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Environmental Careers Organization



Careers in Air Quality

Current Job Trends and Future Growth

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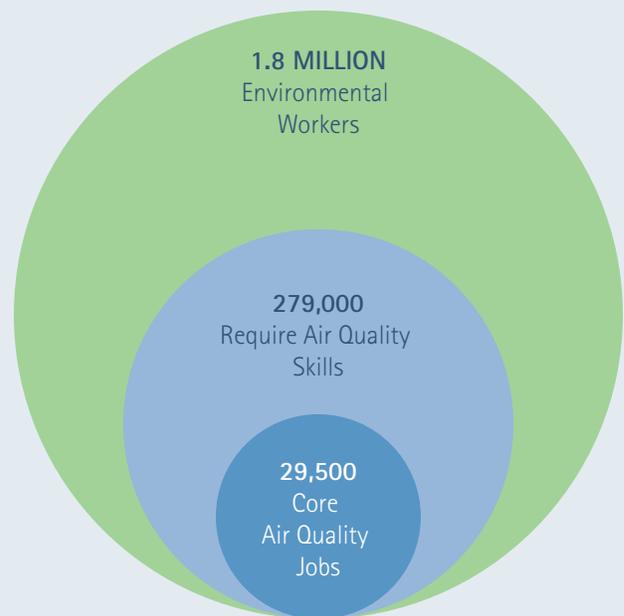
Finally, this research would not have been possible without the participation of the thousands of individuals who contributed their time to speak with researchers and complete the survey.



FOREWORD

There has been long standing public concern regarding the effects of pollution and GHG emissions on human, plant, and animal life. In 2002, more than one-quarter of Canadians (28%) considered poor air quality to be the most important environmental problem facing Canada.¹ This concern, coupled with growing needs to recognize and mitigate the environmental impacts of climate change, has led to continual revisions to environmental legislation to manage air quality. Beginning with the Clean Air Act in 1970,² Canada's national, provincial, and municipal regulation of pollutant and GHG emissions has become increasingly stringent. These regulations relate to both emission point-sources like petrochemical plants, and non-point sources such as agricultural, residential and commercial heating, transportation, and municipal sectors. The efforts of communities, governments, industries, and other stakeholders to protect Canada's air quality have increased the demand for air quality practitioners.

Figure 1
Air Quality Core Occupations, Air Quality Skills,
and Environmental Employment in Canada



Source: The number of environmental workers was taken from ECO Canada's 2013 *Survey of Environmental Employers*. Core jobs were extrapolated from an analysis of job vacancies and Statistics Canada's 2011 *National Household Survey*. Analysis by the author.

¹ Source: Health Canada and Environics Research Group, *Air Pollution - Information Needs and the Knowledge, Attitudes and Behaviour of Canadians - Final Report*, 2002.

² The Canadian Environmental Protection Act (CEPA) is the current principal Act for the regulation of environmental contaminants. The CEPA allows the federal government to regulate and control substances through national quality objectives, guidelines and/or standards. This section will provide useful information on different tools available for the regulation of environmental substances such as air pollutants.

Canada's air quality labour force includes (1) core air quality occupations for practitioners who work mainly in the field of air quality, as well as (2) workers who require some air quality skills and knowledge.

Core air quality practitioners perform activities such as monitoring emissions, analyzing particulate dispersion, auditing and reducing GHG emissions, developing new emission reduction technologies, designing and enforcing protective policies, and analyzing and managing indoor and industrial air quality.

Air quality practitioners who require some knowledge of air quality issues include green building professionals, public health professionals, industrial design engineers, land use planners, environmental policy analysts, and workers in environmental education and awareness.

In 2013, Canada had an estimated 1.8 million workers who use environmental skills as part of their work activities. About 15.4% of these workers (279,000 workers) require air quality knowledge and skills to perform a diverse range of environmental management activities. This report focuses on core occupations in air quality, a subset of approximately 29,500 workers in Canada.



RESEARCH FINDINGS

In Canada, there are approximately 29,500 air quality workers employed in core air quality occupations. These workers include professionals in physical sciences (meteorologists), engineers, senior managers, policy and policy-supporting occupations, technicians, occupational and industrial hygienists (indoor air quality), and other occupations.

- Approximately one third (34.9%) of Canada's air quality labour force (10,300 workers) consists of occupational and industrial hygienists who inspect and manage indoor air quality (IAQ).
- Roughly 6,700 workers in Canada work as air quality scientists, air quality engineers, and senior managers with air quality work responsibilities. This includes approximately 3,000 air quality scientists, 4,700 air quality engineers, emissions control engineers, and environmental compliance specialists, and 1,300 senior industry managers who have job duties related to air quality monitoring or air quality compliance.

- Approximately 5,100 workers are employed in technical jobs in air quality, including air quality monitoring technicians, stack testers, auditors of air quality stations and networks, indoor air quality technicians, air network designers and coordinators. These jobs comprise approximately 17% of the air quality labour force.
- About 3,500 workers perform work related to air quality policy, both from an environmental and from a health policy perspective. These workers can be found in governments, NGOs, and other organizations.
- A small fraction of 1,400 air quality workers are financial supervisors, assessors, valuers, appraisers, and administrative officers who need GHG verifying or auditing knowledge.

Figure 2
Air Quality Labour Force by Occupation Category



Sources: Labour force numbers extrapolated from our analysis of 7,027 job vacancies and Statistics Canada's 2011 National Household Survey. Analysis by the author.

Ambient and Indoor Air Quality

Figure 3
Ambient Air Quality and Indoor Air Quality Occupations



- Niche occupations that are sub-specializations within broader occupation categories
- Extensive use of air quality skills in work activities
- High levels of education required
- Occupations that combine air quality skills with other skill areas
- Need for air quality skills varies by job context and roles
- High levels of education required

Source: Expert Interviews, 2013 Survey of Air Quality Employers.

Air quality jobs span both ambient air quality (outdoor air) and indoor air quality (IAQ). Although these two fields are linked, most jobs in the sector are oriented toward one field or the other. Jobs related to ambient air quality tend to focus more on air quality issues. Many IAQ occupations, such as occupational hygienists, apply air quality skills in combination with skills from other fields including toxicology, statistics, safety, engineering, medicine, ergonomics, epidemiology and other sciences to manage indoor environments. Air quality skills and knowledge requirements for IAQ professionals have varying levels of importance, depending on job roles and function.

Air Quality Practice Areas

Based on interviews with air quality employers in government, consulting and industry, this study identified a total of 21 air quality practice areas. These practice areas fall into 7 categories:

- (1) Ambient air quality and emissions analysis and compliance,
- (2) Air quality operations: monitoring and reporting of ambient air quality and point-source emissions,
- (3) Policy, including climate change, emissions, health, and ambient air quality policy,
- (4) Emissions control and reduction,
- (5) Health: air quality index and advisories,
- (6) Indoor air quality: health and safety/accident prevention, and
- (7) GHG auditing and reductions.

There are 19 core air quality occupations for workers in these practice areas, as seen in Figure 4. These include air quality scientists, air quality engineers, airshed planners and coordinators, environmental policy analysts (air quality focus), health policy analysts (air quality focus), air quality technicians, air quality auditors, air quality data QC/QA analysts, air network designers, air network coordinators, stack testers, emissions control engineers, air quality compliance specialists, GHG auditors, GHG verifiers, health policy analysts (environmental health and safety focus), indoor air quality inspectors/technicians, indoor air quality hygienists, and air quality hygiene technicians. In addition to these core occupations, air quality practitioners may also work as project coordinators, project managers, program managers, team managers, directors, consultants, technical advisors, or other roles.

Figure 4
Core Occupations in Air Quality by Practice Area

Ambient Air Quality and Emissions Analysis & Compliance	Air Scientist / Meteorologist	Air Quality Engineer	Policy	Airshed Planner/ Coord.	Env. / Air Policy Analyst	Health Policy Analyst
	Apply emissions dispersion models and prepare or evaluate approvals applications related to pointsource emissions. Perform impact assessments and air shed planning. Also issue air health risk advisories.	Estimate emissions, analyze industrial processes that create emissions and assess emissions management through new technologies.		Support airshed organizations that implement strategies to mitigate cumulative effects of land use on air quality.	Apply scientific and socio-economic research to guide policy for pollution, climate change, and cumulative effects.	Determine and mitigate effects of air quality on human health.
Air Quality Operations	Air Quality Technician	Air Quality Auditors	Air Quality Data QA / QC	Air Network Designers	Air Network Coordinators	Stack Tester
	Maintain air stations and calibrate instruments for air quality measurements. Review data collected.	Test instrumentation and other quality control activities to ensure instruments are taking correct measurements.	Analyze and validate air quality data prior to release and ensure timely dissemination of air quality data.	Design monitoring networks and implement new remote technologies for air quality monitoring. Recommend equipment.	Coordinate the air quality monitoring network to ensure resources are available for maintenance.	Measure emissions at point sources and implement / maintain continuous monitoring equipment.
Emissions Control & Reduction	Emissions Control Engineer	Compliance Specialist	GHG Auditing	GHG Auditor	GHG Quantifier	Health
	Implement industrial or process designs to reduce emissions.	Manage approvals applications and liaise with community and government. Manage projects with internal stakeholders and consultants.		Apply engineering and accounting knowledge to independently assess and account for GHG emissions.	Quantify, assess and report emissions and emissions reductions that result from reduction projects.	
Indoor Air Quality	Health Policy Analyst	Indoor Air Quality Inspector / Technician	Indoor Air Quality Hygienist	Air Quality Hygiene Technician		
	Study air effects and air health effects to guide policies for indoor air quality standards in industry and public built environments.	Inspect industrial, government, healthcare, and public facilities. Inspect residences or commercial buildings for indoor air quality problems.	Prevent industrial accidents through studies and measurement of air effects and air health effects. Create prevention resources, policies, and procedures.	Ensure that workplaces, hospitals, public facilities and government spaces are free from hazards and potential health threats.		

Source: ECO Canada, *Expert Interviews and Survey of Air Quality Employers*, 2013.

Air Quality Employers

Governments, environmental consulting firms, remediation companies, IAQ occupational health and safety consulting companies, air quality instrument and equipment vendors, and employers in many other industries employ air quality professionals:³

- **Approximately one out of ten government organizations (10.9%) employs at least one air quality professional.**⁴ Air quality workers in government are employed by Environment Canada, Health Canada, Fisheries and Oceans, at other federal ministries, similar ministries within provincial governments, and by cities and regions. Provincial governments develop and enforce air quality policies for both ambient air quality and indoor air quality. They also employ air quality specialists to review applications for emissions approvals and licenses.
- **Approximately 8.6% of professional, scientific and technical services companies and 7.8% of remediation, waste management and related services firms employ air quality workers.**⁵ Consulting firms in these industries employ air quality workers to perform analytical work for emissions analysis, dispersion modeling, approvals applications, air quality monitoring, stack testing to measure emissions, and special projects, such as inventories of emissions. In indoor air quality, consulting firms may hire occupational or industrial hygienists to help clients implement environmental health and safety measures to prevent workforce injuries and maintain good air quality in mines, hospitals, public buildings, and other built environments. Environmental remediation consultants employ air quality technicians to analyze buildings for mold and other chemical or biological agents in the air. Chemical labs also hire air quality technicians to test and analyze samples taken from buildings, mines, and industrial facilities. While greenhouse gasses (GHG) are not technically pollutants affecting air quality, air quality consulting firms also employ engineers who audit or verify GHG emissions to support accounting functions and GHG emissions credit trading.

- **In industry, 6.3% of mining and oil and gas companies, 5.1% of utilities companies, and 5.2% of companies providing miscellaneous services (typically to the public) employ air quality workers.**⁶ Air quality workers are also employed by organizations in arts and entertainment (indoor air quality), transportation, agriculture, cultural industries, information, education, manufacturing, construction, and healthcare. These employees may work on activities such as implementing emissions reduction and control measures, managing compliance with air quality regulations, and managing indoor air quality.
- **A significant number of jobs in air quality are at companies that are vendors to the air quality sector.**⁷ These firms supply instruments and controls to measure and monitor air quality. They also provide technologies or services that improve air quality monitoring, such as remote sensing of emissions using satellite technology to monitor atmosphere reflections caused by smog. Sales professionals at these vendors sometimes perform work in a consulting role as systems integrators, helping clients to design air quality monitoring networks.



³ Sources: ECO Canada, *Expert Interviews and Survey of Air Quality Employers*, 2013.

⁴ Source: ECO Canada, *Survey of Environmental Employers*, 2013.

⁵ Source: Ibid.

⁶ Source: Ibid.

⁷ Source: Ibid.

Competencies for Air Quality Professionals

According to our survey of air quality employers, their workers use these environmental competencies:

- Analyzing or interpreting environmental samples and data (83% of employers have workers who need this competency),
- Collecting samples and data for environmental purposes (79% of employers)
- Liaising and partnering with stakeholders (78% of employers)
- Presenting expert information on environmental matters (71% of employers)
- Implementing or monitoring sustainable development strategies or programs (60% of employers)

Employers also identified knowledge and skills that they believe their workers need to know more about, including some skills that are less commonly used today. These include:

- Developing sustainable development indicators, plans or strategies (17% of employers don't currently use these skills, but think their workers need to learn more)
- Identifying and mitigating climate change impacts (15% of employers)
- Identifying and implementing activities for commercialization of environmental technologies, systems, or equipment (15% of employers)

Air quality workers require different environmental skills required depending on their occupation. Table 1 contains a description of the skills in greatest demand in each occupational category.

Table 1
Environmental Competency Requirements -
Share of Job Vacancies Requiring Environmental (NOS) Competencies by Air Quality Occupation

NOS DESCRIPTION		Air Quality Scientist	Air Quality Engineer	Policy Analysts	Air Quality and Regulatory Compliance	Air Quality Technicians - Instrumentation and Data Quality Control	Air Quality Technicians - Monitoring Focus	Industrial / Occupational Hygienist / Health and Safety Manager
A	Environmental Impact Assessment	8%	7%	6%	0%	0%	5%	3%
B	Site Assessment	62%	45%	0%	10%	14%	29%	26%
C	Regulatory & Enforcement	44%	34%	12%	70%	0%	43%	38%
D	Pollution Prevention, Abatement, & Control	3%	10%	0%	10%	0%	0%	3%
E	Climate Change	8%	2%	65%	0%	0%	10%	5%
F	Waste Management	5%	4%	0%	10%	0%	14%	4%
G	Water Quality Management	26%	20%	12%	40%	43%	38%	10%
H	Environmental Sampling & Analytical Work	21%	20%	6%	0%	86%	29%	19%
I	Policy Development & Planning	11%	6%	53%	10%	0%	5%	21%
J	Planning, Monitoring & Reporting for Sustainability	10%	4%	12%	10%	0%	0%	4%
K	Corporate Environmental Program Planning & Implementation	23%	29%	24%	40%	14%	5%	41%
L	Environmental Health & Safety	26%	12%	24%	0%	29%	29%	98%
M	Natural Resources Planning & Management	36%	30%	47%	20%	14%	29%	28%
N	Environmental Education & Training	23%	13%	24%	20%	57%	48%	32%
O	Environmental Research	3%	1%	24%	0%	0%	19%	2%
P	Environmental Business, Technology & Product Development	11%	11%	12%	10%	14%	24%	30%
Q	Environmental Communications & Public Awareness	26%	32%	35%	20%	14%	14%	11%

Source: ECO Canada, *Job Vacancies for Air Quality Occupations, March 2012 - March 2013*, n=105, 2013.

Career Pathways in Air Quality

Figure 5
Careers in Air Quality

	Meteorologist / Scientist	Engineers		Policy	Technicians		IAQ Hygienist	
		<i>In Consulting</i>	<i>In Industry</i>				<i>In Consulting</i>	<i>In Industry</i>
Career Stages	Expert	Expert	Senior Manager	Director	Division Director			
	↑	↑	↑	↑	↑			
	Advanced	Advanced	Manager	Policy Manager	Network Designer		Manager	Senior / Independent Consultant
	↑	↑	↑	↑	↑		↑	↑
	Intermediate	Intermediate	Specialist	Senior Analyst	Auditor	Coordinator	Coordinator	Consultant
↑		↑	↑	↑	↑	↑	↑	
Beginner		Beginner	Intermediate	Intermediate	Technician	Technician	Hygienist	Manager
↑		↑	↑	↑	↑	↑	↑	↑
Novice		Novice	Junior Analyst	Junior Analyst	Technician	Technician	Hygienist	Hygienist
Occupations Requiring 5 or More Years Work Experience		AQ Project Manager			Air Network Coordinators			
	Senior Air Scientist	AQ Program Manager	Env. / Air Policy Analyst		Air Network Designers			Consulting Hygienist
	AQ Project Manager	Emissions Control Engineer	Health Policy Analyst		Air Quality Auditors	EHS Project Manager		EHS Program Manager
	AQ Project Coordinator	Compliance Specialist	Airshed Planner / Coord.		Air Quality Data QA / QC	EHS Program Coordinator		Health and Safety Manager
Occupations with Entry Level Positions	Air Scientist / Meteorologist	Air Quality Engineer	Urban Planner		Air Quality Technician	Indoor Air Quality Inspector/Technician		Indoor Air Quality Hygienist
		GHG Auditor	Junior Policy Analyst		Stack Tester	Air Quality Hygiene Technician		
		GHG Quantifier						
Education	Master's / PhD	Master's	Master's / PhD		2-Year Certificate	3-Year Diploma		Master's
	Bachelor's	Bachelor's	Bachelor's					Bachelor's

Source: ECO Canada, *Job Vacancies for Air Quality Occupations, March 2012 - March 2013*, n=105, 2013.

Air quality career pathways fall into two broad groups: (1) pathways to professional or analytical occupations and (2) pathways to technical or operational occupations. Technical and operational occupations in air quality are typically well defined with clear pathways leading to air quality careers. By comparison, many organizations that perform analytical work in air quality employ teams of individuals who have diverse and complementary technical backgrounds, as well as career experience in different industries or domains.

As a result, analytical and professional jobs in the air quality sector are often less defined by step-by-step education-to-career pathways. Instead, these careers take shape according to how an individual's skills, knowledge, and experience complement a team, fill gaps in a team's expertise, and fit the business needs for the position.

The vast majority of job openings in air quality (over 99%) require some post-secondary education:

- A 2-year certificate from an environmental monitoring program is required for air quality field technicians, such as emissions stack testers or air station maintenance and instrumentation technicians.
- A 3-year diploma from an environmental sciences program or from a chemical technology program is required for air quality technicians working in air quality testing – either at a lab or performing field work.
- A 3-year diploma from an occupational hygiene program or 3-year diploma from a physical sciences or engineering technology program is required for indoor air quality technicians.

For professionals working in air quality, a Bachelor's degree is required for fields such as atmospheric science, physical sciences, engineering, chemistry, or environmental health and safety. Many workers have obtained one or more Master's degrees or a Ph.D.

Table 2
Fields of Study for Bachelor's and Master's Degrees, by Occupational Category

Air Quality Scientist	Air Quality Engineer	Air Quality Policy Analyst	Occupational / Industrial Hygienist
Bachelor's of Science in: <ul style="list-style-type: none"> • Atmospheric Science • Chemistry • Earth sciences • Environmental Chemistry • Environmental Science • Physical Sciences • Physics Alternative: <ul style="list-style-type: none"> • Computer Science • Mathematics • Microbiology Master's of Science/Ph.D. in: <ul style="list-style-type: none"> • Environmental Science 	Bachelor's or Master's Degree in: <ul style="list-style-type: none"> • Chemical Engineering • Civil Engineering • Mechanical Engineering Master's of Science/Ph.D. in: <ul style="list-style-type: none"> • Environmental Science 	Bachelor's or Master's Degree in: <ul style="list-style-type: none"> • Atmospheric Science • Chemistry • Earth sciences • Environmental Chemistry • Environmental Science • Environmental Studies • Physical Sciences • Physics • Political Science • Urban Planning 	Bachelor's, Master's or Ph.D. in: <ul style="list-style-type: none"> • Biology • Chemistry • Environmental Chemistry • Environmental Science • Health, Safety and Environment • Mathematics • Microbiology • Occupational Health and Safety • Physical Sciences • Physics

Sources: ECO Canada, *Expert Interviews and Survey of Air Quality Employers*, 2013.

Career Outlook

Based on both long term and recent trends, the need for air quality professionals is increasing in Canada.

- According to a survey of air quality employers in July to August 2013, in the past two years (2011-2013), more than half of air quality employers have had job openings. Over the next two years (2013-2015), approximately two thirds of employers (64%) expect the size of their workforce to increase.
- One in five employers (21%) expects that their air quality labour force will increase by up to 10% and a similar number of employers are expecting an increase of 11 to 25%. None of the employers reported an expectation of decline in their air quality labour force.

- In March 2013, there were an estimated 687 advertisements for job vacancies in Canada that required air quality skills, a 25% increase from March 2012. Based on the survey of 78 air quality employers in July and August 2013, 42% of employers had vacant positions that they were trying to fill.

Several factors will positively affect the future demand for air quality professionals in Canada. These factors include increasingly stringent environmental regulations, new environmental regulations on pathogens in the air, changes in the types of pollutants that are being monitored, ongoing economic growth (a driver of demand for emissions approval applications), and other factors. These positive factors will be tempered by changes in government funding for air quality and new technology that increases the productivity of air quality monitoring, thereby reducing demand for air quality technicians.

Table 3
Trends Affecting Future Demand for Air Quality Practitioners

TRENDS		TYPE OF TREND	AFFECTS*
↗	Public concern over climate change, air pollution, and health	Structural – Long Term	AAQ
↗	More stringent environmental legislation and regulations on pollutant and GHG emissions	Structural – Long Term	AAQ
↗	Increasingly stringent regulation of workplace safety	Structural – Long Term	IAQ
↑	Environmental legislation on public safety and biological agents in the air (new and additional to existing legislation on chemical particles in the air)	New – Impact – Near Term and Long Term	IAQ
↗	Legislative requirements on types and size of pollutants being monitored in ambient air quality	Future – Long Term (Over next 10 years)	AAQ, IAQ
↘	Funding cutbacks at national and provincial government organizations	Recent	AAQ
↗	Increasing municipal focus on green cities	New – Long Term	AAQ, IAQ
↘	Remote management technology for greater productivity of air quality technicians	New – Long Term	AAQ
→	Government outsourcing of air quality monitoring functions to private companies or community groups	Long Term	AAQ
↗	Economic growth (industry expansion, requiring more work for approvals and licenses for large projects).	Cyclical	AAQ, IAQ

*Note: AAQ denotes Ambient Air Quality and IAQ denotes Indoor Air Quality.
Source: ECO Canada, *Expert Interviews* and *Survey of Air Quality Employers*, 2013.

Earnings for Air Quality Professionals

Most air quality occupations have similar starting salaries across employers. According to our survey of air quality employers in July to August 2013, most professional occupations in ambient air quality have starting salaries that are in the \$50,000 to \$60,000 range, with slightly higher salaries for engineers than for air quality scientists. With five years of experience, air quality scientists have mean earnings of just below \$73,000 and air quality engineers earn a mean salary of \$82,600. Project managers with five years of experience have mean earnings of approximately \$108,700 and senior managers and directors earn average salaries ranging from \$120,000 to over \$150,000 (average of \$133,000).

Air quality technicians have average starting salaries of \$45,800 and earn average salaries of \$61,800 with five years of experience. Air quality technicians who are auditors typically require five to ten years of experience as an air quality technician. They have a mean starting salary of \$60,000 and a mean salary of \$85,000 with five years of auditing experience. Air quality workers in policy analysis have a wide range of earnings, depending on their employer. Mean starting salaries for these workers were \$55,000 and mean salaries for workers with five years' experience were \$75,000. GHG auditors have a mean starting salary of \$62,500 and mean wages of \$92,125 after five years of experience. Occupational hygienists earn mean starting wages of \$67,750 and mean wages of \$92,650 for workers with five years of experience.

Table 4
Mean Annual Base Salaries by Occupation, 2013:
Starting Salaries and Top Salaries for Workers with Five Years' Experience

OCCUPATION	MEAN STARTING SALARY	MEAN SALARY AFTER 5 YEARS' EXPERIENCE
Air Quality Scientist / Meteorologist	\$50,875	\$72,983
Air Quality Engineer	\$51,063	\$82,600
Air Quality Project Manager (Scientist, Engineer)	\$60,500	\$108,722
Senior Manager / Director	n.a.	\$133,000
Air Quality Technician	\$45,800	\$61,800
Air Quality Auditor	\$60,000	\$85,000
Airshed Coordinator / Planner / Policy Analyst	\$55,000	\$75,000
GHG Auditor	\$62,500	\$92,125
Occupational Hygienists (Indoor Air Quality Focus)	\$67,750	\$92,650

Source: ECO Canada, *Survey of Air Quality Employers and Employer Interviews, July – August, 2013*.

Hiring and Retention Difficulties

Over the past two years, approximately half of air quality employers (47%) have experienced difficulties hiring.

The challenges are linked to skills shortages, problems with retention of highly qualified workers, and hiring difficulties related to international applicants.

- Skills shortages are the most common difficulty and specific challenges include a general scarcity of workers with air quality qualifications. Employers face this challenge for senior level positions and especially for intermediate level positions, where consulting firms and other employers struggle to find workers who have the right education, skills, and experience level to fit the needs of their organization.
- Employers also report that many applicants lack the written and verbal communication skills they need to explain air quality issues at the right level for different audiences.
- Retirements will impact the air quality sector over the next decade. Approximately 21% of workers in the air quality sector were age 55 or older in 2011, placing these workers within ten years of retirement age. The share of workers nearing retirement is higher among managers in industry (31%) and workers in air quality policy (22%).
- Both within industry and in consulting, employers report that they have a high turnover of qualified workers, creating continuous demand to replace workers in these vacant positions.
- International applicants represent one source of qualified applicants, but it can take a long time for international applicants to obtain credential recognition (for professional engineers) and progress through provincial or national immigration systems.





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