overheating Events: 13 | Duration of Longest Health Risk Event: 7 Days

Number of Health Risk Events: 3 | Severity of Worst Health Risk Event: 504 (°Ch)

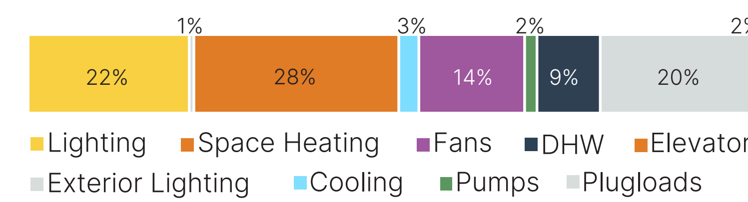
Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	06-06	06-06	1	6	0.2	NO
2	23-06	24-06	2	42	0.9	NO
3	06-07	06-07	1	6	0.2	NO
4	11-07	14-07	4	68	0.7	NO
5	20-07	20-07	1	4	0.2	NO
6	23-07	25-07	3	31	0.4	NO
7	28-07	03-08	7	110	0.7	YES
8	09-08	15-08	7	504	3.0	YES
9	17-08	17-08	1	11	0.5	NO
10	19-08	21-08	3	127	1.8	NO
11	24-08	29-08	6	97	0.7	YES
12	31-08	01-09	2	18	0.4	NO
13	14-09	14-09	1	5	0.2	NO

Building Energy Performance

Energy performance represents the Bundle #2 whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

Bundle #2 meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	30	kWh/m²
CEDI	8	kWh/m²
TEUI	80	kWh/m²
GHGI	0.9	kgCO²e/m²
Energy Use	2,481	MWh
Peak Electricity	1,162	kW
Energy Cost	$322,512	$/Year
Energy Cost (MFA)	$10.4	$/m²/Year



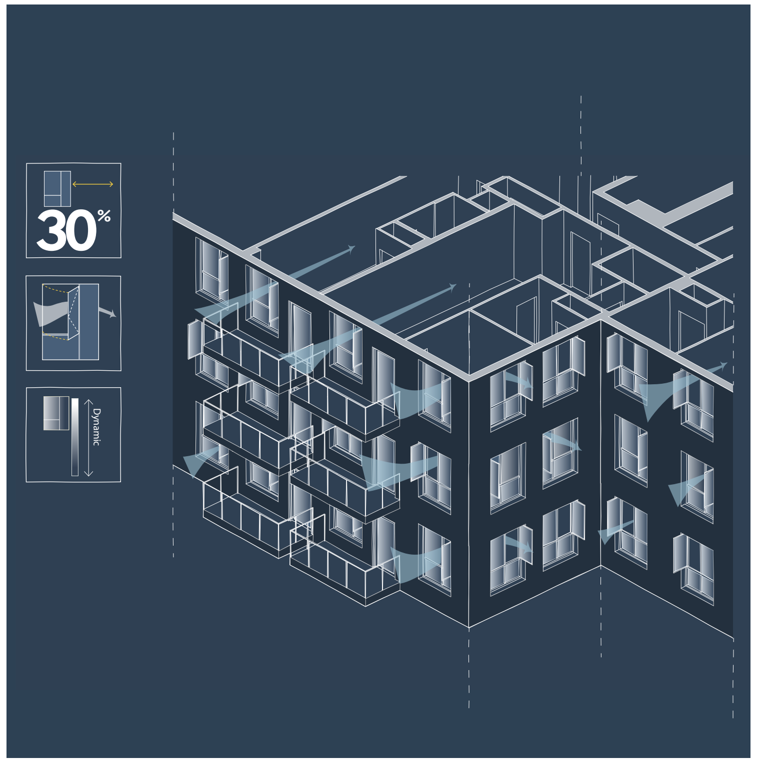
Incremental Cost

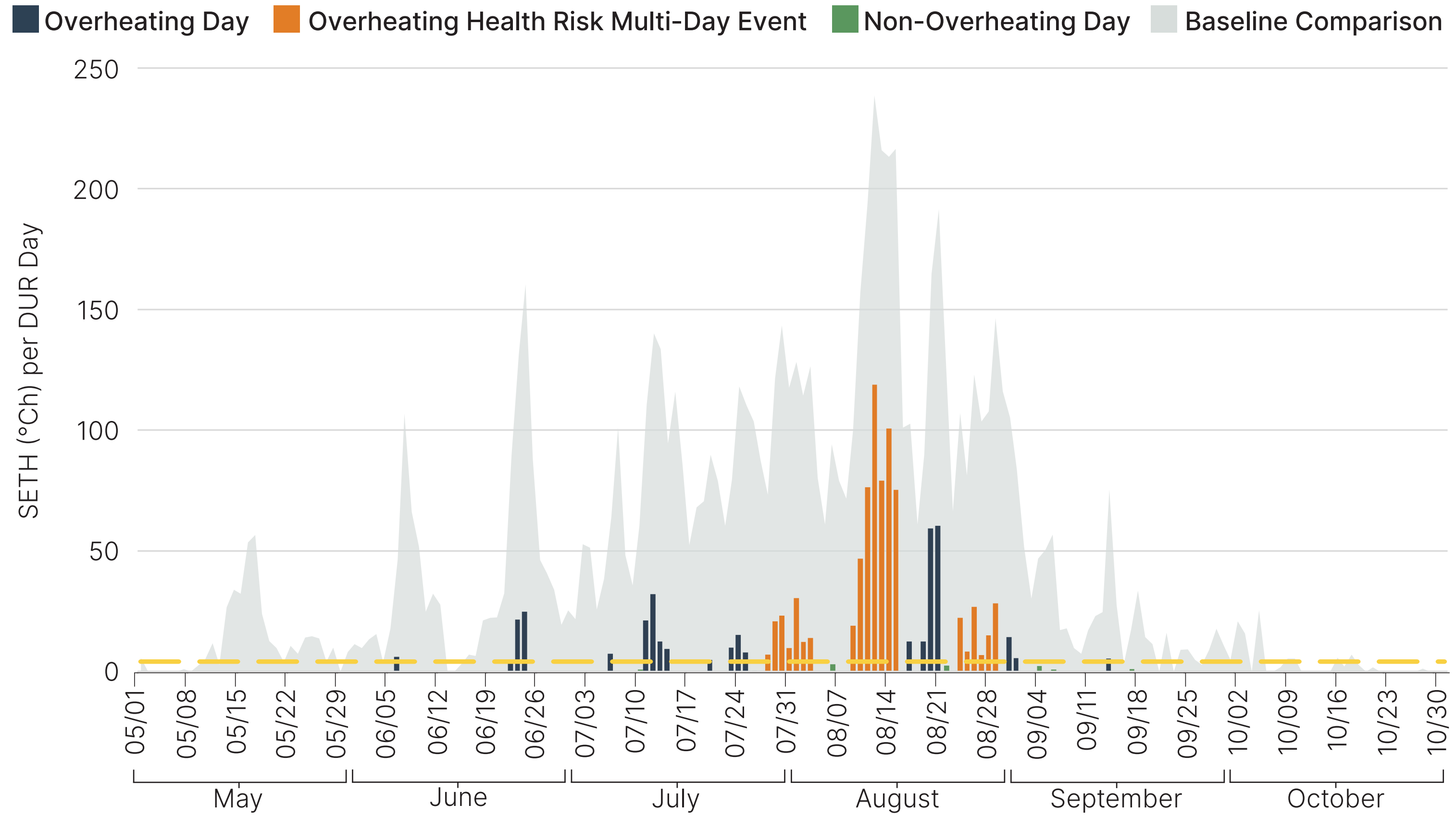
Incremental cost represents the change in façade cost for Bundle #2 relative to the baseline. Cost input is provided by Peak Construction and trades.

Cost Metric	Baseline	Bundle 2
Façade Cost ($/m² façade area)	$1,114	$1,238
Incremental Façade Cost ($ vs baseline)	n/a	$36,414
Incremental Façade Cost (% vs baseline)	n/a	11.1%

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

35 STOREY MURB — BUNDLE 3





Overheating Evaluation

Bundle #3 reduces cumulative heat exposure and limits prolonged overheating conditions compared to the baseline:

- The longest overheating health risk event is reduced from **92 days to 7 days**
- The severity (SETH) of the worst health risk event is reduced by approximately **93%**, from **7,728°Ch to 516°Ch**
- Intensity (INT) remains below the health risk threshold

Remaining health risk events are shorter and lower in cumulative severity, with values approaching the health risk thresholds.

Number of Overheating Events: 13 | Duration of Longest Health Risk Event: 7 Days

Number of Health Risk Events: 3 | Severity of Worst Health Risk Event: 516 (°Ch)

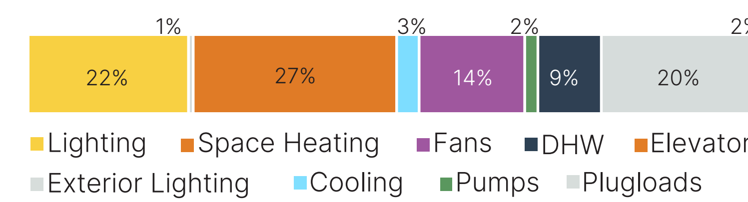
Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	06-06	06-06	1	6	0.3	NO
2	22-06	24-06	3	51	0.7	NO
3	06-07	06-07	1	7	0.3	NO
4	11-07	14-07	4	75	0.8	NO
5	20-07	20-07	1	5	0.2	NO
6	23-07	25-07	3	33	0.5	NO
7	28-07	03-08	7	117	0.7	YES
8	09-08	15-08	7	516	3.1	YES
9	17-08	17-08	1	12	0.5	NO
10	19-08	21-08	3	132	1.8	NO
11	24-08	29-08	6	107	0.7	YES
12	31-08	01-09	2	20	0.4	NO
13	14-09	14-09	1	5	0.2	NO

Building Energy Performance

Energy performance represents the Bundle #3 whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

Bundle #3 meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	30	kWh/m²
CEDI	9	kWh/m²
TEUI	81	kWh/m²
GHGI	0.9	kgCO²e/m²
Energy Use	2,490	MWh
Peak Electricity	1,141	kW
Energy Cost	$323,662	$/Year
Energy Cost (MFA)	$10.5	$/m²/Year



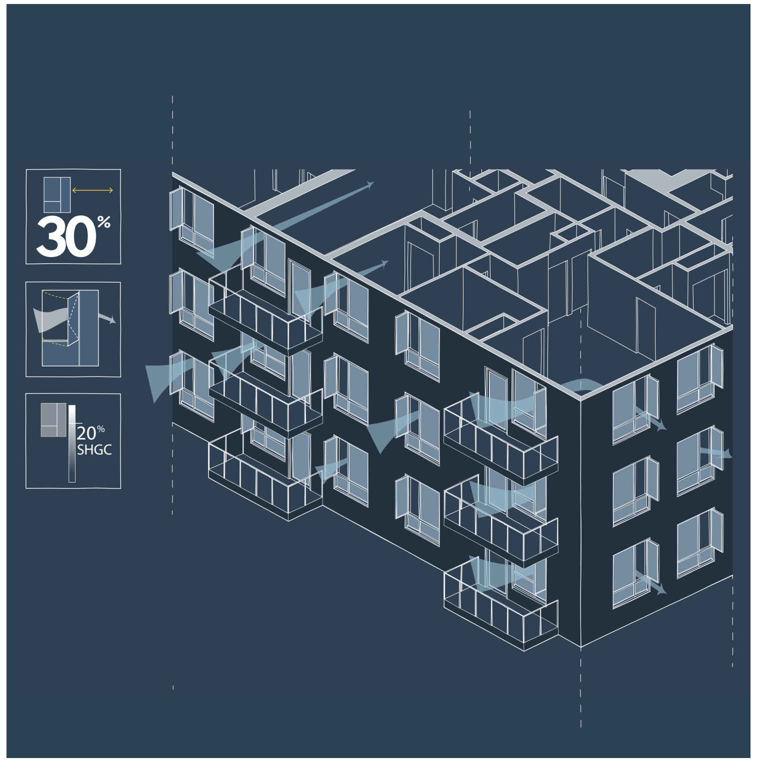
Incremental Cost

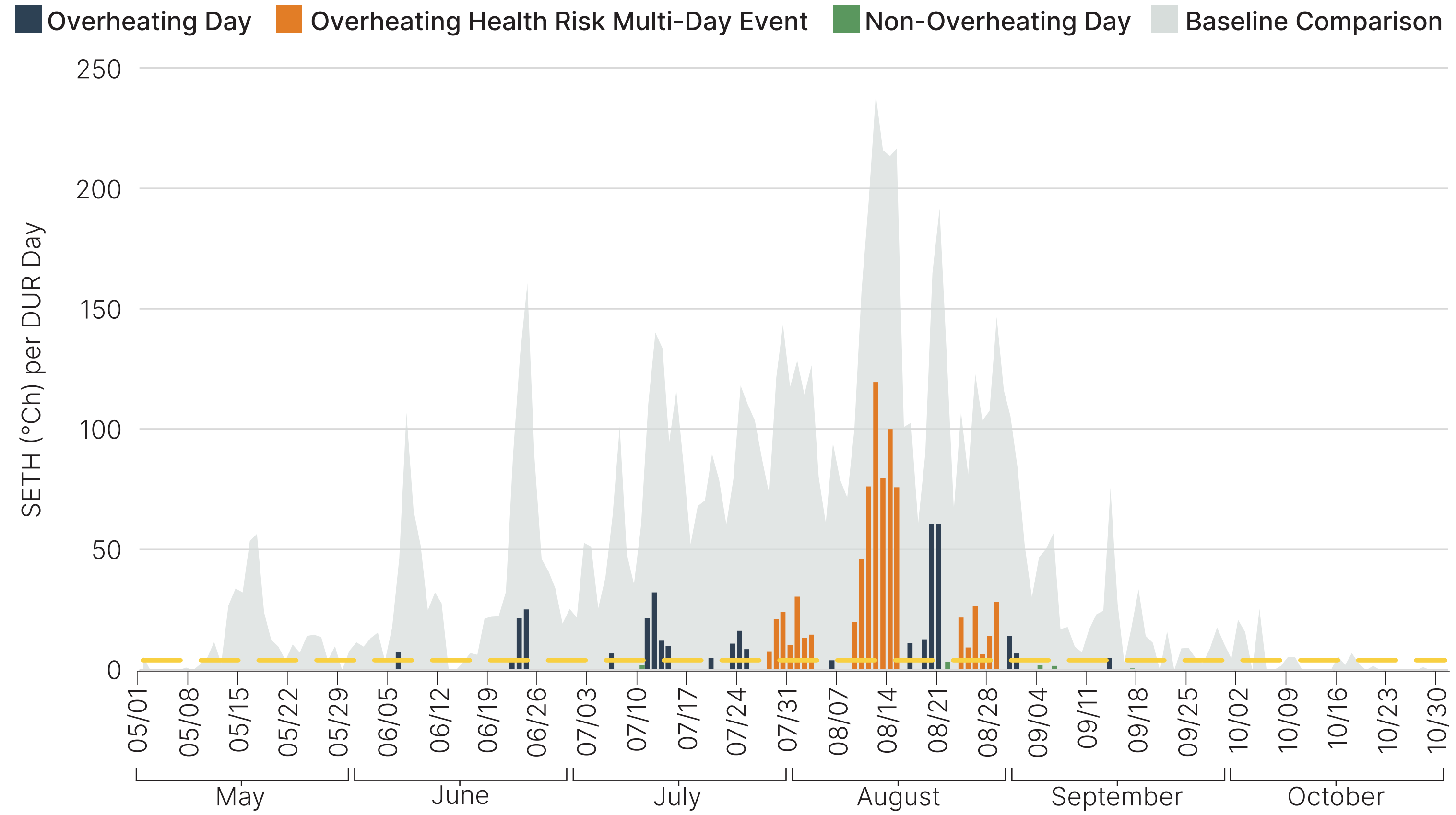
Incremental cost represents the change in façade cost for Bundle #3 relative to the baseline. Cost input is provided by Peak Construction and trades.

Cost Metric	Baseline	Bundle 3
Façade Cost ($/m² façade area)	$1,114	$1,759
Incremental Façade Cost ($ vs baseline)	n/a	$189,018
Incremental Façade Cost (% vs baseline)	n/a	57 .8%

Appendix A: Summary of Overheating, Energy, and Cost by Archetype and Bundle

35 STOREY MURB — BUNDLE 4





Overheating Evaluation

Bundle #4 reduces cumulative heat exposure and limits prolonged overheating conditions compared to the baseline:

- The longest overheating health risk event is reduced from **92 days to 7 days**
- The severity (SETH) of the worst health risk event is reduced by approximately **93%**, from **7,728°Ch to 517°Ch**
- Intensity (INT) remains below the health risk threshold

Remaining health risk events are shorter and lower in cumulative severity, with values approaching the health risk thresholds.

Number of Overheating Events: 14 | Duration of Longest Health Risk Event: 7 Days

Number of Health Risk Events: 3 | Severity of Worst Health Risk Event: 517 (°Ch)

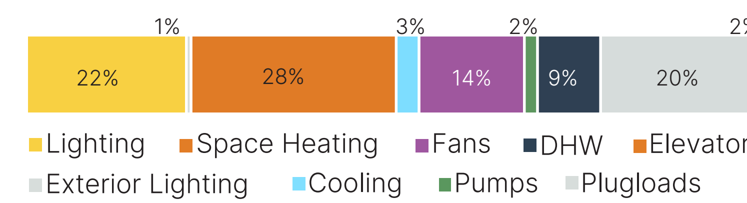
Overheating Event	Start Date	End Date	Duration (Days) Max 6	SETH (°Ch) Max 150	INT (°C) Max 5.13	Health Risk Event Yes/No
1	06-06	06-06	1	7	0.3	NO
2	22-06	24-06	3	51	0.7	NO
3	06-07	06-07	1	7	0.3	NO
4	11-07	14-07	4	76	0.8	NO
5	20-07	20-07	1	5	0.2	NO
6	23-07	25-07	3	36	0.5	NO
7	28-07	03-08	7	122	0.7	YES
8	06-08	06-08	1	4	0.2	NO
9	09-08	15-08	7	517	3.1	YES
10	17-08	17-08	1	11	0.5	NO
11	19-08	21-08	3	134	1.9	NO
12	24-08	29-08	6	107	0.7	YES
13	31-08	01-09	2	21	0.4	NO
14	14-09	14-09	1	5	0.2	NO

Building Energy Performance

Energy performance represents the Bundle #4 whole building including above and below grade areas, modelled with climate file GW+1°C (2014-2024) per VBBL.

Bundle #4 meets VBBL energy and operational carbon requirements, equivalent to Step 3 of the BCBC Energy Step Code and EL-4 of the BCBC Zero Carbon Step Code.

Performance Metric	Value	Unit
TEDI	30	kWh/m²
CEDI	9	kWh/m²
TEUI	81	kWh/m²
GHGI	0.9	kgCO²e/m²
Energy Use	2,500	MWh
Peak Electricity	1,157	kW
Energy Cost	$324,954	$/Year
Energy Cost (MFA)	$10.5	$/m²/Year



Incremental Cost

Incremental cost represents the change in façade cost for Bundle #4 relative to the baseline. Cost input is provided by Peak Construction and trades.

Cost Metric	Baseline	Bundle 4
Façade Cost ($/m² façade area)	$1,114	$1,120
Incremental Façade Cost ($ vs baseline)	n/a	$1,640
Incremental Façade Cost (% vs baseline)	n/a	0.5%

Appendices

APPENDIX B — COST ANALYSIS AND COMPARISON

Appendix B: Cost Analysis and Comparison

This appendix presents the cost analysis and comparison of passive design strategies, including summary results, benchmark inputs, and detailed cost breakdowns for each archetype (6, 12, and 35 storey). The tables provide the inputs, assumptions, and calculations supporting the cost analysis in Section 3.

Façade Cost Comparison by Passive Strategy

This table summarizes façade cost impacts of passive strategy bundles relative to the baseline condition across all archetypes, including both façade-level and total project cost implications.

Summary Cost breakdown of each Archetype and Bundle

Archetype	Bundle	Cost per Floor ($)	Cost per m^2 (Floor Area)	Façade Cost ($/$m^2$)	Incremental Cost ($, vs. Baseline Façade)	Incremental Cost (% vs. Baseline Façade)
6 Storey	Baseline	$ 287,501	$ 172	$ 461		0.0%
	Bundle 1	$ 286,556	$ 171	$ 459	($945)	-0.3%
	Bundle 2	$ 390,750	$ 234	$ 626	$103,249	35.9%
	Bundle 3	$ 586,848	$ 351	$ 941	$299,347	104.1%
	Bundle 4	$ 288,899	$ 173	$ 463	$1,398	0.5%
12 Storey	Baseline	$ 354,095	$ 473	$ 1,125		0.0%
	Bundle 1	$ 347,733	$ 464	$ 1,104	($6,362)	-1.8%
	Bundle 2	$ 389,557	$ 520	$ 1,237	$35,462	10.0%
	Bundle 3	$ 541,283	$ 723	$ 1,719	$187,189	52.9%
	Bundle 4	$ 355,342	$ 474	$ 1,129	$1,248	0.4%
35 Storey	Baseline	$ 327,024	$ 462	$ 1,114		0.0%
	Bundle 1	$ 319,500	$ 451	$ 1,089	($7,525)	-2.3%
	Bundle 2	$ 363,438	$ 513	$ 1,238	$36,414	11.1%
	Bundle 3	$ 516,042	$ 729	$ 1,759	$189,018	57.8%
	Bundle 4	$ 328,664	$ 464	$ 1,120	$1,640	0.5%

Example Total Project Cost (Altus Benchmark, 2025)

Altus Baseline Cost (2025 Vancouver MURB, Including Below-Grade Areas)	Baseline Façade Cost (20% of Total Construction Cost)	Bundle Façade Cost	Incremental Façade Cost (vs. Baseline)	Incremental Cost (% of Total Project Cost – Scaled)	Estimated Total Project Cost with Bundle
$45,380,859	$9,076,172				
		$9,046,334	($29,838)	-0.1%	$45,351,020
		$12,335,652	$3,259,480	7.2%	$48,640,338
		$18,526,300	$9,450,128	20.8%	$54,830,987
		$9,120,317	$44,145	0.1%	$45,425,004
$51,344,563	$10,268,913				
		$10,084,416	($184,497)	-0.4%	$51,160,066
		$11,297,334	$1,028,421	2.0%	$52,372,984
		$15,697,469	$5,428,556	10.6%	$56,773,119
		$10,305,094	$36,181	0.1%	$51,380,744
$160,267,305	$32,053,461				
		$31,315,917	($737,544)	-0.5%	$159,529,760
		$35,622,577	$3,569,116	2.2%	$163,836,420
		$50,580,157	$18,526,696	11.6%	$178,794,001
		$32,214,207	$160,746	0.1%	$160,428,050

Benchmark cost inputs used to contextualize project-level impacts are provided in the following table.

Detailed cost breakdowns for each archetype are provided in subsequent tables.

Benchmark Cost Inputs (Altus, 2025)

This table provides benchmark construction cost ranges used to contextualize façade costs within total project cost, based on Altus 2025 Vancouver MURB data. These benchmarks are used to scale façade cost impacts to overall project cost in the summary table.

BUILDING TYPE

Residential

CONDOMINIUMS/APARTMENTS	Vancouver Low		Vancouver High
Up to 12 Storeys	330	to	405
13-39 Storeys	360	to	455
40-60 Storeys	360	to	480
60+ Storeys	370	to	485
Premium for High Quality	up to		275

PARKING			
Surface Parking	13	to	25
Freestanding Parking Garages (Above Grade)	130	to	210
Underground Parking Garages	170	to	290
Underground Parking Garages – Premium for Unusual Circumstances	up to		220

Archetype	Above Grade Range - V		Below Grade Range - V				Project Benchmark Cost - Low			
	Low ($/m^2)	High ($/m2)	Low ($/m^2)	High ($/m2)	Above Grad	Below Grad	Low Range	High Range	Midpoint	Facade Cost @20% of high range
6 Storey MidRise	$2,960	$3,929	$1,830	$3,122	10,549	3,653	$37,910,030	$52,851,687	$45,380,859	$9,076,172
12 Storey	$3,552	$4,359	$1,830	$3,122	9,539	5,498	$43,943,868	$58,745,257	$51,344,563	$10,268,913
35 Storey HighRise	$3,875	$4,898	$1,830	$3,122	29,229	12,946	$136,953,555	$183,581,054	$160,267,305	$32,053,461

- Traditionally, façade costs accounted for approximately 10% to 15% of the total building cost / increase in façade costs, reaching levels of 20% to 30% of the overall building cost (https://masterfacades.com/estimation-costing/)

Archetype 1 — [6 Storey] Detailed Cost Breakdown

This table provides a detailed cost breakdown of façade components for the baseline condition and each passive strategy bundle, forming the basis for the summary cost comparisons presented in this appendix.

Items	(WWR reduced to 25%, 100% operable windows)			(WWR reduced to 20%, 100% operable windows)			(WWR reduced to 30%, External fixed shading to S façade / operable on the E / W facades, 100% operable windows)			(WWR reduced to 30%, Electrochromic glazing on E/S/W facades, 100% operable windows)			(WWR reduced to 30%, Reduced SHGC 0.20, 100% operable windows)			Comments/ Notes
	Baseline			Bundle 1			Bundle 2			Bundle 3			Bundle 4			
Mid-rise 6 storey																
# of stories above grade	6			6			6			6			6			
# of stories below grade	1			1			1			1			1			
MFA	0 sf			0 sf			0 sf			0 sf			0 sf			
GFA	0 sf			0 sf			0 sf			0 sf			0 sf			
Total Area Above Grade	0 sf			0 sf			0 sf			0 sf			0 sf			
Total Area Below Grade	0 sf			0 sf			0 sf			0 sf			0 sf			
Total Residential Suite Areas	0 sf			0 sf			0 sf			0 sf			0 sf			
Floor plate area	17997 sf			17997 sf			17997 sf			17997 sf			17997 sf			
Perimeter length	751 lf			751 lf			751 lf			751 lf			751 lf			ALL QUANTITIES AND PRICING BASED ON ONE TYPICAL FLOOR OF EACH BUILDING
Facade area	40290 sf			40290 sf			40290 sf			40290 sf			40290 sf			
Floor to floor height	8.9 lf			8.9 lf			8.9 lf			8.9 lf			8.9 lf			STAIRCASE WINDOW NOT INCLUDED
Glazing	25%			20 %			20%			20%			20%			
Operable windows	100%			100			100%			100%			100%			
SHGC	0.3			0.3			0.3			0.3			0.2			
Cladding	Cementitious			Cementitious			Cementitious			Cementitious			Cementitious			
Stud wall assembly	Qty	Rate	Price	Qty	Rate	Price	Qty	Rate	Price	Qty	Rate	Price	Qty	Rate	Price	
Cladding	4499.7 sf	$36.00 /sf	$161,991	4950.9 sf	$36.00 /sf	$178,234	4950.9 sf	$36.00 /sf	$178,234	4950.9 sf	$36.00 /sf	$178,234	4950.9 sf	$36.00 /sf	$178,234	
Small windows	1217.4 sf	$38.00 /sf	$46,262	768.2 sf	$38.00 /sf	$29,193	768.2 sf	$38.00 /sf	$29,193	768.2 sf	$38.00 /sf	$29,193	768.2 sf	$38.00 /sf	$29,193	window size to be made known for each bundles
Sidelight	420.9 sf	$38.00 /sf	$15,995	418.9 sf	$38.00 /sf	$15,918	418.9 sf	$38.00 /sf	$15,918	418.9 sf	$38.00 /sf	$15,918	418.9 sf	$38.00 /sf	$15,918	Bundle 2- Door sidelights not shown or included as operable.
Doors	576.9 sf	$83.00 /sf	$47,880	576.9 sf	$83.00 /sf	$47,880	576.9 sf	$83.00 /sf	$47,880	576.9 sf	$83.00 /sf	$47,880	576.9 sf	$83.00 /sf	$47,880	
Operable window premium	429.9 sf	$10.00 /sf	$4,299	432.0 sf	$10.00 /sf	$4,320	432.0 sf	$10.00 /sf	$4,320	432.0 sf	$10.00 /sf	$4,320	432.0 sf	$10.00 /sf	$4,320	Bundle does not show additional operable windows
Operable sidelight premium				219.2	$10.00 /sf	$2,192	219.2	$10.00 /sf	$2,192	219.2	$10.00 /sf	$2,192	219.2	$10.00 /sf	$2,192	
Interior blinds	2215.2 sf	$5.00 /sf	$11,076	1764.0 sf	$5.00 /sf	$8,820	1764.0 sf	$5.00 /sf	$8,820	1764.0 sf	$5.00 /sf	$8,820	1764.0 sf	$5.00 /sf	$8,820	$5/SF Brite Blinds: Manual Roller shade (0-3%) - 3" L shaped extruded aluminum fascia
External fixed shading to S	n/a	n/a		n/a	n/a		9.0 lf	$330.76 /lf	$2,979	n/a	n/a		n/a	n/a		May not be accurate reflection based on only 1 window south facing. Solid aluminum
Blocking							9.0 lf	$35.00 /lf	$315							
Rigid							9.0 lf	$30.00 /lf	$270							
External roller shading to E/W	n/a	n/a		n/a	n/a					n/a	n/a		n/a	n/a		
Windows							653.0 sf	$89.00 /sf	$58,116							Priced as roll-shutters. Complete black out when fully rolled down
Sidelights							342.7 sf	$93.90 /sf	$32,180							No roll-shutters included across door area.
Blocking							51.3 lf	$35.00 /lf	$1,795							
Rigid							51.3 lf	$30.00 /lf	$1,539							
Electrical							20.0 unit	$350.00 /unit	$7,000							$350/unit - Wood Frame - Variances depending on final installation type (Voltage, location, bulkheads etc)
Electrochromic E/S/W	n/a	n/a		n/a	n/a		n/a	n/a					n/a	n/a		
Small windows										587.0 sf	$250.00 /sf	$146,749				Price can range from $200-$300
Sidelight										328.3 sf	$250.00 /sf	$82,087				
Doors										256.4 sf	$250.00 /sf	$64,106				
Electrical										21.0 unit	$350.00 /unit	$7,350				$350/unit - Wood Frame - Variances depending on final installation type (Voltage, location, bulkheads etc)
Reduced SHGC to 0.2	n/a	n/a		n/a	n/a		n/a	n/a		n/a	n/a					
Small windows													587.0 sf	$2.00 /sf	$1,174	Cheaper upgrade for wood frame because of thinner glass
Sidelight													328.3 sf	$2.00 /sf	$657	
Doors													256.4 sf	$2.00 /sf	$513	
Total project cost		number of floors * by number of floors														
Total Façade Area (m^2)			3,743			3,743			3,743			3,743			3,743	
Total Floor Area (m^2)			-			-			-			-			-	
Cost per Floor (Typical Level)			$287,501			$286,556			$390,750			$586,848			$288,899	
Cost per m^2 (Per Floor Area)			$171.95			$171			$234			$351			$173	
Façade Cost ($/$m^2$)			$460.86			$459			$626			$941			$463	
Incremental Cost ($, vs. Baseline Façade)						-$945			$103,249			$299,347			$1,398	
Incremental Cost (% vs. Baseline Façade)						-0.3%			35.9%			104.1%			0.5%	

Example Total Project Cost (Altus Benchmark, 2025)

		Bundle 1	Bundle 2	Bundle 3	Bundle 4
Altus Group Cost (2025 Vancouver MURB, Including Below-Grade Areas)	$45,380,859				
Baseline Façade Cost (20% of Total Construction Cost)	$9,076,172				
Bundle Façade Cost (Per Scenario)		$9,046,334	$12,335,652	$18,526,300	$9,120,317
Incremental Façade Cost (vs. Baseline)		($29,838)	$3,259,480	$9,450,128	$44,145
Incremental Cost (% of Total Project Cost – Scaled)		-0.1%	7.2%	20.8%	0.1%
Estimated Total Project Cost with Bundle (Baseline + Incremental Façade Cost)		$45,351,020	$48,640,338	$54,830,987	$45,425,004

NOTES:

- Costs are based on 2025 Vancouver market conditions, informed by Peak Construction Group trade and market analysis, with Altus Group benchmarks used for additional cost context.
- Project-level cost impacts are derived by scaling façade cost changes using an assumed 20% enclosure contribution to total construction cost (Altus benchmark).
- Incremental façade costs reflect enclosure-related scope only; all other project costs are held constant across scenarios.
- Values are Class D (indicative) and intended for comparative analysis, not project-specific pricing.
- Incremental cost as a percentage of total project cost decreases with building scale, reflecting the reduced proportional contribution of façade costs within larger, more system- and structure-dominated buildings.

10.7639151 **ft2-m2**

Archetype 2 — [12 Storey] Detailed Cost Breakdown

This table provides a detailed cost breakdown of façade components for the baseline condition and each passive strategy bundle, forming the basis for the summary cost comparisons presented in this appendix.

Items	(WWR reduced to 40%, 100% operable windows)			(WWR reduced to 20%, 100% operable windows)			(WWR reduced to 30%, External fixed shading to S façade / operable on the E / W facades, 100% operable windows)			(WWR reduced to 30%, Electrochromic glazing on E/S/W facades, 100% operable windows)			(WWR reduced to 30%, Reduced SHGC 0.20, 100% operable windows)			Comments/ Notes
	Baseline			**Bundle 1**			**Bundle 2**			**Bundle 3**			**Bundle 4**			
High-Rise 12 storey																
# of stories above grade	12			12			12			12			12			
# of stories below grade	2			2			2			2			2			
MFA	124,033 sf			124,033 sf			124,033 sf			124,033 sf			124,033 sf			
GFA	161,868 sf			161,868 sf			161,868 sf			161,868 sf			161,868 sf			
Total Area Above Grade	102,688 sf			102,688 sf			102,688 sf			102,688 sf			102,688 sf			
Total Area Below Grade	59,180 sf			59,180 sf			59,180 sf			59,180 sf			59,180 sf			
Total Residential Suite Areas	85,175 sf			85,175 sf			85,175 sf			85,175 sf			85,175 sf			
Floor plate area	8,063 sf			8,063 sf			8,063 sf			8,063 sf			8,063 sf			
Perimeter length	379 lf			379 lf			379 lf			379 lf			379 lf			
Facade area	40,671 sf			40,671 sf			40,671 sf			40,671 sf			40,671 sf			
Floor to floor height	8.9 lf			8.9 lf			8.9 lf			8.9 lf			8.9 lf			
Glazing	40%			20%			30%			30%			30%			
Operable windows	100%	what is industry sta		100%			100%			100%			100%			
SHGC	0.3			No Shading			Fixed S Shad						0.2			
Cladding	Composite A			Composite A			Composite A			Composite A			Composite A			
	Qty	**Rate**	**Price**	**Qty**	**Rate**	**Price**	**Qty**	**Rate**	**Price**	**Qty**	**Rate**	**Price**	**Qty**	**Rate**	**Price**	
Cladding	1999.4 sf	$90.00 /sf	$179,947	2706.9 sf	$90.00 /sf	$243,624	2377.2 sf	$90.00 /sf	$213,950	2377.2 sf	$90.00 /sf	$213,950	2377.2 sf	$90.00 /sf	$213,950	Difference in cost due to window size
Large windows	1265.8 sf	$95.00 /sf	$120,255	0 sf	$95.00 /sf	$0	0 sf	$95.00 /sf	$0	0 sf	$95.00 /sf	$0	0 sf	$95.00 /sf	$0	$5/SF Brite Blinds: Manual Roller shade (0-3%) - 3" L shaped extruded aluminum fascia
Small windows	113 sf	$95.00 /sf	$10,737	671.4 sf	$95.00 /sf	$63,778	1001.1 sf	$95.00 /sf	$95,100	1001.1 sf	$95.00 /sf	$95,100	1001.1 sf	$95.00 /sf	$95,100	Aluminum slats - not solid
Doors	11 ea	$3,000.00 ea	$33,000	11 ea	$3,000.00 ea	$33,000	11 ea	$3,000.00 ea	$33,000	11 ea	$3,000.00 ea	$33,000	11 ea	$3,000.00 ea	$33,000	Priced as roll-shutters. Complete black out when fully rolled down
Operable window premium	239.7 sf	$10.00 /sf	$2,397	329.4 sf	$10.00 /sf	$3,294	218.8 sf	$10.00 /sf	$2,188	219.6 sf	$10.00 /sf	$2,196	219.6 sf	$10.00 /sf	$2,196	
Interior blinds	1551.7 sf	$5.00 /sf	$7,759	807.5 sf	$5.00 /sf	$4,038	1173.9 sf	$5.00 /sf	$5,870	1173.9 sf	$5.00 /sf	$5,870	1173.9 sf	$5.00 /sf	$5,870	
External fixed shading to S	n/a	n/a		n/a	n/a		40.7 lf	$150.00 /lf	$6,103	n/a	n/a		n/a	n/a		$500/unit - more expensive for concrete building - Variances depending on final installation type (Voltage, location, bulkheads etc)
External roller shading to E/W	n/a	n/a		n/a	n/a		467.2 sf	$59.80 /sf	$27,936	n/a	n/a		n/a	n/a		
Blocking							21.7 lf	$35.00 /lf	$760							
Rigid							21.7 lf	$30.00 /lf	$651							
Electrical							8 unit	$500.00 /unit	$4,000							$500/unit - more expensive for concrete building - Variances depending on final installation type (Voltage, location, bulkheads etc)
Electrochromic E/S/W	n/a	n/a		n/a	n/a		n/a	n/a					n/a	n/a		
Small windows										620.7 sf	$250.00 /sf	$155,183				More expensive upgrade for concrete build - thicker glass
Doors										125.9 sf	$250.00 /sf	$31,485				
Electrical										9 unit	$500.00 /unit	$4,500				
Reduced SHGC to 0.2 E/S/W	n/a	n/a		n/a	n/a		n/a	n/a		n/a	n/a					
Small windows													620.7 sf	$7.00 /sf	$4,345	
Doors													125.9 sf	$7.00 /sf	$882	
Total Façade Area (m^2)			**3,778**			**3,778**			**3,778**			**3,778**			**3,778**	
Total Floor Area (m^2)			**15,038**			**15,038**			**15,038**			**15,038**			**15,038**	
Cost per Floor (Typical Level)			**$354,095**			**$347,733**			**$389,557**			**$541,283**			**$355,342**	
Cost per m^2 (Per Floor Area)			**$473**			**$464**			**$520**			**$723**			**$474**	
Façade Cost ($/$m^2$)			**$1,125**			**$1,104**			**$1,237**			**$1,719**			**$1,129**	
Incremental Cost ($, vs. Baseline Façade)						**-$6,362**			**$35,462**			**$187,189**			**$1,248**	
Incremental Cost (% vs. Baseline Façade)						**-1.80%**			**10.00%**			**52.90%**			**0.40%**	

Example Total Project Cost (Altus Benchmark, 2025)

		Bundle 1	Bundle 2	Bundle 3	Bundle 4
Altus Group Cost (2025 Vancouver MURB, Including Below-Grade Areas)	**$51,344,563**				
Baseline Façade Cost (20% of Total Construction Cost)	**$10,268,913**				
Bundle Façade Cost (Per Scenario)		**$10,084,416**	**$11,297,334**	**$15,697,469**	**$10,305,094**
Incremental Façade Cost (vs. Baseline)		**-$184,497**	**$1,028,421**	**$5,428,556**	**$36,181**
Incremental Cost (% of Total Project Cost – Scaled)		**-0.40%**	**2.00%**	**10.60%**	**0.10%**
Estimated Total Project Cost with Bundle (Baseline + Incremental Façade Cost)		**$51,160,066**	**$52,372,984**	**$56,773,119**	**$51,380,744**

NOTES:

- Costs are based on 2025 Vancouver market conditions, informed by Peak Construction Group trade and market analysis, with Altus Group benchmarks used for additional cost context.
- Project-level cost impacts are derived by scaling façade cost changes using an assumed 20% enclosure contribution to total construction cost (Altus benchmark).
- Incremental façade costs reflect enclosure-related scope only; all other project costs are held constant across scenarios.
- Values are Class D (indicative) and intended for comparative analysis, not project-specific pricing.
- Incremental cost as a percentage of total project cost decreases with building scale, reflecting the reduced proportional contribution of façade costs within larger, more system- and structure-dominated buildings.

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Archetype 3 — [35 Storey] Detailed Cost Breakdown

This table provides a detailed cost breakdown of façade components for the baseline condition and each passive strategy bundle, forming the basis for the summary cost comparisons presented in this appendix.

	Baseline	Bundle 1	Bundle 2	Bundle 3	Bundle 4	Comments/ Notes
	(WWR reduced to 40%, 100% operable windows)	(WWR reduced to 20%, 100% operable windows)	(WWR reduced to 30%, External fixed shading to S façade / operable on the E / W facades, 100% operable windows)	(WWR reduced to 30%, Electrochromic glazing on E/S/W facades, 100% operable windows)	(WWR reduced to 30%, Reduced SHGC 0.20, 100% operable windows)	
High-Rise 35 storey						
# of stories above grade	35	35	35	35	35	
# of stories below grade	4	4	4	4	4	
MFA	332,702 sf	332,702 sf	332,702 sf	332,702 sf	332,702 sf	
GFA	453,968 sf	453,968 sf	453,968 sf	453,968 sf	453,968 sf	
Total Area Above Grade	314,618 sf	314,618 sf	314,618 sf	314,618 sf	314,618 sf	
Total Area Below Grade	139,350 sf	139,350 sf	139,350 sf	139,350 sf	139,350 sf	
Total Residential Suite Areas	235,934 sf	235,934 sf	235,934 sf	235,934 sf	235,934 sf	
Floor plate area	7,619 sf	7,619 sf	7,619 sf	7,619 sf	7,619 sf	
Facade area	110,554 sf	110,554 sf	110,554 sf	110,554 sf	110,554 sf	
Perimeter length	353.42 lf	353.42 lf	353.42 lf	353.42 lf	353.42 lf	
Floor to floor height	8.9 lf	8.9 lf	8.9 lf	8.9 lf	8.9 lf	
Glazing	40%	20%	30%	30%	30%	
Operable windows	100%	100%	100%	100%	100%	
SHGC	0.3	No Shading	Fixed S Shading, Operable E/W Shading	(3) Electrochrom	0.2	
Cladding	Composite Aluminum Panel	Composite Aluminum Panel	Composite Aluminum Panel	Composite Alum	Composite Alum	

	Baseline Qty	Baseline Rate	Baseline Price	Bundle 1 Qty	Bundle 1 Rate	Bundle 1 Price	Bundle 2 Qty	Bundle 2 Rate	Bundle 2 Price	Bundle 3 Qty	Bundle 3 Rate	Bundle 3 Price	Bundle 4 Qty	Bundle 4 Rate	Bundle 4 Price	Comments/ Notes
Cladding	1807.3 sf	$90.00 /sf	$162,658	2552.9 sf	$90.00 /sf	$229,764	2135.8 sf	$90.00 /sf	$192,225	2135.8 sf	$90.00 /sf	$192,225	2135.8 sf	$90.00 /sf	$192,225	
Windows	1293 sf	$95.00 /sf	$122,832	596.8 sf	$95.00 /sf	$56,692	964.5 sf	$95.00 /sf	$91,623	964.5 sf	$95.00 /sf	$91,623	964.5 sf	$95.00 /sf	$91,623	
Transom	49.4 sf	$95.00 /sf	$4,694	0 sf	$95.00 /sf	$0	49.4 sf	$95.00 /sf	$4,694	49.4 sf	$95.00 /sf	$4,694	49.4 sf	$95.00 /sf	$4,694	
Doors	9 ea	$3,000.00 ea	$27,000	9 ea	$3,000.00 ea	$27,000	9 ea	$3,000.00 ea	$27,000	9 ea	$3,000.00 ea	$27,000	9 ea	$3,000.00 ea	$27,000	
Operable window premium	242.2 sf	$10.00 /sf	$2,422	235.3 sf	$10.00 /sf	$2,353	204.2 sf	$10.00 /sf	$2,042	204.9 sf	$10.00 /sf	$2,049	204.9 sf	$10.00 /sf	$2,049	
Interior blinds	1483.6 sf	$5.00 /sf	$7,418	738.2 sf	$5.00 /sf	$3,691	1155.3 sf	$5.00 /sf	$5,777	1155.3 sf	$5.00 /sf	$5,777	1155.3 sf	$5.00 /sf	$5,777	$5/SF Brite Blinds: Manual Roller shade (0-3%) - 3" L shaped extruded aluminum fascia
External fixed shading to S	n/a	n/a		n/a	n/a		31.5 lf	$150.00 /lf	$4,725	n/a	n/a		n/a	n/a		Aluminum slats - not solid
External roller shading to E/W	n/a	n/a		n/a	n/a		516.7 sf	$59.60 /sf	$30,794	n/a	n/a		n/a	n/a		Priced as roll-shutters. Complete black out when fully rolled down. No roller-shutters to door transom.
Blocking							24 lf	$35.00 /lf	$840							
Rigid							24 lf	$30.00 /lf	$720							
Electrical							6 unit	$500.00 /unit	$3,000							$500/unit - more expensive for concrete building - Variances depending on final installation type (Voltage, location, bulkheads etc)
Electrochromatic E/S/W	n/a	n/a		n/a	n/a		n/a	n/a					n/a	n/a		
Small windows										614.7 sf	$250.00 /sf	$153,676				
Transom										31.8 sf	$250.00 /sf	$7,949				
Doors										110.2 sf	$250.00 /sf	$27,549				
Electrical										7 unit	$500.00 /unit	$3,500				$500/unit - more expensive for concrete building - Variances depending on final installation type (Voltage, location, bulkheads etc)
Reduced SHGC to 0.2 E/S/W	n/a	n/a		n/a	n/a		n/a	n/a		n/a	n/a					
Small windows													614.7 sf	$7.00 /sf	$4,303	More expensive upgrade for concrete build - thicker glass
Transom													31.8 sf	$7.00 /sf	$223	
Doors													110.2 sf	$7.00 /sf	$771	
Total Façade Area (m^2)			**10,271**			**10,271**			**10,271**			**10,271**			**10,271**	
Total Floor Area (m^2)			**42,175**			**42,175**			**42,175**			**42,175**			**42,175**	Difference
Cost per Floor (Typical Level)			**$327,024**			**$319,500**			**$363,438**			**$516,042**			**$328,664**	
Cost per m^2 (Per Floor Area)			**$462**			**$451**			**$513**			**$729**			**$464**	
Façade Cost ($/$m^2$)			**$1,114**			**$1,089**			**$1,238**			**$1,759**			**$1,120**	
Incremental Cost ($, vs. Baseline Façade)						**-$7,525**			**$36,414**			**$189,018**			**$1,640**	
Incremental Cost (% vs. Baseline Façade)						**-2.30%**			**11.10%**			**57.80%**			**0.50%**	

Example Total Project Cost (Altus Benchmark, 2025)

		Bundle 1	Bundle 2	Bundle 3	Bundle 4
Altus Group Cost (2025 Vancouver MURB, Including Below-Grade Areas)	**$160,267,305**				
Baseline Façade Cost (20% of Total Construction Cost)	**$32,053,461**				
Bundle Façade Cost (Per Scenario)		**$31,315,917**	**$35,622,577**	**$50,580,157**	**$32,214,207**
Incremental Façade Cost (vs. Baseline)		**-$737,544**	**$3,569,116**	**$18,526,696**	**$160,746**
Incremental Cost (% of Total Project Cost – Scaled)		**-0.50%**	**2.20%**	**11.60%**	**0.10%**
Estimated Total Project Cost with Bundle (Baseline + Incremental Façade Cost)		**$159,529,760**	**$163,836,420**	**$178,794,001**	**$160,428,050**

NOTES:

- Costs are based on 2025 Vancouver market conditions, informed by Peak Construction Group trade and market analysis, with Altus Group benchmarks used for additional cost context.
- Project-level cost impacts are derived by scaling façade cost changes using an assumed 20% enclosure contribution to total construction cost (Altus benchmark).
- Incremental façade costs reflect enclosure-related scope only; all other project costs are held constant across scenarios.
- Values are Class D (indicative) and intended for comparative analysis, not project-specific pricing.
- Incremental cost as a percentage of total project cost decreases with building scale, reflecting the reduced proportional contribution of façade costs within larger, more system- and structure-dominated buildings.

10.7639151 **ft2-m2**

Appendices

APPENDIX C — CONSTRUCTABILITY AND MARKET AVAILABILITY METHODOLOGY AND INPUTS

Appendix C Constructability and Market Availability

This appendix presents a review of market availability and constructability considerations for passive design strategies across the study archetypes. The assessment is based on engagement with trades and suppliers to confirm availability within the local market and to identify typical construction considerations.

This is not a readiness or delivery assessment, but a high-level review of whether strategies are currently available and how they are typically implemented in practice.

This review complements the cost analysis (Appendix B) and performance evaluation (Appendix F), providing context on whether strategies can be sourced and constructed using current market practices.

			Archetype 1 **Mid-Rise 6 Storeys**		**Archetype 2** **High-Rise 12 Storeys**		**Archetype 3** **High-Rise 35 Storey**	
Bundle	**Measures**	**Comments / Notes**	**Market Availability**	**Constructability Issues**	**Market Availability**	**Constructability Issues**	**Market Availability**	**Constructability Issues**
Bundle 1 (Costing Exercise)	WWR reduced to 20%	lowest WWR; relies on full operability for purge and night cooling. Verify cross-vent area and indoor air quality when windows are closed.	Yes	None	Yes	None	Yes	None
	100% openable windows		Yes	- Extra large openable windows could cost more depending on LxW and opening direction.	Yes	- Extra large openable windows could cost more depending on LxW and opening direction.	Yes	- Extra large openable windows could cost more depending on LxW and opening direction.
Bundle 2 (Costing Exersize)	WWR reduced to 30%	Increasing WWR compensated with openable exterior shading. Check wind-lock, maintenance, and occupant behaviour implications.	Yes		Yes	None	Yes	None
	External fixed shading to S façade / openable on the E / W		Fixed - Availible and common openable - Can be roller shades or openable mesh screen. Not widely used in Canada	-assume attachement to wall not windows -enevlope penetrations need to be coordinated - structural coordination depending on size	Fixed - Availible openable - Can be roller shades or openable mesh screen. Not widely used in Canada	-could attach to windows or caldding -enevlope penetrations need to be coordinated - structural requirements	Fixed - Availible openable - Can be roller shades or openable mesh screen. Not widely used in Canada	-attachement to window all OK -typical sizes 4-16" -vertical installed with WW -horizontal installed after WW compelte with swing stage $$
	100% openable windows		Yes	- Extra large openable windows could cost more depending on LxW and opening direction.	Yes	- Extra large openable windows could cost more depending on LxW and opening direction.	Yes	- Extra large openable windows could cost more depending on LxW and opening direction.
Bundle 3 (Costing Exercise)	WWR reduced to 30%	Increasing WWR compensated with dynamic glazing. Validate control logic (fail-safe state), glare management, and embodied-carbon trade-offs. ACTION: market feasibility of Electrochromic/ Thermochromic and functionality, i.e. does the system turn opaque when 'off'.	Yes		Yes	None	Yes	None
	Electrochromic glazing on E/S/W facades		- Exterior grade dual pane product exists but not commonly used. - Limted local product. Manufactured mostly USA or Asia	-Electrical connections to come from unit electrical panel -Maintenance requirements -Product life span 15-25 years -Cost for use passed to tenant or owner.	- Exterior grade dual pane product exists but not commonly used. - Limted local product. Manufactured mostly USA or Asia	-Electrical connections to come from unit electrical panel -Maintenance requirements -Product life span 15-25 years -Cost for use passed to tenant or owner.	- Exterior grade dual pane product exists but not commonly used. - Limted local product. Manufactured mostly USA or Asia	Electrical connections to come from unit electrical panel -Maintenance requirements -Product life span 15-25 years -Cost for use passed to tenant or owner.
	100% openable windows		Yes	- Extra large openable windows could cost more depending on LxW and opening direction.	Yes	- Extra large openable windows could cost more depending on LxW and opening direction.	Yes	- Extra large openable windows could cost more depending on LxW and opening direction.
Bundle 4 (Costing Exercise)	WWR reduced to 30%	Lower SHGC would impact glazing aesthetic	Yes		Yes	None	Yes	None
	Reduced SHGC 0.20		Products exist in market to acheive SHGC 0.20. Typically Low E Tripple Silver +	May require some level or tinting to achieve.	Products exist in market to acheive SHGC 0.20. Typically Low E Tripple Silver +	-May require some level or tinting to achieve. -Pricing can increase on high rise due to glass strength requirements	Products exist in market to acheive SHGC 0.20. Typically Low E Tripple Silver +	-May require some level or tinting to achieve. -Pricing can increase on high rise due to glass strength requirements
	100% openable windows		Yes	- Extra large openable windows could cost more depending on LxW and opening direction.	Yes	- Extra large openable windows could cost more depending on LxW and opening direction.	Yes	- Extra large openable windows could cost more depending on LxW and opening direction.

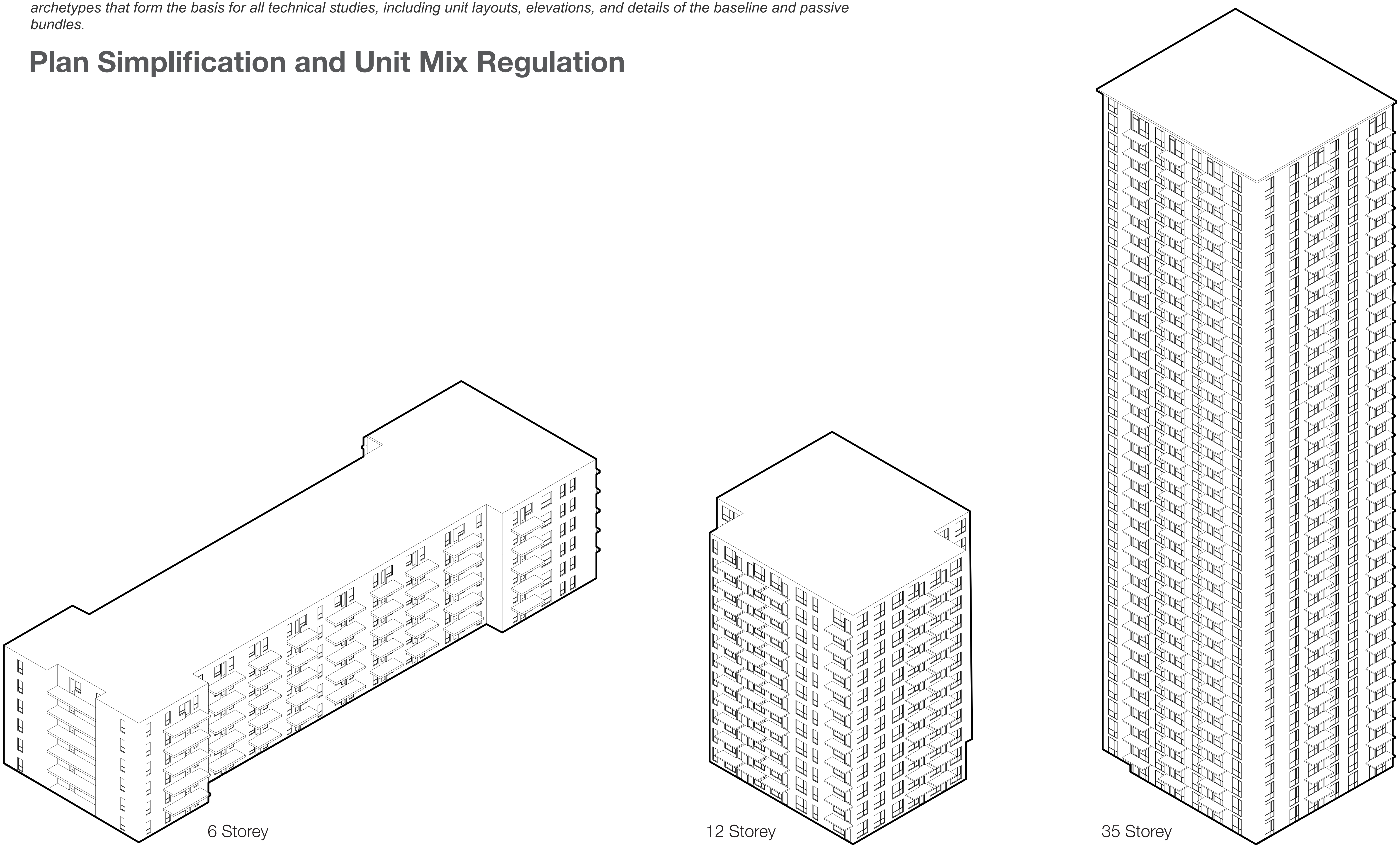
• Assessment is based on input from trades, suppliers, and typical industry practice; it is not a detailed procurement or delivery review.
• Availability reflects current market conditions in Metro Vancouver and may vary by supplier, project scale, and timing.
• Constructability considerations are indicative and subject to project-specific design, coordination, and procurement approaches.
• No pricing validation is included; refer to Appendix B for cost analysis.

Appendices

APPENDIX D — SUMMARY OF ARCHETYPE ARCHITECTURAL INPUTS

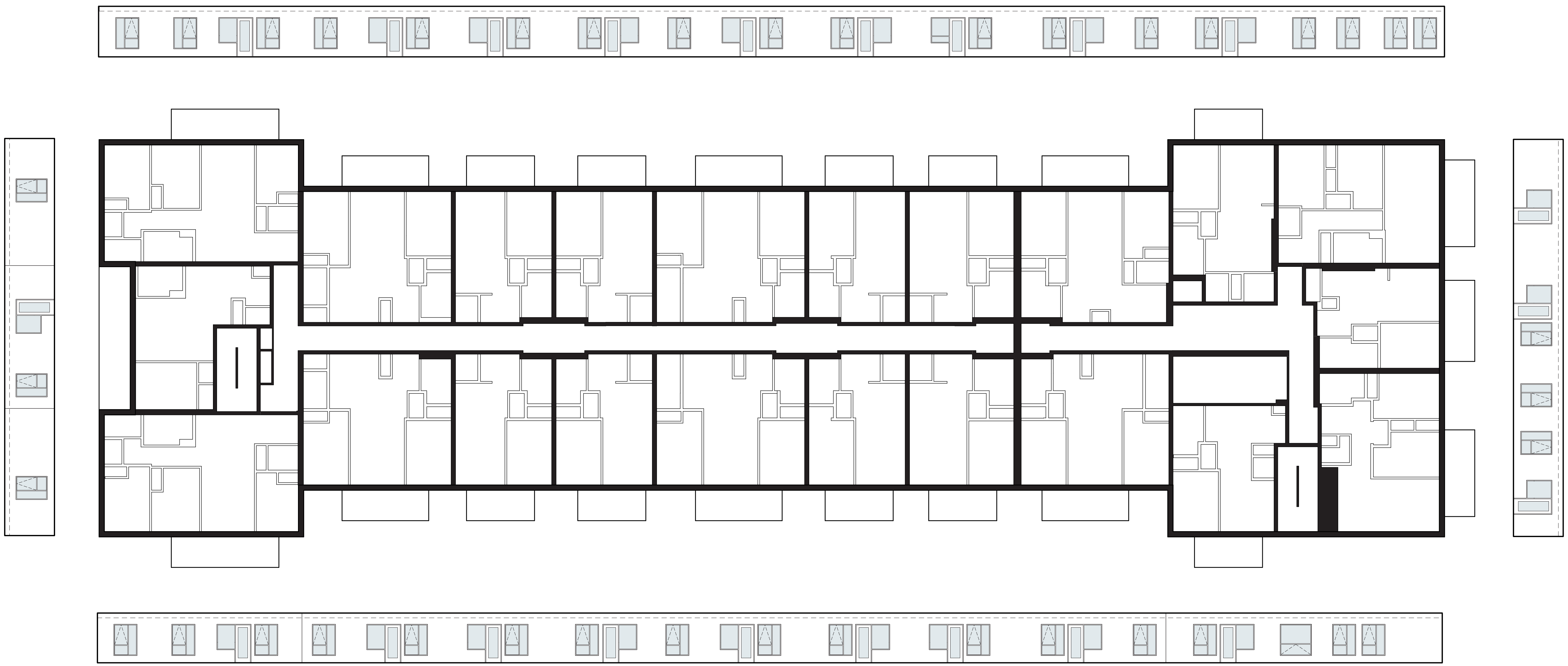
This appendix includes excerpts from TRiM sketches generated by Ryder Architecture, illustrating configurations of the studied archetypes that form the basis for all technical studies, including unit layouts, elevations, and details of the baseline and passive bundles.

Plan Simplification and Unit Mix Regulation



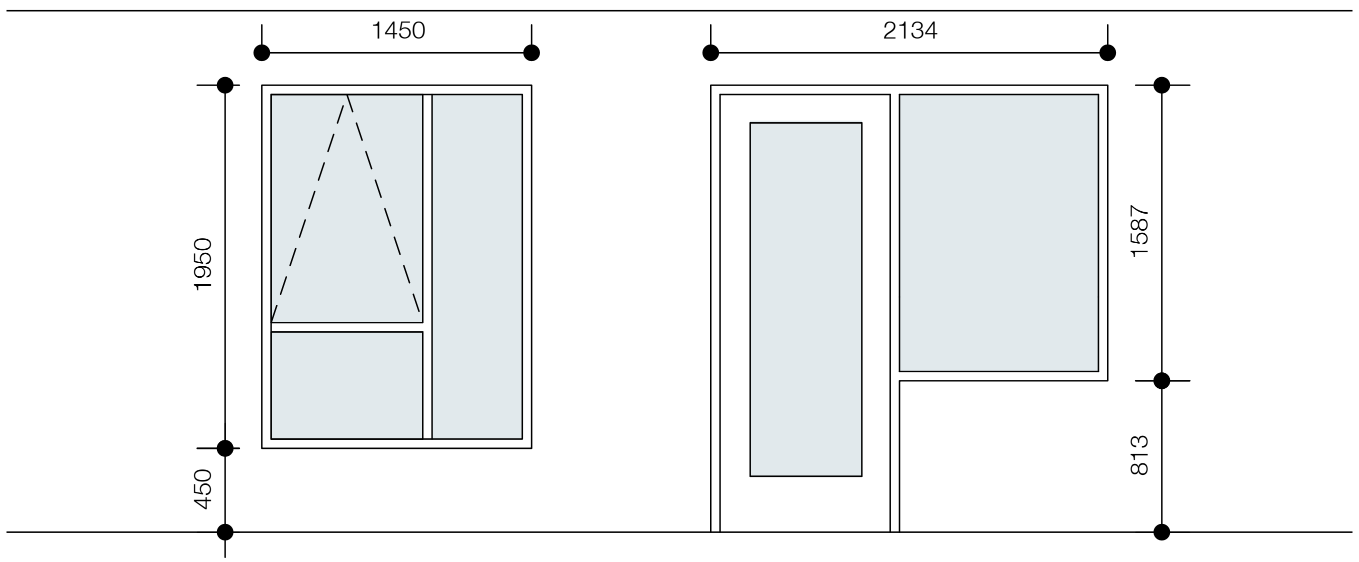
N

Baseline Assumptions
6 Storey

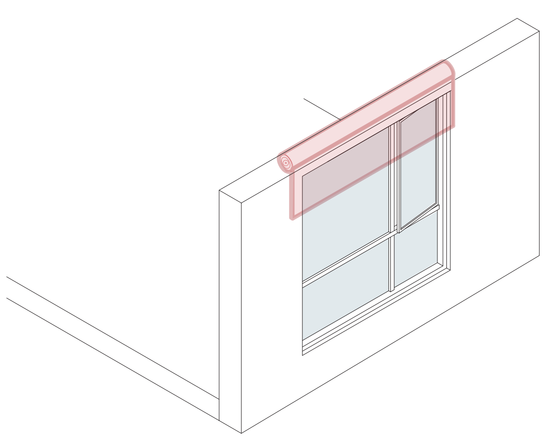


	6 stories					
	Wall area	Nb of W	Size of W	Nb of D	Size of D	Total
N	96.5	3	2.83	1	2.92	11.41
W	266	16	2.83	9	2.92	75.36
S	96.5	3	2.83	3	2.92	17.25
E	266	18	2.83	9	2.92	77.22
	725					181.24
	25%					

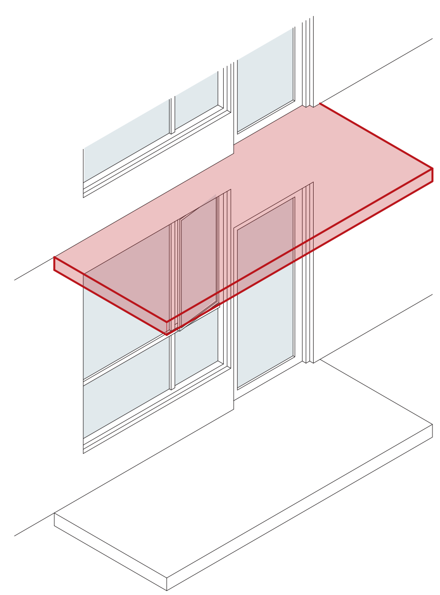
Baseline Assumptions
6 Storey



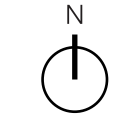
Size of windows and doors



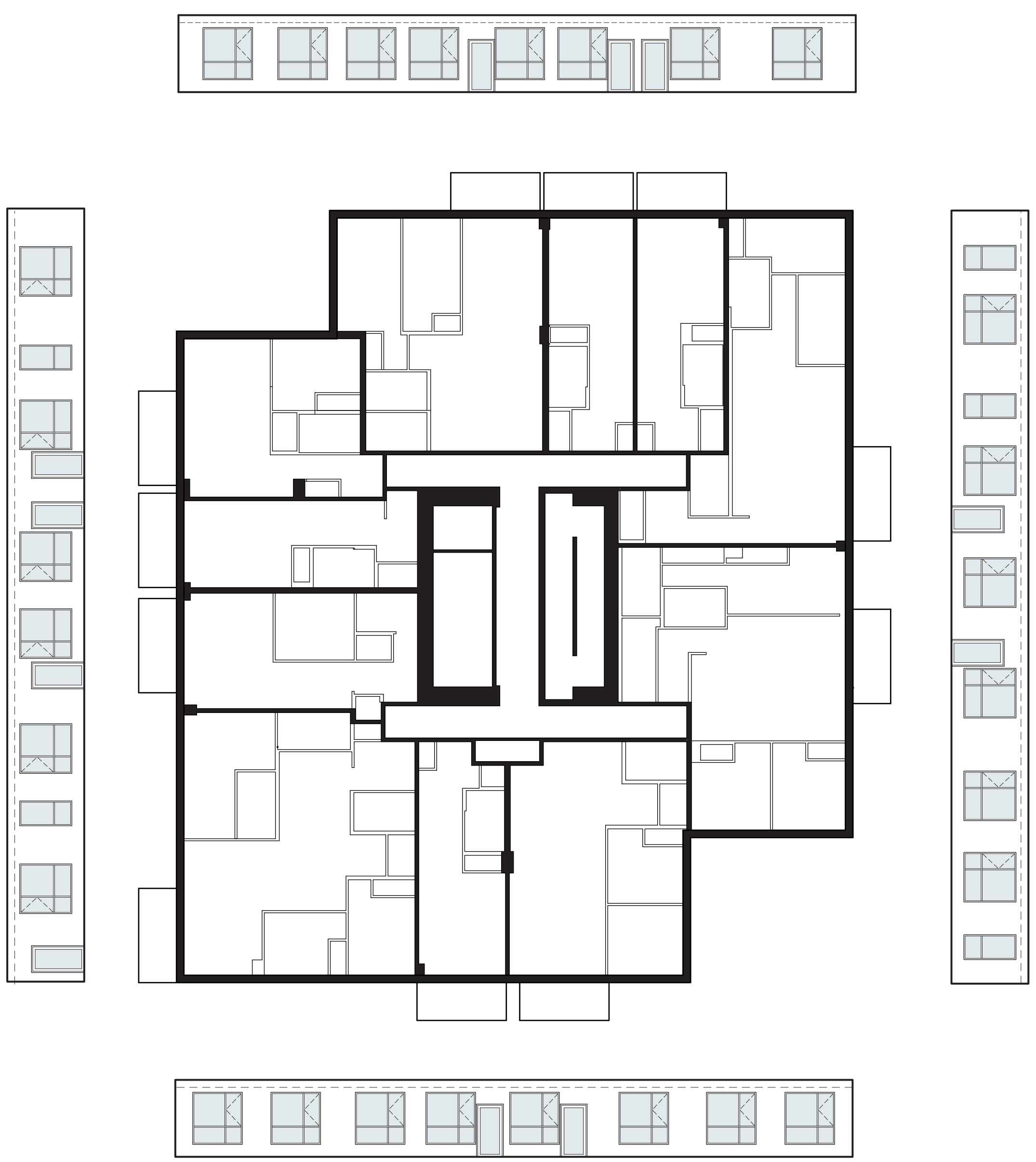
Interior blinds on all openings



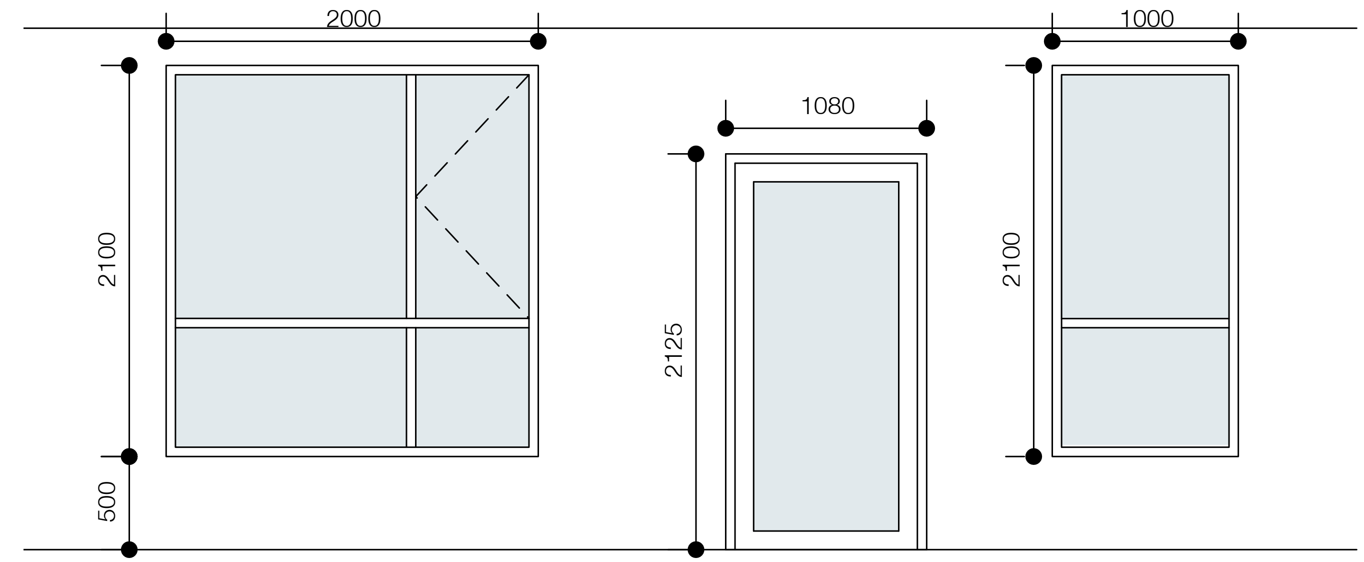
Overshade from balconies above
(5' deep)



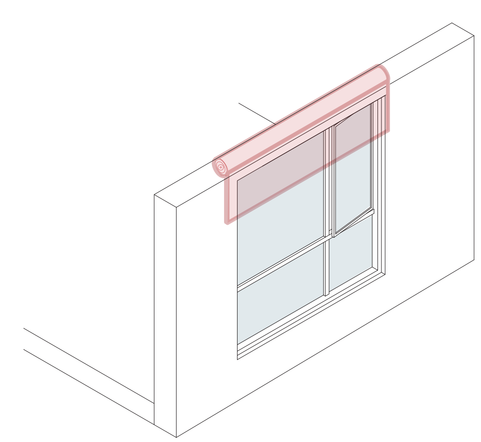
Baseline Assumptions
12 Storey



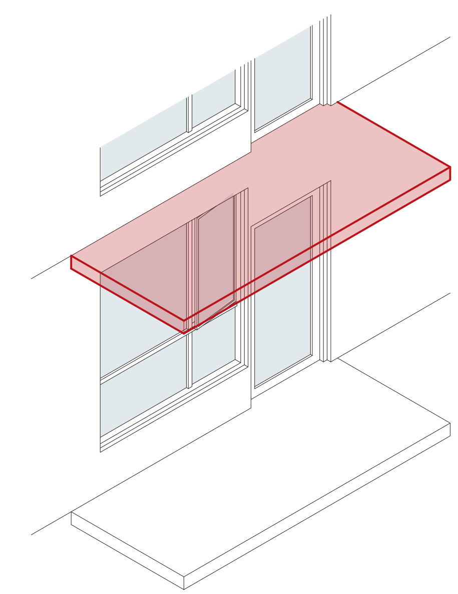
	12 stories					
	Wall area	Nb of W	Size of W	Nb of D	Size of D	Total
N	84.6	8	4.2	3	1.4625	37.9875
W	96.6	6	4.2	4	1.4625	31.05
S	84.6	8	4.2	2	1.4625	36.525
E	96.6	6	4.2	2	1.4625	28.125
	362.4	Small W	12.6			146.2875
	40.4%					



Size of windows and doors

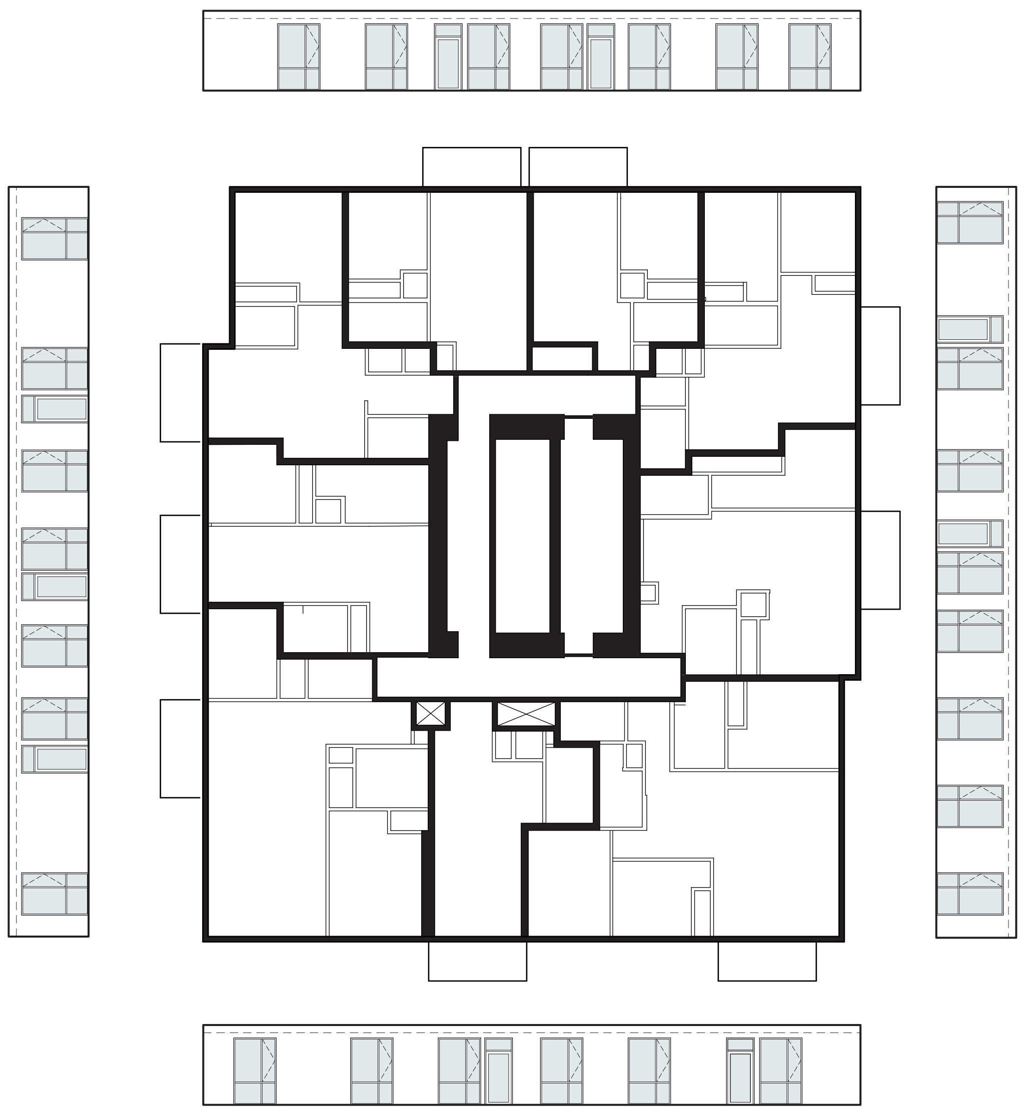


Interior blinds on all openings

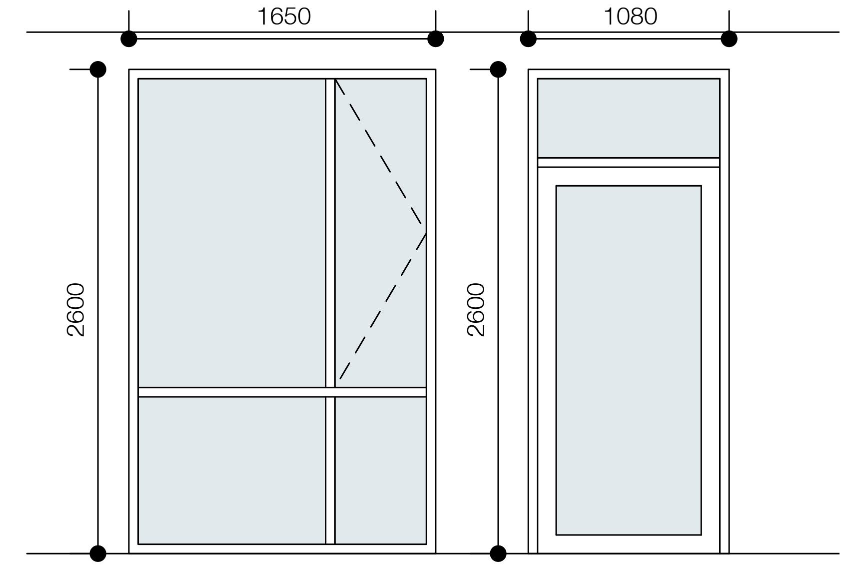


Overshade from balconies above
(5' deep)

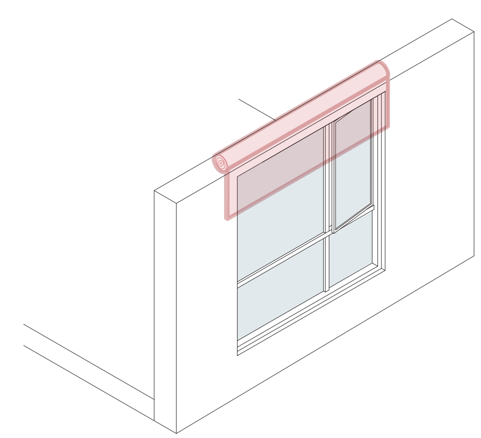
Baseline Assumptions
35 Storey



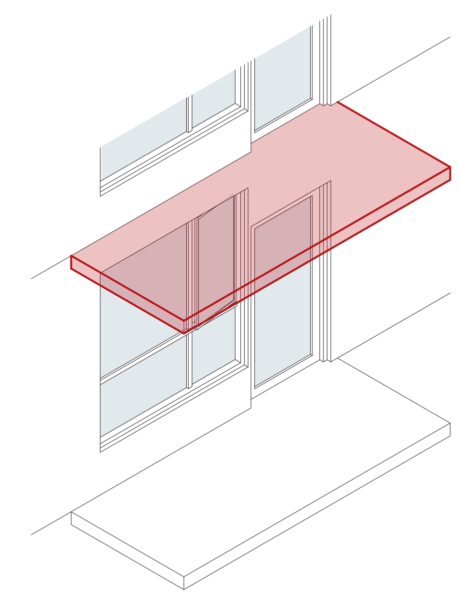
	35 stories					
	Wall area	Nb of W	Size of W	Nb of D	Size of D	Total
N	79.1	7	4.29	2	1.88	33.79
W	90.2	7	4.29	3	1.88	35.67
S	79.1	6	4.29	2	1.88	29.5
E	90.2	8	4.29	2	1.88	38.08
	338.6					137.04
	40.5%					



Size of windows and doors



Interior blinds on all openings



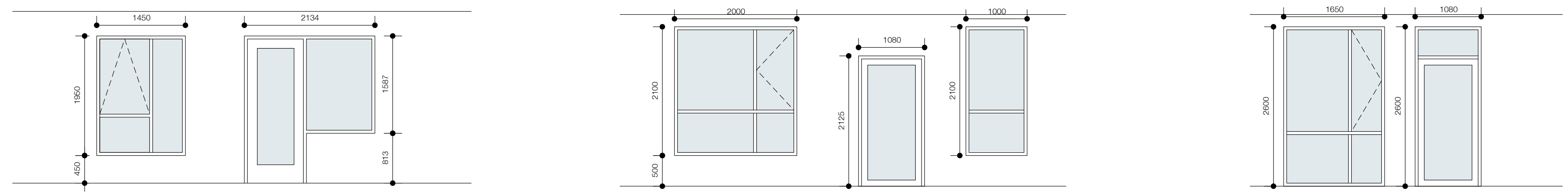
Overshade from balconies above
(5' deep)

Summary

6 Storey | 12 Storey | 35 Storey

BASELINE

All operable windows are expected to have controlled openings on them and open no more than 100mm.

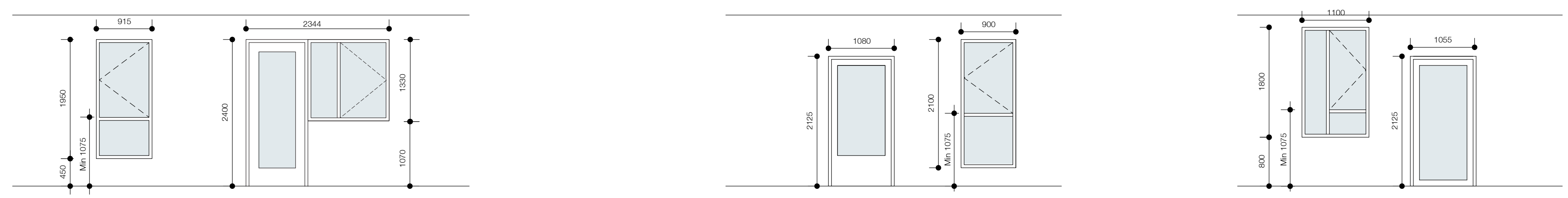


WWR 25% | WWR 40% | WWR 40%

BUNDLE 1

WWR	20%
Free opening windows (bedroom and living room)	

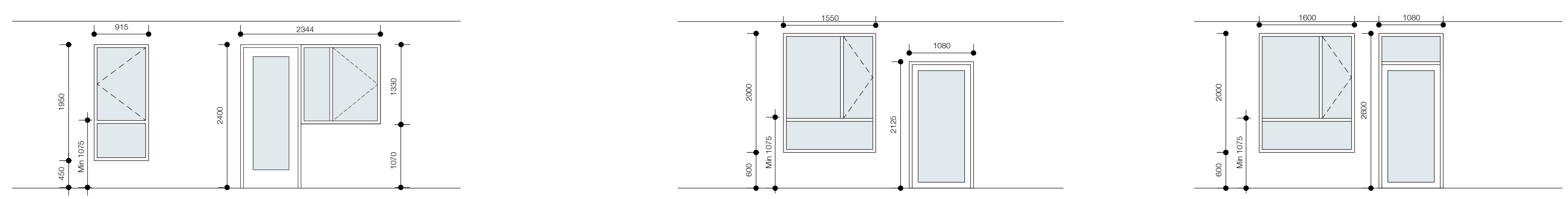
All openable windows higher than min 1075 are expected to be fully operable without the need for restrictors.



BUNDLE 2

WWR	30%
Free opening windows (bedroom and living room)	
Shading	Fixed and Operable

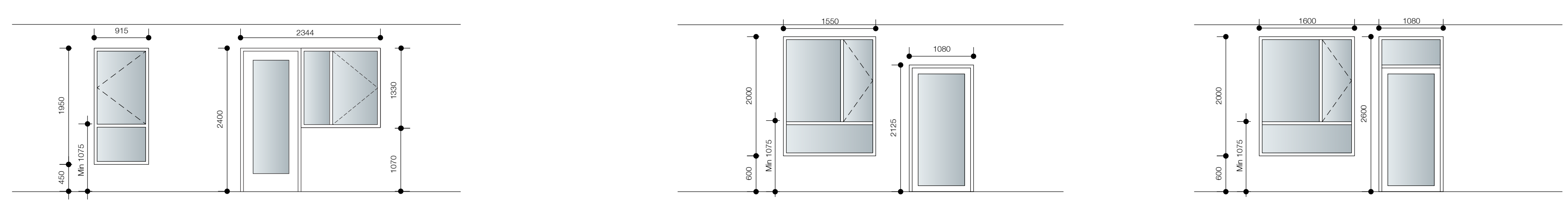
All openable windows higher than min 1075 are expected to be fully operable without the need for restrictors.



BUNDLE 3

WWR	30%
Free opening windows (bedroom and living room)	
Glass Properties	Electrochromatic glass

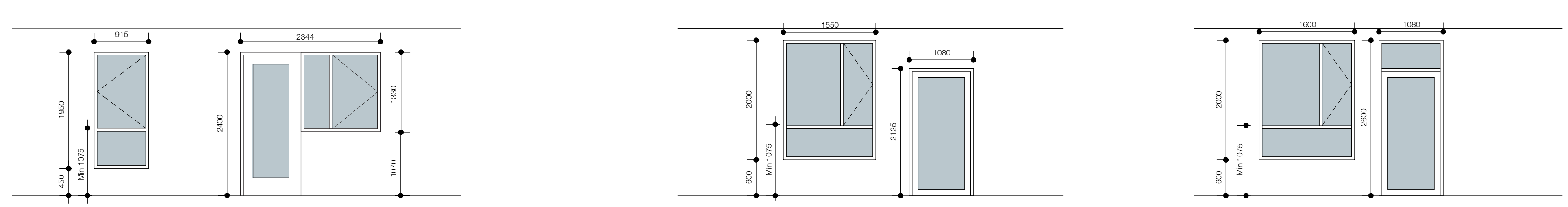
All openable windows higher than min 1075 are expected to be fully operable without the need for restrictors.



BUNDLE 4

WWR	30%
Free opening windows (bedroom and living room)	
Glass Properties	20% SHGC

All openable windows higher than min 1075 are expected to be fully operable without the need for restrictors.



Summary
Window Wall Ratio

BASELINE ARCHETYPES

	6 stories						12 stories						35 stories					
	Wall area	Nb of W	Size of W	Nb of D	Size of D	Total	Wall area	Nb of W	Size of W	Nb of D	Size of D	Total	Wall area	Nb of W	Size of W	Nb of D	Size of D	Total
N	96.5	3	2.83	1	2.92	11.41	84.6	8	4.2	3	1.4625	37.9875	79.1	7	4.29	2	1.88	33.79
W	266	16	2.83	9	2.92	75.36	96.6	6	4.2	4	1.4625	31.05	90.2	7	4.29	3	1.88	35.67
S	96.5	3	2.83	3	2.92	17.25	84.6	8	4.2	2	1.4625	36.525	79.1	6	4.29	2	1.88	29.5
E	266	18	2.83	9	2.92	77.22	96.6	6	4.2	2	1.4625	28.125	90.2	8	4.29	2	1.88	38.08
	725					181.24	362.4	Small W	12.6			146.2875	338.6					137.04
	25%						40.4%						40.5%					

BUNDLE 1 - 20% WWR

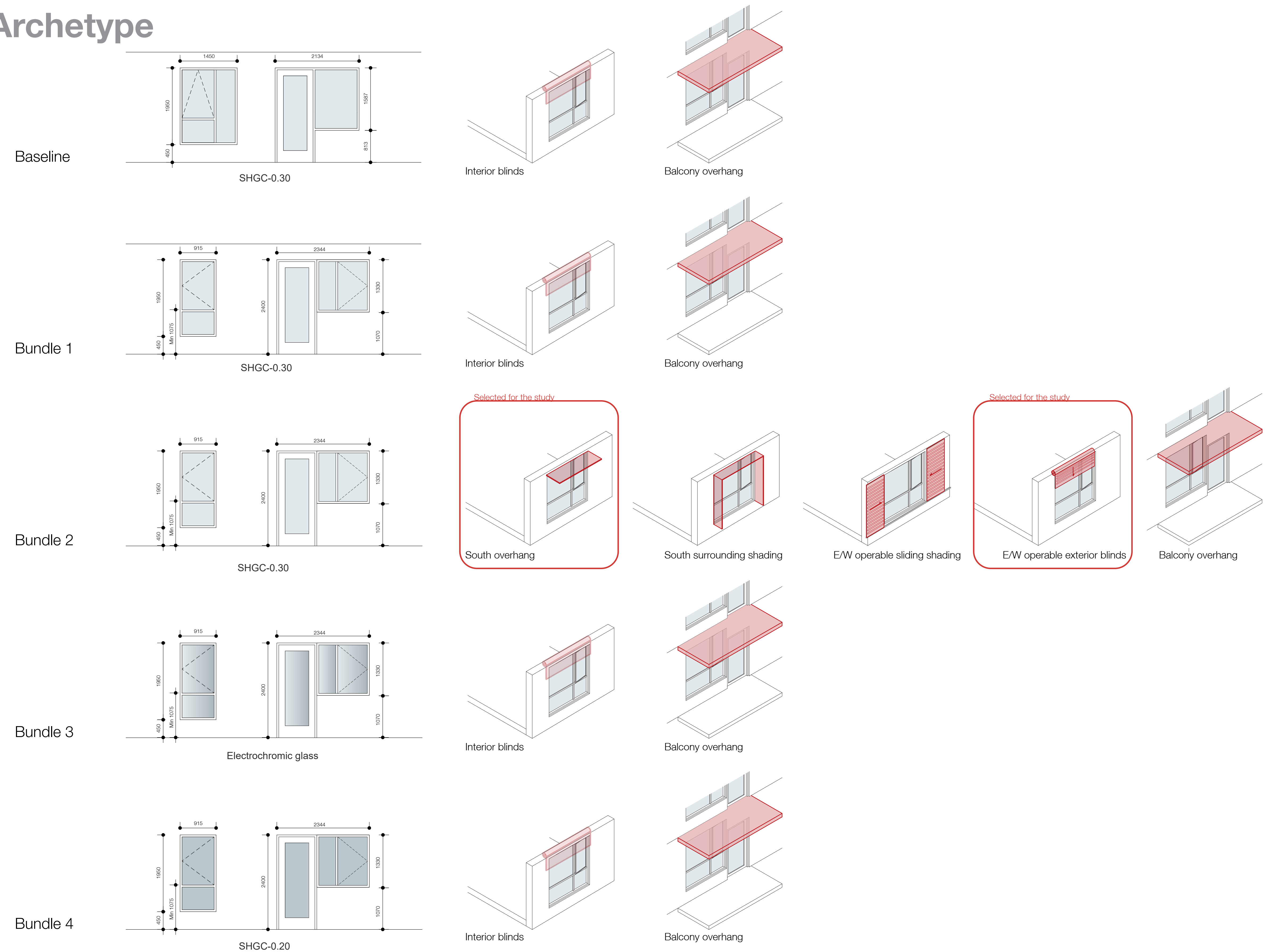
	6 stories						12 stories						35 stories					
	Wall area	Nb of W	Size of W	Nb of D	Size of D	Total	Wall area	Nb of W	Size of W	Nb of D	Size of D	Total	Wall area	Nb of W	Size of W	Nb of D	Size of D	Total
N	96.5	3	1.785	1	2.92	8.275	84.6	8	1.89	3	1.15	18.57	79.1	7	1.98	2	1.46	16.78
W	266	16	1.785	9	2.92	58.64	96.6	7	1.89	4	1.15	17.83	90.2	7	1.98	3	1.46	18.24
S	96.5	3	1.785	3	2.92	14.115	84.6	9	1.89	2	1.15	19.31	79.1	6	1.98	2	1.46	14.8
E	266	18	1.785	9	2.92	58.41	96.6	9	1.89	2	1.15	19.31	90.2	8	1.98	2	1.46	18.76
	725					139.44	362.4					75.02	338.6					68.58
	19%						20.7%						20.3%					

BUNDLE 2,3,4 - 30% WWR

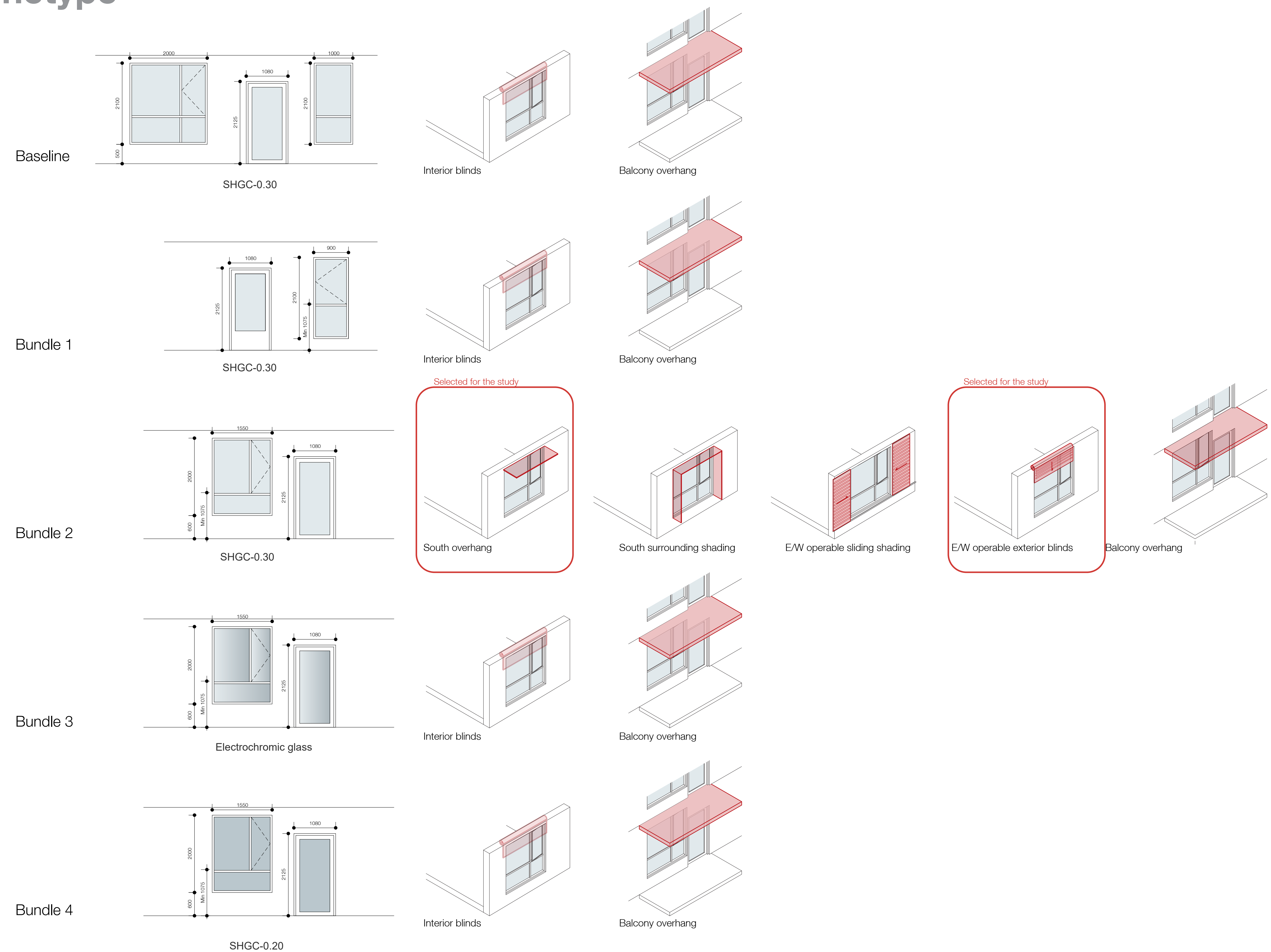
	6 stories						12 stories						35 stories					
	Wall area	Nb of W	Size of W	Nb of D	Size of D	Total	Wall area	Nb of W	Size of W	Nb of D	Size of D	Total	Wall area	Nb of W	Size of W	Nb of D	Size of D	Total
N	96.5	3	1.785	1	2.92	8.275	84.6	8	3.1	3	1.4625	29.1875	79.1	7	3.2	2	1.46	25.32
W	266	16	1.785	9	2.92	58.64	96.6	6	3.1	4	1.4625	24.45	90.2	7	3.2	3	1.46	26.78
S	96.5	3	1.785	3	2.92	14.115	84.6	8	3.1	2	1.4625	27.725	79.1	6	3.2	2	1.46	22.12
E	266	18	1.785	9	2.92	58.41	96.6	8	3.1	2	1.4625	27.725	90.2	8	3.2	2	1.46	28.52
	725					139.44	362.4					109.0875	338.6					102.74
	19%						30.1%						30.3%					

Note: All door areas only account for glass surfaces instead of entire door opening.

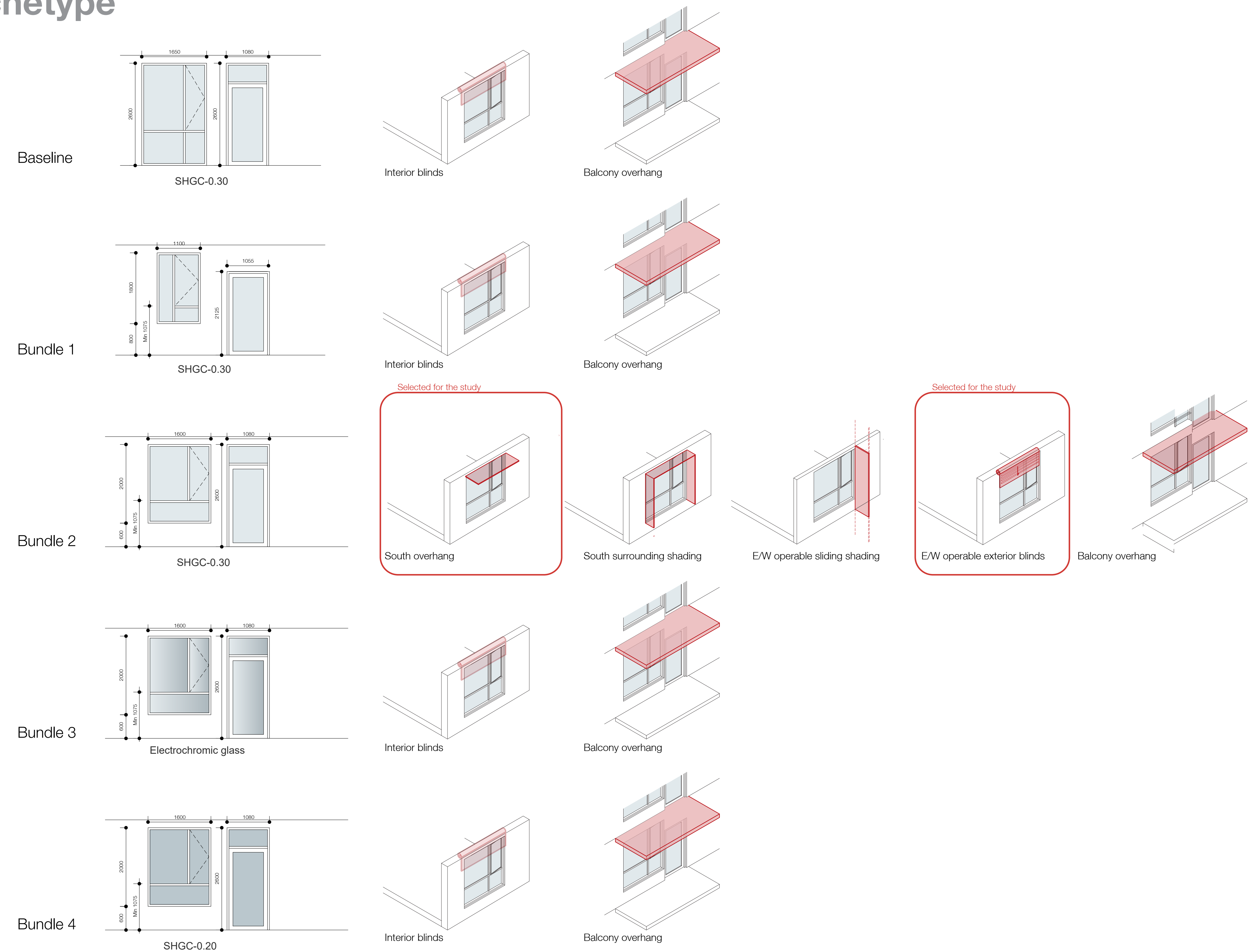
Summary
6 Storey Archetype



Summary
12 Storey Archetype



Summary
35 Storey Archetype



Appendices

APPENDIX E — CLIMATE FILE SCENARIOS

Appendix E – Climate File Scenarios

The purpose of the Climate File analysis was to narrow down climate scenarios for use in the TRiM study. The goal was to select two climate scenarios, one to best represent a file for overheating analysis over a typical future-shifted annual period, one for assessing a summer including a heat dome event for sensitivity. Ultimately the study included three files to also align with the current VBBL requirements, as listed in Section 2.10 of the report.

Table 1 summarizes all reviewed climate files and some information about the files. Information including the adjusted variables in each data set are from [Guidance on Using Future Climate Data for Building Performance Simulation – ClimateData.ca]

Table 1: Summary of all Reviewed Climate Files

Future Shifted Weather Files	PCIC	NRC
Variables Adjusted	Dry Bulb Temperature Dew Point Temperature Relative Humidity Surface Pressure	Global Horizontal Irradiance Direct Normal Irradiance Diffused Horizontal Irradiance Total Cloud Cover Rainfall Wind Speed Wind Direction Relative Humidity Dry Bulb Temperature Dew Point Temperature Surface Pressure Snow-Cover Flag
Time Periods	2011 – 2040 (2020s) 2041 – 2070 (2050s) 2071 – 2100 (2080s)	Present (1991 – 2021) +0.5 °C (2003 – 2023) +1.0 °C (2014 – 2044) +1.5 °C (2024 – 2054) +2.0 °C (2034 – 2064) +2.5 °C (2042 – 2072) +3.0 °C (2051 – 2081) +3.5 °C (2064 – 2094)
Type of Weather Data	Typical Meteorological Year (TMY)	Typical Meteorological Year (TMY) Typical Downscaled Year (TDY) Extreme Cold Year (ECY) Extreme Warm Year (EWY) Conditioning and Extreme Moisture Reference (MRY)
Additional Files provided by NRC – see next page	N/A	• Extreme Weather Files (EWF) GW 0.5-3.5 °C • EWF for Historical Observation Data • EWF for Vancouver with Urban Heat Island (UHI) consideration

Approach & Analysis

- Analysis was completed of all publicly accessible future-shifted weather files for Vancouver, consisting of PCIC, NRC TMY GW 0.5°C to +3.5°C, NRC Extreme Heat GW 0.5°C to +3.5°C.
- All EPW files were compared to the Government of Canada 2021 hourly data for a realistic heat dome event equivalent, accounting for Urban Heat Island effects.
- It was identified in the analysis neither of the EPW files reflected the added intensity of the urban heat island effect on temperature profiles for Vancouver.
- Analysis was presented to the advisory group, in which NRC representatives informed of new climate files that may be better representing for this heat dome analysis, but were not publicly available at present.
- NRC shared additional files for use. These new data sets were all extreme weather files comprised of 3 EPWs per scenario - *intensity, duration and severity*, in line with the SETH metric.
  The data sets shared were:
  - Extreme Weather Files (EWF) GW 0.5-3.5 °C for all ECCC's BC datapoints
  - EWF for Historical Observation Data for all ECCC's datapoints
  - EWF for Vancouver with Urban Heat Island (UHI) consideration, based on urban treatment with reflective (albedo) surfaces (40% and 80%), vegetated green cover (40% or 80%) or a combination of both.

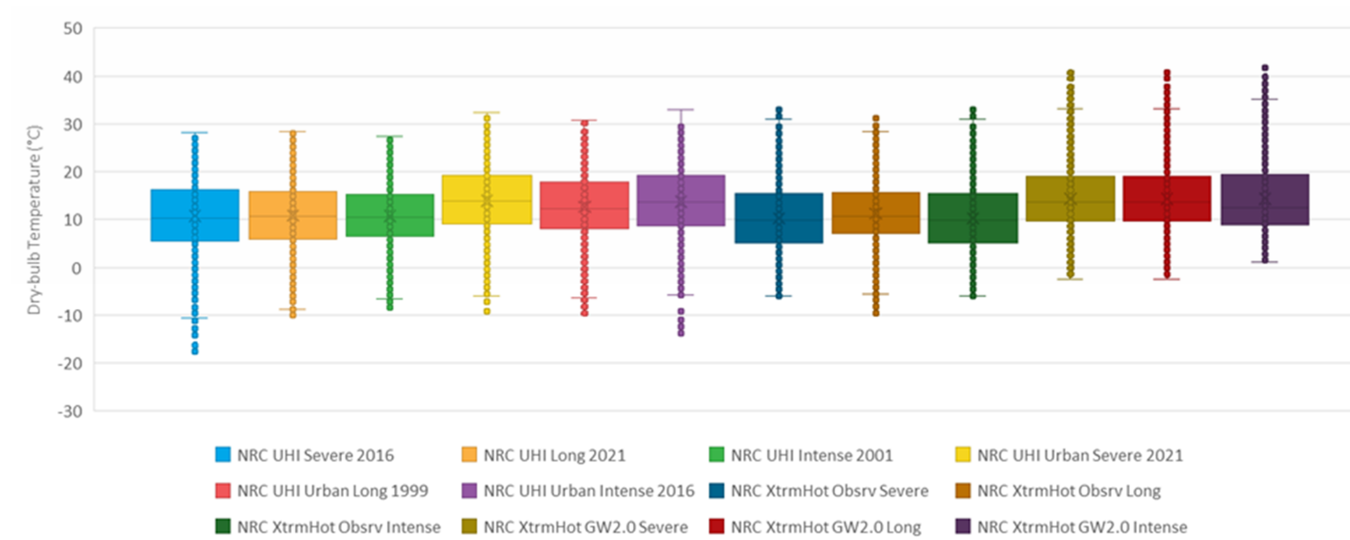


Figure 1: Additional NRC files Reviewed - Temperature Range and Average Point

- Further climate data analysis was completed on these files to find the best representation of a heat dome event, searching for a period of 2-7 days where temperatures do not drop during the night.

Summary Finding

The best representation of heat dome event was identified from the Extreme Weather Files (EWF) with Urban Heat Island (UHI), as it was based on 2021 climate data and had a period in August that showed consistent high temperatures for a number of days.

Appendices

APPENDIX F — PASSIVE STRATEGY LONGLIST, SHORTLIST, AND EVALUATION RUBRIC

Appendix F: Passive Strategy Longlist, Shortlist, and Evaluation Rubric

This appendix presents the evidence base and evaluation framework underpinning the study, including the literature and precedent review and the structured assessment of passive design strategies.

Guiding Principles:

Passive-first (PF) → adopt design strategies that reduce reliance on mechanical cooling.
Survivability-focused (PS) → ensure buildings can maintain safe, habitable conditions in extreme heat or outage scenarios.
Passive and/or performance (PPP) → allow compliance through minimum prescriptive safeguards, performance-based outcomes, or a blend, depending on context and regulatory intent.
Balanced & practical Metric (BPM) → use metrics that are simple enough for adoption but robust enough to reflect health and resilience.
Future Climate-Ready (FCR) → ensure regulations are tested against future climate files (2050s/2080s) and stress-test events.

Instructions for Using the 0–4 Ratings:

Each passive strategy is rated on a 0-4 scale against the guiding principles (Passive-first, Survivability-focused, Passive and/or performance).
Use the following scale to assign or validate ratings:
0 = Not Applicable / No Contribution
1 = Very Low Effectiveness or Feasibility
2 = Moderate Effectiveness with Some Limitations
3 = High Effectiveness, Feasible in Most Cases

Appendix F: Passive Strategy Longlist, Shortlist, and Evaluation Rubric

Table 1 — Literature & Precedent Review

This table summarizes the key technical, policy, and research sources that informed the study, including their relevance, application, and limitations within the Vancouver context.

References are organized into core (R-series) and supporting (E-series) sources to distinguish primary inputs from broader context and precedent.

				RUBRIC					
Category	**Strategy / Measure**	**Description (from literature)**	**Metrics to be Impacted**	**PF (0–4)**	**PS (0–4)**	**PPP (0–4)**	**BPM (0–4)**	**FCR (0–4)**	**Raw Total (20)**
Envelope	Reduced Window-Wall Ratio (WWR)	ratio of the total area of windows (or glazed surfaces) on a building façade to the total gross exterior wall area of that facade	Lower from baseline to 20%; Between 20% and 30% for highly efficient buildings (prescriptive code max is 40% WWR; typical high rise in excess of 50%)	4.00	3.75	3.50	3.75	4.00	19.00
Envelope	Lowering SHGC in Glazing	SHGC ≤baseline	**SHGC** ranges from 0.20 to 0.42; lower for west, south, and east exposures to limit overheating Note: Overall envelope strategies coordinate window SHGC with shading (balconies, fins, screens) for optimal performance	3.50	3.75	4.00	3.75	3.75	18.75
High-Performance Fenestration	Lower SHGC in glazing	high-performance frames, reduced thermal bridging; Lower SHGC is favored on east, south, and west facades	**SHGC** between 0.20–0.32 depending on orientation and overheating risk	3.75	3.75	3.75	3.25	3.50	18.00
High-Performance Fenestration	U-value (Thermal Transmittance)	for glazing & frame, standardized per product; measures heat transfer of window/door	Walls: R-15 to R-22 effective (U ≈ 0.27 to 0.16 $W/m^2{\cdot}K$), considering both insulation and all thermal bridges. Roofs: R-40+ (≈0.06 $W/m^2{\cdot}K$) Windows: 1.6 $W/m^2{\cdot}K$ or lower **U-value**, high-rise (≈1.70–1.93 $W/m^2{\cdot}K$); low-rise: (≈1.54 $W/m^2{\cdot}K$); Triple-glazed, thermally broken aluminum or composite framed windows can reach 0.57–0.78 $W/m^2{\cdot}K$	3.50	3.50	3.75	3.25	3.75	17.75
Ventilation	Hybrid Cooling	Combination of natural and mechanical ventilation applied as needed based on conditions or occupancy	IAQ, Energy use, Thermal comfort, Cooling load	4.00	3.33	3.33	3.33	3.33	17.33
Ventilation	Operable Window Control	Manual or automated control of windows to optimize ventilation based on indoor/outdoor temperature and CO2 levels	IAQ, Occupant comfort, Overheating hours	3.67	3.67	3.67	3.33	3.00	17.33
Envelope	Exterior Shading (Fixed)	Overhangs/fins reduce (extension to balconies) Case studies show fixed/operable shading reduces peak cooling loads		3.50	3.25	3.50	3.00	3.50	16.75

Appendix F: Passive Strategy Longlist, Shortlist, and Evaluation Rubric

Table 1 — Literature & Precedent Review

This table summarizes the key technical, policy, and research sources that informed the study, including their relevance, application, and limitations within the Vancouver context.

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				RUBRIC					
Category	**Strategy / Measure**	**Description (from literature)**	**Metrics to be Impacted**	**PF (0–4)**	**PS (0–4)**	**PPP (0–4)**	**BPM (0–4)**	**FCR (0–4)**	**Raw Total (20)**
Ventilation	HRV with Bypass/Boost	Seasonal bypass and boosted airflow modes in HRVs reduced overheating significantly	Overheating hours, Thermal comfort, Energy consumption	3.00	3.67	3.33	3.00	3.67	16.67
Ventilation	Active Cooling (Targeted Refuge)	Cooling systems installed in LTC/school refuge rooms		3.00	3.00	3.33	3.67	3.67	16.67
Envelope	Integrating Insulation within wall/roof/floor assemblies	type of insulation depends on the purpose of integrating within the assembly eg, bulk/ continuous/ spray; also closely links to airtightness	**Effective R-values** (actual performance of an assembly, factoring in framing/thermal bridges and discontinuities) Above-grade walls: R-13 to R-15 effective (U ≈ 0.38–0.27 $W/m^2{\cdot}K$), Roofs: R-20 to R-40 effective (U ≈ 0.28–0.14 $W/m^2{\cdot}K$), Floor over unheated: R-15 effective (U ≈ 0.38 $W/m^2{\cdot}K$), Foundation/basement wall: Varies, but often R-10 to R-20 effective	3.25	3.75	3.25	2.75	3.25	16.25
Ventilation	Mechanical Ventilation (HRV/ERV)	Systems that mechanically supply and exhaust air, often with heat (and moisture) recovery to improve energy efficiency and IAQ.	IAQ, Energy Use Intensity (EUI), Thermal comfort, Heat recovery efficiency	3.00	2.75	3.50	3.50	3.50	16.25
Envelope	Exterior Shading (Operable)	Automated / manual		3.75	3.25	3.25	2.75	3.00	16.00
High-Performance Fenestration	Thermal Bridging	Must aggregate all linear/point bridges (e.g., slab edges, balcony connections, wall/window intersections)	Considered at frame, spacer, and edge-of-glass; can be isolated and reported in product specs, impacts **U-value**	2.50	3.00	3.25	3.25	3.00	15.00
Ventilation	Natural Ventilation / Stack Effect	Use of operable windows, vents, and building orientation to promote airflow and cooling without mechanical systems. Relies on outdoor air conditions.	Indoor air quality (IAQ), Overheating hours, Thermal comfort, Energy use reduction (cooling energy)	3.25	3.00	3.00	2.50	3.25	15.00
Envelope	Orientation Effects	Location and alignment of the building relative to sun	Optimize for seasonal solar gains and shading while minimizing unwanted gain in hot climates	4.00	3.50	2.25	2.00	3.00	14.75
Ventilation	Fan	Personal Fan Ventilation	Thermal comfort, energy consumption	3.50	2.50	2.75	3.00	3.00	14.75

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Category	Strategy / Measure	Description (from literature)	Metrics to be Impacted	RUBRIC					
				PF (0–4)	PS (0–4)	PPP (0–4)	BPM (0–4)	FCR (0–4)	Raw Total (20)
Envelope	Reducing Air leakages	0.1–0.2 L/s·m^2 reduces TEDI but worsens CEDI	**Airtightness** ≤ 1.5 L/(s·m^2) at 75 Pa (as per Step Code)	2.75	3.00	3.00	3.00	2.75	14.50
Thermal Mass	Night-Time Ventilation	Use of natural or mechanical ventilation at night to cool down thermal mass elements, so they can absorb more heat during the following day	Enhances passive cooling, lowers daytime peak temperatures, supports passive survivability in hot periods	3.25	3.25	2.75	2.25	3.00	14.50
High-Performance Fenestration	Airtightness	Perimeter air leakage rates (e.g., L/s·m^2 of window/door); tested by product type	**Product specific airtightness**; Air permeance of materials: ≤ 0.004 cfm/ft^2 at 0.3 in. w.g. (1.57 psf or 75 Pa), tested in accordance with ASTM E2178.	2.75	3.00	3.00	2.75	2.75	14.25
Envelope	Heat Loss Form Factor	Ratio of thermal envelope surface area to treated (heated) floor area	a design metric, used to evaluate heat lost through the envelope relative to the usable space. Lower values indicate a more compact and thus more energy-efficient building form. Higher values indicate potential heat loss and greater need for insulation.	2.75	2.75	2.75	3.00	2.75	14.00
Ventilation	Ventilative Cooling	Use of outdoor air ventilation (natural or mechanical) to cool indoor spaces, including strategies like indirect evaporative cooling	Cooling energy, Thermal comfort, Energy use	2.67	3.00	2.67	2.67	3.00	14.00
Envelope	Electrochromatic glazing	Active control; flexible & highly adaptable, can be tuned for daylighting control and glare reduction while limiting cooling loads; On-demand control via building automation or user input	**VT** can vary (e.g., ~0.60 in clear state → ~0.05 in tinted state); **SHGC** also varies with tinting	3.75	2.75	2.25	1.75	3.25	13.75
Earth tube / Ventilation	Passive cooling	Uses underground pipes to pre-cool incoming ventilation air. Significanlty reduce OA ventilation supply temperature. Can be coupled with boost mode for passive cooling in suites	Overheating hours, Thermal comfort, Cooling Load, Energy consumption	3.75	3.00	1.75	2.25	3.00	13.75
	Hybrid mechanical/passive	TermoDeck, Radiant slab combined with controlled heating/cooling	Thermal comfort, energy consumption	3.00	3.00	2.33	2.00	3.33	13.67
Envelope	Thermal Bridging	Must aggregate all linear/point bridges (e.g., slab edges, balcony connections, wall/window intersections)	includes all significant linear (psi) & point (chi) losses in effective assembly **U-value** calculations	2.75	3.00	2.50	2.75	2.50	13.50

Appendix F: Passive Strategy Longlist, Shortlist, and Evaluation Rubric

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				RUBRIC					
Category	**Strategy / Measure**	**Description (from literature)**	**Metrics to be Impacted**	**PF (0–4)**	**PS (0–4)**	**PPP (0–4)**	**BPM (0–4)**	**FCR (0–4)**	**Raw Total (20)**
Massing (Building Volume)	Orientation effects	Location and alignment of the building relative to sun	Optimize for seasonal solar gains and shading while minimizing unwanted gain in hot climates	3.50	3.00	2.00	2.25	2.75	13.50
Ventilation	Night-Time Ventilation	Enhanced ventilation during cooler night hours to pre-cool building thermal mass, reducing daytime cooling needs.	Overheating hours, Cooling energy demand, Thermal comfort	2.67	2.33	3.00	2.33	3.00	13.33
Massing (Building Volume)	Form-Based Adjustments	compactness ratio can be used to adjust expected energy use targets; Compact forms like cubes or spheres minimize exposed surface area relative to floor volume	Lower **Surface-to-Volume Ratio** is better: less heat loss, improved thermal efficiency; Lower VFAR favors simpler, compact forms for energy savings; high VFAR values are linked to slender or tall forms	2.50	2.75	2.50	2.75	2.50	13.00
Envelope	Breaking Balconies	address balcony thermal bridging to lower cooling loads; complex detailing like slab edges adds to it		2.80	2.20	2.40	2.60	2.80	12.80
Thermal Mass	Thermally Activated Building Systems (TABS)	heating/cooling pipes or embedded systems within concrete slabs actively use the mass for thermal regulation	Increases capacity for heating/cooling load shifting, improves thermal comfort, and can provide low-energy conditioning	3.25	2.75	1.75	2.25	2.75	12.75
Envelope	Interior shading (Operable)	Automated / manual		3.00	2.50	2.25	2.50	2.25	12.50
Envelope	Thermochromic glazing	Controlled by temperature change (Passive control), responds to heat; cannot be actively controlled by occupants/building systems; Less flexibility than electrochromic	**VT** decreases as glass temperature rises above a threshold; **SHGC** decreases in hot conditions, reducing solar heat gain	3.00	2.75	2.00	2.00	2.75	12.50
Roof	Reflective Roof	High albedo roof reduces cooling loads	Surface temperature, Cooling load, Urban heat island, Biophilic benefits	2.00	2.33	3.00	2.67	2.33	12.33

Appendix F: Passive Strategy Longlist, Shortlist, and Evaluation Rubric

Table 1 — Literature & Precedent Review

This table summarizes the key technical, policy, and research sources that informed the study, including their relevance, application, and limitations within the Vancouver context.

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				RUBRIC					
Category	**Strategy / Measure**	**Description (from literature)**	**Metrics to be Impacted**	**PF (0–4)**	**PS (0–4)**	**PPP (0–4)**	**BPM (0–4)**	**FCR (0–4)**	**Raw Total (20)**
Landscape	Green Infrastructure	Urban greening to mitigate Urban Heat Island effects		2.67	2.33	2.33	2.33	2.33	12.00
Thermal Mass	High-Mass Envelope Assemblies	Use of heavyweight construction to increase building's ability to absorb excess internal and solar heat during the day and release it at night.	Reduces indoor temperature swings, delays peak temperature, decreases overheating risk and peak cooling demand	2.40	2.40	2.20	2.20	2.60	11.80
Envelope	Use of Phase Change Materials (PCMs)	Application of materials that store/release large amounts of heat at specific temperatures	Offers additional heat storage capacity with less material thickness; enhances the diurnal performance of thermal mass	3.00	2.25	2.00	2.00	2.50	11.75
Roof	Green Roof	Evapotranspiration cooling, stormwater control	Surface temperature, Cooling load, Urban heat island, Biophilic benefits	2.25	2.25	2.25	2.25	2.50	11.50
Ventilation	Enhanced Filtration and Zoning	Targeted ventilation control with high-efficiency filters and compartmentalization to minimize pollutant migration between units	IAQ, Pollutant levels, Building pressurization control	2.67	1.67	2.33	2.33	2.00	11.00
High-Performance Fenestration	balancing daylighting and glare control with VT	measures daylight passage through glass	**Visible Transmittance (VT)**; unitless, 0–1 scale, in accordance with NFRC 200 (or NFRC 300 for some skylight types); often paired with SHGC to calculate the VT/SHGC ratio It is not mandatory, moderate to high VT is desirable where daylighting is prioritized, provided overheating risk is managed	2.25	2.00	2.25	2.00	2.25	10.75

Notes:
Envelope includes roof, slab, wall
High performance fenestrations separated from envelope as their performance assessment method varies
Difference:
1) Electrochromic glazing → Active control → Greater adaptability, optimized daylighting & energy savings (dynamic VT & SHGC under user/system control).
2) Thermochromic glazing → Passive control → VT & SHGC shift only in response to temperature, not user demand.

Appendix F: Passive Strategy Longlist, Shortlist, and Evaluation Rubric

Table 2 — Passive Strategies & Evaluation Framework

This table presents the evaluation of passive design strategies, including the longlist, shortlist, and scoring rubric used to assess performance against the study guiding principles and future climate conditions

Sr no	Prescriptive Strategies	Description (from literature)	Building Components	Co-relation to other strategy/measure	Metrics to be Impacted	PF (0–4)	PS (0–4)	PPP (0–4)	BPM (0–4)	FCR (0–4)	Raw Total (20)
1)	**Reduced Window-Wall Ratio (WWR)**	windows (or glazed surfaces) on a building façade to the total gross exterior wall area of that facade	Envelope		Lower from baseline to 20%; Between 20% and 30% for highly efficient buildings (prescriptive code max is 40% WWR; typical high rise in excess of 50%)	4.00	3.75	3.50	3.75	4.00	19.00
2)	**Lowering SHGC in Glazing**	SHGC ≤baseline; Lower SHGC is favored on east, south, and west facades	Envelope / High-Performance Fenestration	Location and **Orientation** of the building relative to sun, impacts the SHGC	**SHGC** ranges from 0.20 to 0.42; lower for west, south, and east exposures to limit overheating Note: Overall envelope strategies coordinate window SHGC with shading (balconies, fins, screens) for optimal performance Optimize for seasonal solar gains and shading while minimizing unwanted gain in hot climates	3.50	3.75	4.00	3.75	3.75	18.75
3)	**U-value (Thermal Transmittance)**	Standardized per product for glazing & frame; accounts for the actual performance of an assembly, factoring in framing/thermal bridges and discontinuities, measures heat transfer of window/door Must aggregate all linear/point bridges (e.g., slab edges, balcony connections, wall/window intersections)	Envelope / High-Performance Fenestration	check for **insulation** within wall/roof/floor assemblies which is directly proportional to **airtightness**	**Glazing - U-value**, BC Energy Step Code (Zone 4) Better performance (Steps 3–4): ≤1.4 W/m^2·K (~R-4.1) High performance (Step 5): ≤0.80–1.0 W/m^2·K (~R-6 to R-7), considering both insulation and all thermal bridges. High-rise (≈1.70–1.93 W/m^2·K); low-rise: (≈1.54 W/m^2·K); Triple-glazed, thermally broken aluminum or composite framed windows can reach 0.57–0.78 W/m^2·K	3.50	3.50	3.75	3.25	3.75	17.75
					Opaque Envelope - Effective R-values Above-grade walls: R-30+ (RSI 5.3+) effective, Roofs: R-50–60 (RSI 8.8–10.5) effective, Below-Grade Walls/ Slabs (on grade): R-12 to R-20 (RSI 2.1–3.5)	2.50	3.00	3.25	3.25	3.00	15.00
4)	**Ventilation**	Natural ventilation, consider cooling of thermal mass elements at night to absorb more heat during the following day	Ventilation	**Operable Window Control** (Manual or automated)	Volume of supply air, controls	3.67	3.67	3.67	3.33	3.00	17.33
				Night-Time ventilation enhances passive cooling, lowers daytime peak temperatures; supports passive survivability in hot periods		3.25	3.25	2.75	2.25	3.00	14.50
5)	**Exterior Shading**	Overhangs/fins reduce (extension to balconies); block or filter solar radiation before it reaches glazing, reducing heat gain, glare and cooling demand while maintaining daylight	Envelope	**Fixed Shading**	Size of shading	3.50	3.25	3.50	3.00	3.50	16.75
				Operable Shading Control can be automated / manual	Type of shading & mechanism type	3.75	3.25	3.25	2.75	3.00	16.00
				Electrochromatic glazing - Active control; flexible & highly adaptable, can be tuned for daylighting control and glare reduction while limiting cooling loads ; NOTE: **SHGC** also varies with tinting	Installed or not	3.75	2.75	2.25	1.75	3.25	13.75
				Thermochromic glazing - Controlled by temperature change (Passive control), responds to heat; cannot be actively controlled by occupants/building systems NOTE: **SHGC** also varies with tinting	Installed or not	3.00	2.75	2.00	2.00	2.75	12.50

Appendices

APPENDIX G — PERFORMANCE METRICS AND EVALUATION RUBRIC

Appendix G: Performance Metrics and Evaluation Rubric

This appendix presents the performance metrics reviewed in the study and the evaluation framework used to assess their applicability to overheating risk, health outcomes, and regulatory use.

The table below evaluates candidate performance metrics using a structured rubric based on the study guiding principles, including their relevance to thermal comfort, physiological risk, and implementation within policy and design practice.

				RUBRIC						
Metric	**Description**	**Unit**	**Reference**	**PF (0–4)**	**PS (0–4)**	**PPP (0–4)**	**BPM (0–4)**	**FCR (0–4)**	**Raw Total (20)**	**Notes / Reasoning**
Overheating Severity (OS)	A weighted indicator that accounts not just for the number of overheating hours, but also how far above the threshold temperatures rise	degree Celsius-hours (∘C·h)	NRC Overheating; CIBSE TM52	3	4	3	2	4	16	Captures both frequency and intensity of overheating. Strong for health/survivability but harder to explain to industry compared to OH.
SETH – Standard Effective Temperature for Heat / Survivability	Overheating thresholds are based on a number or percentage of hours exceeding an upper acceptability limit (such as those provided in ASHRAE and CIBSE), are not directly applicable to evaluations of human heat stress. It is measurement of magnitude (or severity) of overheating determined from the SET measured in °C·h	degree Celsius-hours (∘C·h)	NRC Overheating Guideline	3	4	2	2	4	15	Directly links to health outcomes and survivability (esp. LTC, outages); less widely adopted in policy but highly relevant to resilience.
Overheating Hours (OH)/ Hours of Exceedance (HE)	number of occupied hours when indoor temperatures exceed a defined thermal comfort threshold	number of hours/ hours within a given period	CIBSE TM59; VBBL; IEA Annex 80	3	3	4	2	3	15	Widely used, simple to interpret ("≤20 hrs above 26 °C"), codified in VBBL. Strong combination of clarity, prescriptive threshold, and survivability relevance. However, treats all overheating equally (does not matter when it happens or how long it happens for or how severe overheating is)
PMV / PPD	PMV - An index that predicts the mean value of the votes of a large group of persons on the seven-point thermal sensation scale Note: calculation takes into account several factors; air temperature, mean radiant temperature, air velocity, relative humidity, clothing insulation & metabolic rate PPD - Expected % of people dissatisfied with the overall thermal conditions in an environment, based on the PMV value. It provides a numerical measure (in percentage) of how many occupants are likely to feel uncomfortable	PMV - dimensionless index PPD - proportion of occupants in %	ASHRAE 55; NRC	2	3	3	4	1	13	Classic comfort metric, globally recognized, but limited in capturing heat extremes/resilience. Strong clarity but weak survivability signal.
OEF – Overheating Escalation Factor	The ratio of Indoor Overheating Degree (IOD) to AWD Note: IOD is Hourly summation over the summertime period of the positive values of the difference between the operative temperature of the occupied building thermal zones and the zonal thermal comfort limit temperature, divided by the sum of the zonal occupied hours	dimensionless number	IEA Annex 80	2	4	2	1	3	12	Shows how quickly conditions worsen at higher thresholds. Valuable in research; low clarity for practitioners and difficult to regulate.

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				RUBRIC						
Metric	**Description**	**Unit**	**Reference**	**PF (0–4)**	**PS (0–4)**	**PPP (0–4)**	**BPM (0–4)**	**FCR (0–4)**	**Raw Total (20)**	**Notes / Reasoning**
AWD – Ambient Warmness Degree	Heat stress of an outdoor environment. Hourly summation over the summertime period of the positive values of the difference between the outdoor air temperature and a fixed base temperature. The value of this base temperature must be defined and declared	Kelvin (K)	IEA Annex 80	3	3	2	1	3	12	Measures buffering effect of the building (indoor vs outdoor). Good research insight, but too technical and low clarity for adoption
Thermal Autonomy (TA)	The fraction of time a building can passively maintain comfort conditions without active systems	% of the occupied hours	IEA Annex 80	3	1	3	2	3	12	Shows % of time building stays within comfort without cooling, however does not relate at all to intensity, severity or duration. Speaks to generally how a building performs, but not occupants
CEDI – Cooling Energy Demand Intensity	The **annual total cooling energy, sensible and latent cooling, of all space and ventilation cooling equipment, divided by the modelled floor area (m2)**. Analogous to the Step Code's TEDI metric for space cooling equipment. Cooling process loads, such as for walk-in food storage, is typically not included in the CEDI	kWh/m^2·year	CaGBC ZCB; UBC; CoV	3	2	2	2	3	12	Already embedded in ZCB and CoV guidance for reporting only. Energy metric, not linked to occupant experienced thermal comfort or passive survivability relevance. Unintended consequences: Building-level metric may mask worst-case overheating in individual suites
Peak Load	The maximum instantaneous heating or cooling capacity required by the building during design conditions	kW or W/m^2	CoV Rezoning Study	2	2	3	2	3	12	Important for electrification and resilience to outages, building metric not health metric related directly.
Standard Effective Temperature (SET)	A thermal comfort index that combines the effects of air temperature, humidity, mean radiant temperature, clothing, and activity into an equivalent "felt" temperature	°C	ASHRAE 55; NRC Overheating Guideline	2	2	2	3	2	11	Comfort-focused metric, useful in research; harder to communicate and less tied to resilience outcomes.

Appendices

APPENDIX H — NRC OVERHEATING RISK METRIC CALCULATION METHODOLOGY

Appendix H - NRC Overheating Risk Metric Calculation Methodology

This appendix documents the methodology used to calculate overheating risk indicators (DUR, SETH, INT) within the TRiM study using the simplified SETH approach. The appendix provides sufficient detail to support transparency, reproducibility, and technical review. The methodology is based on the NRC overheating risk framework and Laouadi et al. (2020). Full derivation of the metrics is provided in the referenced sources.

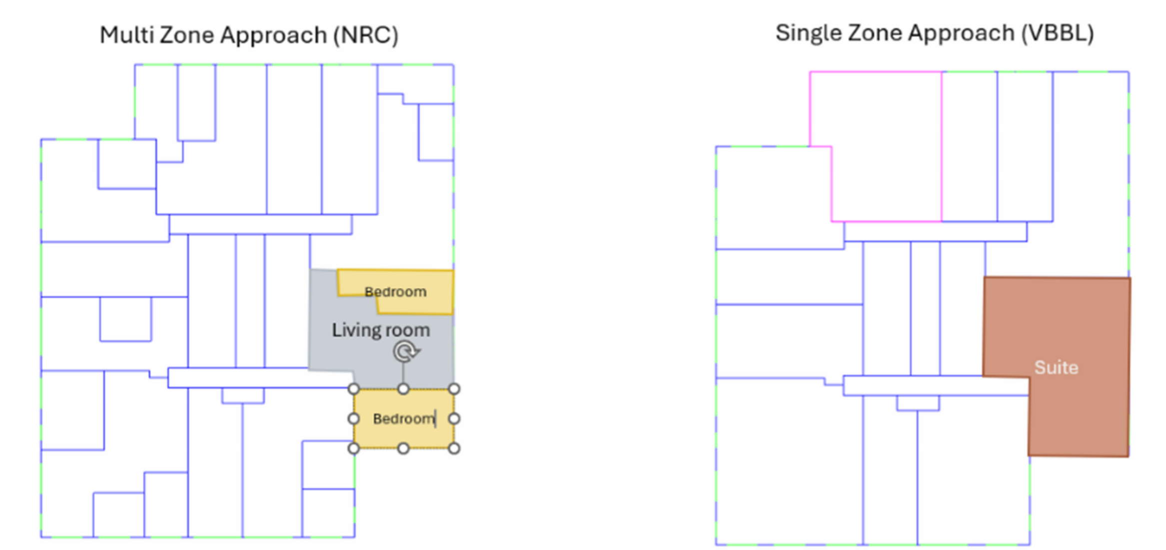
Model Platform

Energy and thermal simulations were performed using IES Virtual Environment (IESVE).

Multi-Zone Implementation

To align with NRC methodology, modelling distinguished between:

- Living zones (daytime exposure)
- Bedroom zones (nighttime exposure)



This approach captures cumulative exposure and recovery dynamics and reflects occupancy patterns within residential suites.

Model Outputs and Post-Processing

The NRC overheating risk framework applies temperature-based thresholds representing physiological heat stress limits (e.g. dehydration and elevated core body temperature) to assess cumulative heat exposure.

The following physiological parameters with thresholds indicating overheating risk are calculated:

- Duration (DUR)
- Cumulative Severity (SETH)
- Intensity (INT)

The NRC calculation workflow was as follows:

1. Export hourly dry-bulb temperature
2. Evaluation Period Selection (May 1 – October 30)
3. Simplified SET approach
4. Aggregate SETH for cumulative heat stress
5. Identify overheating days and overheating events
6. Calculation of health risk indicators (DUR, SETH, INT)
7. Identify health risk event with Vancouver thresholds

A structured calculation template was developed for TRiM to follow the NRC overheating risk framework and to streamline the processing of modelling outputs. This approach ensures consistency across results processing per archetypes, climate files, and baseline and passive bundle scenarios.

Step 1. Export Hourly Indoor Air Temperature

Hourly outputs were exported for post-processing for each Archetype, baseline and passive bundle scenario. The hourly outputs distinguished between:

- Zone identification (living area / bedroom)
- Zone orientation
- Zone dry-bulb temperature
- Climate file reference

Outputs were exported in hourly format for the defined summer analysis period.

Step 2. Evaluation Period Selection

To evaluate overheating risk, the hourly data was selected to align with VBBL EMG v3.0 overheating analysis period:

- May 1 – October 30

This period exceeds one month (October) beyond NRC methodology for seasonal heat exposure assessment.

Step 3. Simplified SET Approach

The NRC methodology is based on Standard Effective Temperature (SET), which incorporates:

- Air temperature
- Mean radiant temperature
- Relative humidity
- Air speed
- Clothing level
- Metabolic rate

As SET is not directly calculated as output within all energy modelling platforms and workflows without post processing or scripts, the TRiM study applied the temperature-based simplified SET method developed by NRC.

In the TRiM study, the simplified NRC approach was applied as follows:

- Indoor dry-bulb temperature is used as proxy to SET to calculate cumulative heat stress.
- Vancouver-specific temperature-based physiological thresholds were applied.
- The method maintains consistency with NRC temperature-calibrated limits for older adults.

This approach enables consistent and replicable implementation across modelling scenarios.

Step 4. Aggregate SET to Daily Cumulative Heat Stress SETH

The SET metric is temperature only (°C). To understand cumulative impact, SET can be measured at an hourly timestep. For each living room and bedroom, the daily cumulative heat stress SETH (°C·h) can be derived using that hourly basis, as:

- Σ (T_indoor – T_threshold) for hours where T_indoor > T_threshold

Where:

- T_indoor = hourly dry-bulb temperature of space (simplified SET method)
- T_threshold = NRC temperature-based physiological reference value for use in calculation[1].

Then, aggregate for daytime and nighttime hours, using living room zones for daytime exposure and bedroom zones for nighttime exposure. Different threshold values are applied for daytime and nighttime periods..

The daily cumulative heat stress can be summarised as:

- $SETH = SETH_{day} + SETH_{night}$

Overheating day classification is based on daytime cumulative heat stress (SETHday) only, consistent with NRC methodology for identifying daily overheating conditions based on daytime exposure.

Step 5. Identification of Overheating Day and Overheating Event

Overheating Day:

- An overheating day is defined when daytime cumulative heat stress SETH > 4°C·h
- This minimum threshold filters low cumulative heat stress conditions that do not translate to an overheating day.

Overheating Event:

- Consecutive overheating days form an overheating event.
- Events are separated by at least one recovery day in which cumulative heat stress SETH does not exceed 4°C·h.
- Each overheating event has an identified start-date and end-date.

Step 6. Calculation of Health Risk Indicators

After an overheating event is identified, the next step is to identify if the event is classified as a health risk event. Three core indicators are calculated:

- DUR (Duration)
- SETH (Severity)
- INT (Intensity)

Duration (DUR)

DUR = Number of consecutive overheating days within an event.

Severity (SETH)

SETH = Total cumulative heat stress (°C·h) accumulated across all overheating days within an event.

Intensity (INT)

INT = SETH ÷ DUR

This represents the average intensity of overheating during the event.

Step 7. Identify Overheating Health Risk Events

An overheating event is considered a health risk event when any of the following thresholds are exceeded:

- DUR ≥ 6 days
- SETH ≥ 150°C·h
- INT ≥ 5.13°C

These thresholds are derived from NRC physiological modelling linking cumulative exposure to dehydration and core temperature rise for residential application, older adults *in Vancouver* climate conditions.

REFERENCE

1. Laouadi, A., Bartko, M., & Lacasse, M. A. (2020). *A new methodology of evaluation of overheating in buildings*. Energy & Buildings, 226, 110360.
2. Laouadi, A., Bartko, M., Gaur, A., & Lacasse, M. A. (2021). *Climate resilience buildings: guideline for management of overheating risk in residential buildings.* National Research Council Canada.

Appendices

APPENDIX I — ENERGY MODELLING INPUTS AND PROCESS

Appendix I - Energy Modelling Inputs and Process

Detailed Modelling Parameters

Energy modelling and overheating analysis were performed using consistent inputs across baseline and bundle scenarios to enable comparative evaluation. The following modelling specific clarifications were made:

- Energy Modelling and Overheating Hours (OH) analysis is following VBBL EMG v3.0 (for compliance reasons) .
- The methodology assumes patio doors closed (per VBBL EMG). This was noted by Project team to be an unrealistic assumption however to ensure VBBL compliance maintained in study.
- Overheating scenarios are modelled with mechanical cooling off, to isolate passive thermal response.
- A full power outage scenario is not studied - internal gains including lighting and plug loads are still present.
- VBBL requires single thermal zone modelling for one residential suite.
- NRC requires multi zone modelling, splitting living room and bedrooms. One floor of the building in each archetype was modelled for NRC method evaluation.

The selected climate scenarios were applied consistently across archetypes and bundle scenarios to assess performance under projected warming and extreme heat conditions.

- The NRC EWF+UHI scenario was modelled with results extracted and post-processed for all suite types in each orientation (N, E, W, S) for each archetype. All overheating scenarios were modelled with operable windows enabled and mechanical cooling systems off (aligned with VBBL).
- The NRC TMY GW+2°C is the VBBL overheating compliance file and this was tested with results extracted and post-processed for west facing suites for comparison and modelled with operable windows enabled and cooling system off.
- The NRC TMY GW+1°C file was used to evaluate energy compliance (per VBBL), with cooling systems on and operable windows closed (residential suites without active mixed mode ventilation control).

Thermal Zoning Approach

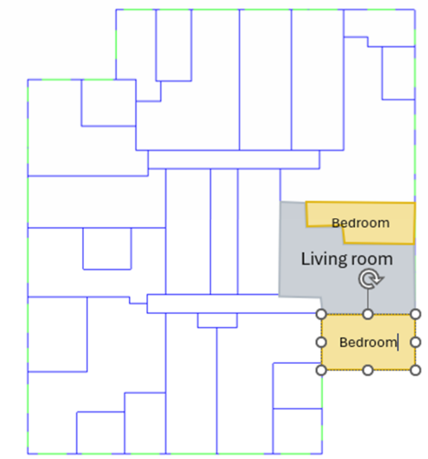
The VBBL overheating requirement extracted from energy modelling is based on single thermal zone approach, meaning all rooms within a suite is treated as one thermal zone.

In the NRC modelling methodology, modelling distinguished between:

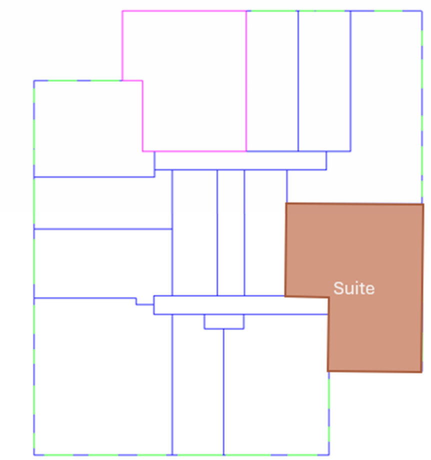
- Living zones (daytime exposure)
- Bedroom zones (nighttime exposure)

As such, to satisfy both the VBBL OH method and the NRC Overheating method, one floor in each model was modelled as multi zone thermal area, splitting living room and bedrooms.

Multi Zone Approach (NRC)



Single Zone Approach (VBBL)



Detailed Modelling Inputs

Table 1: Building Areas

Category	Parameter	BASELINE ARCHETYPE		
Archetype		**Mid-Rise 6 storeys**	**High rise 12 storeys**	**High rise 35 storeys**
MFA	**m²**	11,270	11,523	30,909
GFA	**m²**	14,202	15,038	42,175
Total Area Above Grade	**m²**	10,549	9,540	29,229
Total Area Below Grade	**m²**	3,653	5,498	12,946
Total Residential Suite Areas	**m²**	9,254	7,913	21,919

Table 2: Modeling Inputs per Archetype

Modelling Input per Archetype			
Parameter	**Mid-Rise 6 storeys**	**High rise 12 storeys**	**High rise 35 storeys**
Envelope			
Typical Wall Assembly Type (BETB value)	4" Exterior insul. wood stud wall (no cavity insul) Effective Rip-10	Hybrid steelstud built up + spandrel windowwall 4" Ext. MW + 4" insulated metal spandrel Effective Rip-7	100% windowwall (all spandrel) Effective Rip-5

Modelling Input per Archetype			
Parameter	**Mid-Rise 6 storeys**	**High rise 12 storeys**	**High rise 35 storeys**
Typical Roof Assembly Type	5" poly iso with sloped structure Effective Rip-30	4" poly iso with slope pack insulation – concrete slab Effective Rip-30	4" poly iso with slope pack insulation – concrete slab Effective Rip-30
Window-to-wall ratio	25%	40%	40%
Window type / glazing	Punched windows Vinyl double pane U-0.27, SHGC-0.30	Double pane metal frame (WW) U-0.32, SHGC-0.30	Double pane metal frame (WW) U-0.32, SHGC-0.30
Exterior Shading	Balconies only,living room typical	Balconies only,living room typical	Balconies only,living room typical
Airtightness	1.5 L/s/m²@75 Pa tested Modelled rate 0.30 L/s/m² Vertical wall	1.5 L/s/m²@75 Pa tested Modelled rate 0.23 L/s/m² Vertical wall	1.5 L/s/m²@75 Pa tested Modelled rate 0.19 L/s/m² Vertical wall
Internal Gains			
Occupancy	Residential Suite: # Bedrooms +1 Other areas per example project design, see tables below.		
Lighting Power Densities & Control	Residential Suite 3.5 W/m² Other areas per example project design, see tables below.		
Plug Loads	Residential Suite 5.0 W/m² Other areas per example project design, see tables below.		
Mechanical System			
Ventilation System Suites	Suite by-suite: ERVs 75% eff. sensible / 65% latent.	Suite by-suite: ERVs 75% eff. sensible / 65% latent.	Suite by-suite: ERVs 75% eff. sensible / 65% latent.
Ventilation Rates Suites	Minimum/Boost Mode 1-Bed 17 / 33 L/s 2-Bed 21 / 40 L/s 3-Bed 28 / 47 L/s Corridor: 7 L/s/door Other areas: ASHRAE 62.1-2016	Minimum/Boost Mode 1-Bed 17 / 33 L/s 2-Bed 21 / 40 L/s 3-Bed 28 / 47 L/s Corridor: 7 L/s/door Other areas: ASHRAE 62.1-2016	Minimum/Boost Mode 1-Bed 17 / 33 L/s 2-Bed 21 / 40 L/s 3-Bed 28 / 47 L/s Corridor: 7 L/s/door Other areas: ASHRAE 62.1-2016
Heating + Cooling System	PTAC (partial cooling) with electric baseboards PTAC EER-11.9 EER (ASHRAE 90.1-2019)	VRF+FCU, 0.45 W/L/s Heating COP-3.3 @47Fdb/43Fwb Cooling COP-10.8 EER Air-cooled multisplit with heat recovery	Hydronic 4-pipe FCUs, 0.45 W/L/s Central ASHP 2 x 450 kW, Backup / Top Up electric boiler (HP operates down to -5°C (adjustable)). Heating COP-2.77 (48°C / 120°F LWT) at full load Cooling EER- 9.6 full load, EER -

Modelling Input per Archetype			
Parameter	**Mid-Rise 6 storeys**	**High rise 12 storeys**	**High rise 35 storeys**
			13 (IPLV) 4-pipe configuration
Hydronic Loops (Space Heating + cooling)	n/a	n/a	HW Loop: OA reset, variable flow HW Loop Pump: 320 W/l/s VSD CHW Loop: 7C supply, 13C return, variable flow CHW Loop Pump: 402 W/l/s, VSD
MUA	Corridor MUA, electric coil 1085 L/s @ 1.1 kW COP-1.0 LAT 18°C heating, 31 kW	Corridor MUA (ASHP+electric resistance) 936 L/s @ 1.3 kW LAT 18°C heating/25°C cooling EER-12 (EERnf-14.6) and COP-3.3 @8.33 °C	Corridor MUA (ASHP+electric resistance) 1671 L/s Lat 18°C heating, 25°C cooling EER-12 (EERnf-14.6) and COP-3.3 @8.33 °C
Other areas	Main Lobby: ERV, PTAC+EBB, Autosized	Amenity/Lobby: ERV, VRF+FCU, Autosized, FCU: 0.45 W/l/s	Amenity/Lobby/Office/Gym: ERV, VRF+FCU, Autosized, FCU: 0.45 W/l/s
Misc Heating	Vestibules electric 3xFFHs, 220 L/s, 10 kW total Stairs electric BBrds 0.5-1.0 kW Service rooms, electric FFHs, autosized	Vestibules electric 4xFFHs, 160 L/s, 8 kW total Stairs electric BBrds 0.5-1.0 kW Service rooms, electric FFHs, autosized	Vestibules electric 8xFFHs, 240 L/s, 16.8 kW total Stairs electric BBrds 0.5-2.0 kW Service rooms, electric FFHs, Autosized
Misc 24/7 cooling	24/7 cooling Electrical room, Comms room Elevator machine room Total average cooling load 13.5 kW DX cooling EER-11, (EERnf-13.2) 0.9 W/L/s fan power	24/7 cooling Electrical room, Comms room Elevator machine room Total average cooling load 13.7 kW DX cooling EER-11, (EERnf-13.2) 0.9 W/L/s fan power	24/7 cooling Electrical room, Comms room Elevator machine room, HV room, Total average cooling load 22.5 kW DX cooling EER-11, (EERnf-13.2) 0.9 W/L/s fan power
Exhaust Fans	Parking garage (total): 12,000 L/s, 7.5 kW Garage Exh and Misc: 660 L/s,0.24 kW Laundry Exh: 1 hr/day, 80 Watts Kitchen Exh: 1.5/day, 100 Watts	Parking garage (total): 13,395 L/s, 12.1 kW Garage Exh and Misc: 650 L/s,0.26 kW Laundry Exh: 1 hr/day, 80 Watts Kitchen Exh: 1.5/day, 100 Watts	Parking garage (total): 43,000 L/s, 40.3 kW Garage Exh and Misc: 1500 L/s,0.6 kW Laundry Exh: 1 hr/day, 80 Watts Kitchen Exh: 1.5/day, 100 Watts

Modelling Input per Archetype			
Parameter	**Mid-Rise 6 storeys**	**High rise 12 storeys**	**High rise 35 storeys**
Domestic Hot Water Load	0.0016 L/s/person per CoV Energy Modelling Guide 252 occupants, 1,452 L/h Schedule NECB G	0.0016 L/s/person per CoV Energy Modelling Guide 259 occupants, 1,492 L/h Schedule NECB G	0.0016 L/s/person per CoV Energy Modelling Guide 588 occupants, 3,387 L/h Schedule NECB G
Domestic Hot Water	CO2 Air-to-Water Heat Pump and hot water recirc. High temperature 60°C LWT, electric resistance top up System annual average COP-3 140 kW	CO2 Air-to-Water Heat Pump and hot water recirc. High temperature 60°C LWT, electric resistance top up System annual average COP-3 140 kW	CO2 Air-to-Water Heat Pump and hot water recirc. High temperature 60°C LWT, electric resistance top up System annual average COP-3 310 kW

Table 3: Occupancy Load - Modeling Inputs – All Archetypes

Occupancy Load – Archetype 6 storey, 12 storey, 35 storey				
Space Type	**m^2/Person**	**Sensible Heat Gain W/person**	**Latent Heat Gain W/person**	**Schedule**
1-bed units	# Bd. Rm. + 1	81	45	NECB G
2-bed units	# Bd. Rm. + 1	81	45	NECB G
3-bed units	# Bd. Rm. + 1	81	45	NECB G
Amenity Rooms	5	84	46	NECB C
Gym & Yoga Rm.	5	117	132	NECB C
Mail Room	10	90	60	NECB C
Electrical/Mechanical/Comms	-	0	0	off
Elevators	-	0	0	off
Garbage/Recycling	100	88	53	NECB C
Elevator Lobby	10	88	53	NECB C
Lobby	10	88	53	NECB C
Parkade	1000	88	53	off
Stairs	200	88	53	off
Storage Areas / Bike Storage	100	88	53	NECB C
Vestibule	100	88	53	NECB C

Table 4: Lighting Load - Modeling Inputs – Per Archetype (based on design information for non residential areas)

Lighting Archetype – 6 Storey					
Space Type	**Load (W/m^2)**	**Occupancy Sensor**	**Daylight Sensor**	**OS Diversity Factor**	**Schedule**
Residential Dwelling Units	3.5	-	-	-	NECB G
Corridors	8.5	x	-	0.75	24 hrs/day
Mail Room	2.7	x	-	0.75	24 hrs/day
Entrance Vestibule	5.0	x	x	0.75	24 hrs/day
Lobby	14.0	x	-	0.75	24 hrs/day
Stairs	4.2	x	-	0.25	24 hrs/day
Bike Storage	2.1	x	-	0.55	NECB C
Storage >5 m^2 <100m^2	3.1	x	-	0.55	NECB C
Storage <5 m^2	3.8	x	-	0.55	NECB C
Garbage/ Waste Holding	1.9	x	-	0.55	NECB H
Parking	1.1	x	-	0.85	24 hrs/day
Electrical/Mechanical Main Room	3.3	-	-	-	24 hrs/day
Electrical Comm Room/Elec Closet	3.6	-	-	-	24 hrs/day
Elevator Lobby	4.4	x	-	0.75	24 hrs/day
Exterior Lighting	2.1 kW	-	x	-	Photocell Control
Lighting Archetype –12 Storey					
Space Type	**Load (W/m^2)**	**Occupancy Sensor**	**Daylight Sensor**	**OS Diversity Factor**	**Schedule**
Residential Dwelling Units	3.5	-	-	-	NECB G
Amenity	8.2	x	-	0.90	NECB C
Corridors	8.4	x	-	0.75	24 hrs/day
Electrical/Mechanical/Comms	4.2	-	-	-	NECB F
Elevators	4.9	-	-	-	24 hrs/day
Garbage/Recycling	4.4	x	-	0.55	24 hrs/day
Elevator Lobby	9.4	x	-	0.75	24 hrs/day
Lobby	9.0	x	-	0.75	NECB G
Parkade	1.1	x	-	0.85	24 hrs/day
Stairs	8.3	x	-	0.25	24 hrs/day
Storage Areas / Bike Storage	2.4	x	-	0.55	24 hrs/day
Vestibule	3.9	-	-	0.75	24 hrs/day
Exterior Lighting	2.5 kW	-	x	-	Photocell Control
Lighting Archetype – 35 Storey					
Space Type	**Load (W/m^2)**	**Occupancy Sensor**	**Daylight Sensor**	**OS Diversity Factor**	**Schedule**
Residential Dwelling Units	3.5	-	-	-	NECB G
Corridors	7.1	-	-	0.75	24 hrs/day

Amenity Rooms	13.3	x	-	0.9	NECB C
Gym & Yoga Rm.	7.8	x	-	0.9	NECB C
Office	8.9	x	-	0.9	NECB A
Mail Room	7.8	x	-	0.9	24 hrs/day
Vestibules	9.7	-	-	-	24 hrs/day
Lobby	7.0	-	-	-	24 hrs/day
Stairs	7.4	x	-	0.25	24 hrs/day
Storage > 5 m^2	6.8	x	-	0.55	NECB C
Garbage/ Waste Holding	5.1	x	-	0.9	24 hrs/day
Parking	1.5	x	-	0.85	24 hrs/day
Electrical/Mechanical Main Room	4.6	-	-	-	24 hrs/day
Electrical Comm Room/Elec Closet	4.6	-	-	-	24 hrs/day, 0.1 Diversity
Exterior Lighting	2.5 kW assumed		x	-	Photocell Control

Table 5: Plug Loads & DHW Loads - Modeling Inputs – all Archetypes

Plug Loads & DHW Loads – Archetype 6 storey, 12 storey, 35 storey				
Space Type	**Plug load W/m²**	**Plug load Schedule**	**DHW W/person**	**DHW Schedule**
Residential Dwelling Units	5	NECB G	0.0016 L/s/pers.	NECB G, per CoV
Corridors	0	off	0	off
Amenity Rooms	1	NECB C	45	NECB C
Gym & Yoga Rm.	2.5	NECB C	90	NECB C
Office	7.5	NECB A	60	NECB A
Mail Room	0	24 hrs/day	0	off
Vestibules	0	24 hrs/day	0	off
Lobby	1	24 hrs/day	0	off
Parkade	0	off	0	off
Stairs	0	off	0	off
Storage Areas / Bike Storage	0	off	0	off
Vestibule	0	off	0	off
Garbage/ Waste Holding	0	off	0	off
Electrical/Mechanical General	1	NECB F	0	off
Main Electrical Room	custom	custom	0	off
Transformer room	custom	custom	0	off
Comms Room	custom	custom	0	off
Elevator control room	custom	Same as elevator	0	off
Elevators	3 kW/elevator, ASHARE hotel schedule		0	off

Appendices

APPENDIX J — LITERATURE AND PRECEDENT REVIEW DETAILED RESULTS

Appendix J - Literature and Precedent Review

This appendix provides a structured review of key literature, technical guidance, and policy precedents that informed the study's scope, methodology, and interpretation of results.

R-series references, which include core technical and policy documents that directly informed the study's scope, methodology, and alignment with the City of Vancouver context.

E-series references, which include supporting literature, standards, academic research, and policy precedents used to expand understanding, test assumptions, and identify considerations for future study.

ID	Document title (short)	Link / access	Document type	Geographic context	Key content used	Limitations / caveats	Equity / vulnerable populations addressed
R1	UBC Future Climate Design for MURBs (2021)	https://planning.ubc.ca/sites/default/files/2021-11/R-21007_001%202021%2009%2027%20UBC%20Climate%20Resilience%20Final%20Report_ISSUED.pdf	Research report	British Columbia (Vancouver focus)	Uses PCIC 2050s and 2080s climate scenarios	Not a compliance or prescriptive document	Vulnerable populations referenced at high level
					Identifies increased overheating risk in high-performance envelopes	Overheating metrics not standardized	Not a primary analytical focus
					Discusses passive strategies qualitatively	Numeric overheating-hour thresholds not consolidated	
					References CIBSE TM59 and NRC survivability concepts (not adopted)		
R2	NRC Climate Resilience Buildings – Overheating Guidelines	https://nrc-publications.canada.ca/eng/view/ft/?id=9c60dc19-ca18-4f4c-871f-2633f002b95c&dp=2&dsl=en	Technical guidance	Canada	Defines overheating thresholds	Guidance document only	Explicit focus on elderly
					Introduces adaptive comfort models	Metrics require jurisdictional interpretation before adoption	Children
					Introduces passive survivability (>30 °C)		Chronically ill
					Dedicated MURB section		Low-income occupants
R3	City of Vancouver Zero Emissions Building Options Costing Study (2019)	https://vancouver.ca/files/cov/zero-emissions-building-options-costing-study.pdf	Technical + costing study	Vancouver	Uses PCIC RCP 8.5 2050s weather file	Includes active cooling strategies beyond TRiM scope	Not explicitly addressed
					Applies overheating hours and CEDI	Costing is indicative	
					Finds passive-only strategies insufficient under future climate	Market availability varies	
					Includes indicative cost data		
R4a	IEA Annex 80 – Resilient Cooling KPIs (2024)	https://www.aivc.org/sites/default/files/International-Energy-Agency-Resilient-Cooling-of-Buildings-Key-Performance-Indicators-Report-Annex-80.pdf	International research / guidance	International	Defines passive survivability	KPI framework only	Equity not a primary focus
					Defines thermal autonomy	Not jurisdiction-specific	
					Defines overheating escalation factor	Requires local calibration	
					Frames resilience under outages and system failure		
R4b	IEA Annex 80 – Resilient Cooling Field Studies (2024)	https://annex80.iea-ebc.org/Data/publications/International%20Energy%20Agency%20-%20Resilient%20Cooling%20of%20Buildings%20-%20Field%20Studies%20Report%20(Annex%2080).pdf	International research synthesis	International	Summarizes field studies of passive, hybrid, and active cooling strategies	Not MURB-specific	Equity not a primary focus
					Demonstrates performance during heat events and outages	Contextual evidence only	
					Supports KPI concepts in R4a	Limited transferability without local calibration	

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R5	City of Vancouver Passive Cooling Measures for MURBs (2017)	https://vancouver.ca/files/cov/passive-cooling-measures-for-murbs.pdf	Technical study	Vancouver	Evaluates shading, glazing, ventilation Assesses current and 2050 climate scenarios Shows significant reduction in overheating hours Residual risk remains	Concept-level analysis Limited cost data Not prescriptive	Not explicitly addressed
R6	BC Building Code (BCBC) 2024	https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/construction-industry/building-codes-and-standards/revisions-and-mo/bcbc-revision-3/bcbc-revision-4/bcbc_2024_web_version_20240409.pdf	Standard / Policy	British Columbia	Establishes prescriptive envelope and energy targets No overheating or thermal comfort criteria included	Energy-focused only Overheating risk not addressed	Not primary
E01	CIBSE TM59 – Overheating in Homes (2017)	https://cibseorg.sharepoint.com/:b:/r/sites/KnowledgeLibrary/Shared%20Documents/CIBSE%20PDFs/TM59%20Design%20methodology%20for%20the%20assessment%20of%20overheating%20risk%20in%20homes%20(2017).pdf?csf=1&web=1&e=dkKEno	Technical standard / guidance	UK	• Defines pass/fail overheating criteria using DSY1 weather files • Applies adaptive comfort (TM52) for NV homes and fixed 26 °C for mechanically cooled homes • Identifies bedrooms and top-floor units as high-risk	• UK climate and regulatory context • DSY weather files not aligned with BC practice • Not health-based or survivability-focused	Not explicit
E03	CaGBC Zero Carbon Building – Design Standard v4 (2024)	https://www.cagbc.org/wp-content/uploads/2024/07/CAGBC_Zero_Carbon_Building–Design_Standard_v4.pdf	National design standard	Canada	• Encourages passive design and airtight envelopes • References future climate files and resilience reporting • Mentions passive survivability conceptually	• No explicit overheating thresholds • Not prescriptive for thermal safety	Not explicit
E04	Designing Energy Efficient Buildings (Surrey, 2016)	https://edit.surrey.ca/sites/default/files/media/documents/DesigningEnergyEfficientBuildings.pdf	Municipal guidance	Canada (Surrey, BC)	• Provides passive design strategies (orientation, WWR, shading, massing) • Includes cost-effectiveness discussion	• Does not quantify overheating hours • No thermal comfort or survivability metrics	Not explicit

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E05	EPBD – Overheating Guidance (EU, 2016)	https://discovery.ucl.ac.uk/id/eprint/10174565/1/Mavrogianni_ResearchPaperDraft_V27_clean.pdf	Research / policy analysis	EU	• Reviews calculation methods, criteria, and indicators used in EU regulations • Recognizes overheating as compliance issue	• European regulatory context • Transferability to BC intentionally out of scope	Not explicit
E07	UBC Passive Survivability Report (2025 Draft)	shared with team - confidentially as draft	Research report	Canada (BC)	• Evaluates survivability under power-off conditions • Uses multiple future weather files • Demonstrates passive measures extending survivability duration	• Draft / confidential • Not regulatory guidance	Vulnerable populations implied
E08	General Formulation for PMV Index	https://www.mdpi.com/2075-5309/12/10/1572	Academic paper	International	• Expands PMV formulation • Explores adaptive extensions	• Theoretical • No direct application to codes or TRiM metrics	Not explicit
E09	Overheating Risk Analysis in LTC Homes (2023)	https://www.mdpi.com/2075-5309/13/2/390	Academic / health-based	International	• Develops overheating limit criteria for LTC residents • Proposes 26°C and 28°C thresholds • Links heat exposure to health outcomes	• Focused on LTC, not MURBs • Not directly transferable	Explicit – elderly / vulnerable
E10	Schools Overheating Criteria (2023)	https://www.mdpi.com/2075-5309/14/1/165	Academic / health-based	International	• Defines overheating limits for classrooms • Links heat exposure to cognitive impairment	• Non-residential typology • Used as precedent only	Children
E11	Physiological Indicators of Thermal Comfort (MPMV)	https://www.mdpi.com/2075-5309/14/12/3861	Academic paper	International	• Links skin temperature and blood flow to thermal sensation • Expands beyond classical PMV	• Limited validation in transient conditions • Not used in TRiM modelling	Not explicit
E12	Thermal Comfort of Older People – MPMV Validation	https://www.mdpi.com/1996-1073/18/6/1484	Academic paper	International	• Shows elderly have narrower comfort ranges • Higher heat sensitivity identified	• Not regulatory • Sample limitations	Explicit – elderly
E14	Thermal Safety in Existing MURBs – Policy Toolkit (2025)	https://focalengineering.b-cdn.net/wp-content/uploads/2025/07/Thermal-Safety-in-Existing-MURB-Report_Apr2025.pdf	Policy toolkit	Canada	• Defines thermal safety vs comfort • Supports 26°C indoor max • Identifies retrofit policy tools	• Retrofit-focused • Not new-build specific	Low-income / vulnerable
E15	Policy Tools for Cooler Spaces (2023)	https://www.fraserhealth.ca/-/media/Project/FraserHealth/FraserHealth/Health-Topics/Sun-and-heat-safety/Policy-Tools-Cooler-Spaces.pdf	Policy survey	International	• Reviews global cooling policies • Includes shading, cool roofs, urban strategies	• Limited building-scale detail	Vulnerable populations implied

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E-series references, which include supporting literature, standards, academic research, and policy precedents used to expand understanding, test assumptions, and identify considerations for future study.

ID	Document title (short)	Link / access	Document type	Geographic context	Key content used	Limitations / caveats	Equity / vulnerable populations addressed
E17	ASHRAE 55 (2017 Addenda)	https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20addenda/55_2017_d_20200731.pdf	Standard	International	• Defines operative temperature ranges • Adaptive comfort model (80% acceptability)	• Not health-based • Not binding in BC	Not explicit
E18	2025 BCBC Bylaw Change	https://council.vancouver.ca/20250416/documents/cfsc3.pdf	Regulatory update	BC	• Introduces max indoor temperature of 26°C • First BC regulatory reference to overheating	• Early-stage regulation • Limited scope	Not explicit
E19a	CoV Energy Modelling Guidelines v3.0	https://guidelines.vancouver.ca/guidelines-energy-modelling.pdf	Municipal guideline	Vancouver	• Specifies weather file use • Requires overheating reporting	• Modelling guidance only • Not policy thresholds	Not explicit
E19b	Updates to CoV Energy Modelling Guidelines v3.0	https://vancouver.ca/files/cov/emgs-v3-updates-recommendations-report.pdf	Technical update	Vancouver	• Clarifies modelling expectations	• No new thresholds	Not explicit
E20	NRC Focal Passive Survivability (2024 Draft)	shared with team - confidentially as draft	Research draft	Canada	• Defines survivability hours above 30°C and 35°C • Links overheating directly to health risk	• Draft / confidential	Vulnerable populations implied
E21	ISO 7730:2005/2025	Not reviewed as needs to be purchased	International standard	International	• PMV calculation framework	• Not reviewed due to paywall	Not explicit

Appendices
APPENDIX K — DETAILED OVERHEATING ANALYSIS RESULTS

Appendix K - Detailed Overheating Analysis Results

This appendix to TRiM summarizes results from overheating analysis for each archetype and passive bundle per building orientation. The results include both the NRC metric evaluation and the VBBL overheating hours evaluation.

The results are presented per Archetype: 6 storey, 25 storey and 35 storey, and includes results for a suite in each orientation.

The main overheating analysis is based on the NRC EWF + UHI climate file (refer to section 2.10 Climate File Selection)

The VBBL overheating climate file NRC GW+2.0C scenario is included for comparison of the worst performing orientation only.

6 Storey Archetype

Overheating Analysis - Summary Results per Orientation

Climate File NRC EWF+UHI

Orientation	Case	Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	NR of Health Risk Events	VBBL Overheating Hours (OH)		
											Peak Temp.	Peak Temp. Time	VBBL Overheating Hrs
North	Baseline	L4 - Apt 22-N-1 Bed - Living-NRC	1	May 14, 2025	May 17, 2025	4	76	0.79	NO	2	35 °C	Aug-14, 11:00 PM	1056
			2	June 6, 2025	June 9, 2025	4	157	1.63	YES				
			3	June 11, 2025	June 12, 2025	2	17	0.35	NO				
			4	June 21, 2025	September 7, 2025	79	6,117	3.23	YES				
			5	September 14, 2025	September 15, 2025	2	57	1.19	NO				
			6	September 17, 2025	September 18, 2025	2	41	0.86	NO				
	Bundle 1	L4 - Apt 22-N-1 Bed - Living-NRC	1	June 6, 2025	June 6, 2025	1	5	0.20	NO	4	32.72 °C	Aug-14, 11:00 PM	227
			2	June 22, 2025	June 24, 2025	3	71	0.98	NO				
			3	July 6, 2025	July 6, 2025	1	7	0.27	NO				
			4	July 11, 2025	July 14, 2025	4	90	0.94	NO				
			5	July 20, 2025	July 20, 2025	1	7	0.28	NO				
			6	July 23, 2025	July 26, 2025	4	47	0.49	NO				
			7	July 28, 2025	August 3, 2025	7	168	1.00	YES				
			8	August 6, 2025	August 6, 2025	1	7	0.31	NO				
			9	August 9, 2025	August 15, 2025	7	589	3.50	YES				
			10	August 17, 2025	August 17, 2025	1	13	0.52	NO				
			11	August 19, 2025	August 22, 2025	4	166	1.73	YES				
			12	August 24, 2025	August 29, 2025	6	140	0.97	YES				
			13	August 31, 2025	September 1, 2025	2	22	0.46	NO				
	Bundle 2		1	June 6, 2025	June 6, 2025	1	5	0.19	NO	4	32.73 °C	Aug-14, 11:00 PM	224
			2	June 22, 2025	June 24, 2025	3	68	0.95	NO				
			3	July 6, 2025	July 6, 2025	1	6	0.26	NO				
			4	July 11, 2025	July 14, 2025	4	88	0.92	NO				
			5	July 20, 2025	July 20, 2025	1	7	0.28	NO				
			6	July 23, 2025	July 26, 2025	4	45	0.47	NO				
			7	July 28, 2025	August 3, 2025	7	166	0.99	YES				
			8	August 6, 2025	August 6, 2025	1	7	0.29	NO				
			9	August 9, 2025	August 15, 2025	7	584	3.48	YES				
			10	August 17, 2025	August 17, 2025	1	12	0.51	NO				
			11	August 19, 2025	August 22, 2025	4	164	1.71	YES				
			12	August 24, 2025	August 29, 2025	6	138	0.96	YES				
			13	August 31, 2025	September 1, 2025	2	22	0.45	NO				
	Bundle 3		1	June 6, 2025	June 6, 2025	1	4	0.19	NO	4	32.72 °C	Aug-14, 11:00 PM	223
			2	June 22, 2025	June 24, 2025	3	68	0.95	NO				
			3	July 6, 2025	July 6, 2025	1	6	0.27	NO				
			4	July 11, 2025	July 14, 2025	4	88	0.92	NO				
			5	July 20, 2025	July 20, 2025	1	7	0.28	NO				
			6	July 23, 2025	July 26, 2025	4	46	0.48	NO				
			7	July 28, 2025	August 3, 2025	7	166	0.99	YES				
			8	August 6, 2025	August 6, 2025	1	7	0.31	NO				
			9	August 9, 2025	August 15, 2025	7	584	3.47	YES				
			10	August 17, 2025	August 17, 2025	1	12	0.52	NO				
			11	August 19, 2025	August 22, 2025	4	164	1.71	YES				
			12	August 24, 2025	August 29, 2025	6	139	0.97	YES				
			13	August 31, 2025	September 1, 2025	2	22	0.46	NO				
	Bundle 4		1	June 22, 2025	June 24, 2025	3	63	0.88	NO	4	32.69 °C	Aug-14, 11:00 PM	211
			2	July 6, 2025	July 6, 2025	1	5	0.21	NO				
			3	July 11, 2025	July 14, 2025	4	82	0.86	NO				
			4	July 20, 2025	July 20, 2025	1	5	0.23	NO				
			5	July 23, 2025	July 25, 2025	3	37	0.51	NO				
			6	July 28, 2025	August 3, 2025	7	157	0.94	YES				
			7	August 6, 2025	August 6, 2025	1	6	0.24	NO				
			8	August 9, 2025	August 15, 2025	7	572	3.41	YES				
			9	August 17, 2025	August 17, 2025	1	11	0.48	NO				
			10	August 19, 2025	August 22, 2025	4	158	1.64	YES				
			11	August 24, 2025	August 29, 2025	6	131	0.91	YES				
			12	August 31, 2025	September 1, 2025	2	20	0.41	NO				

6 Storey Archetype

Overheating Analysis - Summary Results per Orientation

Climate File NRC EWF+UHI

											VBBL Overheating Hours (OH)		
Orientation	Case	Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	NR of Health Risk Events	Peak Temp.	Peak Temp. Time	VBBL Overheating Hrs
South	Baseline	L4 - Apt 11-S-1 Bed - Living-NRC	1	May 13, 2025	May 18, 2025	6	152	1.06	YES	4	34.8 °C	Aug-14, 10:00 PM	1213
			2	June 3, 2025	June 3, 2025	1	11	0.44	NO				
			3	June 6, 2025	June 12, 2025	7	263	1.57	YES				
			4	June 18, 2025	September 20, 2025	95	7,470	3.28	YES				
			5	September 22, 2025	September 22, 2025	1	15	0.62	NO				
			6	September 24, 2025	September 26, 2025	3	26	0.36	NO				
			7	September 28, 2025	October 3, 2025	6	139	0.96	YES				
			8	October 5, 2025	October 5, 2025	1	24	1.00	NO				
			9	October 8, 2025	October 10, 2025	3	24	0.34	NO				
			10	October 16, 2025	October 18, 2025	3	40	0.55	NO				
			11	October 21, 2025	October 21, 2025	1	6	0.24	NO				
			12	October 28, 2025	October 28, 2025	1	5	0.21	NO				
	Bundle 1	L4 - Apt 11-S-1 Bed - Living-NRC	1	June 6, 2025	June 6, 2025	1	7	0.28	NO	4	32.57 °C	Aug-14, 11:00 PM	240
			2	June 22, 2025	June 24, 2025	3	69	0.96	NO				
			3	July 6, 2025	July 6, 2025	1	8	0.32	NO				
			4	July 11, 2025	July 14, 2025	4	89	0.93	NO				
			5	July 20, 2025	July 20, 2025	1	8	0.32	NO				
			6	July 23, 2025	July 26, 2025	4	50	0.52	NO				
			7	July 28, 2025	August 3, 2025	7	169	1.00	YES				
			8	August 6, 2025	August 6, 2025	1	9	0.36	NO				
			9	August 9, 2025	August 15, 2025	7	589	3.50	YES				
			10	August 17, 2025	August 17, 2025	1	14	0.58	NO				
			11	August 19, 2025	August 22, 2025	4	168	1.75	YES				
			12	August 24, 2025	August 29, 2025	6	148	1.02	YES				
			13	August 31, 2025	September 1, 2025	2	25	0.53	NO				
			14	September 14, 2025	September 14, 2025	1	5	0.21	NO				
	Bundle 2		1	June 6, 2025	June 6, 2025	1	6	0.25	NO	4	32.55 °C	Aug-14, 11:00 PM	236
			2	June 22, 2025	June 24, 2025	3	66	0.91	NO				
			3	July 6, 2025	July 6, 2025	1	7	0.30	NO				
			4	July 11, 2025	July 14, 2025	4	86	0.89	NO				
			5	July 20, 2025	July 20, 2025	1	7	0.30	NO				
			6	July 23, 2025	July 25, 2025	3	44	0.61	NO				
			7	July 28, 2025	August 3, 2025	7	165	0.98	YES				
			8	August 6, 2025	August 6, 2025	1	8	0.33	NO				
			9	August 9, 2025	August 15, 2025	7	581	3.46	YES				
			10	August 17, 2025	August 17, 2025	1	14	0.57	NO				
			11	August 19, 2025	August 22, 2025	4	165	1.72	YES				
			12	August 24, 2025	August 29, 2025	6	143	1.00	YES				
			13	August 31, 2025	September 1, 2025	2	25	0.51	NO				
			14	September 14, 2025	September 14, 2025	1	5	0.20	NO				
	Bundle 3		1	June 6, 2025	June 6, 2025	1	6	0.27	NO	4	32.52 °C	Aug-14, 11:00 PM	231
			2	June 22, 2025	June 24, 2025	3	68	0.95	NO				
			3	July 6, 2025	July 6, 2025	1	8	0.32	NO				
			4	July 11, 2025	July 14, 2025	4	88	0.92	NO				
			5	July 20, 2025	July 20, 2025	1	8	0.32	NO				
			6	July 23, 2025	July 26, 2025	4	49	0.51	NO				
			7	July 28, 2025	August 3, 2025	7	169	1.00	YES				
			8	August 6, 2025	August 6, 2025	1	8	0.34	NO				
			9	August 9, 2025	August 15, 2025	7	582	3.46	YES				
			10	August 17, 2025	August 17, 2025	1	14	0.57	NO				
			11	August 19, 2025	August 22, 2025	4	164	1.71	YES				
			12	August 24, 2025	August 29, 2025	6	146	1.01	YES				
			13	August 31, 2025	September 1, 2025	2	24	0.51	NO				
			14	September 14, 2025	September 14, 2025	1	5	0.19	NO				
	Bundle 4		1	June 6, 2025	June 6, 2025	1	5	0.21	NO	4	32.5 °C	Aug-14, 11:00 PM	224
			2	June 22, 2025	June 24, 2025	3	61	0.85	NO				
			3	July 6, 2025	July 6, 2025	1	6	0.25	NO				
			4	July 11, 2025	July 14, 2025	4	81	0.84	NO				
			5	July 20, 2025	July 20, 2025	1	6	0.25	NO				
			6	July 23, 2025	July 25, 2025	3	40	0.55	NO				
			7	July 28, 2025	August 3, 2025	7	156	0.93	YES				
			8	August 6, 2025	August 6, 2025	1	6	0.26	NO				
			9	August 9, 2025	August 15, 2025	7	569	3.39	YES				
			10	August 17, 2025	August 17, 2025	1	13	0.53	NO				
			11	August 19, 2025	August 22, 2025	4	158	1.65	YES				
			12	August 24, 2025	August 29, 2025	6	135	0.94	YES				
			13	August 31, 2025	September 1, 2025	2	22	0.47	NO				
			14	September 14, 2025	September 14, 2025	1	4	0.18	NO				

6 Storey Archetype

Overheating Analysis - Summary Results per Orientation

Climate File NRC EWF+UHI

Orientation	Case	Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	NR of Health Risk Events	VBBL Overheating Hours (OH)		
											Peak Temp.	Peak Temp. Time	VBBL Overheating Hrs
East	Baseline	L4 - Apt 2-E-2 Beds-Living-NRC	1	May 12, 2025	May 18, 2025	7	282	1.68	YES	3	36 °C	Aug-14, 11:00 PM	1318
			2	May 24, 2025	May 25, 2025	2	15	0.32	NO				
			3	June 2, 2025	June 3, 2025	2	22	0.46	NO				
			4	June 5, 2025	June 12, 2025	8	403	2.10	YES				
			5	June 16, 2025	June 16, 2025	1	7	0.30	NO				
			6	June 18, 2025	September 15, 2025	90	9,036	4.18	YES				
			7	September 17, 2025	September 20, 2025	4	121	1.26	NO				
			8	September 22, 2025	September 22, 2025	1	18	0.75	NO				
			9	September 24, 2025	September 25, 2025	2	29	0.61	NO				
			10	September 28, 2025	September 29, 2025	2	30	0.63	NO				
			11	October 2, 2025	October 3, 2025	2	52	1.09	NO				
			12	October 5, 2025	October 6, 2025	2	20	0.42	NO				
			13	October 23, 2025	October 23, 2025	1	5	0.19	NO				
	Bundle 1	L4 - Apt 8-E-2 Beds - Living-NRC	1	June 6, 2025	June 7, 2025	2	24	0.49	NO	4	32.95 °C	Aug-14, 11:00 PM	270
			2	June 22, 2025	June 24, 2025	3	113	1.58	NO				
			3	July 6, 2025	July 6, 2025	1	10	0.40	NO				
			4	July 11, 2025	July 14, 2025	4	132	1.37	NO				
			5	July 20, 2025	July 20, 2025	1	10	0.40	NO				
			6	July 23, 2025	July 26, 2025	4	76	0.79	NO				
			7	July 28, 2025	August 3, 2025	7	224	1.33	YES				
			8	August 6, 2025	August 6, 2025	1	14	0.59	NO				
			9	August 9, 2025	August 15, 2025	7	689	4.10	YES				
			10	August 17, 2025	August 17, 2025	1	28	1.18	NO				
			11	August 19, 2025	August 22, 2025	4	215	2.23	YES				
			12	August 24, 2025	September 1, 2025	9	233	1.08	YES				
			13	September 4, 2025	September 4, 2025	1	8	0.33	NO				
			14	September 14, 2025	September 14, 2025	1	8	0.34	NO				
	Bundle 2		1	June 6, 2025	June 7, 2025	2	15	0.32	NO	4	32.87 °C	Aug-14, 11:00 PM	247
			2	June 22, 2025	June 24, 2025	3	95	1.31	NO				
			3	July 6, 2025	July 6, 2025	1	9	0.35	NO				
			4	July 11, 2025	July 14, 2025	4	113	1.17	NO				
			5	July 20, 2025	July 20, 2025	1	8	0.35	NO				
			6	July 23, 2025	July 26, 2025	4	62	0.64	NO				
			7	July 28, 2025	August 3, 2025	7	206	1.23	YES				
			8	August 6, 2025	August 6, 2025	1	11	0.48	NO				
			9	August 9, 2025	August 15, 2025	7	655	3.90	YES				
			10	August 17, 2025	August 17, 2025	1	24	0.99	NO				
			11	August 19, 2025	August 22, 2025	4	200	2.08	YES				
			12	August 24, 2025	September 1, 2025	9	215	1.00	YES				
			13	September 4, 2025	September 4, 2025	1	8	0.31	NO				
			14	September 14, 2025	September 14, 2025	1	8	0.33	NO				
	Bundle 3		1	June 6, 2025	June 7, 2025	2	16	0.33	NO	4	32.9 °C	Aug-14, 11:00 PM	240
			2	June 22, 2025	June 24, 2025	3	94	1.31	NO				
			3	July 6, 2025	July 6, 2025	1	10	0.41	NO				
			4	July 11, 2025	July 14, 2025	4	116	1.20	NO				
			5	July 20, 2025	July 20, 2025	1	10	0.40	NO				
			6	July 23, 2025	July 26, 2025	4	65	0.68	NO				
			7	July 28, 2025	August 3, 2025	7	212	1.26	YES				
			8	August 6, 2025	August 6, 2025	1	13	0.55	NO				
			9	August 9, 2025	August 15, 2025	7	653	3.88	YES				
			10	August 17, 2025	August 17, 2025	1	25	1.04	NO				
			11	August 19, 2025	August 22, 2025	4	203	2.12	YES				
			12	August 24, 2025	September 1, 2025	9	226	1.04	YES				
			13	September 4, 2025	September 4, 2025	1	8	0.33	NO				
			14	September 14, 2025	September 14, 2025	1	8	0.34	NO				
	Bundle 4		1	June 6, 2025	June 7, 2025	2	17	0.36	NO	4	32.89 °C	Aug-14, 11:00 PM	254
			2	June 22, 2025	June 24, 2025	3	99	1.37	NO				
			3	July 6, 2025	July 6, 2025	1	8	0.33	NO				
			4	July 11, 2025	July 14, 2025	4	117	1.22	NO				
			5	July 20, 2025	July 20, 2025	1	8	0.32	NO				
			6	July 23, 2025	July 26, 2025	4	63	0.66	NO				
			7	July 28, 2025	August 3, 2025	7	207	1.23	YES				
			8	August 6, 2025	August 6, 2025	1	12	0.50	NO				
			9	August 9, 2025	August 15, 2025	7	661	3.93	YES				
			10	August 17, 2025	August 17, 2025	1	25	1.03	NO				
			11	August 19, 2025	August 22, 2025	4	202	2.11	YES				
			12	August 24, 2025	September 1, 2025	9	214	0.99	YES				
			13	September 4, 2025	September 4, 2025	1	7	0.30	NO				
			14	September 14, 2025	September 14, 2025	1	8	0.32	NO				

6 Storey Archetype

Overheating Analysis - Summary Results per Orientation

Climate File NRC EWF+UHI

											VBBL Overheating Hours (OH)		
Orientation	Case	Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	NR of Health Risk Events	Peak Temp.	Peak Temp. Time	VBBL Overheating Hrs
West	Baseline	L4 - Apt 17-W-2 Beds - Living-NRC	1	May 13, 2025	May 19, 2025	7	268	1.60	YES	3	37.11 °C	Aug-14, 8:00 PM	1563
			2	May 22, 2025	May 22, 2025	1	6	0.24	NO				
			3	May 24, 2025	May 26, 2025	3	28	0.38	NO				
			4	May 31, 2025	May 31, 2025	1	4	0.17	NO				
			5	June 2, 2025	June 3, 2025	2	18	0.38	NO				
			6	June 5, 2025	June 13, 2025	9	442	2.05	YES				
			7	June 18, 2025	September 20, 2025	95	9,968	4.37	YES				
			8	September 22, 2025	September 22, 2025	1	15	0.62	NO				
			9	September 24, 2025	September 25, 2025	2	22	0.46	NO				
			10	September 29, 2025	September 30, 2025	2	22	0.46	NO				
			11	October 2, 2025	October 3, 2025	2	41	0.85	NO				
			12	October 5, 2025	October 5, 2025	1	23	0.97	NO				
			13	October 23, 2025	October 23, 2025	1	5	0.20	NO				
	Bundle 1	L4 - Apt 17-W-2 Beds - Living-NRC	1	May 16, 2025	May 16, 2025	1	4	0.17	NO	5	33.19 °C	Aug-14, 11:00 PM	264
			2	June 6, 2025	June 7, 2025	2	18	0.36	NO				
			3	June 22, 2025	June 24, 2025	3	95	1.32	NO				
			4	July 6, 2025	July 6, 2025	1	11	0.47	NO				
			5	July 10, 2025	July 15, 2025	6	130	0.90	YES				
			6	July 20, 2025	July 20, 2025	1	12	0.50	NO				
			7	July 23, 2025	July 26, 2025	4	72	0.75	NO				
			8	July 28, 2025	August 3, 2025	7	224	1.34	YES				
			9	August 5, 2025	August 6, 2025	2	21	0.44	NO				
			10	August 8, 2025	August 15, 2025	8	661	3.44	YES				
			11	August 17, 2025	August 17, 2025	1	24	1.01	NO				
			12	August 19, 2025	August 22, 2025	4	207	2.16	YES				
			13	August 24, 2025	September 1, 2025	9	238	1.10	YES				
			14	September 4, 2025	September 4, 2025	1	7	0.30	NO				
			15	September 6, 2025	September 6, 2025	1	5	0.21	NO				
			16	September 14, 2025	September 14, 2025	1	9	0.37	NO				
	Bundle 2		1	June 6, 2025	June 7, 2025	2	12	0.25	NO	4	33.05 °C	Aug-14, 11:00 PM	235
			2	June 22, 2025	June 24, 2025	3	85	1.18	NO				
			3	July 6, 2025	July 6, 2025	1	9	0.39	NO				
			4	July 11, 2025	July 14, 2025	4	106	1.11	NO				
			5	July 20, 2025	July 20, 2025	1	10	0.40	NO				
			6	July 23, 2025	July 26, 2025	4	61	0.64	NO				
			7	July 28, 2025	August 3, 2025	7	206	1.23	YES				
			8	August 6, 2025	August 6, 2025	1	12	0.52	NO				
			9	August 9, 2025	August 15, 2025	7	632	3.76	YES				
			10	August 17, 2025	August 17, 2025	1	21	0.88	NO				
			11	August 19, 2025	August 22, 2025	4	194	2.02	YES				
			12	August 24, 2025	September 1, 2025	9	216	1.00	YES				
			13	September 4, 2025	September 4, 2025	1	6	0.27	NO				
			14	September 14, 2025	September 14, 2025	1	8	0.33	NO				
	Bundle 3		1	June 6, 2025	June 7, 2025	2	12	0.25	NO	4	33.03 °C	Aug-14, 11:00 PM	232
			2	June 22, 2025	June 24, 2025	3	87	1.21	NO				
			3	July 6, 2025	July 6, 2025	1	11	0.44	NO				
			4	July 11, 2025	July 14, 2025	4	109	1.13	NO				
			5	July 20, 2025	July 20, 2025	1	10	0.41	NO				
			6	July 23, 2025	July 26, 2025	4	63	0.66	NO				
			7	July 28, 2025	August 3, 2025	7	210	1.25	YES				
			8	August 6, 2025	August 6, 2025	1	13	0.53	NO				
			9	August 9, 2025	August 15, 2025	7	637	3.79	YES				
			10	August 17, 2025	August 17, 2025	1	23	0.96	NO				
			11	August 19, 2025	August 22, 2025	4	198	2.06	YES				
			12	August 24, 2025	September 1, 2025	9	223	1.03	YES				
			13	September 4, 2025	September 4, 2025	1	7	0.28	NO				
			14	September 14, 2025	September 14, 2025	1	8	0.34	NO				
	Bundle 4		1	June 6, 2025	June 7, 2025	2	12	0.25	NO	4	33.12 °C	Aug-14, 11:00 PM	237
			2	June 22, 2025	June 24, 2025	3	84	1.17	NO				
			3	July 6, 2025	July 6, 2025	1	9	0.37	NO				
			4	July 10, 2025	July 14, 2025	5	110	0.92	NO				
			5	July 20, 2025	July 20, 2025	1	9	0.38	NO				
			6	July 23, 2025	July 26, 2025	4	61	0.63	NO				
			7	July 28, 2025	August 3, 2025	7	206	1.23	YES				
			8	August 6, 2025	August 6, 2025	1	12	0.52	NO				
			9	August 9, 2025	August 15, 2025	7	632	3.76	YES				
			10	August 17, 2025	August 17, 2025	1	21	0.89	NO				
			11	August 19, 2025	August 22, 2025	4	195	2.03	YES				
			12	August 24, 2025	September 1, 2025	9	216	1.00	YES				
			13	September 4, 2025	September 4, 2025	1	6	0.26	NO				
			14	September 14, 2025	September 14, 2025	1	8	0.32	NO				

6 Storey Archetype

Overheating Analysis - Summary Results per Orientation

Climate File NRC GW+2°C

Orientation		Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	NR of Health Risk Events	VBBL Overheating Hours (OH) Peak Temp.	Peak Temp. Time	VBBL Overheating Hrs
West	Baseline	L4 - Apt 17-W-2 Beds - Living-NRC	1	May 10, 2025	May 17, 2025	8	160	0.8	YES	6	35.81 °C	Aug-13, 7:00 PM	750
			2	May 21, 2025	May 23, 2025	3	20	0.3	NO				
			3	June 1, 2025	June 1, 2025	1	7	0.3	NO				
			4	June 5, 2025	June 9, 2025	5	81	0.7	NO				
			5	June 14, 2025	June 19, 2025	6	134	0.9	YES				
			6	June 22, 2025	July 8, 2025	17	536	1.3	YES				
			7	July 10, 2025	September 3, 2025	56	4965	3.7	YES				
			8	September 6, 2025	September 16, 2025	11	138	0.5	YES				
			9	September 19, 2025	September 30, 2025	12	80	0.3	YES				
			10	October 10, 2025	October 12, 2025	3	15	0.2	NO				
	Bundle 1	L4 - Apt 17-W-2 Beds - Living-NRC	1	June 17, 2025	June 17, 2025	1	5	0.19	NO	2	32.76 °C	Aug-13, 6:00 PM	95
			2	July 2, 2025	July 2, 2025	1	8	0.31	NO				
			3	July 6, 2025	July 7, 2025	2	14	0.28	NO				
			4	July 12, 2025	July 13, 2025	2	19	0.39	NO				
			5	July 18, 2025	July 20, 2025	3	42	0.58	NO				
			6	July 28, 2025	July 31, 2025	4	46	0.48	NO				
			7	August 2, 2025	August 8, 2025	7	180	1.07	YES				
			8	August 11, 2025	August 26, 2025	16	477	1.24	YES				
	Bundle 2		1	July 2, 2025	July 2, 2025	1	6	0.24	NO	2	31.83 °C	Aug-13, 7:00 PM	74
			2	July 6, 2025	July 6, 2025	1	7	0.30	NO				
			3	July 12, 2025	July 13, 2025	2	15	0.32	NO				
			4	July 18, 2025	July 20, 2025	3	36	0.50	NO				
			5	July 28, 2025	July 31, 2025	4	39	0.40	NO				
			6	August 2, 2025	August 8, 2025	7	165	0.98	YES				
			7	August 11, 2025	August 26, 2025	16	439	1.14	YES				
	Bundle 3		1	July 2, 2025	July 2, 2025	1	6.6	0.27	NO	2	31.7 °C	Aug-13, 7:00 PM	72
			2	July 6, 2025	July 6, 2025	1	8.2	0.34	NO				
			3	July 12, 2025	July 13, 2025	2	18.7	0.39	NO				
			4	July 18, 2025	July 20, 2025	3	48.9	0.68	NO				
			5	July 28, 2025	July 31, 2025	4	50.5	0.53	NO				
			6	August 2, 2025	August 8, 2025	7	226.0	1.35	YES				
			7	August 11, 2025	August 26, 2025	16	594.0	1.55	YES				
	Bundle 4		1	July 2, 2025	July 2, 2025	1	5.1	0.21	NO	2	32.1 °C	Aug-13, 6:00 PM	75
			2	July 6, 2025	July 6, 2025	1	6.6	0.27	NO				
			3	July 12, 2025	July 13, 2025	2	14.1	0.29	NO				
			4	July 18, 2025	July 20, 2025	3	33.3	0.46	NO				
			5	July 29, 2025	July 31, 2025	3	32.2	0.45	NO				
			6	August 2, 2025	August 8, 2025	7	156.9	0.93	YES				
			7	August 11, 2025	August 26, 2025	16	420.9	1.10	YES				

12-Storey Archetype

Overheating Analysis - Summary Results per Orientation

Climate File Scenario: NRC EWF+UHI

											VBBL Single Zone method		
Orientation	Case	Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	Nr of Health Risk Events	Peak Temp.	Peak Temp. Time	VBBL Overheating Hrs
North	Baseline	L7-Apt 9-N-2 Bed -Living NRC	1	May 13, 2025	May 13, 2025	1	6	0.26	NO	2	35.8 °C	Aug-12, 12:00 PM	535
			2	May 15, 2025	May 17, 2025	3	41	0.57	NO				
			3	June 3, 2025	June 3, 2025	1	5	0.21	NO				
			4	June 6, 2025	June 9, 2025	4	121	1.26	NO				
			5	June 11, 2025	June 12, 2025	2	12	0.24	NO				
			6	June 21, 2025	June 28, 2025	8	324	1.69	YES				
			7	June 30, 2025	June 30, 2025	1	5	0.21	NO				
			8	July 2, 2025	July 3, 2025	2	41	0.86	NO				
			9	July 5, 2025	September 2, 2025	60	3,831	2.66	YES				
			10	September 4, 2025	September 6, 2025	3	69	0.95	NO				
			11	September 14, 2025	September 14, 2025	1	35	1.45	NO				
	Bundle 1	L7-Apt 9-N-2 Bed -Living NRC	1	June 23, 2025	June 24, 2025	2	23	0.48	NO	1	31.95 °C	Aug-14, 11:00 PM	102
			2	July 11, 2025	July 12, 2025	2	35	0.74	NO				
			3	July 24, 2025	July 24, 2025	1	9	0.36	NO				
			4	July 29, 2025	July 30, 2025	2	32	0.67	NO				
			5	August 1, 2025	August 1, 2025	1	23	0.94	NO				
			6	August 3, 2025	August 3, 2025	1	7	0.28	NO				
			7	August 9, 2025	August 15, 2025	7	421	2.50	YES				
			8	August 19, 2025	August 21, 2025	3	91	1.27	NO				
			9	August 24, 2025	August 24, 2025	1	13	0.54	NO				
			10	August 26, 2025	August 26, 2025	1	17	0.69	NO				
			11	August 28, 2025	August 29, 2025	2	24	0.50	NO				
			12	August 31, 2025	August 31, 2025	1	6	0.25	NO				
	Bundle 2		1	June 23, 2025	June 24, 2025	2	35	0.73	NO	2	32.06 °C	Aug-14, 11:00 PM	112
			2	July 11, 2025	July 14, 2025	4	57	0.59	NO				
			3	July 23, 2025	July 25, 2025	3	24	0.33	NO				
			4	July 28, 2025	August 3, 2025	7	93	0.56	YES				
			5	August 9, 2025	August 15, 2025	7	467	2.78	YES				
			6	August 17, 2025	August 17, 2025	1	7	0.29	NO				
			7	August 19, 2025	August 21, 2025	3	110	1.53	NO				
			8	August 24, 2025	August 26, 2025	3	42	0.59	NO				
			9	August 28, 2025	August 29, 2025	2	34	0.71	NO				
			10	August 31, 2025	August 31, 2025	1	9	0.37	NO				
	Bundle 3		1	June 23, 2025	June 24, 2025	2	36	0.74	NO	2	32.07 °C	Aug-14, 11:00 PM	116
			2	July 11, 2025	July 14, 2025	4	58	0.60	NO				
			3	July 23, 2025	July 25, 2025	3	24	0.34	NO				
			4	July 28, 2025	August 3, 2025	7	95	0.56	YES				
			5	August 9, 2025	August 15, 2025	7	469	2.79	YES				
			6	August 17, 2025	August 17, 2025	1	7	0.29	NO				
			7	August 19, 2025	August 21, 2025	3	111	1.54	NO				
			8	August 24, 2025	August 26, 2025	3	43	0.59	NO				
			9	August 28, 2025	August 29, 2025	2	35	0.72	NO				
			10	August 31, 2025	August 31, 2025	1	9	0.38	NO				
	Bundle 4		1	June 23, 2025	June 24, 2025	2	30	0.62	NO	1	32.08 °C	Aug-14, 11:00 PM	109
			2	July 11, 2025	July 14, 2025	4	51	0.53	NO				
			3	July 23, 2025	July 25, 2025	3	19	0.27	NO				
			4	July 29, 2025	July 30, 2025	2	35	0.73	NO				
			5	August 1, 2025	August 3, 2025	3	40	0.56	NO				
			6	August 9, 2025	August 15, 2025	7	451	2.69	YES				
			7	August 17, 2025	August 17, 2025	1	6	0.25	NO				
			8	August 19, 2025	August 21, 2025	3	104	1.44	NO				
			9	August 24, 2025	August 24, 2025	1	15	0.64	NO				
			10	August 26, 2025	August 26, 2025	1	19	0.78	NO				
			11	August 28, 2025	August 29, 2025	2	31	0.64	NO				
			12	August 31, 2025	August 31, 2025	1	7	0.30	NO				

12-Storey Archetype

Overheating Analysis - Summary Results per Orientation

Climate File Scenario: NRC EWF+UHI

											VBBL Single Zone method		
Orientation	Case	Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	Nr of Health Risk Events	Peak Temp.	Peak Temp. Time	VBBL Overheating Hrs
South East	Baseline	L7-Apt 3-S-2 Bed-Living-NRC	1	May 13, 2025	May 18, 2025	6	132	0.92	YES	5	35.1 °C	Aug-12, 1:00 PM	621
			2	June 3, 2025	June 3, 2025	1	12	0.51	NO				
			3	June 5, 2025	June 12, 2025	8	202	1.05	YES				
			4	June 18, 2025	September 9, 2025	84	5,071	2.52	YES				
			5	September 11, 2025	September 20, 2025	10	270	1.12	YES				
			6	September 22, 2025	September 22, 2025	1	21	0.87	NO				
			7	September 24, 2025	October 3, 2025	10	264	1.10	YES				
			8	October 5, 2025	October 6, 2025	2	36	0.75	NO				
			9	October 8, 2025	October 10, 2025	3	56	0.78	NO				
			10	October 16, 2025	October 19, 2025	4	92	0.95	NO				
			11	October 21, 2025	October 21, 2025	1	10	0.42	NO				
			12	October 28, 2025	October 28, 2025	1	13	0.54	NO				
	Bundle 1	L7-Apt 3-S-2 Bed-Living-NRC	1	June 23, 2025	June 24, 2025	2	32	0.67	NO	2	32.76 °C	Aug-14, 1:00 PM	123
			2	July 6, 2025	July 6, 2025	1	4	0.17	NO				
			3	July 11, 2025	July 12, 2025	2	43	0.90	NO				
			4	July 14, 2025	July 14, 2025	1	5	0.21	NO				
			5	July 23, 2025	July 25, 2025	3	25	0.35	NO				
			6	July 28, 2025	August 3, 2025	7	86	0.51	YES				
			7	August 9, 2025	August 15, 2025	7	450	2.68	YES				
			8	August 17, 2025	August 17, 2025	1	8	0.35	NO				
			9	August 19, 2025	August 21, 2025	3	109	1.51	NO				
			10	August 24, 2025	August 26, 2025	3	48	0.66	NO				
			11	August 28, 2025	August 29, 2025	2	33	0.68	NO				
			12	August 31, 2025	August 31, 2025	1	10	0.41	NO				
	Bundle 2		1	June 6, 2025	June 6, 2025	1	6	0.24	NO	3	32.2 °C	Aug-14, 1:00 PM	124
			2	June 22, 2025	June 24, 2025	3	45	0.63	NO				
			3	July 6, 2025	July 6, 2025	1	6	0.25	NO				
			4	July 11, 2025	July 14, 2025	4	64	0.66	NO				
			5	July 20, 2025	July 20, 2025	1	5	0.19	NO				
			6	July 23, 2025	July 25, 2025	3	32	0.44	NO				
			7	July 28, 2025	August 3, 2025	7	103	0.62	YES				
			8	August 6, 2025	August 6, 2025	1	4	0.18	NO				
			9	August 9, 2025	August 15, 2025	7	483	2.87	YES				
			10	August 17, 2025	August 17, 2025	1	11	0.47	NO				
			11	August 19, 2025	August 22, 2025	4	127	1.33	NO				
			12	August 24, 2025	August 29, 2025	6	106	0.73	YES				
			13	August 31, 2025	September 1, 2025	2	18	0.38	NO				
	Bundle 3		1	June 6, 2025	June 6, 2025	1	6	0.25	NO	3	32.58 °C	Aug-14, 1:00 PM	131
			2	June 22, 2025	June 24, 2025	3	48	0.66	NO				
			3	July 6, 2025	July 6, 2025	1	7	0.28	NO				
			4	July 11, 2025	July 14, 2025	4	66	0.69	NO				
			5	July 20, 2025	July 20, 2025	1	5	0.22	NO				
			6	July 23, 2025	July 25, 2025	3	33	0.45	NO				
			7	July 28, 2025	August 3, 2025	7	106	0.63	YES				
			8	August 9, 2025	August 15, 2025	7	480	2.86	YES				
			9	August 17, 2025	August 17, 2025	1	11	0.47	NO				
			10	August 19, 2025	August 21, 2025	3	119	1.65	NO				
			11	August 24, 2025	August 29, 2025	6	104	0.72	YES				
			12	August 31, 2025	August 31, 2025	1	13	0.53	NO				
	Bundle 4		1	June 6, 2025	June 6, 2025	1	5	0.21	NO	3	32.81 °C	Aug-14, 1:00 PM	132
			2	June 22, 2025	June 24, 2025	3	44	0.61	NO				
			3	July 6, 2025	July 6, 2025	1	5	0.22	NO				
			4	July 11, 2025	July 14, 2025	4	62	0.64	NO				
			5	July 20, 2025	July 20, 2025	1	4	0.17	NO				
			6	July 23, 2025	July 25, 2025	3	30	0.41	NO				
			7	July 28, 2025	August 3, 2025	7	98	0.59	YES				
			8	August 9, 2025	August 15, 2025	7	478	2.84	YES				
			9	August 17, 2025	August 17, 2025	1	11	0.45	NO				
			10	August 19, 2025	August 21, 2025	3	119	1.66	NO				
			11	August 24, 2025	August 29, 2025	6	98	0.68	YES				
			12	August 31, 2025	September 1, 2025	2	16	0.34	NO				

12-Storey Archetype

Overheating Analysis - Summary Results per Orientation

Climate File Scenario: NRC EWF+UHI

Orientation	Case	Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	Nr of Health Risk Events	VBBL Single Zone method		
											Peak Temp.	Peak Temp. Time	VBBL Overheating Hrs
East	Baseline	L7-Apt 2-E-3 Beds 2 Baths-Living-NRC	1	May 13, 2025	May 13, 2025	1	13	0.53	NO	5	35.8 °C	Aug-12, 12:00 PM	535
			2	May 15, 2025	May 16, 2025	2	32	0.66	NO				
			3	June 6, 2025	June 9, 2025	4	124	1.29	NO				
			4	June 11, 2025	June 11, 2025	1	6	0.25	NO				
			5	June 21, 2025	June 25, 2025	5	284	2.37	YES				
			6	June 27, 2025	June 28, 2025	2	17	0.35	NO				
			7	June 30, 2025	June 30, 2025	1	6	0.24	NO				
			8	July 2, 2025	July 2, 2025	1	18	0.73	NO				
			9	July 6, 2025	July 7, 2025	2	83	1.73	NO				
			10	July 10, 2025	August 3, 2025	25	1,298	2.16	YES				
			11	August 5, 2025	August 15, 2025	11	1,099	4.16	YES				
			12	August 17, 2025	August 17, 2025	1	55	2.31	NO				
			13	August 19, 2025	August 22, 2025	4	390	4.06	YES				
			14	August 24, 2025	September 2, 2025	10	576	2.40	YES				
			15	September 4, 2025	September 4, 2025	1	11	0.45	NO				
			16	September 6, 2025	September 6, 2025	1	26	1.07	NO				
			17	September 13, 2025	September 14, 2025	2	36	0.75	NO				
	Bundle 1	L7-Apt 2-E-3 Beds 2 Baths-Living-NRC	1	June 6, 2025	June 6, 2025	1	6	0.24	NO	3	32.8 °C	Aug-14, 1:00 PM	125
			2	June 22, 2025	June 24, 2025	3	66	0.92	NO				
			3	July 6, 2025	July 6, 2025	1	6	0.26	NO				
			4	July 11, 2025	July 14, 2025	4	87	0.91	NO				
			5	July 20, 2025	July 20, 2025	1	5	0.20	NO				
			6	July 23, 2025	July 25, 2025	3	36	0.51	NO				
			7	July 28, 2025	August 3, 2025	7	124	0.74	YES				
			8	August 9, 2025	August 15, 2025	7	552	3.28	YES				
			9	August 17, 2025	August 17, 2025	1	15	0.62	NO				
			10	August 19, 2025	August 21, 2025	3	146	2.03	NO				
			11	August 24, 2025	August 29, 2025	6	112	0.78	YES				
			12	August 31, 2025	September 1, 2025	2	17	0.36	NO				
	Bundle 2		1	June 6, 2025	June 6, 2025	1	6	0.26	NO	4	32.29 °C	Aug-14, 1:00 PM	126
			2	June 22, 2025	June 24, 2025	3	70	0.97	NO				
			3	July 6, 2025	July 6, 2025	1	7	0.28	NO				
			4	July 11, 2025	July 14, 2025	4	90	0.94	NO				
			5	July 20, 2025	July 20, 2025	1	6	0.23	NO				
			6	July 23, 2025	July 25, 2025	3	37	0.52	NO				
			7	July 28, 2025	August 3, 2025	7	140	0.83	YES				
			8	August 6, 2025	August 6, 2025	1	4	0.17	NO				
			9	August 9, 2025	August 15, 2025	7	577	3.43	YES				
			10	August 17, 2025	August 17, 2025	1	16	0.68	NO				
			11	August 19, 2025	August 22, 2025	4	163	1.70	YES				
			12	August 24, 2025	August 29, 2025	6	126	0.88	YES				
			13	August 31, 2025	September 1, 2025	2	19	0.41	NO				
			14	September 4, 2025	September 4, 2025	1	4	0.17	NO				
			15	September 14, 2025	September 14, 2025	1	5	0.20	NO				
	Bundle 3		1	June 6, 2025	June 6, 2025	1	8	0.32	NO	4	32.7 °C	Aug-14, 1:00 PM	136
			2	June 22, 2025	June 24, 2025	3	76	1.06	NO				
			3	July 6, 2025	July 6, 2025	1	9	0.37	NO				
			4	July 11, 2025	July 14, 2025	4	98	1.03	NO				
			5	July 20, 2025	July 20, 2025	1	7	0.30	NO				
			6	July 23, 2025	July 25, 2025	3	43	0.60	NO				
			7	July 28, 2025	August 3, 2025	7	153	0.91	YES				
			8	August 6, 2025	August 6, 2025	1	6	0.26	NO				
			9	August 9, 2025	August 15, 2025	7	589	3.51	YES				
			10	August 17, 2025	August 17, 2025	1	17	0.70	NO				
			11	August 19, 2025	August 22, 2025	4	171	1.78	YES				
			12	August 24, 2025	August 29, 2025	6	141	0.98	YES				
			13	August 31, 2025	September 1, 2025	2	22	0.46	NO				
			14	September 4, 2025	September 4, 2025	1	4	0.19	NO				
			15	September 14, 2025	September 14, 2025	1	5	0.21	NO				
	Bundle 4		1	June 6, 2025	June 7, 2025	2	13	0.28	NO	4	32.82 °C	Aug-14, 1:00 PM	137
			2	June 22, 2025	June 24, 2025	3	82	1.14	NO				
			3	July 6, 2025	July 6, 2025	1	8	0.32	NO				
			4	July 11, 2025	July 14, 2025	4	104	1.08	NO				
			5	July 20, 2025	July 20, 2025	1	6	0.26	NO				
			6	July 23, 2025	July 25, 2025	3	44	0.62	NO				
			7	July 28, 2025	August 3, 2025	7	151	0.90	YES				
			8	August 6, 2025	August 6, 2025	1	6	0.25	NO				
			9	August 9, 2025	August 15, 2025	7	603	3.59	YES				
			10	August 17, 2025	August 17, 2025	1	18	0.76	NO				
			11	August 19, 2025	August 22, 2025	4	176	1.83	YES				
			12	August 24, 2025	August 29, 2025	6	138	0.96	YES				
			13	August 31, 2025	September 1, 2025	2	20	0.42	NO				
			14	September 14, 2025	September 14, 2025	1	5	0.19	NO				

12-Storey Archetype

Overheating Analysis - Summary Results per Orientation

Climate File Scenario: NRC EWF+UHI

											VBBL Single Zone method		
Orientation	Case	Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	Nr of Health Risk Events	Peak Temp.	Peak Temp. Time	VBBL Overheating Hrs
South West	Baseline	L7-Apt 5-SW-3 Beds 2 Baths -Living-NRC	1	May 1, 2025	May 1, 2025	1	5	0.22	NO	4	36.94 °C	Aug-12, 7:00 PM	783
			2	May 10, 2025	May 20, 2025	11	273	1.03	YES				
			3	May 22, 2025	May 22, 2025	1	11	0.45	NO				
			4	May 24, 2025	May 26, 2025	3	44	0.62	NO				
			5	May 28, 2025	May 28, 2025	1	9	0.38	NO				
			6	May 30, 2025	June 3, 2025	5	63	0.52	NO				
			7	June 5, 2025	June 12, 2025	8	361	1.88	YES				
			8	June 16, 2025	September 20, 2025	97	7,249	3.11	YES				
			9	September 22, 2025	September 22, 2025	1	22	0.92	NO				
			10	September 24, 2025	October 3, 2025	10	216	0.90	YES				
			11	October 5, 2025	October 5, 2025	1	31	1.31	NO				
			12	October 8, 2025	October 10, 2025	3	38	0.52	NO				
			13	October 16, 2025	October 19, 2025	4	65	0.67	NO				
			14	October 21, 2025	October 21, 2025	1	7	0.29	NO				
			15	October 28, 2025	October 28, 2025	1	9	0.36	NO				
	Bundle 1	L7-Apt 5-SW-3 Beds 2 Baths -Living-NRC	1	June 23, 2025	June 23, 2025	1	9	0.37	NO	1	32.15 °C	Aug-14, 11:00 PM	113
			2	July 11, 2025	July 12, 2025	2	30	0.62	NO				
			3	July 23, 2025	July 24, 2025	2	14	0.30	NO				
			4	July 29, 2025	July 30, 2025	2	30	0.62	NO				
			5	August 3, 2025	August 3, 2025	1	6	0.24	NO				
			6	August 9, 2025	August 15, 2025	7	403	2.40	YES				
			7	August 20, 2025	August 21, 2025	2	80	1.67	NO				
			8	August 24, 2025	August 24, 2025	1	7	0.31	NO				
			9	August 26, 2025	August 26, 2025	1	16	0.65	NO				
			10	August 28, 2025	August 29, 2025	2	20	0.43	NO				
			11	August 31, 2025	September 1, 2025	2	12	0.25	NO				
	Bundle 2		1	June 23, 2025	June 23, 2025	1	11	0.44	NO	1	32.18 °C	Aug-14, 11:00 PM	118
			2	July 11, 2025	July 12, 2025	2	34	0.70	NO				
			3	July 23, 2025	July 24, 2025	2	17	0.35	NO				
			4	July 29, 2025	July 30, 2025	2	36	0.75	NO				
			5	August 3, 2025	August 3, 2025	1	6	0.24	NO				
			6	August 9, 2025	August 15, 2025	7	457	2.72	YES				
			7	August 19, 2025	August 21, 2025	3	108	1.50	NO				
			8	August 24, 2025	August 24, 2025	1	10	0.40	NO				
			9	August 26, 2025	August 26, 2025	1	17	0.72	NO				
			10	August 28, 2025	August 29, 2025	2	27	0.57	NO				
			11	August 31, 2025	September 1, 2025	2	13	0.28	NO				
	Bundle 3		1	June 23, 2025	June 23, 2025	1	11	0.48	NO	1	32.15 °C	Aug-14, 11:00 PM	121
			2	July 11, 2025	July 12, 2025	2	35	0.73	NO				
			3	July 23, 2025	July 24, 2025	2	18	0.37	NO				
			4	July 29, 2025	July 30, 2025	2	36	0.75	NO				
			5	August 3, 2025	August 3, 2025	1	6	0.27	NO				
			6	August 9, 2025	August 15, 2025	7	463	2.75	YES				
			7	August 19, 2025	August 21, 2025	3	110	1.52	NO				
			8	August 24, 2025	August 24, 2025	1	10	0.41	NO				
			9	August 26, 2025	August 26, 2025	1	18	0.74	NO				
			10	August 28, 2025	August 29, 2025	2	28	0.59	NO				
			11	August 31, 2025	August 31, 2025	1	8	0.32	NO				
	Bundle 4		1	June 23, 2025	June 24, 2025	2	27	0.55	NO	1	32.26 °C	Aug-14, 1:00 PM	124
			2	July 11, 2025	July 12, 2025	2	36	0.75	NO				
			3	July 23, 2025	July 24, 2025	2	21	0.43	NO				
			4	July 29, 2025	July 30, 2025	2	37	0.78	NO				
			5	August 3, 2025	August 3, 2025	1	7	0.28	NO				
			6	August 9, 2025	August 15, 2025	7	467	2.78	YES				
			7	August 19, 2025	August 21, 2025	3	112	1.56	NO				
			8	August 24, 2025	August 24, 2025	1	10	0.41	NO				
			9	August 26, 2025	August 26, 2025	1	19	0.77	NO				
			10	August 28, 2025	August 29, 2025	2	29	0.61	NO				
			11	August 31, 2025	September 1, 2025	2	15	0.31	NO				

12-Storey Archetype

Overheating Analysis - Summary Results per Orientation

Climate File Scenario: NRC GW+2°C

Orientation	Case	Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	Nr of Health Risk Events	VBBL Overheating Hours (OH) Peak Temp.	Peak Temp. Time	VBBL Overheating Hrs
South West	Baseline	L7-Apt 5-SW-3 Beds 2 Baths -Living-NRC	1	May 9, 2025	May 23, 2025	15	295	0.8	YES	8	36.24 °C	Aug-13, 6:00 PM	468
			2	May 28, 2025	May 28, 2025	1	8	0.3	NO				
			3	June 1, 2025	June 1, 2025	1	21	0.9	NO				
			4	June 3, 2025	June 8, 2025	6	111	0.8	YES				
			5	June 12, 2025	June 27, 2025	16	302	0.8	YES				
			6	June 29, 2025	July 8, 2025	10	377	1.6	YES				
			7	July 10, 2025	September 3, 2025	56	3785	2.8	YES				
			8	September 6, 2025	September 7, 2025	2	21	0.4	NO				
			9	September 9, 2025	September 9, 2025	1	13	0.5	NO				
			10	September 11, 2025	September 16, 2025	6	149	1.0	YES				
			11	September 19, 2025	September 30, 2025	12	297	1.0	YES				
			12	October 7, 2025	October 12, 2025	6	126	0.9	YES				
			13	October 14, 2025	October 15, 2025	2	18	0.4	NO				
	Bundle 1	L7-Apt 5-SW-3 Beds 2 Baths -Living-NRC	1	July 6, 2025	July 6, 2025	1	5	0.19	NO	2	32.07 °C	Aug-13, 5:00 PM	70
			2	July 19, 2025	July 20, 2025	2	14	0.30	NO				
			3	July 30, 2025	July 31, 2025	2	26	0.53	NO				
			4	August 3, 2025	August 7, 2025	5	99	0.83	NO				
			5	August 11, 2025	August 18, 2025	8	154	0.80	YES				
			6	August 20, 2025	August 26, 2025	7	145	0.86	YES				
	Bundle 2		1	July 6, 2025	July 6, 2025	1	4	0.18	NO	2	32.01 °C	Aug-13, 5:00 PM	61
			2	July 19, 2025	July 20, 2025	2	14	0.29	NO				
			3	July 31, 2025	July 31, 2025	1	22	0.92	NO				
			4	August 3, 2025	August 7, 2025	5	112	0.93	NO				
			5	August 11, 2025	August 18, 2025	8	173	0.90	YES				
			6	August 20, 2025	August 26, 2025	7	164	0.98	YES				
	Bundle 3		1	July 6, 2025	July 6, 2025	1	4.8	0.20	NO	2	32.01 °C	Aug-13, 5:00 PM	72
			2	July 19, 2025	July 20, 2025	2	14	0.30	NO				
			3	July 30, 2025	July 31, 2025	2	28	0.58	NO				
			4	August 3, 2025	August 7, 2025	5	117	0.97	NO				
			5	August 11, 2025	August 18, 2025	8	180	0.94	YES				
			6	August 20, 2025	August 26, 2025	7	169	1.00	YES				
	Bundle 4		1	July 6, 2025	July 6, 2025	1	5	0.20	NO	2	32.07 °C	Aug-13, 5:00 PM	76
			2	July 19, 2025	July 20, 2025	2	15	0.31	NO				
			3	July 30, 2025	July 31, 2025	2	29	0.59	NO				
			4	August 3, 2025	August 7, 2025	5	117	0.98	NO				
			5	August 11, 2025	August 18, 2025	8	184	0.96	YES				
			6	August 20, 2025	August 26, 2025	7	174	1.03	YES				

35-Storey Archetype

Overheating Analysis - Summary Results per Orientation

Climate File Scenario: NRC EWF+UHI

Orientation	Case	Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	Nr of Health Risk Events	VBBL Overheating Hours (OH)		
											Peak Temp.	Peak Temp. Time	VBBL Overheating Hrs
East	Baseline	L19-Apt 2-E-1 Bed-Living-NRC	1	May 12, 2025	May 18, 2025	7	321	1.91	YES	6	37.3 °C	Aug-12, 11:00 AM	911
			2	May 22, 2025	May 22, 2025	1	4	0.18	NO				
			3	May 24, 2025	May 25, 2025	2	27	0.57	NO				
			4	June 1, 2025	June 3, 2025	3	50	0.70	NO				
			5	June 5, 2025	June 9, 2025	5	313	2.61	YES				
			6	June 11, 2025	June 12, 2025	2	74	1.55	NO				
			7	June 16, 2025	June 16, 2025	1	19	0.78	NO				
			8	June 19, 2025	June 28, 2025	10	710	2.96	YES				
			9	June 30, 2025	July 3, 2025	4	152	1.58	YES				
			10	July 5, 2025	September 8, 2025	66	5,449	3.44	YES				
			11	September 11, 2025	September 15, 2025	5	150	1.25	YES				
			12	September 19, 2025	September 20, 2025	2	25	0.52	NO				
			13	September 22, 2025	September 22, 2025	1	15	0.62	NO				
			14	September 25, 2025	September 25, 2025	1	13	0.52	NO				
			15	September 28, 2025	September 29, 2025	2	37	0.76	NO				
			16	October 2, 2025	October 3, 2025	2	42	0.87	NO				
	Bundle 1	L19-Apt 2-E-1 Bed-Living-NRC	1	June 23, 2025	June 24, 2025	2	25	0.53	NO	1	32.8 °C	Aug-14, 1:00 PM	162
			2	July 11, 2025	July 13, 2025	3	49	0.69	NO				
			3	July 24, 2025	July 24, 2025	1	8	0.32	NO				
			4	July 29, 2025	July 30, 2025	2	31	0.64	NO				
			5	August 9, 2025	August 15, 2025	7	437	2.60	YES				
			6	August 17, 2025	August 17, 2025	1	7	0.28	NO				
			7	August 19, 2025	August 21, 2025	3	97	1.35	NO				
			8	August 24, 2025	August 24, 2025	1	8	0.32	NO				
			9	August 26, 2025	August 26, 2025	1	23	0.96	NO				
			10	August 28, 2025	August 29, 2025	2	16	0.34	NO				
			11	August 31, 2025	August 31, 2025	1	5	0.20	NO				
	Bundle 2		1	June 23, 2025	June 24, 2025	2	26	0.54	NO	1	32.2 °C	Aug-14, 1:00 PM	145
			2	July 11, 2025	July 13, 2025	3	45	0.63	NO				
			3	July 24, 2025	July 24, 2025	1	8	0.35	NO				
			4	July 29, 2025	July 30, 2025	2	32	0.67	NO				
			5	August 3, 2025	August 3, 2025	1	5	0.21	NO				
			6	August 9, 2025	August 15, 2025	7	439	2.62	YES				
			7	August 17, 2025	August 17, 2025	1	5	0.22	NO				
			8	August 19, 2025	August 21, 2025	3	99	1.37	NO				
			9	August 24, 2025	August 24, 2025	1	9	0.36	NO				
			10	August 26, 2025	August 26, 2025	1	22	0.90	NO				
			11	August 28, 2025	August 29, 2025	2	17	0.36	NO				
			12	August 31, 2025	August 31, 2025	1	5	0.23	NO				
	Bundle 3		1	June 23, 2025	June 24, 2025	2	34	0.71	NO	1	32.6 °C	Aug-14, 1:00 PM	170
			2	July 11, 2025	July 13, 2025	3	54	0.75	NO				
			3	July 23, 2025	July 24, 2025	2	16	0.33	NO				
			4	July 29, 2025	July 30, 2025	2	34	0.71	NO				
			5	August 1, 2025	August 1, 2025	1	21	0.86	NO				
			6	August 3, 2025	August 3, 2025	1	7	0.30	NO				
			7	August 9, 2025	August 15, 2025	7	457	2.72	YES				
			8	August 17, 2025	August 17, 2025	1	6	0.26	NO				
			9	August 19, 2025	August 21, 2025	3	104	1.45	NO				
			10	August 24, 2025	August 24, 2025	1	10	0.44	NO				
			11	August 26, 2025	August 26, 2025	1	24	1.01	NO				
			12	August 28, 2025	August 29, 2025	2	21	0.45	NO				
			13	August 31, 2025	August 31, 2025	1	8	0.33	NO				
	Bundle 4		1	June 23, 2025	June 24, 2025	2	36	0.75	NO	1	32.8 °C	Aug-14, 1:00 PM	175
			2	July 11, 2025	July 13, 2025	3	59	0.82	NO				
			3	July 24, 2025	July 24, 2025	1	10	0.42	NO				
			4	July 29, 2025	July 30, 2025	2	35	0.73	NO				
			5	August 3, 2025	August 3, 2025	1	6	0.25	NO				
			6	August 9, 2025	August 15, 2025	7	465	2.77	YES				
			7	August 17, 2025	August 17, 2025	1	8	0.33	NO				
			8	August 19, 2025	August 21, 2025	3	108	1.49	NO				
			9	August 24, 2025	August 24, 2025	1	10	0.40	NO				
			10	August 26, 2025	August 26, 2025	1	27	1.10	NO				
			11	August 28, 2025	August 29, 2025	2	19	0.40	NO				
			12	August 31, 2025	August 31, 2025	1	6	0.26	NO				

Overheating Analysis - Summary Results per Orientation

Climate File Scenario: NRC EWF+UHI

											VBBL Overheating Hours (OH)		
Orientation	Case	Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	Nr of Health Risk Events	Peak Temp.	Peak Temp. Time	VBBL Overheating Hrs
West	Baseline	L19-Apt 6-W-2 Beds-Living-NRC	1	May 1, 2025	May 1, 2025	1	6	0.23	NO	5	37.8 °C	Aug-14, 7:00 PM	1256
			2	May 10, 2025	May 11, 2025	2	17	0.35	NO				
			3	May 13, 2025	May 20, 2025	8	249	1.30	YES				
			4	May 22, 2025	May 28, 2025	7	74	0.44	YES				
			5	May 30, 2025	June 3, 2025	5	58	0.48	NO				
			6	June 5, 2025	June 12, 2025	8	373	1.94	YES				
			7	June 16, 2025	September 15, 2025	92	7,728	3.50	YES				
			8	September 17, 2025	September 20, 2025	4	76	0.80	NO				
			9	September 22, 2025	September 22, 2025	1	16	0.67	NO				
			10	September 24, 2025	September 26, 2025	3	23	0.32	NO				
			11	September 28, 2025	October 3, 2025	6	79	0.55	YES				
			12	October 5, 2025	October 5, 2025	1	25	1.06	NO				
			13	October 9, 2025	October 10, 2025	2	11	0.22	NO				
			14	October 16, 2025	October 16, 2025	1	6	0.24	NO				
			15	October 18, 2025	October 18, 2025	1	7	0.29	NO				
	Bundle 1	L19-Apt 6-W-2 Beds-Living-NRC	1	June 23, 2025	June 24, 2025	2	25	0.51	NO	1	32.8 °C	Aug-14, 11:00 PM	199
			2	July 11, 2025	July 12, 2025	2	40	0.83	NO				
			3	July 23, 2025	July 24, 2025	2	16	0.33	NO				
			4	July 29, 2025	July 30, 2025	2	34	0.72	NO				
			5	August 1, 2025	August 1, 2025	1	26	1.06	NO				
			6	August 3, 2025	August 3, 2025	1	8	0.34	NO				
			7	August 9, 2025	August 15, 2025	7	446	2.66	YES				
			8	August 17, 2025	August 17, 2025	1	7	0.28	NO				
			9	August 19, 2025	August 21, 2025	3	107	1.48	NO				
			10	August 24, 2025	August 26, 2025	3	36	0.50	NO				
			11	August 28, 2025	August 29, 2025	2	25	0.53	NO				
			12	August 31, 2025	September 1, 2025	2	15	0.31	NO				
	Bundle 2		1	June 6, 2025	June 6, 2025	1	6	0.24	NO	3	32.7 °C	Aug-14, 11:00 PM	184
			2	June 23, 2025	June 24, 2025	2	42	0.88	NO				
			3	July 6, 2025	July 6, 2025	1	6	0.24	NO				
			4	July 11, 2025	July 14, 2025	4	68	0.70	NO				
			5	July 20, 2025	July 20, 2025	1	4	0.17	NO				
			6	July 23, 2025	July 25, 2025	3	31	0.43	NO				
			7	July 28, 2025	August 3, 2025	7	110	0.66	YES				
			8	August 9, 2025	August 15, 2025	7	504	3.00	YES				
			9	August 17, 2025	August 17, 2025	1	11	0.46	NO				
			10	August 19, 2025	August 21, 2025	3	127	1.77	NO				
			11	August 24, 2025	August 29, 2025	6	97	0.67	YES				
			12	August 31, 2025	September 1, 2025	2	18	0.39	NO				
			13	September 14, 2025	September 14, 2025	1	5	0.21	NO				
	Bundle 3		1	June 6, 2025	June 6, 2025	1	6	0.25	NO	3	32.7 °C	Aug-14, 11:00 PM	205
			2	June 22, 2025	June 24, 2025	3	51	0.70	NO				
			3	July 6, 2025	July 6, 2025	1	7	0.30	NO				
			4	July 11, 2025	July 14, 2025	4	75	0.78	NO				
			5	July 20, 2025	July 20, 2025	1	5	0.20	NO				
			6	July 23, 2025	July 25, 2025	3	33	0.46	NO				
			7	July 28, 2025	August 3, 2025	7	117	0.70	YES				
			8	August 9, 2025	August 15, 2025	7	516	3.07	YES				
			9	August 17, 2025	August 17, 2025	1	12	0.52	NO				
			10	August 19, 2025	August 21, 2025	3	132	1.83	NO				
			11	August 24, 2025	August 29, 2025	6	107	0.74	YES				
			12	August 31, 2025	September 1, 2025	2	20	0.41	NO				
			13	September 14, 2025	September 14, 2025	1	5	0.22	NO				
	Bundle 4		1	June 6, 2025	June 6, 2025	1	7	0.31	NO	3	32.9 °C	Aug-14, 11:00 PM	214
			2	June 22, 2025	June 24, 2025	3	51	0.71	NO				
			3	July 6, 2025	July 6, 2025	1	7	0.29	NO				
			4	July 11, 2025	July 14, 2025	4	76	0.79	NO				
			5	July 20, 2025	July 20, 2025	1	5	0.20	NO				
			6	July 23, 2025	July 25, 2025	3	36	0.50	NO				
			7	July 28, 2025	August 3, 2025	7	122	0.73	YES				
			8	August 6, 2025	August 6, 2025	1	4	0.17	NO				
			9	August 9, 2025	August 15, 2025	7	517	3.08	YES				
			10	August 17, 2025	August 17, 2025	1	11	0.47	NO				
			11	August 19, 2025	August 21, 2025	3	134	1.86	NO				
			12	August 24, 2025	August 29, 2025	6	107	0.74	YES				
			13	August 31, 2025	September 1, 2025	2	21	0.44	NO				
			14	September 14, 2025	September 14, 2025	1	5	0.20	NO				

35-Storey Archetype

Overheating Analysis - Summary Results per Orientation

Climate File Scenario: NRC EWF+UHI

Orientation	Case	Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	Nr of Health Risk Events	VBBL Overheating Hours (OH)		
											Peak Temp.	Peak Temp. Time	VBBL Overheating Hrs
South	Baseline	L19-Apt 4-S-Studio-NRC	1	June 6, 2025	June 7, 2025	2	29	0.60	NO	5	34.4 °C	Aug-14, 11:00 PM	641
			2	June 22, 2025	June 24, 2025	3	127	1.77	NO				
			3	July 6, 2025	July 6, 2025	1	12	0.51	NO				
			4	July 11, 2025	July 14, 2025	4	158	1.65	YES				
			5	July 20, 2025	July 20, 2025	1	13	0.56	NO				
			6	July 23, 2025	July 26, 2025	4	95	0.99	NO				
			7	July 28, 2025	August 3, 2025	7	265	1.58	YES				
			8	August 5, 2025	August 6, 2025	2	25	0.51	NO				
			9	August 9, 2025	August 15, 2025	7	782	4.66	YES				
			10	August 17, 2025	August 17, 2025	1	25	1.06	NO				
			11	August 19, 2025	August 22, 2025	4	286	2.98	YES				
			12	August 24, 2025	September 2, 2025	10	335	1.40	YES				
			13	September 6, 2025	September 6, 2025	1	9	0.38	NO				
			14	September 14, 2025	September 14, 2025	1	12	0.49	NO				
	Bundle 1	L19-Apt 4-S-Studio-NRC	1	June 23, 2025	June 23, 2025	1	8	0.33	NO	1	32.4 °C	Aug-14, 11:00 PM	176
			2	July 11, 2025	July 12, 2025	2	31	0.65	NO				
			3	July 24, 2025	July 24, 2025	1	6	0.26	NO				
			4	July 29, 2025	July 30, 2025	2	29	0.60	NO				
			5	August 1, 2025	August 1, 2025	1	21	0.89	NO				
			6	August 9, 2025	August 15, 2025	7	431	2.57	YES				
			7	August 17, 2025	August 17, 2025	1	5	0.19	NO				
			8	August 19, 2025	August 21, 2025	3	98	1.36	NO				
			9	August 24, 2025	August 24, 2025	1	10	0.43	NO				
			10	August 26, 2025	August 26, 2025	1	18	0.74	NO				
			11	August 28, 2025	August 29, 2025	2	19	0.40	NO				
			12	August 31, 2025	August 31, 2025	1	5	0.23	NO				
	Bundle 2		1	June 23, 2025	June 24, 2025	2	20	0.42	NO	1	32.5 °C	Aug-14, 11:00 PM	194
			2	July 11, 2025	July 12, 2025	2	35	0.72	NO				
			3	July 24, 2025	July 24, 2025	1	8	0.31	NO				
			4	July 29, 2025	July 30, 2025	2	32	0.66	NO				
			5	August 1, 2025	August 1, 2025	1	22	0.92	NO				
			6	August 3, 2025	August 3, 2025	1	6	0.26	NO				
			7	August 9, 2025	August 15, 2025	7	453	2.69	YES				
			8	August 17, 2025	August 17, 2025	1	6	0.24	NO				
			9	August 19, 2025	August 21, 2025	3	106	1.48	NO				
			10	August 24, 2025	August 24, 2025	1	12	0.50	NO				
			11	August 26, 2025	August 26, 2025	1	20	0.83	NO				
			12	August 28, 2025	August 29, 2025	2	24	0.50	NO				
			13	August 31, 2025	August 31, 2025	1	7	0.29	NO				
	Bundle 3		1	June 23, 2025	June 24, 2025	2	20	0.42	NO	1	32.5 °C	Aug-14, 11:00 PM	191
			2	July 11, 2025	July 12, 2025	2	35	0.72	NO				
			3	July 24, 2025	July 24, 2025	1	7	0.31	NO				
			4	July 29, 2025	July 30, 2025	2	32	0.66	NO				
			5	August 1, 2025	August 1, 2025	1	22	0.92	NO				
			6	August 3, 2025	August 3, 2025	1	6	0.24	NO				
			7	August 9, 2025	August 15, 2025	7	444	2.64	YES				
			8	August 17, 2025	August 17, 2025	1	6	0.24	NO				
			9	August 19, 2025	August 21, 2025	3	101	1.41	NO				
			10	August 24, 2025	August 24, 2025	1	12	0.50	NO				
			11	August 26, 2025	August 26, 2025	1	18	0.76	NO				
			12	August 28, 2025	August 29, 2025	2	23	0.47	NO				
			13	August 31, 2025	August 31, 2025	1	7	0.27	NO				
	Bundle 4		1	June 23, 2025	June 24, 2025	2	17	0.36	NO	1	32.5 °C	Aug-14, 11:00 PM	181
			2	July 11, 2025	July 12, 2025	2	33	0.68	NO				
			3	July 24, 2025	July 24, 2025	1	7	0.27	NO				
			4	July 29, 2025	July 30, 2025	2	30	0.62	NO				
			5	August 1, 2025	August 1, 2025	1	22	0.91	NO				
			6	August 3, 2025	August 3, 2025	1	5	0.21	NO				
			7	August 9, 2025	August 15, 2025	7	441	2.62	YES				
			8	August 17, 2025	August 17, 2025	1	5	0.21	NO				
			9	August 19, 2025	August 21, 2025	3	101	1.41	NO				
			10	August 24, 2025	August 24, 2025	1	11	0.46	NO				
			11	August 26, 2025	August 26, 2025	1	18	0.76	NO				
			12	August 28, 2025	August 29, 2025	2	21	0.44	NO				
			13	August 31, 2025	August 31, 2025	1	6	0.24	NO				

35-Storey Archetype

Overheating Analysis - Summary Results per Orientation

Climate File Scenario: NRC EWF+UHI

Orientation	Case	Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	Nr of Health Risk Events	VBBL Overheating Hours (OH)		
											Peak Temp.	Peak Temp. Time	VBBL Overheating Hrs
North	Baseline	L19-Apt 8-N-1 Bed-Living-NRC	1	May 13, 2025	May 17, 2025	5	57	0.47	NO	2	34.2 °C	Aug-14, 11:00 PM	547
			2	June 3, 2025	June 3, 2025	1	6	0.24	NO				
			3	June 6, 2025	June 9, 2025	4	123	1.28	NO				
			4	June 11, 2025	June 12, 2025	2	15	0.30	NO				
			5	June 21, 2025	June 28, 2025	8	320	1.66	YES				
			6	June 30, 2025	July 3, 2025	4	54	0.56	NO				
			7	July 5, 2025	September 2, 2025	60	3,634	2.52	YES				
			8	September 4, 2025	September 6, 2025	3	63	0.88	NO				
			9	September 14, 2025	September 14, 2025	1	36	1.52	NO				
	Bundle 1	L19-Apt 8-N-1 Bed-Living-NRC	1	June 23, 2025	June 24, 2025	2	23	0.48	NO	1	32.2 °C	Aug-14, 11:00 PM	133
			2	July 11, 2025	July 12, 2025	2	37	0.77	NO				
			3	July 23, 2025	July 24, 2025	2	14	0.29	NO				
			4	July 29, 2025	July 30, 2025	2	31	0.65	NO				
			5	August 1, 2025	August 1, 2025	1	21	0.86	NO				
			6	August 3, 2025	August 3, 2025	1	7	0.28	NO				
			7	August 9, 2025	August 15, 2025	7	422	2.51	YES				
			8	August 19, 2025	August 21, 2025	3	92	1.28	NO				
			9	August 24, 2025	August 24, 2025	1	11	0.45	NO				
			10	August 26, 2025	August 26, 2025	1	18	0.74	NO				
			11	August 28, 2025	August 29, 2025	2	20	0.42	NO				
			12	August 31, 2025	August 31, 2025	1	7	0.29	NO				
	Bundle 2		1	June 23, 2025	June 24, 2025	2	32	0.67	NO	1	32.3 °C	Aug-14, 11:00 PM	154
			2	July 11, 2025	July 14, 2025	4	55	0.58	NO				
			3	July 23, 2025	July 25, 2025	3	23	0.32	NO				
			4	July 28, 2025	July 30, 2025	3	40	0.55	NO				
			5	August 1, 2025	August 3, 2025	3	38	0.52	NO				
			6	August 9, 2025	August 15, 2025	7	449	2.67	YES				
			7	August 17, 2025	August 17, 2025	1	5	0.22	NO				
			8	August 19, 2025	August 21, 2025	3	102	1.42	NO				
			9	August 24, 2025	August 26, 2025	3	38	0.53	NO				
			10	August 28, 2025	August 29, 2025	2	25	0.53	NO				
			11	August 31, 2025	August 31, 2025	1	9	0.39	NO				
	Bundle 3		1	June 23, 2025	June 24, 2025	2	32	0.67	NO	1	32.3 °C	Aug-14, 11:00 PM	153
			2	July 6, 2025	July 6, 2025	1	4	0.17	NO				
			3	July 11, 2025	July 14, 2025	4	56	0.58	NO				
			4	July 23, 2025	July 25, 2025	3	23	0.32	NO				
			5	July 28, 2025	July 30, 2025	3	40	0.55	NO				
			6	August 1, 2025	August 3, 2025	3	38	0.52	NO				
			7	August 9, 2025	August 15, 2025	7	450	2.68	YES				
			8	August 17, 2025	August 17, 2025	1	5	0.22	NO				
			9	August 19, 2025	August 21, 2025	3	102	1.42	NO				
			10	August 24, 2025	August 26, 2025	3	38	0.53	NO				
			11	August 28, 2025	August 29, 2025	2	26	0.53	NO				
			12	August 31, 2025	August 31, 2025	1	9	0.40	NO				
	Bundle 4		1	June 23, 2025	June 24, 2025	2	26	0.55	NO	1	32.3 °C	Aug-14, 11:00 PM	142
			2	July 11, 2025	July 12, 2025	2	39	0.82	NO				
			3	July 23, 2025	July 24, 2025	2	15	0.31	NO				
			4	July 29, 2025	July 30, 2025	2	33	0.69	NO				
			5	August 1, 2025	August 1, 2025	1	22	0.90	NO				
			6	August 3, 2025	August 3, 2025	1	7	0.31	NO				
			7	August 9, 2025	August 15, 2025	7	434	2.58	YES				
			8	August 17, 2025	August 17, 2025	1	4	0.18	NO				
			9	August 19, 2025	August 21, 2025	3	97	1.34	NO				
			10	August 24, 2025	August 24, 2025	1	12	0.49	NO				
			11	August 26, 2025	August 26, 2025	1	19	0.78	NO				
			12	August 28, 2025	August 29, 2025	2	22	0.46	NO				
			13	August 31, 2025	August 31, 2025	1	8	0.32	NO				

Overheating Analysis - Summary Results per Orientation

Climate File Scenario: NRC GW+2°C

Orientation	Case	Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	NR of Health Risk Events	VBBL Single Zone method: Peak Temp.	VBBL Single Zone method: Peak Temp. Time	VBBL Single Zone method: VBBL Overheating Hrs
West	Baseline	L19-Apt 6-W-2 Beds-Living-NRC	1	May 9, 2025	May 23, 2025	15	258	0.7	YES	8	37.1 °C	Aug-13, 7:00 PM	680
			2	May 28, 2025	May 28, 2025	1	9	0.4	NO				
			3	June 1, 2025	June 1, 2025	1	16	0.7	NO				
			4	June 3, 2025	June 8, 2025	6	110	0.8	YES				
			5	June 12, 2025	June 19, 2025	8	148	0.8	YES				
			6	June 21, 2025	June 27, 2025	7	138	0.8	YES				
			7	June 29, 2025	July 8, 2025	10	383	1.6	YES				
			8	July 10, 2025	September 3, 2025	56	3908	2.9	YES				
			9	September 6, 2025	September 7, 2025	2	19	0.4	NO				
			10	September 9, 2025	September 16, 2025	8	104	0.5	YES				
			11	September 19, 2025	September 30, 2025	12	143	0.5	YES				
			12	October 9, 2025	October 12, 2025	4	42	0.4	NO				
			13	October 14, 2025	October 14, 2025	1	4	0.2	NO				
	Bundle 1	L19-Apt 6-W-2 Beds-Living-NRC	1	July 18, 2025	July 20, 2025	3	22	0.31	NO	2	32.76 °C	Aug-13, 6:00 PM	94
			2	July 30, 2025	July 31, 2025	2	28	0.57	NO				
			3	August 3, 2025	August 7, 2025	5	114	0.95	NO				
			4	August 11, 2025	August 18, 2025	8	176	0.92	YES				
			5	August 20, 2025	August 26, 2025	7	157	0.93	YES				
	Bundle 2		1	July 6, 2025	July 7, 2025	2	12	0.25	NO	2	32.26 °C	Aug-13, 7:00 PM	86
			2	July 13, 2025	July 13, 2025	1	5	0.22	NO				
			3	July 18, 2025	July 20, 2025	3	36	0.50	NO				
			4	July 30, 2025	July 31, 2025	2	35	0.73	NO				
			5	August 3, 2025	August 8, 2025	6	147	1.02	YES				
			6	August 11, 2025	August 26, 2025	16	421	1.10	YES				
	Bundle 3		1	July 6, 2025	July 7, 2025	2	13.3	0.28	NO	2	32.51 °C	Aug-13, 7:00 PM	102
			2	July 13, 2025	July 13, 2025	1	5	0.21	NO				
			3	July 18, 2025	July 20, 2025	3	37	0.51	NO				
			4	July 30, 2025	July 31, 2025	2	37	0.77	NO				
			5	August 3, 2025	August 8, 2025	6	154	1.07	YES				
			6	August 11, 2025	August 26, 2025	16	441	1.15	YES				
	Bundle 4		1	July 6, 2025	July 6, 2025	1	8	0.33	NO	2	32.84 °C	Aug-13, 7:00 PM	103
			2	July 13, 2025	July 13, 2025	1	6	0.26	NO				
			3	July 18, 2025	July 20, 2025	3	37	0.51	NO				
			4	July 29, 2025	July 31, 2025	3	40	0.56	NO				
			5	August 3, 2025	August 8, 2025	6	149	1.03	YES				
			6	August 11, 2025	August 26, 2025	16	429	1.12	YES				

Patio Door Modelling

The City of Vancouver Energy Modelling Guidelines v3.0 require patio doors to be modelled as closed. During the TRiM study, this assumption was identified by the project team as not representative of typical occupant behaviour.

As the NRC overheating risk metrics differentiate between living rooms and bedrooms, restricting patio door operation can influence the simulated effectiveness of natural ventilation strategies, particularly in baseline scenarios where passive cooling is limited.

To isolate and better understand the impact of this assumption, an additional sensitivity analysis was undertaken.

The 12-storey baseline archetype was modelled under two patio door conditions:

- patio doors modelled as closed (per VBBL requirements as included in larger TRiM study), and
- patio doors modelled as openable, with the same opening schedule assumed as for windows used in both baseline and passive bundles.

All other archetype parameters remained the same and with openable windows assigned for baseline as outlined in section 2.7.1 Bundle Formation.

The intent of this exercise was not to propose an alternative compliance approach, but to quantify the relative impact of patio door operability to inform discussion.

Under the EWF + UHI climate scenario:

- VBBL overheating hours decreased from 783 to 272.
- The NRC overheating metric worst-case health risk event decreased from 97 days to 7 days, with severity reduced from 7,249 to 664 °Ch.

Under the NRC GW +2°C climate scenario:

- VBBL overheating hours decreased from 468 to 191.
- The NRC overheating metric worst-case health risk event decreased from 56 days to 16 days, with severity reduced from 3,785 to 709 °Ch.

The detailed results are included for reference in the table below.

12-Storey Archetype

Overheating Analysis - Summary Results per Orientation

Two Climate Scenarios: NRC EWF+UHI and NRC GW +2°C

											VBBL Overheating Hours (OH)		
Orientation	Case	Room	Overheating Event	StartDate	EndDate	DUR (Days)	SET (°Ch)	INT (°C)	Health Risk Event	Nr of Health Risk Events	Peak Temp.	Peak Temp. Time	VBBL Overheating Hrs
West	Baseline - Patio Door Closed	Climate file EWF+UHI	1	May 1, 2025	May 1, 2025	1	5	0.22	NO	4	36.94 °C	Aug-12, 7:00 PM	783
			2	May 10, 2025	May 20, 2025	11	273	1.03	YES				
			3	May 22, 2025	May 22, 2025	1	11	0.45	NO				
			4	May 24, 2025	May 26, 2025	3	44	0.62	NO				
			5	May 28, 2025	May 28, 2025	1	9	0.38	NO				
			6	May 30, 2025	June 3, 2025	5	63	0.52	NO				
			7	June 5, 2025	June 12, 2025	8	361	1.88	YES				
			8	June 16, 2025	September 20, 2025	97	7,249	3.11	YES				
			9	September 22, 2025	September 22, 2025	1	22	0.92	NO				
			10	September 24, 2025	October 3, 2025	10	216	0.90	YES				
			11	October 5, 2025	October 5, 2025	1	31	1.31	NO				
			12	October 8, 2025	October 10, 2025	3	38	0.52	NO				
			13	October 16, 2025	October 19, 2025	4	65	0.67	NO				
			14	October 21, 2025	October 21, 2025	1	7	0.29	NO				
			15	October 28, 2025	October 28, 2025	1	9	0.36	NO				
	Baseline - Patio Door Openable Model		1	June 6, 2025	June 6, 2025	1	14	0.60	NO	4	33.36 °C	Aug-12, 6:00 PM	272
			2	June 22, 2025	June 24, 2025	3	104	1.45	NO				
			3	July 6, 2025	July 6, 2025	1	15	0.61	NO				
			4	July 11, 2025	July 14, 2025	4	136	1.41	NO				
			5	July 20, 2025	July 20, 2025	1	14	0.59	NO				
			6	July 23, 2025	July 25, 2025	3	77	1.07	NO				
			7	July 28, 2025	August 3, 2025	7	229	1.36	YES				
			8	August 6, 2025	August 6, 2025	1	13	0.53	NO				
			9	August 9, 2025	August 15, 2025	7	664	3.95	YES				
			10	August 17, 2025	August 17, 2025	1	12	0.51	NO				
			11	August 19, 2025	August 22, 2025	4	214	2.23	YES				
			12	August 24, 2025	August 29, 2025	6	186	1.29	YES				
			13	August 31, 2025	September 1, 2025	2	41	0.85	NO				
			14	September 14, 2025	September 14, 2025	1	6	0.24	NO				
West	Baseline - Patio Door Closed	Climate file NRC GW+2°C	1	May 9, 2025	May 23, 2025	15	295	0.82	YES	8	36.24 °C	Aug-13, 6:00 PM	468
			2	May 28, 2025	May 28, 2025	1	8	0.33	NO				
			3	June 1, 2025	June 1, 2025	1	21	0.88	NO				
			4	June 3, 2025	June 8, 2025	6	111	0.77	YES				
			5	June 12, 2025	June 27, 2025	16	302	0.79	YES				
			6	June 29, 2025	July 8, 2025	10	377	1.57	YES				
			7	July 10, 2025	September 3, 2025	56	3,785	2.82	YES				
			8	September 6, 2025	September 7, 2025	2	21	0.44	NO				
			9	September 9, 2025	September 9, 2025	1	13	0.54	NO				
			10	September 11, 2025	September 16, 2025	6	149	1.03	YES				
			11	September 19, 2025	September 30, 2025	12	297	1.03	YES				
			12	October 7, 2025	October 12, 2025	6	126	0.88	YES				
			13	October 14, 2025	October 15, 2025	2	18	0.38	NO				
	Baseline - Patio Door Openable Model		1	May 15, 2025	May 15, 2025	1	7	0.28	NO	2	34.04 °C	Aug-13, 6:00 PM	191
			2	July 2, 2025	July 2, 2025	1	6	0.24	NO				
			3	July 6, 2025	July 7, 2025	2	23	0.48	NO				
			4	July 12, 2025	July 13, 2025	2	18	0.37	NO				
			5	July 18, 2025	July 20, 2025	3	67	0.93	NO				
			6	July 29, 2025	July 31, 2025	3	70	0.97	NO				
			7	August 2, 2025	August 8, 2025	7	238	1.42	YES				
			8	August 11, 2025	August 26, 2025	16	709	1.85	YES				