Health Canada Santé Canada

Canada

RADON

ACTION GUIDE

FOR PROVINCES AND TERRITORIES

Health Canada is the federal department responsible for helping the people of Canada maintain and improve their health. Health Canada is committed to improving the lives of all of Canada's people and to making this country's population among the healthiest in the world as measured by longevity, lifestyle and effective use of the public health care system.

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To obtain additional information, please contact:

Health Canada
Address Locator 0900C2
Ottawa, ON K1A 0K9
Tel.: 613-957-2991
Toll free: 1-866-225-0709
Fax: 613-941-5366
TTY: 1-800-465-7735
E-mail: publications@hc-sc.gc.ca

This publication can be made available in alternative formats upon request.

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Health Canada would like to thank Noah Quastel for the development of the original document. Dr. Quastel is a practicing lawyer and member of the Law Society of British Columbia. He also holds a PhD in Human Geography. Dr. Quastel's research spans sustainability, the built environment and radon exposure law and policy

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Summary

Radon is a naturally occurring radioactive gas that emanates from the ground and can enter and accumulate in buildings. Radon gas is found in every building in Canada at some level. Radon exposure is the leading cause of lung cancer after smoking, and accounts for an estimated 16 percent of lung cancer deaths in Canada. Radon risk reduction is easy to address through testing and mitigation. Simple tests involve placing a long-term radon detector in the lowest lived-in level of a building for three months during the fall-winter months. Health Canada estimates that ~7% of homes will have a high radon level; this percentage varies significantly across Canada, as indicated by Health Canada's radon map. There are relatively inexpensive and very effective ways to reduce radon exposure in homes and buildings with high radon levels, i.e., over the Canadian Radon Guideline of 200 Bq/m^3.

This Radon Action Guide provides many steps provinces and territories can take to reduce radon exposure. Radon affects all types of buildings, and radon action affects many different areas of law and policy concerned with the built environment, from real estate transactions to workplace standards. In Canada's federal system, the federal government can create guidelines and technical standards, but the provinces and territories are uniquely situated to make law and policy change. Provinces and territories can become leaders in advancing radon action through individual actions across areas such as education and awareness, supporting community testing, creating databases and maps, and updating worker and tenant protections. This guide describes how provinces and territories can develop more comprehensive radon strategies.

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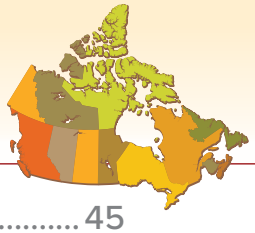

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1. Introduction

Radon gas is a naturally occurring radioactive gas that comes from the breakdown of uranium in the ground. While radon is found in every building in Canada, exposure to higher concentrations has significant health effects. Radon exposure is the leading cause of lung cancer after smoking, and accounts for more than 3,000 lung cancer deaths in Canada.[1] The Government of Canada Radon Guideline is set at 200 Bq/m^3. Remedial measures should be undertaken whenever the average annual radon concentration exceeds the Canadian Guideline in normally occupied areas of buildings.[2] Across Canada an average of 7% of homes have radon concentrations that exceed the Guideline. Radon levels in buildings vary significantly by geography and building characteristics. Surveys have found that in parts of New Brunswick and Manitoba over 40% of homes tested were above the Radon Guideline[3] and in some cities, such as Castlegar, British Columbia and Regina, Saskatchewan over half of homes surveyed have been found above Canada's Radon Guideline of 200 Bq/m^3.[4] Public awareness remains low and a vast majority of Canadian homeowners (>90%) have never tested for radon.[5]

Health Canada has developed guidance on radon testing in homes: Testing ideally involves placing a small detector in the lowest regularly occupied level of the home (basement or main floor) for at least 3 months during the heating season.[6] These do-it-yourself (DIY) long-term test kits are available, typically costing 30 to 60 dollars, from a variety of online suppliers and hardware stores. "Real-time" digital monitors are also available and can give a short snapshot of radon levels, but should be supplemented with 3-month tests. Radon measurement services from Canadian- National Radon Proficiency Program (C-NRPP) certified professionals are also available, at a much higher cost than the DIY test kits. If test results are high, mitigation professionals can install a radon mitigation system that will reduce the radon level. Techniques to lower radon levels are effective and can save lives. A radon mitigation system, which can be installed in less than a day, will reduce the radon level by more than 80% in most homes. The cost is about the same as other common home repairs, such as replacing the furnace or air conditioner.[7] While waiting for mitigation, people can also temporarily open windows on the lowest level of the home or run a well-maintained mechanical ventilation system to dilute with fresh air.[8]

1 Chen, J., Moir, D. and Whyte, J., 2012. "Canadian population risk of radon induced lung cancer: a re-assessment based on the recent cross-Canada radon survey," Radiation Protection Dosimetry 152(1-3), pp. 9-13. For a recent review of the lung cancer risks of radon see United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), 2019. Sources, Effects and Risks of Ionizing Radiation, Annex B: Lung cancer from exposure to radon. Available at https://www.unscear.org/unscear/en/publications/2019.html accessed August 20, 2021.

2 Health Canada, 2009. Government of Canada Radon Guideline. Available at https://www.canada.ca/en/health-canada/services/environmental-workplace-health/radiation/radon/government-canada-radon-guideline.html (accessed August 20, 2021).

3 Health Canada, 2012. Cross Canada Survey of Radon Concentrations in Homes, Final Report. Available at https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/radiation/cross-canada-survey-radon-concentrations-homes-final-report-health-canada-2012.html (accessed August 20, 2021).

4 Rogoza,D., Roberts, H. and Swoveland, B. 2014. Castlegar: Community Wide Radon Testing Results. British Columbia Lung Association. Available at https://bclung.ca/sites/default/files/Castlegar%20Community-Wide%20Testing%20Results.pdf accessed April 21, 2022. Stanley, F.K., Irvine, J. L., Jacques, W.R., Salgia, S.R., Innes, D.G., Winquist, B.D., Torr, D., Brenner, D.R. and Goodarzi, A.A., 2019. "Radon exposure is rising steadily within the modern North American residential environment, and is increasingly uniform across seasons," Scientific Reports 9(1), pp. 1-17.

5 See Statistics Canada, 2017. Knowledge of radon and testing. Table: 38-10-0086-01.

6 See Health Canada, 2017. Guide for Radon Measurements in Residential Dwellings (Homes). Available at https://www.canada.ca/en/health-canada/services/publications/health-risks-safety/guide-radon-measurements-residential-dwellings.html (accessed August 20, 2021); Take Action on Radon, 2021. Testing for Radon. Available at https://takeactiononradon.ca/test/ accessed August 20, 2021.

7 Health Canada, 2018. Residential Radon Mitigation Actions Follow-Up Study: Public Summary. Available at https://www.canada.ca/en/health-canada/services/publications/health-risks-safety/residential-radon-mitigation-actions-follow-up-study.html (accessed August 20, 2021).

8 Take Action on Radon, 2021. Protect Yourself from Radon. Available at https://takeactiononradon.ca/protect/. Accessed August 20, 2021.

There are good reasons for provinces and territories to take action on radon. Canadians look to their governments to help them reduce risks and lead healthier, safer lives. Radon is one of a number of emergent indoor air quality concerns which lead to a focus on indoor environmental health. Radon is included in Health Canada's Residential Indoor Air Quality Guidelines. Radon mitigation is a relatively inexpensive exercise, and well-designed government radon strategies can be a cost-effective way to save lives.[9]

Health Canada's National Radon Program (NRP) has taken a number of steps to ensure radon is taken seriously in Canada. It reduced the Canadian Radon Guideline from 800 to 200 Bq/m^3 in 2007. Health Canada leads an extensive public education program and has conducted surveys[10] and health research.[11] The NRP has developed and validated technical guidance to ensure clear standards for how radon is measured and mitigated.[12] The NRP works with the Canadian National Radon Proficiency Program (C-NRPP) to ensure Canadians have access to accredited radon services and resources to help test and reduce indoor radon exposure. However, in Canada's federal system, provinces and territories have jurisdiction over buildings, public health, and air quality. Provincial and territorial action is needed to ensure radon is fully addressed. Provincial governments need to ensure radon is addressed by provincial public health agencies, and incorporated into relevant laws regulating the indoor environment. Most radon exposure occurs in homes,[13] making building codes, new home warranty programs, rental homes and real estate transactions especially important areas for change. Workplaces, schools, and care facilities are also important places to reach.

This Radon Action Guide will help guide provincial and territorial governments in developing programs to address radon. It describes broader radon planning and strategy development. It also includes interventions such as developing public outreach and testing programs, and rules for real estate transactions or residential tenancies law that can be taken on individually or form parts of a broader plan. This guide also includes an Appendix with examples and specific guidance that will help provinces in formulating policies and regulatory change.

9 Gaskin, J., Coyle, D., Whyte, J., Birkett, N. and Krewksi, D., 2019. "A cost effectiveness analysis of interventions to reduce residential radon exposure in Canada", Journal of Environmental Management 247, pp. 449-461. For a broader introduction to health economics analysis of radon, see World Health Organization, 2009. WHO Handbook on Indoor Radon: A Public Health Perspective. Geneva, Chapter 4, Cost Effectiveness of Radon Control. Available at https://apps.who.int/iris/bitstream/handle/10665/44149/9789241547673_eng.pdf (accessed August 20, 2021).

10 Health Canada, 2012. Cross Canada Survey of Radon Concentrations in Homes, Final Report. Available at https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/radiation/cross-canada-survey-radon-concentrations-homes-final-report-health-canada-2012.html.

11 Chen, J., Moir, D. and Whyte, J., 2012. "Canadian population risk of radon induced lung cancer: a re-assessment based on the recent cross-Canada radon survey," Radiation Protection Dosimetry 152(1-3), pp.-13. Chen, J., 2013. "Canadian lung cancer relative risk from radon exposure for short periods in childhood compared to a lifetime," International Journal of Environmental Research and Public Health 10(5), pp. 1916-1926. Chen, J., Bergman, L., Falcomer, R. and Whyte, J., 2015. "Results of simultaneous radon and thoron measurements in 33 metropolitan areas of Canada," Radiation Protection Dosimetry 163(2), pp. 210-216. Chen, J. 2019. "Risk Assessment for Radon Exposure in Various Indoor Environments," Radiation Protection Dosimetry 185 (2), pp. 143–150.

12 Health Canada, 2008. Guide for Radon Measurements in Residential Dwellings (Homes). Available at https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/radiation/guide-radon-measurements-residential-dwellings-homes.html (accessed August 20, 2021). Health Canada, 2014. Radon—reduction guide for Canadians. Available at https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/radiation/radon-reduction-guide-canadians-health-canada-2013.html (accessed August 20, 2021). Health Canada, 2014. Reducing Radon Levels in Existing Homes: A Canadian Guide for Professional Contractors. Health Canada, 2016. Guide for Radon Measurements in Public Buildings Workplaces, Schools, Day Cares, Hospitals, Care Facilities, Correctional Centres. Available online at https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/radiation/guide-radon-measurements-public-buildings-schools-hospitals-care-facilities-detention-centres.html (accessed August 20, 2021).

13 Chen, J., 2019. "Risk assessment for radon exposure in various indoor environments," Radiation Protection Dosimetry 185(2), pp. 143-150.

This Radon Action Guide builds on comparative research that considers existing actions across Canada, as well as internationally, especially in the United States and European Union.[14] Many US states have specific radon legislation,[15] and in the European Union the Basic Safety Standards Directive requires member states to engage in radon planning, resulting in many country-level legal changes.[16]

Health Canada, C-NRPP and other Canadian organizations have produced extensive guides on testing and mitigation (see Appendix, section 4.1). As companions to the Radon Action Guide, the National Radon Program has also produced:

- **Justifications and Policy Rationales for Radon Action:** This document provides more detail on why governments should take action, discussing societal values around public health, saving lives, and environmental concern. It outlines how radon action is cost-effective in the long term and reduces the costs that lung cancer imposes on the health care system. It discusses initiatives already in place for which radon action is a natural extension, from Disease Prevention Strategies to Healthy Community Planning.
- **Radon Action Guide for Municipalities:** This details a series of steps that municipalities can take.
- **Radon Action in Municipal Law: Understanding the Legal Powers of Cities and Towns in Canada:** Recognizing that municipalities are "creatures of the provinces" and constrained by enabling law, this document looks at the powers that municipalities have to address radon.

14 Quastel, N., Siersbaek, M., Cooper, K. and Nicol A-M. 2018. Environmental Scan of Radon Law and Policy: Best Practices in Canada and the European Union. Toronto and Burnaby: Canadian Environmental Law Association and CAREX Canada. Available at https://cela.ca/wp-content/uploads/2019/07/Radon-Policy-Scan-Full-Rept-with-Appendices_0.pdf (accessed August 20, 2021).

15 For US laws, see Environmental Law Institute, 2019. Database of State Indoor Air Quality Laws. Database Excerpt: Radon Laws. Available at https://www.eli.org/sites/default/files/docs/2019_radon_with_cover_bolded.pdf (accessed August 20 2021).

16 European Union Basic Safety Standards Directive. 96/29/Euratom. Available at http://www.ensreg.eu/nuclear-safety-regulation/eu-instruments/Basic-Safety-Standards-Directive (accessed August 20, 2021).

2. Planning for Radon

2.1 Introduction to Radon Planning & Strategies

All buildings have some level of radon in them; the only way to know how much is to test. Addressing radon requires ensuring measures across many different areas, from workplace standards to residential tenancies to schools and more. This guide includes many measures that provinces and territories can take as discrete actions or bundled together. Governments can start with small steps such as public awareness campaigns while comfort around the issue grows. Governments could also take a more visionary approach and develop a radon plan, which has an overarching aim to systematically address the issue and outlines a range of interventions to achieve that goal. This can ensure a consistent, integrated, and comprehensive approach. By way of example, the European Union's Basic Safety Standards Directive requires member states to prepare action plans. Appendix, section 1 further expands on the Directive, shows important components of radon planning and how member states such as the United Kingdom have followed it for their own National Radon Plan.[17]

There are important components and general areas of concern that an action plan should address.

Surveillance: A province or territory needs to know where elevated radon is prevalent, and how many homes, workplaces, and other indoor environments have high radon.

Guidelines: A province or territory can look to the Government of Canada's Radon Guideline (200 Bq/m^3) as the standard for what counts as unacceptable levels of radon. This will help drive programs for education and awareness, and a system of policy, incentives, and laws for reducing radon in different types of built environments.

Reduction Strategies: Many places (with radon policies) have distinct laws covering different aspects of the built environment. These include specific interventions covering new buildings, older owner-occupied homes (and real estate transactions), workplaces, schools, daycares, and other public spaces.

In a federal system such as Canada's, different aspects of radon planning will fall under the jurisdiction of different orders of government. Health Canada's National Radon Program has taken important steps to begin testing, set a Radon Guideline, developed standards and protocols for testing and mitigation, and developed a framework for radon professionals. However, in Canada, the federal division of powers results in significant gaps that fall on provinces and territories to fill. As this guide discusses, there are many steps remaining for provinces and territories, ranging from learning how much radon there is at the community level, and clarifying (and making into law) guidelines for workplaces and public buildings, to developing policy frameworks for reducing radon in the indoor built environment. Section 1 of the Appendix shows important components of radon planning based on international precedent, and how each order of government in Canada has important roles in the process.

17 Basic Safety Standards Directive 2013/59/EURATOM Council Directive of 5 December 2013, s. 103.1, together with Annex XVIII. Available at http://www.ensreg.eu/nuclear-safety-regulation/eu-instruments/Basic-Safety-Standards-Directive (accessed August 20, 2021).

2.2 Adopt Guiding Principles, Goals, and Indicators

Cohesive plans require guiding principles. Health Canada's National Radon Program's overarching goal is the reduction of radon-induced lung cancer. Provinces and territories are encouraged to set a similar goal in the development of their Radon Action plans. Other values are also important, such as health equity and ensuring everyone has access to guidance and resources to maintain and improve good health. When worked into radon planning, health equity can mean adopting policies ensuring lower income homeowners can get subsidies or incentives to remove cost barriers for testing and mitigation. Further steps could include special protections for renters and workers who lack the ability to impose standards in their living and workplaces.

Good planning should build in indicators and targets that are specific, measurable, achievable, and give clear timelines. This will allow policy-makers and the general public to be focused on success and transparently assess the results.[18] For instance, a goal of "reducing the number of homes in the province with elevated radon by half within 10 years" is specific, clear, and measurable and will more directly drive action compared to a vague promise of future reductions.

It is also important to build a process of learning and evaluation into the Radon Action plan to evaluate what is going right or wrong, learn of unintended consequences, and ensure continuous improvement. Provinces and territories should consider building monitoring and evaluation of programs into the radon policy and planning process. For instance, many provinces have already made changes to their building codes and this could be evaluated with studies to assess whether builders are complying with new building code provisions.

2.3 Linkages to Other Frameworks, Strategies & Plans

Radon action can be incorporated into broader government policies. For instance, some provinces have chronic disease prevention strategies, which often already address lung cancer. Provinces such as Alberta, Manitoba, Ontario, and Newfoundland have dedicated cancer plans which could be extended to include radon action.

A recent focus of city planning has been "Healthy Built Environment" and/or "Healthy Communities Strategies" which promote healthier lifestyles, often including the issue of unhealthy indoor air. These could be extended to include radon action. Ontario's Health Standards target natural and built environments, including indoor pollutants, and in 2018 were updated to particularly mention radon. Ontario also gives specific direction to health boards to work with municipalities to promote healthy built and natural environments to enhance population health and mitigate environmental health risks. This direction in Ontario has already stimulated a number of health units to take on radon-specific work, including health promotion and coordinated testing programs.

Appendix, section 2 includes examples that provide language that could be added to chronic disease prevention strategies, cancer plans, Healthy Built Environment initiatives and Public Health Standards.

The **Justifications and Policy Rationales for Radon Action** document goes into more detail about existing health and environmental strategies in which radon can be included.

18 Boyd, D. 2016, Cleaner, greener, healthier: a prescription for stronger Canadian environmental laws and policies. Vancouver: UBC Press, p. 227.

2.4 Collaboration, Partnerships, Engagement

Collaboration, consultation, and partnership are important components of policy development and can help to garner public and political support for new initiatives.[19]

Provincial level radon planning should include outreach and consultation between government departments, municipalities, health authorities as well as relevant professional associations, diverse civil society actors, including lung, cancer and other health-related associations, environmental organizations, renters' advocates, and others.

Health Boards and Authorities

As previously noted, radon action can be made an important component of Health Standards and directions given to health boards and authorities. Even without legislative or policy change, provincial and territorial radon planners can work with health boards and authorities to develop and execute a Radon Action Plan. Health boards and authorities will be key players in radon action, given they hold personnel trained in public health and preventive health interventions. Health boards/authorities currently have legal authority to advance radon action, investigate complaints (such as by renters), impose conditions on workplaces (such as through health officers in schools), attach conditions to licensing (such as for daycares), and conduct community testing and other initiatives.

Municipalities

Municipalities can play an important role in addressing radon. Municipalities can, for instance, launch their own community testing or incentive programs for testing and mitigation. Municipalities can also help foster coordination between various local authorities such as school boards, libraries and health authorities/boards, each of which can take steps to address radon. Municipalities are the feet on the ground and have a significant role in implementation—ensuring that particular buildings are in fact free of elevated radon levels. Municipalities are responsible for building inspection, health bylaws, standards of maintenance bylaws, bylaws governing public spaces, and business licensing—all important for ensuring low radon in rental accommodations, and places to which the public has regular access.

Provinces and territories can help municipalities with radon action. Provinces and territories can also make clear that radon action is supported by municipal legislation. For instance, municipalities may have broad powers to enact public health bylaws, but when anti-smoking bylaws were being introduced, most provinces clarified municipal law legislation to make it clear that municipalities had the legal power to do so. For examples and model language on supporting legislation and provincial approval procedures, see Appendix, section 3.

Provinces can also develop model bylaws, provide planning guidance, and direct staff to liaise with municipalities and help with coordination. This guide discusses working with municipalities to ensure building code provisions are implemented and inspected (Section 3.5 and Appendix, section 8.1), and model standards of maintenance bylaws that provincial and territorial governments can promote (Section 3.7, and Appendix, section 10).

Provincial and territorial governments with an interest in supporting Municipal Radon Action Plans can refer to **Radon Action in Municipal Law: Understanding the Legal Powers of Cities and Towns in Canada** and **Radon Action Guide for Municipalities.**

19 De Savigny, D. and Adam, T. eds., 2009. Systems thinking for health systems strengthening. World Health Organization. p. 82.

2.5 Finding a Home for Radon Programs

Radon requires a "Whole of Society" approach in the sense that it requires action across many areas of law, policy, and governmental organization that touch on the built environment.[20] This means that any one agency may face significant barriers to solving the problem if left on its own. For instance, public health ministries are an obvious place to lead a Radon Action Plan—and there are important precedents where health officers have interpreted Public Health legislation to take action on radon in Alberta[21] and BC.[22] In Ontario the Public Health Standards have triggered important local level testing initiatives and public outreach.[23] However, if radon is treated as the exclusive domain of public health officers, they may find they have no legislative mandate to make important changes, such as might be required to protect renters, update building codes, or ensure elevated radon is covered by home warranty programs.

More comprehensive radon planning can help ensure issues are not siloed and create intergovernmental cooperation. Governments should consider a single agency for administering the Radon Action Plan, that will guide the policy process, program implementation, and develop systems that foster interaction, flows of information, and cooperation between provincial government departments and agencies and key partners, such as municipalities and organizations representing important sectors (including radon professionals, device manufacturers, landlords, tenants, employers, and health organizations). Another approach is to form a Radon Working Group—a multi-stakeholder task force that brings together radon stakeholders including, as appropriate, staff from relevant provincial/territorial ministries and agencies, federal government representatives, non-governmental organizations, and other stakeholder organizations.[24]

20 Kickbusch, I. and Behrendt, T., 2013. Implementing a Health 2020 vision: governance for health in the 21st century. Making it happen. World Health Organization. Regional Office for Europe. Addy, N.A., Poirier, A., Blouin, C., Drager, N. and Dubé, L., 2014. Whole-of-Society approach for public health policymaking: a case study of polycentric governance from Quebec, Canada. Annals of the New York Academy of Sciences 1331(1), pp. 216-229.

21 See Public Health Act, RSA 2000, c. P-37 s. 59 to 61, and the Nuisance and General Sanitation Regulation, Alta Reg 243/2003, using "Nuisance" defined as "a condition that is or that might become injurious or dangerous to the public health, or that might hinder in any manner the prevention or suppression of disease" (Public Health Act, s. 1(ee)). This is further discussed in Quastel et al., ibid. at p. 86.

22 Using the Community Care and Assisted Living Act, S.B.C. 2002, c. 75 which empowers medical health officers to attach terms and conditions to a license (s. 11) and to revoke licenses if there is a risk to persons in the care of such facilities (s. 14). For further discussion see Phipps, E., Nicol, A.M., Giesbrecht, D., Cooper, K., Baytalan, G. and Bush, K., 2017. Call for action on radon in child care settings. Environmental Health Review 60(3), pp. 77-81. Quastel, et. al., ibid. at p. 93

23 See Take Action on Radon, 2020. Ontario. Available at https://takeactiononradon.ca/ontario/ (accessed August 20, 2021).

24 As reported to authors as Nova Scotia practice by John Drage, Senior Geologist/Hydrogeologist, Geoscience & Mines Branch, Department of Lands and Forestry, Nova Scotia.

3. Radon Reduction Actions

The following are distinct actions that provinces can take, either as standalone interventions or as part of a broader Radon Action Plan. References are made to sections in the appendix that provide resources and tools, such as examples from other jurisdictions, communication materials, and model Code language.

3.1 Testing, Databases, and Mapping

Importance of Widespread Testing

Health Canada stresses that all homes have some level of radon and should be tested. As detailed in Appendix, section 4.1, there is now considerable guidance for the general public and radon professionals for how to test and mitigate. Because radon levels vary significantly by location, identifying high radon areas is important for targeting policy interventions. In British Columbia, radon provisions in the BC Building Code, 2018 are directed at municipalities where there are clear indicators (including from surveys and testing initiatives) that there are radon problems.[25] In Ontario, the building code radon provisions apply where "radon gases are known to be a problem".[26] Many initiatives, such as public education, outreach efforts, and subsidies for testing and mitigation will be more efficient and effective if targeted at high radon risk areas.

Health Canada's 2012 Cross-Canada Survey of Radon Concentrations in Homes was an important first step. However, due to the budget and logistics of surveying all of Canada, it has a limited sample size of approximately 100 results per health region.

There are a variety of testing initiatives across the country, including testing of government-owned buildings at the federal level, public buildings such as schools, and community testing of homes. For example, the Evict Radon program in Alberta, and the Take Action on Radon program, which enrolls municipalities in the "100 Test Kit Challenge." However, most parts of Canada still do not have sufficient numbers of test results.

Building Awareness, Community Testing and Citizen Science

To date, many agencies in Canada have started programs to hand out test kits free of charge or on a subsidized basis (see Appendix, section 4.2 – 4.4). It is important to distinguish different types of programs and rationales.

- Some initiatives are primarily oriented towards building awareness. They seek to both build awareness of radon and help individuals test. Take Action on Radon's "100 Test Kit Challenge" is a good example of this.
- Community testing initiatives are oriented towards learning radon prevalence in the community. Here, researchers estimate an appropriate sample size to allow sufficiently precise estimates for a municipality or region. For example, in the communities of Thunder Bay, Windsor-Essex, and Kingston, Frontenac, and Lennox & Addington in Ontario, hundreds of test results per area were completed to help support policy changes related to building codes and public health standards.

25 BC Building Code, Division B Section 9.13.4, together with Division B Appendix C, Table C-4.
26 Ontario Building Code 2012, as amended, 9.13.4.2, and Supplementary Standard SB- 9.

- In citizen science projects, individual home occupants are asked to test their homes in exchange for allowing researchers to collect radon readings and survey data. Results are typically held in university or health agency databases and are used to provide evidence-based reporting and guidance to the target area (for a list of initiatives, see Appendix, section 4.4).
- There are a variety of programs providing digital radon monitors in public libraries. Patrons are able to to check them out (akin to book loans) and conduct a radon test at home**.** Currently there are radon library lending programs in Nova Scotia, PEI, Alberta, British Columbia, and Ontario (see Appendix, section 4.5 for more detail). These programs can help people with limited funds, or who want an initial introduction to radon. These programs should be considered a screening test only with a primary goal of raising awareness about radon. Health Canada recommends a long-term test (3+ months) during the heating season be conducted in addition to the use of a digital radon monitor. These programs can help people understand radon and can motivate them to conduct long-term tests. Provinces and territories can support municipalities to work with libraries, supporting lending programs or the distribution of long-term test kits to patrons/community members. Health Canada, in collaboration with provincial lung associations and radon experts, has developed a Radon Library Lending Program Guide to provide libraries across the country with support, education, and useful resources to run an effective and successful radon monitor lending program.

In practice, these different testing approaches are compatible and can be combined in a single program. For instance, a community testing initiative can also have a significant public awareness component, and also collect survey data to be shared with researchers.

Databases and Maps

Data collection is important to support the development and implementation of Radon Action plans. A radon database can help build understanding of how radon intersects with local health conditions (such as prevalence of smoking), the links between geological radon and risks in homes, or whether some people have a greater genetic susceptibility to radiation-related illness. Creating a radon map or other visual resource can be an effective way of communicating risk and supporting policy action. For instance, knowledge of local radon risks in the real estate industry can serve to put buyers, sellers, and realtors on alert that radon may be a latent defect in houses for sale. Health Canada's radon data is available at https://open.canada.ca/en.

The government of Nova Scotia and a private sector company (Radon Environmental Management Corp.) have produced maps by using underlying geological and soil information.[27] However, radon concentrations also depend on building structure and design, and collecting indoor tests is also an important way to estimate local radon risks. Health Canada has developed a radon risk map utilizing Nova Scotia and Radon Environmental Management Corp.'s survey data, data from the Cross-Canada Radon Survey (2011), the Radon/Thoron Survey in Canadian Metropolitan Areas (2013), data from radon laboratories, and national geological data. For a list of examples of radon testing approaches and programs, databases and mapping, see Appendix, section 4.5.

In creating maps and databases, efforts can be made to collect test data from diverse sources, such as results of community testing initiatives, government testing of its own buildings, academic research, citizen science projects, and from health associations who have sold or distributed radon test kits. This can require careful attention to obtaining consent and coordinating survey questions to allow for data to be combined. To help with coordination and share knowledge on the technical details of

27 Nova Scotia Department of Natural Resources. Radon Risk Map for Nova Scotia. Available at https://fletcher.novascotia.ca/DNRViewer/?viewer=Radon (accessed August 20, 2021). Radon Environmental Management Corp. 2012. Radon Potential Map for Canada. Available at https://canadaradon.com/UploadedFiles/files/RadonPotentialCanadaOverlay.pdf (accessed April 21, 2022).

database and mapping, database managers, researchers and mappers across Canada have formed the Canadian Radon Database and Mapping Working Group. In developing maps and databases, provinces and territories should consider consulting with members of this group or other experts in radon mapping and database management.

Collection and Reporting of Test Results

There are possibilities for ensuring that whenever buildings are tested for radon, the results are placed into databases. The Canadian government has compiled radon tests of its own buildings, and provincial governments could require that any in-house testing initiatives make public the results. This Guide discusses certification of radon professionals in Section 3.3. Once radon professionals are certified there can be further requirements that any radon test results obtained be shared with government agencies. For a list of jurisdictions (and regulations) that require reporting of test results, see Appendix, section 6.2. A provincial or territorial government could couple the creation of databases with requirements for radon professionals and testing laboratories to contribute to it.

3.2 Education and Awareness

A key component of addressing radon is ensuring that people know that it is a health risk and have the tools to act to remedy it. Many countries and sub-national governments around the world have radon education programs.

While diverse agencies such as municipalities, health authorities, centres for disease control, and government agencies may have information on web pages, it is helpful to have a centralized Provincial/Territorial information portal which can be kept up to date. This helps people navigate the problem of many different and conflicting information sources through the provision of reliable, government-endorsed, and up-to-date public health information (Appendix, section 5).

Along with web resources, other communication and outreach techniques should be used to effectively reach the target audiences, such as radio, television, social media, print media, public meetings and webinars. It is also important to ensure awareness efforts extend to diverse unilingual language users in your communities who may be more receptive to information presented in a language other than English or French.[28] Appendix, section 5 provides access to Health Canada and Take Action on Radon outreach and communication resources.

Resolutions

Educational programs can be strengthened by broad resolutions, such as a legislature recognizing November as Radon Action Month in Canada. Health Canada's 2019 proclamation is a good example. Appendix, section 5.2 provides information and examples of such resolutions.

Empower Health Authorities

An empowered public health administration will play a key role in advancing radon action. Many health authorities have the legal power to offer education on radon but individual officials may lack a clear mandate. One way to improve the situation is to follow the lead of the Ontario Public Health Standards which establish action on radon as a minimum expectation by the province for its boards of health (Appendix, section 5).

28 Statistics Canada, 2011. Linguistic Characteristics of Canadians. Catalogue no. 98-314-X2011001.

Target At-Risk Audiences

Some agencies have found ways of particularly targeting persons at high risk of radon. For instance, where homes with exceptionally high radon levels are found, Public Health England provides additional individual practical support to the householders that can include on-site visits, individual advice, assistance in remediating, and periodic radon monitoring.[29]

Community Testing and Citizen-Science Approaches to Engagement

These can create more active ways of engaging publics in radon. As mentioned earlier, testing initiatives can help people learn about radon, but also contribute to community level knowledge and science on the topic.[30] For further resources on awareness, citizen science and community testing see Appendix, section 4 on testing, databases, and mapping.

Tap into Existing Duties

Many people have direct responsibilities relevant to reducing radon. Landlords, employers, school districts, and others in charge of indoor spaces already have broad obligations to meet health and safety requirements. What is needed from provincial and territorial authorities is to raise awareness about radon and communicate how radon fits into those obligations. For instance, real estate licensees generally have duties to be knowledgeable about environmental conditions and to take the appropriate steps to alert their clients of known health or environmental concerns. Several real estate councils and associations in Canada have been able to significantly advance radon awareness and action through notifying real estate professionals about the ways that their existing duties extend to radon. (See Section 3.6 below and Appendix, section 9 for further discussion on real estate agents' duties around radon.)

Offer Training to Trades and Professional Groups

A variety of occupational and professional groups do not know enough about radon. Municipal building inspectors, building tradespeople and contractors, family doctors, pharmacists and others would be better equipped and more likely to correctly address radon in their work given the correct capacity-building. Section 5.5 of the Appendix lists known radon courses for professionals.

Guidance and Protocols on Testing and Mitigation

Health Canada and the Canadian General Standards Board have already developed many guidance documents on best practices for testing and mitigating different types of buildings. For examples, see Section 4.1 of the Appendix. Provinces and territories can reference these materials to help guide the general public and professionals who work with radon.

Add Radon to Educational Curriculum

Provinces and territories have an excellent opportunity to ensure students learn about the importance of indoor air quality issues and radiation. Educating children and youth helps spread the message to parents and families and helps ensures that in the future the issues are understood through the population.

29 UK Radon Action Plan (2018), s. 3.1.6 p. 11.

30 McKinley, Duncan C., et al. «Citizen science can improve conservation science, natural resource management, and environmental protection,» Biological Conservation 208 (2017), pp. 15-28.

Support Outreach with Stronger Action

Governments can send the message that an issue is important through having clear policy and law change. This includes many tools discussed in this guide, such as incentives and subsidies for testing and mitigation, and a host of regulatory and legislative changes. Section 5.6 of the Appendix discusses jurisdictions with legal requirements around radon education.

3.3 Recognizing Certified Radon Professionals

Radon measurement in larger buildings, and installing radon reduction systems in any building, can require specialized knowledge. In some cases, such as real estate transactions, parties engaged in arms-length transactions require a reliable third party to provide an assessment. As such, qualified radon professionals are an important part of a societal response to the radon problem.

Licensing and Certification of Professionals

Health Canada recommends radon mitigation and measurement professionals certified through the Canadian National Radon Proficiency Program (C-NRPP). However, certification remains voluntary. While Canadian provinces have jurisdiction for regulating professions, none have acted on this for radon professionals. However, many areas such as plumbing, massage therapists etc. do require certification. Consumers may be faced with advertisements and offers for radon abatement from unqualified providers. Consumers who do not know the details of radon may be drawn to providers who offer services at a low cost, creating a danger that substandard work could drive out better qualified providers and become normalized. Licensing and certification can thus ensure high standards and guarantee quality to consumers. Appendix, section 6 provides model language on regulating radon professionals and gives examples of jurisdictions where this has been done.

Ensuring Professional Standards

In Canada, C-NRPP oversees professional education and training, and imposes its own duties on members, set by the C-NRPP Policy Advisory Board. This includes following guidance documents from the Canadian General Standards Board, Health Canada, the Canadian Association of Radon Scientists and Technologists and C-NRPP's own internal documents.[31] As well, C-NRPP has a system for approving radon measurement devices[32] and analytical laboratories.[33]

In regulating radon professionals, provinces and territories should consider requiring C-NRPP certification as the appropriate standard.

Professional Contribution to Radon Databases and Maps

Another advantage of certified professionals is they can be directed to contribute testing results to centralized databases. C-NRPP certified professionals already do this in Canada on a voluntary basis and so help produce C-NRPP's radon map. Twelve US states mandate not only that radon service providers be certified but that they deliver test results to state agencies (Appendix, section 6.2).[34]

31 C-NRPP 2021. Resources for Professionals. Available at https://c-nrpp.ca/resources-for-certified-professionals/ (accessed August 20, 2021).
32 See C-NRPP. 2021. Listed Radon Measurement Devices. Available at https://c-nrpp.ca/approved-radon-measurement-devices/ (accessed January 2021).
33 C-NRPP's process for certifying laboratories is found on this page: https://c-nrpp.ca/how-to-become-certified/ (accessed August 20, 2021).
34 c.f. New Jersey Statutes Title 7, Chapter 28, Subchapters 27. Available at https://www.nj.gov/dep/rpp/radon/download/sub27.pdf accessed August 20, 2021; also Environmental Law Institute 2012, ibid. at p. 6.

Ensuring Services Are Available

Service provision in Canada has been primarily through the private sector. However, governments can have a role, at times, in supporting a still-developing industry. In some locations, there may be a relative absence of C-NRPP professionals, in part because there is not yet customer demand. This creates a potential vicious circle, as consumers who need the services have trouble accessing them. Some provinces have, in the past, taken the approach of directly subsidizing trades workers to take C-NRPP certification (various types of construction, electrical, plumbing, or engineering occupations are obvious entry points).[35] Provinces should also consider regular monitoring of the industry to ensure services are available to consumers.

3.4 Government Buildings and Operations

Governments have broad duties to ensure spaces are safe, whether as employers, landlords (in relation to social housing), or "occupiers." A government might also choose to construct its own buildings to higher standards as a way of acting ethically, leading by example, or to help support local environmental industries. Government testing can also be a way to build databases and maps.

The federal government has conducted extensive testing of federally occupied buildings, and some provinces have also tested their buildings. Some US states have enacted specific legislation requiring testing in government buildings. (Canadian and US examples are provided in Appendix, section 7).

Where widespread mandatory certification of radon professionals is not yet in place, provinces and territories should consider requiring C-NRPP certified professionals be used for any radon work in government owned buildings.

3.5 Reducing Radon in New Homes

Building Codes

New construction is an excellent place to implement radon provisions, given that building codes are often updated, this is an area where health and safety standards are widely accepted, and targeting new construction is particularly cost-effective. There are radon provisions in the (model) National Building Code (with the radon provisions last updated in 2010), and many provinces have incorporated some radon provisions in their Code (Appendix, section 8.1). The National Radon Program continues to work with Codes Canada and the National Research Council to encourage improvements in the radon provisions in the National Building Code. Provinces and territories without radon provisions, or with older iterations of radon standards, should consider updating their Codes.

35 Authors' discussion with Dr. Menn Biagtan, British Columbia Lung Association and participant in the RadonAware program.

To unpack the variety of codes in Canada, it may be useful to analyze different radon reduction strategies, ranging from the most rudimentary to the most effective.

- **Soil gas barriers:** This involves placing a membrane between the slab and the ground below. This remains one option that builders might use in Ontario.[36] **Soil gas barriers are not considered an effective stand-alone radon reduction strategy**.
- **Radon rough-in with stub:** This involves the sealing of radon (and other soil gas) entry points, granular material below the slab, and a radon rough-in "stub"—a short vent pipe which rises from the floor and is capped. This was added to Canada's National Building Code in 2010 and has been adopted into several provincial and territorial building codes. There is a significant risk that high radon environments remain untested and unmitigated. Current best practices require more complete systems.
- **Passive sub-slab depressurization:** This involves a pipe installed through the foundation that runs upwards through the inside of the building and vents to the outside at the roofline. British Columbia's Building Code started with the rough-in stub (following the National Building Code) but after studies showed problems with implementation,[37] moved to a modified form of passive depressurization system in radon risk areas. While often effective at reducing radon, these systems can not be relied on to reduce high radon concentrations to below the guideline level. Homes with these systems should still have the radon level tested.
- **Active sub-slab depressurization:** This involves adding a fan to passive sub-slab depressurization systems to further increase the reduction of radon. Québec's Building Code now requires the radon rough in with stub, with the additional need for radon test results to be submitted to the authority having jurisdiction (generally municipal building officials) and the addition of sub-slab depressurization sufficient to reduce levels to within Health Canada's Guidelines.[38]

Health Canada recommends that all provinces and territories incorporate radon reduction into their building codes. The Canadian General Standard Board's 2019 "Radon control options for new construction in low-rise residential buildings" is the recognized mitigation standard in Canada and should be referenced in building codes. The standard provides detailed technical prescriptions for radon mitigation strategies.

There are significant benefits to targeting radon prone areas and requiring new homes to have operational systems (i.e., at least a passive sub-slab system), ensuring that homes are built with less radon in them and reducing the incidence of radon-induced lung cancer in higher risk regions.

If building codes continue to require forms of 'rough-ins' that are incomplete, provinces and territories should consider requiring clear labelling on these systems stating that they are incomplete. Radon levels in a home will normally not be known until after occupancy, and further radon testing is required by homeowners once they occupy the home. Provinces and territories can consider requiring builders to leave radon test kits and informational guides with new home-owners.

36 Ontario Building Code, s. 9.13.4.2. and MMAH Supplementary Standard SB-9, "Requirements for Soil Gas Control."

37 See Rogoza, D. et al. 2015. A Comparison of Three Radon Systems in British Columbia Homes: Conclusions and Recommendations for the British Columbia Building Code. BC Lung Association. Available at https://bclung.ca/sites/default/files/Castlegar%20Community-Wide%20Testing%20Results.pdf (accessed April 21, 2022).

38 chapter B-1.1, r. 2, Construction Code, s. 9.13.4.6. available at http://legisquebec.gouv.qc.ca/en/pdf/cr/B-1.1,%20R.%202.pdf accessed March 4, 2021

In updating building codes, provinces and territories should also consider important procedures. It is a good idea to require C-NRPP certified professionals be involved in designing, overseeing, and building radon systems in new construction. Any installed radon systems should be labeled. Post-construction testing is necessary to ascertain whether systems have actually reduced radon levels. As well, building codes need to be followed, and provinces should include educational outreach for builders to ensure proper implementation. Provinces should consider research and follow-up surveys to determine the impacts of their building code changes on radon levels in homes and other buildings.[39]

Inspections

A building code is only as good as its implementation. Radon mitigation is often overlooked in whole or in part during post-construction inspections, due to lack of resources, lack of understanding of radon issues, and lack of clarity regarding who is responsible for inspecting radon mitigation systems.[40] Building code legislation should include requirements for education and technical assistance in administering new standards.[41]

Canadian provinces generally delegate building code enforcement to municipalities, either by direct requirement[42] or matter of course.[43] Municipalities may also face liability for negligent inspection.[44] Education and training for inspectors concerning radon will therefore be a key component of provincial collaboration with municipalities.

New Home Warranty

Many real estate associations and councils in Canada now treat elevated radon as a latent defect in home sales. This same idea can extend to new homes. Most Canadian provinces have New Home Warranty systems in place which provide for protection from defects in structure, materials, and workmanship. Tarion (Ontario's provider) explicitly recognizes high radon as a defect and provides direction to home buyers on how to address the issue with builders (see Appendix, Section 8.2, for examples of radon reduction policies for new homes).[45] Tarion's policies apply even where the Ontario Building Code radon provisions are not enforced.

Provinces should give explicit direction to make sure that high radon is understood to be a defect in structure or materials in a home. Provinces can consider recommending or requiring that home builders provide information to new homeowners about the risks of radon and the importance of conducting a long-term radon test after moving in. Radon information should also be included in applicable guidance documents, such as Construction Performance Guides for warranty-approved builders and continuing education requirements for building contractors.

39 Arvela H. et al., 2012. "Radon prevention in new construction in Finland: a nationwide sample survey in 2009," Radiation Protection Dosimetry 148, 4, pp. 465-474. Manitoba Home Builders Association 2014. Radon Demonstration: Application of Building Code Changes in Winnipeg New Home Construction (accessed December 1, 2020). Fabio Barazza et al., 2018. A national survey on radon remediation in Switzerland, Journal of Radiological Protection 38, pp. 25-33.

40 Quastel et. al. 2018 ibid. at p. 37.

41 Environmental Law Institute, 2012, ibid. at p. 28.

42 See Saskatchewan The Uniform Building and Accessibility Standards Act, SS 1983-84, c U-1.2 s. 4 Manitoba. The Buildings and Mobile Homes Act, CCSM c B93 s.4; Ontario, Building Code Act, 1992, SO 1992, c 23 s. 3; New Brunswick Building Code Act, SNB 2009, c N-3.5, s. 4(1), and 6(1); Building Codes Act, RSPEI 1988, c B-5.1 s. 8(3); Nova Scotia, Building Code Act, RSNS 1989, c 46, s. 5.

43 British Columbia, Community Charter 8 (3)(l) and s. 54, Alberta Safety Codes Act, RSA 2000, c S-1, s. 26; Yukon Building Standards Act, RSY 2002, c 19 s. 4 ; Nunavut, Building Code Act, SNu 2012, c 15 s. 21(3).

44 Rothfield v. Manolakos [1989] 2 S.C.R. 1259; Just v. British Columbia, 1989 CanLII 16 (SCC), [1989] 2 SCR 1228; Ingles v. Tutkaluk Construction Ltd., 2000 SCC 12 (CanLII), [2000] 1 S.C.R. 298.

45 Tarion, 2021. Radon and Your Warranty. Available at https://www.tarion.com/homeowners/your-warranty-coverage/radon-and-your-warranty (accessed August 20, 2021).

3.6 Reducing Radon in Owner-Occupied Homes

While building code changes can be an important way to address radon, only 1 to 2% of the housing stock is newly built each year. There are, however, a suite of interventions that can help reach the existing housing stock.

Real Estate Transactions

Radon should be considered a consumer protection issue for buyers and sellers of homes. There is already significant action in Canada related to addressing radon in the real estate process. Quebec courts have stated that radon could be considered a latent defect.[46] Common law courts would likely make the same finding. A significant number of real estate associations and regulatory councils across Canada have concluded that radon is a latent defect in a home, meaning that sellers have a duty to disclose to buyers known elevated radon levels. In the United States some states have passed laws that enshrine the same principles.[47]

Typically, governance of real estate transactions is a complex mix of government legislation, independent regulatory oversight, and industry self-governance. In some cases, provincial radon planning may proceed through a process of education, coordination, and cooperation with industry and independent regulators. Existing experience in Canada suggests both associations and regulators have shown willingness to act, when informed. That said, radon planning should not lose sight of the ability of provincial governments to introduce new legislation and use this power in negotiating with associations and regulators. Key pieces to consider implementing include:

- **Clarification of agents' duties**. These include proactively discussing radon with their clients (whether sellers or buyers), raising the issue in negotiations, and disclosing known high radon levels as a latent defect. Appendix, section 9.1 on policies for radon reduction in existing homes includes details on the work of Canadian provincial level real estate councils and associations in issuing guidance to buyers, sellers and real estate agents.
- **Radon on the Property Disclosure Statement**, including known radon levels, whether there has been a long-term (91-day) test, the date of any testing, and any mitigation performed. Appendix 9.1 provides some examples of Canadian provinces where radon is specifically mentioned in disclosure forms for real estate transactions.
- **Mandating information for home buyers**, such as having sellers give standard forms, typically produced by public health agencies, to buyers (Appendix 9.1). Some US states require such statements, including Delaware, Florida, Iowa, Illinois, Kansas, Minnesota, Montana, and New Hampshire.[48] An alternative approach might be to work with trade associations/regulators to streamline information that realtors give to clients as part of their own professional duties
- **Requiring testing and mitigation prior to sale**. This is common practice in the United States, but relies on short term (typically 2 day) radon tests. Health Canada does not recommend short term testing because radon levels fluctuate over time and short term tests can give false positive or negative results. Imposing a 91-day testing period (plus time to arrange for mitigation) would represent a significant delay for some sellers. However, doing it is an excellent opportunity to drive wide scale reduction in lung cancer risks and can work together with broader public interest housing and real estate regulation. One option is to have a testing and mitigation requirement as the default position, but allow sellers to be exempt if there is a holdback

46 Quebec Civil Code, art. 1726; Pouliot c. Leblanc 2011 QCCQ 7882.

47 2 DE Code § 2572, § 2572a; Maryland Real Property Code § 10-702; Colorado Revised Statutes § 12-61-804.

48 See Environmental Law Institute, 2020. Database of State Indoor Air Quality Laws, Radon Excerpt. Available at https://www.eli.org/sites/default/files/docs/2020_radon_excerpt_3.3.20_bold.pdf (accessed January 20, 2020). Individual state provisions include: Delaware Code, tit. 6, §§ 2570–2578; Florida Statutes § 404.056; Kansas State Act 58-3078a; Illinois Compiled Statutes Ch. 420, §§ 46/1–25; Iowa Code § 558A.1 et seq.; Minnesota Statutes § 144.496; Montana Code Annotated 2017, Montana Radon Control Act, 75-3-606; New Hampshire NH Rev Stat § 477:4-a (2015).

clause in the Contract for Purchase and Sale (see Appendix 9.1). This allows a radon test to be completed after the property transfers and for a release of funds to cover the cost of testing and mitigation. It is important to require that mitigation work done in contemplation of homes sales be completed by certified mitigation professionals.

Subsidies and Financing for Homeowners

In many cases, testing and mitigating elevated radon is a cost-effective health intervention. Health economists have found radon interventions on par with or less expensive than other medical and drug expenses governments regularly incur with an eye to improving life-expectancy and quality of life. This is particularly so in high radon potential areas.[49] Subsidies and incentives work to share the costs of a collective good. Equity considerations arise as well. Homeowners with lower incomes will tend to push off into the future radon testing and any needed mitigation.

Appendix, section 9.2 details a range of subsidy and incentive programs for homeowners, ranging from prices as an incentive to test one's home to tax credits for mitigation work.

Subsidies for mitigation should only be made available where mitigation is performed by C-NRPP certified radon professionals.

Strata/Condominium Units

Special attention should be given to the unique situation of people who live in strata properties (in British Columbia) and condominiums (elsewhere in Canada). The enabling legislation for this type of housing arrangement typically allocates to owners the responsibility to maintain and repair their own units and allocates to a common corporation the duty to maintain and repair common areas. Legislation does not spell out particular indoor health standards.[50] Care should be taken to ensure that any rules around real estate transactions (such as mandatory information or latent defects), home warranty, subsidies and incentives, and certifications extend to strata and condominium units. Special education and outreach on radon can be directed at strata councils/condominium boards or specialty organizations, such as the Condominium Authority of Ontario.

3.7 Rented Homes

Over a third of Canadian households rent their homes. Attention to renters and social housing is important for ensuring action on radon follows principles of health equity, and to ensure a healthy home environment for the tenants. Renters do not normally have the legal right nor the funds to conduct major repairs on buildings they do not own.

Testing programs (as described above in section 3.1) should be careful to include rented accommodation, and education and awareness programs (as described above in Section 3.2) can be specifically tailored to renters. As well, there are a number of areas of law, regulation, and policy that can specifically target radon in rented homes.

49 Gaskin, J., Coyle, D., Whyte, J., Birkett, N. and Krewksi, D., 2019. "A cost effectiveness analysis of interventions to reduce residential radon exposure in Canada," Journal of Environmental Management 247, pp. 449-461. For a broader introduction to health economics analysis of radon see World Health Organization, 2009. WHO Handbook on Indoor Radon: A Public Health Perspective. Geneva, Chapter 4, Cost Effectiveness of Radon Control.

50 Strata Property Act, SBC 1998, c. 43, s. 72; Condominium Property Act, RSA 2000, c C-22 s. 37; The Condominium Property Act, 1993, SS 1993, c C-26.1 s. 35; The Condominium Act, CCSM c C170 s. 180; Condominium Act, 1998, SO 1998, c 1 s. 90; Condominium Act, RSNS 1989, c 85 s.35; Condominium Act, RSPEI 1988, c C-16; Condominium Act, 2009, SNL 2009, c C-29.1 s. 55; Condominium Act, RSY 2002, c 36 s. 18; Condominium Property Act, SNB 2009, c C-16.05s. 48; Condominium Act, RSNWT 1988, c C-15 s. 23; Quebec Civil Code s. 1039.

Residential Tenancies/Landlord Tenant

Each province and territory has legislation, typically named as Residential Tenancy or Landlord-Tenant law, that includes necessary terms in the landlord-tenant contract. Generally, these include broad provisions giving landlords the duty to ensure living spaces are in "good repair." Administrative tribunals in Ontario and Quebec have already held that elevated radon will violate those provisions.[51] It is only a matter of time (and efforts by renters and their advocates) before tribunals in other provinces and territories also identify radon as a problem.[52] One way to ensure such tribunals make findings around radon is to support tenants' advocacy organizations, and housing advocates to bring cases forward. More generally, education should be directed at both landlord and tenant groups. Provinces and territories can also work with tribunals to provide interpretations and guidance documents that indicate residential tenancy law supports radon action.

A further step would be to implement new legislation or regulation that makes clear what counts as a problematic state of disrepair. This makes it much easier for renters (or their advocates) to explain the issue to landlords and avoids the situation where a renter has to go to a tribunal to have their situation taken seriously. For instance, in the United Kingdom, the Homes (Fitness for Human Habitation) Act 2018 together with regulations take explicit steps to protect tenants through listing out a series of indoor contaminants, air quality issues, and health hazards that affect rented accommodation (and so render it unfit for human habitation). This includes radiation from radon.[53] Appendix 10 covers existing legislation and model language suitable at the provincial and territorial level. Renters can also be protected through Public Health Regulations and municipal level Standards of Maintenance Bylaws. (Standards of Maintenance Bylaws are further discussed in the Radon Action Guide for Municipalities, section 8.)

Provinces and territories could update their residential tenancies laws to require radon testing in occupied rentals in contact with the ground. Mitigation should be explicitly required if tests show levels above the Canadian Guideline. This would make explicit when landlords test, disclose results to tenants, and mitigate high radon in rental dwellings.[54] This would allow landlords and tenants to understand their rights and obligations by direct reference to legislation or regulation and may help avoid the cumbersome process of applying to administrative tribunals to secure rights. In some provinces or territories it may be appropriate to specify this only for known radon-prone areas. One option could be to allow renters to test and if necessary pay the costs of mitigation and then recoup this from landlords—in the form of reduced rent. In British Columbia this power is already given to tenants in areas of "emergency repairs"[55] which could be clarified to include mitigation of elevated radon. For radon reduction it is recommended that the use of certified mitigation professionals be required. This will ensure the quality of service and an ability to be able to track compliance and report radon results through the accreditation body.

Landlords and their organizations are more likely to support radon measures that do not simply pass on to them the costs for supplying a social good. **Policy makers should consider linking mandatory requirements to address radon in rental accommodation with forms of financial support for housing providers, such as subsidized or free radon testing kits, extending tax credits, direct grants, and other incentives for radon work**.

51 Ontario, CET-67599-17 (Re) 2017 CanLII 60362 (ON LTB); Quebec– Vanderwerf v. Dolan, 2019 QCRDL 37417.

52 Quastel, N. 2021. Radon and Renters: Current BC Law and Potential for Reform. Healthy Indoor Environments Legal Brief No. 5. British Columbia Lung Association. Available at https://bc.lung.ca/radon-rights-and-duties-for-landlords-and-renters, accessed August 20, 2021.

53 United Kingdom Ministry of Housing, Communities & Local Government, 2019. Guide for tenants: Homes (Fitness for Human Habitation) Act 2018. Available at https://www.gov.uk/government/publications/homes-fitness-for-human-habitation-act-2018/guide-for-tenants-homes-fitness-for-human-habitation-act-2018 (accessed August 20, 2021).

54 For Norway see references in Quastel et al. 2018, ibid. Appendix 1, Page 23; Maine, 14 M.R.S.A. Section 6030-D.

55 Residential Tenancy Act, SBC 2002, c 78, s. 33.

Housing and Maintenance Standards

Some Canadian provinces have explicit housing standards that apply to residential accommodation. Generally, these are regulations to public health acts, and empower health officers to take action once a renter lodges a complaint with them. This can provide renters with access to a sympathetic advocate rather than needing to go through a complex tribunal process. Currently no provincial or territorial standards explicitly include radon in housing and maintenance standards.

It might be possible for health officials with knowledge and understanding around radon to apply very general public health clauses to renters' complaints and work with a landlord to require mitigation. In Alberta a health officer drew on general nuisance clauses in the *Public Health Act* and the *Nuisance and General Sanitation Regulation*.[56]

A better approach is to ensure that radon and other indoor air quality concerns are explicitly mentioned in these regulations. Appendix, section 10.3 provides examples and model language for health regulations. Ideally there needs to be direction given to health boards and authorities to take action on radon, coupled with supportive policies, such as empowering health officers to spend the time needed to learn about, and take enforcement action concerning, elevated radon.

In many cases provinces have delegated maintenance standards to municipalities. Provinces should then work with municipalities to ensure radon is considered. If provinces have model standards of maintenance bylaws, they should be sure radon is included. Appendix, section 10 provides model language for standards of maintenance bylaws. (See also Radon Action Guide for Municipalities, section 8).

Affordable Housing

Canada has a hybrid system of support for non-market housing and care should be taken to tailor radon policies to each type.

Some building sites are **owned directly by provincial governments and their agencies**. In these cases, governments should address radon both as part of their own operations and as part of their responsibilities as landlords. Indeed, a number of provinces and public housing corporations have already conducted radon testing (Appendix, Section 10.6). Beyond testing and mitigation programs, efforts can include updating internal standards, guides, and toolkits for housing managers.

Often, affordable housing is provided by **non-profit housing societies**. There are many avenues for addressing radon here, including directed education to providers, updating guides and toolkits, and ensuring radon testing and mitigation requirements are included in required standards and operating and management agreements. Policy makers should consider direct subsidies and incentives for testing and mitigation as well as tying requirements to financial support.

Special consideration should be given to **housing cooperatives**, which make up a sizeable number of social housing units in Canada. While housing cooperative participants typically pay rent on a month-to-month basis, they largely have a membership, rather than tenant status: Most inhabitants are also collective owners of buildings and land. They do not have protection under landlord-tenant laws. Underlying legislation covering cooperative associations does not specify indoor air quality or other health standards. Issues as to indoor health and environment standards are established by bylaws of the cooperative or settled by collective decision making. Unlike strata units, cooperatives often do make collective decisions (and pool money) for some maintenance issues within individual units. A good approach can be to direct education and outreach to housing cooperatives. Provinces and territories can also offer forms of assistance such as drafting model policies for housing cooperatives or providing targeted subsidies and incentives for radon testing and mitigation.

56 *Public Health Act* at s. 59 to 61, and the Nuisance and General Sanitation Regulation, Alta Reg 243/2003 Reg 243/2003, further discussed in Quastel et al. 2018, ibid, at p. 97.

Some provinces have moved to providing **portable rent subsidies**—these allow eligible individuals to receive subsidy for rental units (at times provided by co-ops and non-profit housing providers, but also through private market rental units). This may occur for persons in need in locations where no subsidized housing is available. While landlord-tenant laws will apply, housing agencies may also conduct independent checks to ensure basic safety standards are met.[57] A further condition for review of potential units could include radon testing, disclosure of results to agencies and tenants, and, if needed, mitigation.

3.8 Work, Study, and Care Spaces

Workplaces

It is estimated that the majority of exposure to radon in the Canadian population is from time spent at home.[58] Still, it is important to test and reduce radon exposure in work environments, schools, and daycares.

The Canada Labour Code, which governs workplaces under federal jurisdiction, has been updated to reflect the National Radon Guideline of 200 Bq/m^3. As well, the Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM Guidelines) recommends a radon protection framework for all workplaces in Canada.[59] The NORM Guidelines provide a tailored way to ensure workplaces align with the National Radon Guideline of 200 Bq/m^3 and other radiation protection standards.

Provinces and territories should ensure their occupational health and safety regulation provide workers protection against elevated radon. Provincial and territorial workplace legislation does not generally provide specific wording on radon in the normal workplace, although some do have provisions for ionizing radiation or incorporate lists of exposures from organizations such as the American Conference on Government Industrial Hygienists (ACGIH). All provinces, however, have "general duty clauses" that require attention to hazards.[60] One important example that can be followed is Ontario, which has issued guidance for how the NORM Guidelines work together with the general duty clause to apply to workplaces in the province.[61] Provincial and territorial regulators should identify types of workplaces that are prone to elevated radon levels. Workplaces commonly identified as having large numbers of exposed workers include elementary and secondary schools, public administration, banks and credit unions, federal protective services and universities.[62] Other industries where workers are prone to exposure to naturally occurring radioactive materials include mineral extraction and processing, oil and gas production, metal recycling, forest products and thermal-electric production, and water treatment facilities.[63] Efforts should be taken by workplace regulators to ensure employers measure and monitor workplace radon levels and communicate the results to employees.

57 BC Housing and Province of British Columbia, 2015. Program Guide: Housing Provider Kit. pp. 68-73.

58 Chen, J., 2019. "Risk assessment for radon exposure in various indoor environments," Radiation Protection Dosimetry 185(2), pp. 143-150.

59 Health Canada, 2013. Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM). available at https://www.canada.ca/en/health-canada/services/publications/health-risks-safety/canadian-guidelines-management-naturally-occurring-radioactive-materials.html, accessed August 20, 2021.

60 British Columbia, Occupational Health and Safety Regulation, BC Reg 296/97, Part 4 - General Conditions - 296/97 at s. 4.1; Alberta, Occupational Health and Safety Act, RSA 2000, c O-2 at s. 2(1); The Saskatchewan Employment Act, SS 2013, c S-15.1, at s. 3-8; Occupational Health and Safety Regulation, 1996 O-1.1. at section 12; Manitoba, Workplace Health and Safety Act, s. 4(1) C.C.S.M. c. W210; Ontario, Occupational Health and Safety Act, RSO 1990, c O.1 s. 25(2)(h); Quebec, Act respecting the occupational health and safety, CQLR c S-2.1 at s. 51 Nova Scotia, Occupational Health and Safety Act, SNS 1996, c 7 at s. 13 (1); New Brunswick, Occupational Health and Safety Act, SNB 1983, c O-0.2 at s.9; Prince Edward Island, Occupational Health and Safety Act, RSPEI 1988, c O-1.01 s. 12; Newfoundland, Occupational Health and Safety Regulations, 2012 under the Occupational Health and Safety Act (O.C. 2012- 005) at s. 42, Yukon, Occupational Health and Safety Act, RSY 2002, c 159 at s. 3(1); Northwest Territories, Safety Act, RSNWT 1988, c S-1 at s. 4. (1); Nunavut, Safety Act, RSNWT (Nu) 1988, c S-1 at s. 4(1).

61 Ontario Ministry of Labour, Training and Skills Development, 2016. Radon in the workplace. Available at https://www.labour.gov.on.ca/english/hs/pubs/gl_radon.php, 2021).

62 CAREX Canada, 2021. Radon Occupational Exposures. Available at https://www.carexcanada.ca/profile/radon-occupational-exposures/ accessed August 20, 2021

63 NORM Guidelines, ibid. at s. 1.3.

Section 11 of the Appendix, provides resources to help provinces and territories update their workplace standards to ensure workers are protected from elevated radon.

Schools, Day-Cares and Long-Term Care Facilities

Exposure to high radon during childhood increases the lifetime risk of developing lung cancer later in life.[64] There is a legal basis for radon action in schools based on the occupational health and safety rights of staff, but also because schools have broad duties to protect the health of students. In addition, schools can share educational information with families to encourage testing at home. Appendix, section 11.2 provides examples of Canadian school testing programs, noting that in many parts of the county only a few schools have been tested.[65]

Many US states and other countries specifically mandate testing in schools. Specific rules not only help create transparency but can ensure all schools are tested. Appendix, section 11.2 details jurisdictions with requirements for school testing.

Childcare centres and long-term care facilities are another important area for addressing radon. Appendix, section 11.3 lists childcare testing initiatives in Canada. Like schools, childcare settings would ideally be covered by workplace legislation, but may be introduced earlier in the process given the immediacy of concern and public sentiment. Appendix, section 11.3 describes jurisdictions with mandatory childcare testing. In some US states there is specific legislation. In Canada, at least one health authority has ordered radon testing in childcare as part of licensing requirements.

3.9 Energy Efficiency

Many provinces and territories are moving to promote energy efficiency in homes and building codes across Canada will over time adopt stricter energy efficiency standards. However, attention to energy efficiency needs to be matched with attention to radon. The limited exchange between indoor and outdoor air in energy efficient homes can prevent radon from escaping into the outdoors.[66] Energy-efficient home insulation practices reduce heat loss but also often suppress air exchange. Indeed, increasing airtightness can elevate mean radon concentrations by over 50%.[67] Tight buildings that control indoor air flow have unique advantages beyond reducing energy use, including ensuring quiet, lack of moisture ingress, and thermal comfort. However, care must be taken to avoid unwanted consequences, of which radon is a major concern.[68] Energy efficiency programs and guides thus need to be coupled with attention to ventilation rates as well as testing and mitigating for radon.[69]

There are clear opportunities and benefits to providing education and outreach to existing energy efficiency initiatives to make clear the importance of radon. Appendix, section 12.1 provides examples of energy efficiency guides and programs that include recommendations for radon.

Radon action should include ensuring that any government (or agency)-linked incentive and financing

64 Chen, J., 2013. "Canadian lung cancer relative risk from radon exposure for short periods in childhood compared to a lifetime," International Journal of Environmental Research and Public Health 10(5), pp. 1916-1926.

65 Saskatchewan, New Brunswick, Nova Scotia, PEI and Yukon have tested all schools for radon while BC, Alberta, Manitoba, Ontario and Newfoundland have tested very few. CAREX Canada, 2017. Radon in schools: A summary of testing efforts across Canada. Available at https://www.carexcanada.ca/radon_in_schools/ (accessed January 20, 2021).

66 United States General Accounting Office, 1986. Indoor Radon Air Pollution. GAO/BCED-S6-170. Available at https://www.gao.gov/assets/150/144501.pdf (accessed January 20, 2021 at page 12).

67 Stanley, F.K., Zarezadeh, S., Dumais, C.D., Dumais, K., MacQueen, R., Clement, F. and Goodarzi, A.A., 2017. "Comprehensive survey of household radon gas levels and risk factors in southern Alberta," CMAJ Open 5(1), pp. E255-E264.

68 Shrubsole, C., Macmillan, A., Davies, M. and May, N., 2014. 100. Unintended consequences of policies to improve the energy efficiency of the UK housing stock," Indoor and Built Environment 23(3), pp. 340-352.

69 Arvela, H., Holmgren, O., Reisbacka, H. and Vinha, J., 2013. "Review of low-energy construction, air tightness, ventilation strategies and indoor radon: results from Finnish houses and apartments," Radiation Protection Dosimetry 162(3), pp. 351-363.

programs include incentives for radon testing and mitigation along with efficiency and other "green building" improvements. This can extend to home repair loan programs, but also subsidies, loans, and financing programs by public utilities. Appendix 12.3 covers financing programs.

3.10 Smoking Cessation

There is a strong synergistic interaction between radon exposures and smoking, given the damage both cause to lungs.[70] Provinces and territories should consider combining radon awareness and smoking cessation programs. Cessation program outreach workers can be trained in radon awareness and learn about local area risks, and when contacting or counselling smokers in high radon potential zones, explain the radon problem and its relevance. Clinical interventions, such as nicotine prescriptions, can be coupled with free radon test kits and subsidies for mitigation. Because the rates of lung cancer are so high amongst smokers with chronic exposure to high radon, these interventions are likely to be highly cost-effective.[71]

70 Lichtenstein, E., Andrews, J.A., Lee, M.E., Glasgow, R. E. and Hampson, S.E., 2000. "Using radon risk to motivate smoking reduction: evaluation of written materials and brief telephone counselling," Tobacco Control 9(3), pp. 320-326; Hampson, S. E., Andrews, J. A., Barckley, M., Lichtenstein, E., & Lee, M. E. (2006). "Personality traits, perceived risk, and risk-reduction behaviors: A further study of smoking and radon," Health Psychology 25(4), 530–536; Lichtenstein, E., Boles, S. M., Lee, M.E., Hampson, S.E., Glasgow, R. E. and Fellows, J., 2008. "Using radon risk to motivate smoking reduction II: randomized evaluation of brief telephone counseling and a targeted video," Health Education Research 23(2), pp. 191-201.

71 Groves-Kirkby, C.J., Timson, K., Shield, G., Denman, A.R., Rogers, S. and Phillips, P.S., 2011. "Lung-cancer reduction from smoking cessation and radon remediation: a preliminary cost-analysis in Northamptonshire, UK," Environment International 37(2), pp. 375-382.

4. Conclusion

This guide will facilitate and support provinces and territories in developing a Radon Action Plan by providing justification and evidence-based links to existing frameworks, strategies and policies where radon can be considered or incorporated. Included in this document and the Appendix are a variety of resources, examples, links, key messages and sample language that can be used in the development of a Radon Action Plan. It includes numerous actions that can be taken individually or together to start to help reduce the incidence of radon-induced lung cancer in your local communities.

The Radon Action Guide is broken down into sections and component parts and includes supporting evidence and examples so that provinces and territories can build a broad and comprehensive plan or take individual, discrete steps. Radon action can be advanced by choosing a few high impact and appealing interventions, such as ensuring daycare centres or government-operated social housing are tested. In some cases, the first step will be to develop more awareness, and provinces and territories can take advantage of the materials developed by Health Canada's National Radon Program. Other key actions include increasing testing and collecting data to get a better understanding of the regions with higher radon risk. Provinces and territories can use this data to give direction to public health agencies, and target education to professional groups such as real estate licensees and municipal building officials. In many areas, such as landlord-tenant, occupational health and safety, and real estate licensees there is broad scope for alerting people to existing laws, and having agencies issue interpretive bulletins, rather than more formal legal change. There is also significant scope for governments to work with other organizations and institutions, such as academic researchers who conduct citizen science projects, or provincial lung associations who conduct outreach. Municipalities, other local governments, local health boards, schools and libraries will also be important stakeholder partners.

Significant radon outreach and action have been achieved in Canada since the National Radon Program began. Provinces and territories are encouraged to take advantage of the existing resources and materials from the National Radon Program, Take Action on Radon Network and many of the already existing initiatives by provinces, territories, regulatory councils and non-profits in Canada. By using this guide and taking action on radon you will help people, improve indoor environments, and save lives.

Appendix

1. International Examples of Radon Action Plans

The European Union's Basic Safety Standards Directive (BSS-Directive) requires member states to adopt radon action plans. It specifies necessary components.

There is extensive literature on radon action plans by individual states. Some easily accessible plans include:

- UK National Radon Action Plan
- Czech Republic National Radon Action Plan (English)
- Federal Republic of Germany Radon Action Plan for the sustainable reduction of radon exposure (English)
- French national action plans for radon risk management (French)

Further guidance on developing radon action plans is provided in the Flow Chart for the Development of a Radon Action Plan prepared by the International Atomic Energy Agency (IAEA).

The World Health Organization's Global Health Observatory provides a Radon Data Repository that lists countries by national action plans, regulations and other activities.

1.1 Understanding Components of a Radon Action Plan in Canada's Federal System

Because of the division of powers in Canada, each federal and provincial/territorial government are needed to ensure comprehensive coverage of the radon issue. Table 1 sets out the key components of a radon plan (column 1), showing how this is provided in the BSS-Directive (column 2) and implemented in the United Kingdom (column 3).

The Table shows (column 4) how, for Canada, there will be distinct roles for the federal and provincial-territorial governments given Canada's constitutional division of powers. Column 4 also provides an assessment of where the federal government has acted, and where further provincial/territorial action is needed.

Table 1: Components of a Radon Action Plan			
Key Components of a Radon Action Plan	BSS Directive Annex XVIII	UK National Radon Plan (2018)	**Canadian Federal-Provincial Division of Powers and Existing Action**
Goals			
Long-term goals in terms of reducing lung cancer risk attributable to radon exposure	Section (s.) 13	s. 2, p. 6	Goals possible at federal and P/T level. No clear radon reduction goals yet pronounced by federal or any P/T government. Further discussion in P/T Radon Action Guide (RAG) section 2.2.
Surveillance			
Surveys to estimate distribution of indoor radon concentrations	s. 1	s.1.2.1, p.3; s. 4.2.1, p. 18	Surveys can be done by any level of government. Federal: see Cross-Canada Survey of Radon Concentrations in Homes (2012), but insufficient numbers for most communities. See RAG 3.1 and this Appendix, s.4 for details on existing radon testing, mapping and database initiatives at the provincial/territorial level and municipal level in Canada.
Identification of types of workplaces and buildings with public access where measurements are required.	s.3	s.3.2.3 , p. 12	Surveys can be done by any level of government. Occupational Health and Safety is a under provincial jurisdiction and workplace risks are typically assessed by provincial and territorial worker compensation and safety administrations. See RAG 3.8 and this Appendix, s. 11
Financial support for surveys	s. 12	s.1.2.1, p. 3	Financial support possible from any level government. See RAG 3.1 and this Appendix, s.4 for examples of government funded testing, mapping and database initiatives in Canada.
Database of radon measurements	s. 1	s.1.2.1, p.3	Possible by any level of government. Some initiatives in B.C., Nova Scotia, Yukon but so far insufficient. See RAG 3.1 and this Appendix, s.4.
Published radon risk maps and as an online interactive resource	Not found	s. 3.1.2, p. 8; s. 3.2.2, p. 12	Possible by any level of government. Some maps available federally by Health Canada, and the Canadian – National Radon Proficiency Program (C-NRPP), and for B.C., Nova Scotia and the Yukon. For further examples of mapping initiatives in Canada see RAG 3.1 and this Appendix, s.4.
Delineation (approach, data, criteria) of high radon risk areas	s. 2	s. 3.1.2, p. 8; s. 3.2.2, p. 12	Possible by any level of government. Some efforts in B.C. Building Code (see this Appendix, s. 8), in Nova Scotia Radon Risk Map, and individual action in some Ontario municipalities (see this Appendix, s.4).

Table 1: Components of a Radon Action Plan			
Key Components of a Radon Action Plan	BSS Directive Annex XVIII	UK National Radon Plan (2018)	**Canadian Federal-Provincial Division of Powers and Existing Action**
Maintaining and developing the evidence base on radon	Not found	s. 3.8, p. 16	Possible by any level of government. Federally, the National Radon Program employs researchers. Provincial support exists through support for academic researchers in higher educational institutions. See also testing and database initiatives—RAG 3.1 and this Appendix, s. 4.
Reference Levels in Dwellings, Workplaces and other Buildings			
Setting a national radon reference level	s. 4	s. 3.1.1, p. 8	Health Canada has set a National Radon Guideline of 200 Bq/m^3, For workplaces, the NORM Guidelines recommend 200 Bq/m^3.
Education and Awareness			
General education and awareness	s. 10	3.1.6, p. 11; and 3.6.1 to 3.6.3, p. 14-15	Possible by any level of government. Federal action includes efforts by Health Canada's National Radon Program, and Take Action on Radon Alberta's *Radon Awareness and Testing Act*, SA 2017, c R-2.5 requires the government to develop educational materials. See this Appendix, s. 5 for examples.
Informing local decision-makers	s. 10	s.4.2.4, p. 18	Primarily provincial responsibility given jurisdiction for health administration and regulation of indoor spaces. Few known Canadian examples outside of Ontario's Health Standards (discussed at this Appendix, s. 5). Also see RAG 2.4 on collaboration, partnership and engagement.
Targeted to smokers	s. 10	Not found	Possible by any level of government. Health Canada has produced education materials – Radon - Another Reason to Quit. No known Provincial/Territorial programs. See RAG 5.3 and 3.10
Guidance on testing and mitigation	s. 11	s. 3.1.3, p.9	Possible by any level of government. Health Canada, and the Canadian General Standards Board (CGSB) have created Canada wide guidance documents, see RAG 3.2 and this Appendix, s. 5.
Training of professionals (such as the building trades)	Not found	s. 3.6.4, p. 15	Possible by any level of government. C-NRPP operates nationally to provide training and certification. See RAG 3.3 and this Appendix, s. 6. See also Continuing Credit Courses for Professionals, this Appendix, s. 5.
Reduction Strategies for New Construction			
Building Codes	s. 8	Regulations for new buildings (s. 3.3, p. 13)	Federally, the National Building Code serves as a model and includes some radon provisions. Building codes are provincial/territorial jurisdiction. Most provincial/territorial building codes have some radon provisions. See RAG 3.5 and this Appendix, s. 8.
Post construction remediation (e.g. New Home Warranty)	s. 7	Not found	New Home Warranty is provincial/territorial jurisdiction. The only known Canadian example of explicit protection for radon in New Home Warranty is from Tarion in Ontario. See RAG 3.5 and this Appendix, s. 8.

Table 1: Components of a Radon Action Plan			
Key Components of a Radon Action Plan	BSS Directive Annex XVIII	UK National Radon Plan (2018)	**Canadian Federal-Provincial Division of Powers and Existing Action**
Reduction Strategies for Occupied Spaces			
Reduction strategies for radon reduction in older buildings	s. 6	s.3.1.4 to 3.1.6, p. 10- 11; 3.2, p. 12	Any level of government can offer subsidies and incentives, and test/mitigate its own buildings (see RAG 3.4, and this Appendix, s. 7). Regulation of rental accommodation and workplaces primarily provincial/territorial responsibility. For rented homes, see RAG 3.7 and this Appendix, s.10. For workplaces, RAG 3.8 and this Appendix, s. 11.
Ensuring services (and validation of quality) for radon measurements in homes	s.6, 11	s. 3.1.4, p. 10	Any level of government can offer industry support. At the national level, C-NRPP certifies radon testers and mitigators, and approves devices and laboratories for testers and mitigators to use. The Canadian Association of Radon Scientists and Technologists (CARST) serves as an industry association for C-NRPP certified testers and others. There are very few programs at the provincial/ territorial level. For discussion of industry support programs at the provincial/territorial level, see RAG 3.3, for certification of professionals see this Appendix, s. 6.
Ensuring services (and validation of quality) for radon mitigation	s.6, 11	s. 3.1.4, p. 10	Any level of government can offer industry support. At the national level, C-NRPP certifies radon testers and mitigators and approves devices and laboratories for testers and mitigators to use. CARST serves as an industry association for C-NRPP certified testers and others. There are very few programs at the provincial/territorial level. For discussion of support programs at the provincial/ territorial level, see RAG 3.3, for certification of professionals see this Appendix, s. 6.
Quality controls (such as certification) of testing professionals	s.11	s. 3.1.4, p. 10; 4.2.2, p. 18	Professional regulation is a provincial responsibility. The need for provincial regulation is discussed in RAG 3.3 and this Appendix, s. 6.
Quality controls (such as certification) of mitigation professionals	s.11	s. 3.1.4, p. 10; 4.2.2, p. 18	Professional regulation is a provincial responsibility. The need for provincial regulation is discussed in RAG 3.3 and this Appendix, s. 6.
Financial support for remedial measures	s.12	Not found	Possible by any level of government. Most appropriate for provinces and territories as part of health care spending. See this Appendix, s. 9.
Renters protection	Not specified, but s.6 refers to 'dwellings'	s. 3.1.5, p. 11	Tenant protection is a provincial responsibility. For suggested provincial-territorial action See RAG 3.7 and this Appendix, s.10.
Linkages to Indoor Air Quality and Energy Efficiency	s.14	s.1.2.6, p. 5	Possible by any level of government. See RAG 3.9 and this Appendix, s.12 for examples of programs.

Table 1: Components of a Radon Action Plan			
Key Components of a Radon Action Plan	BSS Directive Annex XVIII	UK National Radon Plan (2018)	**Canadian Federal-Provincial Division of Powers and Existing Action**
Plan Implementation			
Assignment of responsibilities (governmental and non-governmental), coordination mechanisms	s. 5	Not found	Nationally, Health Canada's National Radon Program provides Pan-Canadian coordination. See RAG 2.4 and 2.5 on coordination, collaboration and finding a home for radon programs.
Available resources for implementation of the action plan	s. 5	Not found	At this time, provincial and territorial Radon Action Plans have not been initiated in Canada.
Schedules for reviews of the action plan	s. 9	s. 4.1	At this time, provincial and territorial Radon Action Plans have not been initiated in Canada.
Stakeholder Engagement	Not found	s.3.6.5, p. 16	At this time, provincial and territorial Radon Action Plans have not been initiated in Canada.

2. Radon Action in Other Frameworks, Strategies and Plans

2.1 Chronic Disease and Cancer Strategies

These strategies outline goals, principles, and administrative steps to address cancer in the population. Radon can easily be identified as a problem, with the strategy incorporating planning initiatives to address elevated radon levels. In this way a Radon Action Plan can be made one component of larger strategies to prevent cancer or chronic diseases more broadly.

One example is the Chronic Disease Prevention Strategy (Cancer Care Ontario). This identifies radon as a problem, and specifically builds on a report identifying the Environmental Burden of Cancer in Ontario (Public Health Ontario). This report identifies radon as one of three carcinogens that collectively cause 90% of the environmental burden of cancer in Ontario (p. 3). Extensive statistics are supplied on the role of radon in causing cancer in Ontario. Suggestions are provided on programs for reducing exposure to elevated radon.

Other provinces have chronic disease and action plans which could be modified to incorporate radon, including:

- The Way Forward: The Chronic Disease Action Plan (Government of Newfoundland and Labrador, Health and Community Services)
- Gaining Ground: A Provincial Cancer Control Policy Framework for Newfoundland and Labrador (Government of Newfoundland and Labrador)
- Changing Our Future: Alberta's Cancer Plan to 2030 (Government of Alberta)
- 2016-2021 Manitoba Cancer Plan (Cancer Care Manitoba, Action Cancer Manitoba)

2.2 Healthy City and Healthy Communities Strategies

Canada is seeing increased awareness of the importance of the built environment in shaping the physical, psychological and social health of individuals and their communities. Land-use patterns, transportation networks, public spaces, and natural settings can all impact on physical activity, psychological well-being, and healthier outcomes for people. These strategies can directly include radon by drawing attention to the importance of indoor environments and buildings to public health. Healthy City and Healthy Communities Strategies can directly incorporate action items in this Radon Action Guide as well action items described in the **Radon Action Guide for Municipalities**.

One example of a policy document on healthy communities that references radon is the Healthy Built Environment Linkages Toolkit from the B.C. Centre for Disease Control. It provides specific recommendations for how municipalities can address radon.

As well, Ontario's Healthy Environments and Climate Change Guideline, 2018 (Ministry of Health and Long term Care) is intended to assist Boards of Health to develop approaches for promoting healthy built and natural environments, to enhance population health and mitigate environmental health risks. It identifies radon as an important environmental cause of cancer and restates requirements on local boards to provide public education on radon (p. 4). It also references guides to addressing radon (p. 7).

2.3 Public Health Standards and Guidelines

Some provinces, such as Ontario, have Public Health Standards. These identify minimum expectations for public health programs and services. Boards of Health are accountable for implementing the Standards, including the protocols and guidelines that are referenced in the Standards. In Ontario these specify radon as a topic of concern and direct Boards of Health to provide education to the public on the topic (p. 34-35).

In turn, some health units in Ontario have surveyed radon at the municipal level to determine whether radon is a local problem. Examples include:

- Thunder Bay District Health Unit
- Kingston, Frontenac and Lennox & Addington Public Health
- Windsor-Essex Health Unit
- Southwestern Public Health

3. Support for Municipal Radon Action

3.1 Municipal Law Frameworks

Municipalities are 'creatures of the provinces' in the sense that municipalities only have the legal powers that are provided by provincial or territorial legislation. Existing powers of municipalities to address radon are spelt out in **Radon Action in Municipal Law: Understanding the Legal Powers of Cities and Towns in Canada**. Provinces and territories provide sufficient legislative powers to municipalities to address radon. Most provinces' and territories' municipal legislation mentions protecting health and safety as part of the general purposes of a municipality or allows for bylaws concerning health.

Table 2: Municipal Powers to Protect Health in Canada	
British Columbia	Community Charter, SBC 2003, c 26, s. 8(3)(i)
Alberta	Municipal Government Act, RSA 2000, c M-26, s. 3(c) and 7(a)
Saskatchewan	Municipalities Act, SS 2005, c M-36.1. s. 4(2), and s. 8(1)(b); The Cities Act, SS 2002, c C-11.1, s. 4(2) and (8(1)(b); The Northern Municipalities Act, 2010, SS 2010, c N-5.2 s. 4(2) and 8(1)(b);
Manitoba	Municipal Act, CCSM c M225 s. 232(1) (a)
Ontario	Municipal Act, 2001, SO 2001, c 25, ss. 10 (1), 10(2)(6), 11(1) and 11(2)(6)
Quebec	Municipal Powers Act, CQLR c C-47.1, ss. 4, 19 to 54, 55, 63 to 65
New Brunswick	Local Governance Act, SNB 2017, c 18, s. 10 (1)(a)
Prince Edward Island	Municipal Government Act, RSPEI 1988, c M-12.1, s. 180
Nova Scotia	Municipal Government Act, SNS 1998, c 18 s. 172 (1)(a).
Northwest Territories	Hamlets Act, SNWT 2003, c 22, Sch C s. 72(1)(a); Cities, Towns and Villages Act, SNWT 2003, c 22, Sch B s. 70(1)(a); Charter Communities Act SNWT 2003, c 22, Sch A s. 74(1)(a);
Yukon	Municipal Act, RSY 2002, c 154 s. 265(a)
Nunavut	Hamlets Act, RSNWT (Nu) 1988, c H-1 s. 54.2, 102 (a) Cities, Towns and Villages Act, RSNWT (Nu) 1988, c C-8, 1 s. 54.2, 102 (a)
Newfoundland	N/A

However, there are specific steps that provinces and territories can take to ensure that municipalities do not have to worry that bylaws will be contested in court.

3.2 Specific Amendments to Municipal Law –Learning from Anti-Smoking laws

Through the 1990s many municipalities in Canada came to adopt bylaws prohibiting smoking in public spaces such as restaurants, shopping malls, and workplaces. In this period, provinces and territories also enacted amendments to municipal law frameworks explicitly stating that municipalities had the legal power to pass bylaws to prohibit smoking. This was likely to prevent any possible court challenges. For much of the twentieth century, municipalities were confined to acting only where provincial laws explicitly gave permission. There was a worry that without specific legal provisions allowing municipalities to pass anti-smoking bylaws, such bylaws would be struck down by the courts.

The courts have found that anti-smoking bylaws can be supported by very general powers to regulate to protect health (Restaurant and Food Services Association of British Columbia and the Yukon v. Vancouver (City)). As well, since the 2000s, courts have become much more willing to defer to municipalities (United Taxi Drivers' Fellowship of Southern Alberta v. Calgary (City)). Provinces and territories have continued to ensure provisions allowing municipalities to have anti-smoking bylaws, even after passing provincial legislation that duplicates municipal efforts. While not strictly necessary, this continues to clarify that municipalities can take action, reduces potential conflicts between municipal and provincial-territorial law, and provides added assurance to municipalities concerning court challenges to their efforts.

Table 3: Municipal Law and Anti-Smoking Provisions in Canada

	Municipal Law Enabling Anti-Smoking Bylaws	**Provincial legislation with prohibitions on smoking in enclosed public spaces**
British Columbia	*Municipalities Enabling and Validating Act (No. 2)*, SBC 1990, c 61 , s.40; *Municipalities Enabling and Validating Act (No. 3)*, S.B.C. 2001, c. 44 s. 2,	Tobacco and Vapour Products Control Act s.2.3
Alberta	*Tobacco and Smoking Reduction Act*, SA 2005, c T-3.8, s. 10	*Tobacco and Smoking Reduction Act*, SA 2005, c T-3.8
Saskatchewan	*The Tobacco and Vapour Products Control Act*, SS 2001, c T-14.1. s. 33, 35, and 36; *Northern Municipalities Act*, SS 1983, c N-5.1 s. 108.1, *Rural Municipality Act, 1989*, SS 1989-90, c R-26.1, s. 215.1 ; *The Urban Municipality Act, 1984,* SS 1983-84, c U-11, s. 142	*The Tobacco and Vapour Products Control Act*, SS 2001, c T-14.1
Manitoba	*The Smoking and Vapour Products Control Act*, CCSM c. S150, s.6	*The Smoking and Vapour Products Control Act*, CCSM c. S150
Ontario	*Municipal Act, 2001*, SO 2001, c 25, s. 115 (1)	*Smoke-Free Ontario Act, 2017*, SO 2017 c 26, Sch 3
Quebec	n/a	*Tobacco Control Act*, CQLR c L-6.2,
New Brunswick	*Local Governance Act, SNB 2017, c 18 s. 10(1)(a)*	*Smoke-free Places Act*, RSNB 2011, c 222

Table 3: Municipal Law and Anti-Smoking Provisions in Canada		
	Municipal Law Enabling Anti-Smoking Bylaws	**Provincial legislation with prohibitions on smoking in enclosed public spaces**
Prince Edward Island	*Smoke-free Places Act*, RSPEI 1988, c S-4.2, s. 3	*Smoke-free Places Act*, RSPEI 1988, c S-4.2
Nova Scotia	*Smoke-free Places Act*, SNS 2002, c 12, s. 16	*Smoke-free Places Act*,, SNS 2002, c 12
Newfoundland and Labrador	*Smoke-free Environment Act, 2005*, SNL 2005, c S-16.2, s. 12	*Smoke-free Environment Act, 2005*, SNL 2005, c S-16.2,
Nunavut	*Cities, Towns and Villages Act*, RSNWT (Nu) 1988, c C-8, s. 54.6	*Tobacco Control and Smoke-Free Places Act*., SNu 2003, c 13
Northwest Territories	*Smoking Control and Reduction Act*, SNWT 2019, c 29 s. 4.	*Smoking Control and Reduction Act*, SNWT 2019, c 29
Yukon	*Tobacco and Vaping Products Control and Regulation Act*, SY 2019, c14 s. 39(1)	*Tobacco and Vaping Products Control and Regulation Act*, SY 2019, c14

3.3 Model Language for Radon in Municipal Law and Conflict of Law Provisions

Potential amendments to municipal and/or local government acts and city charters may be to the effect that:

> **A municipality or local government may make regulations or by-laws respecting the control and mitigation of radon gas exposure.**

Any specific radon legislation should also include provisions enabling municipal action, to the effect that:

> **A municipality and/or local government may make a bylaw governing radon and in the event of conflict between municipal and provincial/territorial law, the stricter law will apply.**

4. Testing, Databases, and Mapping

4.1 Canadian Guidance and Protocols on Testing and Mitigation

- Government of Canada Radon Guideline

Guides for the general public on radon testing and mitigation

- Radon - Reduction Guide for Canadians (Health Canada)
- Testing for Radon (Take Action on Radon)
- Testing for Radon (C-NRPP)
- Reducing Radon (Take Action on Radon)
- Steps to Reduce Radon (C-NRPP)

Technical Guidance and Studies on Testing and Mitigation

- Guide for Radon Measurements in Residential Dwellings (Homes) (Health Canada)
- Guide for Radon Measurements in Public Buildings (Schools, Hospitals, Care Facilities, Detention Centres) (Health Canada)
- Cross-Canada Survey of Radon Concentrations in Homes - Final Report (Health Canada)
- Reducing Radon Levels in Existing Homes: A Canadian Guide for Professional Contractors (Health Canada)
- Summary Report on Active Soil Depressurization (ASD) Field Study (Health Canada)
- Residential Radon Mitigation Actions Follow-Up Study: Public Summary (Health Canada)
- Radon mitigation options for existing low-rise residential buildings. CAN/CGSB-149.12-2017 (Canadian General Standards Board)(for purchase)
- Radon control options for new construction in low-rise residential buildings. CAN/CGSB-149.11-2019 (Canadian General Standards Board)

4.2 Testing as Awareness

- Take Action on Radon 100 Test Kit Challenge
  - This Health Canada supported campaign distributes 100 test kits to approximately 20 communities per year.
- Yukon Radon Awareness Campaign
  - The Yukon Housing Corporation, in partnership with Yukon Lung Association, Health Canada, and Yukon Health and Social Services delivered a radon awareness campaign that included free radon kits and testing in remote communities (2019 - present).
- Donna Schmidt Lung Cancer Prevention Society
  - In British Columbia, this non-profit, volunteer driven society, provides radon test kits through the library offices of the Regional District of Central Kootenay in Creston, Nakusp, and Nelson.

4.3 Community Testing Initiatives

These initiatives aim to assess radon prevalence in a community through sample testing of homes and other buildings (ranging from approximately 400 to 1,100 tests depending on community characteristics). They also improve awareness.

- Ontario Health Units, in support of policy changes related to building codes. Examples include:
  - Thunder Bay District Health Unit
  - Kingston, Frontenac and Lennox & Addington Public Health
  - Windsor-Essex Health Unit
  - York Region Public Health
  - BC Lung Association, Radon Community Testing: BC Municipalities and Regional Districts

4.4 Citizen Science Projects

- Evict Radon
  - This includes significant public education and outreach materials.
- Simon Fraser University Citizen Science Project for Radon Gas

4.5 Library Lending Programs

Ontario

- Thunder Bay Public Library
- Saul Ste. Marie Public Library
- Essex County Public Library
- Hamilton Public Library

Alberta

- Edmonton Public Library
- Red Deer Public Library
- Parkland Regional Public Library
- Marigold Library System
- Strathmore Municipal Library

Nova Scotia

- Nova Scotia Library Service

Prince Edward Island

- PEI Library Service

British Columbia

- North Shore and Sunshine Coast Libraries
- Kootenay's Library Federation
- Okanagan Region Libraries
- Thompson-Nicola Region Libraries

Health Canada has a Radon Library Lending Program Guide. Available on request, send email to radon@hc-sc.gc.ca

4.6 Database and Mapping Initiatives

Public maps in Canada

- Health Canada Radon Map
- Nova Scotia Radon Map
- C-NRPP Radon Database and Map

International Examples

- EPA Map of Radon Zones
- United Kingdom Maps of Radon
- Connaître le potentiel radon de ma commune (République Française. Institut de Radioprotection et de sûreté nucléaire)
- Radon in the soil and air in Germany (German Federal Office for Radiation Protection)
- WHO Existence of National Radon Map

Other Maps, Data Sets and Working Groups

- Radon and Thoron Data from Canadian Homes
- British Columbia Centre for Disease Control BC Radon Data Repository
- Canadian Radon Mapping Working Group
- Radon Environmental: Mapping Radon Risk (for purchase)
- United Kingdom Radon Data: Radon Potential Dataset (British Geological Survey)

5. Education and Awareness

A key component of addressing radon is ensuring that people know that it is a health risk and have the tools to act to remedy it. Many government agencies in Canada and around the world have radon education programs, information portals and outreach resources.

5.1 Radon Web Pages

Canada (Federal)

- Take Action on Radon Resources of Stakeholders
- Health Canada Materials to Share or Print

Canada (Provincial and Territorial)

- Public Health Ontario
- Cancer Care Ontario, Risk of Residential Radon Varies Geographically
- Health Link BC
- Manitoba, Health, Seniors and Active Living
- Nova Scotia Environmental Health

Canada (Municipal and Regional)

- Peterborough Public Health
- Algoma Public Health
- Grey Bruce Public Health
- Toronto, Ontario
- Edmonton, Alberta
- Guelph, Ontario
- Chelsea, Quebec

International

- European Radon Association
- Ireland Environmental Protection Agency
- US Environmental Protection Agency
- Public Health England

5.2 Government Resolutions

Educational programs can be strengthened by broad resolutions, such as legislation and declarations recognizing November as Radon Action Month in Canada.

- Health Canada Radon Action Month and Lung Cancer Awareness Month
- Legislative Gazette Part I, November 1, 2019, No. 44, 2577-2624 (Saskatchewan)
- Edmonton, Alberta
- Chelsea, QC

In the United States, the Environmental Protection Agency declares January Radon Action Month and the Center for Disease Control focuses on Radon Awareness Week in late January.

5.3 Targeting At-Risk Audiences

- The Canadian Partnership for Children's Health & Environment provides radon information targeted at families.
- Health Canada targets smokers with RADON - Another Reason to Quit

5.4 Public Health Studies

Public Health Ontario undertook specific studies on the Environmental Burden of Cancer. This was accompanied by an academic article, Lung cancer risk of radon in Ontario, Canada: how many lung cancers can we prevent?, and production of accessible materials, Public Health Ontario: Radon Risks and Realities. A further result was the incorporation of radon education and awareness into Ontario's Public Health Standards.

5.5 Courses for Professionals

- Continuing credit courses for real estate agents are provided by the Alberta Real Estate Council British Columbia Real Estate Association and the Nova Scotia Real Estate Commission.
- McMaster University, together with Health Canada, the Ontario College of Family Physicians and the Clean Air Partnership, have designed a free, certified program for doctors.
- C-NRPP Radon Training for Building Professionals (including Municipal Inspectors): Controlling Radon in New Canadian Homes (CRNCH): CNRPP-EL-9
- C-NRPP Certification for Radon Measurement Professionals
- C-NRPP Certification for Radon Mitigation Professionals

5.6 Radon Laws that Mandate Governments to Make Educational Materials

Alberta's *Radon Awareness and Testing Act, SA 2017, c R-2.5* (not yet signed into force), requires the government to develop educational materials explaining the health risks associated with exposure to radon for the public, and for purchasers in residential real estate transactions. The materials are to be developed in consultation with not-for-profit organizations, other levels of government and other stakeholders. They will identify methods of testing for radon and ways to reduce the risks of exposure to radon and encourage homeowners to test and mitigate. There are also provisions for government to communicate with the public, implement a public awareness campaign, partner with not-for-profit organizations to distribute educational materials; provide educational materials for use in schools; and other methods.

Eight U.S. States have similar laws mandating public education, including:

- California Cal. Bus. & Prof. Code § 10084.1
- Colorado Col. Rev. Stat. 25-11-114(2)
- Florida Fla. Stat. Ann. § 404.056 (3)
- Montana Mont. Code Ann. § 75-3-605
- New Hampshire N.H. Rev. Stat. Ann. § 125:9 (X)
- Utah UT Code Ann. § 26-7-7
- Virginia VA. Code Ann. § 32.1-229
- Wisconsin Wisconsin Statutes § 254.34 (h)

6. Recognizing Certified Radon Professionals

6.1 Professional Certification Requirements

In the United States, radon has been treated primarily as an issue of consumer protection. One outcome is that a central emphasis has been on mandatory certification of radon professionals. The following Table lists states with requirements for radon certification and the applicable statutes and/or codes.

Table 4: US States with Mandatory Certification for Radon Professionals

State	Radon certification statute and/or codes
California	Cal. Bus. & Prof. Code. Radon Certification. Sec. 106750 - 106795
Connecticut	Conn. Gen. Stat. Ann. Sec. 20-420
District of Columbia	D.C. Code Ann. Sec. 28-4201
Florida	Fla. Stat. Ann. Sec. 404.056 (2)
Illinois	Ill. Ann. Stat. Ch. 420 Sec. 44/25. Radon Industry Licensing Act. Ill. Ann. Stat. Ch. II 422.10. Regulations for Radon Service Providers
Indiana	IN Code § 16-41-38-2 (2019) IN. Code Ann. 5.1-1-22
Iowa	Iowa Code Ann. Sec. 64144.3(136B). Radon Testing
Kansas	Kan. Stat. Ann. Sec. 48-16a01. Radon Certification Law
Kentucky	KY. Rev. Stat. Ann. Sec. 211.9101- 211.9135
Maine	ME. Rev. Stat. Ann. tit. 22 Radon Registration Act Sec. 772 to Sec 784
Maryland	MD Env Code § 8-305 (2018)
Minnesota	Minnesota Statutes Sec. 144.4961 Minnesota Radon Licensing Act.
Montana	Mont. Code Ann. Sec. 75-3-603. Montana Radon Control Act, Radon Testing and Mitigation Proficiency Listing Requirements
Nebraska	Neb. Rev. Stat. 38-121 (kk)
New Hampshire	N.H. Rev. Stat. Ann. Sec. 310-A:189-a
New Jersey	N.J. Stat. Ann. Sec. 7:28-27.1 Certification of Radon Testers and Mitigators. N.J. Stat. Ann. 26:2D-71 Radiation Protection Act
New York	N.Y. Comp. Codes R. & Regs. tit. 9 § 7930.3
Ohio	Omo. Rev. Code Ann. Sec. 3723.02
Pennsylvania	PA. Stat. Ann. tit. 68, 7503 (a)(5) Radon Certification Act (act of July 9, 1987, P.L. 238, No. 43); 25 Pa. Code Chapter 240.
Rhode Island	R.I. Gen. Laws. Sec. 23-61-5
Tennessee	Tenn. Code Ann. Sec. 62-6-302
Utah	Utah Code Ann. Sec. 58-55-305
Virginia	VA. Code Ann. Sec. 54.1-201, VA. Code Ann. 32.1-229.01
West Virginia	W. VA. Code Sec. 16-34-1

The wording of the statutes and codes varies considerably. However, it is possible to piece together general requirements which can also be used by Canadian provinces and territories seeking to implement a mandatory certification program.

- There are restrictions on any person testing and mitigating radon for a fee unless they are certified pursuant to a state approved program.
- Civil and criminal penalties are in place for persons who conducting radon testing or mitigation work without certification.
- Exceptions are made to ensure people can, on their own, test buildings they occupy, own, or lease.
- States approve certification and training through the National Radon Safety Board and/or the National Radon Proficiency Program (In Canada's C-NRPP has already been created to serve as an analogous program, providing training and examinations as a condition to certification).
- There are specific requirements of persons who are certified, such as:
    - qualifying education and exams,
    - registration,
    - following the law,
    - following technical standards for conducting testing and mitigation,
    - continuing education,
    - submitting quality assurance/quality control,
    - using approved devices, and,
    - worker safety plans (In Canada C-NRPP imposes these requirements on its members).

In Canada, C-NRPP is already positioned to maintain national standards for radon professionals, and currently provides training, examinations, certification, registration, and technical standards (see C-NRPP List of Certifications). Provincial and territorial legislation covering radon professionals can make use of this existing structure by requiring (in legislation or regulation) that radon testing and mitigation services performed for a fee be done by C-NRPP certified professionals.

6.2 Professional Contribution to Radon Databases and Maps

Good databases of radon test results are an important component of understanding radon prevalence. These in turn can contribute to maps and other forms of public information that can guide homeowners, landlords, real estate professionals and others to be vigilant around radon. One important tool for building databases is to require radon testing and mitigation professionals to submit test results to centralized databases. U.S. states require radon professionals to report test results to government agencies.

Table 5: US States with Reporting Requirements for Radon Professionals or Laboratories

State	Reporting Requirement
Florida	Florida Statutes, 2020 s. 404.056(2)(c)
Illinois	420 ILCS 44/30 Ill. Admin. Code Section 422.110
Indiana	410 Ind. Admin. Code 5.1-1-25 (d) and (f)
Iowa	Iowa Code Ann. Sec. 64144.3 (136B.2)
Kansas	Kan. Stat. § 48-16a10
Maine	Maine Rev. Stat., tit. 22 (2) §778
Minnesota	Minn. Admin. Rules 4620.7800
Nebraska	Nebraska Administrative Code 180- 11-004.01 , 11-010
New Jersey	N.J. Admin. Code § 7:28-27.28; New Jersey Statutes 26:2D-74.
New York	10 N.Y. Codes Rules & Reg. Section 16.130
Ohio	Ohio Admin. Code 3701-69-13
Pennsylvania	25 Pa. Code § 240.303.
Rhode Island	216-50-15 R.I. Code R. § 2.7.7

While each of these statutes or codes are written differently it is possible to describe general characteristics and best practices.

- A requirement of certified radon professionals is that they report all radon test results to a government agency on a regular basis (such as monthly or within a time frame such as 30 or 45 days after conducting the test).
- Some contents of the report are specified such as:
  - The radon levels detected
  - The location, age, and description of the building
  - Location in the building where test performed
  - The name and certification numbers of the certified radon measurement business and individual who performed the measurements
  - Start and end dates for measurements
  - Whether a radon reduction system is currently in use, the type and identification tag/numbers
  - The type of test performed, device used, and laboratory used

- A prescribed method for submitting data (such as type of computer file) to facilitate ease of database construction.
- Resolution of potential privacy and freedom of information issues. This can take the form of requirements to obtain consent of clients to share radon tests with model language for a consent form (see Kansas and New Jersey). In other cases, there are explicit exemptions from Freedom of Information requests for radon data held by government agencies (Illinois).
- Some states impose requirements directly on labs (Indiana, Minnesota, Nebraska).

Canadian provinces and territories that wish to create reporting requirements should consult with C-NRPP and the Canadian Radon Database and Mapping Working Group on reporting requirements, methods for submitting data, and privacy and freedom of information concerns. Working with national standard setting organizations and groups can ensure national harmonization of standards and best practices are met.

7. Government Buildings and Operations

The federal government has conducted and reports on Radon Testing in Federal Buildings.

Examples of radon testing of government buildings at the provincial level:

- Nova Scotia. See Environment and Labour Annual Accountability Report for the Fiscal Year 2007-2008 at p. 12
- Prince Edward Island
- Alberta
- British Columbia

CAREX Canada's, 2017 Radon in schools: A summary of testing efforts across Canada documents radon testing across Canada. All public schools have been tested in Nova Scotia, Prince Edward Island, New Brunswick, Saskatchewan, Quebec, and Yukon. Some schools have been tested in British Columbia, Alberta, Ontario, and Northwest Territories.

Section 10 of this Appendix discusses initiatives for testing and mitigating social housing.

8. Reducing Radon in New Homes

8.1 Building Codes

Table 6: Building Codes in Canada and Radon System Requirements

Building Code	If Limited Area of Application	Soil Gas Barrier only	Radon rough-in with stub only	Passive sub-slab depressurization
National Building Code of Canada, 2015			Explained here	
Provinces and territories that follow the National Building Code: Saskatchewan, Manitoba, New Brunswick, Nova Scotia, Newfoundland and Labrador, Northwest Territories, Yukon, Nunavut. PEI in major municipalities.			Explained here	
British Columbia Building Code, 2018	Select municipalities predominantly east of Coast Mountains, see Table C-4 Locations in British Columbia Requiring Radon Rough-Ins			s. 9.13.4
National Building Code – 2019 Alberta Edition			Explained here, to be augmented with testing and other design as per **6.2.1.1** and "good engineering practice'	
Ontario Building Code, 2017 in Conjunction with Supplementary Standard SB-9, providing three options	Areas of Ontario with known radon problem	s.9.13.4.2.4(a) and Supplementary Standard SB-9, explained here (with Voluntary radon gas testing)	Supplementary Standard SB-9, explained here	9.13.4.2. 4(b) and Supplementary Standard SB-9, explained here

Table 6: Building Codes in Canada and Radon System Requirements				
Building Code	**If Limited Area of Application**	**Soil Gas Barrier only**	**Radon rough-in with stub only**	**Passive sub-slab depressurization**
Quebec Construction Code		Quebec Construction Code A-9.13.2.1.(3) (prior to Sept 2020)	Quebec Construction Code, 9.13.4.6. (as of September 2020),	Quebec Construction Code, 9.13.4.6. (as of September 2020), if test results show need

A British Columbia study found the radon rough-in stub was generally insufficient.

- A Comparison of Three Radon Systems in British Columbia Homes: Conclusions and Recommendations for the British Columbia Building Code
- This led to changes to the BC Code to require an outside venting pipe.

Current best practices in mitigation are outlined in the Canadian General Standard Board's 2019 "*Radon control options for new construction in low-rise residential buildings*" and should be referenced in building codes. The standard provides detailed technical prescriptions for radon mitigation strategies.

8.2 New Home Warranty

New Home Warranty providers will normally cover failures of builders to follow the building code, and this should include radon provisions.

Tarion treats high radon as a major structural defect, as discussed in Tarion's Radon and Your New Home Warranty. Tarion explicitly warrants construction against levels of radon exceeding 200 Bq/m^3 for seven years.

Radon will likely fall within other New Home Warranty systems given that:

- The National Radon Guideline provides a clear standard for health in a home.
- High radon is considered to be a latent defect by many real estate councils and associations.
- Building code provisions on radon are part of a suite of measures relating to ensuring that the building envelope offers suitable protection from water and gas ingress.

9. Reducing Radon in Owner Occupied Homes

9.1 Real Estate Transactions

General information: Many Canadian organizations now offer general information to the public on radon and real estate.

- The Canadian Real Estate Association has a Homeowners Guide to Radon and a general information page entitled: More Time at Home? Test for Radon
- Health Canada has an information page on Radon and Real Estate
- The Canadian Association of Radon Scientists and Technologists has prepared materials directed at real estate agents including an online webinar recording, and CARST's Guideline for Radon Measurements during Real-Estate Transactions

Real estate licensee duties: Real estate agents are also typically members of professional regulatory organizations. As real estate licensees (or association members) they have professional duties around radon. This includes not only disclosing radon as a known latent defects to buyers, but generally being appraised of, and able to guide clients concerning, environmental conditions in homes. Real estate licensees should also help clients negotiate who will pay for any needed testing and mitigation.

Real Estate Councils and Associations in Canada that have issued directions and materials to licensees that clarify duties, including:

- Real Estate Council of Alberta: a bulletin, general information on radon, checklists, and requirements to study radon as part of re-licensing requirements in 2019.
- Real Estate Council of British Columbia: Radon Precautions for Real Estate Professionals including checklists.
- Real Estate Association of British Columbia: Practice tips and FAQ and online course.
- New Brunswick Real Estate Association Radon: What you Need to Know.
- Nova Scotia Real Estate Commission. Online course.
- Organisme d'autoréglementation du courtage immobilier du Quebec (OACIQ): How to prevent radon from affecting your real estate transaction.

The British Columbia Lung Association conducted its own law and policy research, including recommendations for real estate licensees (substantially matching those of the Real Estate Council of British Columbia) and a summary for policymakers.

Holdback Clauses: Health Canada recommends a 3-month (long-term) radon test because radon levels fluctuate over time. Shorter tests may thus not accurately capture average radon levels. A three month waiting period can cause significant problems for real estate transactions and radon testing may not be possible during the subject removal period. A buyer may be uncomfortable moving forward with the purchase without knowing radon levels or wish to conduct the test themselves once they occupy the home. A holdback clause in the Contract for Purchase and Sale can allow a radon test to be completed after the property transfers and for a release of funds from seller to buyer to cover the cost of testing and if necessary, mitigation.

Holdback clauses are provided as a possible solution in guidance for licensees by:

- Real Estate Council of British Columbia
- Real Estate Council of Alberta
- New Brunswick Real Estate Association.

Property Disclosure Statements: In some Canadian provinces, Property Disclosure Statements include a line for radon.

- Nova Scotia
- New Brunswick
- Quebec, with Instructions
- British Columbia

As well, 37 states in the United States of America have laws requiring homeowners to disclose radon information to potential home buyers, see Environmental Law Institute's Database of Radon Laws.

Property Disclosure Statements should offer sellers the ability to clearly indicate:

- The date and duration of the test (and whether a long term 3-month test has been conducted).
- Whether the homeowner or CNRPP certified professional conducted the test.
- The type of equipment or device used.
- Whether there has been mitigation, and by whom (including space to specify a CNRPP certified professional).

Written Radon Warnings Delivered to Buyers: Some U.S. states require that sellers provide buyers with written warnings concerning radon. These can specifically notify the buyer that:

- There is a risk of dangerous levels of indoor radon gas in the home.
- Radon is a Class-A human carcinogen and is the leading cause of lung cancer in non-smokers.
- The seller is required to disclose to the buyer any known elevated radon readings.
- Public health officials recommend that the buyer test for radon.
- Elevated radon concentrations can easily be reduced by certified radon mitigators.

Table 7: US States with Requirements for Radon Warning Statements	
State	**Requirement**
Delaware	6 DE Code § 2572A (2017)
Illinois	420 ILCS 46/10
Iowa	Iowa Code §§ 193E—14.1(543B)
Kansas	Kansas Statutes Minn Stat. § 58-3078a
Minnesota	Minn Stat. 144.496
Montana	Mont. Code Ann.§ 75-3-606.
New Hampshire	NH Rev Stat § 477:4-a (2015)
Rhode Island	Rhode Island General Laws §§ § 5-20.8-2

In Minnesota, the law directs the Health Department to create a publication, Radon In Real Estate Transactions, which sellers must give to buyers. In Iowa, the law directs sellers to give buyers the Iowa Radon Home-Buyers and Sellers Fact Sheet.

Some states require that the buyer signs off on having received the information, including Delaware, Illinois, Iowa, and Montana (see Table 7 for links).

The United States Department of Housing and Urban Development also requires a Radon Gas and Mold Notice and Release Agreement in the sale of its properties. This puts buyers on notice that radon may be an issue.

Testing Prior to Sale: This is recommended in the United States' EPAs Home Buyers' and Sellers' Guide to Radon

9.2 Subsidies and Financing and other Aid for Homeowners

Prizes: Radon Reduction Sweepstakes – Take Action on Radon and the Canadian Association of Radon Scientists and Technologists offered a $1,000 prize (in 10 regions) towards the cost of mitigation.

Distribution of Free or Subsidized Test Kits

- Take Action on radon's 100 Test Kit Challenge distributes 100 free test kits to 10 or more Canadian municipalities a year
- The Donna Schmidt Lung Cancer Prevention Society (charity in the Kootenays Region of British Columbia)
- Ontario health boards have distributed free test kits as part of community testing – see Section 4, Testing, Databases, and Mapping
- State of Pennsylvania and the American Lung Association targeted free distribution for high risk zones
- The Wyoming Department of Health offers free home radon test kits
- The Canadians municipalities of Chelsea, QC and Saint Joseph du Lac, QC sell subsidized test kits

Free Air Quality Inspections: The City of Fort Collins, Colorado has a Healthy Homes program, which offers free indoor air quality testing in residents homes, including for radon, as well as self-assessment tools.

Tax Credits for Mitigation: Saskatchewan's renovation tax credit now includes radon mitigation.

On-Bill Financing Loans: Manitoba Hydro's Energy Finance Plan provides an on-bill financing loan for upgrades to gas and electrical systems and includes radon mitigation. Provinces and territories can consider low or zero interest loans be attached to various.

Direct Subsidies for Mitigation

- The Habitation Durable program in Quebec offers financial subsidies to home renovations, including radon, and applies in Dixville, Piessisville, Ham-Sud, Dixville, Petite-Rivière-St-François, St-Valérien, Varennes and Victoriaville.
- After participating in Take Action on Radon's 100 Test Kit Challenge, the City of Vaudreuil-Dorion began selling radon detectors for just $5, including analysis and shipping. It will reimburse 50 per cent of the cost of installing a radon mitigation system to a maximum of $500 per residence.

10. Rented Homes

10.1 Existing Landlord-Tenant Law in Canada

All Canadian provinces and territories have landlord tenant (or residential tenancy) legislation that provides rental accommodation should be habitable and in good repair and comply with the law, and right to remedies for tenants.

Table 8: Good Repair Provisions in Provincial and Territorial Residential Tenancy Law

Province / Territory	Provision	Reference
British Columbia	*Residential Tenancy Act* S.B.C. 2002	s. 32(1)
Alberta	Residential Tenancies Act, SA 2004, c R-17.1 (RTA) Housing Regulation, Alta Reg 173/1999 Minimum Housing and Health Standards *(MHHS)*	RTA s. 16(c), HR. s. 3(1), 4, MHHS, s. 4
Saskatchewan	*Residential Tenancies Act*, 2006, SS 2006, c R-22.0001	s. 49 (1)
Manitoba	*The Residential Tenancies Act*, CCSM c R119	s. 59 (1)
Ontario	*Residential Tenancies Act*, 2006, SO 2006, c 17	s. 20
Quebec	*Civil Code of Québec*, CQLR c CCQ-1991	Ss 1910, 1913
New Brunswick	*Residential Tenancies Act*, SNB 1975, c R-10.2	s. 3
Prince Edward Island	*Rental of Residential Property Act*, c. R-13.1	s. 6(1)
Nova Scotia	*Residential Tenancies Act*, RSNS 1989, c. 401	s. 9
Newfoundland and Labrador	*Residential Tenancies Act* SNL 2000 c. R-14.1	s. 8(1)
Nunavut	*Residential Tenancies Act*, RSNWT (Nu) 1988, c R-5	s. 30(1)
Northwest Territories	*Residential Tenancies Act*, RSNWT 1988, c R-5	s. 30 (1)
Yukon	*Residential Landlord and Tenant Act*, SY 2012, c. 20	s. 33(1)

Administrative decision makers have ruled that these provisions are violated by radon levels over Health Canada Guidelines.

- Ontario Landlord Tenant Board:
  - *CET-67599-17 (Re)* 2017 CanLII 60362
- Quebec Régie de Logement:
  - *Barak c. Osterrath* 2012 CanLII 150609
  - *Pickard c. Arnold*, 2015 CanLII 129833
  - *Bramley c. Vanwynsberghe*, 2017 QCRDL 11313
  - *Vanderwerf c. Dolan*, 2019 QCRDL 37417

10.2 Current Property Manager Duties

As real estate licensees, rental property managers must disclose known latent defects to prospective and current tenants, including radon levels over 200 Bq/m^3. Guidance is provided in:

- Radon Checklist for Rental Property Managers (Real Estate Council of British Columbia)
- Radon Checklist –Property Managers (Residential) (Real Estate Council of Alberta)

10.3 Potential Reforms to Residential Tenancies Law and Regulations

Make explicit in law that radon is a contaminant or hazard.

Tenants will be better protected and landlords more likely to act when there is a clear statement in law concerning the need to test and mitigate when the long-term average radon reading is at 200 Bq/m^3 or over.

The United Kingdom's *Home (Fitness for Human Habitation) Act, 2018* gives renters the right to go to court to obtain an order for landlords to make repairs. The associated Guide for Tenants make clear that elevated radon negatively affects accommodation (and so render it unfit for human habitation). Radon has long been considered a hazard in rental housing in the UK, under the Housing Act, 2004, and associated Housing Health and Safety Rating System.

In Canada, provinces and territories have diverse systems for ensuring standards in rental housing, but in most cases standards—including for radon—could be specified by regulation rather than legislative chance.

- Ontario's *Residential Tenancies Act,* s. 224(1) provides for maintenance standards in a local municipality if there is no municipal property standards by law that applies. Ontario Regulation 517/06, Maintenance Standards details requirements such as homes being damp-proof, free of fungus and rot, having toilets, sinks and showers and indoor heating to 20 degrees Celsius.
- Newfoundland's Occupancy and Maintenance Regulations, CNLR 1021/96, spell out conditions for human habitation for select municipalities.
- Some provinces and territories provide minimum standards for rental accommodation in regulations that accompany residential tenancy laws. These typically include issues such as access to running water, and sufficient heating. Radon testing and mitigation could be added. Examples include:
    - Residential Tenancies Regulation, YOIC 2015/193 (Yukon)
- In some cases the regulations merely specify that the landlord must provide and maintain the residential property in a reasonable state of decoration and repair.
    - Residential Tenancy Regulation, BC Reg 477/2003 (British Columbia)
    - Residential Tenancies Regulations, 2007, RRS c R-22.0001 Reg 1 (Saskatchewan)

These regulations could be expanded to provide details of what reasonable repair consist in, including ensuring radon levels are below 200 Bq/m^3.

- In some provinces rental housing standards are provided in regulations under Public Health Acts.
    - Rental Accommodation Regulations, PEI Reg EC142/70 (Prince Edward Island)

- Health Hazards Regulation, BC Reg 216/2011 (British Columbia)
- Housing Regulation 173/1999, in conjunction with the Minimum Housing and Health Standards (Alberta)
- Dwellings and Buildings Regulation 322/88 R (Manitoba)

When these regulations are updated to include radon testing and mitigation, effort should be made to ensure landlords and tenants know they spell out minimum standards in law for the condition of repair of rental accommodation.

Specify that landlords need to test for radon and disclose results to tenants.

Current law on material latent defects implies that landlords should inform tenants of known high radon levels. However, explicit direction in law can do more to ensure that landlords test and inform tenants. In turn, tenants will be informed as to the radon levels in their home. Landlords should be directed to follow Health Canada's Guide for Radon Measurements in Residential Dwellings (Homes). Radon levels can change over time, and it should be emphasized that testing should be repeatedly periodically, such as every ten years.

U.S. states with rules on testing and disclosure rules for radon and rental accommodation include:

- Illinois 420 ILCS 46/10, Radon Awareness Act
- Maine 14 M.R.S.A. Section 6030-D

Direct landlords to provide a written notice to tenants concerning radon risks.

This can be prepared by public health agencies and describes the risks of radon as well as renters' rights. Ideally, standard form rental agreements will include formal recognition by the tenant that they have received this information (such as through initials). Examples include:

- Illinois 420 ILCS 46/10, Radon Awareness Act
- Maine 14 M.R.S.A. Section 6030-D

Direct landlords to use certified mitigation professionals.

It is a good idea to require landlords to use independent, certified testing and mitigation professionals. If radon testers and mitigators are certified, they can also be directed to report test results and mitigation activity to the state. Absent such a law, a rental housing policy should require such reporting by landlords. This will also assist provinces in tracking compliance with the law and in furthering radon policy in general through improving databases and maps. Section 6 of this Appendix, lists U.S. states with mandatory certification requirements for mitigators and with requirements that mitigators release data to state agencies.

Ensure access to justice for renters.

Renters can face many obstacles to redress against landlords. As part of ensuring renters have protections against high radon, provinces and territories can also assess whether the landlord-tenant system works to ensure access to justice. Key issues include: proper funding to the residential tenancy departments to hold investigations, support for housing advocates and tenants organizations, reliable and consistent enforcement, ensuring the availability of hearings for all types of people, independence

and training of arbitrators, access to databases of written decisions, and remote access (such as through teleconferencing or computers) to tribunals for persons in rural and remote areas. Examples of analysis of access to justice issues for renters includes:

- Analysis by the National Collaborating Centre for Determinants of Health (Ontario)
- Work by the Community Legal Assistance Society and the City of Vancouver's Renters' Advisory Committee (British Columbia)

10.4 Public Health Acts

Public Health Acts generally provide that public health officials can obtain consent from occupants of private residences to enter premises, and then inspect, request information and documents and conduct tests on the premises. If an inspection reveals a health hazard or a contravention of the law, public health officials can issue orders, including having the building vacated, requiring work to be done, or removing health hazards.

Public Health Acts and policies could be updated to help reduce radon risks for renters in the following ways.

Clear statements that elevated radon is a health hazard or otherwise violates housing standards for public health reasons.

As noted above, in some provinces rental housing standards are provided in regulations under *Public Health Acts*.

- Rental Accommodation Regulations, PEI Reg EC142/70 (Prince Edward Island)
- Health Hazards Regulation, BC Reg 216/2011 (British Columbia)
- Housing Regulation 173/1999, in conjunction with the Minimum Housing and Health Standards (Alberta)
- Dwellings and Buildings Regulation 322/88 R (Manitoba)

These regulations can be updated to clarify that Canada's Radon Guideline of 200 Bq/m^3 is an important component of housing and maintenance standards. Alternatively, if housing standards (including those pertaining to radon) are provided elsewhere, such as in Residential Tenancies legislation, it should be made clear that public health officials can investigate and issue orders concerning housing standards.

Clear language can be provided to the effect that violations of housing standards are health hazards.

- Prince Edward Island's Rental Accommodation Regulations, PEI Reg EC142/70 clearly states:
  - 15. *A contravention or failure to meet the requirements of these regulations may constitute a health hazard.*

Language that requires property owners to carry out repairs and make units safe.

- Alberta's Housing Regulation 173/1999 provides:
  - 3(1) *Subject to subsection (3) and section 4, an owner shall ensure that (a) the housing premises are (i) structurally sound, (ii) in a safe condition, (iii) in good repair, and (iv) maintained in a waterproof, windproof and weatherproof condition*;
- Prince Edward Island's Rental Accommodation Regulations, PEI Reg EC142/70 provides:
  - 9 *The owner of any dwelling shall, when necessary (a) carry out repairs or alterations weatherproof, damp-proof, vermin-proof, safe and sanitary in every respect*;
- Manitoba's Dwellings and Buildings Regulation, Man Reg 322/88 states:
  - 15(2) No owner of a dwelling shall let it or a dwelling unit therein to any person unless...
  - (d) the foundation is weather tight, rodent proof, and in good repair;...
  - (j) the walls and ceilings are free from major cracks and crevices that, in the opinion of a medical officer or inspector, may create a condition detrimental to the health of the occupant;

Mandate to respond to renters' complaints, inspect residential tenancies, and make orders against landlords.

- Manitoba' Health Protection Unit's Safe Housing Program responds to concerns from tenants and the general public. Public Health Inspectors inspect rental houses, apartments, hotels, and other types of accommodations to determine whether these places are satisfactory and free from health hazards. Inspectors enforce and apply the regulations to ensure that housing units provide safe and healthy living environments.

It is suggested that as part of this mandate there be specific budget and staff allocated to address radon in rental accommodation, and radon specific training for public health officials (such as through C-NRPP).

10.5 Working with Municipalities to Help Renters

Many municipalities have standards of maintenance bylaws that specify some minimum environmental conditions within rented homes. Provinces can provide specific wording in municipal law allowing local governments to make standards of maintenance bylaws. For examples see:

- *Local Government Act*, RSBC 2015, c 1 s. 298(1)(n)) (British Columbia)
- *Municipal Act*, CCSM c M225 s. 232(1)(c) and 233(a) (Manitoba)
- *Building Code Act*, S.O. 1992, c.23, s. 15.1 (Ontario)
- *Act respecting land use planning and development*, CQLR c A-19.1 s. 145.41 (Quebec)
- *Local Government Act*, SNB 2017, c. 18 s. 10(1)(e) (New Brunswick)
- *Municipal Government Act*, RSPEI 1988, c M-12.1 s. 180(i) (Prince Edward Island)

In some cases there is a process for approval of standards of maintenance bylaws.

- New Brunswick's *Local Governance Act*, SNB 2017, c 18 s. 17(b)

Provinces can provide specific language directing municipalities to receive complaints, make investigations and issue orders against landlords.

- Residential Tenancies Act, 2006, SO 2006, c. 17 s. 224 to 225 (Ontario)
- *Act respecting land use planning and development*, CQLR c A-19.1 s. 145.41 (Quebec)
- Residential Properties Maintenance and Occupancy Code Approval Regulation, NB Reg 84-86, s. 3 (New Brunswick)
- Occupancy and Maintenance Regulations, CNLR 1021/96, s. 41 (Newfoundland and Labrador)

Municipalities can be encouraged to have standard of maintenance bylaws that protect renters, including from radon.

Provinces and territories can encourage municipalities to enact and enforce standards of maintenance bylaws that include radon, and if necessary, take steps to ensure that municipalities have the power to enact and enforce such standards.

In some cases, provinces already provide explicit guidance to municipalities that include indoor conditions. British Columbia has a guidance document on Standards of Maintenance Bylaws and a Sample Standards of Maintenance Bylaw. In New Brunswick, the Residential Properties Maintenance and Occupancy Code Approval Regulation, NB Reg 84-86 specifies contents for standards of maintenance bylaws.

Any model standards or explicit direction to municipalities on standard of maintenance bylaws can be updated to include radon.

10.6 Radon Testing and Mitigation Initiatives in Social Housing

Test social housing as part of recognizing renter protection

- Quebec Housing Corporation (SQH) initiated a pilot project in Gaspésie in 2014, with a follow up on all social housing being tested and mitigated
- The Aboriginal Housing Society of Prince George participated in a radon testing program in 2014. Of 137 social housing units tested, 36 were above Guidelines and then mitigated.
- In 2015 Manitoba Housing and Renewal Corporation committed to testing and mitigation.
- Manitoba Housing's Design Guidelines for Multi-Unit Affordable and Social Housing (November, 2017) include provisions for radon control
- In 2019, Yukon Housing Corporation reported all units being tested for radon and mitigation to be completed by 2020
- In Kingston Ontario, the local health authority (KFL&A Public Health), as part of broader radon testing initiatives, approached the City of Kingston and housing providers concerning testing social housing units. KFL&A Public Health organized the testing of the units (hired term staff to place and pick up the detectors) and the City offered to pay the cost of radon mitigation. KFL&A staff used a sampling strategy, focusing on ground floor and basement units. They sampled 1135 units leading to 923 detectors being analyzed (212 detectors were lost to follow-up). Of the 923 detectors analyzed, 27 were above HC's limit of 200 Bq/m^3. Currently, 18 of 27 have been mitigated (author's correspondence with Sarah Ryding, Environmental Health Team Manager, KFL&A Public Health, also see Radon Testing Initiative in Kingston Social Housing)

Ensure performance guides for health and safety standards for social housing discuss radon:

Canadian examples where radon is mentioned include:

- BC Housing Design Guidelines and Construction Standards (2019)
- Manitoba Housing's Design Guidelines for Multi-Unit Affordable and Social Housing (November, 2017)

Ideally these will mandate radon prevention measures in new construction and radon testing after energy retrofits

Tie financing of social housing to testing and mitigation.

In the United States, the Department of Housing and Urban Development (HUD) requires radon testing as a condition for multifamily social housing developments receiving federal funds. This has also been adopted by Minnesota Housing.

11. Work, Study, and Care Spaces

11.1 Workplaces

Many countries have general workplace laws that also cover schools and daycares such as Norway's Radiation Act and Guide and the United Kingdom's *Ionising Radiation Regulations 2017* (IRR17), explained on the UK government Health and Safety Executive website for radon in the workplace.

There are a number of routes that occupational health and safety law and regulation can take to cover radon.

Federal guidance: Federal legislation can provide some guidance for provinces and territories in setting limits to radon and doses of ionizing radiation.

- The *Nuclear Safety and Control Act, SC 1997, c 9* sets out allowable effective doses of radiation for workers in the nuclear fuel chain. The Radiation Protection Regulations, SOR/2000-203, specifies that this should include radiation doses from radon.
- The Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM) (or "NORM Guidelines") seeks to ensure workers outside the nuclear fuel chain have similar protections to those within the nuclear fuel chain. It provides 200 Bq/m^3 as the action level in workplaces, with the goal of mitigation to achieve levels as low as reasonably achievable below 200 Bq/m^3.
- The Canada Occupational Health and Safety Regulations, SOR/86-304, at s. 10.26(4) applies to workers under federal jurisdiction. It says that no worker other than a nuclear energy worker should be exposed to a yearly average of over 800 Bq/m^3. This provision is outdated and in the process of being updated.

Direct Regulation of Radon Exposure

Provinces and territories can directly specify allowable average radon levels in indoor workspaces.

- Occupational Health Regulations, YOIC 1986D/164 ss. 43 to 46 (Yukon)
- Underground Mine Regulation, NB Reg 96-105, s. 62 (New Brunswick)
- Mines and Mining Plants, RRO 1990, Reg 854, ss. 288 to 293 (Ontario)
- Mine Health and Safety Regulations, NWT Reg 125-95 at ss. 9.76 to 9.96

Provinces and territories should consider updating radon specific workplace legislation to conform to the NORM Guidelines and to cover all workplaces.

Workplace Restrictions on Exposure to Ionizing Radiation

Some provinces directly regulate exposure to ionizing radiation in the workplace.

- Occupational Health and Safety Regulation, BC Reg 296/97 s. 7.19 (British Columbia)
- Regulation respecting occupational health and safety, CQLR c S-2.1, r 13 s. 144 (Quebec)
- Occupational Health and Safety Code 2009 Order, Alta Reg 87/2009, s. 291 (Alberta)

Governments and/or Workers Compensation Boards should be careful to provide guidance on allowable limits to exposure and how workers exposure to elevated radon concentrations in air translates into radiation dose. Workers who are not governed by the Nuclear Safety and Control Act should still receive similar protections from radiation. Here guidance can be found in the NORM Guidelines and the International Commission on Radiological Protection's Summary of Recommendations on Radon.

General Duty Clauses

All provinces and territories occupational health and safety regulation contains catch all clauses to the effect that employers should ensure workers are healthy and safe, and that workplaces and workplace practices are designed to prevent or reduce the risk of occupational injury.

All provinces and territories can consider following the lead of Ontario's Ministry of Labour, Training and Skills Development. It has issued policy guidance on radon which states that the general duty clause is to be interpreted as applying the NORM Guidelines to all workplaces.

Identify workplaces prone to elevated radon

The European Union's BSS Directive Annex XVIII, s. 3 directs member states to identify workplaces that need to be measured. While all workplaces should be tested, it can also be helpful to identify workplaces that are particularly susceptible to high radon.

List radon induced lung cancer as an occupational disease.

Worker's compensation legislation throughout Canada features lists of workplace diseases that are covered, and in some cases, radon induced lung cancer is explicitly listed. This makes it easier for workers to receive compensation, as it may mean the burden of proving the cause of the illness is reduced.

Provinces which list diseases caused by ionizing radiation

- *Workplace Health, Safety and Compensation Act*, RSNL 1990, c W-11, s. 90(2); Workplace Health, Safety and Compensation Regulations, CNLR 1025/96 s.23(25) (Newfoundland and Labrador)
- *Workers' Compensation Act*, SNS 1994-95, c 10 s. 15(1) (Nova Scotia)
- *Workers' Compensation Act*, RSA 2000, c W-15 s. 24(6); The Workers' Compensation Regulation, Alta Reg 325/2002 s. 20(1), and Schedule B (Alberta)

Provinces which list radon and lung cancer.

- Workers Compensation Act, RSBC 2019, c 1, ss. 136 to 138 and Schedule 1

By explicitly listing radon, provinces can both aid workers and send a message to employers to take radon seriously. Provision should be made for the chronic nature of the risk that radon poses—compensation systems should recognize that there is often a long-term gap between exposure and onset of disease.

11.2 Schools

- CAREX Canada has a comprehensive report, Radon is Schools: A Summary of Testing Efforts Across Canada
- Norway not only requires radon testing and mitigation in schools but uses a stronger 100 Bq/m^3 action level than for homes (at 200 Bq/m^3): Norway Forskrift 16. desember 2016 nr. 1659 om strålevern og bruk av stråling, Section 6 and explanatory notes to Section 6

U.S. states with mandatory school testing:

Table 9: US States with Mandatory School Testing

State	Regulation
Colorado	6 Colo. Code Regs. 1010-6:8.1(E2)
Connecticut	Conn. Gen. Stat. Ann. § 19a-37b. Conn. Gen. Stat. Ann. § 10-220 (d). Conn. Gen. Stat. Ann. § 10-291(b)(1)
Florida	Fla. Stat. Ann. § 404.056 (4)
Illinois	Il. Ann. Stat. Ch. 105 § 10-20.48
New Jersey	N.J. Stat. Ann. § 18A:20-40
Rhode Island	R.I. Gen. Laws §§ 23-61-4 R.I. Gen. Laws. § 1.04-3; 216 R.I. Admin. Code 50-15-2.3.1 A(13) and 50-15-2.5
Tennessee	Tenn. Code Ann. § 49-2-121
Virginia	VA. Code Ann. § 22.1-138
West Virginia	W. VA. Code §18-9E-3 (d)

11.3 Daycares

Mandatory Childcare Testing

- Alberta's *Radon Awareness and Testing Act*, SA 2017, c R-2.5 (not yet in force) states:
  - **3(1)** Prior to a licence being issued or renewed for a child care program under Part 1 of the *Early Learning and Child Care Act*, the statutory director under that Act shall require an applicant to provide the statutory director with the results of a radon test completed within one year immediately preceding the submission of the application within the premises where the child care program will be provided.
  - **(2)** If the results of the radon test completed under subsection (1) exceed the acceptable radon level prescribed by the regulations, the statutory director shall require the applicant to provide a plan to reduce the radon level in accordance with the prescribed standards.
- British Columbia's Interior Health Authority (servicing the Southeast of the province, including major cities such as Kelowna) ordered childcare facilities to test for radon in 2017. It relied on the *Community Care and Assisted Living Act*, S.B.C. 2002, c. 75 s.11(3) which empowers medical health officers to attach terms and conditions to a license and to revoke licenses if there is a risk to persons in the care of such facilities.
- Testing in childcare facilities has been mandated in some U.S. states.

Table 10: Mandatory Testing in Childcares in US States

State	Regulation
Connecticut	Conn. Gen. Stat. Ann. § 19a-79-7a (17)
Colorado	6 Colo. Code Regs. 1010-7:7.14.2
Florida	Fla. Stat. Ann. § 404.056 (4)
Illinois	Ill. Ann. Stat. Ch. 225 § 10/5.8
Idaho	Idaho Admin. Code 16.06.02.726
Iowa	Iowa Admin. Code 441-109.11 (7)
Maryland	Md. Regs. 14.31.06.07(4)
Michigan	Mich. Admin. Code r. 400.1934
New Jersey	N.J. Stat. Ann. § 30:5B-5.2
New York	18 N.Y. Code Rules & Regs. 416.2(a)(13), and 418-1.2(a)(6) plus New York State Office and Children Family Services radon guidance
Rhode Island	216 R.I. Admin. Code 50-15-2.3.1 A(13) and 50-15-2.5

12. Energy Efficiency

The following guides, standards and programs include radon.

12.1 Energy Efficiency Guides

- Natural Resources Canada, 2018. Keeping the Heat In, s. 1.4.3
- BC Housing Design Guidelines and Construction Standards

12.2 Home Renovation Subsidies and Incentives

- The Saskatchewan Provincial Government's Home Renovation Tax Credit allows homeowners to claim a 10.5% tax credit on up to $20,000 of eligible home renovation expenses. The eligible expenses include the cost of labour, professional services, and the building materials required for radon reduction measures.
- Habitation Durable provides financial incentives for residents of Victoriaville, Dixville, Piessisville, Ham-Sud, Dixville, Petite-Rivière-St-François, St-Valérien, and Varennes. It includes both a range of energy efficiency upgrades as well as radon.

12.3 Financing for Retrofits and Repairs

- Yukon Housing Corporation Home Repair Loan program with reduced interest up to $50,000 at interest rates of prime + 1% amortized over 15 years.
- Manitoba Hydro Energy Finance Plan is an 'on bill' financing program for upgrades to energy systems in homes. It includes financing for radon mitigation.

12.4 Green Certification Standards that include Radon Measures

- Natural Resources Canada, 2012. R-2000 Standard.
- LEED. See Direction on Radon Resistant Construction Techniques to Meet Prerequisite EQ 9.1 in LEED Canada for Homes (Canada Green Building Council) and Reference Guide for Homes Design and Construction, page 364
- Exigences Techniques, Colets, Maison et Petit Bâtiment Multilogement (Novoclimat)
- BOMA BEST Sustainable Buildings 3.0 Universal Questionnaire (BOMA BEST Building Environmental Standards)
- WELL Building Standard V2 (under Air Quality Concept, Feature A01, Part 4