

The Tower Renewal Benchmark – Methodology

Background

The City of Toronto Tower Renewal benchmark supports multi-residential building owners and property managers to understand how their buildings' performance in energy, water and waste compares with over 280 similar buildings in Toronto, and to identify the areas where they can improve building performance and achieve savings. It is one of the largest multi-residential benchmarks in Canada.

The benchmark involves two components:

- Benchmark graphs (page 1 of the benchmark report) help visualize how a building's total annual energy and water consumption and waste generation compare to 285 other similar buildings.
- Detailed performance information and targets (page 2 of the benchmark report) break down building energy performance into energy components and show actual vs. target performance for each energy component (and for overall energy, water and waste performance). Estimated financial savings (based on each target) are also included.

How are buildings benchmarked?

A building's utility data from the past two years (electricity, natural gas, water and waste) is analyzed. The total energy is calculated as the kilowatt hours of electricity (kWh) plus equivalent kilowatt hours of natural gas (ekWh). The total energy is divided by building area (in m², not including underground levels) and normalized for weather variations, to arrive at a total energy intensity (ekWh/m²) that is plotted on the graph on page 1. On page 2, total energy is separated into five components: base electricity, heating electricity, cooling electricity, base thermal, and heating thermal.

The total annual water consumption in cubic meters (m³) is divided by the building area (in m²) to arrive at the buildings' water use intensity (m³/m²) and is normalized to a 365-day period for comparison. Total waste generation in cubic yards of un-compacted garbage produced (yd³) is divided by the total number of units to arrive at a yd³/unit intensity. (Compacted waste amounts are multiplied by two to arrive at the total un-compacted amount of garbage). Garbage amounts do not include recycling.

These energy, water, and waste intensities are plotted on the Page 1 graphs alongside the other 285 buildings in the benchmark. The median value from the previous calendar year is indicated for each graph, as is the 'Top Performance Zone' (details below). Page 2 of the report provides more detail for each component, including performance targets and estimated cost savings.

What do the Median and Top Performance Zone represent?

The Median and "Top Performance Zone" values for the Energy, Water and Waste graphs are calculated annually and fixed at the beginning of the calendar year, based on the data from the previous calendar year (ending December 31st). The "Top Performance Zone" values represent the top quartile values from the up-to-date database at the end of the previous calendar year, and the Median represents the median value (middle number of the database) from the database at the end of the previous year.

The Median is indicated on each graph with a line and its value. The "Top Performance Zone" value is indicated with lighter shading on the left side of the graph. For 2018, the values are:

- 2017 Energy Median: 283.8 ekWh/m²
- 2017 Water Median: 2.3 m³/m²
- 2017 Waste Median: 5.4 yd³/unit
- Energy Top Performance Zone (2017 top quartile total energy value): 250.1 ekWh/m²
- Water Top Performance Zone (2017 top quartile total water value): 1.8 m³/m²
- Waste Top Performance Zone (2017 top quartile total waste value): 3.7 yd³/unit

Representing sub-metered buildings in the Energy Benchmark Graph

For buildings that do not have electricity sub-metering, or buildings that are sub-metered through a third party (e.g. Wyse, Enercare, Carma or others), the building's main common area electricity meter includes all tenant in-suite electricity usage. The full building electricity data is available on the main meter, and is included as part of the overall energy graph on page 1, and in the actual performance details and performance targets on page 2.

For buildings that are sub-metered through Toronto Hydro, each suite has an individual meter which means that the tenants' in-suite electricity use is not captured on the building's main common area meter. Because the Tower Renewal benchmark compares total annual energy consumption across the dataset of buildings, it is important that full-building electricity use is represented for all buildings.

- In most cases, aggregated data for tenant in-suite electricity usage is available, and is added to the building's total annual energy use on the graph.
- In some cases, aggregated data for tenant in-suite electricity usage is only available for a year other than the year the property was originally benchmarked (for example, if a property was benchmarked with 2010 data, and their aggregated tenant data is only available from 2012 onwards). For these properties, the 2012 tenant usage data is used as an estimate of what their tenant usage would have been in the year they were benchmarked.
- If no tenant data is available, an average of other buildings' tenant consumption is used on the total energy benchmark.

This portion for tenant in-suite electricity usage in Toronto Hydro sub-metered buildings is represented on the Energy graph as a small darker shaded line on top of the building's annual energy consumption. With this visual representation for tenant electricity use, these building owners can get a better sense of how their total annual energy consumption may compare to other buildings in the benchmark, while always being able to see the difference between their common area and tenant electricity usage.

How does the tenant electricity portion affect targets for Toronto Hydro sub-metered buildings?

The actual or estimated portion for tenant electricity usage does not affect electricity performance targets for these buildings. The darker shaded line representing the tenant electricity portion is only used for the purpose of comparing buildings in the benchmark graph, but is not included as part of the

performance details or targets on page 2. Page 2 of the report only refers to actual electricity use that is measured by the building's main common area electricity meter.

How are Page 2 performance targets calculated?

Performance targets are calculated as the top quartile values of the up-to-date database at the end of the last calendar year, and are fixed for the full year. If a building is already in the "Top Performance Zone", their performance targets become the value of the top decile of buildings, to encourage further improvement and savings.

For Water and Waste, if a building is already in the top decile, its performance target is set as 10% better than the top building. For Energy, even if a building is already in the top decile for Energy, its component targets remain top decile targets, as it will not usually have achieved top decile targets for all components. A target of 10% better than the top performer may also be unrealistic for energy savings due to numerous factors that affect energy consumption in the different buildings.

Total Energy, Water, and Waste Performance Targets:

Target (as of January 2018)	Top Quartile	Top Decile
Total Energy – the sum of Energy component targets (see below): heating & base thermal; base, heating & cooling electricity	245.4 kWh/m ²	197.6 kWh/m ²
Total Water – the top quartile or decile of benchmarked water consumption	1.8 m ³ /m ²	1.4 m ³ /m ²
Total Waste – the top quartile or decile of benchmarked waste generation	3.7 yd ³ /unit	2.5 yd ³ /unit

Energy Component Targets:

The performance targets for each energy component are based on the top quartile values for each component – or based on the top decile values, if the building is already in the Top Performance Zone for total energy performance. If a building has already achieved one or more of its component targets, their target will be the same as their actual performance, and there will be no savings potential shown.

The components and their targets are detailed below and explained on the next page.

Component Target (as of January 2017)	Top Quartile	Top Decile
Base Electricity - Full Building (Non sub-metered or 3 rd -party sub-metered buildings)	54.7 kWh/m ²	46.0 kWh/m ²
Base Electricity - Common Area Only (Toronto Hydro sub-metered buildings)	19.0 kWh/m ²	15.1 kWh/m ²
Heating Electricity	4.1 kWh/m ²	2.3 kWh/m ²
Cooling Electricity - Central Cooling	6.4 kWh/m ²	5.5 kWh/m ²
Cooling Electricity - Individual (window A/C units)	Depends on % of A/C units; see next page	
Base Thermal	57.1 ekWh/m ²	45.8 ekWh/m ²
Heating Thermal	118.6 ekWh/m ²	96.5 ekWh/m ²

Base Electricity – Full Building – top quartile of all buildings where full building electricity data (including in-suite tenant electricity use) is available. Please note, for buildings that are not sub-metered, or that are sub-metered through a 3rd party provider, tenant in-suite electricity use is included as part of this performance target, therefore some savings potential will be dependent on tenant use.

Base Electricity – Common Area – top quartile of all buildings where only common area electricity data (not in-suite tenant electricity use) is available. Please note, even if an estimated portion for tenant in-suite electricity use was added to the graph (or an actual aggregated portion, when available, was added to the graph), the tenant portion is not included in the performance details or targets on page 2.

Heating Electricity – top quartile of benchmarked heating electricity in buildings that use natural gas as a primary heating source. Heating electricity in natural-gas heated buildings includes garage electric ramp heating, electric pipe tracing, lobby vestibule heaters, tenant space heaters, and any other sources of electric heat used in the winter.

Cooling Electricity – Central – top quartile of benchmarked cooling electricity from buildings that have a central cooling plant including a chiller and cooling tower and supply cooling to the entire building.

Cooling Electricity – Individual (window A/C units) – top quartile of benchmarked cooling electricity from buildings where suites are responsible for their own cooling equipment installation (i.e. individual window A/C units). The majority of buildings in the database reported that ~25% of their tenants install window A/C units. The top quartile for cooling electricity for this group of buildings rounded to a single decimal is 2.7 kWh/m². This is then multiplied by 2, 3 or 4 in order to arrive at the target for buildings with 50%, 75% or 100% A/C units. The current top quartile targets are:

- 2.7 kWh/m² for buildings with ~25% A/C units
- 5.5 kWh/m² for buildings with ~50% A/C units
- 8.2 kWh/m² for buildings with ~75% A/C units
- 10.9 kWh/m² for buildings with 100% A/C units.

For buildings with individual cooling that are also sub-metered:

- When only the common area electricity data is available (e.g. buildings sub-metered through Toronto Hydro), there is no cooling electricity target. This is because the electricity used by the window A/C units is part of tenant in-suite electricity data, which is not available to analyze. (It is only available as an aggregated tenant portion for electricity usage to add to the Energy graph).
- If full-building electricity data is available (e.g. buildings who are sub-metered through a 3rd party), cooling electricity is captured in the main common area meter and is part of the components analysis. Please note, in this case some savings potential would be dependent on tenant use and some would accrue to tenants who pay for their own electricity.

Base Thermal – is the top quartile of benchmarked base thermal from buildings that use natural gas for domestic hot water.

Heating Thermal – is the top quartile of benchmarked base thermal from buildings that are heated primarily through natural gas.

Adjusting for Electric Heating or Electric Domestic Hot Water:

When buildings generate hot water to heat the building through natural gas-fired boilers, there is energy lost through this process after energy has been recorded on the meter (25% of the energy used to produce natural gas is occurring at the power plant that generates electricity). However, buildings that are heated by electricity are receiving energy directly through power lines and are not metered for energy lost when generating the electricity. The targets for electric heating or domestic hot water are therefore 75% of the thermal targets to account for the efficiency of electric power at the site level.

Heating and Base Thermal – if a building is either fully heated or domestic hot water is supplied by electricity sources, the target value is set to 0.0 ekWh/m² since there is no thermal fuel energy used.

Heating Electricity – if the building is heated through electricity, this number is the heating thermal top quartile multiplied by the source energy factor of 0.75 (118.6 ekWh/m² x 0.75 = 89.0 kWh/m²).

Base Electricity – will be increased by an amount which is the base thermal top quartile multiplied by the source energy factor of 0.75 (currently 57.1 ekWh/m² x 0.75 = 42.9 kWh/m²). The revised base electricity target will be (54.7 kWh/m² + 42.9 kWh/m² = 97.5 ekWh/m²).

How are financial savings calculated?

Energy and Water savings:

The estimated financial savings are calculated as the difference between the actual energy components and target energy components, multiplied by the previous year's utility rates. The current standard utility rates used for all buildings are:

- \$0.15 per kWh of electricity
- \$0.30 per m³ of natural gas
- \$3.63 per m³ of water
- Because waste collection costs vary depending on waste collection provider, number of units, and allowable generation per unit, financial savings from waste are not included in the report.

Buildings that are not sub-metered for electricity have tenant electricity use included on their main common area meter. This means a portion of their savings potential will be affected by tenant behaviour, and effective tenant engagement would be needed to realize the full savings potential.

Buildings with 3rd party sub-metering also have tenant electricity use included on their main common area meter. This means a portion of their electricity savings potential will depend on tenant behaviour. Further, some of the electricity is paid for by tenants so some savings would accrue to the tenants.

Potential estimated Energy and Water savings are summarized on the first page of the Action Report.

Operations & Maintenance Savings, and Tenant & Staff Engagement Savings:

Potential estimated Operations & Maintenance and Tenant & Staff Engagement savings are also summarized on the first page of the Action Report.

The estimated savings for these two areas are calculated using a fixed formula, based on studies that have measured energy and water savings resulting from investment in tenant engagement, staff training and maintenance:

- Tenant and Staff Engagement – 5% of the total combined energy and water savings
- Operations and Maintenance – 5% of the total combined energy and water savings

The 5% savings formula is a conservative estimate, as the range of savings shown in these areas has sometimes been as high as 20%. Select studies used to arrive at the 5% estimate include:

- [New York City: One City – Built to Last Plan](#) found that building operator staff training can result in energy savings of 5 to 20%
- American Council for an Energy-Efficient Economy [2016 Study](#) summarized other studies of residential energy engagement activities and resulting savings of 3 to 6%
- One [2005 review of intervention studies](#) aimed at residential energy conservation found a range of savings, depending on the intervention, from 3 to 20% energy and water savings
- One [Build Smart NY report](#) showed that building commissioning programs, as part of operations and maintenance, could save up to 16%

Any questions?

Please contact the City of Toronto Tower Renewal team at 416-397-5227 or tower@toronto.ca. The Benchmarking Methodology document is a public document that is updated annually.