RENOVATING FOR ENERGY SAVINGS

Case studies

October 2004 Issue 3

Post-60s Two-Storey Homes

More than 750,000 two-storey houses have been built in all parts of Canada since the beginning of the 1970s. These houses have an average floor area of 200 m² (2,200 sq. ft.) plus basement, but they can be 400 m² (4,200 sq. ft.) or larger.

What you've got

- Two-storeys
- Possibly an attached garage, maybe a "bonus" room over garage
- Full basement, ranging from unfinished to finished

How it's built

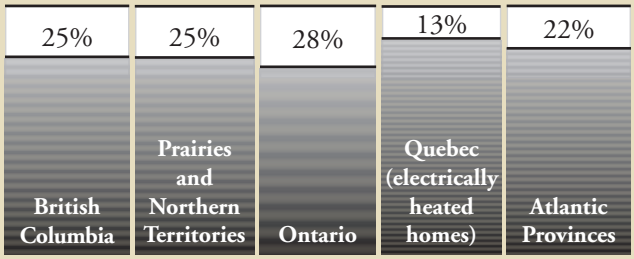
Actual construction details used in your house may differ and over the years some improvements may have been made.

This is simply a general description:

- Exterior walls: 2 x 4 in. stud walls with RSI 2.1 (R-12) batt insulation. Newer homes will have 2 x 6 in. walls with RSI 3.5 (R-20) batt insulation; (R-28) in the North
- Ceiling insulation: RSI 4.5 (R-28) Coastal B.C. to RSI 6.5 (R-40) in the Prairies and Northern Territories
- Windows: double (triple in North) glazed, or single-glazed with storms
- Original exterior doors: typically insulated metal doors
- Foundation: concrete, partially insulated, typically to 600 mm (2 ft) below grade; fully insulated, pressure-treated wood in the North

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 post-60s, two-storey homes. 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:

- Air leakage is distributed throughout the house, but can be concentrated at the rim joist and header area in the basement and at the garage–house shared surfaces. If all air leakage paths are combined, the average house of this type and vintage would have a hole that is about 980 cm^2 (or roughly 12 x 13 in.). Houses in B.C. are leakier, with a hole that could be up to 3,200 cm^2 (or roughly 57 x 57 cm (22 x 22 in.)).
- Older houses 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. Houses built since the late 1980s, especially those built in Atlantic Canada, may have a "whole house" ventilation system, such as an air exchanger or heat recovery ventilator (HRV) installed as original equipment. Homes in the Prairies and Quebec, which tend to be the most airtight, will benefit most from improved ventilation systems.
- Most two-storey houses still have the original furnace or boiler, likely older low-efficiency equipment that is only about 68 per cent—or less—efficient. Homes built since the late 1980s may have mid-efficiency equipment. Other than improved thermostats, electric baseboard equipment has not changed greatly in efficiency over the years. Water heating is usually provided by a conventional tank.

Draftproof Everywhere!

- Draft-proof or air-seal the top of foundation walls, attic hatches, around window and door frames. Other areas include ceiling penetrations around light fixtures and wiring and service penetrations through the exterior walls, as well as at chimney and fire stop.
- Seal the joint between floor and walls (behind the baseboards).
- Caulk and seal 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.
- Insulate and draft-proof the header area in the basement with expanding spray foam to reduce drafts across the main floor.
- Basement sumps should have a tight-fitting cover installed.
- Pay special attention to any walls and ceilings shared with the garage. It is important to stop exhaust fumes from entering the house.

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 to 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.

Install newer, more accurate thermostats in electrically heated houses.

If you are using the basement as living space, make sure you have adequate supply-and-return ducting. The original heating system may not have been designed to include the basement.

Improvements that can save energy in two-storey homes built after 1969

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 contractor can help you with this.

Ⓐ 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 a high-performance unit with selective glazing (such as double-glazed units with a Low-e coating, argon-gas fill and insulating spacers).

Houses built in the 1970s may have aluminum frame "sashless sliders," (where the glazing sits directly in tracks in the frame). Reduce condensation problems by installing new sliders set in sashes, or adding magnetic storms to the interior, or replacing the complete unit. These windows are most likely reaching the end of their usable life and should be replaced.

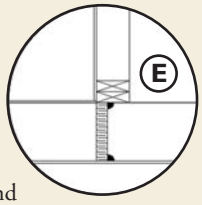
Existing wood-frame windows can be retrofitted using custom, double-glazed units in the original sash. If window repair is required, replacements should be high-performance units.

(B) Basement Floor

Reduce moisture and soil gas concerns in basements by covering dirt floors. If you have a dirt floor, cover it with polyethylene sheets, overlap and tape seams by 300 mm (12 in.) and run the poly 150 mm (6 in.) up the walls. Cover poly with a layer of sand and paver stones or concrete.

(D) 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

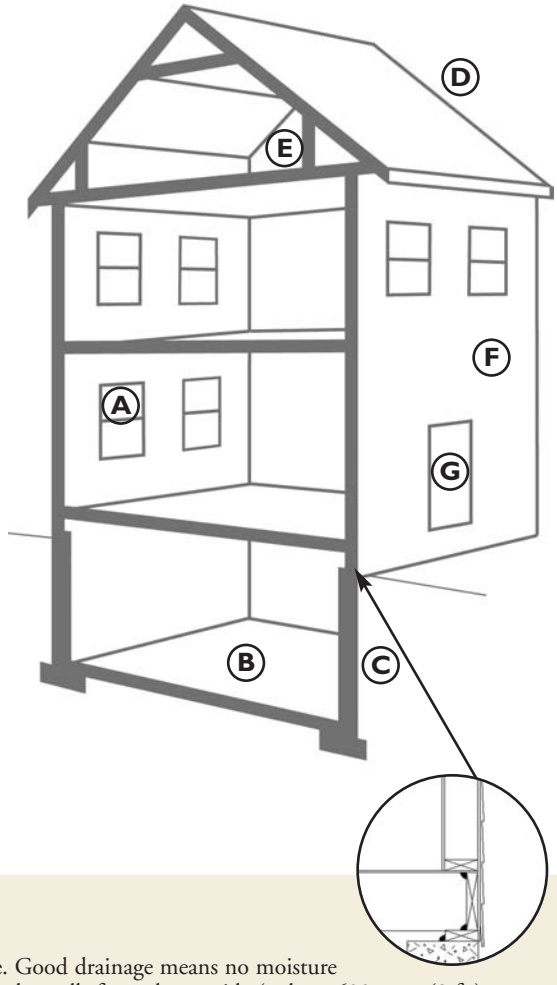


The amount of insulation you can add will depend on roof structure and access. Where an attached garage does not have any living space above, check that any wall section between the house and the garage attic is well-sealed and insulated with rigid board on the garage attic side to reduce heat loss and air leakage.

Garage Wall

Insulate the common wall between the house and the garage to the same level as the rest of the exterior walls. If there is a "bonus" room above the garage, insulate the garage ceiling to at least the same level as the exterior walls. If the garage is finished, insulation could be blown-in through the joist cavities without too much damage to the finish. Using spray-on foam insulation on unfinished garage ceilings and walls that are shared with the house will reduce air leakage at the same time as reducing heat loss.

"Bonus rooms" are usually not very airtight and require a fair amount of work at the perimeter edges and penetrations. The wall between the house and the bonus room is often a major air leakage area. Air sealing and insulating might best be accomplished by removing the garage ceiling to do the work.



(C) Basement 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, (2 ft.) below grade for poured concrete, from top to bottom for concrete block). If the walls are completely finished with little or no insulation on the interior, insulate on the exterior as noted above.

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 approved, rigid-board insulation thick enough to give RSI 2.1 (R-12) and finish it with a fire-resistant material, for example, 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.

If this house has a walkout basement please see Issue 10 in the *Renovating for Energy Savings* series: *Homes with Walkout Basements.*

(F) 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. Obtain a professional contractor's advice on how to approach this retrofit.

(G) Exterior Doors

Replace older, wooden exterior doors with metal, insulated units, which are more durable, easier to weatherstrip, and maintain their appearance with lower maintenance needs.

Make sure that the weatherstripping on your existing exterior doors is in good condition.

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 16ºC (61F) minimum temperature to prevent condensation and mold problems and maintain heat in all rooms.
- Replace leaky dampers and repair chimney flues on wood stoves 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 (U.S. Environmental Protection Agency)-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 sidewall vent unit or a high-efficiency, electric water heater. This eliminates the chimney and associated air leakage and backdrafting problems.

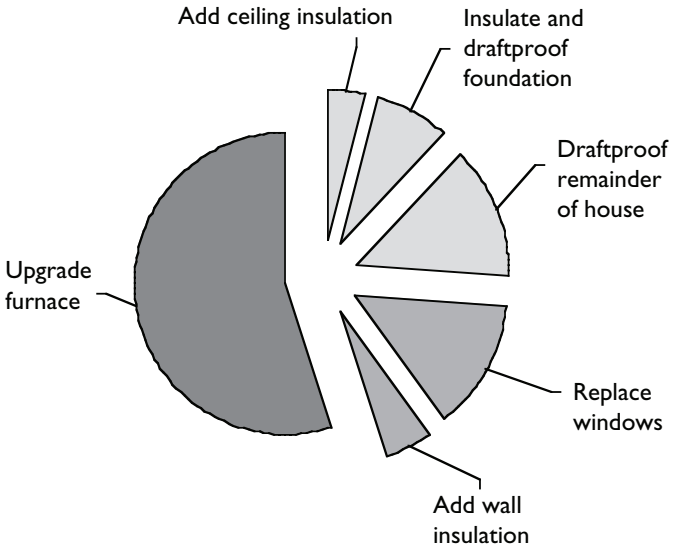
  Check into integrated space- and water-heating systems —a boiler for space heating fitted with a “tankless coil” or “indirect heater” that provides domestic hot water. A solar hot-water system can produce up to 60 per cent of your annual water heating needs. Solar hot water systems, instantaneous water 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, draft-proofing, 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.
- Low winter humidity levels are 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 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 26%; door and window replacement 14%; exterior wall insulation 5%; furnace upgrade 55%.



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* series**
  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 ACQ (Association de la construction du Québec) at www.ACQ.org Tel. 514-354-0609
- **The Renovation Roadmap**
  Website 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.

OUR WEB SITE ADDRESS: www.cmhc.ca

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