

Indoor Air Quality in Alberta

A report from the Indoor Air Quality Project Team
to the CASA Board of Directors

March 2010

Acknowledgements

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About CASA

The Clean Air Strategic Alliance (CASA) is a multi-stakeholder partnership composed of representatives selected by industry, government and non-government organizations. Stakeholders are committed to developing and applying a comprehensive air quality management system for all Albertans. All CASA groups and teams, including the board of directors, make decisions and recommendations by consensus. Recommendations are likely to be more effective and long lasting than those reached through adversarial processes.

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Contents

EXECUTIVE SUMMARY	1
1. Introduction	3
1.1 CASA Indoor Air Quality Team	3
2. Indoor Air Quality in Alberta	5
2.1 Priority Sources of Indoor Air Quality Pollutants	5
2.2 Current Governance of IAQ in Alberta	6
2.3 Roles and Responsibilities for Indoor Air Quality	10
3. Principles to Improve Indoor Air Quality in Alberta	13
3.1 Approaches used to address indoor air quality in other Jurisdictions	14
3.2 Information	14
3.3 Awareness and Training	15
Appendix A: Potential actions	17
Appendix B: Team members	19
Appendix C: Survey results	21
Appendix D: Jurisdictional Review	28

List of Acronyms and Compounds

AbCaGBC	Alberta Chapter of the Canadian Green Building Council
AB EI	Alberta Employment and Immigration
ASHRAE	American Society of Heating, Refrigeration
BOMA	Building Owners and Managers Association
CASA	Clean Air Strategic Alliance
CHBA	Canadian Home Builders Association
CO	Carbon monoxide
COSHR	Canadian Occupational Safety and Health Regulations
CMHC	Canadian Mortgage and Housing Corporation
HCHO	Formaldehyde
Hg	Mercury
HVAC	Heating, Ventilation and Air Conditioning
IAQ	Indoor air quality
IFMA	International Facility Management Association
LEED	Leadership in Energy and Environmental Design
NO ₂	Nitrogen dioxide
O ₃	Ozone
PAH	Polycyclic aromatic hydrocarbon
PM	Particulate matter
SO ₂	Sulfur dioxide
TVOC	Total volatile organic compound
VOC	Volatile organic compound
US EPA	US Environmental Protection Agency

EXECUTIVE SUMMARY

Indoor air quality (IAQ) refers to the quality of the air found inside a person's home, place of work or any other buildings. Given the large scope of the issue and many stakeholders involved, CASA was asked to form a multi-stakeholder project team to develop recommendations to address indoor air quality in Alberta.

There are many possible sources of indoor air quality issues, ranging from off-gassing furniture to HVAC systems and air fresheners to pollen. Some sources are caused by an occupant's behaviour, such as smoking, while other sources relate to the building itself. The team engaged the community of professionals working in IAQ to narrow the list of possible sources to create a priority list of IAQ sources and contributing factors.

A principle task of the project team was to clarify the complex roles and responsibilities of various organizations involved in indoor air quality. The report outlines the current roles of all levels of government and non-government organizations in indoor air quality, including a decision tree that describes the roles and responsibilities of jurisdictions in Alberta related to IAQ.

Recommendation 1: The Government of Alberta considers the information in this report should they undertake any future work on indoor air quality in the province. The information in this report draws on the perspectives and expertise of multiple stakeholder groups. The team also engaged other experts in IAQ in Alberta to identify the priority sources of IAQ pollutants. Using the information and principles in this report would help the Government of Alberta set priorities for future work and identify the most effective means to implement IAQ activities

Included in the information are six principles that the team identified as the most beneficial opportunities to improve IAQ. Possible actions to achieve the principles are in Appendix A.

Principle 1: Ensure the roles and responsibilities for indoor air quality in Alberta are clear. This Principle speaks to the need to disseminate and maintain the decision tree.

Principle 2: Alberta has information that includes location, severity, follow-up and cause (if known) of IAQ complaints. Such information is currently lacking, but would improve policy development, monitoring and evaluation

Principle 3: Albertans are aware of the sources and effects of indoor air quality and actions they can take to improve their indoor environments. There are everyday actions Albertans can take to improve their indoor air quality and awareness is the first step to making a change.

Principle 4: Alberta has coordinated, standard training programs for professionals involved in the proactive avoidance of IAQ issues and the responsive investigations of IAQ concerns. There are numerous opportunities for training in the province, but coordination would benefit all applicable professions.

Principle 5: Building owners, managers and operators are encouraged to upgrade the building to meet best practices where cost-effective to do so. Incentives, information and monitoring are important steps to ensure indoor air quality in older buildings still meets the original design standards.

Principle 6: Stakeholders involved with IAQ in Alberta understand the principals and benefits of a proper building commissioning process. Stakeholders should adopt best practices regarding building commissioning as outlined by organizations such as National Building Code, ASHRAE and LEED.

1 Introduction

Indoor Air Quality (IAQ) refers to the quality of the air found inside a person's home, place of work or any other building. Canadians spend nearly 90% of their time indoors, making IAQ an important factor in a person's health status. Human exposure studies have shown pollutant concentrations may be higher indoors than outdoors, in some cases by several orders of magnitude.¹ The term "sick building syndrome" is used to describe situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but no specific illness or cause can be identified. One reason for sick building syndrome is tightly sealed buildings built during the 1970s energy crises to improve energy efficiency..

A wide variety of physical, chemical and biological contaminants contribute to IAQ problems. These contaminants vary depending on the type of indoor environment (workplace, industrial, residential, etc). Often the combination of low concentrations of several air pollutants and surrounding environmental factors are responsible for causing IAQ problems and associated health effects.

Common indoor air pollutants include carbon monoxide (CO), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), ozone (O₃), formaldehyde (HCHO), volatile organic compounds (VOCs), pesticides and other semi volatile organics, polycyclic aromatic hydrocarbons (PAHs), particulate matter (PM), product aerosols, and bioaerosols (bacteria, fungi, viruses, pollen, allergens, endotoxins, and mycotoxins) and radon (Rn) gas. Radon is a known issue in some areas of Canada. The geological formations in Alberta led many to believe radon was not an issue in Alberta, however programs are being proposed in Alberta to determine actual levels.² Other elements to the indoor environment that impact indoor air quality include temperature and humidity.

There are a variety of human health effects associated with poor IAQ, including allergic reactions, infectious diseases and toxic exposures. The nature and severity of these effects are dependent on personal exposure, toxicity of the contaminant and individual susceptibility. Common symptoms generally attributed to IAQ include respiratory effects (e.g. asthma), central nervous system effects irritation of the skin and mucous membranes. Long-term health impacts include lung cancers (mainly from asbestos), asthma, other chronic respiratory ailments and cardiovascular problems.

In addition to health concerns, poor indoor air contributes to nuisance complaints where it impacts the comfort of occupants and can affect the productivity at the workplace and in people's homes. Therefore, poor indoor air quality can have negative impacts on the economy as well as the overall well-being of individuals.

1.1 CASA Indoor Air Quality Team

In 2004, CASA formed a project team to create a strategic plan to address IAQ issues in Alberta. The issue was seen as one of emerging importance involving numerous stakeholders because of the many sources of indoor air quality concerns. It was felt at the time that bringing together all relevant stakeholders, would help develop more consistent and effective approaches to address IAQ issues in Alberta.

¹ US EPA. "The Inside Story: A Guide to Indoor Air Quality." <http://www.epa.gov/iaq/pubs/insidest.html#Intro>

² Programs are planned by Alberta Employment and Immigration and Alberta Health and Wellness to investigate the prevalence of radon in Alberta. The Lung Association of Alberta, BC and NWT is also conducting a voluntary radon monitoring program in residences in 2010.

The project team encountered difficulties as IAQ was an emerging issue outside the usual mandate of CASA. In 2007, the multi-stakeholder team reformed and set themselves three immediate principles:

1. Foster an understanding and awareness of IAQ and decision-making of Albertans of illness prevention and health promotion;
2. Encourage understanding of current legislation, guidelines and standards and their application;
3. Improve the understanding and co-ordination of the roles and responsibilities of various levels of government

The overarching task for the team was to develop a strategic plan to address IAQ issues in Alberta. Another principle task was to actively engage IAQ knowledge and awareness between team members and stakeholders and to make that knowledge available to the stakeholders and the public.

The team encountered a dearth of information specific to IAQ in Alberta. Work is occurring in many different arenas (government at various levels and industry groups). However, IAQ was not always the focus of the research or activities, but instead improved IAQ was an indirect benefit. Little information existed on the scope, severity and type of IAQ issues faced in Alberta. Some stakeholders reported that jurisdictional roles and responsibilities were unclear.

This report identifies the priority sources of IAQ pollutants and clarifies the roles and responsibilities for IAQ in Alberta. Based on that information, the team identified principles that should be considered for any future work in Alberta. These principles identify the most beneficial policy tools given the information available and jurisdictional responsibilities. This is the first time this IAQ information has been compiled and priorities identified in Alberta.

Therefore, the team recommends that:

Recommendation 1: The Government of Alberta considers the information in this report should they undertake any future work on indoor air quality in the province. The information in this report draws on the perspectives and expertise of multiple stakeholder groups. The team also engaged other experts in IAQ in Alberta to identify the priority sources of IAQ pollutants. Using the information and principles in this report would help the Government of Alberta set priorities for future work and identify the most effective means to implement IAQ activities.

2 Indoor Air Quality in Alberta

There are many contributors to IAQ concerns in any indoor environment. Some can vary by the type of building or setting, others by the practices of the occupants. Accordingly, different government, industry and NGO groups are involved in various aspects of IAQ. This section outlines the sources of IAQ the team found to be a priority in Alberta and the jurisdictional roles and responsibilities for IAQ in Alberta.

2.1 Priority Sources of Indoor Air Quality Pollutants

Narrowing the scope of IAQ issues is complex because there are numerous sources and factors involved. People can be exposed to indoor air pollutants in many different places. For example, exposure to pet dander could occur in one's home or be carried on people's clothing to their workplace. The team categorized IAQ sources into five categories: occupant activities; building construction and design; furnishings and equipment; maintenance and operations and outdoor sources. While useful, these categories are not discreet. There are also other factors that contribute to IAQ, positively or negatively, but are not themselves sources of IAQ concerns. These are termed contributing factors in the table below.

To narrow the list of sources of IAQ contaminants the team sought the opinions of experts in IAQ through a survey completed in March 2009. Forty-two participants responded, representing government, industry, non-government organizations and other experts. One of the limitations was that none of the forty-two participants were physicians who may have specialization in illnesses related to poor IAQ. It is unknown if this is a statistically significant sample because the population of IAQ practitioners (i.e. those who address IAQ routinely or exclusively in their profession) is unknown. In addition to the input from the participants, the team used some discretion determining the priority list below. One area the team considered is where CASA's recommendations could add value to work already underway. The complete results of the survey, including all sources of IAQ concerns originally considered are in Appendix C.

Table 1 below shows the priority sources and contributing factors to IAQ concerns in Alberta. The priorities are the highest ranked sources and factors as indicated in the survey of IAQ experts in Alberta as well as the analysis of the project team. These sources and contributing factors influence the quality of the indoor air.

Table 1: Priority Sources and Contributing Factors of Indoor Air Quality Issues in Alberta

Category: Occupant Activities	
Smoking	Biologics (e.g. pets, animal dander, allergens)
Personal care products and air fresheners	
Category: Building Construction and Design	
Building construction materials (e.g. glues, solvents, paints)	Heating and ventilation (e.g. location of air intakes, rate of exchange, etc)
Moisture infiltration leading to mould	
Category: Furnishings and Equipment	
Furniture	Indoor fireplaces and appliances
Category: Maintenance and Operations	
Janitorial products	Occupational exposures (e.g. dry cleaners, veterinary labs, chemical labs)

Category: Outdoor Sources	
Vehicle exhaust	Biologics (e.g. pollen, moulds)
Contributing Factors³	
Building code & building / housing standards	Maintenance of Heating, ventilation and air conditioning (HVAC)
Maintenance of plumbing	Maintenance of building envelope
Training (e.g. knowledge of guidelines)	Education and awareness

The team believes these priority sources and contributing factors are the most pressing underlying reasons for IAQ concerns. Future efforts on IAQ in Alberta should focus on these sources.

2.2 Current Governance of IAQ in Alberta

The system of government and non-government organizations and their respective guidelines, standards and codes surrounding IAQ in Alberta is complex. Many organizations at federal, provincial and municipal levels are involved in IAQ largely due to the many sources and types of indoor environments as discussed above. Table 2 attempts to capture the complexity of IAQ jurisdiction by describing some of the activities that can address indoor air quality and which organizations are undertaking those activities

Government of Canada

The federal government is involved in policy development, education, regulation and enforcement (among other activities) in Alberta. The overall direction of many IAQ policies and development of many guidelines take place at a federal level and are later adopted provincially. There are joint federal-provincial advisory committees involved in policy development, guidelines and safety regulation, such as residential exposure guidelines⁴ (e.g. formaldehyde, mould) to regulatory standards under the national and provincial building codes. For example, the National Building Code 2010 will include updated requirements for radon and Alberta and other provinces are likely to adopt those requirements after public and internal reviews. The National Building Code is developed by a national body with input from the provinces and other stakeholders.

In terms of education and information services at the federal level, Health Canada publishes documents specific to indoor air quality, such as the Tools for Schools and Action Guide about Indoor Environmental Concerns. Other government departments provide information related to sources of indoor air quality, but may not specifically reference IAQ. Public Works Government Services Canada provides information services for architects, construction and renovations professionals. Natural Resources Canada has an Indoor Environment Program that conducts research and oversees the R-2000 program for residential energy efficiency and IAQ guidelines. NRC's Indoor Air Initiative studies the links between home ventilation and IAQ and creates scientific analysis of solutions and services. Work is overseen by the Canadian Committee on Indoor Air Quality. CMHC conducts research and provides information to homeowners how to improve IAQ. They also provide training courses on IAQ aimed at housing professionals.

Regulations for some sources are enforced in Alberta by the federal government. For example, Labour Canada enforces the Non-smokers Health Act and Transport Canada enforces the Non-

³ These factors can improve or worsen indoor air quality, depending on their adequacy.

⁴ A summary of Health Canada's residential exposure guidelines can be found in the jurisdictional review in Appendix D.

smokers Health Regulations for transportation services under federal jurisdiction. Health Canada enforces the Hazardous Product Act for consumer products.

Government of Alberta

Provincially, there are a number of agencies with a role in IAQ management. These include Alberta Health and Wellness, Alberta Infrastructure, Alberta Employment and Immigration (AB EI), Alberta Environment and Alberta Municipal Affairs that all address different sources of indoor air quality concerns. Alberta Employment and Immigration handles workplace and industrial indoor air quality issues and the compliance area of Workplace Health and Safety enforce the Occupational Health and Safety Code for occupational exposure limits. Alberta Health and Wellness determines the need for health policy or legislation, and acts as a referring agency, related to public buildings and private homes. Alberta Health and Wellness also conducts surveillance programs which assess the association between health and IAQ.

Alberta Municipal Affairs administers the Alberta Building Code under the Safety Codes Act used for all new construction in the province. IAQ is referenced directly in the Alberta Building Code both as requirements under standards and objectives. One of the objectives (i.e. purpose) of the building code that directly references IAQ is OH1 Health – Indoor Conditions: “An objective of this Code is to limit the probability that, as a result of the design or construction of the building or facility, a person in the building or facility will be exposed to an unacceptable risk of illness due to indoor conditions. The risks of illness to indoor conditions address in this code are those caused by – OH 1.1 – inadequate indoor air quality; OH 1.2 – inadequate thermal comfort; and, OH 1.3 – contact with moisture.”

Where as Alberta Health & Wellness and Alberta Environment are the authority having jurisdiction for their legislation throughout the Province of Alberta, the Safety Codes Act administered by Municipal Affairs delegates authority to municipalities, regional service commissions and corporations to administer the Act in their jurisdiction. As an example, an accredited municipality is responsible for issuing permits, conducting inspections and enforcing the Act in its jurisdiction. The Act also delegates authority to private agencies to provide services, such as permits, inspections and orders for enforcement in areas under provincial responsibility and areas that wish to contract for an agency service rather than provide their own. Entities that may administer or provide services under the Act are known as “accredited”. The accredited area must still comply with the provincial codes and standards under the Act and cannot pass bylaws or rules that purport to regulate a subject matter that is regulated by the Act. There will be differences in interpretation, application and enforcement with indoor air quality, subject to the conditions of the site, the degree of health and safety risk, the discretion of the safety codes officer and the flexibility allowed within the codes and standards for different interpretations.

Other ministries have an indirect role in IAQ. Alberta Infrastructure oversees the “Red Book” Design Guidelines for provincial buildings. Alberta Environment is responsible for the management of outdoor air, which can impact indoor air. Therefore, Alberta Environment consults with its partners in other provincial, federal and municipal ministries on policies or management practices that would impact the health of Albertans.

Local Government

At the municipal level, there are several cities adopting LEED (Leadership in Energy and Environmental Design) standards for institutional and other publically-funded buildings. LEED require a “Minimum Indoor Air Quality Performance” and offers points for measures to improve

IAQ. The City of Calgary's Sustainable Building Policy AMCW005 endorses both LEED and BuiltGreen and includes specific reference to IAQ. The Town of Cochrane also uses both BuiltGreen and LEED. Local Governments may apply such programs in their communities provided that it does not purport to regulate where the Province of Alberta is regulating. For example, currently the Safety Codes Act does not regulate for the objective of energy efficiency, which is the objective of LEED and BuiltGreen. If the Province does at some point regulate energy efficiency as an objective, local governments will have to comply with those provincial standards and abolish their bylaws to the extent the bylaw or rule infringes on provincial regulation. Anti-idling bylaws and education programs are undertaken by several Albertan municipalities. Local Governments may not impose on persons additional requirements that exceed the requirements of the Safety Codes Act unless the person affected agrees to such conditions or it is the only option to mitigate an unsafe condition.

Non-government and Industry Organizations

There are numerous non-government organizations involved directly and indirectly in indoor air quality issues. Some organizations related to building design, BuiltGreen and LEED, include the Canadian Home Builders Association - Alberta (CHBA - Alberta) and the Alberta Chapter of the Canadian Green Building Council (AbCaGBC). The International Facility Management Association (IFMA), ASHRAE and Building Owners and Managers Association (BOMA) are involved in the upkeep of buildings. These groups provide training and information resources to their members. The Lung Association of Alberta and NWT provides public education and supports research on IAQ. With respect to indoor air quality programs and the built environment, non-government and industry organizations are required to comply with provincial legislation and cannot design, manufacture, sell, operate, construct or install any thing, process or activity that does not comply with the Safety Codes Act. This principally concerns such components as heating and ventilation, insulation and water reuse

Table 2: Activities and Responsibilities for Indoor Air Quality in Alberta

	Legislation	Enforcement	Policy Development	Monitoring & Evaluation	Issue Identification	Voluntary Initiatives	Research	Training	Education
Municipalities	X ⁵	X	X	X	X	X	X	X	X
Provincial Level									
AB Health & Wellness	X	public residences	X	X	X		X	X	X
AB Infrastructure			X			X			
AB Employment & Immigration	X	X	X		X		X		
AB Environment			Consulted		X				X
AB Municipal Affairs	X	X	X		X				X
AB Health Services		X	Consulted	X	X				
Federal Level									
Health Canada	X	product safety	X	X	X		X	X	X
Natural Resources Canada	X		X	X	X	X	X	X	X
Labour & Transport Canada	X	X	X	X	X			X	X
Canada Mortgage and Housing Corporation			X		X		X	X	X
Public Works Government Services Canada	X	X	X	X	X			X	X
Professional and Non-government organizations									
BOMA				X		X		X	X
CHBA - Alberta			Consulted	X	X	X	X	X	X
AbCaGBC				X		X		X	X
IFMA						X		X	X
The Lung Association					X		X		X

⁵ Note: Bylaws created by municipalities must be in accordance with provincial legislation.

As the table shows, there is action being taken by all levels of government, professional organizations and non-government organizations. LEED and BuiltGreen standards, which address IAQ, are becoming the norm for publically funded buildings at the municipal and provincial level, as well as for private residential buildings in both the single-family and multi-family sectors. Alberta Health and Wellness is involved in federal processes to set residential exposure guidelines. Surveillance and research is conducted by Health Canada, Alberta Health and Wellness and Alberta Employment and Immigration. As seen in other jurisdictions, much of the action involves tools such as education, training and research and there is less focus on regulation and enforcement.

Another finding from the activities and responsibilities table (Table 2) is that activities can be fragmented among organizations. For example, one organization is responsible for residential buildings and another for workplace or industrial buildings. The priority sources and contributing factors (Table 1) include products (e.g. indoor fireplaces and personal care products), building design (e.g. heating and ventilation, building code) and outside sources (e.g. biologics and vehicle exhaust) which all influence IAQ, but regulation and education is conducted by different organizations. One principle area for improvement recognized early in the team's work was to clarify the roles and responsibilities of various actors involved in IAQ.

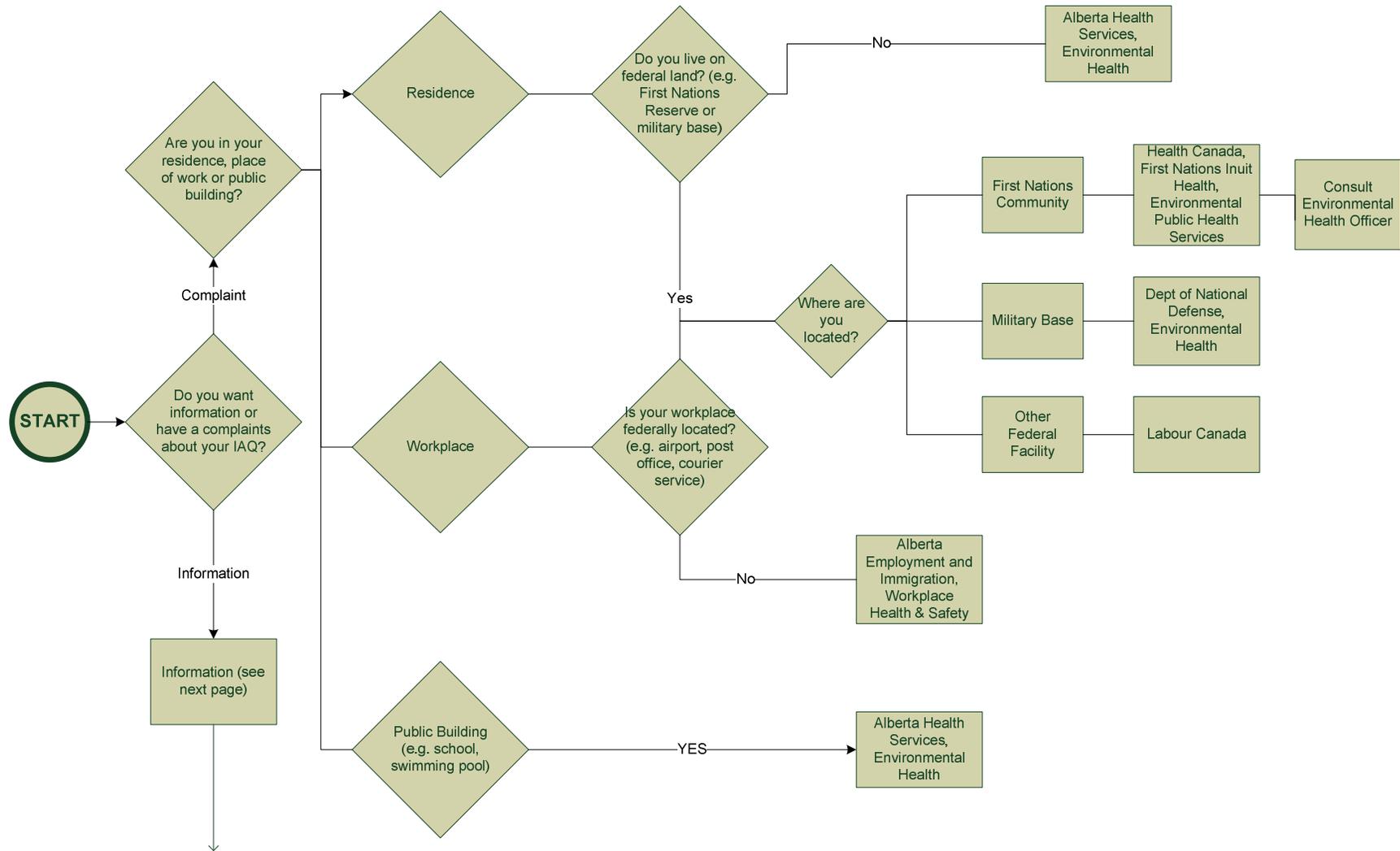
2.3 Roles and Responsibilities for Indoor Air Quality

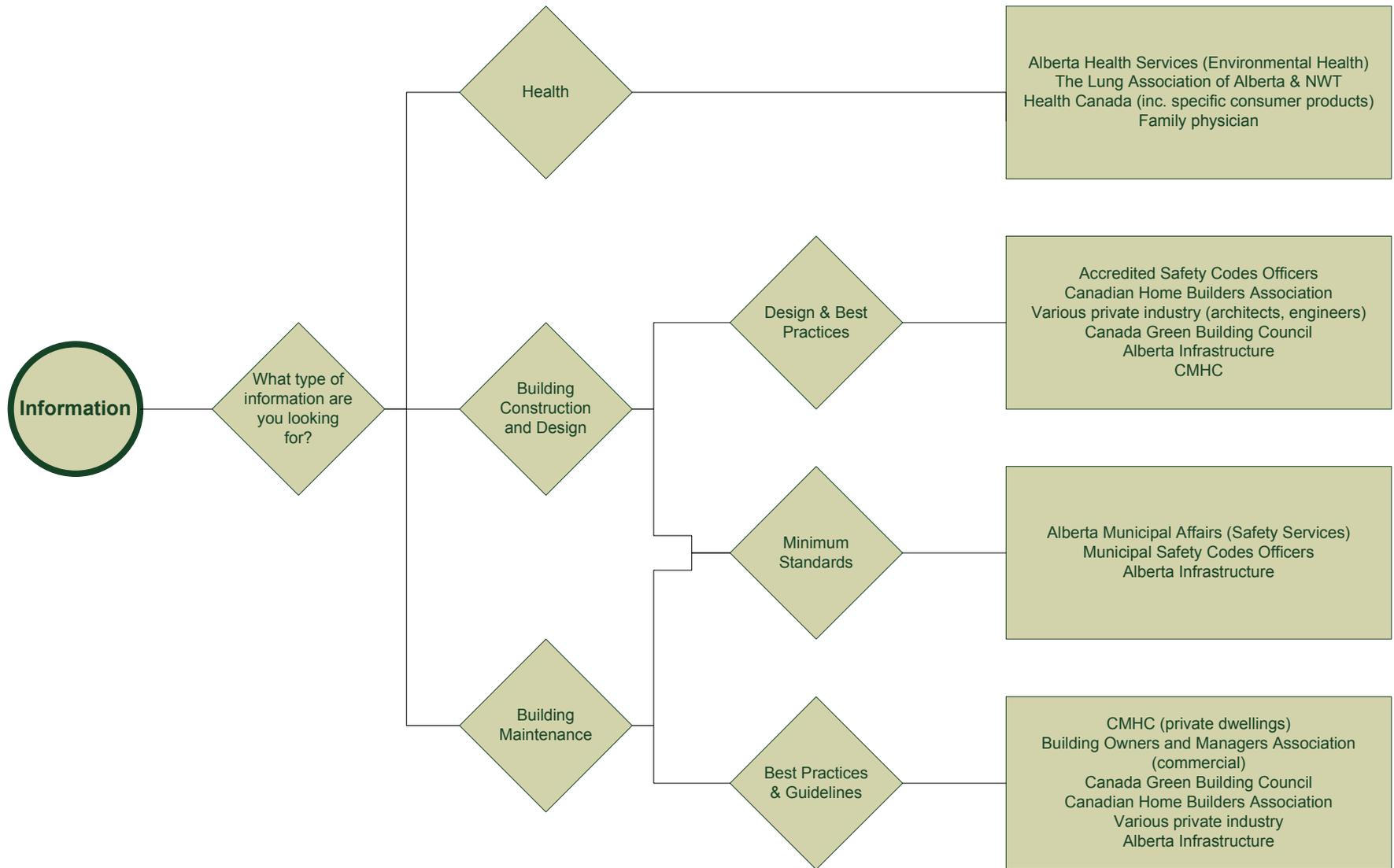
The various roles and responsibilities of jurisdictions often depend on what type of indoor environment is involved and which source may be responsible for the issue. To clarify the roles and responsibilities, the team developed the following decision tree guides Albertans to the appropriate organization that can address their concern or provide information.

This decision tree explains what jurisdictions are ultimately responsible for IAQ concerns in different spaces. The jurisdictions identified are the lead organizations, but will often involve other groups. The tree also provides resources for those looking for information regarding IAQ.

Other avenues exist that are not captured in this decision tree, such as contacting one's employer or the building owner or manager. Some buildings, such as federal buildings, will have Occupational Safety and Health Committees that are required to address IAQ complaints.

Indoor Air Quality Decision Tree





As the decision tree shows, there are numerous groups working in Alberta that can address complaints or provide information. The purpose of the decision tree is to provide accurate information on the roles and responsibilities of government, industry and non-government organizations. Only government organizations (federally or provincially) can address complaints. Industry and NGOs provide valuable information to the public.

Roles and responsibilities can change among all groups involved in IAQ. Therefore, the decision tree should be maintained to ensure it remains relevant and accurate.

Principle 1: Ensure the roles and responsibilities for indoor air quality in Alberta are clear. The decision tree above shows the current roles and responsibilities for indoor air quality in the province. It requires adoption, maintenance and evaluation by the groups involved in IAQ issues in order to ensure information is readily available to indoor air quality stakeholders and the public. The project team envisions this decision tree as a tool useful to the many organizations involved in indoor air quality. It should be distributed and regularly updated.

3 Principles to improve indoor air quality in Alberta

The team undertook an analysis of actions in Alberta to address IAQ and compared those to other jurisdictions and the CASA vision. The findings showed that regulatory approaches are already in place in Alberta, as seen in the previous section. The team also learned through a jurisdictional review that regulatory approaches are not widely adopted to address the issue. Therefore, the team identified principles in the areas of information, awareness and training that would be reasonable and beneficial for future IAQ work. They developed a list of ideas how these principles could be applied. These thoughts are captured in Appendix A.

3.1 Approaches used to address indoor air quality in other Jurisdictions

As attention to IAQ issues has increased, efforts by government, industry and non-government groups to address IAQ have also increased. The project team conducted a high-level jurisdictional review to identify leading examples of jurisdictions using various policy tools to address IAQ. For the full report, see Appendix D. The tools considered were:

- market-based mechanisms (such as incentives, taxes, tax credits);
- regulatory approaches (such as prescriptive standards, bans, permits, etc);
- voluntary approaches (such as non-binding agreements, procurement policies, corporate social responsibility); and
- supportive approaches (such as information disclosure, promotion / awareness and capacity building).

While information on specific sources was limited, the review found similar themes across jurisdictions. Regulatory approaches are not used in non-workplace settings because of difficulties enforcing the rules, as well as the lack of monitoring and economic data. Within the workplace, the Canadian Occupational Safety and Health Regulations (COSHR) apply as part of the Canadian Labour Code. Guidelines and standards for indoor air pollutant concentrations are developed by different groups (Health Canada, ASHRAE), but are not enforced. They represent a capacity-building tool to inform industry, public health inspectors, the public and others of guidelines for exposure and concentrations.

Overall, voluntary approaches and educational programs were the largest area of indoor air quality initiatives. Certification programs, such as BuiltGreen, LEED, BOMA BEST and US Indoor AirPlus, are led by industry groups or governments. Eco-labelling is becoming a popular educational tool to help consumers choose low-emitting materials, furnishings and products. Some jurisdictions are offering tax incentives for the construction of green buildings with low-emitting materials.

3.2 Information

Information related to the scope and type of IAQ problems experienced in Alberta was scarce. Such information would inform future policy directions and educational efforts by government, industry and non-government organizations.

Therefore, the team proposes that the following principle be adopted for future IAQ work in Alberta: **Principle 2: Alberta has information that includes location, severity, follow-up and cause (if known) of IAQ complaints.** Ideally, this information would be collected by the agencies involved through a harmonized mechanism, or centralized system, to allow compilation, comparison and dissemination of provincial data that will inform future policy activities. Future action on IAQ would be improved with a sound understanding of the issues faced in Alberta.

3.3 Awareness and Training

Many of the priority sources and contributing factors (see Table 1) can be effectively addressed through better awareness and training, such as personal care products, smoking, furniture, indoor fireplaces and appliances, janitorial products, vehicle exhaust and maintenance of HVAC and plumbing. These sources can create IAQ concerns when occupants, operators or staff are unaware of the IAQ consequences of their actions. Better awareness and training is a first step to enabling changes to practices that could worsen IAQ.

Public awareness

Health Canada reports that 65% of Canadians believe outdoor air can be a major health concern; however, only 15% feel indoor air could have health implications. Most Canadians associated indoor air quality concerns with second-hand smoke or poor ventilation, but not with household products (e.g. new materials, cleaning products, air fresheners or various biologics such as pets).⁶ The actions of individuals in their homes and workplaces can influence their indoor environment; however awareness of this link is low.

Either in a workplace or a residential building, the owner (i.e. the person who has care and control over the building) is responsible for ensuring the building complies with the building code. The owners “own” the non-compliance issue even if they were not in possession of the building when it was constructed or renovated (i.e. when the offense occurred). The “buyer beware” aspect of the legislation adds to the need for public awareness of the issues related to IAQ.

Therefore, the team proposes that the following principle be adopted for future IAQ work in Alberta: **Principle 3: Albertans are aware of the sources and effects of indoor air quality and actions they can take to improve their indoor environment.** Public awareness is a key component of this principle as there are many actions individual Albertans can take as occupants. There is a lot of information about IAQ available through a variety of sources. Consistent messaging would help Albertans take appropriate steps to prevent or mitigate their IAQ concerns. Opportunities should be available for public to provide input and share their concerns and issues. This could include the promotion of existing IAQ resource materials.

Training programs

In the workplace, the actions of a few key individuals can influence the IAQ for the entire building (e.g. building operators, managers, maintenance staff). There are few certifications related to IAQ for workers such as those in charge of boilers and plumbers. However, the need for other disciplines to have specialized training in IAQ is not common or well recognized. What training is offered, by numerous organizations may not always lead to certification. This lack of coordination and standardization was a gap noted by the project team.

Therefore, the team proposes that the following principle be adopted for future IAQ work in Alberta: **Principle 4: Alberta has coordinated, standard training programs for professionals involved in the proactive avoidance of IAQ issues (e.g. building design, maintenance and operations) and the reactive investigation of IAQ concerns (e.g. health inspectors, etc).** Evaluation of current programs leading to their standardization would ensure all operators and managers receive the same information.

⁶ Health Canada. 2009. “Canadians Views on Indoor Air Quality.” Accessed from www.hc-sc.gc.ca/ewh-semt/air/in/res-centre/facts-faits-eng.php

Maintenance and Operations

Many of the priority sources in Table 1 become concerns after a building is built. LEED is becoming the standard for public buildings in Alberta and BuiltGreen is becoming more common for residential buildings. The provincial building code references ASHRAE standards; both of these guidelines refer to IAQ directly and indirectly. However, after the building is occupied, the operations and maintenance practices may decrease the effectiveness of the design and construction in preventing IAQ issues. Having high quality building management can improve IAQ performance over and above what was in the original design. Awareness and information are important for building owners and managers to understand the impact of maintenance and operations on IAQ.

Therefore, the team recommends that the following principle be adopted for future IAQ work in Alberta:

Principle 5: Building owners, managers and operators are encouraged to upgrade the building to meet best practices where cost-effective to do so.

Building operators are required to maintain the building up to the code in force when the building was constructed. There should be incentives for maintaining buildings in a manner that exceeds these standards. Policies and information would be required to support beyond-compliance behaviour.

An important part of maintenance and operations is building commissioning. ASHRAE defines the commissioning process as “A quality focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements.” In short, it is a process to discover if the building’s systems and operations meet the original design. Commissioning helps pinpoint when systems fail to meet standards and identify problems that could impact IAQ early on. Better education and understanding of commissioning would help owners, operators and managers avoid IAQ issues.

Therefore, the team recommends that the following principle be adopted for future IAQ work in Alberta:

Principle 6: Stakeholders involved with IAQ in Alberta understand the principals and benefits of a proper building commissioning process. Stakeholders should adopt best practices regarding building commissioning as outlined by recognized standards/programs such as ASHRAE and LEED.

4 Conclusion

The information compiled in this report identifies potential issues and approaches which would best inform future work in indoor air quality in Alberta. The governance structure of indoor air quality specifically for Alberta is synthesized into a summary which directs individuals and agencies to the appropriate indoor air quality lead. A survey engaged Alberta’s indoor air quality experts in deriving the priority sources or issues. Finally the team’s review of other jurisdictions helped identify the most beneficial areas and policy tools to employ for future indoor air quality work. As a package, the principles suggest future work in indoor air quality should utilize policy tools that complement the current regulation and guidelines in place.

2 Appendix A: Potential actions

While developing the principles in this report, the team discussed how best to achieve those principles given the current state of knowledge and resources associated with indoor air quality. The team viewed these actions as valuable work to inform future work on indoor air quality, but they are not part of the consensus agreement.

Principle 1: The roles and responsibilities for indoor air quality in Alberta are made clearer.

Potential actions:

- 1.1 The organizations identified in the decision tree adopt the Indoor Air Quality Decision Tree to direct people to the appropriate organization.
- 1.2: The CASA secretariat, working with the relevant stakeholders where appropriate, assumes responsibility for updating the decision tree every 2 years.
- 1.3: The CASA secretariat conducts a survey in 2012 that evaluates the impact of the decision tree in terms of organizational efficiency and public awareness of jurisdictional responsibilities and seeks to improve the tree where necessary. If necessary, a small group of stakeholders could support this work.

Principle 2: Alberta has information that includes location, severity, follow-up and cause (if known) of IAQ complaints.

Possible actions:

- 2.1: Alberta Employment and Immigration and Alberta Health Services collect IAQ information including location, severity, follow-up and cause (if known).
- 2.2 Alberta Employment and Immigration and Alberta Health Services and Health Canada, use a common template for collection of information
- 2.3: Alberta Employment and Immigration and Alberta Health Services and Health Canada promote review and use of the information

Principle 3: Albertans are aware of the sources and effects of indoor air quality and actions they can take to improve their indoor environment.

Potential actions:

- 3.1: Alberta Environment, Alberta Health and Wellness and Alberta Health Services will include information on IAQ on their websites. Both organizations work with all stakeholders providing information to ensure consistent information and messaging and identify the most credible websites.
- 3.2: Develop a mechanism for the public to share concerns and issues related to public and private buildings. The following departments would be involved: Alberta Health and Wellness, Alberta Employment and Immigration, Alberta Infrastructure, Alberta Municipal Affairs, Alberta Health Services and Health Canada

Principle 4: Alberta has coordinated, standard training programs for professionals involved in the proactive avoidance of IAQ issues (e.g. building design, maintenance and operations) and the reactive investigation of IAQ concerns (e.g. health inspectors, etc).

Possible actions:

- 4.1 Industry lead the creation of a certification program for building operators. Current certification programs could be modified to include specific reference to IAQ.
- 4.2 Alberta Health and Wellness and Alberta Health Services provide training and awareness for environmental public health professionals and building inspectors.

- 4.3 CHBA-Alberta and BOMA develop an independent mechanism to evaluate and rate the available training courses.

Principle 5: Building owners, managers and operators are encouraged to upgrade the building to meet best practices where cost-effective to do so.

Potential actions:

- 5.1 Industry groups, including BOMA, etc, conduct periodic certifications to show a building is upholding standards
- 5.2 Alberta Infrastructure, Alberta Employment and Immigration, BOMA and others fully utilize, and update if necessary, their maintenance & operations guides to accompany design standards. This includes making the guides available to anyone who may use them.
- 5.3 BOMA continue its recognition and awards programs for well-operated and maintained programs and include indoor air quality parameters.
- 5.4 Alberta Infrastructure ensures building commissioning becomes standard practice for all public buildings when buildings are bought, leased or turned over to ensure they meet the building design standards.
- 5.5 Alberta Infrastructure develop measurement and verification mechanisms in support of action 5.4 above.

Principle 6: Stakeholders involved with IAQ in Alberta understand the principals and benefits of a proper building commissioning process. Stakeholders should adopt best practices regarding building commissioning as outlined by recognized standards/programs such as ASHRAE and LEED.

Appendix B: Team members

Member	Stakeholder Organization
Anand Mishra	Canadian Mortgage and Housing Corporation
Dean Befus	The Lung Association
Ian Peace	Residents for Accountability in Power Industry Development
James Orr	Alberta Municipal Affairs
Janine Ross	Alberta Environment
Jennifer Allan	CASA
Ken Erikson	Edmonton Public School Board
Linda Sloan	Alberta Urban Municipalities Association
Ludmilla Rodriguez	Alberta Health Services, Edmonton Zone
Merry Turtiak	Alberta Health and Wellness
Opel Vuzi	Health Canada
Roger Steele	Building Owners and Managers Association of Edmonton
Roy Clough	Alberta Employment and Immigration
Stephani Carter	Green Alberta, EcoAmmo Sustainable Consulting Inc / Alberta Chapter of the Canada Green Building Council

Corresponding members:

Brenda Woo	Health Canada
Diane Radnoff	Alberta Employment and Immigration
Michael Nyikes	Canadian Home Builders Association – Alberta
Colin Wildgrube	Alberta Infrastructure

Former team members:

Alex Joseph	EnerVision
Alex MacKenzie	Alberta Health and Wellness
Asish Mohapatra	Alberta Health Services, Calgary Region
Bryan Smith	Health Canada
Darcy Garchinski	Alberta Health Services, Northern Lights Region
David Lee	Alberta Health Services, Northern Lights Region
Dennis French	DF Technical Services
Dennis Stephani	Alberta Health Services, Calgary Region
Grant Ainsley	Canadian Home Builders Association - Alberta
Heather Rock	Sierra Club
Jason Foster	Alberta Federation of Labour
Justin Balko	Alberta Health and Wellness
Karen Smith	The Lung Association
Karina Thomas	Alberta Health and Wellness
Les Hagen	Action on Smoking and Health
Lloyd Harman	Alberta Forest Products Association
Meaghen Allen	Alberta Health Services, Northern Lights Region
Mike Queenan	Ecological Sound Planning and Community Envolvement
Myles Kitagawa	Toxics Watch Society of Alberta
Raymond Wong	Alberta Environment
Russell Miyagawa	Toxics Watch Society of Alberta
Steven Probert	Alberta Health Services, Edmonton Zone

Tannis Zuk
Tim Leung
Warren Kindzierski

Health Canada
Alberta Infrastructure
WBK & Associates

3 Appendix C: Survey results

The scope of indoor air quality concerns is vast, including a large number of pollutants and types of indoor environments. The Indoor Air Quality (IAQ) project team decided to focus on the sources of indoor air quality concerns which cross-cut the various indoor environments. In an effort to prioritize the sources and issues involved, the project team agreed to survey those involved in the indoor air quality field. A subgroup was created to develop the survey methods and questions. This report is the findings from the survey.

Methods

There were two challenges to the methods: the diffuse nature of the indoor air quality field of professionals and budget constraints. These challenges inform the sampling procedure, questions and question delivery.

Sampling

The indoor air quality field includes professionals in numerous fields such as health, remediation, construction, architecture and engineering. As such, there is no list of indoor air quality professionals or experts in Alberta. If a random sample were possible, it would be an arduous task to assemble the necessary information for the sample. The team's budget was limited and there was a desire to complete the survey in a timely fashion as these results were the first steps to scope the team's work.

Therefore, the team chose a snow ball sample and web survey. A snowball sample is an approach for locating people with particular knowledge or skills. This sampling method is particularly valuable because it is cost effective, targeted and easy to begin. Indoor air quality professionals outside Alberta were delimited. Using this approach, potential respondents were identified, asked to participate and requested to forward the survey onto another IAQ professional.

Once respondents were identified, an invitation to complete the survey was sent followed by reminders and thank you notes. Maintenance of the sample was done by the secretariat through tracking responses and sending requests to pass on the survey. All information was kept confidential by the secretariat. Team members provided an initial sample of 68 and 29 symposium registrants⁷ for a total 97 in the first round. There were 38 responses from this pool and 4 responses from the snowball.

Questions and delivery

The questions were designed to identify priority sources, asking respondents to identify sources as or high, medium and low concern, then prioritize the 'high' and medium' sources. Participants were also asked to offer any solutions.

The survey was conducted via the web. This is a cost-effective measure that allowed respondents easy access. The majority of questions were quantitative to reduce resources necessary for data analysis. In the end, the secretariat and the subgroup completed the data analysis.

Data Analysis

Given the number of responses, the data analysis used descriptive statistics only. The mean and median were reported for each source. The mode was reported for each of the 'high,' 'medium,' and

⁷ The project team organized a symposium on indoor air quality in 2009. However, due to low registration, the event was cancelled.

‘low; priority ranking. A keyword search was used for the qualitative answers and responses with a similar theme were grouped. The quotes included in this report are representative of the group.

Who we heard from

The survey achieved a good spread between government, industry, non-governmental organizations and ‘others.’ Over 77% of respondents had more than 4 years experience in the IAQ field: 37.1% were novices (4-6 years) and 40% were experts (6+ years).

About two thirds (65.7%) of respondents had a primarily responsive role in IAQ management. Respondents were asked to select any area that applied and nearly everyone in the responsive role indicated they performed investigations (95.2%). Many also were involved with remediation (42.9%) and health protection (57.1%).

For those with a proactive role in IAQ management (34.3%), most indicated they were involved with education (53.3%), policy development (46.7%) or health promotion (40%).

There were limits to the sample. No physicians were identified in the initial sample and therefore were not included in the subsequent ‘snowball.’ Because the total number of indoor air quality practitioners and experts is not known, it is impossible to determine if this is a statistically significant sample, although the sample did achieve a reasonable representation of the group.

What we heard

The results below indicate whether a source was of high, medium or low concern and the level of priority assigned to the sources.

Occupant Activity

The table below shows the most frequent responses indicating the level assigned to each source in this category. Ranking each source as high, medium or low priority was the first question for each source category. For illegal activity, there was a range of responses, so reported here is the median response. The data was: High (13); Medium (5) and Low (17), thus ‘medium’ indicates the middle range for this source.

	High	Medium	Low
Air fresheners			
Candles (scented/unscented)			
Smoking (inc second & third hand smoke)			
Home cooking			
Pets			
Moisture (i.e. plants, aquariums, water features)			
Personal care products (makeup, hairspray, perfumes)			
Illegal activity (grow-ops, meth labs)			
Unsanitary conditions			
Other: Cleaning Products (3)			

The table shows that smoking is the only sources rated as a high priority. Air fresheners, personal care products, illegal activity and unsanitary conditions were deemed medium sources of IAQ issues.

When asked to rank the sources, smoking was by far the highest priority with a median of 1 and a mean of 2.2. The complete ranking for high and medium ranked sources is:

1. Smoking Median = 1; Mean = 2.2 (highest possible=10)
2. Personal Care Median = 3; Mean = 4.07
3. Air Fresheners Median = 4; Mean = 4.25
4. Illegal Activity Median = 3.5 Mean = 4.58
5. Unsanitary Conditions Median = 4; Mean = 4.46

Over 66% of respondents advised the IAQ team to recommend education and awareness programs for sources of IAQ issues related to occupant activities. Most of these respondents advocated public awareness programs geared toward consumer choices and personal behaviour.

Representative quote:

Increase awareness of individuals to look at their own behaviour (e.g. smoking, use of fresheners, personal care products, etc) as a contributor to their indoor environment.

Building Construction and Design

The responses in this section were very close when asked to rate the sources. For many sources, the difference was n= 2 or less between ranks. Building code adequacy and compliance was a difference of 1.

	High	Medium	Low
Carpets			
Glues			
Paints			
Hard surface floor (linoleum, laminate)			
Attached garages			
Moisture Removal (i.e. exhaust fans)			
Building code adequacy and compliance			
Heating and ventilation (method of heating, return/make-up of air)			
Water infiltration			

The high concerns are glues, building code adequacy and compliance, heating and ventilation and water infiltration. The latter two sources were clearly ranked high. Medium sources are carpets, paints and moisture removal.

The ranking of the high and medium sources is as below (the scale was 1-10):

1. Water infiltration Median = 2.5; Mean = 3.23
2. Heating and ventilation Median = 3; Mean = 3.5
3. Glues Median = 3; Mean = 3.82
4. Building code Median = 4; Mean = 4
5. Moisture removal Median = 4; Mean = 4.5
6. Paints Median = 4; Mean = 4.6
7. Carpets Median = 5; Mean = 4.83

Almost one-third (32%) offered education directed to both building trades and consumers on proper design and consumer products.

“Further study on codes related to these areas, focused education for building trades, public education related to prevention.”

“Support for programs educating homeowners about prompt repairs of leaks and infiltration problems.”

Building code improvements garnered 22.7% of the responses. Specific advice related to building envelope advice for water infiltration and office space occupancy and ventilation rates. Enforcement of the building code was cited by 18.1 %.

There were three respondents for considering ways to encourage up to date HVAC systems and promoting low VOC products each.

Furnishings and Equipment

In furnishings and equipment, a standout sources did not emerge as clearly as in the other source categories.

Table 3: Furnishings and Equipment - Rank			
	High	Medium	Low
Furniture (pressed particle material, glues)			
Office equipment			
Dry cleaning			
Laundry equipment (washing machines, dryers)			
Indoor wood fireplaces and stoves			
Indoor gas appliances (inc gas stoves, fireplaces)			

Furniture was the only source ranked as high, but had an equal number of responses indicating a medium level of concern. Dry cleaning, indoor wood fireplaces and stoves and indoor gas appliances were all ranked medium. Office equipment had the same number of responses in the medium and low category.

The ranking system was out of 8 and was as follows:

- | | |
|------------------------------------|-------------------------|
| 1. Furniture | Median = 2; Mean = 2.29 |
| 2. Indoor wood fireplaces & stoves | Median = 2; Mean = 2.45 |
| 3. Indoor gas appliances | Median = 2, Mean = 2.74 |
| 4. Dry cleaning | Median = 4, Mean = 3.37 |
| 5. Office equipment | Median = 4, Mean = 4 |

The most commonly offered idea (40%) was to promote low or no VOC or formaldehyde furniture. *“Similar to energy star, materials can get a pollutant emitting rating.”*

Twenty percent of responses were for regulation of indoor burning appliances and consumer education programs each.

Maintenance and Operations

Table 4: Maintenance and Operations - Rank			
	High	Medium	Low
Maintenance: HVAC			
Maintenance: Plumbing (e.g. sewer gas, leaks)			
Maintenance: Building envelope (e.g. windows, roof)			
Maintenance plan and adherence			
Operational plan and adherence			
Training and maintenance and operational staff			
Cleaning products			
Custodial Plan and adherence			
Carpet cleaning			

Most sources were ranked as high, except custodial plans and adherence and carpet cleaning. No sources were deemed low.

The ranking, out of 10, is below. The top five all related to maintenance.

- | | |
|--|-------------------------|
| 1. Maintenance: HVAC | Median = 2, Mean = 2.64 |
| 2. Maintenance: Plumbing | Median = 3, Mean = 3.54 |
| 3. Maintenance: Building envelope | Median = 3; Mean = 3.75 |
| 4. Training of maintenance & operational staff | Median = 4; Mean = 3.71 |
| 5. Maintenance plan & adherence | Median = 4, Mean = 4.1 |
| 6. Cleaning products | Median = 5, Mean = 4.96 |
| 7. Operational plan and adherence | Median = 5, Mean = 5.32 |
| 8. Custodial plan and adherence | Median = 6, Mean = 5.7 |
| 9. Carpet cleaning | Median = 8, Mean = 6.86 |

The ideas of programs for maintenance and cleaning (37.5%) as well as training programs (31.2%) each received were the most often offered.

“Look to a form of maintenance / clean certification programs that would be similar to APPA as a measuring tool.”

“Workshops for cleaning and maintenance staff, understanding the connections between good HVAC and cleaning and IAQ and health.”

Creating a list of “clean” cleaning products was advocated by 12.5% of responses.

Outside Sources

Table 5: Outside Sources - Rank			
	High	Medium	Low
Vehicle Exhaust (e.g. idling vehicles)			
Odours			
Odours from livestock operations			
Fire/BBQ pits			
Changing weather conditions			

The only high or medium sources were vehicle exhaust and odours.

Vehicle exhaust was ranked first (median = 1; mean = 1.58) and odours second (median = 2, mean = 2.42).

The majority of solutions offered by respondents were to address vehicle idling (58.3%): including creating legislation for excessive idling, creating idle-free zones, banning remote car starters, educating and participating in anti-idling programs.

Public awareness and education were put forth by 25% of respondents.

Ranking the source categories

The source categories were ranked as:

1. Occupant activity
2. Building construction and design
3. Maintenance and operations
4. Furnishings and materials
5. Outside sources

Highlighted Survey Findings

Education for various groups (consumers, public at large, builders, custodial, maintenance staff) was the most common suggestion across source categories.

Occupant activity ranked first among the source categories. Smoking was the standout issue. The majority of suggestions related to education and awareness with the eventual aim of helping people modify their behaviours.

Overall in the maintenance and operations category, nothing was ranked low and the category ranked third among the others. Maintenance was cited in the top five sources in that category above operations, particularly HVAC, plumbing and building envelope maintenance. Training and maintenance plan and adherence rounded out the top five.

Furnishings and equipment was ranked fourth among source categories and no clear source stood out as an issue.

The results of this survey should inform a long list of IAQ priorities. The team previous agreed that the criteria above should be used to shorten the list. In particular, a 'value added' criteria (i.e. areas CASA recommendations could add value beyond current initiatives) is meant to determine which priorities this team can make a meaningful difference.

4 Appendix D: Jurisdictional Review

Below is a high-level review of the various policy tools used to improve indoor air quality. Primarily, the focus is on North America, but some European examples are cited.

Overview:

Based on the review, a body with sole oversight for indoor air quality in Canada or Alberta was not identified. There are a few coordination bodies of note in the United States. The Federal Interagency Committee on Indoor Air Quality (CIAQ) coordinates research, exchanges of information between federal agencies, state and local governments, research communities, the private sector and the general public. California has a similar inter-agency body (CAL-IAQ); however it does not appear to have been active since 2004. In Germany there is an ad hoc working group under the Federal Environmental Agency called the Indoor Air Hygiene Commission.

Several jurisdictions apply or advocate for a source-control approach including Australia, US EPA, Germany and WHO. For standards, guidelines and regulations, there was a sharp distinction between occupational and non-occupational environments. However, for market-based mechanisms, voluntary approaches and some supportive approaches, the same approach could be applied to both settings.

Policy tool 1: Market-based mechanisms (e.g. incentives, taxes, tax credits)

Two examples of market-based mechanisms, both relating to building materials, were found.

The state of New York has a Green Building Tax Credit as of 2000. The credit provides financial assistance in designing and procuring materials for a green building. Relevant to IAQ are credits for non-toxic materials in construction (5% of the cost of a project up to \$3.75 per sq ft for interior work and \$7.50 for exterior work).

Germany imposes bans on the import of the following products to prevent exposure to carcinogenic VOCs from building materials:

- Import of wood products that are tested to emit more than 100 ppb of formaldehyde;
- Import of cleaning products that contain more than 0.2% formaldehyde;

Policy Tool 2: Regulatory approaches (e.g. prescriptive standards, bans, restrictions, permits, codes of practice, performance or design-based standards)

The regulatory environment is very different for workplace and non-workplace buildings. For residential and other non-workplace buildings, there are no enforceable regulations (with one exception noted below). There are numerous standards and guidelines offered by various industry groups and jurisdictions. These are summarized under Policy tool 4: Supportive approaches because they are not legally binding in many jurisdictions. They represent a capacity building-tool to inform industry, public health inspectors, the public and others of guidelines for exposure and concentrations. Below is an explanation of the barriers to regulations in residential environments, followed by a summary of workplace regulations.

The one area of where regulation is commonly employed is for product safety. In Canada, the Hazardous Product Act bans specific products in workplace or non-workplace environments such as

asbestos. California has standards for formaldehyde emissions from pressed-wood products and ozone emissions from air cleaners.

Non-Workplace Buildings

An Australian (2001) and a BC (2007) IAQ review conclude that there are commonly no enforceable regulations specifically for non-workplace indoor environments. Most Canadian jurisdictions do not have specific legislation that deals with indoor air quality issues. In the absence of such legislation, the “general duty clause” applies, which is common to all Canadian occupational health and safety legislation. It states an employer must provide a safe and healthy workplace, making IAQ the employer’s duty.

The Australian study offers three reasons why regulating indoor air out of the workplace is difficult:

1. the public would regard government control of private indoor environments as unacceptable interference;
2. regulations on air quality within homes would be impossible to enforce; and,
3. internal air quality reflects a complex set of factors, including the effects of building and ventilation system design, construction, operation and maintenance; outdoor climate and pollutant sources; a range and mixture of pollutants and their sources; diverse health effects; and protection of a wide range of people and their sensitivities.

There are other barriers to regulation, cited in the BC IAQ backgrounder related to available data and technical barriers. There is a lack of biomarkers of exposure for many contaminants, making setting health based guidelines difficult and few resources have been devoted to policy-relevant research. Data on the costs associated with inaction are also scant. Economic analysis of the impact of diseases and lost productivity associated with poor indoor home and work environments are lacking. Costs are real, but often overlooked because they are shifted to the health care sector, where they appear as medical care costs. Technically, the BC study cites barriers related to material testing, availability of alternatives and energy efficiency. Such barriers would make it difficult to develop and implement prescriptive regulations with confidence.

Workplace Buildings

There are enforceable regulations for industrial and some commercial environments. The U.S. Occupational Health and Safety Administration (OSHA) developed enforceable maximum exposures for industrial settings. These do not take into account possible reactions of sensitive individuals. In Canada, COSHR (Canadian Occupational Safety and Health Regulations) stipulates requirements for maintaining a healthy and safe work environment and form part of the Canadian Labour Code. These are requirements for federal government organizations and recommendations for other Canadian institutions.

Policy tool 3: Voluntary approaches (e.g. voluntary agreements, procurement policies, corporate social responsibility)

Voluntary approaches are often at the initiative of industry groups and may be supported by government policies (e.g. procurement policies). LEED, BOMABEST, BuiltGreen and other non-government certification programs are summarized here.

There are several voluntary approaches to green buildings; the best known for non-residential construction is likely LEED certification, which has links to indoor air quality. LEED offers points for the following:

- Sequence construction activities so that materials are kept dry and those that absorb contaminants are installed after other materials have off-gassed their contaminants to reduce the sink effect.
- Low-VOC content of adhesives, sealants and sealant primers
- Low-VOC paints
- Composite wood and laminate adhesives must contain no urea-formaldehyde.

Several jurisdictions have reference LEED standards for publicly-funded projects, but these are all at the municipal level. The State of Minnesota's Sustainable Building Guidelines exceed LEED standards for publicly-funded buildings. Ucluelet, British Columbia became the first municipality in British Columbia to require all new multi-family residential, hotel, condominium and commercial development to at least meet LEED silver standards (BC Housing, 2001).

BOMABEST: BOMA's Building Environmental Standards launched in 2009. Using a list of best practices and third-party verifiers, BOMA certifies commercial and government buildings to various levels of BOMA BEST. There is one indoor environment best practice: "Does the building management have in place a documented means for addressing tenant/occupant concerns regarding indoor air quality (such as a complaint form and incident log?)"

BuiltGreen: The recognized standard for the construction of energy efficient and environmentally friendly residential buildings in both Alberta and British Columbia is established by the Built Green program. This industry-driven voluntary program was launched in 2003 and has over 13,000 homes enrolled as certified by Natural Resources Canada in accordance with the EnerGuide Rating System. The Built Green program accommodates single-family, multi-family, high-rise and renovation residential projects. The current Built Green checklist has two full sections which are dedicated specifically to indoor air quality and to ventilation protocol. More information on the program can be found at www.builtgreencanada.ca

Some of the non-government certification systems include:

- Scientific Certification Systems – Indoor Advantage and FloorScore
- Carpet and Rug Institute – Green Label Plus Carpet
- Green Guide for Health Care
- Green Seal Certified Products
- Collaborative for High Performance Schools (CHPS) – Low-emitting materials criteria
- Institute for Market Transformation to Sustainability – Textile and Flooring standards

The US EPA has a voluntary certification system for new homes called Indoor AirPlus. The construction specifications include the careful selection of and installation of moisture control systems; heating, ventilating, and air-conditioning systems; combustion-venting systems; radon resistant construction; and low-emitting building materials

Policy tool 4: Supportive approaches (e.g. information disclosure (eco-labelling), promotion / awareness, capacity building)

Standards and Guidelines

There are numerous standards and guidelines recommended by international health associations, industry organizations, state governments and private programs. However, there are no currently defined federal regulations covering IAQ (see Policy tool 2 above).

The general conclusion to be drawn from this review is that there are a myriad of non-enforceable guidelines and standards for various substances in occupational and non-occupational settings.⁸ The commonly cited sources of guidelines and standards are:

1. **Health Canada:** Health Canada guidelines can be enforced at the discretion of a Public Health Inspector in the case of public buildings (e.g. residential rental units, common public venues), but they are not automatically enforced because provincial authorities do not adopt the guidelines as legislative requirements. The risk assessment and management guidelines were developed in 1987 and are currently under review by a working group of experts on indoor air quality.
2. **ASHRAE:** The American Society for Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) develops guidelines for refrigeration processes and design and maintenance of indoor environments. These guidelines are often cited worldwide. ASHRAE Standard 62 (2001) is a ventilation standard for acceptable indoor air quality. The Standard defines indoor air quality as "... determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed to not express dissatisfaction."
3. **WHO / Europe:** Guidelines for non-industrial settings intended for application to indoor and outdoor environments. Non-enforceable.
4. **NIOSH** (US National Institute for Occupational Safety and Health): Non-enforceable limits for industrial environments that are reviewed regularly and in some cases set above those needed for health reasons.
5. **ACGIH** (American Council of Governmental Industrial Hygienists): Guidelines for maximum exposure applicable for normal industrial working conditions and single contaminant exposure.

Education and Awareness Programs

There is a long list of education products and awareness programs available. Two examples are the Health Canada and the US EPA Tools for Schools Toolkit. The Lung Association has information on IAQ and health on its website.

California's Proposition 65, the Safe Drinking Water and Toxic Enforcement Act of 1986 require the State to publish a list of chemicals known to cause cancer, birth defects or other reproductive harm. The list of approximately 750 chemicals includes additives or ingredients in pesticides, common household products, food, drugs, dyes, solvents, building materials and other sources found indoors. Businesses are required to provide a "clear and reasonable" warning when their products or actions may result in a release of chemicals above a specified threshold level. The aim is to inform the public of possible exposure. Proposition 65 pollutants and safe harbor levels are available at <http://oehha.ca.gov/prop65.html>.

Eco-labelling

⁸ The National Research Council of Canada's report "Indoor Air Quality Guidelines and Standards" (2005) summarizes 10 occupational and non-occupational standards and guidelines. Pages 7-10.

Eco-labelling has become a popular educational tool. Most are related to the certification systems (see Policy Tool 3: Voluntary Approaches). The additional information below is a list of IAQ Labelling Programs used in various jurisdictions in the world compiled by the National Research Council of Canada. These programs are run by industry or non-government organizations and some are supported by government programs.

Additional information: IAQ Labelling Programs

Source: National Research Council. 2005.

Environmental Choice Eco-Logo (Canada)

<http://www.environmentalchoice.ca>

The Canadian Environmental Choice Label Program was one of the original labeling systems, preceded only by Germany's Blue Angel program. It was developed in 1988 by Environment Canada, and is administered by TerraChoice Environmental Services. The labeling program is much broader than just emissions testing and includes many environmental management requirements. Example:

- Adhesives: no use in manufacture of aromatic or halogenated solvents, formaldehyde, borax, Hg, PB, Cd, Cr; detailed instructions for safe (health) application and disposal; VOC content < 5% by weight.

Green Label (USA)

<http://www.carpet-rug.com/index.cfm>

Industry-designed and administered. Developed in 1992 by the Carpet and Rug Institute (The national trade association of carpet and rug industry) in consultation with US EPA. The program specifies maximum emission rates for 4-PC, formaldehyde, styrene and TVOC following small emission chamber trials conducted by a single commercial lab.

Green Label Plus (USA)

<http://www.carpet-rug.com/index>

This is a revised version of the Green Label program developed to satisfy California's CHPS Criteria. Every carpet receiving Green Label Plus certification has been tested for emission levels for all chemicals as required by Section 01350, plus six additional chemicals for a total of 13 chemicals:

Green Seal (USA)

www.greenseal.org

Developed by independent non-profit organization of the same name. Based on ISO 14020 and ISO 14024, and US EPA, and global ecolabelling network. Guiding principles and procedures are from Type I Environmental labelling (ISO 14024). Example criteria:

- Paints – should not contain any of the following ingredients – methylene chloride, 1,1,1-trichloroethane, benzene, toluene (methylbenzene), ethylbenzene, vinyl chloride, naphthalene, 1,2-dichlorobenzene, di (2-ethylhexyl) phthalate, butyl benzyl phthalate, din-butyl phthalate, di-n-octyl phthalate, diethyl phthalate, dimethyl phthalate, isophorone, antimony, cadmium, hexavalent chromium, lead, mercury, formaldehyde, methyl ethyl ketone, methyl isobutyl ketone, acrolein, acrylonitrile.

Green Guard (USA)

<http://www.greenguard.org>

Developed from AQSPEC List, which was first initiated in 1996. Product-by-product specifications for emissions of formaldehyde, VOC, respirable particles, ozone, and other pollutants using small environmental chambers. Tested to see if they meet “acceptable IAQ pollutant guidelines and standards” within a 5-day period of unpackaging. Examples:

- Construction materials, furnishings and office furniture must meet the low pollutant of the State of Washington's IAQ program, OSHA's formaldehyde rule, US EPA's office furniture specifications, US EPA's national ambient air quality standards, and 1/10 of all regulated chemical exposure limits established by OSHA.

Environmentally Preferable Product (USA)

<http://www.scscertified.com/epp>

Managed by Scientific Certification Systems (SCS). EPP Certification is based upon a full Lifecycle Impact Assessment (LCIA). To achieve certification, part of the evaluation protocol requires that calculated model building concentrations (school classroom and office space) for chemicals emitted by the product must conform to the following:

- Formaldehyde – Less than or equal to 16.5 ug/m³; and
- All other organic chemicals – Less than or equal to 1/2 the established Chronic

Reference Level as listed in the latest edition of the Cal/EPA OEHHA list of chemicals with noncancer chronic Reference Exposure Levels (RELs). The current version of this list is accessible at http://www.oehha.ca.gov/air/chronic_rels/AllChrels.html

Blue Angel (Germany)

www.blauer-engel.de/englisch/

The first environmental label, created in 1977, now used by about 710 companies for ~3,800 products in ~80 product categories. The label is the property of the Federal Ministry of the Environment, Nature Protection and Nuclear Safety. It is sponsored and administered by the Federal Environmental Agency and the quality assurance and product labelling institute RAL Deutsches Institut für Gütesicherung und Kennzeichnung. All technical demands placed on products and services for the award of the Environmental Label are decided by an independent Environmental Label jury. Emission data assessed after 28 days of chamber testing.

EMICODE (Germany)

<http://www.emicode.com>

A group of German manufacturers of flooring installation products founded the "Gemeinschaft Emissionskontrollierter Verlegewerkstoffe e.V." (GEV), or translated "Association for the Control of Emissions in Products for Flooring Installation". The EMICODE ® system is based on defined analytical test chamber procedures and strict classification criteria. These criteria have been defined by the Technical Council of the GEV with the professional support of the environmental institute Miljö-Chemie, the Carpet Research Institute (TFI) and the Association for Environmentally-Friendly Carpets (GuT).

GuT (Germany)

The Association of Environmentally-Friendly Carpets was established in 1990. A new evaluation scheme, instituted in Jan.2004, is based on the ECA-18-system and is compatible with other systems such as the procedure suggested by AgBB (Ausschuss zur gesundheitlichen Bewertung von Bauprodukten = Committee for Health-related Evaluation of Building Products) for the evaluation of building products used for large indoor areas. Emissions testing is now conducted after 72 hours, and uses the LCI (Lowest Concentration of Interest) table published by AgBB. Prohibits carcinogens vs EU list Classes 1 and 2.

Finnish M-1, M-2 (Finland)

<http://www.rts.fi/english.htm>

The first version of the emission classification was developed by the Finnish Society of Indoor Air Quality and Climate (FiSIAQ) in 1995 as part of Classification of Indoor Climate, Construction, and Finishing Materials. In May 2000 the system changed its name into emission classification of building materials. Classifications are granted by the Building Information

Foundation (RTS), a private foundation with representatives from 43 Finnish building organisations, and Finland's leading information service for the building and construction sector. Carcinogens are identified vs. IARC.

Indoor Climate Label (Denmark and Norway)

www.dsic.org

The scheme was developed by the Danish Society of Indoor Climate in 1995 on the initiative of The Danish Ministry of Housing. Normative bodies for the system are the Danish Society of Indoor Climate and the Norwegian Forum of Indoor Climate Labelling. Chemical and sensory odour emission testing in cells or conventional chambers for 28 days is required. Results are converted to indoor air concentrations in a standard room.

All products are declared with an “indoor-relevant time-value”, which is based on of the time it takes the most slowly emitting individual substances to fall below their odour and irritation thresholds.

Assessment protocols for the following product-areas have been developed:

- Wall and ceiling systems
- Carpets
- Interior doors and folding partitions
- Windows and exterior doors
- Resilient floors, wood-based floors and laminated floors
- Oils for wood-based floors
- Kitchen, bath and wardrobe cabinets
- Interior building paint
- Furniture

Nordic Swan (Scandinavia)

<http://www.svanen.nu/Eng/default.asp>

The Nordic Swan labelling system was developed in 1989 by the Nordic Council of Ministers and administered by the Nordic Ecolabelling Board. It is a voluntary program intended to enable consumers to select products that are the least harmful to the environment. Lifecycle assessment criteria are developed on a product-by-product basis.

Chemical emissions impacting indoor air are assessed based on 28-day chamber tests.

Examples of emissions criteria include:

- Plywood: Formaldehyde emission: ≤ 0.125 mg/m² at 28 days
- Adhesives: TVOC: < 0.2 mg/m²h (as toluene equivalent)

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