CE 69

Understanding Energy Efficiency Retrofit Options for Your House

How do you decide what to do to make your house more energy efficient? There are so many questions, so many possible directions and so many possible answers. How do you get started? How are pre-existing problems addressed? What are your retrofit options? How can the retrofit work be organized to help ensure the best results? It is no wonder homeowners sometimes find themselves unsure of how best to proceed with energy efficiency retrofit projects.

While you can get good advice from qualified contractors, suppliers and other sources of renovation information, it's a good idea to be generally informed about your energy efficiency retrofit options so you are aware of the possibilities and potential obstacles you might encounter. By increasing your understanding of some of the more common energy efficiency retrofit options available, you will be better prepared to sort through all the information you will be offered by renovation contractors. It can also give you a head start in developing a retrofit plan.

To help guide homeowners through energy efficiency retrofits, the following "decision trees" have been prepared. The decision trees were developed to help homeowners decide how best to approach an energy efficiency retrofit while, at the same time, addressing typical pre-existing conditions and avoiding problems in the future that can undermine their retrofit investment. Typical questions a homeowner might have concerning a number of common retrofits are asked and, based on a "yes" or "no" response, further options are provided to help them develop their energy efficiency retrofit strategy.

The decision trees provide a pathway toward aggressive energy saving retrofits, as these are often the most challenging for homeowners to fully understand and plan. For instance, the levels of insulation retrofit often recommended are close to what is required for modern, energy-efficient, new houses. While such retrofits may seem ambitious, it is worthwhile to note that you often have only one chance to cost-effectively make a renovation or retrofit project as energy efficient as it could be. Don't let future energy costs leave you wishing that you had chosen to make your newly renovated house more energy efficient and comfortable.

The decision trees and energy efficiency retrofit options presented were developed based on common approaches to generic retrofits for common house types. To formulate specific retrofit plans for your house, CMHC recommends that you retain the services of a qualified residential energy advisor to undertake an EnerGuide Rating System (ERS) evaluation of your house. ERS evaluations can be obtained from service organizations licensed by Natural Resources Canada. For more information on finding a qualified service organization, visit http://oee.nrcan.gc.ca/residential/personal/home-improvement/service/contact-advisors.cfm.

RETROFIT CATEGORIES

The decision trees are grouped into three retrofit categories:

1. basement, crawl space and slab-on-grade foundation retrofits;

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2. first- and second-storey retrofits (walls, windows and roofs); and
3. mechanical system retrofits (furnaces, water heaters and ventilation systems).

They will not necessarily apply to all houses and all situations and are intended to provide general guidance only. The actual physical characteristics and condition of your house as well as the local availability of products and expertise will affect your actual retrofit decisions. However, by following the decision trees through their various steps, you will be better informed of the various options and considerations for your retrofit project and the ways in which various issues that may arise may be handled.

Basement, crawl space and slab-on-grade foundation retrofits

If you plan on retrofitting your basement, cellar or crawl space, or slab-on-grade foundation, use Decision tree 1, on page 4, to establish which of the following retrofit decision trees best apply to your situation. More than one may apply.

1(a) Basement **floor** retrofits

1(b) Basement **wall** retrofits

1(c) Slab-on-grade foundation retrofits

1(d) Crawl space retrofits

First- and second-storey retrofits

If you plan on retrofitting your walls, windows or roof, use Decision tree 2, on page 9, to establish which of the following retrofit decision trees best apply to your situation. More than one may apply.

2(a) Wall retrofits

2(b) Window retrofits

2(c) Roof retrofits

Mechanical system retrofits

If you plan on upgrading your heating, ventilation or domestic hot water systems, use Decision tree 3, on page 13, to establish which of the following retrofit decision trees best apply to your situation. More than one may apply.

3(a) Space heating system retrofits

3(b) Ground-source heat pump retrofits

3(c) Ventilation system retrofits

3(d) Domestic water heating system retrofits

PRECAUTION

Energy efficiency retrofits can have unintended effects, so before the work is started, the house should be checked for pre-existing problems. This will help anticipate the possible impacts of the retrofit work on indoor air quality, building envelope durability and heating appliance performance, as well as other potential issues.

Pre-existing problems

Often, houses may have pre-existing problems that should be corrected before starting an energy efficiency building envelope retrofit project. These might include moisture problems (high humidity, water leaks, dampness, mold, etc.) in the roof, walls, floors or foundation; indoor air quality problems (stale air, lingering odours, soil gas, pollutant emissions from household products, etc.); or structural sags, cracks and deflections in the walls, floors or ceilings. Undertaking an energy efficiency building envelope retrofit before dealing with the pre-existing problems **may make the problems worse** and may result in the loss of the time and money invested in the retrofit work. A qualified home inspector or a knowledgeable energy advisor can help identify pre-existing problems and develop solutions.

Indoor air quality

Reducing air leaks will reduce the amount of air entering and leaving the house. This may cause the air in the retrofitted house to seem stale and odours to linger longer. Odours from previously unnoticed sources

(such as hobbies, pets or stored items) may become more apparent and more objectionable. Measuring the air leakage of the house with a blower door depressurization test before and after the retrofit work can give an idea of how much the air leakage of the house has been reduced. If the reduction is significant, it may be necessary to add mechanical ventilation (bathroom fans, a range hood, an air exchanger or, better yet, a heat recovery ventilator). When properly designed and installed, mechanical ventilation is more energy efficient and effective than natural air leakage.

Building envelope durability

Adding insulation to exterior walls, basements and attic spaces can lead to moisture-related damage to the building envelope if inside and outside sources of moisture are not controlled. Outside sources of moisture can be controlled by ensuring that the roof properly drains water, that there are adequate roof overhangs to protect the walls and window openings below, that a rainscreen assembly is used on the exterior walls, that eavestroughs catch and drain water away from the foundation, that the foundation is protected from moisture and that the site is properly graded to flow surface water away from the house. Inside sources of moisture can be controlled by ensuring that there is adequate mechanical ventilation (bathroom fans, range hoods, air exchangers or heat recovery ventilators) to remove high interior humidity (for example, from showers or cooking). Installing a vapour retarder (such as a polyethylene sheet or vapour retarding paint) and—more importantly—reducing air leaks will help prevent moisture from moving from the house into attic spaces and exterior walls.

Combustion appliance backdrafting

Reducing air leaks in houses with natural-draft furnaces, water heaters and fireplaces can decrease the air needed for the safe and efficient operation of these appliances. Also, the presence of powerful or numerous exhaust fans in a more airtight house could increase the risk that the appliances will not properly vent combustion gases when an exhaust fan is in operation—a situation known as "backdrafting." Providing adequate combustion air for heating appliances and sufficient make-up air to balance exhaust air systems may be a necessary part of a building envelope insulation retrofit project. The safest solution is to convert combustion appliances to direct-vent units or sealed-combustion units. The backdrafting risk can often be assessed by a qualified energy advisor. Mechanical contractors can be consulted regarding make-up air systems as well as direct-vent and sealed-combustion appliance options for furnaces, hot water tanks, fireplaces, etc.

Heating system performance

An energy efficiency building envelope retrofit will reduce space heating needs and, as a result, the original furnace or boiler may be oversized for the house. Oversized heating equipment may not operate efficiently, as it tends to cycle on and off more frequently. If the furnace (or boiler) is old enough to consider replacing (15 years or older) as a part of the overall retrofit project, a qualified contractor can be consulted to perform a heat loss calculation and determine the right size of the new furnace or boiler based on the reduced heat loss from the house. This will help ensure the heating system runs as efficiently as possible.

Renovation hazards

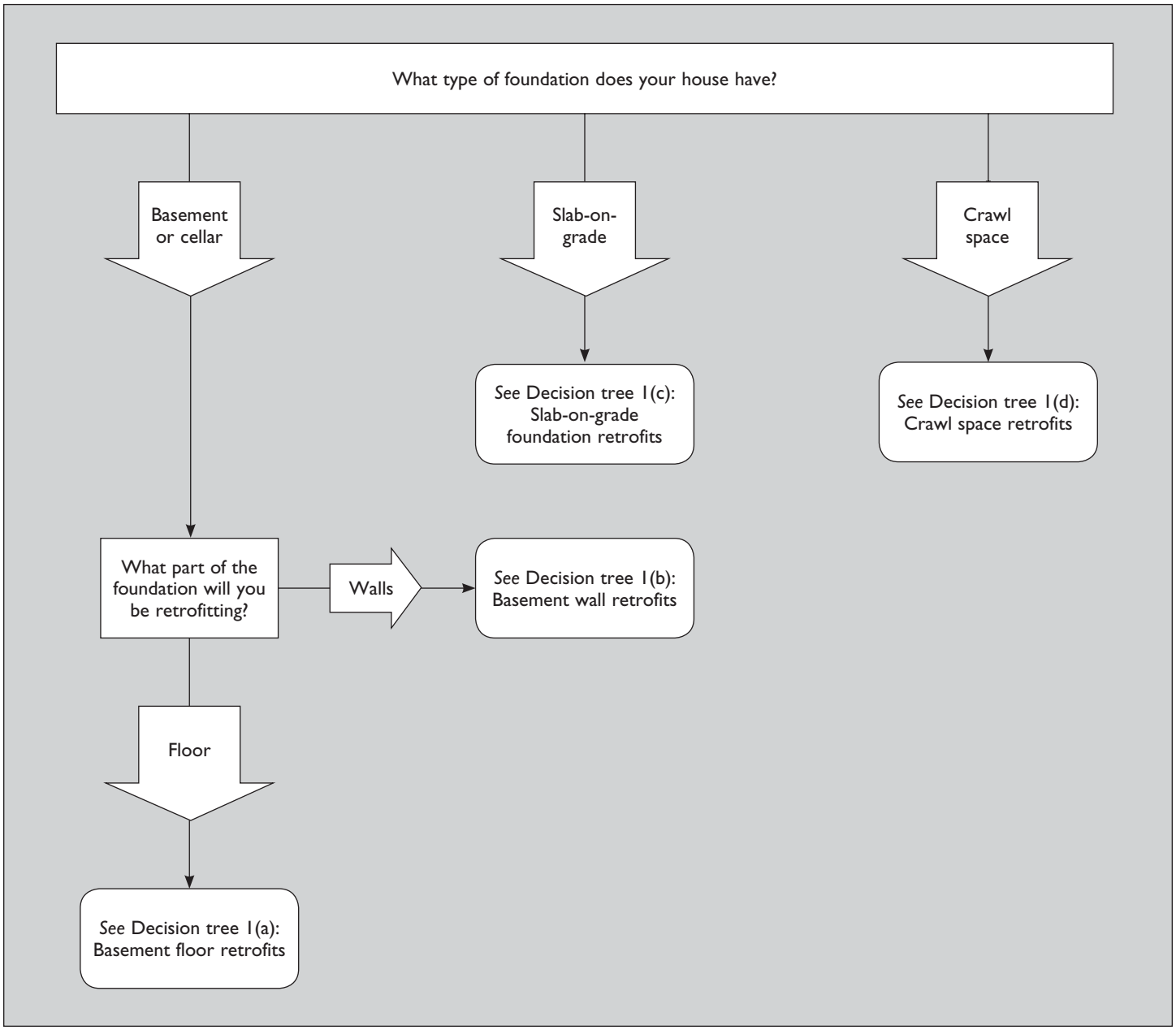
Some interior finishes and materials, especially in older houses, may contain hazardous materials, such as asbestos in insulation and siding, lead in paint, and rodent or bird waste. Some equipment, such as knob and tube wiring, can represent

other hazards. When renovating, take care to protect workers and the home's occupants from hazardous materials. For information on hazardous materials, visit Health Canada's website at http://www.hc-sc.gc.ca/ewh-semt/index-eng.php.

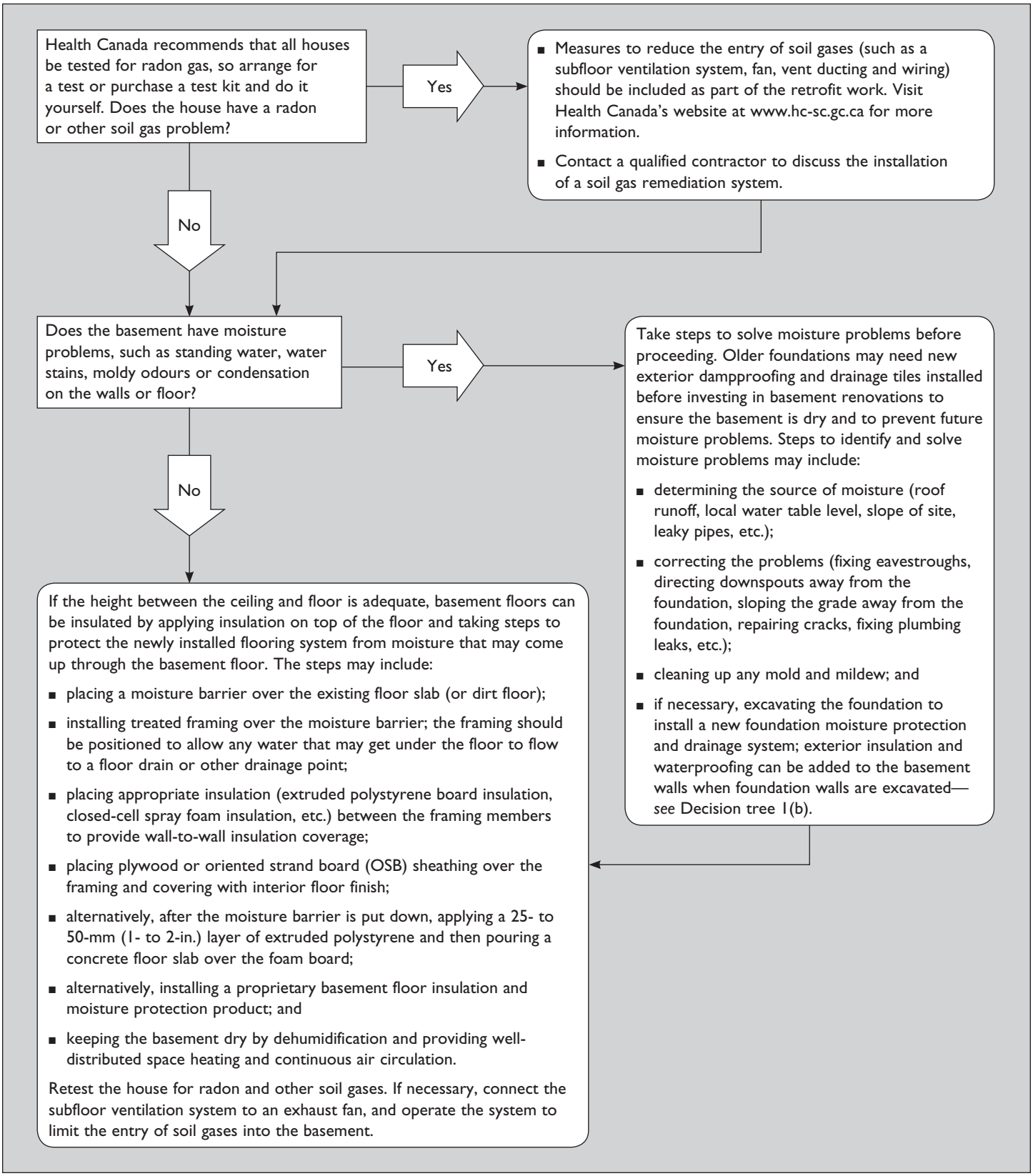
GETTING THE HELP YOU NEED

Consult a qualified energy advisor, building professional, home inspector or contractor before the retrofit to better understand, and plan for, pre-existing conditions and possible unintended effects of the retrofit project. Often, corrective measures can be planned that not only prevent problems but also add value to the overall project. For more information on retrofit and renovation considerations, visit CMHC's website at www.cmhc.ca.

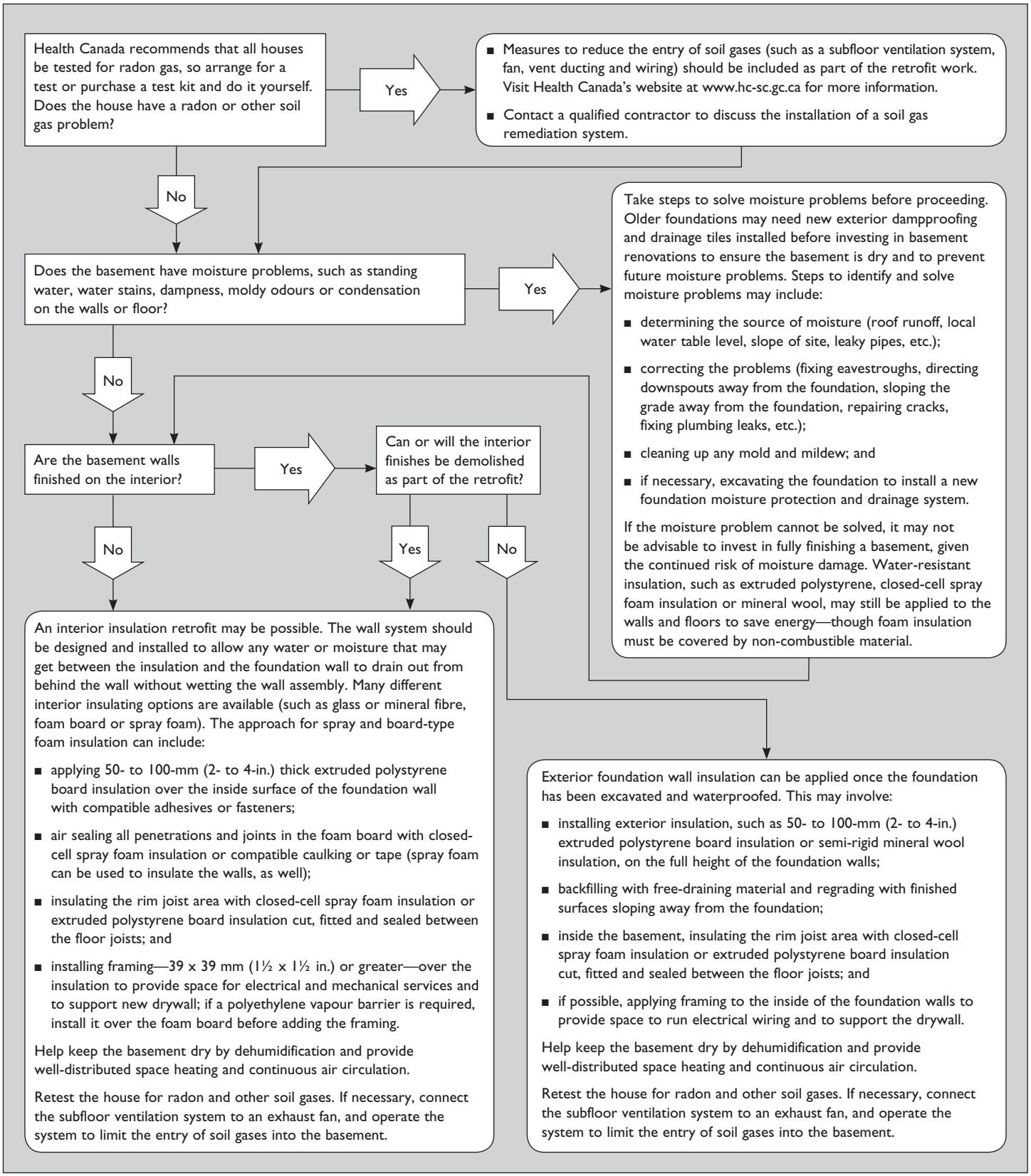
Decision tree 1 Basement, crawl space and slab-on-grade foundation retrofits



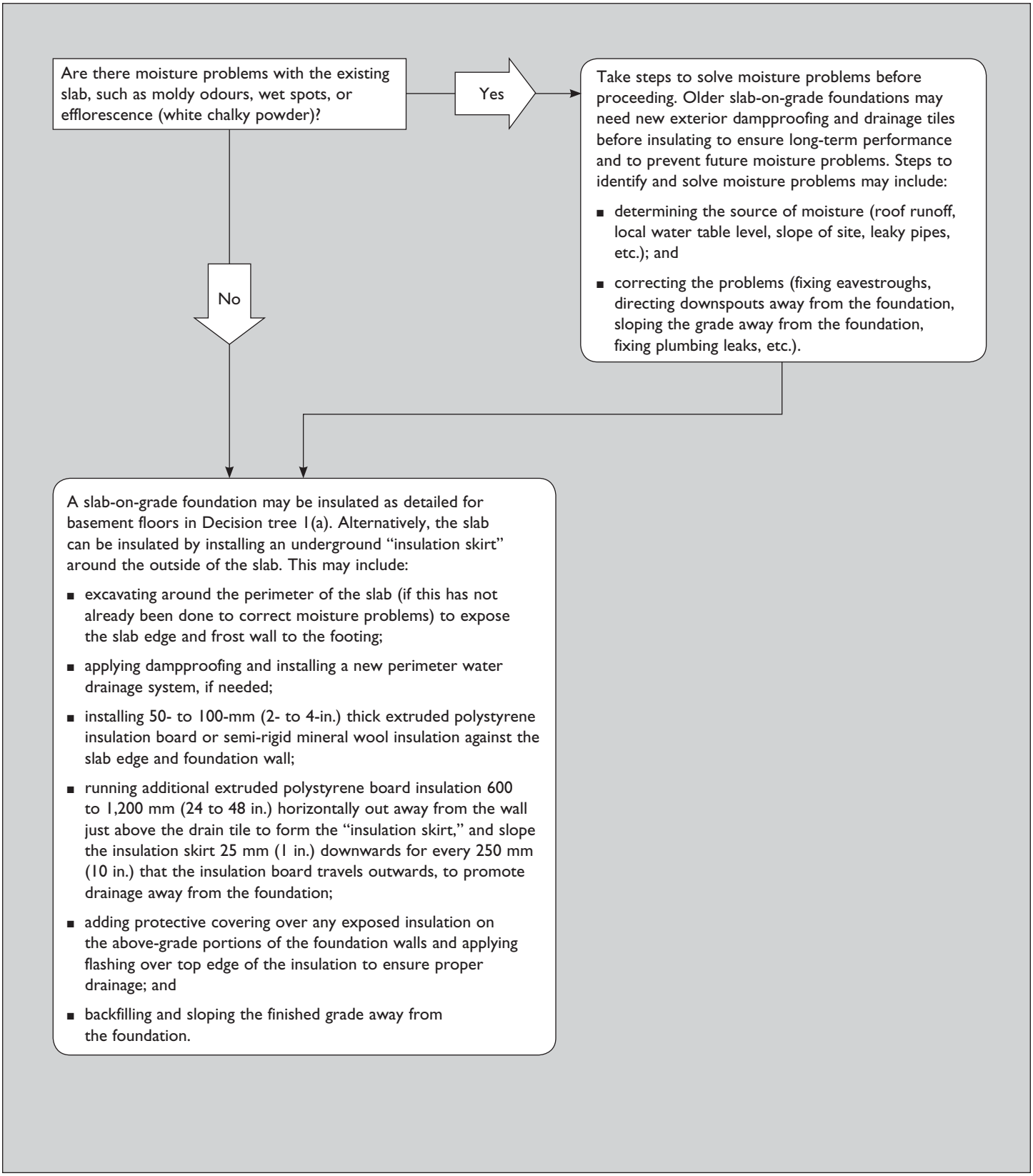
Decision tree 1(a) Basement floor retrofits



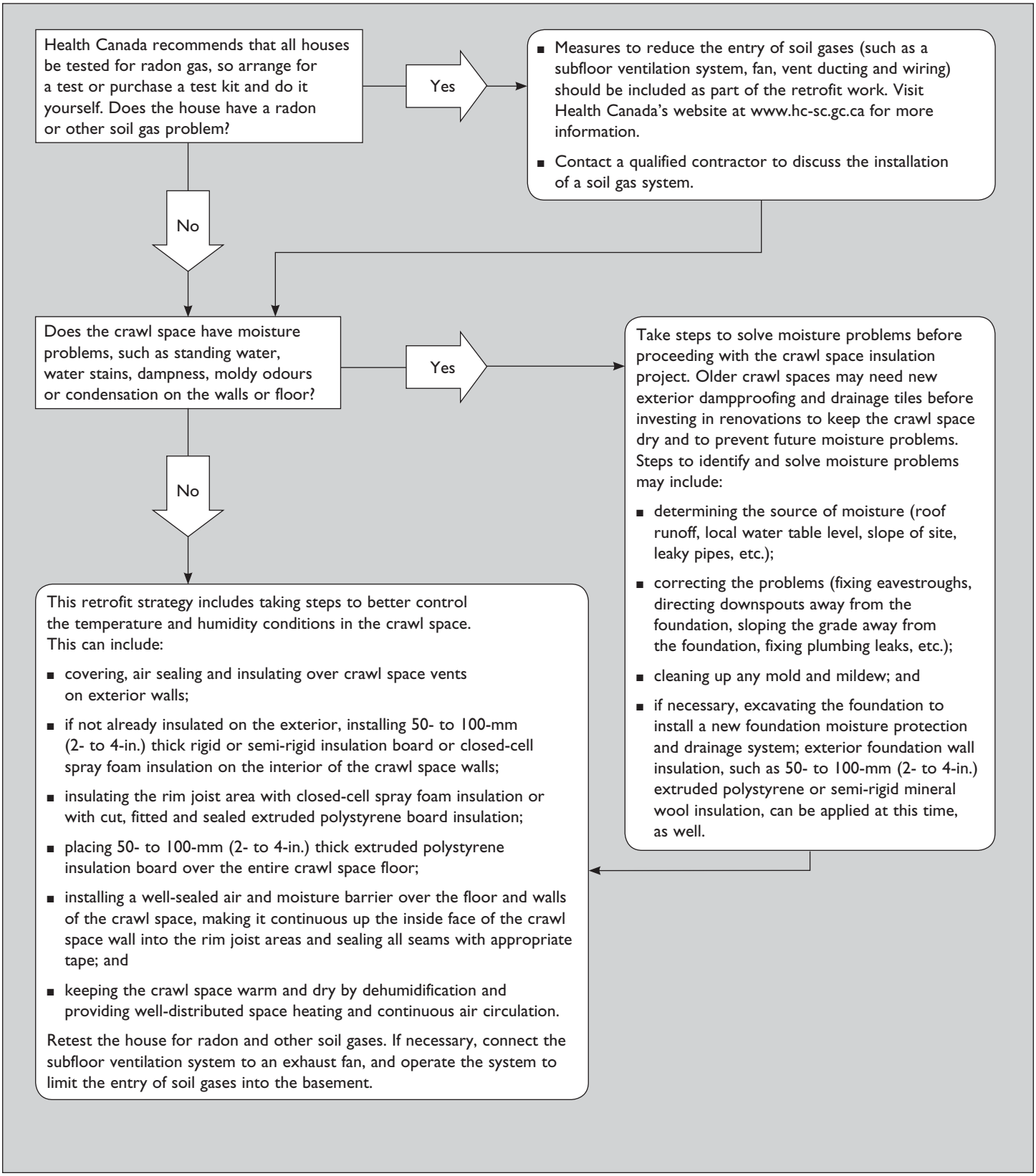
Decision tree 1(b) Basement wall retrofits



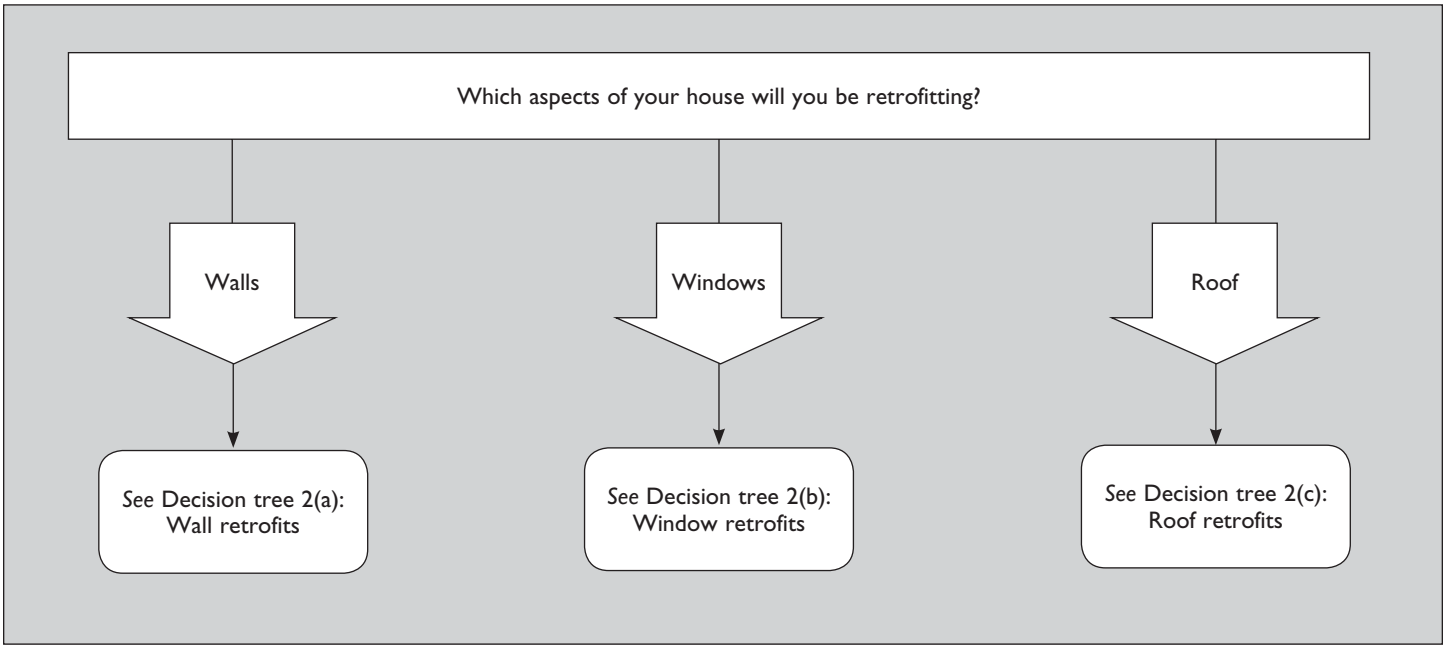
Decision tree 1(c) Slab-on-grade foundation retrofits



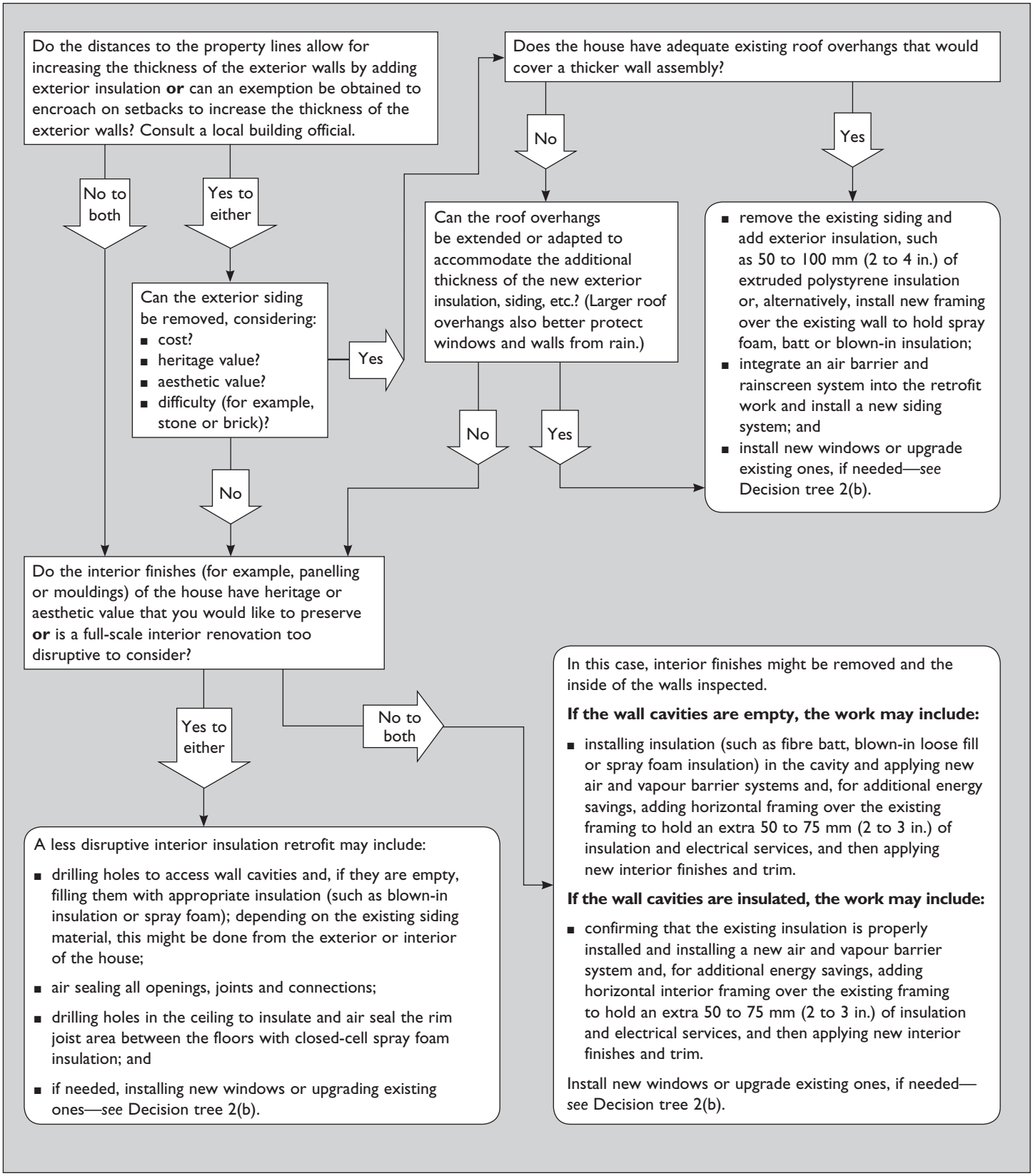
Decision tree 1(d) Crawl space retrofits



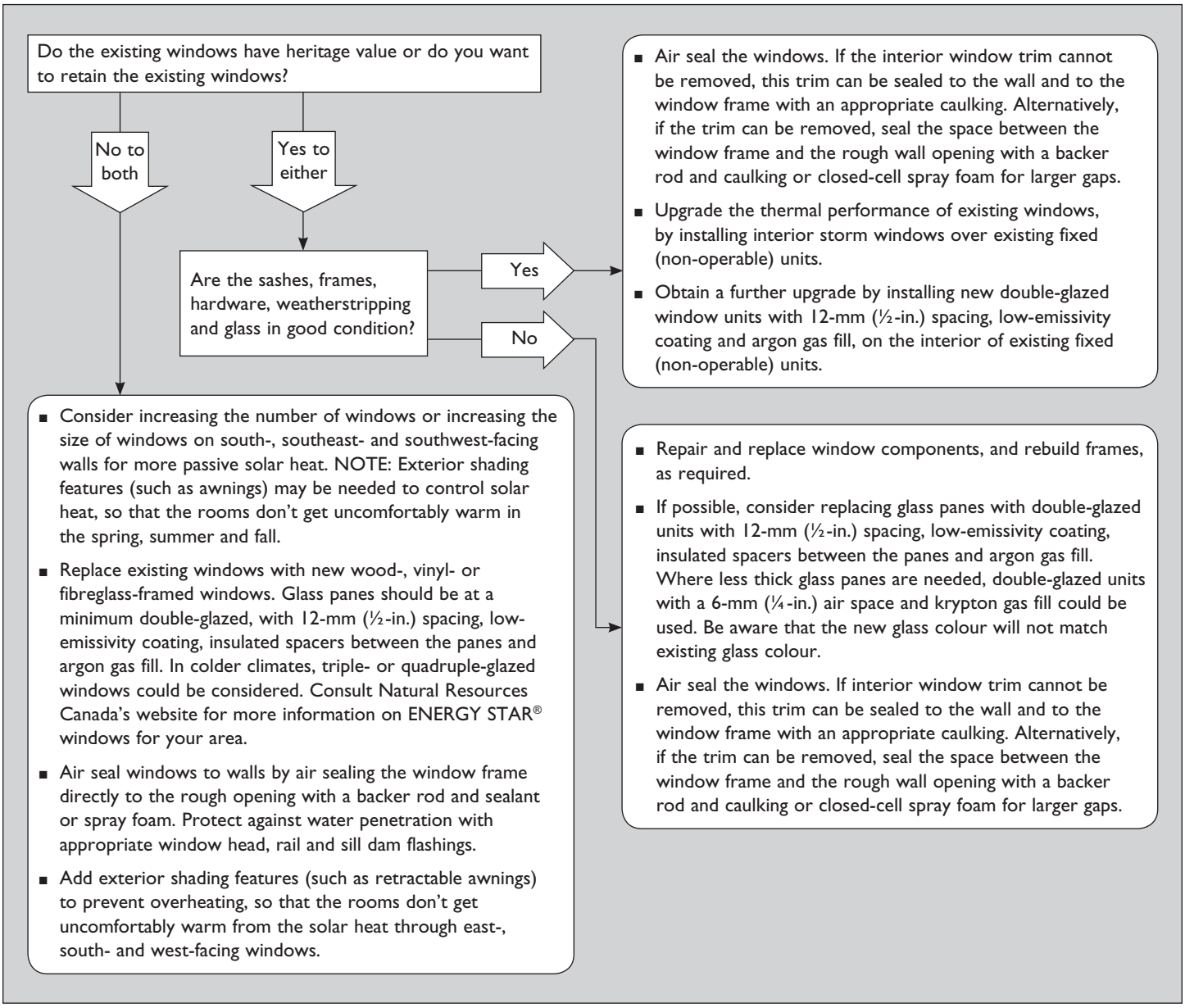
Decision tree 2 First- and second-storey retrofits



Decision tree 2(a) Wall retrofits



Decision tree 2(b) Window retrofits



Decision tree 2(c) Roof retrofits

Do you have the option to change the roof structure and height? Check with your local municipal planning department.

No

Existing attic

- Explore options to remove the existing attic insulation to allow for thorough air sealing between the attic and the house. Be careful to protect any existing air and vapour barrier material located above the ceiling drywall. Do not remove any insulation that is adhered to building paper, unless all existing insulation and air and moisture barrier systems are to be replaced.
- Before adding insulation, make sure to air seal all openings in the attic floor, including around ducts, pipes and wiring, as well as gaps between partition wall top plates and interior wall finishes. Cover bathroom fans with sealed boxes made from rigid polystyrene board insulation caulked to an air and vapour barrier. Replace any recessed pot lights with approved airtight units. Air sealing helps prevent heat loss and moisture transfer between the house and the attic.
- Place insulation dams under the roof sheathing at the exterior walls to ensure that ventilation from soffit areas into the attic space is maintained. Install closed-cell spray foam insulation between the insulation dams and the top of the exterior walls to maximize the insulation in these typically low-clearance areas.
- Insulate the attic by reinstalling the original insulation and adding new batt or blown-in insulation to achieve the desired RSI value. Closed-cell spray foam insulation offers the best insulating, air sealing and vapour retarder system—especially where attic space is limited.
- Insulate the top of the attic hatch with 200 mm (8 in.) of rigid board insulation or add a plywood box to the top of the hatch to contain the batt or blown-in insulation. Ensure that the joint between the attic hatch and the ceiling has a gasket.
- Ensure that the attic ventilation meets code requirements.

If you were not able to obtain desired insulation levels in the attic, you can also consider adding insulation to the underside of the ceiling under the attic, if the height between the floor and the ceiling permits it.

- Apply 50 to 75 mm (2 to 3 in.) of rigid insulation over the existing ceiling finish. Alternatively, install a dropped ceiling and fill the resulting ceiling space with batt, blown-in or spray foam insulation.
- Provide a continuous air and vapour barrier across the entire ceiling beneath the newly installed insulation. Install ceiling gypsum board.

Yes

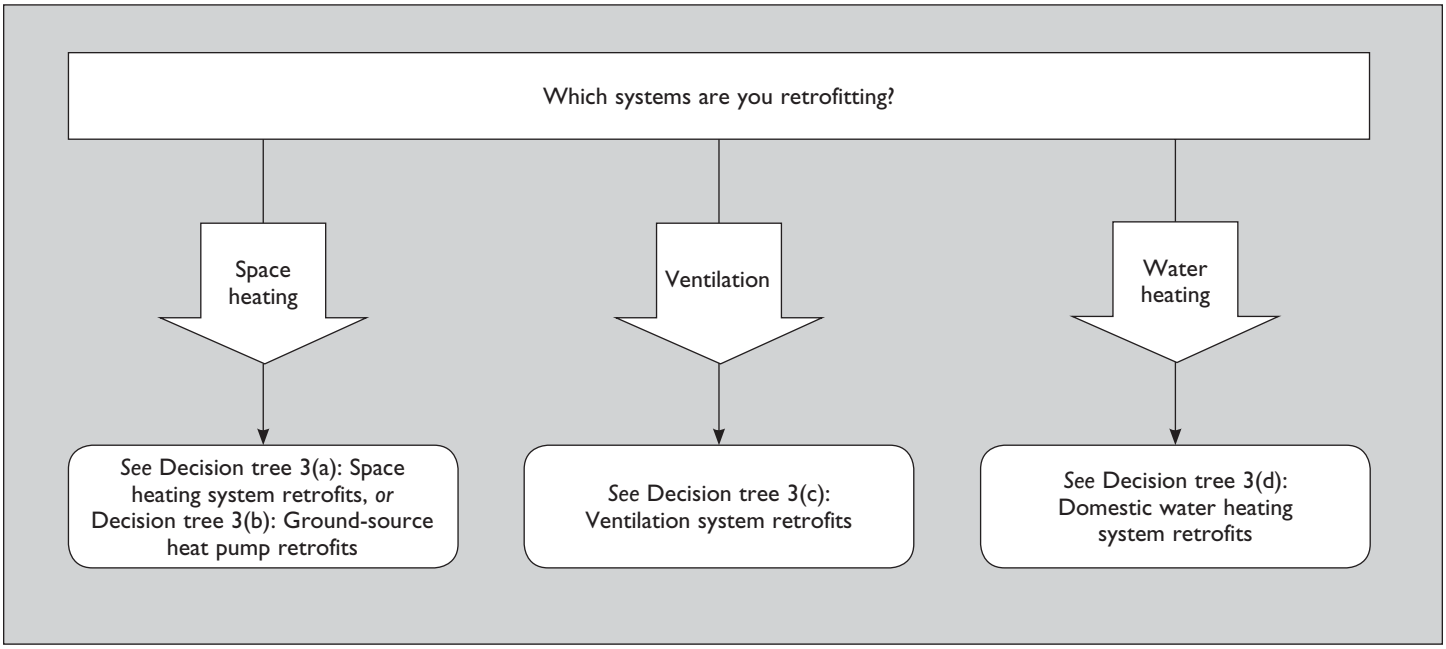
New roof option

- Remove the existing roof to have an opportunity to design and install new rafters or raised heel trusses in order to accommodate full-depth RSI-10.6 to RSI-14 (R-60 to R-80) insulation out to, and over, the exterior wall. Make sure that the new roof system provides an adequate overhang to protect the walls and windows from the rain. Apply air and vapour barriers on the underside of the new trusses, and seal them to the existing exterior wall air barrier system.

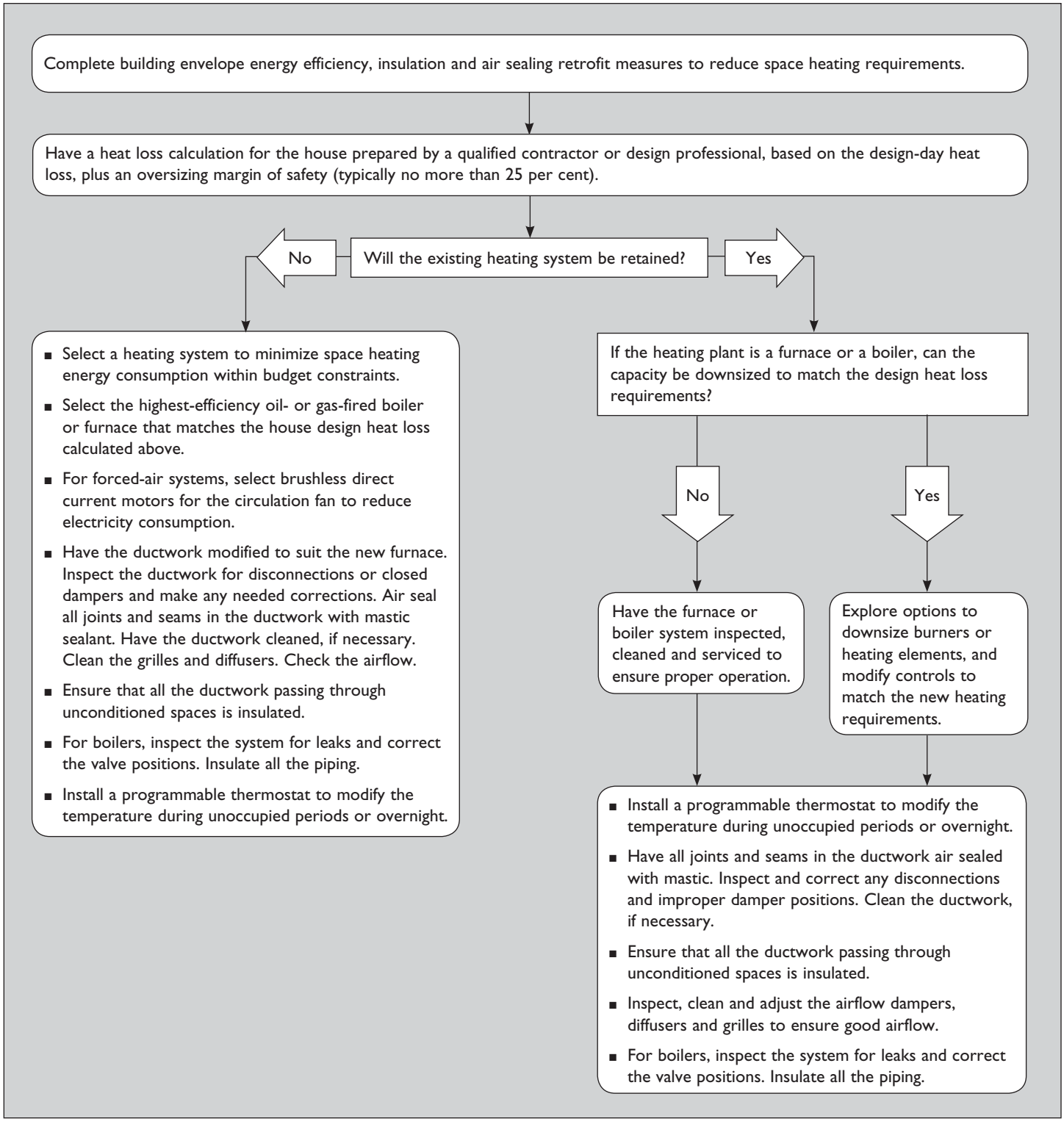
Over-roofing option

- Alternatively, design and install a new roof structure over the existing roof. In this case, remove the existing roofing material (shingles, steel), and install new air and vapour barriers over the old roof sheathing. Connect the roof air barrier to the exterior wall air barrier system to reduce air leakage.
- Then, install parallel cord trusses or rafters over the new air and vapour barrier systems aligned with the existing rafters, fill the spaces between the trusses and rafters with RSI-10.6 to RSI-14 (R-60 to R-80) insulation, leaving adequate space above the insulation for ventilation. Apply new sheathing and cover the sheathing with new roofing material.

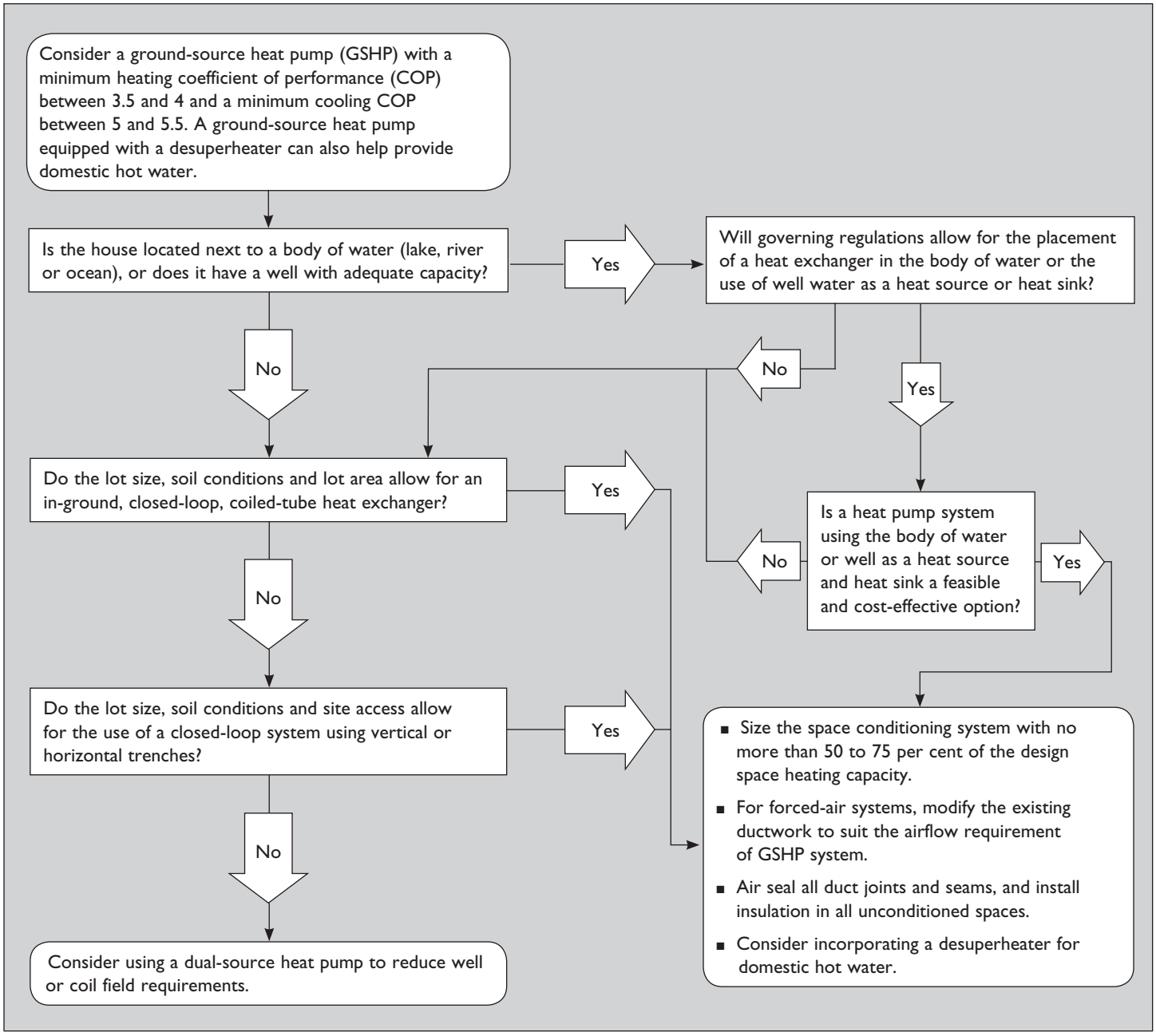
Decision tree 3 Mechanical system retrofits



Decision tree 3(a) Space heating system retrofits



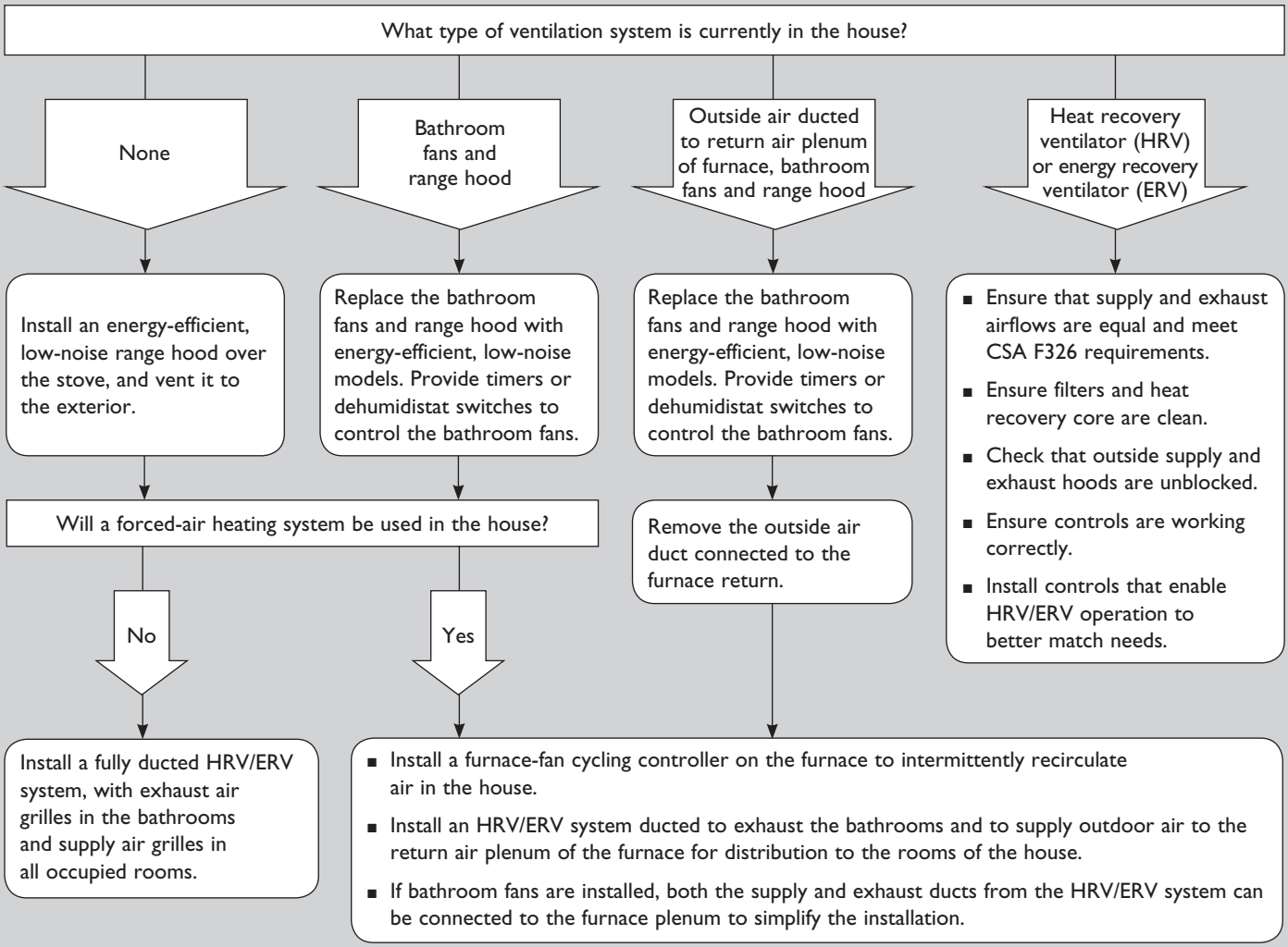
Decision tree 3(b) Ground-source heat pump retrofits



Decision tree 3(c) Ventilation system retrofits

Air sealing or installing a new continuous air barrier system when retrofitting walls, ceilings and foundations is necessary to reduce heat loss, protect the house's structure from moisture accumulation and help keep the house more comfortable. However, air sealing reduces natural ventilation and so must be balanced by the addition of a mechanical ventilation system to help ensure healthy indoor air quality. An airtightness test performed after the completion of the retrofit work can help determine the need for mechanical ventilation.

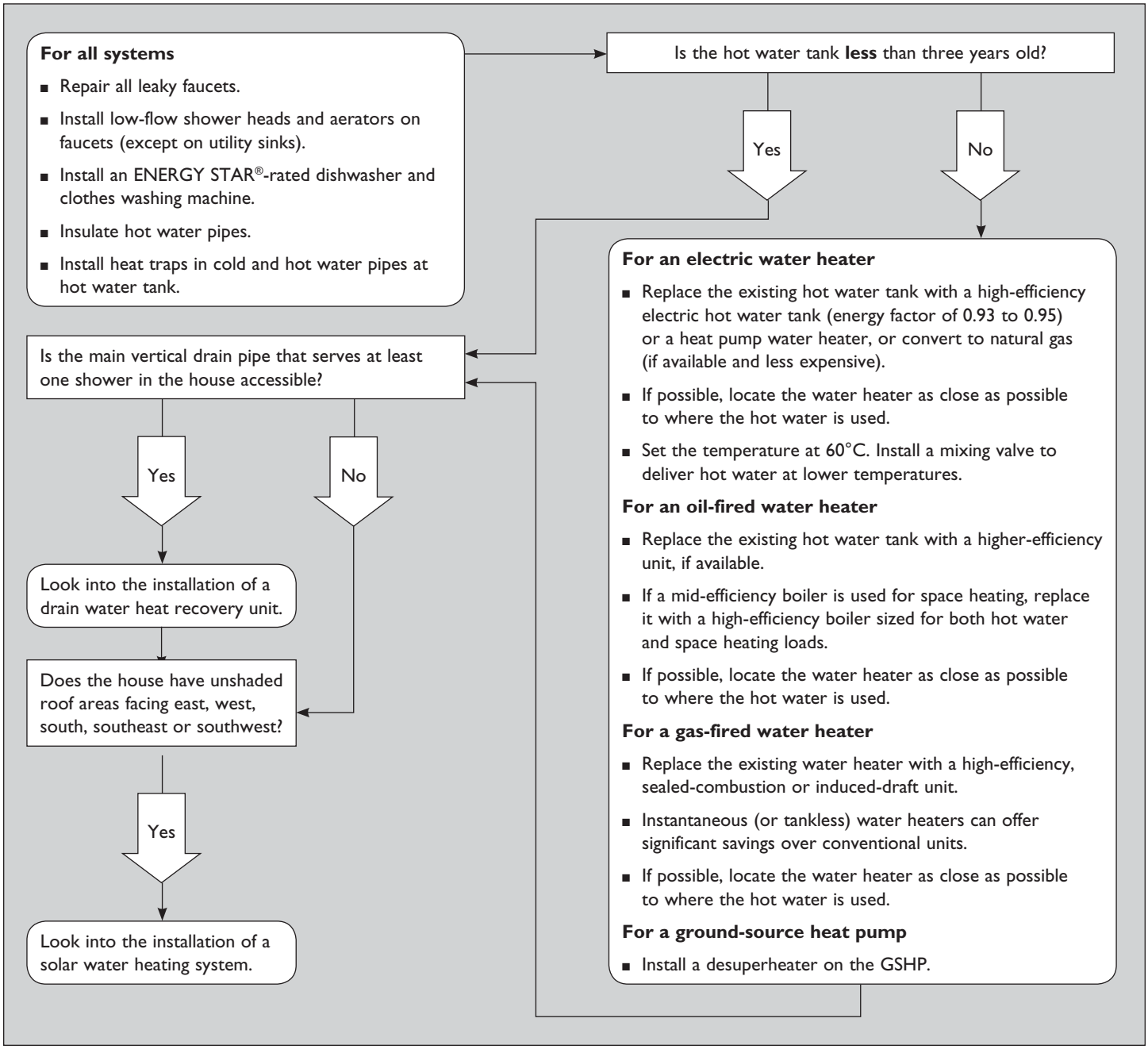
Note: HRV = Heat Recovery Ventilation, ERV = Energy Recovery Ventilation



Energy-efficient HRV/ERV system features

- ENERGY STAR®-certified
- Heat/energy recovery efficiency greater than 70 per cent
- Brushless direct current motors
- Proper design to meet specific ventilation needs of the house
- Centrally located control panel to adjust airflow speed and operating schedule
- Controls in bathrooms to operate HRV/ERV on high speed as needed
- Installation by a trained contractor (certified by the Heating, Refrigeration and Air Conditioning Institute of Canada, for example) in compliance with local codes and regulations

Decision tree 3(d) Domestic water heating system retrofits



ADDITIONAL RESOURCES

For more information about energy-efficient windows, appliances and mechanical systems, contact Natural Resources Canada at 1-800-387-2000 or visit the Office of Energy Efficiency's website at www.oee.nrcan.gc.ca (*see* direct links below).

Office of Energy Efficiency—ENERGY STAR® in Canada
http://oee.nrcan.gc.ca/residential/10759

Office of Energy Efficiency—Keeping the Heat In
http://oee.nrcan.gc.ca/publications/residential/8584

Office of Energy Efficiency—Windows, Doors and Skylights
http://oee.nrcan.gc.ca/equipment/windows-doors/4753

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To find more *About Your House* fact sheets and other housing-related information products, visit our website at www.cmhc.ca. You can also reach us by telephone at 1-800-668-2642 or by fax at 1-800-245-9274.

Free Publications

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