



**Standards Council of Canada**  
**Conseil canadien des normes**

# A BREATH OF FRESH AIR:

How updating indoor air quality standards can  
improve employee health and productivity



Canada

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Canada has some of the cleanest outdoor air in the world.<sup>1</sup> However, outdoor air quality is not the only air that matters. Canadian adults spend approximately 90% of their time indoors.<sup>2</sup> Unfortunately, indoor air quality is not always on par with Canada's outdoor air. In fact, poor jobsite air is the leading cause of workplace fatalities in Canada. Between 1996 and 2014 workplace exposure to asbestos accounted for approximately one third of all workplace fatalities.<sup>3</sup>

In 2000, the World Health Organization declared that healthy indoor air is a human right.<sup>4</sup> Given the importance of indoor air quality, federal, provincial, and territorial governments have drafted regulations mandating acceptable indoor air quality. These regulations often rely on standards to establish acceptable levels. Standards are an important resource for regulators. They are developed through a consensus-based process by relevant experts and stakeholders. The standards development process is specifically designed to safeguard the validity and utility of standards, making them efficient and effective regulatory tools.

While referencing standards in regulation can help regulators meet their objectives, an understanding of the standards development process is essential to ensuring that standards continue to fulfill that purpose. Standards are not static. They represent the evidence, judgment, and perspective of experts and stakeholders at a point in time. However, as technology evolves and

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1 World Health Organization, *Ambient (Outdoor) Air Pollution in Cities Database* (Geneva: WHO, 2014).  
2 Judith A. Leech, William C. Nelson, Richard T. Burnett, Shawn Aaron, and Mark E. Raizenne, "It's about time: A Comparison of Canadian and American time – Activity Patterns" (*Journal of Exposure Analysis and Environmental Epidemiology* 12 (2002): 427-432), 429.  
3 Tavia Grant, *Asbestos Revealed as Canada's Top Cause of Workplace Death*, (Globe and Mail, 15/12/2014).  
4 World Health Organization, *The Right to Healthy Indoor Air* (Geneva: WHO, 2000), 3.

new knowledge is acquired standards are designed to be responsive to these advances. The Standards Council of Canada (SCC), similar to the International Organization for Standardization (ISO) and other national standards bodies, requires that national standards under its purview be maintained on a five-year cycle. Specifically, every five years a national standard is to be reviewed to determine if it should continue to stand as is, be revised to incorporate new developments, or withdrawn because it is no longer relevant or applicable.<sup>5</sup>

The five-year cycle for standards has implications for regulators. Regulators need to review the status of a standard, and possibly update a regulation, five years after a standard's publication date. While this may seem like an administrative burden, it increases the integrity of the process and provides opportunities for continuous improvement. Updated standards also have the potential to result in significant economic and social gains for the involved parties. Examining the latest research on indoor office air quality we can begin to quantify the potential impacts of updating standards to align with new research findings.

## Poor air quality is the leading cause of workplace fatalities in Canada.



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<sup>5</sup> For more details on the Standard Development Process see: SCC, [Requirements & Guidance](#), 2015.



Indoor working conditions have created challenges for people. Over time there have been some ingenious responses to address the difficulties that have arisen given the technology and knowledge that existed at the time. For example, starting in 1911 British coal miners relied on canaries to warn of dangerous air conditions.<sup>6</sup> Canaries are highly sensitive to toxic gases, including Carbon Monoxide, consequently any signs of distress in these birds were an indication that miners should evacuate. The canaries were so effective, that it was not until 1986 that they were completely replaced by electronic detectors.

Indoor air quality standards are intended to safeguard the health and safety of employees; they can also impact worker productivity and economic output.

In office settings, ventilation is a critical issue. Research in the 1930s aimed to identify the ventilation rates at which the smell of body odour in a confined space was not perceived as objectionable by individuals entering the space from a clean-air environment.<sup>7</sup> In 1973, ASHRAE 62, one of the most prominent ventilation


<sup>6</sup> BBC, *1986: Coal Mine Canaries Made Redundant* (Accessed 08/07/2016).

<sup>7</sup> Andrew Persily, "Challenges in Developing Ventilation and Indoor Air Quality Standards: The Story of ASHRAE Standard 62" (*Building and Environment* 97 (2015): 61-69), 62.

standards, was first published. Ventilation rates have been debated in subsequent versions of this standard. While increased ventilation will improve air quality, it can simultaneously decrease energy efficiency. These competing demands for ventilation rates have economic and health implications that technical experts must consider.

Air quality standards are not limited to ventilation rates; air quality is also affected by the compounds in the air (e.g., chemicals, volatile organic compounds, etc.). The presence of chemicals in the air is most often attributed to flooring and furniture. The development of standards in this area can be highly specific, focusing on a select number of chemicals, or very expansive as the list of chemicals covered increases. Recognizing the importance of air quality, the federal government has referenced air quality standards in regulation. The Canadian Occupational Health and Safety Regulations include standards that specify the minimum acceptable air quality in commercial buildings. These standards are intended to safeguard the health and safety of employees, but research has shown that they can also have an impact on productivity and economic output.





# The Impact of Indoor Air Quality on Workers

Poor indoor air quality can negatively affect workers health and longevity. Asbestos is a prime example of the devastating effects that poor workplace air quality can have on individuals. In 2013, there were 368 death claims for asbestos related illness.<sup>8</sup> Asbestos related fatality claims were higher than the combined total claims for workplace fires, traffic accidents, and chemical exposures.<sup>9</sup> It is important to note that claims processed through Worker Compensation Boards likely underestimate the impact of poor air quality on employee health. Not every symptom associated with poor air quality would qualify for a claim, whereas others would not be approved, and some individuals may opt not to initiate a claim in the first place, even if justified.

The bottom line is that workers suffer physically from working in environments with poor air quality. This reduces not only their quality of life, but also their earning potential if they die prematurely or are otherwise impaired. Employers lose valuable resources as a result of absenteeism, presenteeism,<sup>10</sup> and disability. The government pays for poor workplace air quality through increased health care costs from sick employees and disability payments for employees who are unable to work for periods of time.<sup>11</sup>

Conversely, improving air quality – which can be achieved through meeting or even exceeding relevant standards – has positive health and economic

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8 Tavia Grant, [Asbestos Revealed as Canada's Top Cause of Workplace Death](#), (Globe and Mail, 15/12/2014).

9 Tavia Grant, [Asbestos Revealed as Canada's Top Cause of Workplace Death](#), (Globe and Mail, 15/12/2014).

10 Presenteeism occurs when employees come to work when they are not well. The issue with presenteeism is that employees' performance is likely to be sub-par under these conditions.

11 See for example, [Canadian Workers' Compensation System – Year at a Glance](#) (Accessed 25/08/2016).

implications. Research has found that employees in offices with better ventilation rates (24L/s compared to 12 L/s) take 35% less short-term sick leave.<sup>12</sup> This translates into approximately one to two less sick days per person per year in the offices with better ventilation rates. If those estimates hold across Canadian workplaces, the **additional** cost of sick leave attributed to poor indoor air quality is estimated at between \$1.4 billion and \$2.8 billion CAD to Canadian businesses.<sup>13</sup>

Beyond physical health, indoor air quality also has implications for employees' workplace performance. Studies have shown that improved ventilation can increase productivity by up to 11%.<sup>14</sup> Specifically, one study found that poor air quality and higher temperatures decreased typing speed and units output by up to 10%.<sup>15</sup> Another study reported that improved air quality increased employee productivity by 2.6%, which translated into an additional 39 hours of work per employee, per year.<sup>16</sup> If the estimated increase in productivity holds for Canadian office workers, improved air quality in commercial buildings could increase labour productivity by \$7.5 billion CAD.<sup>17</sup>

In addition to reducing sick leave, improving air quality can increase workers' productivity. Improved air quality could increase labour productivity by \$7.5 billion CAD.

One limitation of much of the previous research demonstrating the link between indoor air quality and productivity is that it has been correlational in nature.<sup>18</sup>

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12 Donald K. Milton, P. Mark Glencross and Michael D. Walters, "[Risk of Sick Leave Associated with Outdoor Air Supply Rate, Humidification, and Occupant Complaints](#)" (*Indoor Air* 10 (2000): 212-221), 216.

13 The cost of sick days calculation is based on two assumptions: 1) number of employees affected, and 2) the average hourly wage. The number of office workers impacted was estimated at 8.8 million. This includes employees who work in commercial buildings in the service industries (Statistics Canada. Table 281-0024). According to Statistics Canada the average salary in these sectors was \$21.86 or \$163.94/day (based on a 7.5 hour day).

14 Vivian Loftness, Volker Hartkopf, Beran Gurtekin, David Hansen and Robert Hitchcock, "[Linking Energy to Health and Productivity in the Build Environment](#)" (2003 Greenbuild Conference, Carnegie Mellon) 5.

15 Olli Seppänen O. "REHVA Guidebook: Indoor Climate and Productivity in Offices" (*Eurovent Review* July/August 2006).

16 Amanjeet Singh, Matt Syal, Sue C. Grady, and Sinem Korkmaz, "[Effects of Green Buildings on Employee Health and Productivity](#)" (*American Journal of Public Health* 100 no. 9 (2010): 1665-1668), 1667.

17 The dollar equivalency was calculated by multiplying the average hourly wage (\$21.86; Statistics Canada. Table 281-0030) by 39 hours and by the total number of employees who are likely to work in office settings (8.8 million, Statistics Canada. Table 281-0024).

18 While it seems logical that air quality affects performance, and not the other way around, the design of the previous research was only able to show an association between the two factors.





## Better office air quality could improve employees' strategic thinking by 288%.

However, more recent research has shown a **causal** relationship between air quality and employee productivity.<sup>19</sup> The study compared the performance of employees in a "conventional" office, a "green" office and a "green+" office. Indoor air quality was lowest in the conventional office, higher in the green office, and highest in the green+ office.

Improving air quality markedly improved employees' performance. Compared to conventional offices, those working in the best air quality condition (i.e., green+) had improved cognitive function. Specifically, individuals' total cognitive scores were 101% higher. The largest increases were for crisis response (131% higher), information usage (299% higher), and strategy (288% higher). In other words, employees working in an environment with better air quality have enhanced capacity for planning, prioritizing, and decision making. Perhaps most importantly, the authors noted that the higher indoor air quality conditions were not that difficult to achieve. The lead author stated, "The idea was to simulate office environments that can easily be obtained. What's shocking is that you see this big effect and the effort it takes to reach it wasn't that much."<sup>20</sup>

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<sup>19</sup> Joseph G. Allen, Piers MacNaughton, Usha Satish, Suresh Santaname, Jose Vallarino, and John D. Spengler, "Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers" (*Environmental Health Perspectives* 124, no. 6 (2016): 805).

<sup>20</sup> Adam Wernick, [Want Better Thinking and Productivity? Improve the Air Quality in your Office](#), (Public Radio International 11/11/2015).



# How can standards help?

Governments have a responsibility to safeguard the health and safety of Canadians and promote economic growth. In some cases, regulators within governments find it appropriate to turn to standards to assist in fulfilling this responsibility. Standards are developed by experts and are informed by the latest research. They are living documents intended to evolve to meet the ever-changing needs of those they serve. As government regulators consistently and concertedly make use of the latest standards, this can support them in the fulfillment of their mandate.

For businesses, approximately 90% of operating costs are due to salaries and benefits, compared to 1% for energy.

As evidenced with air quality, standards have been updated to respond to new research and concerns (e.g., toxicity, energy efficiency, etc.). Improvements in air quality standards have implications for regulators, employers, and employees. Governments will benefit from updated standards that improve the health of employees thereby lowering healthcare costs and reducing disability payments. Analysis from the United States has found that air quality **regulations** – which include standards – have resulted in annual net benefits to the American economy estimated at \$157 billion to \$778 billion.<sup>21</sup> The benefits are primarily realized

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<sup>21</sup> Office of Management and Budget, 2015 Report to Congress on the Benefits and Costs of Federal Regulations and Agency Compliance with the Unfunded Mandates Reform Act, (Executive Office of the President of the United States, 2015) 11.

through reductions in the risk to public health from fine particulate matter exposure. When the costs of implementing air quality regulations are accounted for the benefits outweigh the costs by a minimum ratio of 4 to 1; making air quality regulations the most economically beneficial of all US government regulations.<sup>22</sup>

Employers need to recognize that while governments specify the requirements that must be met, in some cases employers can realize additional benefits from exceeding the identified standards (e.g; increased ventilation rates). For businesses, approximately 90% of operating costs are due to salaries and benefits, compared to 1% for energy.<sup>23</sup> If increasing indoor air quality can decrease absenteeism and increase productivity, most businesses will recognize that this is a profitable investment.

Based on the economic impact estimated from current research, improved office air quality could add \$1.4 to 7.5 billion CAD to the economy.

Employees obviously benefit from improved indoor air quality. They benefit by having improved health and improved capacity to perform their job. And these benefits will have positive spillover effects for the employees' economic stability and personal life.

Standards form a basic infrastructure that touches on all aspects of our life, from the air we breathe to the technology we use. Standards are continuously being developed to meet emerging needs. Once a standard is developed, it is subject to a continuous improvement process that includes reaffirmations, amendments, and new additions to ensure its utility.

For Canada and Canadians to continue to benefit from standards, regulators, and others in a position to use standards need to be engaged in the standardization process (e.g., participating in technical committees, checking for updates to standards). As regulators are aware of the standardization process, they will be

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22 World Bank and Institute for Health Metrics and Evaluation, [The Cost of Air Pollution: Strengthening the Economic Case for Action](#), (Washing DC: World Bank) 6.

23 World Green Building Council, [Health, Wellbeing & Productivity in Offices](#), (World Green Building Council: United Kingdom, 2014) 6.

in a better position to capitalize on referencing standards in regulation, and ensure that they are effectively deployed. As the example of indoor air quality illustrates, individuals, businesses, and governments can substantially benefit from standards that are responsive to new knowledge. Based on the economic impact estimated from current research, improved office air quality could add \$1.4 to 7.5 billion CAD to the Canadian economy. Undoubtedly, the time that is spent to ensure standards referenced in regulation are up to date is well worth the investment. Updated standards will pay dividends in terms of health, safety, productivity, profitability and economic growth.

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