

INDOOR AIR QUALITY THEME OF THE CLEAN AIR AGENDA

EVALUATION

Final Report

Approved by

Executive Committee Finance, Evaluation and Accountability (EC-FEA) Health Canada

October 7, 2010



Executive Committee - Finance, Evaluation and Accountability (EC-FEA) Indoor Air Quality Theme Of The Clean Air Agenda - Evaluation

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Executive Committee - Finance, Evaluation and Accountability (EC-FEA) Indoor Air Quality Theme Of The Clean Air Agenda - Evaluation

Health Canada Management Response Action Plan Evaluation of the Indoor Air Quality Theme of the Clean Air Agenda (CAA): Radon Program

#	Recommendation	Response/ Decision	Planned Actions	Responsible Manager	Time Frame
IAQ	Theme Level Recommendation - Responsibility shared with	h National Rese	arch Council (NRC)		
1	Bring theme level partners together to start planning for the future beyond 2010/11, ensuring that 'lessons learned' identified in this evaluation are discussed. Determine how Theme partners would like to proceed and then broaden the discussion to include CAA operational managers and other CAA stakeholders to discuss whether there is a rationale for going forward under one agenda, with certain components of the CAA or not at all.	Accepted	Discussions have already been held between various members of departments at a senior level regarding this decision. Health Canada (HC) is working with the National Research Council and other HC partners to ensure that the Indoor Air Quality Theme is represented and will be renewed taking into account lessons learned from Phase 1. Environment Canada (EC) has primary responsibility for CAA Renewal, as CAA lead. HC will continue to work with EC on this renewal process and will remain fully engaged in the renewal process.	Director General, Environmental and Radiation Health Sciences Directorate (ERHSD), Healthy Environments and Consumer Safety Branch (HECSB), Health Canada (HC) and Vice-President, Engineering, National Research Council	End of 2010-2011 fiscal year.
Rado	on Program Recommendations – under the responsibility of	Health Canada	•		
1	Review communication practices with delivery partners to ensure clear communication channels are in place (e.g., clear points of contact at HC) and that messages are consistent (e.g., regarding the assistance that HC desires from stakeholders).	Accepted	 Development and implementation of a mutually agreed upon communication plan and protocol with key stakeholders and partners. To establish a committee representing key stakeholders and partners for the radon program To review with the committee what is working and not working with regards to communication To jointly develop a communication plan and protocols to ensure that communication channels are clear, we are maximizing efforts and messaging is consistent 	Head, Radon Education and Awareness Section, Radiation Protection Bureau (RPB), ERHSD, HECSB, HC	November 15, 2010

#	Recommendation	Response/ Decision	Planned Actions	Responsible Manager	Time Frame
2	Ensure the performance data is being tracked against targets outlined in the IAQ Result-based Management and Accountability Framework (RMAF) including IAQ funded regional and provincial outputs.	Accepted	Comprehensive tracking of performance data for the Radon Program requires reporting by Program staff within the NCR as well as regional Radon Program staff, including activities with provincial partners.		
			• In order to more effectively track the data, a report based on the annual performance targets from the RMAF and operational plans (RPB and regions) will be developed, tracked and reported to RPB management at the end of the fiscal year. This will require input by the Health Canada regions.	Chief, Radiation Health Assessment Division, RPB, ERHSD, HECSB, HC	August 31, 2010 for the development of the report format March 31, 2010 for the final report on progress
			• As a jointly developed Operational Plan and Work Plan for HC and NRC has been developed, Regions and Program Branch (RAPB) program activities will be collected by HC and incorporated into targets outlined in the IAQ RMAF. NRC provides Work Plan updates on a monthly basis to HC.	Radon Strategy Manager, Office of Management Services and Strategic Planning, Director General's Office (DGO), ERHSD, HECSB, HC and Chief, Radiation Health Assessment Division, RPB, ERHSD, HECSB, HC	August 1, 2010 & ongoing
3	If there is a continued absence of approval to conduct POR for determining awareness levels; investigate whether alternate methods could be used to capture this change	Accepted	 HC is working with stakeholders and other federal departments who perform surveys of the public to have radon awareness questions added. Continue work with Statistics Canada to develop radon awareness questions to be included in their Household and Environment Survey (HES) which is conducted every two years. 3 new radon questions were added in the 2009 HES and results are expected in September 2010. 	Head, Radon Education and Awareness Section, RPB, ERHSD, HECSB, HC	November 15, 2010

#	Recommendation	Response/ Decision	Planned Actions	Responsible Manager	Time Frame
4	Ensure that comprehensive financial data is being tracked against the budget outlined in the IAQ RMAF and assign responsibility for this tracking.	Accepted	The Program has requested this issue be placed on the agenda of the Directorate Management Committee for the Environmental and Radiation Health Sciences Directorate (ERHSD). A plan will be developed to ensure that comprehensive financial data, including cost centres and internal orders, is being tracked by HECSB, RAPB and Branch Senior Financial Officer (BSFO.) At the Assistant Deputy Minister (ADM) Horizontal Accountability Management Board, challenges pertaining to comprehensive financial data will be discussed in order to obtain joint agreement on an approach	Director General, ERHSD, HECSB, HC and Intermediate Planning and Financial Analyst, BSFO, Financial Services - HECSB, Financial Operations Directorate, Chief Financial Officer Branch, HC	September, 2010
			obtain joint agreement on an approach.		

National Research Council (NRC) Management Response Action Plan Evaluation of the IAQ Theme of the Clean Air Agenda: Indoor Air R&D Initiative

#	Recommendation	Type of Recommendation	Response/ Decision	Planned Actions	Responsibility	Expected Date of Completion (M/D/Y)	Measures of Achievement
IAQ	Theme Level Recommendation – Responsibility	shared with Health	Canada				
1	Bring theme level partners together to start planning for the future beyond 2010/11, ensuring that 'lessons learned' identified in the evaluation are discussed. Determine how Theme partners would like to proceed and then broaden the discussion to include CAA operational managers and other stakeholders to discuss whether there is a rationale for going forward under one agenda, with certain components of the CAA or not at all.	Program Design and Delivery	Accepted	NRC has been meeting with two branches of Health Canada (the Water, Air and Climate Change Bureau (WACCB) and Radiation Protection Bureau (RPB)) regularly and are working on a common plan for future funding. Synergies and leverages between the proposed activities of the 3 branches are being discussed. NRC and Health Canada are also working with Environment Canada to best position the Theme collaborators within the overall Clean Air Agenda. Lessons learned noted in the evaluation will be considered in	NRC Vice-President, Engineering and Director General, Environmental and Radiation Health Sciences Directorate, Healthy Environments and Consumer Safety Branch, Health Canada	Submission of template for funding renewal to Environment Canada by June 15, 2010.	NRC and Health Canada proposal for CAA renewal is finalized and submitted to Environment Canada
				these discussions, particularly as they relate to next steps for the Canadian Committee on IAQ and Buildings.			
Indoo	r Air R&D Initiative Recommendations – unde	r the responsibility of	of the National I	Research Council (NRC)	-		
1	Ensure intellectual property issues with INSPQ are resolved and MOU with provincial partner is signed.	Program Design and Delivery	Accepted	The IP issues have been resolved, and the MOU with the provincial health partner, INSPQ, has now been signed	NRC Vice-President, Engineering	March 1, 2010	MOU signed by NRC Vice-President, Engineering and INSPQ Management

#	Recommendation	Type of Recommendation	Response/ Decision	Planned Actions	Responsibility	Expected Date of Completion (M/D/Y)	Measures of Achievement
2	Put in place an NRC staff member who is dedicated to supporting the Canadian Committee on IAQ and Buildings (CCIAQB) (e.g., coordination, administration, follow-up, assistance with government processes) and ensure funds are available to conduct planned research activities.	Program Design and Delivery	Partially Accepted	The level of effort to support the CCIAQB is not constant enough to require a staff member dedicated to support the Committee. The resource currently acting as the Secretary to the Committee will be able to access additional NRC-IRC staff on an as-needed basis when more support is required, including during the procurement process. In 2010/11 more funding has been allocated to this activity and future funding applications will reflect the additional resources required. The next CCIAQB meeting will include an agenda item as to whether the committee members feel the committee is now sufficiently supported.	NRC Institute for Research in Construction, Director, Indoor Environment	September 30, 2010	Committee minutes reflect that members of the CCIAQB feel that the Committee is sufficiently supported. Financial expenditures show an increase in NRC-IRC financial and human resources expended on CCIAQB
3	Revisit program plans and determine if there are alternate methods of collecting information that has been delayed by public opinion research restrictions, or if other information could be used.	Program Design and Delivery	Accepted	NRC-IRC and NRC Corporate Communications Branch have revisited definition of public opinion research and determined that the desired collection of information (Awareness Survey of Building Operators) is no longer considered public opinion research. Request for quotes has been sent to potential contractors.	Project Manager, Awareness Survey of Building Operators, NRC	June 10, 2010	Request for quotes for resources to conduct Awareness Survey of Building Operators has been sent out



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June 2010



Prepared for:

Health Canada and National Research Council

Prepared by:

Government Consulting Services Public Works and Government Services Canada

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LIST OF ACRONYMS

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
CAA	Clean Air Agenda
CARA	Clean Air Regulatory Agenda
CCRS	Cross Canada Radon Survey
СМНС	Canada Mortgage and Housing Corporation
DND	Department of National Defence
E&A	Education and awareness
EC	Environment Canada
FBT	Federal Building Testing
FNIHB	First Nations and Inuit Health Branch
FPT	Federal/Provincial/Territorial
FTE	Full-Time Equivalent
GCS	Government Consulting Services
GoC	Government of Canada
НС	Health Canada
IAQ	Indoor Air Quality
IARC	International Agency for Research on Cancer
IA R&D	Indoor Air Research and Development
INSPQ	L'Institut national de santé publique du Québec
IP	Intellectual Property
LEED	Leadership in Energy and Environmental Design
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MRRS	Management Resources and Results Structure
NGO	Non-governmental organization
NRC	National Research Council
PAA	Program Activity Architecture
PME	Performance Measurement & Evaluation
POR	Public Opinion Research
P/T	Provincial/Territorial
PWGSC	Public Works and Government Services Canada
R&D	Research and Development
RMAF	Results-Based Management and Accountability Framework
SS	Service Standards
ТВ	Treasury Board
TBS	Treasury Board Secretariat

EXECUTIVE SUMMARY

This report presents the findings, conclusions and recommendations of an evaluation of the Indoor Air Quality (IAQ) Theme of the Clean Air Agenda (CAA). The evaluation examines the IAQ Theme's relevance, effectiveness, and efficiency/economy during the period from 2007/2008 to 2009/2010. The research for this evaluation was conducted between November 2009 and February 2010.

Description of the IAQ theme

The IAQ theme is one of eight themes found under the CAA, an interdepartmental initiative with \$1.9 billion in funding over the 2007/2008 to 2010/2011 timeframe. The IAQ theme has been allocated a total of \$23 million over this four-year time frame. The IAQ theme is a horizontal initiative between Health Canada (HC) and the National Research Council (NRC), including two programs: the Indoor Air Research and Development (R&D) Initiative (led by NRC; receiving \$8 million over the four-year timeframe) and the Radon Program (led by HC; receiving \$15 million over the four-year timeframe). It is important to note that the radon program has components in more than one CAA theme. Some radon work is carried out under the Clean Air Regulatory Agenda (CARA) – led by EC. Only the IAQ-related radon work will be presented in this evaluation report. The work conducted under the CARA is not reported on in this evaluation.

The objective of the IAQ theme is to develop and apply knowledge for reducing or eliminating risks from natural and man-made indoor-air pollutants. This objective is expected to be achieved through a focus on the research, evaluation and testing of measures to improve indoor air quality and to identify and address specific risks to human health presented by radon gas in indoor environments¹.

Methodology

This evaluation was conducted in accordance with the 2009 Government of Canada Policy on Evaluation and addresses its core evaluation issues: continued need for the program, alignment with Government priorities, consistency with federal roles and responsibilities, achievement of expected outcomes, and demonstration of efficiency and economy.

The evaluation includes the use of multiple lines of evidence and complementary research methods as a means to ensure the reliability of the information and data collected. Five main lines of inquiry were used for this evaluation:

- document and literature review;
- interviews;
- survey;
- analysis of program data; and
- review of financial data.

¹ Indoor Air Quality Theme Results-based Management and Accountability Framework (HC/NRC, 2008)

Relevance

The IA R&D Initiative and the Radon Program were aligned with federal government priorities when the IAQ theme was developed and continue to be aligned with Health Canada, National Research Council and Environment Canada priorities. Both the IA R&D Initiative and the Radon Program continue to reflect the needs of Canadians. Provinces, non-governmental organizations (NGOs) and at least one Canadian university are conducting work that complements the Radon Program; however there does not appear to be any duplication of either the IA R&D Initiative or the Radon Program.

Effectiveness

Because this evaluation is being conducted during the third year of a four-year program and many of the outcomes are not anticipated until the end of the four-year period (particularly for the IA R&D Initiative), the evaluation focuses on examining progress made to date.

Progress on Achievement of IA R&D Initiative Outcomes

Funding was provided under the IA R&D Initiative for three primary components: 1) Assessment of the Impacts of Ventilation on Health (\$4.8 million over four years), 2) Evaluation of IAQ Technologies and Solutions (\$1.6 million over four years), and 3) Establishment of a National Advisory Committee Focusing on Indoor Air, now called the Canadian Committee on IAQ and Buildings (\$1.6 million over four years).

Components 1 and 3 are expected to lead to increased knowledge of risks, health impacts and mitigation strategies related to indoor air quality. Component 2 is expected to lead to increased knowledge and support for the development of technological solutions for improved IAQ.

The IA R&D Initiative appears to be generally on track towards achieving expected outcomes. The majority of targets for Components 1 and 2 are expected to be met, with a few minor delays. More challenges have been experienced in Component 3 and these challenges may have an impact on committee members' ability to achieve expected objectives. The committee members come from diverse sectors and are not necessarily familiar with federal government administrative processes (e.g., government contracting process, getting public opinion research approval).

Despite the minor delays, parties outside of NRC (including CMHC and an international expert) have already started to express an interest in the knowledge that is expected to be generated by the IA R&D Initiative. A variety of lessons learned were noted by interviewees, particularly related to improving the effectiveness of the National Advisory Committee (e.g., need for an administrative support function for the committee). This multi-sector collaborative approach that permeates the IA R&D Initiative is viewed by interviewees as a best practice.

Progress on Achievement of Radon Program Outcomes

Funding was provided under the Radon Program for three primary components: 1) Mapping of Radon Zones and Affected Populations (\$8.4 million for four years), 2) Testing and Remediation of Radon in Federal Buildings Located in High Risk Radon-Prone Areas (\$3.6 million for four years) and 3) Radon Education and Awareness Program (\$3 million for four years).

Components 1 and 2 are expected to lead to increased knowledge of risks, health impacts and mitigation strategies related to radon while Component 3 is expected to lead to improved awareness of health risks and causes of elevated radon and strategies to improve it.

The mapping of radon zones and affected populations is mostly being implemented as planned. Targets for this component have been, for the most part, met or exceeded. Component 2 (testing and remediation of federal buildings) is off track due to a number of barriers and external factors. It was targeted that 60 percent of federal buildings would be tested for radon levels by the end of fiscal year 2009/10 but it is anticipated that 17 percent of buildings will actually be tested. Barriers encountered include: getting buy-in from departments at the senior level to conduct Federal Building Testing (FBT) in their buildings, a lack of interest by those at the operational level even if FBT was approved, fewer buildings meeting testing criteria than initially anticipated, and differing expectations on who should be responsible for distributing and collecting radon detectors in federal buildings. Program managers also experienced a number of barriers implementing Component 3 (radon education and awareness program). Program managers developed a broad based radon communication strategy/plan which was approved by senior management for dissemination. However, approval was subsequently revoked and the plan could not be rolled out. As a result, program managers used alternative methods to disseminate the information. The limited performance data available suggests that awareness levels have increased but that alternative methods used have not resulted in the expected level of increased awareness.

Lessons learned were found by comparing Canada's Radon Program to those in other countries. The key difference that should be noted in comparing Canada's program to those in other countries is that Canada is in its third year of implementation, whereas comparison programs operating in other countries have been in place for, in many instances, twenty years. In sum, the key lessons that Canada can learn from are that comparison countries have radon specific public awareness campaigns, access to data on when a house is tested for radon, the results of the test, and whether or not remedial action has been taken).

Efficiency and Economy

Efficiency and Economy of the IA R&D Initiative

The IA R&D Initiative appears, for the most part, to be on track towards achieving objectives and has remained close to budget at the Initiative level. One of the components (Assessment of the Impacts of Ventilation on Health) of the Initiative has drawn resources away from the other two components, suggesting that it is not being delivered as efficiently as planned. Program staff of the remaining two components are attempting to meet objectives with fewer resources than originally planned. The reduced resources for the evaluation of IAQ Technologies and Solutions component does not seem to be affecting the achievement of targets but the lack of resources for the Canadian Committee on IAQ and Buildings is inhibiting the committee's ability to meet targets. However, the concentration of resources has been allocated to activities that will play the greatest role in generating new knowledge, particularly with respect to the risk, health impacts and mitigation strategies related to IAQ.

There is a perception that efficiency of the IA R&D Initiative cannot be improved as NRC is undertaking a large volume of tasks for the amount of funding received and there are no viable alternatives to the current delivery model.

Efficiency and Economy of the Radon Program

Fewer than anticipated resources (financial and human) have been directly expended on Radon Program components. Radon Program funds were used to support lab operational and overhead costs, the regions, the Director General's (DG's) office, accommodation (PWGSC), and corporate service costs. Interim targets for Component 1 have been met or exceeded, for the most part, with fewer resources (financial and human) than anticipated suggesting that the mapping component is being done efficiently. Targets for Component 2 are far from being met and more resources than anticipated have been expended. This suggests that federal building testing has not been efficient. Fewer than budgeted resources were directly allocated to Component 3 (Education and Awareness) and many of the output targets have been met or exceeded meaning that certain aspects of this component are being delivered efficiently. However, resources were expended developing a radon specific public awareness campaign that was approved but never granted permission to be rolled out. Resources were therefore expended but were not used to help affect the intermediate outcome of improving public awareness of health risks and causes of elevated radon and strategies to improve it. The limited awareness data that is available suggests that interim awareness targets have not been met. The reduction of dedicated resources (human and financial) and barriers encountered by Radon Program managers has had an impact on the economy of the awareness building component.

Perceptions of the economy of the Radon Program vary, but just over half of interviewees felt that the program was economical. Suggestions on how to improve the efficiency of the Radon Program vary but tended to concentrate on increasing education and awareness and federal building testing.

RECOMMENDATIONS

The following recommendation should be addressed at the Theme level:

1. Bring theme level partners together to start planning for the future beyond 2010/11, ensuring that 'lessons learned' identified in this evaluation are discussed. Determine how Theme partners would like to proceed and then broaden the discussion to include CAA operational managers and other CAA stakeholders to discuss whether there is a rationale for going forward under one agenda, with certain components of the CAA or not at all.

The following recommendations for the IA R&D Initiative should be addressed:

- 1. Ensure Intellectual Property issues with INSPQ are resolved and MOU with provincial partner is signed.
- 2. Put in place an NRC staff member who is dedicated to supporting the Canadian Committee on IAQ and Buildings (e.g., coordination, administration, follow-up, assistance with government processes) and ensure funds are available to conduct planned research activities.
- 3. Revisit program plans and determine if there are alternate methods of collecting information that has been delayed by Public Opinion Research restrictions, or if other information could be used.

The following recommendations for the Radon Program should be addressed:

- 1. Review communication practices with delivery partners to ensure clear communication channels are in place (e.g., clear points of contact at HC) and that messages are consistent (e.g., regarding the assistance that HC desires from stakeholders).
- 2. Ensure the performance data is being tracked against targets outlined in the IAQ RMAF including IAQ funded regional and provincial outputs.
- 3. If there is a continued absence of approval to conduct POR for determining awareness levels; investigate whether alternate methods could be used to capture this change
- 4. Ensure that comprehensive financial data is being tracked against the budget outlined in the IAQ RMAF and assign responsibility for this tracking.

1. BACKGROUND AND CONTEXT

This report presents the findings, conclusions and recommendations of an evaluation of the Indoor Air Quality (IAQ) Theme of the Clean Air Agenda (CAA). The evaluation examines the IAQ Theme's relevance, effectiveness, efficiency/economy, and design/delivery, during the period from 2007/2008 to 2009/2010. The research for this evaluation was conducted by Government Consulting Services (GCS) between November 2009 and February 2010.

The evaluation report is organized as follows:

- Section 1 : a program description and evaluation context;
- Section 2: methodology for the evaluation;
- Section 3: conclusions and supporting evidence; and,
- Section 4: summary and recommendations.

1.1 Program Description

The Clean Air Agenda (CAA) is an interdepartmental initiative with \$1.9 billion in funding over the 2007/2008 to 2010/2011 timeframe. The CAA is comprised of 43 programs grouped into eight themes: Clean Air Regulations; Clean Energy; Clean Transportation; Indoor Air Quality; Adaptation; International Actions; Partnerships; and Management and Accountability. Eight departments and agencies are collectively responsible for the achievement of the outcomes and results of the CAA and individually accountable for leading themes, managing programs and resources, and delivering and reporting on results.

The IAQ Theme has been allocated a total of \$23 million over the four-year time frame (see Appendix A). The IAQ Theme is a horizontal initiative between Health Canada (HC) and the National Research Council (NRC), resulting in two programs: the Indoor Air Research and Development (R&D) Initiative (led by NRC; receiving \$8 million over the four-year timeframe) and the Radon Program (led by HC; receiving \$15 million over the four-year timeframe). It is important to point out that HC is also conducting some work as part of the Radon Program under the Clean Air Regulatory Agenda of which Environment Canada (EC) is the lead department. The work includes preparing a radon exposure guideline, developing knowledge on susceptible populations and developing testing protocols. Overall, the IAQ theme is concerned with strengthening research and technological capacity, and raising general awareness related to indoor air quality.

The objective of the IAQ theme is to develop and apply knowledge for reducing or eliminating risks from natural and man-made indoor-air pollutants. This objective is expected to be achieved through a focus on the research, evaluation and testing of measures to improve indoor air quality and to identify and address specific risks to human health presented by radon gas in indoor environments².

The activities of the initiatives funded under the IAQ theme are described below³:

- > Indoor Air Research and Development (IA R&D) Initiative:
 - Assessment of the impacts of improved indoor air ventilation and indoor air distribution on indoor air quality and human health, particularly that of children with asthma, through an intervention study over two years in residential houses in the Quebec City area;
 - The construction of a new indoor air research laboratory to enable optimal interventions within the above mentioned field study;
 - Evaluation of the effectiveness of three to four of the most relevant technologies and solutions currently used for indoor air quality management; and
 - Establishment of a national committee focusing on indoor air to review relevant information, identify research gaps, provide a venue for discussion and dissemination of reliable knowledge on indoor air quality.
- > Radon Program:
 - Mapping of radon zones and affected populations, using remote sensing technology supported by fieldwork in targeted areas;
 - The Federal Building Testing (FBT) program: testing of radon in approximately 15,000 federal sites located in known and/or potential high-risk radon areas; and
 - Radon education and awareness (E&A) program: the design, implementation and coordination of a broad-based public awareness and education campaign.

For a further illustration on how initiatives link to outcomes, please refer to the logic model for the IAQ theme in Appendix B.

There are a number of intended beneficiaries of the IAQ theme. It is planned that the findings from the Indoor Air R&D Initiative will be made available for use in support of NRC's and Canada Mortgage and Housing Corporation's (CMHC) ongoing work in the advancement of guidelines and standards (such as the National Building Code, residential construction standards, and a variety of guidelines related to building design, construction, operation and maintenance). Homeowners and owners of commercial buildings are expected to benefit from these findings as the findings lead to healthier home and work environments. In addition, it is expected that the

² Indoor Air Quality Theme Results-based Management and Accountability Framework (HC/NRC, 2008).

³ Ibid.

building industry will be better able to respond to the needs of concerned clients, and public health practitioners will be able to provide scientifically sound advice as it relates to the role of ventilation measures in improving indoor air quality⁴.

It is expected that findings from activities related to the Radon Program will be shared with governments, industry and the public for use in a number of ways to take steps to protect against exposure to radon. This information may be used to inform potential follow-up applications such as: identification and targeting of specific areas and federal buildings of concern that warrant more detailed testing or remedial action; empirical evidence to guide the design of effective protection and mitigation strategies; and increasing consumer and industrial awareness of and demand for cost-effective technologies and practices that will prevent, minimize and reduce exposure to radon⁵.

1.2 Evaluation Context

This IAQ thematic evaluation will feed into a CAA horizontal roll-up of evaluation findings from across the eight theme areas in 2010/2011. Results will support departmental planning regarding future CAA programming and renewal decisions.

As the evaluation was conducted during the third year of a four-year program, conclusions on the program are limited as they are based on data from only the first two and one-half years of the program (2007/08 to the first two quarters of 2009/10.)

The objectives of this evaluation are to assess the relevance, effectiveness, efficiency/economy and design/delivery of the IAQ programs delivered by HC and NRC, as well as to collect data to inform the Radon Component of the Clean Air Regulatory Agenda (CARA) evaluation. The data to inform the Radon component under CARA has been provided to Environment Canada and will be presented in the CARA evaluation report. This report includes only findings related to the Radon Program and the Indoor Air R&D Initiative.

1.3 Evaluation Questions

This evaluation was conducted in accordance with the 2009 Government of Canada (GoC) Policy on Evaluation and addresses its core evaluation issues: continued need for the program, alignment with Government priorities, consistency with federal roles and responsibilities, achievement of expected outcomes, and demonstration of efficiency and economy.

⁴ Indoor Air Quality Theme Results-based Management and Accountability Framework (HC/NRC, 2008).

⁵ Ibid.

During the planning phase for this evaluation (October 2009), GCS consulted with the IAQ Joint Evaluation Committee⁶ to conduct a review of the evaluation plan contained in the IAQ theme Results-based Management and Accountability Framework (RMAF) and to develop an evaluation matrix (see Appendix C) to guide the evaluation. The following evaluation issues and questions were agreed upon:

Relevance

- Do the IA R&D Initiative and the Radon Program continue to reflect government priorities?
- Do the IA R&D Initiative and the Radon Program continue to reflect the needs of Canadians?
- > Do the IA R&D Initiative and the Radon Program duplicate or overlap with any other initiatives?

Performance – Effectiveness

- To what extent are the IA R&D Initiative and the Radon Program being implemented as planned and on time?
- To what extent has the IA R&D Initiative contributed to the achievement of increased knowledge of risks, health impacts and mitigation strategies related to indoor air quality?
- To what extent has the IA R&D Initiative contributed to the achievement of increased knowledge and support for the development of technological solutions for improved IAQ?
- > To what extent has the Radon Program contributed to the achievement of improved awareness of health risks and causes of elevated radon and strategies to improve it?
- To what extent has the Radon Program contributed to the achievement of increased knowledge of risks, health impacts and mitigation strategies related to radon?
- What are the best practices and lessons learned (positive and negative) from the IA R&D Initiative and Radon Program?
- What, if any, unintended (positive or negative) outcomes have occurred? Were actions taken as a result of these?
- > What external factors influenced the success of the IAQ theme?

⁶ Composed of Departmental Evaluation Representatives from HC, NRC, EC, and IAQ program representatives from HC and NRC.

Performance - Efficiency and Economy

- Are there more cost-effective and efficient means of achieving IA R&D Initiative and Radon Program outcomes?
- How could the efficiency of the IA R&D Initiative and Radon Program activities be improved?

Design and Delivery

- ▶ How well have risks been managed?
- > To what extent is the CAA management and accountability structure contributing to the delivery of the IAQ theme?

2. METHODS

The IAQ evaluation matrix (see Appendix C) outlines which methods were used to capture data for each of the evaluation indicators. The evaluation matrix includes the use of multiple lines of evidence and complementary research methods as a means to ensure the reliability of the information and data collected. Five main lines of inquiry were used for this evaluation, including both quantitative and qualitative methods: a document and literature review; interviews; a survey; analysis of program data; and a review of financial data. A description of each data source is described below by line of inquiry.

2.1 Data Sources

2.1.1 Document and Literature Review

Relevant background documents were reviewed in order to develop a better understanding of the IAQ theme, the programs that make up the theme, and how these programs fit into overall Government of Canada priorities. Additionally, the review and analysis of program data (including administrative/performance data and relevant databases) was undertaken to inform the assessment of the level of success that had been achieved and to answer some design and delivery questions. Some of the types of program materials reviewed included: meeting minutes, annual reports, IAQ RMAF, survey data, and research papers.

GCS also reviewed documents that relate more generally to indoor air quality. These documents were reviewed to collect information on the relevance of, and rationale for, the IAQ theme programs. The review also examined any potential overlaps with other programs, any identified best practices, potential alternative delivery approaches, and opportunities for gains in efficiency, particularly from radon programs in other countries. A country comparison was not conducted for the IA R&D Initiative as it was deemed that there were no comparable programs. The specific indicators addressed by the document/literature review are identified in the evaluation matrix (see Appendix C). The list of documents reviewed can be found in Appendix D.

A customized template was populated with findings from the document review. This method enabled GCS to extract and analyze relevant information according to indicators and evaluation questions.

2.1.2 Interviews

GCS conducted a total of 53 interviews with program staff from both programs of the IAQ theme, co-delivery partners/stakeholders, and external experts. These interviews provided insight into program history and delivery, progress towards the achievement of outcomes, potential overlaps with other programs, program efficiency, lessons learned, best practices, cost-effectiveness, and the contribution of CAA management and accountability under the IAQ Theme.

Interviewees were provided with an interview guide in advance of the interview and assured of their anonymity (see Appendix E for Interview Guide Matrix). Interview findings are reported in an aggregate manner with no reference to an individual interviewee, no names were used and work was within the bounds of the Access to Information and Privacy Act.

All interview notes were analysed by indicator and respondent group. Interviewees in a group interview tended to express similar opinions, consequently those interviews were summarised by interview session rather than by individual interviewees. In the few cases where interviewees expressed different opinions within their group interview, their responses were analysed by individual. Note that throughout the report the total number of interviewees (the denominator) may fluctuate as not all interviewees were asked all questions.

Table 1 outlines the number of interviews and the number of interviewees by group. The far left column demonstrates how the interviews were grouped for analysis.

Table 1				
Number	of	Interviewees		

Analysis Groupings	Category of Interviewee	# of Interviews	# of Interviewees						
Radon Program	Radon Program – Health Canada								
1	Program staff (Headquarters)	4	4						
2	Senior Management	4	4						
3	Program staff (Regions)	6	9						
Radon Program	n – Co-Delivery Partners & Stakeholders								
	First Nations and Inuit Health Brach (FNIHB) staff (Headquarters)	2	2						
	Natural Resources Canada representative	1	1						
4	Department of National Defence representative	1	1						
	Public Works and Government Services Canada (PWGSC)	1	1						
	Provincial/National Building Code representative	1	1						
5	Provincial/Territorial representatives	8	8						
6	6 Non-governmental organizations (NGOs): Clean Air Foundation, Canadian Cancer Society, Canadian Lung Association		5						
7	External Experts	3	3						
Total – Radon	Program	35	39						
IA R&D Initia	tive – National Research Council Canada	•							
8	NRC-IRC Program staff	4	7						
9	NRC management	3	3						
IA R&D Initiative – Co-Delivery Partners & Stakeholders									
10 L'Institut national de santé publique du Québec (INSPQ) representatives		2	2						
11 Technical Advisory Committee members		2	2						
12	National Indoor Air Stakeholder Committee members	7	7						
12	External Experts	1	,						
Total – IA R&	D Initiative	18	21						
Total		53	60						

2.1.3 Survey

A web-based survey was administered to collect information related to the Radon Program. The survey sample included all building owners/managers and departmental representatives who had been asked to participate in the Federal Building Testing component of the Radon Program. Contact information for potential survey participants was gathered through contact lists from regional Health Canada offices. Of the 205 email addresses provided, 96 individuals responded to the survey, but one of the responses was deemed invalid and removed from the results. It was deemed invalid as the respondent did not answer the majority of the questions and appeared to have looked through the survey rather than respond to the survey questions. The 95 valid responses resulted in a response rate of 46% and a confidence interval of 95%, plus or minus seven percent (\pm 7.4%). Please see Table 2 below for more details.

Valid Email	Received	Usable	Response	Confidence
Addresses		Responses	Rate	Interval
205	96	95	46.3%	95% ± 7.36%

Table 2Survey Response Rate

The web-based survey was used to help assess the level of success that the Radon Program has had in achieving outcomes. The survey included both open- and closed-ended questions (see Appendix F for a copy of the survey and analysis of quantitative questions). To maximise response rates, an email was sent out from a senior member of the Radon Program announcing that a survey was forthcoming, describing the rationale for the survey and emphasizing the importance of participation. The evaluators followed-up with an email that included a link to the survey. The survey was open for three weeks and respondents were sent a reminder email at 1.5 weeks as well as two days before the close of the survey.

2.1.4 Financial Data

Radon Program managers and IA R&D Initiative managers were asked to provide actual expenditures and Full Time Equivalents (FTEs) for their respective programs. Program managers at NRC were able to report actual expenditures and FTEs classified by fiscal year and subcomponents. Actual expenditures for the Radon Program were initially difficult to obtain. Financial managers and program managers at HC were subsequently approached and were able to report on financial data at an aggregate level for the program, and by funds expended by component.

2.2 Limitations of the Evaluation Methodology and Mitigating Strategies

The evaluation methodology was designed to provide multiple lines of evidence in order to identify relevant evaluation findings. The data and information were collected to respond to the evaluation questions and issues. As in all evaluations, there are limitations and considerations that should be noted.

General Limitations

Timing of evaluation

The IAQ thematic evaluation was conducted during the third year of a four-year program, in order to meet the requirement that the results feed into the 2010/2011 CAA horizontal roll-up report. Findings are therefore based on data from the first two and one-half years of the program (2007/08 to the first two quarters of 2009/10). In some cases it was possible to provide projections for the third year (e.g., number of federal buildings tested). However, many of the

impacts are not expected to be evident until the end of the four-year period, particularly for the IA R&D Initiative. The evaluation therefore reports on progress made toward achieving expected outcomes, as opposed to final conclusions on outcomes achieved.

Public Opinion Research (POR)

Both the IA R&D Initiative and the Radon Program had included POR in their design: the Radon Program as a means to measure public awareness levels about radon and the IA R&D Initiative as a means to measure public awareness about IAQ and IAQ solutions. In both cases, approval for POR was requested but not granted.⁷ The lack of public opinion data served as a limitation in the evaluation of the Radon Program and as a barrier to achieving success in the case of the IA R&D Initiative. In the case of the Radon Program, POR data on awareness levels is needed to be able to determine the level of success that has been achieved in improving awareness of health risk and causes of elevated radon and strategies to improve it. A baseline measurement was taken in 2007 but the current level of public awareness is unknown, making it difficult to measure the change in level of awareness. For the IA R&D Initiative, conducting a survey to assess public awareness of indoor air and improvement strategies was a planned research activity that has been prevented. The lack of data did not limit the evaluation of the Survey can be found in section 3.2).

The lack of available public opinion data for the Radon Program has resulted in the evaluators making use of proxy measures to attempt to assess the Radon Program's success in improving public awareness. The available proxy measures may not provide a valid point for comparison; however, they consisted of data on awareness levels only among participants in the Radon Program and participants of the CARA sponsored Cross Canada Radon Survey. These findings do not necessarily represent the level of awareness among the Canadian public in general.

Limitations in Measurement for Radon Program

Financial information

Financial information was difficult to obtain for the Radon Program. HC financial administrators were able to report on data at the aggregate level for the Radon Program. Efforts were made by program managers to analyze expenditures and after some delay they were able to provide financial data for each of the funded components. More effort was required to try to reconcile the program-held financial data with that of HC's finance directorate, delaying the production of the evaluation report. Eventually, comprehensive financial data was provided.

⁷ Critical data for assessing the success of the education and awareness components of the Radon Strategy is reliant on the ability of Health Canada to conduct POR. During the past number of years, POR has been restricted across the federal government, including Health Canada, and there is a risk that we will not be able to conduct the research required to determine the success of the education and awareness component. In this case, Health Canada will need to rely on any available secondary sources of data, such as the CCRS, and such data may not represent a valid point of comparison.

Interviews with Provincial/Territorial (P/Ts) representatives

The evaluators had planned to interview one representative from each province and territory, but were only able to interview eight representatives within the data collection period. The remainder either declined to be interviewed because they did not feel they were informed enough to participate (3) or were not available for an interview during the data collection period (3). The eight were deemed adequate because they included representatives from the east, central, west and north of the country.

Limitations in Measurement for IA R&D Initiative

There were no significant methodological limitations specific to the IA R&D Initiative. The evaluators were provided with all relevant program data, interviews were secured with all expected individuals, and financial data were tracked and reported by program component.

3. FINDINGS AND CONCLUSIONS

3.1 Relevance

Evaluation questions explored in this section include:

- > Do the IA R&D Initiative and Radon Program continue to reflect government priorities?
- > Do the IA R&D Initiative and Radon Program continue to reflect the needs of Canadians?
- Do the IA R&D Initiative and Radon Program duplicate or overlap with any other initiatives?

Conclusion

The Government of Canada's priorities shifted in 2009 to heavily focus on the global economic crisis; this focus continues in 2010. However, the IA R&D Initiative and the Radon Program were aligned with federal government priorities when the IAQ Theme was developed and continue to be aligned with Health Canada, National Research Council and Environment Canada priorities. Both the IA R&D Initiative and the Radon Program continue to reflect the needs of Canadians. Provinces, non-governmental organizations (NGOs) and at least one Canadian university are conducting work that complements the Radon Program; however there does not appear to be any duplication of either the IA R&D Initiative or the Radon Program.

Supporting Evidence

There is evidence of federal support for IAQ in key documents dating back to 2006; references to clean air are less evident in high level government documents in more recent years. There was no reference to clean air or indoor air quality in the 2009 Budget or Speech from the Throne or in the 2010 Speech from the Throne; however, there is evidence of federal support for IAQ in key documents prior to 2009. The Canada Gazette published a Notice of Intent on October 21, 2006: "Indoor air: The Government intends to develop measures for improving indoor air quality. Information gathering authorities will be used to identify indoor air issues that are national in scope and require government action. Measures will include identification and regulation of products that could result in degradation of indoor air quality.⁸ Subsequently, clean air was mentioned as a priority in the Government of Canada's 2007 and 2008 Budgets. Under the framework used for whole of Government reporting, IAQ themes specifically match government priorities related to the expected Government of Canada outcome of "Healthy Canadians".

Within Health Canada, the National Research Council and Environment Canada, there continues to be alignment between IAQ and organizational priorities. As the lead department on CARA, EC's 2009/2010 Report on Plans and Priorities mentioned IAQ Theme components as contributing to CARA outcomes. NRC's 2009/10 Report on Plans and Priorities indicates that IAQ provides ongoing support to Canada's federal Science & Technology Strategy. In addition, HC's 2009/10 Report on Plans and Priorities mentions "...the Department's efforts in working with partners to carry out health and environmental initiatives such as the Chemicals Management Plan, Clean Air Agenda and National Water Strategy."⁹ thus demonstrating support for the IAQ theme under the Clean Air Agenda.

The IAQ Theme continues to reflect the needs of Canadians. Canadians spend an average of 90% of their time indoors, where they can be exposed to mould from excessive moisture and inadequate ventilation, carbon monoxide, volatile compounds emitted by building materials, and naturally occurring pollutants such as radon gas¹⁰. According to a 2009 poll by the Canadian Lung Association, 54% of Canadians said clean air should be a top or high priority for federal and provincial governments¹¹. Poor indoor air quality is linked to a wide range of health effects, including asthma, allergies, lung cancer, respiratory infections, and ear/nose/throat irritation¹². The Canadian Lung Association has specifically noted that indoor air quality can strongly affect children with asthma.

Radon is a colourless, odourless, radioactive gas that occurs naturally in the environment. Radon gas can move through small spaces in the soil and rock upon which a house is built and seep into a home through fissures in basement floors¹³. While radon represents a far smaller risk for lung cancer than tobacco smoke, it is responsible for approximately 1,900 deaths a year in Canada and

⁸ The Canada Gazette published a Notice of Intent on October 21, 2006

⁹ Reports on Plans and Priorities 2009-2010 (HC, October 2009)

¹⁰ http://www.hc-sc.gc.ca/ewh-semt/air/in/index-eng.php

¹¹ http://www.lung.ca/media-medias/news-nouvelles_e.php?id=149&print=1

¹² Indoor Air Quality Theme Results-based Management and Accountability Framework (HC/NRC, 2008)

¹³ http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/radon-eng.php

is the second leading cause of lung cancer¹⁴. The International Agency for Research on Cancer (IARC) classifies radon as a Group 1 carcinogen, with a well established link to lung cancer.¹⁵ Despite the risks, information collected by Health Canada in 2005 indicated a very low level of understanding among Canadians of the health risks associated with exposure to radon gases¹⁶. In addition, data on exposure levels across Canada are incomplete. Centrally coordinated research is required to create a more comprehensive map of radon risk zones. Since radon is a multijurisdictional health issue, coordination and cooperation between federal/provincial/territorial (FPT) partners is needed for the generation of comprehensive radon data¹⁷.

The IA R&D Initiative is not perceived to overlap or duplicate with any other initiative and measures have been put in place to avoid duplication. Approximately half (11/20) of the interviewees were not aware of any programs similar to the R&D Initiative. Two of the 20 interviewees said the R&D Initiative was complementary to other programs (e.g., HC Indoor Air Quality unit). The remaining interviewees (7/20) mentioned that they were aware of IAQ work taking place, but that the other work was not comparable to NRC's initiative. It was indicated that the NRC Indoor Air Research Facility and field study is unique in design. Interviewees identified various examples of organizations undertaking complementary work, including international networks, Health Canada, the American Society of Heating, Refrigerating and Airconditioning Engineers (ASHRAE), CMHC, and universities. Interviewees mentioned that work conducted by these organizations included: filter standards (ASHRAE); ventilation studies (universities); ventilation studies in other cities (HC), and IAQ research in other countries. It was noted that the work conducted in other countries may not apply to Canada because of Canada's specific climate, building materials and age of buildings. Therefore, Canada needs to conduct its own research. Within Canada, NRC has put in place measures to avoid duplication. Each IAQ research project conducted by NRC has a cross-jurisdictional steering committee in place that helps guide research and ensures that the work being conducted by NRC is not duplicating work that is being conducted in other jurisdictions.

Documents and interviews show that complementary rather than duplicative work is occurring for the Radon Program. The majority of interviewees (28/31) were not aware of programs that duplicate the Radon Program. One interviewee was not aware if any program duplicated the Radon Program whereas the remaining two interviewees noted duplication. Of the two interviewees who noted duplication, one mentioned CAREX Canada, which is funded by Health Canada, as almost exactly duplicating the Radon Program, specifically for radon measurements/mapping. The other interviewee thought that work conducted by the British Columbia Health Authorities was duplicative. In the interviewee's opinion, the British Columbia Health Authorities are hiring dedicated radon staff with the same duties as Radon Program staff, including education, coordination, and the selling of detectors. It would appear that the work noted by these interviewees is complementary rather than duplicative, since HC is not involved in the selling of detectors and works in cooperation with the provinces through an FPT

¹⁴ http://www.cancer.ca/Canadawide/Prevention/Specific%20environmental%20contaminants/Radiation/Radon%20exposure%20and%20lung %20cancer.aspx?sc_lang=en

¹⁵ ATSDR Toxicological Profile for Radon (2008); http://www.atsdr.cdc.gov/toxprofiles/tp145.pdf

¹⁶ National Radon and Indoor Air Quality Survey - Final Report (Environics Research Group, 2007)

¹⁷ Guide for Radon Measurements in Residential Dwellings (Homes) (HC, 2008)

committee to share information and avoid duplication. According to the CAREX website,¹⁸ the objective of CAREX is, "to develop estimates of the number of Canadians exposed to carcinogens in their workplace and community environments". Radon is one of the carcinogens included in their estimates. However, it appears that CAREX is relying on HC data for these estimates, which CAREX admits is incomplete.

Interviewees noted that complementary work is occurring in some provinces (Nova Scotia, New Brunswick, Quebec, Manitoba, Saskatchewan and British Columbia), with NGOs (Canadian Lung Association and Canadian Cancer Society), with Dalhousie University (certification courses) and with several other government departments (CMHC, NRC, DND, and other groups within HC). Most interviewees (33/35) believe the Radon Program is well situated in Health Canada.

Documents revealed that other jurisdictions (provincial, municipal, NGOs) are actively conducting some activities (E&A, testing) complementary to the Radon Program.

- A number of P/T governments are supporting E&A, such as by posting webpages on radon and disseminating information and/or weblinks.
- Both Nova Scotia and Prince Edward Island publish the results of radon tests of public buildings.
- Free building test kits are provided by the Yukon Housing Corporation, and the Government of Yukon tracks the results from building testing.
- The Regina Qu'Appelle Health Region issued a warning in 2007 for homeowners to have their homes tested after high radon readings were detected from regional testing.
- In British Columbia, the Northern Health Authority conducts education and awareness and sells radon test kits to homeowners.
- Some NGOs are involved in the promotion of radon awareness, including the Canadian Lung Association, and the Canadian Cancer Society.
- Meeting minutes for the Radon Mapping Working Group indicate Saskatchewan has contracted soil gas radon measurements and this work is expected to continue in the future.

The work conducted in other jurisdictions complements rather than duplicates Radon Program activities. The level of activity varies by province, and the federal government can help to ensure consistency of messaging regarding radon, as well as share information across provinces. Sharing of information is coordinated through the FPT committee.

¹⁸ http://www.carexcanada.ca/en/our_research/

3.2 Effectiveness

Due to the fact that this evaluation is being conducted during the third year of a four-year program and many of the outcomes are not anticipated until the end of the four-year period (particularly for the IA R&D Initiative), the evaluation focuses on examining progress made to date. This includes an exploration of implementation against targets that were set out in the IAQ theme RMAF, progress towards outcomes, and a discussion of the feasibility of outcomes being achieved within the funding period (2007/2008 to 2010/2011). Unintended outcomes, limitations, barriers, best practices and lessons learned will also be discussed. The flow from activities to immediate outcomes for the two programs in the IAQ theme are, for the most part, independent and will therefore be presented separately (IA R&D Initiative in section 3.2.1 followed by Radon Program in 3.2.2).

3.2.1 Progress on Achievement of IA R&D Initiative Outcomes

Funding was provided under the IA R&D Initiative for three primary components: 1) Assessment of the Impacts of Ventilation on Health (\$4.8 million for four years), 2) Evaluation of Indoor Air Quality Technologies and Solutions (\$1.6 million for four years), and 3) Establishment of a National Advisory Committee Focusing on Indoor Air, now called the Canadian Committee on IAQ and Buildings (\$1.57 million for four years). The primary activities of these components are as follows:

Component 1: Assessment of the Impacts of Ventilation on Health

- Assessment of the impacts of improved indoor air ventilation and indoor air distribution on indoor air quality and human health, with a focus on children with asthma, through an intervention study over two years in residential homes in the Quebec City area (the Field study)¹⁹.
- The construction of a new Indoor Air research laboratory to enable optimal interventions within the above mentioned field study²⁰.

Component 2: Evaluation of Indoor Air Quality Technologies and Solutions

• Evaluation of the effectiveness of three to four of the most relevant technologies and solutions currently used for indoor air quality management²¹.

Component 3: Establishment of a National Advisory Committee

• Establishment of a national committee focusing on indoor air to review relevant information, identify research gaps, and to provide a venue of discussion and dissemination of reliable knowledge on indoor air quality²².

¹⁹ Indoor Air Quality Theme Results-based Management and Accountability Framework (HC/NRC, 2008)

²⁰ Ibid.

²¹ Ibid.

Components 1 and 3 are expected to lead to increased knowledge of risks, health impacts and mitigation strategies related to indoor air quality. Component 2 is expected to lead to increased knowledge and support for the development of technological solutions for improved IAQ (see logic model in Appendix B).

To assess progress on achieving expected outcomes, the following evaluation questions were explored:

- > To what extent is the IA R&D Initiative being implemented as planned?
- To what extent has the IA R&D Initiative contributed to the achievement of increased knowledge of risks, health impacts and mitigation strategies related to indoor air quality?
- To what extent has the IA R&D Initiative contributed to increased knowledge and support for the development of technological solutions for improved IAQ?
- > What, if any, unintended (positive or negative) outcomes have occurred?
- > What external factors influenced the success of the IAQ Theme?
- What are the best practices and lessons learned (positive and negative) from the IA R&D Initiative?

Conclusion

The immediate outcomes of the IA R&D Initiative are not expected to be achieved until the final year of the Initiative (2010/11), making it difficult to determine the level of effectiveness of the IA R&D Initiative at: increasing knowledge of risks, health impacts and mitigation strategies related to IAQ; or increasing knowledge and support for the development of technological solutions to improve IAQ. However, progress against expected targets was assessed, and the IA R&D Initiative appears to be generally on track towards achieving expected targets. Parties outside of NRC (including CMHC and an international expert) have already started to express an interest in the knowledge that is expected to be generated by the IA R&D Initiative. A variety of lessons were learned, particularly related to improving the effectiveness of the National Advisory Committee (e.g., need for an administrative support function for the committee).

Supporting Evidence

Conclusions are based on findings from program data, interviews, and the document review.

A review of the IAQ theme RMAF reveals that new knowledge is not expected to be generated until the end of the funding period (2010/11)²³. Evidence from program data showed that the majority of effort during the first three years has been expended on activities such as: staffing, getting approvals for research, constructing laboratory facilities, establishing relationships with delivery partners, establishing steering committees, establishing protocols, and

²² Indoor Air Quality Theme Results-based Management and Accountability Framework (HC/NRC, 2008).

²³ Ibid.

collecting and analyzing data. Targets were mostly met in regards to these activities and interest has already been expressed by CMHC and at least one international expert in the knowledge that will be generated from these activities (See Table 3 below).

Program data and interviewees revealed that a few delays were experienced, some of which are ongoing. Delays included establishing a Memorandum of Understanding (MOU) with a provincial health partner for a ventilation study, developing the third protocol for the IAQ technologies and solutions component, having a second meeting of the Canadian Committee on IAQ and Buildings (the Committee), and conducting an awareness study on IAQ. Listed in Table 3 are the targets as identified in the IAQ theme RMAF and the current status. The status was determined through a review of program documents and was confirmed with Program staff.

Target	Status	Description
Component 1 - Assessment of the Impacts of Ventilat	ion on Health	
Indoor lab completed in 2008/09	Met	Completed on time
1 MOU with provincial health partner 2008/09	Delayed	Not completed on time; addressing intellectual property issues
Formation of scientific steering committee in 2007/08	Met	First Meeting January 2008. Meet on a regular basis
1 Research study conducted in 2010/11	On track	Expected in 2010/11
New findings of research studies in 2010/11	On track	Findings of 1 study expected in 2010/11. Preliminary results from field studies have been shared with committee members and at conferences (i.e. Healthy Buildings, international conferences)
Component 2 - Evaluation of Indoor Air Quality Tec	hnologies and So	lutions
3 protocols developed in 2009/10	Delayed	2 completed on time; 1 to be completed in 2010/11
2 Technical Advisory Committee meetings by 2009/10	Delayed	1 meeting held in 2008/09; 2nd has not yet been held
2 test systems to test IAQ technologies by 2010/11	On track	Expected in 2010/11
3 technologies tested against protocols by 2010/11	On track	Expected in 2010/11
1 collaborative agreement to support IAQ solution by 2010/11	On track	Expected in 2010/11
Report on procedures in support of rating system by 2010/11	On track	Expected in 2010/11
1 publicly available data set relating to IAQ solutions/technologies by 2010/11	On track	1 data set with 3 subsets expected in 2010/11.
4 Papers published in peer-reviewed journals - 2 in 2009/10 and 2 in 2010/11	Delayed, unlikely to meet	One article in peer review process. One publication in internal review then will go for peer review (peer review takes three months, then 2 more months for potential publication).
Component 3 - Establishment of a National Technica	l Advisory Com	mittee Focusing on Indoor Air
Formation of Canadian Committee on IAQ and Buildings	Met	Completed on time
2 stakeholder meetings/workshops in 2009/10	Delayed	1 completed on time, 2nd meeting cancelled last minute
1 survey on awareness of IAQ in 2009/10	Delayed	Not completed on time; On hold due to POR

Table 3Targets and Status IA R&D Initiative Outputs
The majority of targets for Component 1 and 2 are expected to be met, with a few minor delays. The delays within Component 1 and 2 are minor and there should be time to overcome the delays before the end of the funding period (i.e., before 2010/11). Delays under Component 1 were a result of a change in NRC's Intellectual Property (IP) policy. The new policy was finalized within the last couple of months and discussions are underway with the provincial health partner to finalize the MOU. The lack of signature has not affected the progress of research activities. If unresolved, the lack of a MOU with the province could have an impact on NRC's ability to report on research findings from the Field Study. As part of Component 2, three protocols on the assessment of IAQ improvement solutions/technologies were to be developed: two have been developed to date and one is delayed but is expected to be completed in 2010/11. When interviewees were asked to comment on barriers to implementation, the responses varied but similar issues arose: a new IP policy within NRC that impacted NRC's ability to sign an MOU with its provincial partner for the field study, staffing delays that impacted the ability to get research projects underway, difficulty recruiting participants for the field study, and the late arrival of funding. Additionally, a hiring freeze at NRC was noted in the documents reviewed as causing delays in getting Components 1 and 2 underway 24 .

More challenges have been experienced in Component 3 and these challenges may have an impact on the committee's ability to achieve expected objectives. The mandate of the Canadian committee on IAQ and Buildings is to identify research gaps and help to initiate research in IAQ and building relevant areas²⁵. A target of the IA R&D Initiative was to conduct one survey of stakeholders (industry, homeowners, general interest groups, etc.) on awareness of indoor air and improvement strategies²⁶. The committee took on the responsibility of filling this research gap by commissioning a research study. It was successful in locating an appropriate contractor to conduct the research but has not yet obtained POR approval to conduct the study.

Most Committee members interviewed (5/7) indicated that there has been a lack of progress on committee activities and some (4/7) noted a lack of resources for coordination/follow-up. The Committee members come from diverse sectors and are not necessarily familiar with federal government administrative processes (e.g., government contracting process, getting POR approval).

When interviewees were asked about barriers to implementation their responses varied but similar issues arose: a lack of administrative support for the Canadian Committee on IAQ and Buildings, which is leading to a lack of continuity and progress on committee activities; and difficulties obtaining POR approval, which has led to an inability for the Committee to contract out the conduct of an IAQ awareness study. The awareness survey was going to be used to establish a baseline on the level of awareness of industry, home owners, general interest groups etc. on awareness of indoor air and improvement strategies. The data gathered would help inform future research on IAQ solutions and technologies and provide a basis for measuring a change in public knowledge of IAQ solutions and technologies. A target of 20% of Canadian consumers using technologies which are positively assessed to improve IAQ by 2016 was set in the IAQ RMAF. In the absence of this survey, it will be difficult to determine whether there has been a

²⁴ Clean Air Agenda (CAA) – Horizontal Performance Report 2008-2009

²⁵ Indoor Air Initiative Communications Plan (NRC, 2008)

²⁶ Indoor Air Quality Theme Results-based Management and Accountability Framework (HC/NRC, 2008)

change in uptake because the baseline will not be known. Efforts are still underway to try to get the survey approved and a contingency plan has not yet been established if POR approval is not granted.

Although a few delays and barriers have been encountered, interviewees also noted some external factors²⁷ that have had a positive impact on the Initiative. Interviewees' responses varied but a couple of positive factors were mentioned by individuals in more than one interview group. Factors included: support from CMHC (a financial contribution of \$100,000 to the field study which had not been included in the original Initiative plan), and attention from the media (including an article in Holmes Magazine on NRC's IAQ activities and objectives²⁸). Interviewees also mentioned the level of interest from the facilities management community, influence of external organizations (e.g., Leadership in Energy and Environmental Design - LEED, American Society of Heating, Refrigerating and Air-Conditioning Engineers - ASHRAE) and interest from health professionals.

Suggested lessons learned varied widely. The various lessons learned suggested by interviewees included: the importance of keeping in mind that end research goals may change due to new information/technology emerging and collaboration amongst diverse partners is excellent for research. In general, interviewees were satisfied with the progress of components 1 and 2 of the R&D Initiative and did not, with any consistency across interview groups, note lessons learned that would apply to these components. Lessons learned were generally related to the Committee. Some Committee members (3/7) noted adequate time needs to be provided for meeting preparation or cancellations. It was also noted that timely follow-up to meetings was important to keep up the momentum. Committee members seem to be willing to participate on the committee but indicated that they do not have the time or resources to take care of more administrative matters like distributing meeting minutes, meeting scheduling and logistics, dealing with government processes such as securing POR approval and the government contracting process. Committee members are willing to provide their time and experience to meetings but need support to keep the momentum up between meetings, and with government processes.

The multi-sector collaborative approach that permeates the IA R&D Initiative is viewed as a best practice. Each component of this initiative is working in cooperation with a committee that includes diverse members of the community. Component 1 has a scientific steering committee to help direct the research. NRC researchers are also working in close cooperation with public health care providers for the delivery of the field study. Component 2 has a technical advisory committee that was used to help vet the technologies that would be tested under this component. Component 3 is a committee comprised of a diverse range of representatives from the private sector, provincial organizations, and other federal government departments. Research conducted under the initiative is garnering interest from a diverse range of individuals outside of NRC. This is attributable not only to the multi-sector approach that ensures a diverse group of individuals are familiar with the IAQ activities conducted by NRC, but also to the media

A positive external factor is something that was not funded under the initiative but that has had a positive impact on the initiative.

²⁸ Fresh Air in Your Home – What the Government is Doing to Make it Right, Holmes Magazine (Dauphin Media Group Limited, January-February 2010)

attention received and the increased links between NRC and HC which may also contribute to the dissemination and use of results.

3.2.2 Progress on Achievement of Radon Program Outcomes

Funding was provided under the Radon Program for three primary components: 1) Mapping of Radon Zones and Affected Populations (\$8.4 million for four years), 2) Testing and Remediation of Radon in Federal Buildings Located in High Risk Radon-Prone Areas (\$3.6 million for four years), and 3) Radon Education and Awareness Program (\$3 million for four years). The primary activities of the Radon Program are as follows²⁹:

- Mapping of radon zones and affected populations, using remote sensing technology supported by fieldwork in targeted areas;
- Testing of radon in approximately 15,000 federal sites located in known and/or potential high-risk radon areas; and
- Radon education and awareness (E&A) program: design, implement and coordinate a broad-based public awareness and education campaign.

Component 1 and 2 are expected to lead to increased knowledge of risks, health impacts and mitigation strategies related to radon while Component 3 is expected to lead to improved public awareness of health risks and causes of elevated radon and strategies to reduce radon levels in homes and buildings (see logic model in Appendix B).

To assess progress on expected outcomes, the following evaluation questions were explored:

- Is the Radon Program being implemented as planned and on time?
- To what extent has the Radon Program contributed to improved awareness of health risks and causes of elevated radon and strategies to improve it?
- To what extent has the Radon Program increased knowledge of risks, health impacts and mitigation strategies related to radon?
- What, if any, unintended (positive or negative) outcomes have occurred? Were actions taken as a result of these?
- What external factors influenced the success of the IAQ theme?
- What are the best practices and lessons learned (positive and negative) from the Radon Program?

Conclusions

Some aspects of the Radon Program are on track to being implemented as planned (e.g., field soil measurements, radon testing protocols) whereas others are not (e.g., federal building testing, roll-out of public awareness campaign). Many barriers were expressed regarding implementation by Radon Program managers (e.g., cooperation of other federal government departments for federal building testing, getting approval to conduct the public awareness campaign). The limited available evidence suggests that awareness levels have increased, but have not met target levels. There is a perception that the Radon Program is increasing knowledge of risk, health impacts and

²⁹ Indoor Air Quality Theme Results-based Management and Accountability Framework (HC/NRC, 2008)

mitigation strategies and that the knowledge is being used by target audiences. Both positive and negative external factors played a role in influencing the success of Radon Program. A few positive and negative unintended outcomes were identified by interviewees but there was no consistent trend in responses. Lessons learned were identified by interviewees and also came out of a comparison of Canada's Radon Program to the approach being taken in other countries (e.g., the importance of clear communication among stakeholders, the need to secure early buy-in from senior management for federal building testing, and local engagement).

Supporting Evidence

The conclusions are based on findings from the program data, interviews, the document review and the survey of federal building owners/managers and departmental representatives.

Radon Program staff encountered a number of barriers to producing outputs but the majority of targets have been met or exceeded. Performance data is missing to be able to determine progress against a few targets. Listed in the Table 4 are the targets as identified in the IAQ theme RMAF, and the actual current status as determined through a review of program documents and confirmed by program staff.

Target	Status	Description
Component 1 – Mapping of Radon Zones and A	Affected Popula	ations
2 surveys of homes in Canada tested for radon by 2011	Exceeded	Two surveys completed related to radon/thoron and thoron progeny testing in Ottawa and Winnipeg. A third is underway in Halifax and Fredericton.
Field soil measurements for radon completed in all provinces by 2011	Exceeded	860 for all 10 provinces by end of 2008/09.
Aerial measurement related to radon completed for 25% of Canada by 2011	Met – for less populated areas	HC and NRCan have compiled data for 30% of the country; 28% is from existing measures that were taken for mining or other natural resource activities and 2.2% is from new aerial measurements funded by HC of more densely populated areas representing 50% of the population.
4000 provincial buildings tested by 2011	Unknown - lacking evidence	MOA between HC and some provinces resulted in tests being performed on 1438 provincial buildings (Yukon 166, SK 743, MB 30, PEI 172, NB 77, NS 250) with more expected from Quebec in the next year. NS purported to have tested another 1700 buildings independent of MOA with HC.
Assess new construction radon limit	Met	Complete
9 reports developed by 2011	On track	7 reports developed by 2009/10.
Component 2 – Testing and Remediation in Fed	deral Buildings	Located in High Risk Radon-Prone Areas
% of Federal Buildings Tested 5% by end of 2007/2008 20% by end of 2008/2009 60% by end of 2009/2010 100% by 2010/2011	Delayed	5% by end of 2007/08 11% by end of 2008/09 Estimate of 17% by end of 2009/10

Table 4Targets and Status of Radon Program Outputs

Target	Status	Description
Component 3 – Radon Education and Awarene	ess Program	
30% of target audience aware of radon risks by 2009/2010 50% by 2010/2011	Unknown	Baseline of 17% awareness established in 2007/2008; POR not approved for further testing in subsequent years.
Radon Communication Strategy/Plan developed by 2009	Met but unable to roll- out	Developed and approved in 2008/2009 but not granted permission to roll-out radon-specific public awareness campaign.
Preparation of 2 protocols for radon testing and mitigation by 2009/2010	Exceeded	Prepared in 2008/2009
Establishment and implementation of 1 radon testing and 1 mitigation industry certification/training programs by 2011	On track	Expected by 2011
10 stakeholder engagements for radon by 2009/10	Exceeded	14 in 2007/2008, 33 in 2008/2009, and 52 as of August 2009/10
25% increase in hits on radon webpage by 2009/10	Exceeded	45% increase in web traffic from 2007/08 (23,500) to 2008/09 (33,000). Data unavailable for 2009/10
25% increase in downloads of Radon: a Guide for Canadian Homeowners by 2010/11	Exceeded	PDF downloads - 49% increase from 2007/08 to 2008/09 External print orders - 68% increase from 2007/08 to 2008/09)

Most targets for Component 1 (mapping of radon zones and affected populations) appear to have been met or exceeded but some evidence is lacking to be able to conclude on the success of provincial building testing. Canada is taking a multi-mode approach to mapping of radon zones and affected populations. Data is being collected from various sources including: soil measurements, aerial measurements, testing in public buildings and in homes. Targets related to soil measurement have been exceeded. HC was able to partner with Natural Resources Canada's Geological Survey of Canada group for the field soil testing and, by the end of 2008/2009, 860 sites in ten provinces had already been tested, putting HC well on its way to meeting field soil testing targets. Aerial measurement targets have also been exceeded for less densely populated areas of Canada. NRCan, with funding from HC, has compiled aerial measurements for 30% of the country. The majority of the data (28%) has come from existing measures related to mining or other natural resource activities the remaining (2%) from new aerial measurements of more densely populated areas. Radon Program managers stated that the intention is to continue aerial surveys in 2010/11 with additional flights over Alberta and Saskatchewan. Targets with respect to surveys of homes have also been met. Two surveys have been completed related to radon/thoron and thoron progeny testing in Ottawa and Winnipeg and a third is underway in Halifax and Fredericton. Radon Program staff were also expected to produce reports as a result of findings from these mapping activities. The production of reports is on track with 7 reports having been completed in 2009/10 and more expected by the end of 2010/11. The reports deal with mapping results, testing of soil radon gas levels or identification of the presence of radon isotopes in Canadian homes and the potential for health risks to the population.

Some mapping funds were used to establish MOAs with interested provinces to encourage the testing of public buildings. The funds provided were to be used as an incentive to get the provinces to test at least 4,000 buildings. HC currently has results from tests performed on 1438 provincial buildings (Yukon 166, SK 743, MB 30, PEI 172, NB 77, NS 250). Detectors have

recently been received from Quebec and more are expected this year. Some provinces have tested buildings independent of MOAs, for example Radon Program managers have heard that at least another 1700 public buildings have been tested in NS in 2007/08 but HC does not have results of the tests or reports from the provinces indicating the number of buildings tested. A Radon Program manager explained that the objective was to encourage provinces to test buildings and not for HC to necessarily fund the testing of all of the buildings or to get the results of the testing. The effort was to raise their awareness and provide them with tools (testing and mitigation protocols) to encourage them to test and take action. Even though HC is not necessarily expecting to get the results of all of the tests performed by the provinces independent of the MOAs; HC does need to be able to know at least the number of buildings tested in each of the provinces to be able to report on the progress that has been made against targets set in the IAQ RMAF.

Evidence from program data demonstrates that Component 2 (testing and remediation of federal buildings) is markedly off track due to a number of barriers and external factors. It was targeted that 60 percent of federal buildings would be tested for radon levels by the end of fiscal year 2009/10 but it is anticipated that 17 percent of buildings will actually be tested. Interviewees revealed that a number of barriers were encountered including: getting buy-in from departments at the senior level to conduct FBT in their buildings, a lack of interest by those at the operational level even if FBT was approved, and differing expectations on who should be responsible for distributing and collecting radon detectors in federal buildings.

Program managers explained that FBT was designed such that HC would hold responsibility for providing the detectors and communication material and conducting the laboratory analysis of the detectors following the testing period, but staff members in the federal buildings being tested would be responsible for deploying and collecting detectors and shipping them back to HC. At the program design stage, the amount of time and resources required to gain approval to test in federal buildings was not anticipated nor were allocations provided for the deployment and collection of radon detectors or for remediation. Buy-in was expected because under the Canada Labour Code the specification is made that "no employee shall be exposed in the course of any year to a concentration of radon that on average, over the year, is higher than 800 Bq/m3^{"30}. In reality, consent for testing needed to be approved by senior level management, budgets needed to be allocated to conduct the testing, and contingency funds needed to be made available in the event that remediation was required. HC has had to play a greater than anticipated role in deploying and collecting detectors, a process that has been resource intensive. Evidence from the survey of federal building owners/managers and departmental representatives revealed that HC performed the deployment and collection of detectors in 88 percent of the cases where a building was tested. As a result of these barriers, radon levels in the majority of federal buildings across Canada are not known. This has an impact not only on achieving Radon Program outcomes (i.e., increasing knowledge of radon risks across Canada) but, potentially, on the health of federal building occupants.

³⁰ Canada Occupational Health and Safety Regulations (SOR/86-304), http://laws.justice.gc.ca/eng/SOR-86-304/page-5.html#anchorbo-ga:l_X

There is a perception among the majority of interviewees that the Radon Program contributed to the achievement of increased knowledge of radon risks, health impacts or mitigation strategies. Most interviewees (22/31, or 70%) indicated that the Radon Program has contributed to either the achievement of increased knowledge of risks, health impacts or mitigation strategies related to radon, and only a few (4/31) thought that the Radon Program had not contributed to any new knowledge. The remainder of interviewees did not know or did not comment.

Program managers experienced a number of barriers implementing Component 3. The limited performance data available suggest that awareness levels have increased but targets have not been met. Component 3 was expected to lead to improved awareness of health risks and causes of elevated radon through a broad-based public E&A campaign. Program managers developed a broad based radon communication strategy/plan which was approved by senior management for dissemination. However, approval was subsequently revoked so that the plan could not be rolled out. Instead of going with a broad-based marketing and communication strategy, the focus shifted to fostering stakeholder involvement, as demonstrated in the program data by the increased focus on stakeholder engagements (see Table 4). Workshops were held across Canada with stakeholders who could help to transmit messages through their respective networks. HC provided stakeholders with the communication material on the HC website and in the form of external print orders and PDF downloads. A review of program data shows that there was greater than anticipated uptake of these materials.

Program managers had been able to get a baseline measurement of public awareness in 2007/2008 but were not granted approval to conduct POR to measure the change in the level of public awareness that resulted from the new stakeholder-focused approach. Yet, two proxy measures exist. Homeowners who participated in a Cross Canada Radon Survey (CCRS) funded under CARA in 2009/10 were assessed on their level of informed awareness of radon. It was found that 23 percent of homeowners showed an informed level of awareness³¹. The survey of building owner/managers and departmental representatives conducted during the evaluation showed a 25 percent level of informed awareness³². The target level of public awareness by 2009/10 was 30 percent. It can reasonably be assumed that if individuals participating in testing their homes or buildings have not shown targeted levels of awareness then it is unlikely that these targets have been met for the broader Canadian public.

There is a perception among the majority of interviewees that the Radon Program has led to improved awareness of health risks of radon and causes of radon exposure. The majority of interviewees (21/31, or 68%) believe that the Radon Program has led to improved awareness of the health risks of radon and the causes of radon exposure. The remainder of interviewees thought it was too early to tell (5/31, stakeholders, NGOs, P/Ts), did not know (3/31 - international experts) or thought that the program has not contributed to increased awareness

³¹ The definition of informed awareness, as described to homeowners who participated in the Cross Canada Radon Survey funded under CARA, many not be identical to the definition used in the survey of building owner/managers and departmental representatives.

³² Informed level of awareness means that the individual is aware of the following: 1) Radon is a colourless, odourless, tasteless radioactive gas, 2) Radon is a residual of decaying uranium found in soil and rock that is able to either escape to the atmosphere or seep into buildings and 3) that lung cancer is a health risk of elevated radon levels.

(2/31, NGO and P/T). Half of the interviewees (16/31) made the distinction that, in their opinion, awareness of mitigation strategies has not improved. Interviewees commented that mitigation was not part of the E&A strategy or that there has not been enough communication about mitigation.

Radon Program managers had more success implementing the elements of Component 3 over which they had more direct control. The preparation of testing protocols for federal buildings was completed ahead of schedule and the establishment and implementation of a radon testing and mitigation certification/training program is on track to being completed on schedule.

In addition to experiencing barriers and negative external factors, interviewees also mentioned some positive external factors that have had an impact on the Radon Program. Responses varied across interview groups, however many noted the importance of strong levels of interest in some provinces. This was noted by most (3/4) program managers and a few (2/8) P/T respondents. The considerable amount of leverage that the Radon Program was able to receive from other government departments, media, and academia was also noted. Leveraging included the use of HC employee time that was not budgeted for under the initiative, the media communicating regarding the risks of radon, particularly the media attention that resulted from a research study that discussed the link between radon and granite counter tops, and the fact that a Canadian university is offering a radon awareness and mitigation training program targeted at industry.

Lessons learned mentioned by interviewees varied widely. A couple of areas that were raised more often by interviewees included: the importance of clear communication among stakeholders, the benefits of getting local communities involved and interested in radon testing, and the importance of getting key stakeholders (e.g., senior management) involved early particularly for FBT.

Suggestions regarding communication tended to focus on the need for good communication amongst delivery partners. For example, one of the NGO representatives mentioned that they would like to know who the key players are in HC so they could decide who to contact with particular questions. Suggestions for 'going local' came from individuals in the regions, stakeholders and international experts. Program managers in the regions and stakeholders noted that it was more efficient to use local resources to carry out many aspects of the Radon Program. This was also identified in the interviews with international experts. International experts talked about the importance of getting local government involved (e.g., in the form of a letter from a health protection agency, local government, or local health board) and the importance of putting people in touch with local builders and getting local media involved. They found that the public was more likely to become engaged if the messages were from a local source. The lessons learned regarding FBT testing came from program managers, senior managers and stakeholders. It was recognized that more formal arrangements (e.g., a Memorandum of Understanding) need to be put in place earlier in the process (e.g., at the Memorandum to Cabinet stage) and that those involved in conducting the tests in federal buildings should be involved in the development of the testing protocols.

Lessons learned can also be found by comparing Canada's Radon Program to those in other countries. Canada's program is similar to those in the US, UK and Ireland but there are some key differences that Canada can learn from. The US, UK and Ireland were chosen for comparison purposes because these countries were deemed, by Canadian Radon Program managers, to have mature programs. When making the comparison however, it should be noted that Canada is in the third year of implementation of its Radon Program while the comparison countries have had programs in place, in some instances for over twenty years. Following is a summary of the similarities and differences between Canada's Radon Program and those in the US, UK and Ireland.³³

- Governance: Canada's initiative has a similar governance structure to those of other countries (there is a centrally managed program that requires cooperation with other jurisdictions and other government departments).
- Location: While in other countries radon programs tend to be located in environmental, health or radiological "Protection Agencies", Canada's program is located in its department of health. All experts thought that locating the program in a department of health was a good choice because radon is a health issue.
- E&A: Other countries are using similar education and awareness activities as those planned, and partially implemented, for Canada but there are some different techniques that could be considered (e.g., use of social media such as Twitter, trying to get local media interested in the issue, a national Radon Day to ensure radon gets attention annually). All other countries except for Canada were able to conduct a radon specific public awareness campaign.
- Reference levels: Canada has similar reference levels (200 Bq/m3) for homes but its level is much higher for the workplace than that of the UK and Ireland (Canada's level is set at 800 Bq/m3 compared with international levels of 400 Bq/m3).
- Testing duration: The duration of radon testing is similar. Most countries advocate for long-term testing (radon measurements are taken over a 3 month period), except the US, which uses short-term testing (radon measurements are taken over 48 hours) for realestate transactions.
- Test method: The most common method of testing, internationally, is alpha track. Canada uses a variety of test methods but is moving towards primarily using alpha track testing.
- National testing facilities: All other countries have national testing facilities that conduct the majority of testing. Canada has national testing facilities but homeowners that are not part of the CCRS would use private companies to conduct the testing.
- Maps: All other countries have radon maps; two countries based their maps on indoor testing only (not aerial surveys or soil tests). Canada uses a combination of aerial, soil, homeowner and federal building testing to gather data on radon risk areas.

³³ This information was taken from documents and confirmed through interviews with international experts in these countries.

- Remediation: As in Canada, building owners in other countries are responsible for remediation costs but, unlike Canada, two countries have programs to support some homeowners who cannot afford remediation.
- Measuring success of the Radon Program: All other countries base their assessment of effectiveness on the number of lives saved from lung cancer due to radon exposure. The number of lives saved is calculated based on the number of houses tested and remediated. Unlike other countries, Canada does not track the number of houses tested or remediated.

The most remarkable difference noted in comparing Canada's Radon Strategy to those in other countries is the acceptable radon limits in the workplace. The limit for Canada is 800 Bq/m³ while in the UK and Ireland it is 400 Bq/m3. HC is currently working with HRSDC to have the Canada Labour Code harmonized with the Canadian Radon Guideline of 200 Bq/m3. In an effort to revise the guidelines for radon levels in the Canada Labour Code (CLC), Health Canada gave a presentation to the Part X CLC Working Group in the fourth quarter of 2009/2010. Specifically, at this presentation Health Canada advocated for a revision to the CLC radon levels from the old guideline level of 800Bq/m3 to 200Bq/m3, and the committee stated that they would support the revised Canadian guideline. Canadian Radon Program managers pointed out that although the limit is lower in these other countries they may not have workplace testing programs in place. However, in Ireland radon measurement of the basement and ground floor of a building is legally required when the building is occupied greater than 100 hours per year and is located in a high radon area.

When it comes to E&A, each country reviewed has been able to conduct a radon-specific public awareness campaign. International experts explained that while broad public awareness campaigns are important they need to be supplemented with targeted activities such as local campaigns, an annual reminder of the importance of radon as a health issue (e.g., a Radon Day) and promotion through social media (e.g., Twitter).

Two of the three comparison countries base their radon maps on indoor air measurements. The rationale, as explained by experts in these two countries, is that there is little evidence that the radon limits in the soil or found during aerial mapping are linked to indoor air levels. In the experts' opinion, the most accurate way to map indoor air risk is to measure radon levels indoors. The countries that have employed the indoor testing technique (Ireland and UK) are smaller in geographic area than Canada. The governments also conduct the majority of the testing of homes in these countries, which has resulted in a constant supply of new data to update maps on a regular basis. Canada maps radon potential using data from various sources (aerial, soil, public buildings, homes). Canada's radon program managers believe that the mapping of radon potential provides the best combination of information for multiple purposes. The multi data approach allows for tracking areas as they are remediated and will show areas of higher potential

for radon based on soil radon and uranium measurements. Canada's radon program managers also stated that there are many countries (not included in this comparison) that employ a similar multi data approach to producing maps.³⁴

Another key difference between the comparison countries and Canada is that the comparison countries all have more access to data on when a house is tested for radon, what the results are, or when remedial action is taken. These data are used not only to update maps on a regular basis but also as a means for estimating the ultimate effectiveness (number of lives saved) of the program. Comparison countries, which have had radon programs in place for over a decade, have access to these data, either because the government is responsible for testing or because data sharing arrangements have been put in place with private companies conducting the testing. Canada does not currently have such arrangement in place due to the fact that when Canada's Radon Program began in 2007 there were zero testing companies in the country. In 2009 there are more than 50. The concept of sharing data is being explored through Canada's proposed certification process for testing and mitigation companies.

3.3 Efficiency and Economy

Under the 2009 GoC Policy on Evaluation, efficiency is defined as maximizing the outputs produced with a fixed level of inputs or minimizing the inputs used to produce a fixed level of outputs; and economy is defined as "minimizing the use of resources [...] to achieve expected outcomes"³⁵. These elements of performance are, therefore, demonstrated when:

- a) outputs are produced at minimum cost (efficiency); and
- b) outcomes are produced at minimum cost (economy).

Section 3.2 of this report outlines the progress that has been made towards expected outcomes and whether output targets have been met. The following is a discussion of the cost of producing the outputs and outcomes. The full cost and ability to achieve outcomes is not known as the evaluation was conducted during the third year of a four-year funding period. Program staff were able to provide financial data for the first and second year of the IA R&D Initiative and the Radon Program. Program staff were not able to provide data for the third year as the data was not yet complete when the evaluation was carried out.

3.3.1 Efficiency and Economy of the IA R&D Initiative

NRC was provided with a total of \$8 million dollars over a four-year period (2007/08 to 2010/11) to meet the objectives of the IA R&D initiative. The funding was broken down by three components. The first component – Assessment of the Impacts of Ventilation on Health – received 60 percent of the budget (\$4.8 million for four years), the second component –

³⁴ Some countries that employ a similar multi data approach according to the European Radon Research and Industry Collaboration Concerted Action (Synott & Fenton, 2005): Switzerland, Russia, China, Czech Republic, Finland, Germany, Greece, Italy, Australia, Norway and Spain.

³⁵ Treasury Board of Canada Secretariat. (2009). GoC Policy on Evaluation, April 1, 2009. Accessed online 07/02/09 at http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=15024§ion=text#cha4

Evaluation of Indoor Air Quality Technologies and Solutions – received 20 percent of the total budget (\$1.6 million for four years), and the third component – Establishment of a National Advisory Committee Focusing on Indoor Air now named the Canadian Committee on IAQ and Buildings – received the remaining 20 percent of the budget (\$1.57 million for four years).

In an effort to determine the efficiency and economy of the IA R&D Initiative, the following evaluation questions were explored:

- Are there more cost-effective and efficient means of achieving IA R&D Initiative outcomes?
- > How could the efficiency of the IA R&D Initiative activities be improved?

Conclusion

It is not possible to determine the degree to which the IA R&D Initiative was delivered economically at this time as the immediate outcomes are not expected to be achieved until the final year of the Initiative. However, the Initiative appears, for the most part, to be on track towards achieving objectives and has remained close to budget at the Initiative level. One of the components (Assessment of the Impacts of Ventilation on Health) of the Initiative has drawn resources away from the other two components, suggesting that it is not being delivered as efficiently as planned while the remaining components are attempting to meet objectives with fewer resources than originally planned. There is a perception that efficiency cannot be improved as NRC is undertaking a large volume of tasks for the amount of funding received and there are no viable alternatives to the current delivery model.

Supporting Evidence

The conclusion is based on findings from the review of financial data, program data and interviews.

Component 1 is over budget but meeting most targets, Component 2 is under budget and meeting most targets while Component 3 is under budget and struggling to meet targets. Component 1 is therefore not being delivered as efficiently as planned, while Component 2 is being delivered more efficiently than planned. Little of the Component 3 budget has been expended and more limited progress has been made against targets, suggesting that further resources may need to be expended on Component 3 to enable targets to be met.

The financial data for the first two years of the Initiative (see Table 5 below) reveals that Component 1 of the Initiative was 61 percent (\$1.48 million) over budget and using 4.1 more FTEs than budgeted at the end of the second year of the Initiative. Component 2 was 56 percent (\$485,000) under budget and using 2.4 fewer FTEs than budgeted. Component 3 was 81 percent (\$584,900) under budget and using 1.9 fewer FTEs than budgeted.

Table 5Budgeted Against Actual Expenditures Consolidated for the First Two Year of theIA R&D Initiative

Department/		Tot	al for Fi	rst Two Fiscal `	Years	
Program Component	Budgeted FTEs	Budgeted \$	Actual FTEs	Actual Expenditures	Variance FTEs	Variance \$
National Research Council of Canada						
Assessment of Ventilation on Health	5.5	2,411,000	9.6	3,894,615.0	-4.1	-1,483,615
Evaluation of Indoor Air Quality Technologies and Solutions	4.6	869,000	2.2	383,767.0	2.4	485,233
Establishment of a National Technical Advisory Committee Focusing on Indoor Air	3.3	720,000	1.4	135,100.0	1.9	584,900
Sub-Total	13.3	4,000,000	13.2	4,413,482.0	0.2	-413,482*

* Note that NRC contributed \$414,543 to bridge funding gap in FY 2008

The higher than expected cost of Component 1 was associated with the building of the indoor air research laboratory. The facility cost more to build than anticipated. Contractors responsible for building the laboratory did not build the laboratory to specification and extra resources were required in order to meet the requirements. NRC appeared to see the long-term value of the laboratory beyond the scope of the IA R&D Initiative, and allocated internal resources to provide the additional resources required for the construction. The variance noted above represents the additional funding from NRC and did not come from resources allocated to the Clean Air Agenda.

At the end of the second year of the Initiative, targets under Component 2 were mostly being met while 44 percent of the allocated budget had been spent. This could indicate that Component 2 is being delivered in a very efficient manner or that the cost of Component 2 was overestimated at the planning stage. However, those involved with Component 2 indicated that development and testing of three protocols is a significant amount of work for the allocated budget and time frame.

Component 3 is being delivered with 18 percent of its budget and 42 percent of the allocated FTEs and is struggling to meet targets. Over half of committee members interviewed (4/7) stated that while little had been spent, results produced had also been limited. One interviewee indicated that the Component was being delivered efficiently while the other two could not comment. The lack of dedicated resources to help the committee overcome administrative barriers and to provide continuity between committee meetings is having an impact on efficiency.

Overall, the Initiative is 10 percent over budget but the concentration of resources has been allocated to activities that will play the greatest role in generating new knowledge.

The majority of program staff (5/6) and all senior managers (3/3) think that the IA R&D Initiative is being delivered efficiently. Reasons given included that NRC was undertaking a lot of tasks for \$8 million and there are no alternatives to the current delivery model. It was also noted that the ventilation laboratory, which was built as part of Component 1, could be used for future research activities.

3.3.2 Efficiency and Economy of the Radon Program

HC was provided with a total of \$15 million over a four-year period (2007/08 to 2010/11) to meet the objectives of the Radon Program under the IAQ theme. The funding was broken down by three components. The first component - Mapping of Radon Zones and Affected populations – was allocated 56 percent of the budget (\$8.4 million for four years), the second component – Testing and Remediation of Radon in Federal Buildings – was allocated 24 percent of the budget (\$3.6 million for four years) and the third component – Radon Education and Awareness Program – was allocated 20 percent of the budget (\$3 million for four years).

In an effort to assess the efficiency and economy of the Radon Program the following evaluation questions were explored:

- Are there more cost-effective and efficient means of achieving Radon Program outcomes?
- > How could the efficiency of the Radon Program activities be improved?

Conclusions

It is not possible to determine the degree to which the Radon Program was delivered economically at this time as the immediate outcomes are not expected to be achieved until the final year of the program. However, output targets were set and the amount of funds expended on the various components of the Radon Program are known making it possible to draw some conclusions on efficiency. Program funds were used to support the Director General's (DG's) office, accommodation (PWGSC) and corporate service costs. Interim targets for Component 1 have been met or exceeded, for the most part, with fewer resources (financial and human) than anticipated suggesting that the mapping component is being done efficiently. Targets for component 2 have not been met and most anticipated resources have been expended. Fewer than budgeted resources were directly allocated to Component 3 and many of the output targets have been met or exceeded meaning that certain aspects of this component are being delivered efficiently. However, the limited data that is available suggests that interim outcome targets have not been met. The reduction of resources and barriers encountered by Radon Program managers has had an impact on the economy of this awareness building component. Perceptions of the economy of the Radon Program vary, but just over half of interviewees felt that the program was economical. Suggestions on how to improve the efficiency of the Radon Program vary but tended to concentrate on E&A and FBT.

Supporting Evidence

The conclusion is based on findings from the review of financial data, program data and interviews.

Overall slightly fewer dollars than anticipated have been directly expended on Radon Program Components. Funding for the Radon Program was allocated to the three program components with an expectation that roughly 7% of the budget in each fiscal year would be allocated to support employee benefit plan and accommodations costs leaving 93% of the budget to directly support each of the components. In actuality 85% of the budget in 2007/08 and 92.2% of the budget in 2008/09 went to directly support the three program components within the Radiation Protection Bureau of Health Canada. A small amount of funds lapsed in 2007/08 (\$116,000 or 3%) and no funds lapsed in 2008/09. Of the remaining funds for 2007/08 (12% of the expended budget), 2% was expended to the DG's office which supports the advancement of three components, 2% went to support accommodation (PWGSC), and 8% went to corporate service costs. In 2008/09 \$48,531 (1.3%) went to accommodation costs (PWGSC) and \$239,982 (6.5%) went to corporate services costs (see Table 6 below).

The funds expended on lab operational costs and overhead should support Component 2 (testing and remediation of federal buildings) as the labs are responsible for conducting the analysis of the radon detectors deployed in federal buildings. The money expended by the regions should support Component 2 and Component 3 (radon education and awareness program) as the regions should be working with local contacts to help advance Radon Program objectives. However, the regions have not been required to report on where funds have been expended so it is unclear what specific outputs they have produced with the funds.

Denartment / Program		2007-08		2008-09				
Component	Budgeted \$	Actual Expenditures \$	Variance \$ (Budget – Actual)	Budgeted \$	Actual Expenditures \$	Variance \$ (Budget – Actual)		
Health Canada / Santé Canada								
 Mapping of Radon Zones and Affected Populations 	1,300,000	274,830	1,025,170	2,100,000	1,700,000	400,000		
 Testing and Remediation of Radon in Federal Buildings Located in High Risk Radon-Prone Areas 	1,600,000	1,600,000	0	800,000	700,000	100,000		
3) Radon Education and Awareness Program	600,000	200,000	400,000	400,000 800,000		300,000		
Regions		386,873	-386,873		0	0		
Lab Operational Costs		501,027	-501,027		511,487	-511,487		
Component sub-total	3,500,000	2,962,730	537,270	3,700,000	3,411,487	288,513		
DG office		75,469	-75,469		0	0		
Accommodation		53,940	-53,940		48,531	-48,531		
Corporate Service Costs		291,861	-291,861		239,982	-239,982		
Sub-Total Other		421,270	-421,270		288,513	-1,600,000		
Total HC	3,500,000	3,384,000	116,000	3,700,000	3,700,000	0		

 Table 6

 Budgeted Against Actual Expenditures for the Radon Program³⁶

³⁶ The budgeted numbers is Table 6 include the 7% allocated to support employee benefit and accommodations costs

Fewer than budgeted FTEs are working directly on Radon Program components. There were ten fewer than anticipated FTEs working on the Radon Program in 2007/08 and nearly six fewer than anticipated in 2008/09 (see Table 7). The lack of dedicated FTEs in fiscal year 2007/08 may be related to late receipt of funds in 2007/08. The funds were not received until the summer of 2007.

Department/		2007-08		2008-09			
Program Component	Budgeted FTEs	Actual FTEs	Variance FTEs	Budgeted FTEs	Actual FTEs	Variance FTEs	
Health Canada / Santé Canada							
1) Mapping of Radon Zones and Affected Populations	2.2	1.0	1.2	2.4	1.0	1.4	
2) Testing and Remediation of Radon in Federal Buildings Located in High Risk Radon-Prone Areas	7.0	3.0	4.0	6.5	6.0	0.5	
3) Radon Education and Awareness Program	6.1	1.0	5.1	5.9	2.0	3.9	
Total HC	15.3	5.0	10.3	14.8	9.0	5.8	

 Table 7

 Budgeted Against Actual FTEs for the Radon Program

Interim targets for Component 1 have been met or exceeded, for the most part, with fewer resources (financial and human) than anticipated suggesting that the mapping component is being done efficiently. Over the first two fiscal years program managers have been allocated 58% of their anticipated budget and have managed to meet or exceed most targets. It is too early to be able to tell whether these efforts will prove economical. For example aerial measurements have been compiled for 28% of the country when the target was 25% of the country but the majority of the aerial measurements are of less densely populated areas. It is still too soon to be able to tell whether the aerial measurements will prove useful in helping to increase knowledge of risks, health impacts and mitigation strategies related to radon.

Targets for component 2 have not been met and more resources than anticipated have been expended suggesting that this component is not efficient. Over the first two years, component 2 was directly allocated 96% (on target once employee benefit and accommodation costs are factored in) of its anticipated budget but was also, in theory, supported by the funds provided to the labs (which conduct the analysis of the radon detectors distributed to the federal buildings) and the regions. Despite receiving the majority of allocated funds and the support of the labs and regions, it was only possible to test 11% of federal buildings when it was anticipated that 20% of buildings would be tested by the end of 2008/09. More funds were expended on the program in 2009/10 and it is anticipated that 17% of buildings will be tested when the target was 60% suggesting that efficiency is not improving over time.

Fewer than budgeted resources were directly allocated to Component 3 and the limited data that is available suggests that awareness levels have increased but interim awareness targets were not met. As discussed in section 3.2.2 Radon Program managers experienced a number of barriers, which were beyond the control of the program, in the roll-out of the radon public awareness campaign and had to resort to alternative strategies to build awareness of radon risks. In addition to these barriers, program managers were only allocated 50% of their anticipated budget for this Component and had fewer than anticipated FTEs to conduct the work.

Over the first two years of the program the anticipated level of FTE effort was 12 and the actual allocated FTEs over the period was 3. The alternative efforts and reduced resources still resulted in the majority of output targets being met suggesting that the alternative methods employed were efficient. However, resources were expended developing a radon specific public awareness campaign that was approved but never granted permission to be rolled out. Resources were therefore expended but were not used to help affect the intermediate outcome of improving public awareness of health risks and causes of elevated radon and strategies to improve it. The limited awareness data that is available suggests that interim awareness building targets have not been met. The reduction of dedicated resources (human and financial) and barriers encountered by Radon Program managers has had an impact on the economy of the awareness building component.

Perceptions of the economy of the Radon Program vary, but just over half of interviewees felt that the program was economical. Just over one-half of interviewees (18/34) think the Radon Program is economical; seven interviewees were not able to comment, while the remainder (9/34) thought the program was not economical. Reasons for why interviewees deemed the Radon Program to be economical varied widely. Some interviewees noted that the program is a good use of taxpayer dollars because of the health risks associated with radon, while others highlighted specific components of the program, such as laboratory testing, they felt were efficient. Reasons interviewees gave for why the program is not economical included:

- The radon map was not complete before the program began so the program was not riskbased.
- > Many dollars were spent on a public awareness campaign that did not happen.
- There was a lack of cooperation for the FBT program and an excess of radon detectors are used when conducting federal building testing (e.g., the second floor of buildings was tested and this was deemed excessive).

It should be noted that an environmental health awareness campaign was launched in March 2010 that included information on radon. At the time of the evaluation, program staff had mixed opinions on whether or not the work conducted for the radon specific campaign would be transferable to the broader environmental health campaign and in fact the work conducted for the radon campaign was not used for the environmental health campaign.

Suggestions on how to improve the efficiency of the Radon Program vary but tended to concentrate on E&A and FBT. Just over one-half (56%) of interviewees who were asked about how to improve the efficiency of the Radon Program offered suggestions. The majority of the suggestions came from program managers in HQ and the regions, senior managers and stakeholders. Those interviewees who offered suggestions on how to improve the efficiency of the E&A all thought that a public awareness campaign was the most efficient way to inform the public about radon. Suggestions were also offered on how to improve FBT: implement a stronger policy framework (TBS should mandate other government departments to test their buildings as part of their responsibilities with respect to health and safety), and ensure other government departments are on board and that there is participation and partnership between different levels of these organizations (e.g., working level, senior management) to see the FBT through.

3.4 Design and Delivery

Evaluation questions explored in this section include:

- ▶ How well have risks been managed?
- To what extent is the CAA management and accountability structure contributing to the delivery of the IAQ theme?

Conclusions

Potential risks were identified in the IAQ theme RMAF at the inception of the IAQ theme. Risks are discussed on a regular basis for the IA R&D Initiative and the Radon Program, but they are not discussed or tracked in the context of a formal risk management plan. The CAA management and accountability structure is not viewed as making a significant contribution to the delivery of the IAQ theme.

Supporting Evidence

Documents show that potential program risks and mitigation strategies for both the IA R&D Initiative and the Radon Program were identified in the 2008 IAQ theme RMAF³⁷. There is evidence that risks were addressed through meetings for both the IA R&D Initiative and the Radon Program.

Key risks identified for the R&D Initiative in the IAQ theme RMAF included: the risk of NRC duplicating research that is being conducted in another jurisdiction, and families dropping out of the field study (see Appendix G for a full list of risk and mitigation strategies identified in the IAQ theme RMAF). Most, but not all, IA R&D program staff and senior management (7/9) indicated they were aware of the formal risk management plan but there was no evidence that they were monitoring risk against the plan. However, four out of six program staff stated that risks were addressed through regular committee meetings and communicated to management when appropriate. Committee meeting minutes confirm that risks associated with the field study and recruitment for the Canadian Committee on Indoor Air and Buildings was monitored by the NRC³⁸.

Risks identified for the Radon Program in the IAQ theme RMAF included: delays that could impact the schedule, insufficient communication to build awareness, and unrealistic expectations regarding funding for remediation. All senior managers (3/3) confirmed that the Radon Program had a risk management plan, whereas half of the program staff were aware of risks as identified in the RMAF although none were aware of a formal risk management plan. However, almost all headquarter and regional program staff (9/10) mentioned that regular meetings and

³⁷ Indoor Air Quality Theme Results-based Management and Accountability Framework (HC/NRC, 2008)

³⁸ Indoor Air Initiative Meeting Minutes, (NRC 2007-2009); Indoor Air Initiative - Evaluation of IAQ Solutions in Support of Industry Innovation (NRC's website) http://www.nrc-cnrc.gc.ca/eng/projects/irc/air-initiative/iaqsolutions.html

teleconferences allowed for discussions and regular updates on risks. There is documented evidence, in the form of meeting minutes, that steps are being taken to manage risks on a regular (at least quarterly) basis. As an example, the hold placed on the national radon awareness campaign was discussed in meetings and mitigated by alternative communication methods such as outreach through partnerships with NGOs³⁹.

The CAA management and accountability structure is not perceived to be contributing significantly to the delivery of the IAQ theme. The CAA management and accountability structure was viewed by R&D senior management (3/3) and the program staff who interact with CAA (3/6) as helping to set clear objectives for the IAQ theme and keeping work focused on achieving results. However, the same respondents also frequently found the requirements of the reporting process and the CAA HMARF to be tedious and burdensome relative to the amount of funding provided to the IAQ theme (1% of CAA budget or \$23 million out of a \$1.9 billion dollar budget). NRC has communicated information, results and decisions to CAA through annual performance reports. Senior Managers (4/4) of the Radon Program did not consider the CAA reporting structure to be a program enabler. Communication within the CAA management and accountability structure was considered to be one-way, in that program managers were reporting program activities and results without obtaining information from other areas of the CAA. They also noted that some form of reporting at the theme level would be practical but that reporting beyond that level (i.e., at the CAA level) is not meaningful. It was noted by one senior manager that the Radon Program does differ from other HC programs because of how comprehensive and results focused it is, as a result of the planning undertaken at the commencement and as a result of the need to work cross-departmentally to achieve IAQ objectives. Documents showed that information on the Radon Program is being communicated up to CAA parties but there is no evidence that CAA information, results or decisions are being communicated to IAQ theme parties.

4. SUMMARY AND RECOMMENDATIONS

The IAQ R&D Initiative and the Radon Program were aligned with government priorities when the IAQ theme was developed and continue to be aligned with Health Canada, National Research Council and Environment Canada priorities. Both the IAQ R&D Initiative and Radon Program continue to reflect the needs of Canadians. Complementary work for the Radon Program exists, and there does not appear to be any duplication for the IAQ R&D Initiative or the Radon Program.

As IAQ theme immediate outcomes are not expected to be achieved until the end of 2010/11, it is not possible to make concrete determinations on the effectiveness and economy of the IAQ theme. The data that is available allows for determinations on expected achievement of outcomes and efficiency of the IA R&D Initiative. The following table (see Table 8) provides a summary on effectiveness, efficiency and economy of the IA R&D Initiative and the Radon Program.

³⁹ Meeting Minutes (Regional Radiation Specialists) (HC, 2009)

Table 8Summary of Effectiveness, Efficiency and Economy of IA R&D Initiative
and Radon Program

IAQ Theme	Effectiveness	Efficiency	Economy
IA R&D Initiative	Evidence suggests that immediate outcomes should be achieved by the end of 2010/11.	Some components are being delivered efficiently while others are not.	Outcomes expected to be delivered within budget.
Radon Program	Evidence suggests that some immediate outcome targets will be achieved by the end of 2010/11 and others may not.	Some components are being delivered efficiently while others are not.	Those outcomes that will be achieved are expected to be delivered for less than budgeted but the overall budget will have been expended.

It appears that IA R&D Initiative program staff and managers have been able to overcome most barriers presented and are on track to achieving most objectives within budget. However, resources have been re-allocated within the Initiative to focus on assessment of ventilation on health, in particular the development of the test house, which is leaving fewer resources (FTE and financial) for the evaluation of indoor air technologies and solutions and for establishing a national advisory committee focusing on indoor air. This re-allocation of resources has had little impact on the progress made in evaluating IAQ technologies and solutions but it does appear to be having an impact on the Committee's ability to meet objectives. However, the concentration of resources has been allocated to activities that will play the greatest role in generating new knowledge, particularly with respect to the risk, health impacts and mitigation strategies related to IAQ. Demonstrated interest and support for the knowledge being generated out of IA R&D Initiative goes beyond the Initiative.

The IAQ theme is part of a much larger and multifaceted Clean Air Agenda. There has not been a significant degree of communication through the CAA management structure, beyond annual reporting of theme activities. IAQ theme partners will need to be pro-active in communicating with other CAA partners to get planning under way for any activities beyond 2010/11. Decisions will need to be made about the rationale for continuation under one agenda, at a theme level, a program level, or not at all.

The following recommendation should be addressed at the theme level:

Bring theme level partners together to start planning for the future beyond 2010/11, ensuring that 'lessons learned' identified in this evaluation are discussed. Determine how Theme partners would like to proceed and then broaden the discussion to include CAA operational managers and other CAA stakeholders to discuss whether there is a rationale for going forward under one agenda, with certain components of the CAA or not at all.

IAQ program managers and staff have been focused on delivering the components of the initiative and overcoming barriers to implementation. Going forward specific attention will need to be placed on planning for beyond 2010/11, and ensuring funds and resources are available to publish results of studies. Research is expected to be complete in 2010/11 (when funding expires) but knowledge generated is expected to be far reaching (e.g., public, consumer groups,

industry); there is a risk that time and resources will expire before results have been published. Some ongoing issues also need to be addressed in the near future: ensure MOU with provincial partners is signed now that NRC IP policy has been put in place, and ensure that the Committee is provided with adequate support.

The following recommendations for the IA R&D Initiative should be addressed:

- Ensure Intellectual Property issues with INSPQ are resolved and MOU with provincial partner is signed.
- Put in place an NRC staff member who is dedicated to supporting the Canadian Committee on IAQ and Buildings (e.g., coordination, administration, follow-up, assistance with government processes) and ensure funds are available to conduct planned research activities.
- Revisit program plans and determine if there are alternate methods of collecting information that has been delayed by Public Opinion Research restrictions, or if other information could be used.

The work planned under the Radon Program is important and will help bring Canada up to par with government radon programming in other countries that have had radon programs in place for several years. The Radon Program was designed to be effective, efficient and economical but numerous barriers, beyond the control of Radon Program managers have resulted in a program that has not yet achieved the anticipated level of success when it comes to measuring radon levels in federal buildings or increasing public awareness of radon. Despite barriers, HC program managers and staff have been able to get numerous and diverse stakeholders (private sector, NGOs, a few other government departments and provinces/territories) engaged in the issue. Outside of the government context, there seems to be interest and need to address radon issues: many homeowners have been willing to participate in radon/thoron measurements in their homes, NGOs recognize radon as an important issue and are willing to use their resources combined with HC's communication material to get the message out, industry is engaged and interested in the development of the radon testing and mitigation certification/training program. Although these stakeholders are engaged, they are looking for more communication between HC and the various stakeholders. An increase in communication would help ensure that all parties are aware of what each other is doing and of HC's expectations.

A number of barriers were encountered in conducting the radon public awareness campaign but approval has recently been granted to include radon awareness as part of a broader environmental health awareness campaign. The pieces that are still missing, despite considerable effort, include: buy-in from senior levels of government outside of HC and a few select departments for knowledge building (through FBT) of radon risk levels, and aerial measurements of more densely populated areas across Canada, performance information (especially in regards to public awareness of radon) and financial data that is more integrated and readily available for reporting.

The following recommendations for the Radon Program should be addressed:

- Review communication practices with delivery partners to ensure clear communication channels are in place (e.g., clear points of contact at HC) and that messages are consistent (e.g., regarding the assistance that HC desires from stakeholders).
- Ensure the performance data is being tracked against targets outlined in the IAQ RMAF including IAQ funded regional and provincial outputs.
- If there is a continued absence of approval to conduct POR for determining awareness levels; investigate whether alternate methods could be used to capture this change
- Ensure that comprehensive financial data is being tracked against the budget outlined in the IAQ RMAF and assign responsibility for this tracking.

APPENDIX A — IAQ BUDGET

Department/ Program Component	20	007/08	20	008/09	20	009/10	20	TOTAL	
Ministère/Composante de programme	FTEs/ ÉTP	Total \$	FTEs/ ÉTP	Total \$	FTEs/ ÉTP	Total \$	FTEs/ ÉTP	Total \$	\$
National Research Council of Canada/ Conseil nationa	l de reche	erches du Can	ada						
Assessment of Ventilation on Health	1.5	1,196,000	4.0	1,215,000	4.0	1,179,000	4.0	1,239,000	4,829,000
Evaluation of Indoor Air Quality Technologies and Solutions	2.3	544,000	2.3	325,000	2.3	393,000	2.3	341,000	1,603,000
Establishment of a National Technical Advisory Committee Focusing on Indoor Air	1.3	260,000	2.0	460,000	2.0	428,000	2.0	420,000	1,568,000
Sub- Total / Sous-total	5.0	2,000,000	8.3	2,000,000	8.3	2,000,000	8.3	2,000,000	8,000,000
Health Canada / Santé Canada									
Mapping of Radon Zones and Affected Populations	2.2	1,300,000	2.4	2,100,000	2.4	2,300,000	2.6	2,700,000	8,400,000
Testing and Remediation of Radon in Federal Buildings Located in High Risk Radon-Prone Areas	7.0	1,600,000	6.5	800,000	6.4	600,000	6.4	600,000	3,600,000
Radon Education and Awareness Program	6.1	600,000	5.9	800,000	5.9	800,000	5.9	800,000	3,000,000
Sub-Total / Sous-total	15.3	3,500,000	14.8	3,700,000	14.7	3,700,000	14.9	4,100,000	15,000,000
GRAND TOTAL / TOTAL GENERAL	20.3	5,500,000	23.1	5,700,000	23.0	5,700,000	23.2	6,100,000	23,000,000

APPENDIX B — LOGIC MODEL



APPENDIX C — EVALUATION MATRIX

	Evaluation Questions	Ind. #	Indicators	Program Data	Doc. Review	Lit. Review	Interviews Program Staff	Interviews Co-Deliverers	Interviews Committees (R&D)	Interviews Peer Review/ Experts	Survey Facility Mgr/DA Reps	Financial Analysis
Rele	vance											
R1.	Do the IA R&D Initiative and Radon	R1.1	Extent to which IAQ Theme matches federal government priorities		Both							
	Strategy continue to reflect government priorities?	R1.2	# References to IAQ theme in key documents (RPP/Budget Speeches/Speech from the Throne/Economic Statements by year)		Both							
R2.	Do the IA R&D Initiative and Radon	R2.1	Demonstration of utility/rationale for IAQ Theme activities;		Both	Both			R&D	Both		
	Strategy continue to reflect the needs of Canadians?	R2.2	IAQ Theme activities remain relevant as new scientific evidence on indoor air quality emerges.		Both	Both			R&D	Both		
R3.	Do the IA R&D Initiative and Radon Strategy duplicate or overlap with any other initiatives?	R3.1	Extent to which IAQ Theme activities overlap with other initiatives		Radon	Radon	Both	Both	R&D			
Perf	ormance (effectiveness, ef	ficiency an	id economy)					•			•	
Effe	ctiveness - Assessment of p	rogress tow	vards expected outcomes									
P4.1	To what extent has the IA R&D Initiative	P4.1.1	# of research studies conducted	R&D								
	contributed to the achievement of	P4.1.2	# new findings by research studies	R&D								
	Increased knowledge of risks, health impacts and	P4.1.3	# & type of publications in peer- reviewed journals	R&D								
	risks, nealth impacts and mitigation strategies related to indoor air quality.	P4.1.4	Perception of stakeholders that IA R&D Initiative contributed to the achievement of Increased knowledge of risks, health impacts and mitigation strategies related to indoor air quality.				R&D	R&D	R&D			

	Evaluation Questions	Ind. #	Indicators	Program Data	Doc. Review	Lit. Review	Interviews Program Staff	Interviews Co-Deliverers	Interviews Committees (R&D)	Interviews Peer Review/ Experts	Survey Facility Mgr/DA Reps	Financial Analysis
P4.2	To what extent has the IA R&D Initiative contributed to the	P4.2.1	# of publicly available data sets relating to Indoor Air Quality solutions/technologies	R&D	R&D							
	achievement of Increased knowledge and support for the development of technological solutions for improved IAQ.	P4.2.2	Perception of stakeholders that IA R&D Initiative contributed to the achievement of Increased knowledge and support for the development of technological solution for improved IAQ.				R&D		R&D			
P5.1	To what extent has the Radon Strategy contributed to the achievement of	P5.1.1	% of target audience aware of radon risks	Radon (2007 and 2009)	Radon		Radon				Radon	
	Improved awareness of health risks and causes of elevated radon and	P5.1.2	# of stakeholder interactions / engagements related to awareness of radon-related health risks	Radon			Radon	Radon			Radon	
	strategies to improve it.	P5.1.3	# of hits on radon webpage	Radon								
		P5.1.4	# of downloads of Radon: a Guide for Canadian Homeowners	Radon								
		P5.1.5	# of Provinces using radon maps for targeting public awareness campaigns	Radon								
		P5.1.6	Perception that the Radon Strategy contributed to the achievement of Improved awareness of health risks and causes of elevated radon and strategies to improve it				Radon	Radon				
P5.2	To what extent has the Radon Strategy	P5.2.1	# of research studies conducted on radon management	Radon			Radon	Radon				
	Radon Strategy contributed to the achievement of increased knowledge of risks, health impacts and	P5.2.2	# new findings by research studies: public; provinces; NRC codes.	Radon			Radon	Radon				
	mitigation strategies related to radon.	P5.2.3	Perception that the Radon Strategy contributed to the achievement of increased knowledge of risks, health impacts and mitigation strategies related to radon.				Radon	Radon		Radon	Radon	

	Evaluation Questions	Ind. #	Indicators	Program Data	Doc. Review	Lit. Review	Interviews Program Staff	Interviews Co-Deliverers	Interviews Committees (R&D)	Interviews Peer Review/ Experts	Survey Facility Mgr/DA Reps	Financial Analysis
P6.	What, if any, unintended (positive or negative)	P6.1.1	Presence/absence of unintended outcomes		Both		Both	Both	R&D	Both	Radon	
	Were actions taken as a result of these?	P6.1.2	When appropriate, documented management actions and/or lessons learned from unintended outcomes		Both		Both					
P7.	What external factors influenced the success of the IAQ Theme?	P7.1	Presence or absence of external influencing factors		Both		Both	Both	R&D	Both		
Effic	iency and Economy - asses	ssment of r	esource utilization in relation to the prod	duction of	outputs a	nd progre	ess towards ex	pected outcom	es			
Р8.	Are there more cost- effective and efficient means of achieving IA R&D Initiative and Radon Strategy outcomes?	P8.1.1	Opinion of program managers, deliverers, partners and stakeholders on the ability of program elements to achieve intended results, compared to alternative design/delivery approaches				Both	Both	R&D	Both		
		P8.1.2	Comparison of IAQ Theme activities to other comparable programs (IA - component level)		Radon					Radon		Radon
		P8.1.3	Opinions of program managers, deliverers and partners on whether IAQ Theme investments are a good use of public funds and whether the cost of producing outputs is as low as possible				Both	Both	R&D			
		P8.1.4	Output costs of program components (target vs actual)				Both	Both				Both
P9.	How could the efficiency of the IA R&D Initiative and Radon Strategy activities be improved?	P9.1	Opinions of program managers and deliverers on how efficiency could be improved				Both	Both				

Evaluation Questions	Ind. #	Indicators	Program Data	Doc. Review	Lit. Review	Interviews Program Staff	Interviews Co-Deliverers	Interviews Committees (R&D)	Interviews Peer Review/ Experts	Survey Facility Mgr/DA Reps	Financial Analysis
Design and Delivery											
P10. To what extent have the IA R&D Initiative and	P10.1.1	Proof that the IAQ Theme components are being implemented as designed	Both	Both		Both	Both	R&D			
implemented, or to what extent are they on track to being implemented as planned and on time?	P10.1.2	Key outputs are produced: o Targeted education and awareness information related to radon risks o Info/analysis/ recommendations related to radon risk o NRC research laboratory, info & analysis for ventilation and Health o Partnerships and stakeholder forums o Information on IAQ technologies and evaluation systems	Both	Both		Both	Both				
	P10.1.3	Barriers to program implementation are identified		Both		Both	Both	R&D			
	P10.1.4	Barriers to program implementation are resolved		Both		Both	Both	R&D			
P11. What are the best practices and lessons learned (positive and	P11.1.1	Lessons learned and best practices have been identified		Both		Both	Both	R&D	Both		
R&D Initiative and Radon Strategy?	P11.1.2	Strengths and weaknesses have been identified		Both		Both	Both	R&D			
	P11.1.3	Factors that contribute to/detract from the achievement of results have been determined		Both		Both	Both	R&D			
P12. How well have risks been managed?	P12.1.1	Evidence that risks were identified		Both		Both					
	P12.1.2	Evidence that risk management strategies were developed		Both		Both					
	P12.1.3	Evidence of successful implementation of risk management strategies		Both		Both					

Evaluation Questions	Ind. #	Indicators	Program Data	Doc. Review	Lit. Review	Interviews Program Staff	Interviews Co-Deliverers	Interviews Committees (R&D)	Interviews Peer Review/ Experts	Survey Facility Mgr/DA Reps	Financial Analysis
P13.1 To what extent is the CAA management and	P13.1.1	Opinions of program managers, deliverers and partners				Both					
contributing to the delivery of the IAQ Theme?	P13.1.2	Documented evidence of IAQ Theme information, results and decisions being communicated to the appropriate CAA parties	Both	Both		Both					
	P13.1.3	Documented evidence of CAA information, results and decisions being communicated to IAQ Theme parties	Both	Both		Both					

APPENDIX D — DOCUMENT LIST

Title (Nov 18th)	Publication Date	Author	
INTERNATIONAL RADON PROJECT -SURVEY ON RADON GUIDELINES, PROGRAMMES AND ACTIVITIES (WHO)	2007	Dr. Hajo Zeeb (WHO)	
Radon Legislation and National Guidelines	July 1999	Gustav Åkerblom (Swedish Radiation Protection Institute)	
Indoor Air Quality Theme Results-based Management & Accountability Framework Health Canada -National Research Council October 30, 2008	October 30, 2008	HC/NRC	
International Guidelines on Indoor Radiation (survey)	March 2005	Senes Consulting	
WHO Handbook on Indoor Radon - A PUBLIC HEALTH PERSPECTIVE	2009	WHO	
Radon A Guide for Canadian Homeowners	2007	CMHC and HC	
A preliminary design of a radon potential map for Canada: 3 a multi-tier approach [Article Proofs Receipt (Accepted 20 January 2009)]	Accepted (Environmental Earth Sciences) January 20, 2009	Jing Chen	
Evaluation Plan for the Clean Air Agenda - Indoor Air Quality Theme	January 2009	HC/NRC	
Cross-Canada Survey of Radon Concentrations in Homes	April 24, 2009	PWGSC	
Radon exhalation from building materials for decorative use	Manuscript draft - Journal of Environmental Radioactivity (2009)	Jing Chen, Rahman Naureen M., and Ibrahim Abu Atiya	
Canadian Population Risk of Radon Induced Lung Cancer	Canadian Journal of Respiratory Therapy (Autumn 2005)	Jing Chen and Tracy L. Bliss	
Canadian Individual Risks of Radon-induced Lung Cancer for Different Exposure Profiles	Canadian Journal of Public Health (October 2005), Vol. 130, No.5	Jing Chen	
Pb concentration in household dust: a potential indicator of long-term indoor radon exposure	Radiation and Environmental Biophysics September 16, 2009	Jing Chen, Zhang Weihua, Sandles Diane G., Timmins Rachel, and Kyle Verdecchia	
A PRELIMINARY RADON MAP FOR CANADA ACCORDING TO HEALTH REGION	Radiation Protection Dosimetry (2008), Vol. 130, No. 1, pp. 92–94	Jing Chen, et al.	
SIMULTANEOUS 222Rn AND 220Rn MEASUREMENTS IN WINNIPEG, CANADA	Radiation Protection Dosimetry (2009), Vol. 134, No. 2, pp. 75–78	Jing Chen, et al.	
Radon diffusion coefficients of vapour barrier membranes used in Canadian building construction	Radiation and Environmental Biophysics February 12, 2009	Jing Chen, et al.	
CORRELATION OF SOIL RADON AND PERMEABILITY WITH INDOOR RADON POTENTIAL IN OTTAWA	Radiation Protection Dosimetry (2009), Vol. 136, No. 1, pp. 56–60	Jing Chen, et al.	
RADON MEASUREMENT IN CANADA WITH ELECTRET ION CHAMBERS	Health Physics Society February 13, 2007	Jing Chen	
Guide for Radon Measurements in Residential Dwellings (Homes)	2008	НС	
National Radon Lab documents, including testing protocols, operating procedures, quality process manuals, authorities, working instructions, etc.	Various Dates	НС	

Title (Nov 18th)	Publication Date	Author
CANADIANS AND INDOOR AIR QUALITY May 15th, 2007 FINAL REPORT [focus groups] (S:\GISB\Common Folders\2812\New Folder Oct 2009\Program General Documents)	May 2007	Western Opinion Research
Guide for Radon Measurements in Public Buildings (Schools, Hospitals, Care Facilities, Detention Centres)	2008	НС
Regions bldgs tested 08-09 & projections 09-10.xls	2008	HC
Meeting Minutes (Regional Radiation Specialists)	2009	HC
2007 National Radon and Indoor Air Quality Survey - Final Report	2007	Environics Research Group
General Guidance and Expectations with Respect to the Implementation of the Project to Test Federal Workplaces for Radon	August 2009	НС
a&b -Radon E & A Monthly Minutes 2008-2009	2008-2009	HC
Regional Public Inquiries tracking.xls (2007-2009)	2007-2009	HC
Comm Plan - Radon - 09.doc	2009	HC
a&b -2009 Calendar.doc	2009	HC
Radiation Protection Bureau Radon Awareness and Outreach Marketing Campaign Summary of Campaign Products and Rationale	November 2009	НС
Radon E&A Products Status and Issues 09.doc	2009	НС
Radon Consumers Brochure ENGLISH.pdf (French exists too)	2008	HC
2009 Radon Outreach Activities by region jul09.doc	July 2009	HC
Radon-professionals_eng_FINAL.pdf	2008	HC
Radon Mapping Working GroupRecords of Decision	2009	HC
NSDNR Radon Map.doc	2008	Nova Scotia Department of Natural Resources
RRSMonthly reports	2009	HC
Provincial radon awareness Oct 15 '09.xls	October 2009	HC
Proposed Changes on Protection from Radon Ingress in Parts 5, 6 and 9 of the 2005 NBC		НС
CLEAN AIR AGENDA PROGRAM LEVEL TEMPLATE Clean Air Agenda (CAA) – Horizontal Performance Report 2008-2009	2009	НС
Indoor AIr Initiative Comms plan 07 Final.doc	August 2008	NRC
IA R&D House opens.pdf	June 2009	NRC
Fin Status Summary.xls	September 2009	NRC
IAI Meeting Minutes	2007 -2009	NRC
Draft Work Plans - various Activities (this is one example only)	Undated	NRC
National Research Council of Canada – Institute for Research in Construction (Activity 2: Technical Advisory Committee, ToR)	Undated	NRC
NRC Indoor Air Initiative - June 2009 (PP Presentation)	June 2009	NRC
Mobilizing Science and Technology to Canada's Advantage	2007	Industry Canada
Report on Plans and Priorities 09/10	2009	NRC
DPR 07/08	March 2008	NRC
Report on Plans and Priorities 08/09	2008	NRC
CLEAN AIR AGENDA THEME LEVEL TEMPLATE	May 2009	NRC
Clean Air Agenda (CAA) – Horizontal Performance Report 2008-2009		-

Title (Nov 18th)	Publication Date	Author	
Final CAA NRCv3.doc	May 2009	NRC	
IAI Evaluation - Web site visitors.htm	November 2009	NRC	
Re-profiling minutes 2008 06 20.doc	June 2008	NRC	
Minutes of First TAC IAQST Meeting - FINAL.doc	January 2008	NRC	
Reprofiling Memo for DG 04 July 08-H.doc	July 2008	NRC	
IAI Minutes of Meeting 17 November 2009	17 November 2009	NRC	
Households and the Environment (2007).pdf	August 2007	Statistics Canada	
Holmes Magazine	January- February 2010	Dauphin Media Group Limited	
BC Radon Map	February. 2010 website	British Columbia Centre of Disease Control	
BC Northern Health Authority	February. 2010 website	British Columbia Northern Health Authority	
Government of Saskatchewan	February. 2010 website	Saskatchewan Ministry of Advanced Education, Employment and Labour	
Government of Manitoba	February. 2010 website	Manitoba Health	
Government of Nova Scotia	February. 2010 website	Nova Scotia Department of Environment	
Government of PEI	February. 2010 website	Prince Edward Island Department of Health and Wellness	
Government of Yukon	February. 2010 website	Yukon Territory Health and Social Services	
Regina Qu'Appelle Health Region (RQHR)	February. 2010 website	Regina Qu'Appelle Health Region (RQHR)	
National Collaborating Centres for Public Health	February. 2010 website	National Collaborating Centres for Public Health	
Government of Quebec	February. 2010 website	L'Institut national de santé publique du Québec	
Government of New Brunswick	February. 2010 website	New Brunswick Department of Health	
The Lung Association	February. 2010 website	The Lung Association	
Whole of Government Framework	October 2009	TBS	
Reports on Plans and Priorities 2009-2010 [HC] Section I - Departmental Overview	October 2009	НС	
Reports on Plans and Priorities 2009-2010 [HC] Section II - Analysis of Program Activities by Strategic Outcome	October 2009	НС	
Reports on Plans and Priorities 2009-2010 [Department of Environment - horizontal Initiatives]	October 2009	Environment Canada	
Departmental Performance Reports (DPR) 2007-2008	March 2008	HC	
Government of Canada Budgets; a- 2007, b- 2008	2007, 2008	Finance Canada	
Notice of Intent published in the Canada Gazette October 21, 2006	October 2006	Environment Canada	
HC Website	October 2009	НС	
The Clean Air Agenda	October 2009	TBS	
Canada Occupational Health and Safety Regulations (SOR/86-304)	Current to May 18, 2010	Justice Canada	
U.S. Environmental Protection Agency	October 2009	United States Environmental Protection	

Title (Nov 18th)	Title (Nov 18th)Publication Date	
		Agency
Canadian Cancer Society (October 25/09)	October 2009	Canadian Cancer Society
Canada's Performance Report 2007-08: The Government of Canada's Contribution	2007-2008	TBS
HC DPR 08/09	March 2009	NRC
Responses to Public Comments on the Proposed Revision to the Radon Guideline	Undated	НС
An Update on Health Canada's National Radon Program: 19th International Radon Symposium	September 2009	НС
Advantage Canada -Chapter 4, Investing for Sustainable Growth [Nov 23 2006]	November 2006	Finance Canada
NRC Website	Undated	NRC
Indoor Air Initiative - Evaluation of IAQ Solutions in Support of Industry Innovation (NR Can's website)	November 2009	NRC
Canadian Committee on Indoor Air Quality and Buildings (NRC website)	November 2009	NRC
Regulatory Framework for Air Emissions released on April 26, 2007.	April 2007	Environment Canada
DPR 08/09 [HC] Section 2 - Analysis of Program Activities by Strategic Outcomes	November 2009	НС
DPR 08/09 NRC Section II – Analysis of Program Activities	November 2009	NRC
2009-2010 RPPs - Horizontal Initiatives	October 2009	TBS
Speeches from the Throne	January 2009	Government of Canada
TBS Submission # 833777- Indoor Air Program in Support of the Government's Clean Air Agenda	March 2007	HC/NRC
American Cancer Society	October 2009	American Cancer Society
WHO website	October 2009	WHO
Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM)	October 2009	НС
Canadian Centre for Occupational Health & Safety website	November 2009	Canadian Centre for Occupational Health and Safety

APPENDIX E — MATRIX OF INTERVIEW QUESTIONS

Government Consulting Services (GCS) has been engaged by the Indoor Air Partners (Health Canada, National Research Council, Environment Canada) to conduct an evaluation of the Indoor Air Quality (IAQ) Theme of the Clean Air Agenda (CAA). The purpose of this evaluation is to examine the relevance, success, cost-effectiveness and potential alternatives of the program.

As part of the evaluation, GCS is conducting interviews with key stakeholders involved in the program. The goal of the interviews is to gain a better understanding of the program, collect information to assess the success of the program, and identify possible program improvements.

The following questions will serve as a guide for our interview. In some cases, questions will not be relevant to your particular situation. The interviewers will focus on those questions relevant to you. Please note that the responses you provide will not be attributed to you in the evaluation report (only aggregate information will be released) or in any documentation provided to the responsible department.

Ind. #	Interview Question	Senior Managers	Interviews Program Staff	Interviews Co-Deliverers	Interviews Committees/ Experts
	Can you briefly describe your role or involvement with the following components of the Indoor Air R&D Initiative: - Creation of the research laboratory and field study involving INSPQ - Evaluation of available technologies to assess effectiveness - Canadian Committee on IAQ and Buildings that was established to identify priorities for indoor air quality research	X	X	X	X
Relevan	ce				
R2.1	What should the Government of Canada be doing to help Canadians with respect to Indoor Air R&D?	X	X	X	X
	What is your understanding of the rationale of the Indoor Air R&D Initiative? <i>Prompt – what were the driving factors at the time of creation</i> ?	X	X		
R2.2	What should Canadians be most concerned about when it comes to indoor air quality? Is the Indoor Air R&D Initiative aligned with these priorities?				X
R3.1	Are you aware of other programs that might be duplicating or complementing the work that is being conducted under the Indoor Air R&D Initiative? If yes, can you describe them?	X	X	X	X
P4.1.4	Are you aware of outputs produced by the Indoor Air R&D Initiative? Have they contributed to increasing knowledge related to the risks, health impacts and mitigation strategies related to indoor air quality?		X	X	X
P4.2.2	Are the outputs produced under the Indoor Air R&D Initiative contributing to the development of technological solutions (i.e., products available for consumers) for improved IAQ?		X		X
	Has the knowledge generated through the Indoor Air R&D Initiative been used by anyone outside program staff? If so, by whom and how has the information been used?		X	X	X
	Have new products or techniques to reduce health risks from poor indoor air quality been developed through the Indoor Air R&D Initiative? If yes, how have they been made available to target groups and what has been the uptake?		X	X	X

Ind. #	Interview Question	Senior Managers	Interviews Program Staff	Interviews Co-Deliverers	Interviews Committees/ Experts
P6.1.1	Can you please describe any unintended outcomes resulting from the Radon Program?				
P6.1.2	Can you please provide documentation/evidence to support your view.	X	X	X	X
	Did you take any action as a result of those negative unintended outcomes?				
P7.1	Please describe any external factors (anything not funded under the Indoor Air R&D Initiative) that influenced (positively or negatively) the success of the e Indoor Air R&D Initiative?	X	X	X	X
P8.1.1	In your opinion is the Indoor Air R&D Initiative cost effective? Why or Why not? <i>Probe:</i> Is the Indoor Air R&D Initiative a good use of public funds? Are the sector of producing autoute as here appendix as the sector.				
P8.1.3	We me costs of producing outputs as low as possible? Were all of the funds that were allocated expended? Is the Indoor Air R&D Initiative affordable? If not, are there aspects of the Initiative that could be abandoned?	x	x	v	x
P8.1.4		Λ	А	Λ	А
	Are there alternative means to achieve the objectives of the Indoor Air R&D Initiative? Would these alternatives be more or less cost-effective than the current				
P9.1	Indoor Air R&D Initiative?				
P10.1.1	Has the current design and structure of the Indoor Air R&D Initiative enabled or been a barrier to the achievement of program objectives?	x	x	x	x
	Probe the design and structure of the individual components as well				25
P10.1.2	To what extent has the Indoor Air R&D Initiative been implemented as planned?				
	 - amount of information on IAQ technologies and evaluation systems produced - # of partnerships & stakeholder forums - types and amount of information and analysis for ventilation, indoor air quality and health produced 	X	Х	Х	
P10.1.3	Please describe any barriers encountered in implementing the various components				
P10.1.4	of the Indoor Air R&D Initiative. What has been done to overcome these barriers?	X	X	X	Х
P11.1.1	Please describe any best practices or lessons learned (positive and negative) from the Indoor Air R&D Initiative?				
P11.1.2			Х	Х	Х
P11.1.3					
P12.1.1	Does the Indoor Air R&D Initiative have a risk management plan? If so please describe how it is used? If not, how are risks identified and addressed.				
P12.1.2	Where you able to mitigate risks according to the plan?				
P12.1.3	Can you please provide any relevant documentation?	X	X		
	Are there any other risks (not in the risk management plan) that were identified? What were their impacts?				

Ind. #	Interview Question	Senior Managers	Interviews Program Staff	Interviews Co-Deliverers	Interviews Committees/ Experts
P13.1.1 P13.1.2 P13.1.3	In your opinion, is the CAA management and accountability structure contributing to the delivery of the Indoor Air R&D program? (probe: What have been the impacts (positive and negative) of situating components of the Radon Program within the CAA IAQ Theme and the CAA CARA Theme? (Probe: how information is shared between the Indoor Air R&D Initiative IAQ	X	X		
	parties, CARA parties, and CAA parties?)				
APPENDIX F — QUANTITATIVE RESULTS FROM SURVEY OF BUILDING OWNERS/MANAGERS AND DEPARTMENTAL REPRESENTATIVES

Survey of Building Owners/Managers and Departmental Representatives

Government Consulting Services (GCS) has been engaged by the Indoor Air Partners (Health Canada, National Research Council, Environment Canada) to conduct an evaluation of the Indoor Air Quality (IAQ) Theme of the Clean Air Agenda (CAA). The purpose of this evaluation is to examine the relevance, success, cost-effectiveness and potential alternatives of the program. Undertaking radon testing in areas under federal jurisdiction is a component the IAQ theme.

You have been chosen to participate in this survey because HC has contacted you in regards to conducting radon testing in a property that you own or manage. Your participation in the survey is important regardless of whether or not you have yet to conduct the testing. The answers that you provide will be anonymous and will only be reported in aggregate format.

1. Are you a:

n= 95	Percent
Departmental representative	34.0
Building manager	35.1
Building owner	10.6
Other (Includes 7.4 % Safety Officer)	20.2

2. How many building(s) do you own, manage or act as the departmental representative for? (insert number)

n= 95	
Mean	35
Range	809
Minimum	0
Maximum	809

n= 93	Percent
British Columbia	7.4
Alberta	14.7
Saskatchewan	7.4
Manitoba	13.7
Ontario - outside National Capital region	11.6
National Capital region	27.4
Quebec - outside National Capital region	42.1
New Brunswick	9.5
Nova Scotia	16.8
Prince Edward Island	4.2
Newfoundland and Labrador	5.3
Northwest Territories	3.2
Yukon	3.2
Nunavut	3.2

3. Your building(s) is located in which province/territory? (please check all that apply)

4. Approximately how many federal employees work in this building(s)?

n= 93	
Mean	866
Range	12,000
Minimum	0
Maximum	12,000

5. The health risks of elevated radon levels include (please check all that apply):

n= 86	Percent
Asthma	30.5
Lung cancer	82.1
Emphysema	24.2
Chronic Bronchitis	24.2
Other	1.1

6. To the best of your knowledge, how would you describe radon? (please check all that apply)

n= 95	Percent
Colourless, odourless, tasteless radioactive gas	78.9
By-product of flame retardant materials found in building materials	1.1
Residual of decaying uranium found in soil and rock that is able to either escape to the atmosphere or seep into buildings	64.2
Residual when common household pesticides and/or insecticides are found in elevated concentrations in buildings	1.1
Not Sure	4.2
Other	0

7. Under the Radon Program, did Health Canada provide your organization with the following (please check all that apply):

n= 94	Percent
The purpose of the federal building radon testing program	85.3
Information on radon, including its causes and health effects	72.6
Educational information for employees working in the building (e.g., posters, pamphlets)	52.6
Information regarding the radon testing purpose, process and devices used to detect radon levels	75.8
Government of Canada obligations under the Canada Labour Code	53.7
Other	8.4

8. Was testing of radon levels undertaken for any of your building(s) under the federal building radon testing project?

n= 95	Percent
Yes	75.8
No	17.9
Don't know	6.3

□ Yes (skip to 11) □ No (go to 9 and 10 then done) □ Don't Know (exit survey)

9. If no, why was there no assessment of radon levels undertaken for your building(s)?

n= 15	Percent
Limited resources to participate in program	20.0
Testing is planned, but has not yet occurred	46.7
There is no budget allotted for potential remediation costs	0.0
Other	33.3

- 10. Please describe anything Health Canada could have done differently that would have enabled your building to have been tested for radon. (*text box*)
- 11. What group was responsible for the deployment of radon detectors in the building?

n=71	Percent
Health Canada	88.7
Facilities Management	8.5
Other	2.8

12. What group was responsible for the collection of the radon detectors in the building after testing was done?

n= 70	Percent
Health Canada	87.1
Facilities Management	7.1
Other	5.7

13. After being informed by Health Canada that your building would be tested for radon levels, what steps were taken by your organization to inform building occupants that radon testing was to take place? (please select all that apply)

n=72	Percent
No communication strategy was implemented	5.3
E-mail sent to all building occupants	56.8
Posters/banners placed throughout the building	20.0
Information sessions	22.1
Radon brochures distributed to building occupants	28.4
Other	14.7

14. Please rate the following statements according to the scale:

n=72	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Don't know or not applicable
The radon information from Health Canada assisted me in implementing radon testing	4.2	0	12.5	37.5	34.7	11.1
The radon information from Health Canada assisted me in improving my knowledge of radon	1.4	1.4	11.1	40.3	41.7	4.2
The radon information from Health Canada assisted me in informing employees about radon testing in the building	1.4	1.4	5.6	43.1	40.3	8.3
Overall, I was satisfied with the delivery of the federal building radon testing project in my building	1.4	4.2	4.2	41.7	40.3	8.3

15. Did your organization encounter any challenges when implementing radon testing?

n= 70	Percent
Limited resources available to implement program	12.5
Limited information available to inform building occupants	2.8
Resistance and/or lack of interest from government department(s)	5.6
There is no budget allotted for potential remediation costs	23.6
None	55.6
Other	9.7

16. Is there anything else that Health Canada could have done to better facilitate the implementation of the federal building radon testing project? (*text box*)

APPENDIX G — RISK AND MITIGATION STRATEGIES FROM IAQ RMAF

R&D – RISKS AND MITIGATION STRATEGIES

- a. There is a risk that research carried out under the Indoor Air R&D Initiative will duplicate work carried out by other organizations.
 - **Mitigation Strategy:** NRC will work with the provinces, territories, federal departments, industry associations, manufacturers, and other organizations involved in indoor air, to minimize overlap and develop the desired research capacity and knowledge in Canada.
- b. There is a risk that too many families drop out of the study, thus limiting the value and the statistical power of the study.
 - **Mitigation Strategy**: To compensate for potential drop-outs, the study will start with 120 homes, while only 80 to 100 homes are required for scientifically sound results
- c. There is a risk that interventions, e.g., retrofitting of mechanical ventilation systems, will inconvenience parents or asthmatic children, leading to complaints, non-compliance and dropping-out.
 - **Mitigation Strategy**: To minimize the disturbance of families by the retrofit of ventilation systems in Quebec City homes, a modeling and ventilation research facility will be built to enable the prediction of the impact of different ventilation systems or strategies prior to their installation into Quebec City houses. Visits in homes can be limited, ideally, to one visit by an accredited contractor.
- d. There is a risk that the new committee cannot recruit adequate members from relevant stakeholder communities, and that the results of this committee might not be accepted by a broad range of stakeholders.
 - **Mitigation Strategy**: Steps will be taken to ensure that the National Technical Advisory Committee does not raise unrealistic expectations regarding the kind and amount of research and other work on Indoor Air issues that can be achieved with available resources. The NRC will ensure clear communication about research directions and possible future actions flowing from the Indoor Air R&D Initiative.
- e. There is a risk that unrealistic expectations will be raised regarding the kind and amount of research and other work being done and delivered by NRC's Indoor Air Initiative. In general the broad dissemination of the deliverables upfront will be the key mitigation so that stakeholders are informed about the scope and amount of the expected results. Unrealistic expectations with respect to the 3 activities of the Indoor Air Initiative include:

- 1) Ventilation field study: there is a risk that it is expected that the answer given by the end of the field study will apply for the whole Canadian population. Although it is anticipated, that many correlations or associations will be found out between ventilation and indoor air quality, the results with respect to health only refer to asthmatic children. This limitation has to be addressed and broadcast upfront.
- 2) Indoor Air Quality solutions: In a stakeholder forum, 3 4 most relevant air purification technologies/systems (referred to as "Indoor Air Quality solutions") will be identified and prioritized. The public or certain manufacturers might expect to get an answer on the efficiency on many more air purification technologies on the market. This will not be possible within this timeframe. However, it must be ensured that this stakeholder forum represent relevant interest groups, and that the prioritization step is close to optimal.
- **Mitigation Strategy:** The Committee on IAQ and Buildings will not raise unrealistic expectations regarding the kind and amount of research and other work. This Committee is a stakeholder forum with a strong engagement and dissemination policy among the most relevant stakeholders in the country, thus ensuring that scope, mandate, and the amount of work which can be delivered within the next 3 years is made clear.
- f. There is a risk that industry may not support the development and application of technology evaluation tools.
 - **Mitigation Strategy**: The objective of this project is to develop protocols for the evaluation of technologies that claim to have beneficial impact on indoor air quality. While not a direct deliverable of this project, the developed protocols will support future certification/labeling systems for the assessed technologies. Some devices or technologies may not perform well when evaluated according to the new protocols. Therefore some concerned industries may be in opposition to the application of findings to any future possible assessment system for consumers or manufacturers. Any such concerns or criticisms from industry will be dealt with on a case-by-case basis, with a clear focus on the public good and the protection of the health and well-being of Canadians.

RADON PROGRAM – RISKS AND MITIGATION STRATEGIES

- a. There is a risk that delays early on in the program schedule affect the ability to deliver the program on time.
 - **Mitigation Strategy:** This risk will be mitigated through clear communication of program schedule dependencies to the funding agencies. The program will apply for authorized carry over of the survey funds into year two should the aerial survey not be completed in time.
- b. There is a risk that insufficient communication leads to low Radon Program awareness.
 - **Mitigation Strategy:** Building on the best practices of the US Environmental Protection Agency, HC will work with other federal departments, provincial and territorial governments, and non-governmental organizations to develop a common communications strategy. Part of this strategy will involve the development of education

materials on the health effects of radon exposure. HC will make information available to health advocacy groups such as the Canadian Lung Association, and will work jointly with them to develop materials that address the health effects of radon exposure. Information will be shared through a variety of methods, including the HC web site, stakeholder workshops and forums, and informal multi-stakeholder working groups.

- c. There is a risk that unrealistic expectations regarding responsibility and funding for radon remediation are created.
 - **Mitigation Strategy:** HC will hire new staff in each of the regional offices to coordinate building owners/managers in the conduct of testing; and increase awareness and education about radon in radon prone areas.
 - HC information materials and communications with building owners/managers will make it clear that:
 - i. PWGSC (or other relevant custodial agency) is responsible for remediation costs.
 - ii. While the building radon testing initiative will have the effect of accelerating the identification of buildings requiring radon remediation, remediation costs will typically be modest in the overall scheme of the building life-cycle in the context of operation and maintenance.
 - iii. The timely identification of buildings of concern will help to expedite the discharge of responsibilities associated with protecting the health of occupants and visitors.
 - iv. Remedial action will also help to reduce or eliminate the likelihood to legal challenges such as any alleged failure to comply with health and safety codes.
 - HC will also provide technical advice and assistance to facilitate timely remediation action by building owners/managers. PWGSC acknowledges that the approach to be used is consistent with similar situations where departments are responsible for absorbing the cost of other types of remediation, such as lead pipe and paint removal, and removal of asbestos.