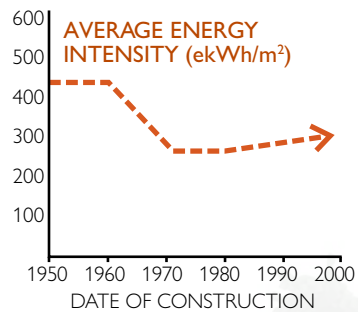


# ACHIEVING HIGH-PERFORMANCE MULTI-UNIT RESIDENTIAL BUILDINGS: THE OPPORTUNITIES

## OVERVIEW

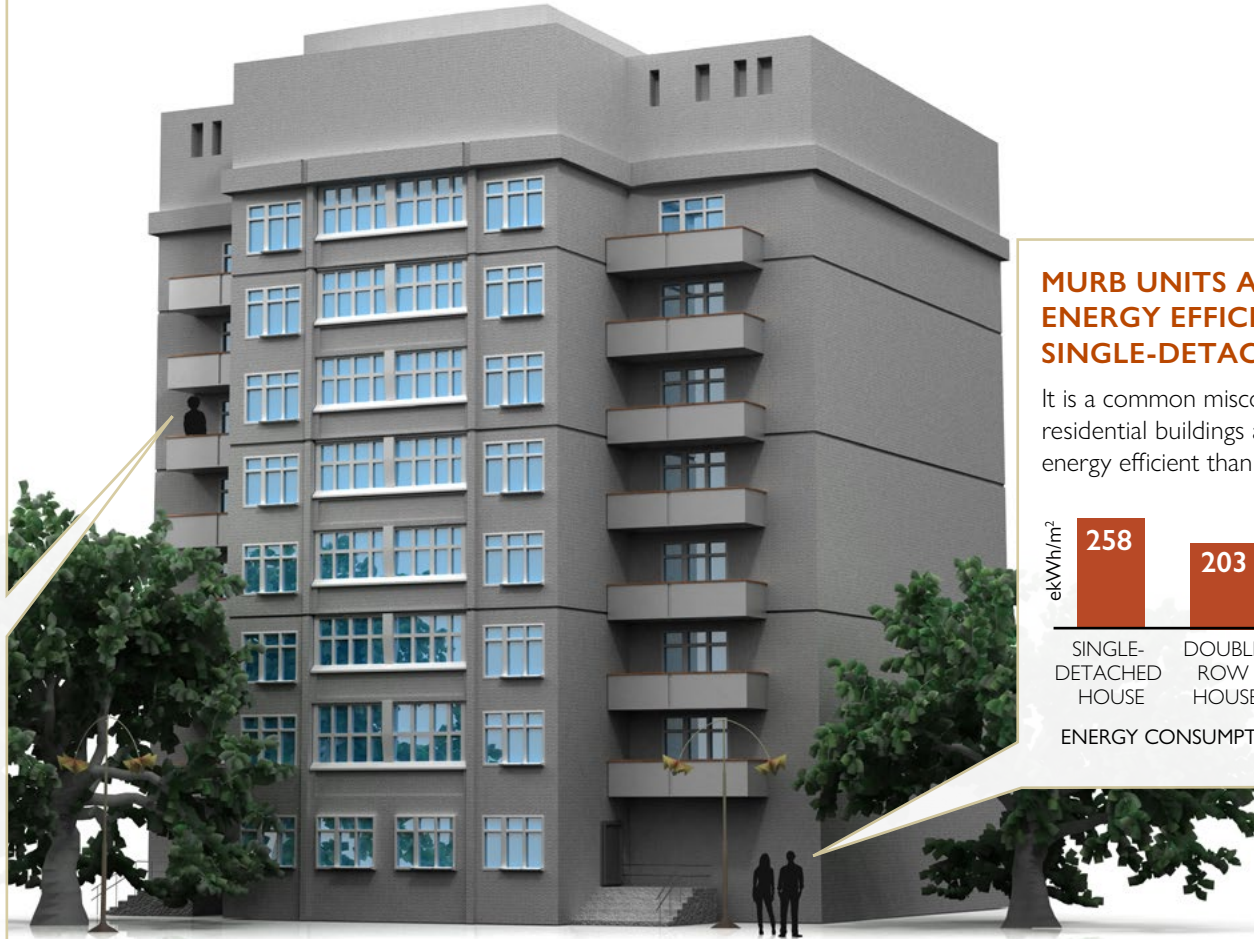
### CHALLENGES OF MURB PERFORMANCE

Energy intensity of multi-unit residential buildings (MURBs) has been marginally increasing since the 1970s, despite an increased awareness of and attention to energy efficiency.



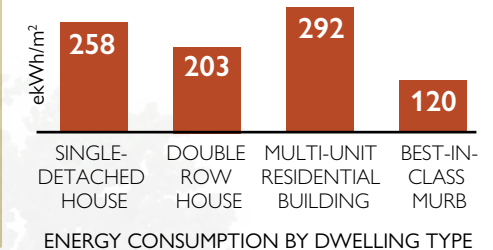
### KEY FACTORS:

- Building envelope
- Mechanical systems
- Controllability and accountability of the systems by the building operator and occupants
- Lighting
- Plug loads
- Water consumption



### MURB UNITS ARE LESS ENERGY EFFICIENT THAN SINGLE-DETACHED HOUSES.

It is a common misconception that multi-unit residential buildings are necessarily more energy efficient than single-detached homes.



This series of infographics will highlight the opportunities in achieving high performance in multi-unit residential buildings (MURBs) under key performance categories.

**CLICK ON THEMES TO EXPLORE**

**THEME 1: SPACE AND WATER HEATING**  
Space and water heating typically accounts for 80% of all energy consumed.

**THEME 2: VENTILATION AND AIR QUALITY**  
Type of ventilation system, air leakage patterns and the occupants' use of their windows and doors all impact the quality of air getting into the suites.

**THEME 3: BUILDING ENVELOPE**  
Despite advances in building envelope materials and systems, the benefits of these assemblies are often negated by thermal bridges and increased window-to-wall ratio.

**THEME 4: MEASUREMENT, CONTROL AND ACCOUNTABILITY**  
Individual suites and occupant behaviour can affect energy and water consumption in MURBs so there is a large opportunity for savings.

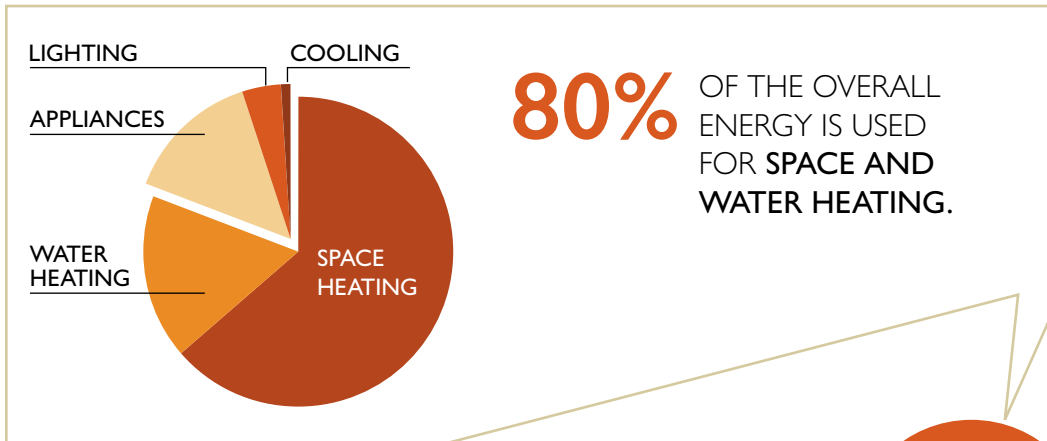
**THEME 5: LIGHTING AND PLUG LOADS**  
Lighting, plug loads and appliances represent approximately 18% of the total energy end use for a typical MURB.

**THEME 6: WATER CONSUMPTION**  
On average, Canadians use an average of 251L of freshwater per capita per day, which is the fourth highest average consumption globally.



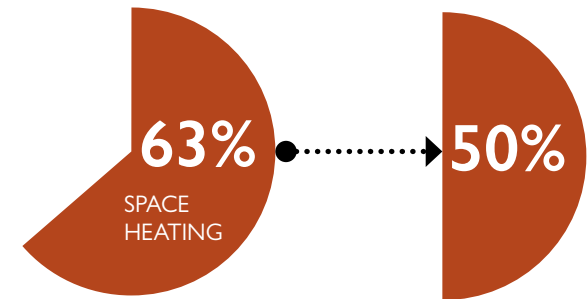
# THEME 1: SPACE HEATING AND WATER HEATING

Space and water heating consume 80% of the overall energy consumed.

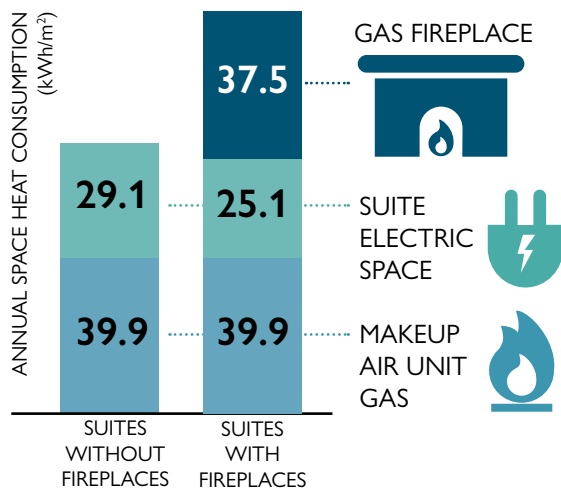


**13%** OVERALL ENERGY SAVINGS can be achieved with

HEAT RECOVERY VENTILATION SYSTEMS. The heat recovery system also improves the indoor air quality while achieving energy savings.



**48%** INCREASE IN TOTAL SPACE HEATING IN SUITES WITH DECORATIVE GAS FIREPLACES.



EXPLORE OTHER THEMES:

- OVERVIEW
- 1 SPACE HEATING AND WATER HEATING
- 2 VENTILATION AND AIR QUALITY
- 3 BUILDING ENVELOPE
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- 6 WATER CONSUMPTION

**21%** ENERGY SAVINGS can be achieved with HIGH-EFFICIENCY CONDENSING BOILERS

Using a high-efficiency condensing boiler (93% efficient) rather than a standard efficiency boiler (80% efficient) can reduce space heating energy consumption by **21%**.

THEME 1 CONTINUES

# THEME 1: SPACE HEATING AND WATER HEATING (CONT.)

Space and water heating consume 80% of the overall energy consumed.

## IN THE INDIVIDUAL SUITES

**11%** ELECTRICAL SAVINGS  
IN SPACE COOLING  
DURING THE SUMMER  
when the thermostat setpoint is  
increased by 3°C during the day.

**6.5%** SAVINGS  
IN SPACE HEATING  
DURING THE WINTER  
when the thermostat setpoint  
is decreased by 4°C overnight.



Simple actions by the occupant, such as ADJUSTING THE THERMOSTAT, have an impact on the energy consumption.



## IN THE CORRIDORS

**9%** SAVINGS  
IN SPACE HEATING  
WHEN THE THERMOSTAT  
SETPOINT IS DECREASED  
BY 5°C.



Simple actions by the building operator, such as ADJUSTING THE THERMOSTAT from 21°C to 16°C, have an impact on the energy consumption.

### EXPLORE OTHER THEMES:

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-  5 LIGHTING AND PLUG LOADS
-  6 WATER CONSUMPTION

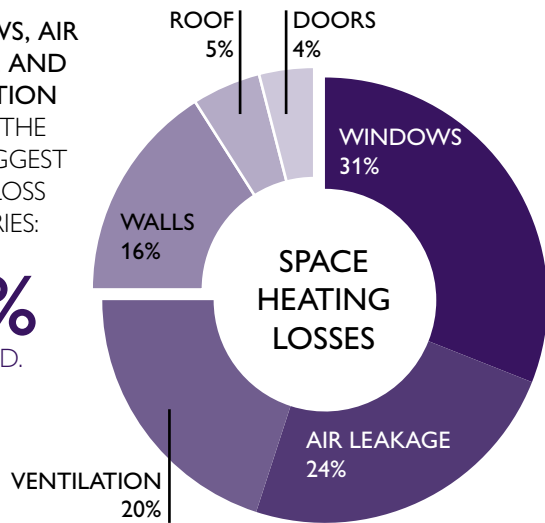


# THEME 2: VENTILATION AND AIR QUALITY

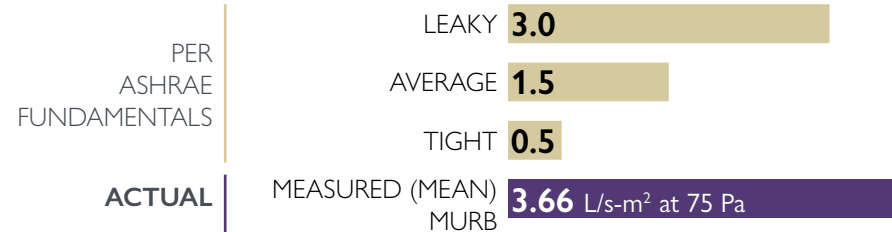
The type of ventilation system, air leakage and occupant actions all impact the quality of fresh air getting into the suites.

WINDOWS, AIR LEAKAGE AND VENTILATION MAKE UP THE THREE BIGGEST ENERGY LOSS CATEGORIES:

**75%**  
COMBINED.

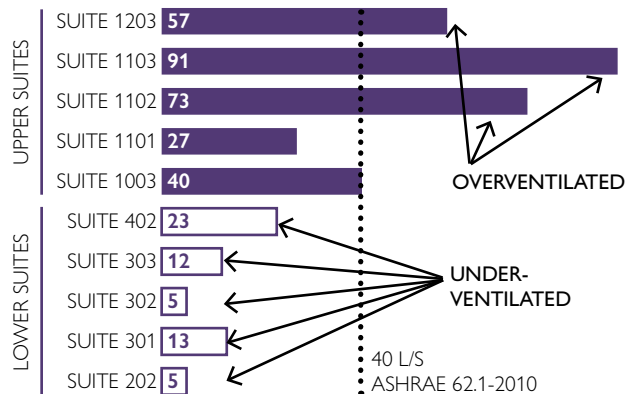


On average, **MURBS HAVE BEEN FOUND TO BE MORE LEAKY** than the values set by ASHRAE fundamentals.



## FRESH AIR IS NOT EQUAL ACROSS THE FLOORS.

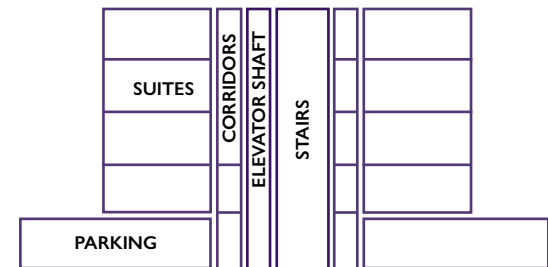
Fresh air provided by corridor ventilation mechanical systems often does not make its way into the suites as a result of stack and wind effect and air leakage.



TOTAL AIRFLOW FROM ALL SOURCES INTO EACH OF THE MEASURED SUITES (L/s)

### EXPLORE OTHER THEMES:

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**COMPARTMENTALIZATION** aims to provide controlled ventilation rates in all suites by a combination of airtight suites, corridors, etc., resistance to stack and wind effects, and independent ventilation provided directly to each suite via in-suite heat recovery ventilators. It also provides additional benefits to:

- **MOISTURE CONTROL;**
- **ODOUR CONTROL;**
- **FRESH AIR CONTROL;**
- **PRESSURE CONTROL;**
- **SOUND/ACOUSTICAL CONTROL;**
- **FIRE/SMOKE CONTROL;** and
- **HEAT LOSS AND COMFORT.**



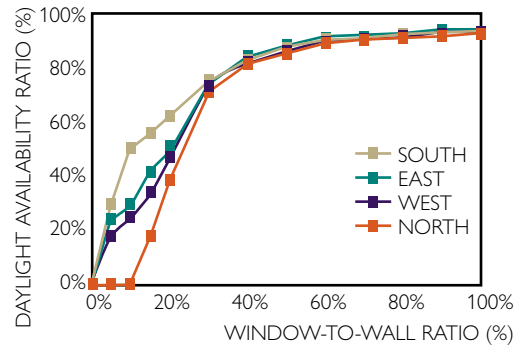


# THEME 3: BUILDING ENVELOPE

Despite advances in building envelope materials and systems, the benefits of these assemblies are often negated by thermal bridges and increased window-to-wall ratio.

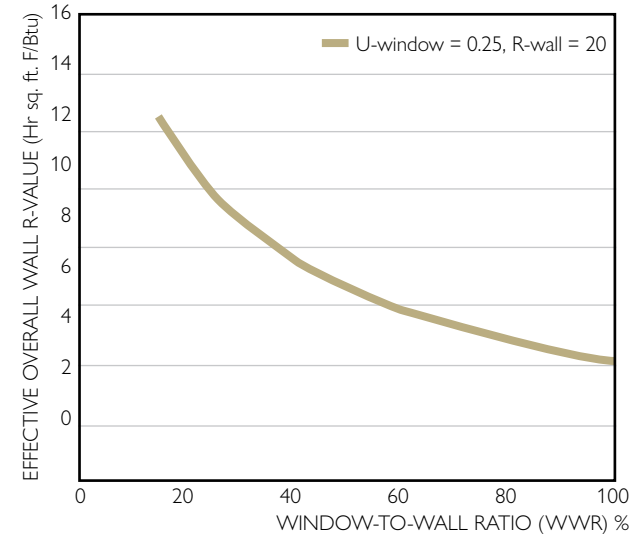
**40%** IS THE OPTIMAL WINDOW-TO-WALL RATIO as recommended by recent building codes. Placement of this available glazing is also important, as upward of

**80%** of the annual available interior daylighting can still be achieved with this fenestration ratio.

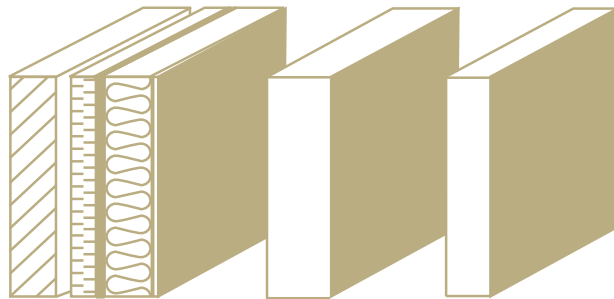


THE WINDOW-TO-WALL RATIO DRAMATICALLY INFLUENCES THE THERMAL PERFORMANCE OF THE OVERALL ENCLOSURE.

The higher the window-to-wall ratio is, the lower the effective overall wall R-value becomes.



DEPENDING ON THE ASSEMBLY, THERMAL BRIDGES REDUCE THE THERMAL PERFORMANCE OF THE OVERALL ENVELOPE BY AS MUCH AS **70%.**



**R-22** vs. **R-15.4** vs. **R-5.5**

30%  
REDUCTION

THE NOMINAL (DESIGN) PERFORMANCE of a sample brick veneer wall.

THE EFFECTIVE (TRUE) PERFORMANCE when the conductive loss of the veneer wall is taken into account.

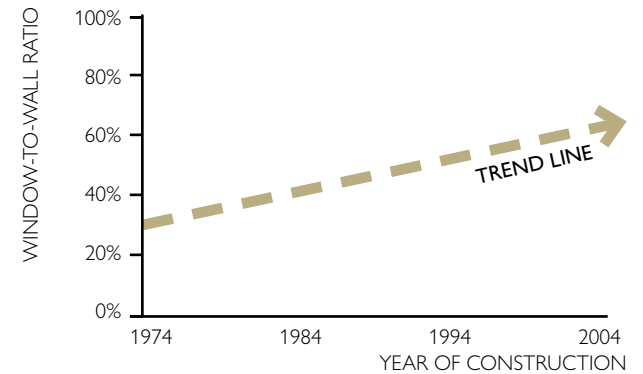
70%  
REDUCTION

THE EFFECTIVE (TRUE) PERFORMANCE when the conductive losses of the entire building are taken into account.

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THE WINDOW-TO-WALL RATIO IS INCREASING IN THE CURRENT DESIGN TREND.



# THEME 4: MEASUREMENT, CONTROL AND ACCOUNTABILITY

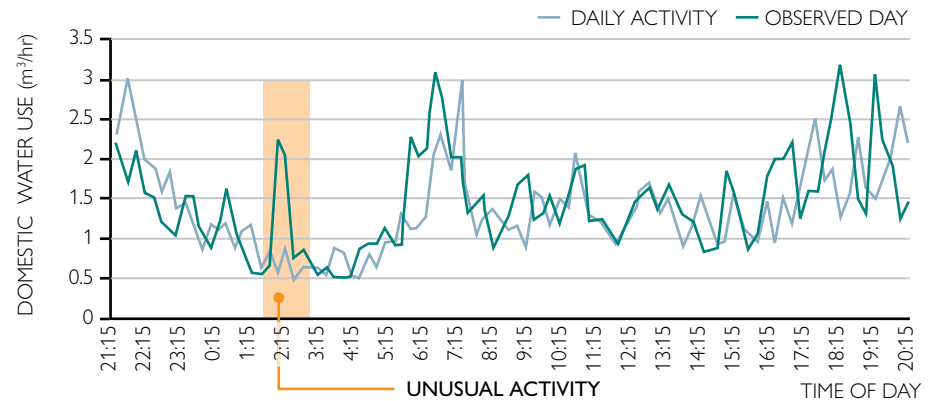
Individual suites and occupant behaviour can affect energy and water consumption in MURBs so there is a large opportunity for savings.



**+12% MORE ELECTRICITY**  
**+15% MORE WATER**

CONSUMPTION INCREASES WHEN UNITS ARE NOT SUB-METERED AND BILLED INDIVIDUALLY.

Sub-metering provides feedback on energy and water consumption to occupants, which can alter their habits and ultimately reduce energy and water end use.



**YOU CAN'T IMPROVE WHAT YOU DON'T MEASURE.**

REAL-TIME METERING of building equipment and consumption allows building operators and residents to identify when equipment isn't operating properly.

**30%**

**ELECTRICAL HEATING ENERGY SAVINGS** can be achieved with



**HEATING MANAGEMENT SYSTEMS**, which adjust the available heat output from boiler systems based on:

- exterior temperature;
- floor level; and
- suite orientation.

This can reduce electricity consumption for space heating while still maintaining a comfortable indoor space temperature.

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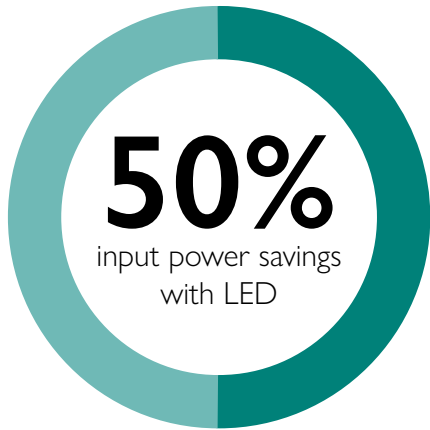
**+2°C WARMER**

On average, occupants living in the bulk metered apartments keep their units about 2°C warmer than occupants living in units where they pay for the heat they use.

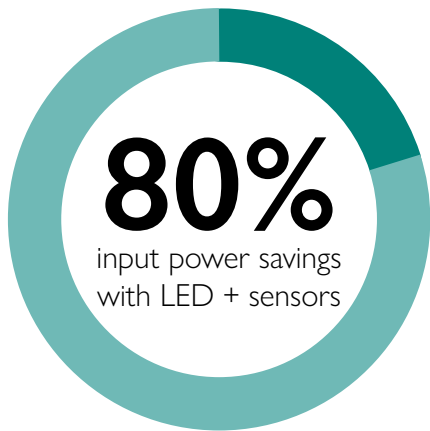


# THEME 5: LIGHTING AND PLUG LOADS

Lighting, plug loads and appliances represent approximately 18% of the total energy end use for a typical MURB.



LED (light emitting diode) technology can reduce the input power without compromising lighting levels in the space.



Occupancy sensor placement can further save electricity in common areas by **APPROXIMATELY 30%** by shutting off non-essential lighting when not in use.



### EXPLORE OTHER THEMES:

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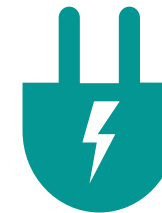
**9-25%** **ELECTRICITY SAVINGS**



can be achieved with **ENERGY-EFFICIENT IN-SUITE APPLIANCES** rather than standard appliances.

UP TO **2%** **OF OVERALL ENERGY CONSUMPTION**

The size of a household's 'phantom load' will depend on the number of electronic devices and their design but can account for up to 2% of overall energy consumption for MURBs.



In North America, the average home has **25 OR MORE PRODUCTS** THAT CONSUME ELECTRICITY 24 HOURS A DAY.

CONSIDER **UNPLUGGING PRODUCTS WHEN NOT IN USE** OR PLUGGING THESE ITEMS INTO A TIMED POWER SWITCH.





# THEME 6: WATER CONSUMPTION

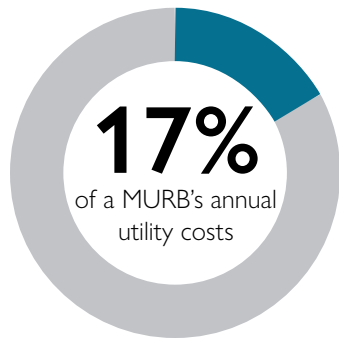
On average, Canadians use an average of 251L of freshwater per capita per day, which is the fourth highest average consumption globally.

CANADIAN AVERAGE USE OF FRESHWATER PER CAPITA PER DAY

**251L**

**FOURTH HIGHEST AVERAGE CONSUMPTION GLOBALLY**

These high water demands put a strain on both upstream and downstream facilities, including municipal water supply, wastewater and stormwater infrastructure.



WATER CONSUMPTION can represent up to 17% of a MURB's annual utility costs.



Building and site design can also **REDUCE IMPACT ON DOWNSTREAM STORMWATER FACILITIES**

by reducing the extent of impermeable surfaces on site through:

- GREEN ROOFS;
- AT-GRADE VEGETATION; and
- PERMEABLE PAVEMENT.

Low-impact development maximizes the amount of water infiltrated on site to reduce stormwater runoff.

Native and adaptive planting species also reduce the amount of water required for irrigation while providing vegetation that is suitable to the microclimate.

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**37%** WATER SAVINGS were achieved with

**A PLUMBING RETROFIT** of low-flow toilets and shower heads, which was recently conducted by Ottawa Community Housing across its portfolio. Indoor water consumption can be reduced in multi-unit residential buildings through the use of low-flow plumbing fixtures for faucets, water closets and shower heads.

RECOMMENDED FLOW AND FLUSH RATES FOR

SHOWER HEAD



**5.7**  
L/min

TOILET



**3.8**  
L/flush

LAVATORY FAUCET



**3.8**  
L/min

KITCHEN FAUCET



**5.7**  
L/min



## OVERVIEW

*Energy Consumption and Conservation in Mid- and High-Rise Residential Buildings in British Columbia*, RDH, 2012

*Energy Consumption Trends of Multi-Unit Residential Buildings in the City of Toronto*, University of Toronto  
<http://towerwise.ca/wp-content/uploads/2013/07/TAF-MURB-Energy-Performance-Report-Phase-II.pdf>

*Energy Benchmarking and Energy Saving Assessment in High-Rise MURB*, Yirong Huang, Ryerson University, 2012

## THEME 1

*Energy Consumption and Conservation in Mid- and High-Rise Residential Buildings in British Columbia*, RDH

*Energy Benchmarking and Energy Saving Assessment in High-Rise Multi-Unit Residential Buildings*, Yirong Huang, Ryerson University – NRCAN data

*Heat Recovery Ventilation Guide for Multi-Unit Residential Buildings*, BC Housing, 2015

Condensing Boilers Evaluation, National Renewable Energy Laboratory, p. 47

*Energy Consumption and Conservation in Mid- and High-Rise Residential Buildings in British Columbia*, RDH, p. 190

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<https://www.cmhc-schl.gc.ca/odpub/pdf/63816.pdf?lang=en>

*Controlling the Temperature in Canadian Homes*, Statistics Canada, 2008  
<http://www.statcan.gc.ca/pub/16-001-m/2008006/5212652-eng.htm>

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## THEME 2

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## THEME 3

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*High Performance Enclosures*, John Straube, 2012

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## THEME 4

*Energy Benchmarking and Energy Saving Assessment in High-Rise MURB*, Yirong Huang, Ryerson University, 2012

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## THEME 5

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U.S. Environmental Protection Agency, “Consumer Messaging Guide for Energy Star Certified Appliances,” 2015  
[https://www.energystar.gov/products/appliances/clothes\\_washers](https://www.energystar.gov/products/appliances/clothes_washers)  
[https://www.energystar.gov/sites/default/files/asset/document/ES\\_Consumer\\_Messaging\\_Guide\\_2015\\_508\\_1.pdf](https://www.energystar.gov/sites/default/files/asset/document/ES_Consumer_Messaging_Guide_2015_508_1.pdf)

“Electrical Energy Efficiency and Phantom Load Reduction Strategies,” *EQuilibrium™ Housing InSight*, 2014  
<http://www.cmhc-schl.gc.ca/odpub/pdf/68215.pdf?fr=1421176057897>

## THEME 6

*Residential Water Use in Canada*  
<https://www.ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=7E808512-1>

Ottawa Community Housing Case Study, Plumbing Retrofits, <http://www.och-lco.ca/green-plan/>

*EQuilibrium™ Communities Insight: Green Infrastructure and Low-Impact Development*, CMHC, 2013

WSP/MMM project database

