Toronto Green Standard Version 3

Expectations versus Reality: Energy in MURBs

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Back in 2018, EQ wrote an article titled '*TGS v3 – How do MURBs stack up?*'. Starting January 1, 2020, all archetype buildings must comply with the TGS v3 absolute targets and meet Tier 1 at a minimum. Prior to this, compliance modelling was done primarily as a 'reference percentage better than' approach, which is still the case for the Ontario Building Code and many other certifications. In continuing this series, as we are now 2 years in to TGS v3, EQ has conducted a technical analysis on business-as-usual multi-unit residential building (MURB) design in a new-age building code.

You may recall that with the new version 3 of the Toronto Green Standard, three key metrics that have set the basis for comparing and evaluating building performance in Toronto:

Energy Use Intensity – EUI – ekWh/m^2: Annual building energy use, divided by the conditioned floor area. This is the classic, straightforward metric that many new and existing building standards, for example *EnergyStar Portfolio Manager,* use in some way.

Thermal Energy Demand Intensity – TEDI – ekWh/m^2: Annual heating load, divided by the conditioned floor area. TEDI excludes the effects of mechanical efficiencies (e.g. high efficiency condensing boilers) but includes passive systems such as in-suite heat recovery, solar gains, and internal gains. In general, TEDI will require builders to focus on the *real* performance of the passive building envelope, rather than relying on active mechanical systems to achieve targets.

Greenhouse Gas Intensity – GHGI – kg CO_2e/m^2: Annual greenhouse gas emissions, divided by the conditioned floor area. Because of the relatively carbon free electricity grid, this metric favours the use of electricity over natural gas. As a result, fuel switching is now on the table as a viable strategy for compliance.

Any new development in Toronto must meet the minimum performance outlined by TGS Tier 1 for each of the above metrics. As outlined in the *Zero Emissions Buildings Framework* and in Table 1, Tier 1 targets will become progressively more stringent.

> *Tier 1 targets will become progressively more stringent as we approach a **net-zero** ready target in **2030.***

Table 1 - TGS MURB Absolute Targets

Future TGS Versions	TGS v3 Tier	EUI (ekWh/m^2)	TEDI (ekWh/m^2)	GHGI (kg CO_2e/m^2)
-	TGS v3 Tier 1	170	70	20
TGS v4 Tier 1 (2022)	TGS v3 Tier 2	135	50	15
TGS v5 Tier 1 (2026)	TGS v3 Tier 3	100	30	10
TGS v6 Tier 1 (2030)	TGS v3 Tier 4	75	15	5

In addition to the new performance metrics, there are new energy modelling rules to follow. We have summarized some of the key differences between the older reference path (still used by the building code) and modelling to achieve compliance with the new absolute TGS v3 targets.

Table 2 - Modelling Differences between Reference and Absolute Modelling in TGS v3

	Reference Modelling Guidelines	TGS v3 Modelling Guidelines
Envelope *Opaque Wall* *Glazing* *Roof* *Slab*	- Account for major thermal bridges in exterior assembly (i.e. steel studs) - Ignore balcony thermal bridging if <2% of envelope area	- Account for major architectural thermal bridges including detailing of: o Balconies + Slab Edges o Window Perimeters o Parapets
Mechanical Systems *Heating/Cooling Equip.* *Terminal Air Units* *Circulation Pumps*	- Reference building HVAC is adjusted as per the energy code - Mechanical efficiencies are selected based on code standards	- Model should most accurately represent the design - High-efficiency equipment should be considered at a minimum - New GHGI target encourages designs to fuel switch from gas to electricity
Process Loads *Elevators* *Pool heating* *Garage/Exhaust fans*	- Modelled equal in the reference and proposed	- Model should most accurately represent the design - More care should be taken to minimize process loads
Ventilation Rates *Fresh air delivery rates*	- Minimum ventilation rates required by Code	- Per the design (often over-ventilated in MURB corridors)
Passive Design Features *Shading from balconies* *Building orientation* *Building shape/floorplate*	- Modelled equal in the reference and proposed	- Model should most accurately represent the design - Passive design should help building performance, and not hurt it

Case Study: A Typical Toronto MURB

To demonstrate the differences between the relative performance compliance path and the new absolute targets, EQ conducted an analysis on a typical MURB, Building A, which possesses the following characteristics:

- 45-stories, with associated amenities and some retail at-grade
- Moderate-high (50%) window-to-wall ratio
- Opaque enclosure primarily spandrel window-wall, some precast at the podium
- Fan coils connected to high-efficiency hydronic plant, in-suite energy recovery ventilators (ERVs)

Building A was designed at the time to comply under TGS v3 but using the older v2 reference modelling guidelines. The analysis will take the base modelling results as per TGS v2 rules and apply the new TGS v3 step-by-step as shown in Figure 1.

Figure 1 - Simplified Workflow of Modelling as per the new TGS v3 Guidelines

The initial modelling results of Building A per the Reference Path approach can be seen in Figure 2. This indicates that this building would not comply with TGS v3 Tier 1 using the absolute targets. From this baseline, the model was revised to account for the modelling updates for v3 as per Table 2.

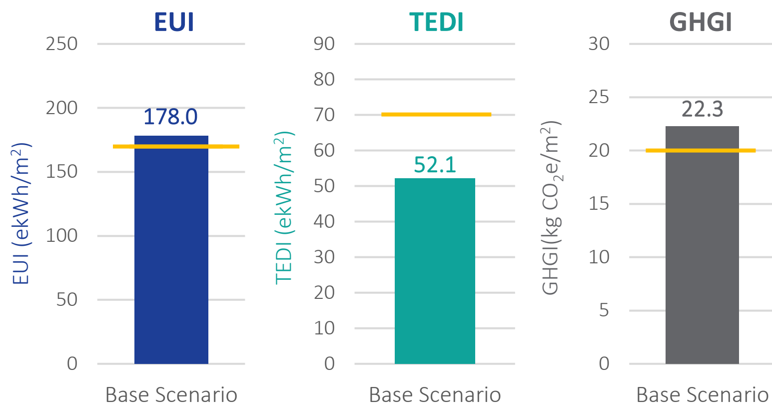

Figure 2 - Initial Modelling Results of Building A

Full Thermal Bridging

The first change to modelling is that architectural thermal bridging elements must be fully considered. A thermal bridge is any detail in the building envelope that penetrates the insulation, resulting in higher heat flows through the walls, roof, and other building components. Some notable thermal bridges include balconies, slab edges, glazing perimeters, interior and exterior wall interfaces, and parapet details. A full thermal bridging calculation was performed for Building A, **reducing its R-10 opaque wall assembly to R-3.5**. This **65% decrease** is not uncommon, due to the high number of slab balconies and reflects typical details in MURBs, which often do not fully consider thermal performance.

Figure 3 – Thermal Bridging at a Slab Balcony

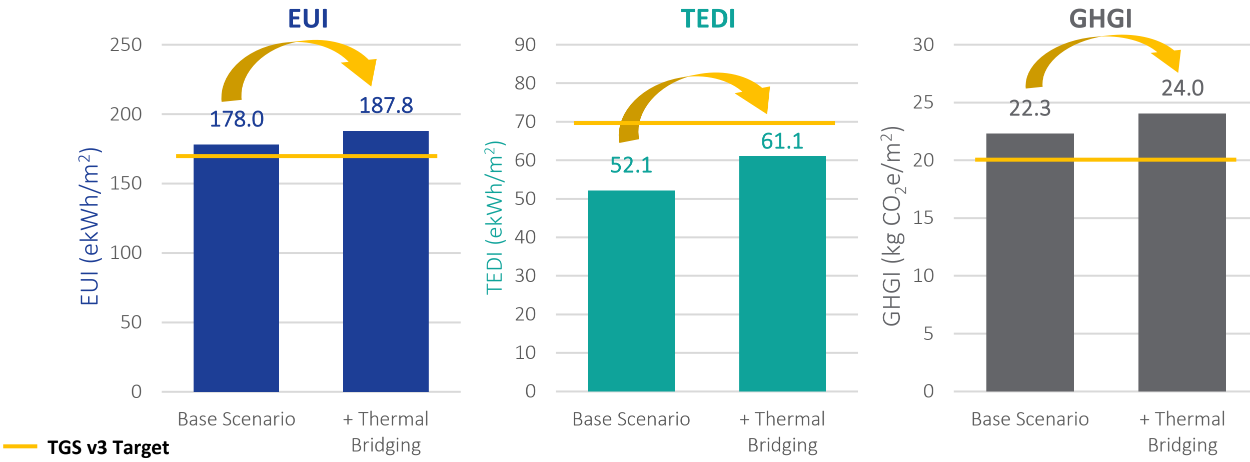

Figure 4 – Building A Modelled Performance Accounting for Full Thermal Bridging

Real Outdoor Air Rates

The second major change to the modelling process is that ventilation rates must be modelled as per the design, when following the reference building approach they were modelled based on the minimum ventilation rates required by Code, as defined by ASHRAE Standard 62.1. This places more emphasis on the reduction of overventilation in new building design. Typical MURB design in Toronto consists of suites receiving their outdoor air to meet ASHRAE 62.1 requirements through an energy recovery ventilator on a per-suite basis. Corridors are then typically supplied with fresh air at a rate of 30-50 cfm/door to pressurize the building in times of high exhaust fan use – such as cooking or clothes drying – or to combat stack effect. Compared to ASHRAE 62.1, a corridor fresh air delivery of 30 cfm/door can still be 3 times higher than what is required. For Building A, **ASHRAE 62.1 minimum corridor ventilation rates were equivalent to approximately 7 cfm/door**. An assumed **design rate of 30 cfm/door** was used in the adapted model, which results in the corridors being **over ventilated by over 300%**.

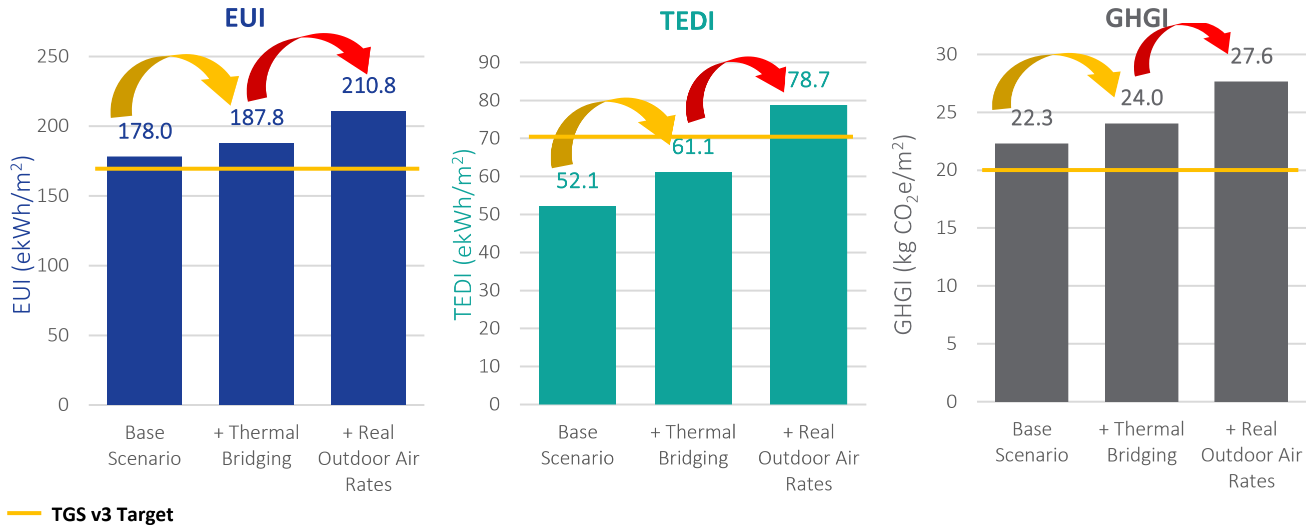

Figure 5 – Building A Modelled Performance Accounting for Full Thermal Bridging and Design Ventilation Rates

As shown in Figure 2, at first glance, Building A was close to complying with TGS v3 Tier 1, and might have only required a few minor changes to the design. However, after adjusting the model to be compliant to the new modelling guidelines, Building A was shown to be perform much worse than initially perceived, and would require more significant changes to comply with TGS v3 Tier 1.

The Toronto Market Today

The reality is that most existing MURBs in Toronto would not be able to comply with the current Tier 1. As evidenced by EQ's extensive MURB modelling database below, approximately half of the MURBs that have applied for TGS v3 Tier 1 under the reference building approach would not meet the EUI target. Many of these results, much like Building A, do not even consider the impacts of full thermal bridging or design outdoor air rates.

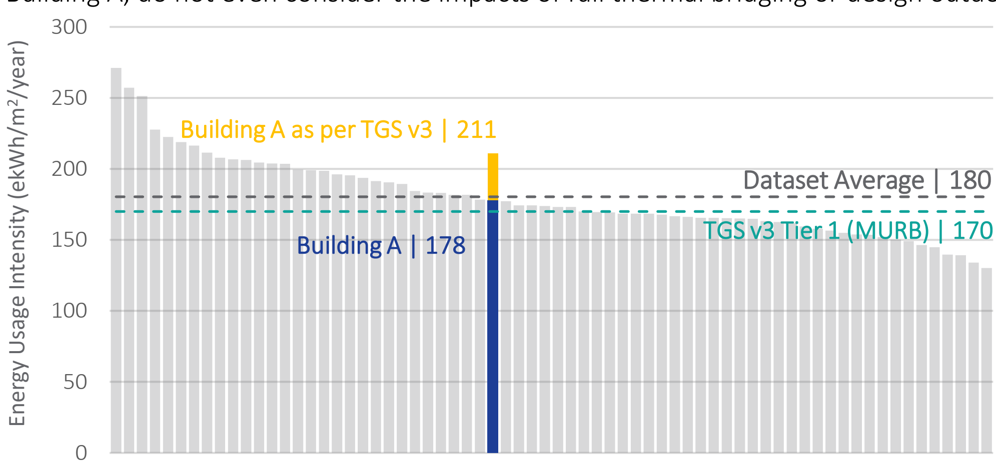

Figure 6 - EQ's MURB Modelling Database: TGS v3 Tier 1 SPA Applications

Moving forward, developers and designers will need to strongly consider these elements that have previously been overlooked. Increased accounting for thermal bridging in the enclosure and the use of design ventilation rates will require a more resilient and detailed design earlier in the design process.