Number 12

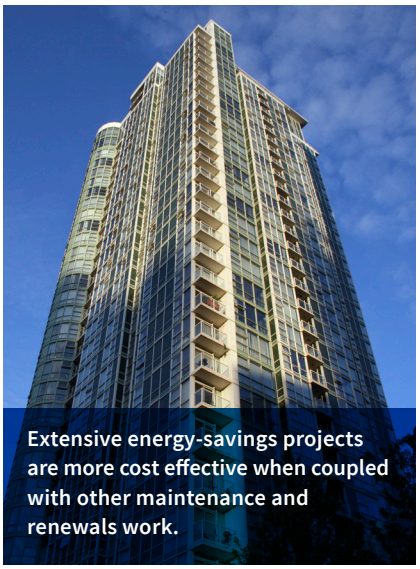
MAINTENANCE MATTERS

BC HOUSING RESEARCH CENTRE

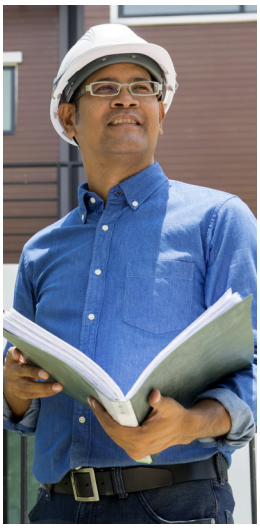
Reducing Energy Use in Multi-Unit Residential Buildings

We all want to decrease our energy use to help the environment and to save money. Saving energy can be as easy as adjusting temperatures and turning off fireplace pilot lights in summer. Options also include more extensive energy-savings projects, such as building enclosure improvements, that are more cost effective when coupled with other maintenance and renewals work.

This bulletin provides an overview of where energy is consumed, and what can be done to reduce the energy consumption and lower monthly energy bills for owners, occupants and strata corporations.



Extensive energy-savings projects are more cost effective when coupled with other maintenance and renewals work.



Maintenance Matters

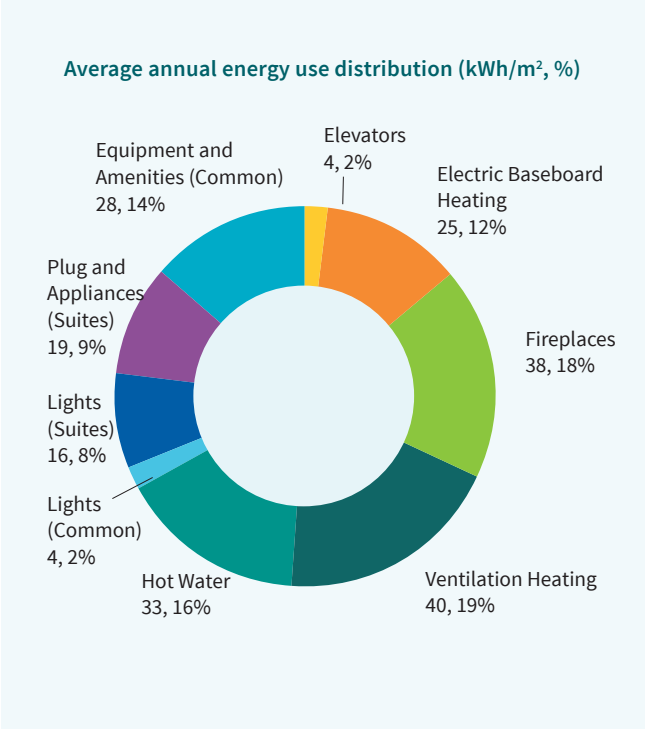
This series of bulletins and companion videos is designed to provide practical information on maintaining residential buildings. Produced by BC Housing, this bulletin was prepared by RDH Building Engineering in collaboration with Canada Mortgage and Housing Corporation, BC Hydro, Fortis BC, and the City of Vancouver.

Where is Energy Consumed in the Building?

Before you start thinking about potential energy savings in your building, it's important to understand how buildings consume energy.

Mid to high-rise buildings in British Columbia typically use a combination of electricity and natural gas. Electric baseboards are used for in-suite heating in most cases with some buildings using hydronic radiators (hot water heaters typically serviced by a central natural gas fired boiler).

Based on a study of 39 mid to high-rise buildings in the Lower Mainland, the total average energy consumption per year is roughly 213 kWh/m^2 at a cost of approximately $1,220 per suite assuming 2013 utility rates (8¢/kWh for electricity and $9/GJ for gas). Utility rates change with time and by customer rate structure, and these costs are presented as an example only. Similar usage patterns are likely in the rest of British Columbia, although the relative proportion of space heating, and the use of air conditioning may be a factor, depending on the local climate zone.



How is Energy Used?

Ventilation

Ventilation refers to the exchange of air within a building to provide a fresh supply of outdoor air to occupants, in order to improve health and reduce moisture build-up and odours. Outdoor air, typically heated with natural gas, is brought into the building by a make-up air unit through large ducts, and is provided to the suites through hallways and gaps below their doors. This outdoor air is intended to replace stale air within suites while also pressurizing the corridors to help contain odours to the suites.

This outdoor air does not always get to where it is needed. It can be blocked by door-threshold sweeps that are often installed by occupants to reduce noise, odours or light from the corridors. Ideally, this gap should remain open to allow the distribution of outdoor air. Air also leaks out through elevators, stairwells and other openings before it reaches the suites, resulting in an increased demand for conditioned air and thus increasing energy consumption.

Typical rooftop make-up air unit

Central domestic hot water system

Space Heating

Space heating within suites is commonly provided by electric baseboard heaters or hydronic radiators, and is controlled by thermostats set by the occupants. Gas fireplaces are also common and are regulated by occupant-controlled thermostats or switches. (Note: most fireplaces are intended to be decorative and therefore are not efficient heating appliances.) Even though the make-up air unit is intended primarily to supply outdoor air into the suites, it often also serves as a major source of space heating.

Hot Water

Hot water is typically heated using natural gas, but it can also be heated using electricity. Electric pumps are used to move hot water through pipes within the building.

Lighting

Suite lighting is controlled by occupants. Common area lighting consists of a mix of incandescent and florescent fixtures and often remains on at all times.

Other Building Systems

Significant amounts of energy are also consumed by elevators, pools, hot tubs, electronics and appliances.

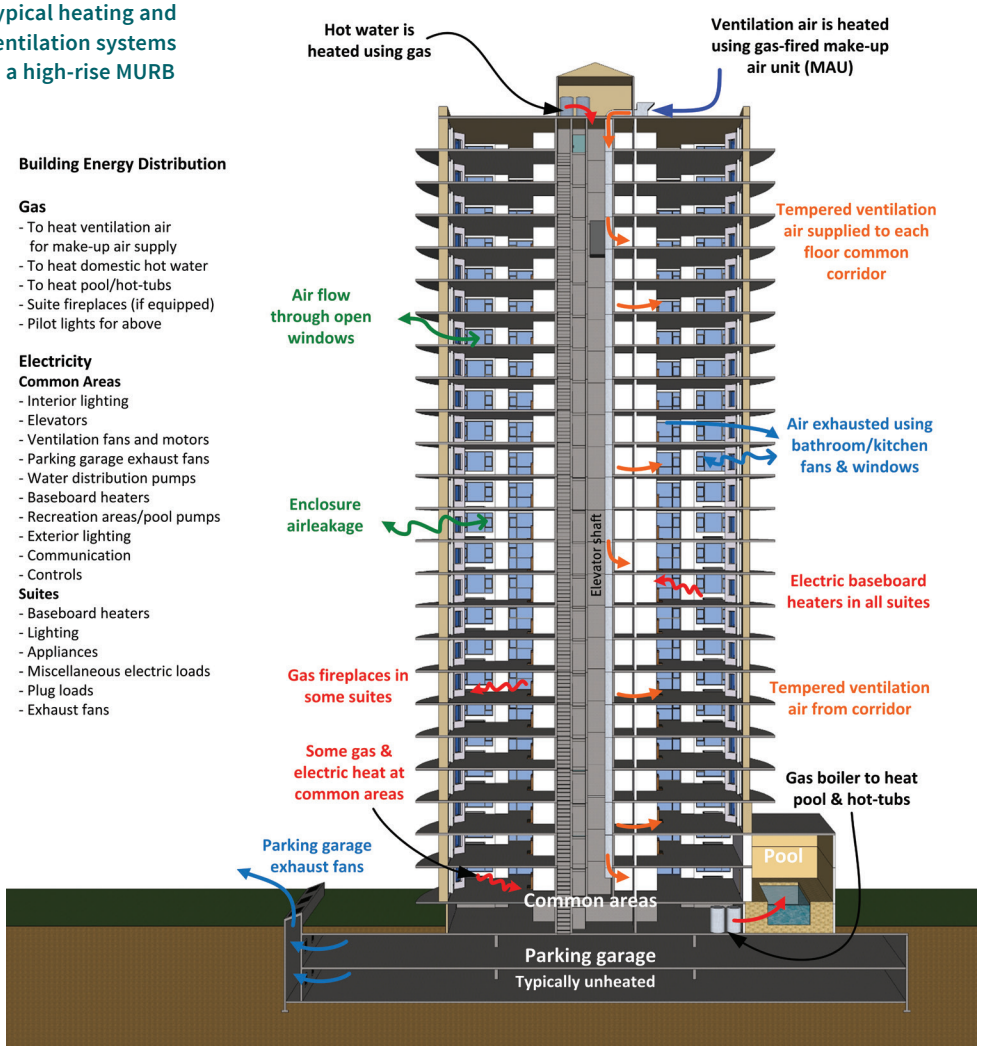
Typical heating and ventilation systems in a high-rise MURB

Building Energy Distribution

Gas
- To heat ventilation air for make-up air supply
- To heat domestic hot water
- To heat pool/hot-tubs
- Suite fireplaces (if equipped)
- Pilot lights for above

Electricity
Common Areas
- Interior lighting
- Elevators
- Ventilation fans and motors
- Parking garage exhaust fans
- Water distribution pumps
- Baseboard heaters
- Recreation areas/pool pumps
- Exterior lighting
- Communication
- Controls

Suites
- Baseboard heaters
- Lighting
- Appliances
- Miscellaneous electric loads
- Plug loads
- Exhaust fans



Outdoor air is intended to replace stale air within suites while also pressurizing the corridors to help contain odours to the suites.

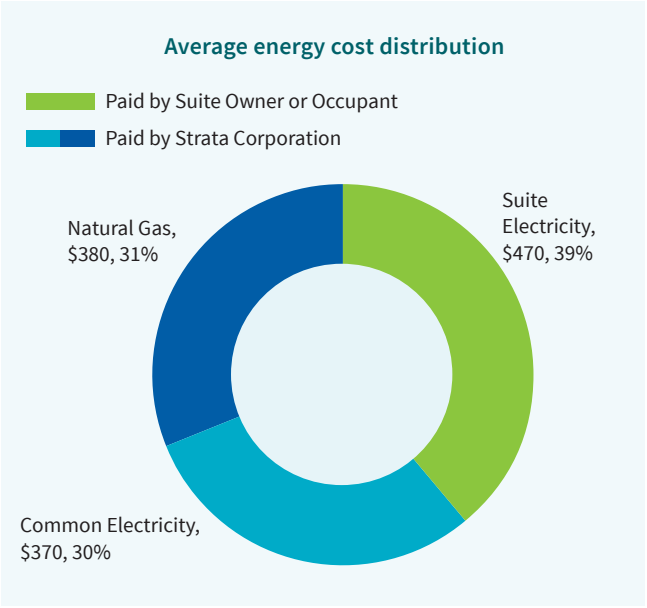
Who Pays For This Energy?

Of the average energy cost of $1,220/suite/year, the owner or occupant pays only approximately $470 of that directly.

In buildings where fireplaces are present, approximately $160/suite/year additonal may be used, paid by the strata corporation.

Given that just over one-third of energy costs are paid directly by the owner or occupant, those who use more energy than others do not feel the full impact of their actions in the form of higher utility bills. Instead the majority of these costs are evenly distributed to everyone in the building through strata fees.

Educating occupants on the full cost of their energy use could lead to reduced consumption.



How to Save Energy?

Many opportunities exist to significantly improve the energy performance of buildings. Here are some examples:

Make-Up Air Units (MAUs)

- MAUs provide fresh air to buildings and are often the largest single energy user – particularly in buildings constructed in the past decade, as they typically have higher ventilation rates.
- Ventilation air is provided for the health and comfort of the building occupants. For this reason, don't attempt to adjust the MAU flow rate (for energy savings or other reasons) without first consulting a professional to determine how the change would affect air quality.
- Keep MAUs in optimal operating condition. Ensure maintenance is performed by professional contractors at regular intervals and filters are changed at least every season. The filters can become plugged with dust after a few months of use and that can impact air flow, indoor air quality and energy use.
- One simple way to generate substantial energy savings is to reduce the MAU set-point temperature. In many buildings outdoor air is heated to a temperature greater than 20°C (68°F), which is higher than necessary for corridors. Reducing the temperature from 20°C to 15°C (68°F to 59°F) can lower MAU consumption by about 21%. The lower fresh air temperatures would increase in-suite heating by 15%, but would still lead to building-wide savings of 12%.

  Ensure the set-point temperature and other performance settings on the MAU are regularly monitored by the building's mechanical service contractor.
- When the MAU is at the end of its service life, choose a high efficiency replacement unit for significant energy savings.

Natural Gas Fireplaces

- Older style decorative fireplaces are inefficient space heaters and can consume approximately 18% of the energy in a building.

  Pilot lights consume energy whenever they are on, and in fact are responsible for up to 50% of the fireplace's energy use. Strata or owner groups should consider building-wide pilot light shut-off during the summer. Shutting off pilot lights for six months of the year can reduce fireplace gas use by up to 25%. If cooling is provided, it can also reduce cooling costs and improve comfort in the summer.
- When replacing in-suite fireplaces, install high efficiency units with electronic ignition starters and no pilot light for even more savings.
- Install fireplace timers as these are relatively inexpensive and easy to install and are good at reducing gas consumption.
- Ensure fireplaces are regularly serviced by a licensed contractor to optimize their efficiency. Consider shutting off pilot lights in the spring and having a licensed service contractor check and start up the units in the fall.

Electric Baseboard and Hydronic Radiator Thermostats

- Consider replacing bi-metallic or mercury-controlled thermostats for electric baseboards and hydronic radiators with programmable electronic thermostats. They are more accurate and allow in-suite temperatures to be lowered to conserve energy while occupants are sleeping and away at work.

Hot Water

- Regularly maintain your domestic hot water systems, and consider temperature adjustments and controls, such as timers on hot water circulating pumps, to improve energy efficiency.
- When equipment is at the end of its service life, choose high-efficiency replacement equipment and systems. Significant energy savings can be achieved with on-demand systems and condensing hot water boilers.

Elevators

- Elevators rely on controls to be energy efficient, and can waste a lot of energy if they aren't working properly. Older elevators may not have effective energy-saving controls, or their controls may be malfunctioning.

  For example, a study found that a number of MURBs constructed in the 1980s to 1990s had AC-DC elevator motor convertors that ran continuously (timers broken or not installed), wasting a significant amount of energy. Hire specialized elevator consultants and service contractors to review the elevator operation, timers and power supply.

Lighting

- Lighting upgrades can be made at a relatively low cost and typically have a short payback period. Options include compact fluorescents, more energy-efficient fluorescent tube bulbs and ballasts, and LED lighting, which is continually getting better and less expensive. These upgrades can be carried out by individual owners in their suites and by strata or owner groups in common areas.
- Common areas such as corridors and stairwells are typically lit 24 hours a day, seven days a week. If your existing system can accommodate them, occupancy sensors and/or daylight sensors can bring significant energy savings and often have a short payback period.

Air-Sealing and Weatherization

- Exterior window and door gaskets and weather-stripping affect your building's airtightness and energy consumption, and should be periodically reviewed and replaced as part of your overall building maintenance and renewal plan. Review and maintain the air sealing of mechanical, plumbing and electrical shafts, all penetrations through floors and suite walls (e.g. garbage chutes), and weather-stripping of stairwell and elevator doors in order to prevent preheated outdoor air from the MAU from escaping outside.
- Occupants sometimes open their windows in cold weather to get some fresh air, but this can significantly increase space-heating costs. Before opening windows, occupants should ensure nothing is obstructing air from the MAU entering their suite from the corridors. If there is simply not enough fresh air, occupants should try to minimize the amount of time windows are open and keep them closed when they leave the suite.

Occupant Education

- Educate occupants on the impact of certain behaviours, such as excess use of fireplaces and opening windows in winter. Explain how the majority of energy costs are paid by the strata corporation, and that lower energy use would in turn lower fees.
- Sub-metering technologies are emerging that allow individual suites to be billed for natural gas use from fireplaces, which would give occupants better feedback on their energy use.

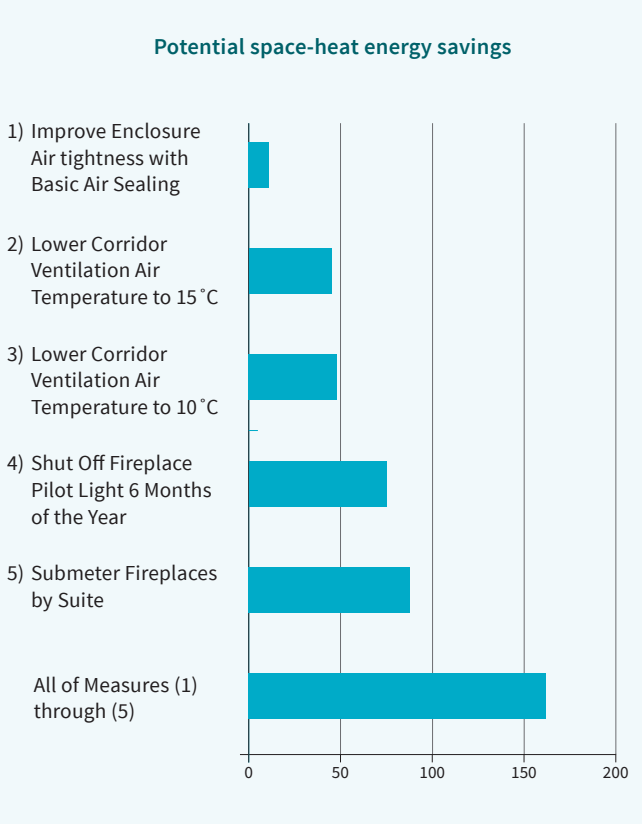
During major rehabilitation projects that include work within suites and common spaces, it might be worth considering separate in-suite ventilation and space heat systems that incorporate heat recovery ventilators (HRV).

What Cost Savings Can I Expect?

Simple tune-ups can reduce building energy consumption and save money. The energy savings will be different for every building, but some guidelines are presented here.

The following graph shows the potential space-heat energy savings for a typical Vancouver building from some of the low or no cost tune-ups discussed in this bulletin. These numbers are based on average 2013 utility rates.

As the graph shows, one cannot simply add up the individual energy savings of different improvements – such as improving the wall and window thermal performance, reducing air leakage and so on – to determine the total energy savings. This is due to the dynamic interactions between different improvements. Upgrades need to be considered as a package.



Including Energy Efficiency in Renewal Projects

Building enclosure rehabilitation projects done for building renewal or to address moisture related problems are relatively common in B.C. and other parts of North America. However, due to cost and other considerations, the projects generally miss a unique opportunity to fully assess the building's energy performance and consider building envelope changes that could significantly save energy and reduce greenhouse gas emissions. Energy conservation measures are more cost effective when undertaken in conjunction with other work.

An analysis of 13 south coastal B.C. high-rise buildings fully renovated for reasons other than energy efficiency, found that they achieved approximately 14% space-heating energy savings and 8% total energy savings. Greater savings could be achieved with a full energy performance assessment.

During a major rehabilitation project that includes work within suites and common spaces, it might be worth considering separate in-suite ventilation and space heat systems that incorporate heat recovery ventilators (HRV). By recovering heat from the exhaust air before it is released outside, an 80% efficient in-suite HRV can achieve average space-heating savings of approximately 34%.

Action Plan Tips

- Strata corporations and building managers may wish to consider implementing the simple building tune-up measures in this bulletin, such as lowering the set-point temperature of Make-Up Air Units (MAUs).
- Retain a building energy consultant to develop a comprehensive building energy efficiency upgrade plan.
- Consider upgrading to energy-efficient equipment as part of regular building upgrades or end of life replacements.
- Evaluate the cost effectiveness of energy efficiency upgrades during any building enclosure rehabilitation work.
- Always keep in mind the overall operation of the building beyond just energy consumption. Be sure to consider how changes to the building systems may impact other functions, including moisture control, indoor air quality and comfort.
- Keep suite owners and occupants aware of any energy efficiency improvements and explain the expected benefits in order to get their buy-in. This is especially important for some measures, such as reducing the MAU temperature set-point, where occupants may feel a difference in the building environmental conditions.

For More Information

1. Subscribe to receive BC Housing updates at www.bchousing.org
2. Maintenance Matters No. 7 – Building Envelope Maintenance and Renewals Planning, available online at www.bchousing.org
3. About Your Apartment: Energy and Water-saving Tips for Your Apartment, published by Canada Mortgage and Housing Corporation (CMHC) available online at www.cmhc-schl.gc.ca
4. Building Asset Management Bulletins, Condominium Home Owners' Association of B.C. (CHOA), available online at www.choa.bc.ca
5. Energy Consumption and Conservation in Mid and High Rise Residential Buildings in British Columbia, available online at www.bchousing.org
6. Contact BC Hydro at www.bchydro.com
7. Contact FortisBC at www.fortisbc.com

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