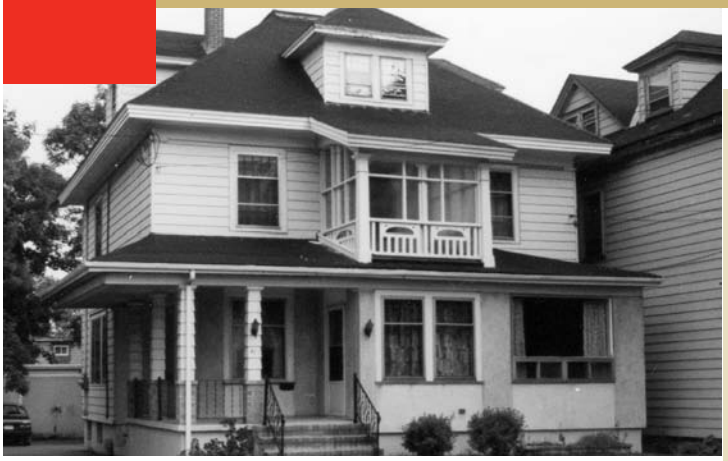
RENOVATING FOR ENERGY SAVINGS

Case studies

October 2004 Issue 8



Duplexes and Triplexes

Up-and-down duplexes and triplexes are found across the country. 'Purpose-built' units are found in central Canada, especially Quebec. In other areas, large, older houses are converted into up-and-down units. The average finished floor area of a unit is 75 to 110 m² (800 to 1 200 sq. ft.).

What you've got

- Two-storey building, some older units are three storeys
- Side-by-side units are covered in Issue 9 of this series: "*Row Houses*"

How it's built

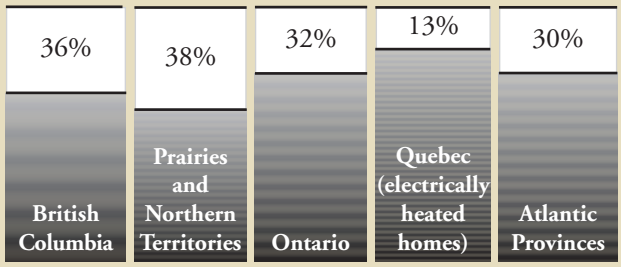
Actual construction details used in your house may differ, and over the years some improvements may have been done.

This is simply a general description:

- Exterior walls: 2 x 4 in. stud walls with RSI 1.8 (R-10) batt insulation
- Ceiling: average range of RSI 3.5 (R-20) insulation (coastal B.C. and Atlantic region) to RSI 4 (R-23) in the Prairies
- Windows: double-glazed or single-glazed with storms (except for coastal B.C.)
- Original exterior doors: hollow wood panels
- Foundation: in Quebec, the basement is typically finished as a living unit.

POTENTIAL ENERGY SAVINGS

If all of the recommended improvements presented here are carried out, overall energy use can be reduced as shown below. Actual energy use is affected by weather and lifestyle, so specific energy savings may vary. If you, or a previous owner, have already carried out some energy-saving measures, the actual reduction in energy use will differ. The energy savings presented here are based on computer simulations done specifically for this type of house in each Canadian region.



Improvements can

- Reduce energy use for space heating
- Reduce drafts
- Reduce summer overheating
- Reduce moisture and condensation problems
- Reduce noise from outside the house
- Reduce greenhouse gas emissions
- Improve indoor air quality
- Improve humidity levels in dry northern houses
- Increase comfort level

How to select energy-saving improvements for duplexes and triplexes. These improvements will save energy and reduce your heating bills, while making your house more comfortable to live in.

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Problems and Opportunities

- The air leakage area is distributed throughout the house, but is often concentrated at the header areas (where the floor framing meets the walls). If all air leakage paths are combined, the average duplex or triplex would have a hole that is about 1,000 cm^2 (or roughly 12 x 12 in.). The tightest units are found in the Prairies with a hole about 580 cm^2. The leakiest units are found in BC, with a hole about 1,700 cm^2.
- Duplexes and triplexes do not generally have an effective ventilation system to maintain proper indoor air quality. There may be a noisy bathroom fan and a kitchen range hood fan in each unit. Units built since the late 1980s, especially in Atlantic Canada, may have a "whole-house" balanced ventilation system using an air exchanger or a heat recovery ventilator (HRV).
- In Quebec, most duplexes are heated with electric baseboards. In other regions, many duplexes still have their original furnace or boiler. If they have been replaced, they will likely be older, low-efficiency equipment that is only about 68 per cent (or less) efficient.Water heating is usually provided by a conventional tank. Furnace and boiler systems are often common to the whole house, making changes to the heating system difficult, especially in rental units.

Draftproof Everywhere!

- Draftproof or air seal, the top of foundation walls (to seal off the lower unit or an unfinished basement), around window and door frames on all levels, at attic hatch (upper unit), ceiling penetrations around light fixtures and wiring (all units), and service penetrations through the exterior walls.
- Other areas to consider include around the staircase, service penetrations through the common floors between suites, connections between floor structure and walls, and floors over garages. The floor structure between units should be tightly air sealed to maintain fire and sound resistance in accordance with local building codes. Typically, there are many service penetrations for wiring and plumbing that are not well-sealed. There is usually a considerable amount of air leakage in duplexes where the staircase is against an outside or common wall. This can lead to cold lower units and upper units with poor indoor air quallity.
- In newer units, or in units that have had bathroom renovations, where one-piece bath or shower enclosures are installed against exterior walls, the air barrier may be discontinuous or damaged. This can be a source of great air leakage that results in significant discomfort when the bath or shower is in use. Caulk with waterproof material around the whole exposed face of the bath enclosure, including at the floor. Also, caulk at the wall/floor junction behind the baseboard to short-circuit the air leakage path in the bathroom along the exterior wall.
- An unfinished garage ceiling can be insulated, and draftproofed at the same time, by using spray-on foam insulation. It is important to pay special attention to air sealing between the garage and living space, to prevent exhaust fumes from entering the house.
- If the basement is not used as living space, all the plumbing and ventilation penetrations that are accessible from the basement as well as all the cracks and gaps in the basement walls and floors should be caulked and sealed. Insulate and draftproof the basement header area with expanding spray foam to reduce drafts across the first floor.
- Basement sumps should have a tight-fitting cover installed.
- If this house has a walkout basement, please refer to #10 in this series: "*Homes with Walkout Basements.*"

For details on draftproofing, see *Keeping the Heat In* by Natural Resources Canada.

If You Rent

If you rent a unit in a duplex or triplex, your energy-saving measures are fairly limited. However, there are still some measures you can take. Draftproof your windows by sealing them with removeable caulking or install "shrinkwrap" plastic or other temporary interior storm windows. Make sure the weatherstripping and sweeps at entry doors are in good repair and seal up any obvious penetrations from the unit above or below with a can of foam-in insulation or paintable caulking. If you own your appliances, you can replace older models with Energy Star® units.

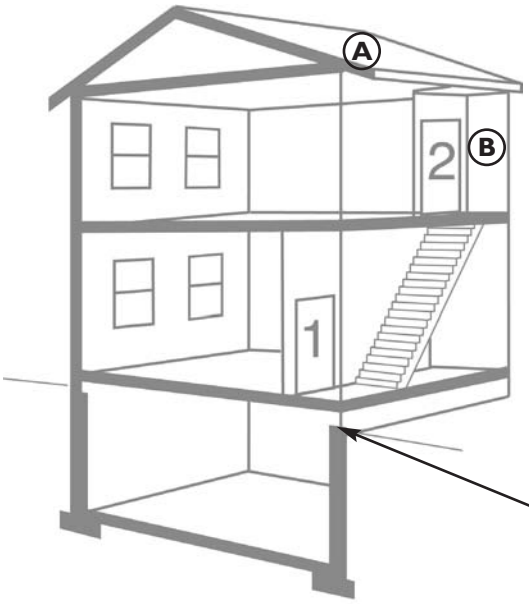
Improvements that can save energy in duplexes and triplexes.

The best time to carry out energy-saving improvements is when you are planning other renovations. Carry out the air sealing and insulation upgrades before you invest in a new heating or mechanical system. A tighter house with better thermal properties has a smaller heating load and a different ventilation requirement. A qualified adviser can help you with this.

(A) Ceiling/Roof Insulation – *Increase to at least:*

- RSI 7 (R-40) natural gas or oil space heating
- RSI 9 (R-52) electric space heating
- RSI 5.6 (R-32) in coastal British Columbia

The amount of insulation you can add will depend on roof structure and access. Only the topmost unit will benefit from energy savings. Flat roofs can be packed with blown-in insulation, or when being re-roofed, a layer of rigid board insulation can be applied to the exterior before the new roof goes down (similar to an exterior wall upgrade). Both of these methods require a professional to ensure that the job meets local building code requirements and good building practices.



(B) Exterior Walls

If you redo the siding on your house, take this opportunity to increase insulation levels and do some air sealing. Insulation can be blown into the wall cavities from the outside. If the wall cavities are already insulated, add a layer of exterior insulation and a house-wrap air barrier. If at the same time, you can replace the windows with better-performing units, the combined retrofit gives your older house a facelift, better energy efficiency and higher levels of comfort while saving you money on labour costs. Contact a professional contractor for advice on this retrofit.

Some older buildings are built with solid brick walls and no insulation. Adding insulation to these should be considered. This can be from the exterior or interior. Obtain a professional contractor's advice on how best to approach this retrofit.

Unfinished Basements Walls

Before insulating foundation walls, make sure they are in good repair and check site drainage. Good drainage means no moisture problems once the walls are insulated. If existing moisture problems cannot be fixed, insulate the walls from the outside (at least 600 mm (2ft.) below grade for poured concrete, from top to bottom for concrete block).

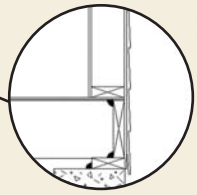
If you are insulating from the inside, most building codes require a moisture barrier on the basement wall, and an air and vapour barrier on the warm side of the insulation. Here are three ways to meet most code requirements:

A) lay polyethylene sheets or tarpaper on the basement wall, build a stud wall with batt insulation and seal the warm side with polyethylene;

B) use an approved, rigid-board insulation thick enough to give RSI 2.1 (R-12) and finish it with a fire-resistant material (e.g., gypsum board);

C) lay 25 mm (1 in.) of extruded polystyrene board insulation against the basement wall, build a stud wall with batt insulation and finish with gypsum board.

Headers should have at least RSI 2.1 (R-12) rigid, foam-friction fit into each cavity and sealed with caulking or foam-in insulation to reduce air leakage. Blown-in polyurethane foam can also be used.



Insulating the foundation walls on an unfinished basement—inside or outside—has the following advantages: the basement is warmer; it is easier to achieve a continuous insulation and air leakage barrier than in the basement ceiling; piping and ducting end up within the conditioned space of the house so they don't need protection against freezing.

Exterior Doors

Consider replacing older, wooden exterior doors with metal, insulated units, which are more durable, easier to weatherstrip, and maintain their appearance with lower maintenance needs. There is a trade-off between the esthetics of older “heritage houses”and thermal values. If you keep the original wooden door, keep the weatherstripping in good condition, upgrade the hardware and block off old mailslots or any other openings as part of your draftproofing measures. Many older homes have a vestibule that can be turned into an airlock entry by installing an inner door, tempering the first blast of cold air before it enters the main living space.

Windows

Energy-efficient windows greatly improve comfort levels, virtually expanding the usable space in the house as the area near the windows is no longer cold and drafty. Replacing windows can also improve house appearance, and increase resale value. The most energy-efficient choice is high performance units with selective glazing (such as double-glazed units with a low-e coating, argon gas fill and insulated spacers and frames). Wood-frame windows can be retrofitted using custom double-glazed inserts. If window repair is required, replacements should be high-performance units. For new and existing windows, seal the joint between the windows frame and wall, and keep weatherstripping and storms in good repair.

Space Heating System

Consider replacing your warm-air furnace or boiler with a new high-efficiency unit. Your heating contractor can do a heat-loss calculation to properly size the furnace for your home's requirements. If your home has central air conditioning, the new furnace will also have to be matched to the existing A/C unit. In some cases, space and water heating systems can be integrated so that only one boiler or heating unit is required to carry out both tasks.

General Energy Efficiency Notes

- Cover hot water pipes within 3 m (9 ft.) of the water tank with pipe insulation—and if possible, insulate all accessible hot water pipes.
- Insulate electric hot water tanks with an insulation blanket.
- Install programmable thermostats to lower temperatures at night or during the day when your home is unoccupied: stay at or above 16°C (61F) minimum temperature to prevent condensation and mold problems, and maintain heat in all rooms.
- Replace leaky dampers and repair chimney flues on woodstoves and fireplaces.
- Glass doors on fireplaces will reduce air leakage up the chimney when not in use.
- Consider other options for fireplaces: an electric fireplace insert (no fuel safety issues), EPA-rated insert unit, or convert to a direct-vent natural gas fireplace insert.
- Gas fireplaces: look for direct-vent units with intermittent electronic ignition systems, or other easy means of turning off and relighting the pilot light.
- Replace your old oil- or gas-fired water heater with a side-wall vent unit or a high-efficiency electric water heater. This eliminates the chimney and associated air leakage and backdrafting problems.

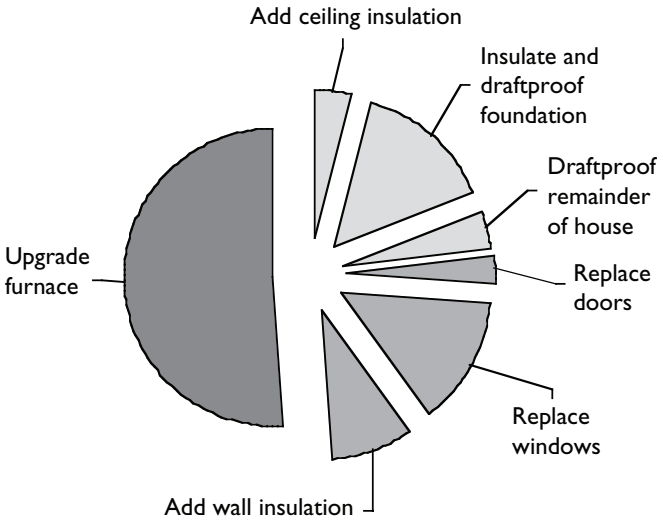
  Check into integrated space and water heating systems (i.e., a boiler for space heating fitted with a "tankless coil" or "indirect heater" that provides domestic hot water). A solar hot water system can produce up to 60 per cent of your annual water heating needs. Solar hot water systems, instantaneous water heaters and other options are becoming more affordable as they become more readily available.
- Before replacing your existing furnace or boiler, carry out any air sealing, draftproofing, insulation upgrades and other energy-saving improvements to the walls, windows and doors and then give your whole heating system a tune-up.
- **It is important to know how airtight your house is to ensure there is no backdrafting of flue gases into the house when exhaust fans are operating. A combustion safety test, carried out by a qualified contractor, can indicate if depressurization is a potential problem.**
- Control energy loss in the furnace room by installing automatic, motorized duct dampers on the combustion air line. The same can be done on the fresh-air intake of most furnaces. This prevents large amounts of cold air from entering the plenum between firing cycles.
- Oil heating systems are often oversized. Changing to a smaller nozzle size can improve system performance.
- Controlled air change—fresh air in, stale air out—is important for good indoor air quality. If you have a forced-air heating system it may be possible to add a heat recovery ventilator (HRV) to the system. In houses without forced-air heating or fuel-fired equipment, a good quality quiet fan in a central bathroom or hall and an exterior-exhausting range hood fan may be an appropriate option. Your ventilation system should be designed and installed by a qualified technician to ensure that the operation and venting of any combustion appliance in the house is not compromised.
- In the coldest periods of winter, the indoor humidity should be between 30 and 35 per cent to avoid condensation on windows. Invest in a low-cost hygrometer to monitor the relative humidity levels in your home. If winter humidity levels are too high, try increasing your ventilation rate (for example, by running a small bathroom fan continuously).
- When winter humidity levels are low, it is often due to excessive air leakage. Better air sealing will raise humidity and save energy. If, after air sealing work has been completed, there is still a problem with low humidity levels, a humidification system may be required.

Other energy-saving improvements

- Water-saving fixtures: low-flush or dual-flush toilets, faucet and shower flow restricters, front-loading clothes washer that reduce water heating loads.
- Energy-efficient appliances: replace and recycle older refrigerators, freezers, electric ranges and dishwashers with Energy Star® rated models.
- Energy-efficient lighting: the average house has 27 lightbulbs in it. On average, lighting in a house consumes 1,800 kWh annually. Switch to fluorescent, compact fluorescent and task lighting.

Average Energy Savings by Improvement

Based on computer simulations, the pie chart below indicates an ***average percentage of potential total energy savings*** that can be expected for each type of improvement: insulation and draftproofing 23%; door and window replacement 17%; exterior wall insulation 19%; furnace upgrade 51%.



Special Health and Safety Considerations

When you make improvements to your home you change the way it operates. This can affect the health and safety of the house and occupants. Review the following table carefully before carrying out your energy improvements.

If you do this	It can cause this	Can be solved by this
Draftproof your house	Depressurization by exhaust fans could cause backdrafting of combustion flue gases.	Replace combustion appliances with direct-vent appliances or incorporate make-up air. If there is a fireplace or woodstove, ensure there is adequate venting and that combustion air is available.
Check ventilation	Exhaust-only ventilation can lead to excessive depressurization and spillage of flue gases from combustion equipment. Supply-only ventilation can lead to excessive pressurization and condensation/frost problems.	Have a qualified contractor carry out a depressurization test to determine if a balanced ventilation system is required.
Upgrade the furnace	Higher noise levels if the ducts are not properly sized for the higher airflows.	Size the heating system for both the heating load and existing ducting, seal all exposed ductwork connections to reduce vibration.
Install high-efficiency water heater and furnace	Reduced air-change rate, stuffiness and higher humidity levels because high-efficiency sealed combustion units exhaust very little house air compared to a standard unit with a chimney.	Install a proper ventilation system.
Replace the windows	Increased airtightness can lead to higher humidity levels, resulting in condensation on the windows and other cooler surfaces.	Install a proper ventilation system with automatic humidity control.

CMHC's
Renovating for Energy Savings series

Issue 1 Pre-World War II Houses
Issue 2 Post-War 11/2-Storey Homes
Issue 3 Post-1960s Two-Storey Homes
Issue 4 1960s-70s One-Storey Homes
Issue 5 Split-Level Homes
Issue 6 Split-Entry Homes
Issue 7 Mobile Homes
Issue 8 Duplexes and Triplexes
Issue 9 Row Houses
Issue 10 Homes with Walkout Basements
Issue 11 Common Additions

Additional Information and Resources
CMHC Canadian Housing Information Centre (CHIC)

- ***Building, Renovating and Maintaining***
  www.cmhc.ca/en/co/renoho/index.cfm
- ***About Your House***
  www.cmhc.ca/en/co/co_001.cfm

Natural Resources Canada

- **Office of Energy Efficiency**
  www.oee.nrcan.gc.ca Tel. 1-800-387-2000
- **Publications**
  www.oee.nrcan.gc.ca/publications/infosource
- **Keeping the Heat In**
  www.oee.nrcan.gc.ca/keep_heat_in/

Canadian Home Builders' Association (CHBA)

The impact of specific improvements for your house can also be provided by technicians and qualified trades persons. The Renovation Council of your local Home Builders' Association can provide some references, or contact the CHBA
www.chba.ca Tel. 613-230-3060

- **In Quebec, please contact the APCHQ** (Association provinciale des constructeurs d'habitations du Québec) at www.APCHQ.com tel. 514-353-9960 or Association de la construction du Québec (ACQ) at www.ACQ.org Tel. 514-354-0609
- **The Renovation Roadmap**
  Web site developed by CHBA, CMHC and NRCAN
  www.myhomereno.com

Provincial Governments

Provincial Government departments will frequently provide detailed recommendations for your region.

Local Utilities

Your local energy utility can usually provide detailed recommendations for your region.

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