

RENOVATING FOR ENERGY SAVINGS

Case studies

October 2004 Issue 1



Pre-World War II Houses

Older houses can be found in all parts of Canada. These houses range in size from 75 to 360 m² (800 to 3,900 sq. ft.).

What you've got

- Larger two- or three-storey house
- Basement originally used for coal or wood storage, not a living space
- Probably has additions or earlier renovations to the original structure (closed-in porch, "summer kitchen" or other)

How it's built

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

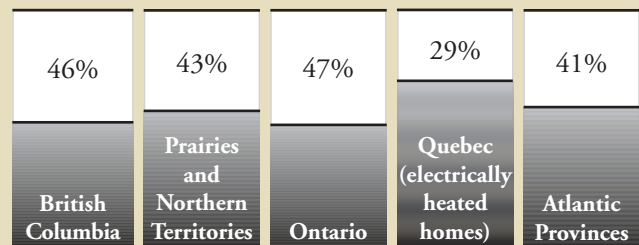
This is simply a general description:

- Exterior walls: 2 x 4 in. stud walls with RSI 1.4 (R-8) batt insulation; also, solid wood, solid stone masonry and solid brick masonry in some regions, possibly uninsulated in all regions
- Ceiling: average RSI 2.6 (R-15) insulation (coastal B.C. and Atlantic region) to RSI 3.5 (R-20) in the Prairies, possibly uninsulated in all regions

How to select energy-saving improvements for homes built in Canada prior to 1940. These improvements will save energy and reduce your heating bills, while making your house more comfortable to live in.

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.



- Windows: single-glazed with storms (except for coastal B.C.)
- Exterior doors: solid wood panels
- Foundation: concrete, stone rubble or brick, often without footings, dampproofing or insulation

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

Problems and Opportunities

- Air leakage is distributed throughout the house, but is often concentrated at the floor-to-wall connection on all storeys and around masonry chimneys when they go through the building envelope. If all air leakage paths are combined, the average pre-WWII house would have a hole about 1,500 cm² (or roughly 15 x 15 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.
- Many older pre-WWII houses will have their second or third furnace or boiler, likely older low-efficiency equipment that is only about 68 per cent (or less) efficient. As well, the heating distribution system has most likely been changed. 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.
- Many older pre-WWII homes have additions such as closed-in porches. For details on how to reduce heat loss in these areas please see no. 11 in the *Renovating for Energy Savings* series: *Common Additions*.

Draftproof Everywhere!

- Draftproof or air seal the top of foundation walls, attic hatches and doors, around window and door frames. Other areas include ceiling penetrations around light fixtures and wiring, and service penetrations through the exterior walls.
- Seal the trim of the attic door or use foam insulation around frame on the attic side.
- Seal the joint between floor and walls (behind the baseboards).
- Seal interior trim around doors and cupboards with paintable caulking.

- Chimneys and flue pipes should have a heat shield installed and sealed to surrounding drywall or framing. An additional heat shield can be installed at the subfloor level.
- Caulk and seal all the plumbing and ventilation penetrations to the exterior that are accessible from the basement, as well as all the cracks and gaps in the basement walls and floors.
- Insulate and draftproof the header area in the basement with expanding spray foam to reduce drafts across the main floor.
- Any basement sumps should have tight-fitting covers installed.

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

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.

Increase the efficiency of your forced-air system by sealing ductwork wherever it is easily accessible.

Improvements that can save energy in homes built in Canada prior to WWII.

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.

A Windows

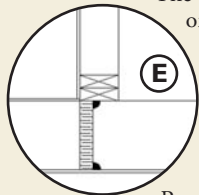
Energy-efficient windows greatly improve comfort levels, virtually expanding the usable space in the house, as the area near the windows is no longer cold and drafty. Replacing windows can also improve house appearance and increase resale value. The most energy-efficient choice is high-performance units with selective glazing (such as double-glazed units with a low-e coating, argon gas fill and insulated spacers and frames). Heritage or period woodframe windows can be retrofitted using custom double- or triple-glazed inserts. If window repair is required, replacements should be high-performance (double or triple glazed) units.

For new and existing windows, seal the joint between the window frame and wall, and keep weather stripping and storms in good repair.

The double- and single-hung windows common to these houses should be weather stripped on the sides, top and bottom of the moving sash. Caulk the fixed portion.

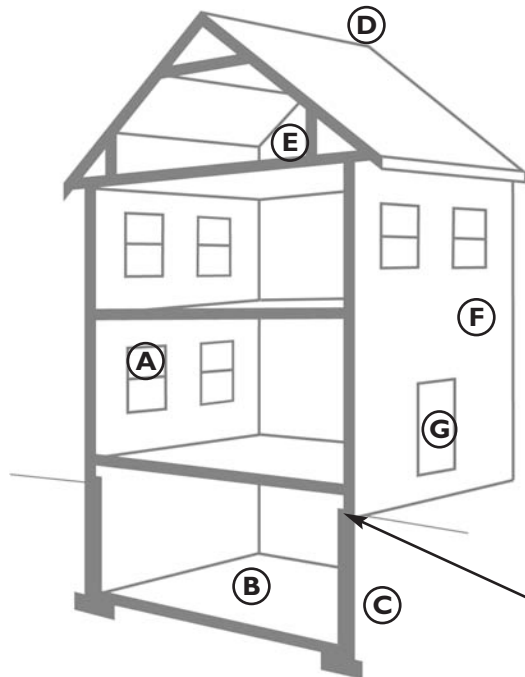
D Ceiling/Roof Insulation – Increase to at least:

- 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 depends on roof structure and access. An attic space with knee walls can be insulated up the knee wall and in the floor of the side attic spaces, or in the eaves. Either way, it is important to seal the base of the knee wall, as shown, to stop air leakage.

Remove any older insulating material (wood shavings, sea grass, peat moss, etc.) from the perimeter where eaves limit the amount of insulation. Replace with rigid insulation or new, blown-in material here to increase insulation values.



B Basement Floor

Reduce moisture and soil gas concerns in basements by covering dirt floors. Many houses of this vintage will already have poured concrete floors in the cellar.

If you have a dirt floor, cover it with polyethylene sheets, overlap and seal 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.

C Basement Walls

First, make sure foundation walls are in good repair and you have positive drainage so that there are no moisture problems after the walls are insulated. If existing moisture problems cannot be fixed, insulate the walls to RSI 2.1 (R-12) from the outside at least 600 mm (2 ft.) below grade for poured concrete; from top to bottom for concrete block. Always insulate rubble or stone foundations from the outside to avoid possible frost damage to old mortar. If there is no moisture problem in your poured or concrete block foundation, insulate from the inside to RSI 2.1 (R-12) including the header area. The header should also be sealed.

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 tar paper 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 foundation walls—inside or out—keeps the basement warmer, protecting pipes and ducts from freezing. It is also easier to make a continuous insulation and air barrier at the walls than in the ceiling. Remember that the basement in this vintage house was not built as a living space, and should not be converted into one. Basement dehumidification may still be required in the summer.

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

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 aesthetics of the “heritage house” and thermal values. If you keep the original wooden door, keep the weatherstripping in good condition, upgrade the hardware and block off the mail slot or any other openings as part of your draftproofing measures. Many older houses have a vestibule that can be turned into an air lock entry by installing an inner door, tempering the first blast of cold air before it enters the main living space.

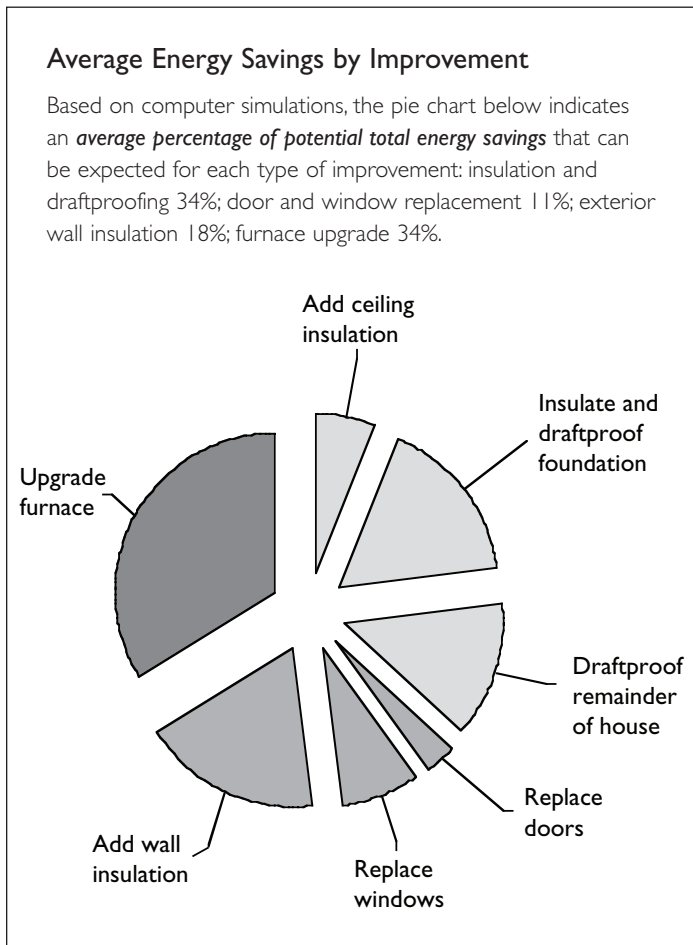
General Energy Efficiency Notes

- 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.



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 1 1/2-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.oeenrcan.gc.ca Tel. 1-800-387-2000
- **Publications**
www.oeenrcan.gc.ca/publications/infosource
- **Keeping the Heat In**
www.oeenrcan.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.

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