STATE OF MAINE
DEPARTMENT OF LABOR
BUREAU OF LABOR STANDARDS
45 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0045
WAGE & HOUR DIVISION

JANET T. MILLS
GOVERNOR

LAURA A. FORTMAN
COMMISSIONER

KATE BURKHART
DIRECTOR

December 3, 2025

Senator Michael Tipping
Representative Amy Roeder
Members of the Joint Standing Committee on Labor

Dear Committee Members,

The Maine Department of Labor, Bureau of Labor Standards, is submitting the enclosed report in accordance with 2025 Resolve c.79, which directs the Department to submit a report on the findings of the Indoor Air Quality Advisory Group that was convened by the Bureau in 2024.

The Board of Occupational Safety and Health received the report on November 24, 2025, and considered it during the public meeting on December 3, 2025. Indoor Air Quality Advisory Group members and Bureau staff presented the findings and recommendations and answered questions from Board members.

After robust discussion of the Advisory Group's report, possible impact to the regulated committee, and the requirements of the Maine Administrative Procedures Act for substantive rulemaking, the Board decided to meet again in January and February of 2026 to organize and plan next steps prior to the March 4, 2026, quarterly meeting.

We appreciate the opportunity to share the valuable work of these dedicated stakeholders and experts.

Sincerely,

Laura A. Fortman
Commissioner

PHONE: (207) 623-7900 (Voice) PRINTED ON RECYCLED PAPER FAX: (207) 623-7934
TTY USERS CALL MAINE RELAY 711
OFFICES LOCATED AT: CENTRAL MAINE COMMERCE CENTER, 45 COMMERCE DR., AUGUSTA, ME 04330

# Indoor Air Quality Advisory Group Recommendations to the Maine Board of Occupational Safety and Health

## November, 2025

### Executive Summary

The Bureau of Labor Standards convened an Indoor Air Quality Advisory Group in 2024 to provide advice on issues related to the regulation of indoor air quality by the Board of Occupational Safety and Health (BOSH). After two years of research and deliberation, the Advisory Group offers findings and recommendations for BOSH's consideration. The Advisory Group developed recommendations for regulatory standards for select indoor air contaminants based on science, research, industry and public health standards, and the expertise of the Advisory Group members.

The Advisory Group makes recommendations related to these contaminants: carbon monoxide, carbon dioxide, nitrogen dioxide, ozone, particulate matter, radon, sulfur dioxide, and volatile organic compounds. They also made recommendations related to humidity and temperature, which affect air quality. The Advisory Group's recommended standards meet or are more protective than OSHA standards and are aligned with modern indoor air quality standards from public health, industry, and safety associations.

The findings and recommendations in this report are made to BOSH, which is the regulatory agency, to inform their deliberations. It is shared with the Maine Legislature pursuant to LD 1407. The recommendations are not made by or endorsed by the Maine Department of Labor.

### Background

The Bureau of Labor Standards, Maine Department of Labor, convened the Indoor Air Quality Advisory Group (Advisory Group) in 2024 to advise the Department and BOSH on issues related to indoor air quality safety and health standards. The Advisory Group members represent the Department of Education, Department of Health and Human Services (including the Center for Disease Control), Bureau of General Services, Maine Indoor Air Quality Council, Maine School Management, Maine Education Association, Johns Hopkins University Bloomburg School of Public Health, Queensland University of Technologies, and others. The Advisory Group is supported by the Director of the Bureau of Labor Standards and Workplace Safety and Health Division staff. A roster of members is provided in Appendix A.

The Maine State Legislature passed LD 1407 on June 6, 2025:

> H.P. 929 - L.D. 1407 Resolve, Directing the Department of Labor to Report the Findings of the Indoor Air Quality Advisory Group
>
> Sec. 1. Indoor air quality advisory group report. Resolved: That, on or before December 3, 2025, the Department of Labor shall submit to the Joint Standing

> Committee on Labor a report containing the findings of the indoor air quality advisory group, which was convened in 2024 by the Department of Labor, Bureau of Labor Standards to advise the Department of Labor, Board of Occupational Safety and Health on indoor air quality matters that are beyond the standards set by the United States Department of Labor, Occupational Safety and Health Administration. After reviewing the report, the committee may report out legislation relating to the report to the Second Regular Session of the 132nd Legislature.

The Advisory Group met throughout 2024, and monthly from March-November 2025. Its meetings in 2025 focused on contaminants listed in the original bill. LD 1407, prior to amendment, listed the following contaminants for consideration: carbon monoxide, nitrogen dioxide, indoor particulate matter, aerosolized particles, mold, volatile organic compounds, radon, lead, asbestos, pesticides, insecticides, formaldehyde, and excess humidity.

## Scope of Recommendations

The Advisory Group's recommendations are structured to provide BOSH, and the Legislature, with information about:

- best practices for public employers and management of public buildings;[1]
- situations warranting a self-evaluation by the employer to ensure healthy indoor air quality;
- situations warranting public enforcement.

The Advisory Group declined to make recommendations about some of the contaminants included in the original bill: lead, asbestos, pesticides, and insecticides. OSHA has established exposure limits for lead,[2] radon,[3] and asbestos.[4] The Maine Department of Agriculture, Conservation, and Forestry regulates pesticides and insecticides.[5] The Maine Department of Environmental Protection regulates asbestos.[6]

[1] LD 1407, as initially filed, directed BOSH to "develop indoor air quality standards for buildings in the State in which public sector workers work." Recognizing that some public employees perform job duties in private homes, private businesses, and community spaces, the Advisory Group limited its recommendations to buildings owned, leased, controlled, and/or occupied by public employers.

[2] OSHA Standard 1910.1025 requires that, in industries other than construction and agriculture, "no employee is exposed to lead at concentrations greater than fifty micrograms per cubic meter of air (50 $\mu g/m^3$) averaged over an 8-hour period." In construction industries, OSHA Standard 1926.62 provides that "no employee is exposed to lead at concentrations greater than fifty micrograms per cubic meter of air (50 $\mu g/m^3$) averaged over an 8-hour period."

[3] OSHA Standard 1910.1096 establishes limits on exposure to ionizing radiation. The OSHA radon exposure limit for adult employees is 100 pCi/L averaged over a 40-hour workweek (*see* 29 CFR 1910.1096(c)(1); 29 CFR 1926.53).

[4] OSHA Standard 1910.1001 requires that, in industries other than construction and shipbuilding, "no employee is exposed to an airborne concentration of asbestos in excess of 0.1 fiber per cubic centimeter of air as an eight (8)-hour time-weighted average."

[5] https://www.maine.gov/dacf/php/pesticides/laws.shtml

[6] https://www.maine.gov/dep/waste/asbestos/index.html

The Advisory Group considered three additional contaminants: carbon dioxide, ozone, and sulfur dioxide. These three contaminants present significant health hazards in the workplace.

The recommendations proposed apply to existing buildings, regardless of age, and new construction. If BOSH pursues rulemaking on indoor air quality, it can establish criteria for when a project is a substantial alteration/renovation requiring indoor air quality upgrades.

## Bases for Findings and Recommendations

The Advisory Group reviewed the relevant standards and guidelines set by public health, engineering, and scientific organizations:

- Occupational Safety and Health Administration (OSHA) General Duty Clause[7] and Standards;[8]
- National Institute for Occupational Safety and Health (NIOSH);
- US Environmental Protection Agency (EPA), which establishes the National Ambient Air Quality Standards (NAAQS) under the Clean Air Act;
- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), a professional organization that establishes guidelines for the design, operation, and maintenance of HVAC systems with a focus on energy efficiency, indoor air quality, and sustainability;
- American Conference of Governmental Industrial Hygienists (ACGIH); and
- World Health Organization (WHO).

The Advisory Group weighed the standards and guidelines in the context of research on indoor air quality. They consulted with experts. The reviewed existing state laws related to indoor air quality. They deliberated on the practicalities of implementation of any new rules or regulations.

## Findings

### *Existing Laws and Standards*

There are state laws and regulations relevant to maintaining healthy indoor air quality in public buildings. These include:

- Maine Uniform Building and Energy Code, which has adopted by reference International Code Council (ICC) Codes, ASHRAE standards 62.1 and 62.2, and the American Society of Testing Materials E-1465-2008, Standard Practice for Radon Control Options;
- Title 10, Chapter 1103: Maine Uniform Building and Energy Code;

[7] 29 USC §654. *See also* 29 CFR 1910.
[8] 29 CFR 1910 *et seq.*

- 20-A MRS §6302 School Building Ventilation;
- Title 20-A, Chapter 609: School Construction;
- Title 26, §565-A Air Quality and Ventilation, which requires BOSH to work with the Bureau of General Services (BGS) "with respect to evaluation of indoor air quality and ventilation in public school buildings and buildings occupied by state employees;"
- Title 38, Chapter 4, Protection and Improvement of Air, which relates to ambient air quality and emissions;
- 12 CMR 179, Board of Occupational Safety and Health; and
- 18 CMR 554 Chapter 4, Standard 62-1981R "Ventilation for Acceptable Indoor Air Quality" Adoption in Public School Design & Construction.

### Concurrent Efforts

The Department of Administrative and Financial Services and BGS are responsible for state owned and occupied facilities. There are two Occupational Health and Safety Compliance Assistance Coordinators for Safety and Environmental Services at BGS. They conduct the assessment, testing and mitigation oversight services for public schools, state-owned properties and leased facilities required by 5 MRS §1742-E. They test for asbestos, lead, radon, mold and other environmental factors. BGS maintains a Building Assessment Record database of state building inspections, including outcomes of its testing, investigations and inspections, and remediation activities.

5 MRS §1742-G requires the Bureau of General Services (BGS), and the owners of buildings leased to the State, to inventory all state-owned buildings to identify the presence of asbestos, lead, radon and other harmful substances. The law requires BGS to maintain a database of buildings with contamination. The database must be available to people performing work in the buildings and reviewed prior to any maintenance or repair work. BGS must also create mitigation and remediation plans for any contamination and monitor those activities.

In response to the COVID pandemic, BGS assessed 48 public buildings in Augusta and upgraded systems in 14 of them. Eight buildings meet the ASHRAE 241 standard, "Control of Infectious Aerosols," and 27 meet the AHRAE Standards for Ventilation and Indoor Air Quality.[9]

Governor Janet Mills established the Governor's Commission on School Construction by executive order in 2024 to review school construction needs and "conduct a comprehensive review of school construction needs throughout the State and provide a report" on new school construction and renovation needs, funding strategies, and any barriers in law, regulation, or policy. The Commission focus includes engineering and energy efficiency, both issues related to indoor air quality.[10]

---

[9] Information provided by Bureau of General Services.
[10] Governor's Commission on School Construction Interim Summary (April 15, 2025).

### *General Ventilation*

Indoor air quality is dependent on the effectiveness of building ventilation systems. Public buildings in Maine range from historic buildings to modern new construction. For example, Maine's school buildings range in age from 1 to 220 years, averaging 54 years old (i.e. built in 1970). About 40% (236) of Maine's school buildings were constructed between 1950 and 1970. This can be partially attributed to district consolidations following the Sinclair Act of 1957, but the construction boom began sooner. There are 122 schools that were built in the post-war years of 1947 to 1957.[11]

Schools with older equipment have higher operating costs and generally need more ongoing repairs and maintenance.[12] Three quarters of Maine school buildings have heating systems that are more than 20 years old.[13] Less than half (46%) have HVAC systems with MERV 13 or higher air filters.[14] The majority (62%) of school buildings rely on oil to power heating systems, with 70% relying on fossil fuels or wood.[15]

Facility managers should evaluate and maximize the ventilation system possible based on the age and condition of the building structure. Public schools must "ensure that the heating, ventilation and air-conditioning system is: A. maintained and operated to provide at least the quantity of outdoor air required by the state building standards code in effect at the time the building permit was issued or the heating, ventilation and air-conditioning system was installed, whichever is later; and B. operated continuously during school activity hours," except under limited circumstances.[16]

Resources:

*School Ventilation: A Vital Tool to Reduce COVID-19 Spread*. Baltimore, MD: Johns Hopkins Center for Health Security; 2021.

### *Carbon Dioxide*

Carbon dioxide is colorless and odorless. It is produced by people, which means that levels in a workplace can fluctuate radically based on the size of the space and the number of people in it. The period of exposure is also relevant. This means that a higher level of carbon dioxide in a lobby area may be acceptable because the space is larger and the exposure is brief, while the same level of carbon dioxide in an office or classroom would be a hazard due to the smaller space and prolonged occupancy. Carbon dioxide is a byproduct of combustion and should be addressed in the same manner as other emissions from combustion.

---

[11] "Summary of Maine School Building Inventory Data," Maine Education Policy Research Institute (January 2025).
[12] *Id.*
[13] *Id.*
[14] *Id.*
[15] *Id.*
[16] 20-A MRS §6302.

Carbon dioxide gas is an asphyxiant and respiratory stimulant. Prolonged exposure can result in loss of consciousness. Exposure to high concentrations can cause convulsions and possible death.[17]

Resources:

Occupational Health Guidelines for Chemical Hazards. DHHS/NIOSH Publication No. 81-123.

Criteria for a Recommended Standard: Occupational Exposure to Carbon Dioxide. DHHS/NIOSH Publication No. 76-194.

### *Carbon Monoxide*

Carbon monoxide is colorless, odorless, and tasteless. It is a byproduct of combustion of fossil fuels and wood.[18] It can contaminate indoor air through cooking and heating using wood, kerosene, fuel oil, or propane/natural gas; or when emissions from vehicles and other sources come in from outside.[19] Exposure to carbon monoxide impairs blood's ability to carry oxygen to tissues, causing headache, nausea, dizziness, rapid breathing, loss of consciousness, and possible death. It can aggravate existing vascular disease.[20]

Resources:

Occupational Health Guidelines for Chemical Hazards. DHHS/NIOSH Publication No. 81-123.

Criteria for a Recommended Standard: Occupational Exposure to Carbon Monoxide. DHHS/NIOSH Publication No. 73-11000.

Integrated Science Assessment (ISA) for Carbon Monoxide, Environmental Protection Agency Publication (EPA/600/R-09/019F), (January, 2010).

"Carbon Monoxide," WHO Guidelines for Indoor Air Quality: Selected Pollutants (2021) at 130.

### *Humidity*

While the Resolve references mold as a contaminant, the Advisory Group focused on the source of mold – water, dampness, and humidity. OSHA does not regulate mold exposure. There are no standardized testing methods to assess for mold, beyond visual inspection. However, humidity can be monitored and tested with precision.

BGS receives complaints about dampness and mold from people working in State owned/occupied buildings and inspects the buildings to identify and remediate any hazards or contamination. Public schools are required by 20-A MRS §6302 to inspect annually, document inspections, and mitigate any problems.

[17] *See* Occupational Health Guideline for Carbon Dioxide. DHHS/NIOSH (September 1978).
[18] "Carbon Monoxide," WHO Guidelines for Indoor Air Quality: Selected Pollutants (2010) at 55.
[19] *Id.*
[20] *See* Occupational Health Guideline for Carbon Monoxide. DHHS/NIOSH (September 1978).

Resources:

ASHRAE 180 establishes minimum HVAC inspection and maintenance requirements that preserve a system's ability to achieve acceptable thermal comfort, energy efficiency, and indoor air quality in new and existing commercial buildings.

American National Standards Institute IICRC S500 and S520 provide guidance on the procedures to be followed when performing water damage restoration and mold remediation.

WHO Guidelines for Indoor Air Quality: Dampness and Mould (January 1, 2009).

Guidelines on Assessment and Remediation of Fungi in Indoor Environments, New York City Department of Health and Mental Hygiene (November 2008).

Care for Your Air: A Guide to Indoor Air Quality, EPA Publication 402/F-08/008 (September 2008).

### *Nitrogen Dioxide*

Nitrogen dioxide is created when fossil fuels such as coal, oil, natural gas, or diesel are burned at high temperatures. Indoor air can be contaminated by nitrogen dioxide from gas, wool, kerosene, oil, and coal burning appliances.[21] Road traffic is a source of nitrogen dioxide that can pollute indoor air quality in some circumstances.[22] Diesel exhaust is another source of nitrogen dioxide that can pollute workplaces (mechanical garages, buildings near school bus parking lots, etc.).[23]

Because older public buildings, including schools, rely on fossil fuels for heating or cooking, the Advisory Group felt it important to include a recommendation for nitrogen dioxide exposure. Exposure to nitrogen dioxide can cause inflammation of the airways, coughing, asthma attacks, and reduced lung function. Elevated levels of nitrogen dioxide are associated with heart and lung disease, negative pregnancy and birth outcomes, and other health problems.

Resources:

Criteria for a Recommended Standard: Occupational Exposure to Oxides of Nitrogen (Nitrogen Dioxide and Nitric Oxide), DHHS/NIOSH Publication No. 76-149.

"Nitrogen Dioxide," American Lung Association (October 26, 2023).

"Nitrogen Dioxide," WHO Guidelines for Indoor Air Quality: Selected Pollutants (2010) at 201.

### *Ozone*

"The predominant physiological effect of ozone is primary irritation of the mucous membranes. Inhalation of ozone can cause sufficient irritation to the lungs to result in pulmonary edema."[24]

[21] "Nitrogen Dioxide," WHO Guidelines for Indoor Air Quality: Selected Pollutants (2010) at 202.
[22] *Id.*
[23] *See* OSHA Occupation Chemical Database, Nitrogen Dioxide (April 15, 2025).
[24] 21 CFR §801.415(b).

Ozone contamination in workplaces comes from outdoor air coming through the ventilation system. Public buildings located near industrial buildings/operations are at greatest risk of ozone contamination. Wastewater treatment plants and public works are also at risk.[25]

Resources:

"Ozone," NIOSH Pocket Guide to Chemical Hazards (October 30, 2019).

### *Particulate Matter*

The bill giving rise to the Resolve referenced "aerosolized particles." These are generally defined as ultrafine particles suspended air. This is not measurable. The Advisory Group instead considered particulate matter. Particulate matter (PM) refers to a mixture of solid particles and liquid droplets found in the air. Some particles, like dust or soot, can be seen with the naked eye. Others are so small they can only be detected using an electron microscope.[26]

PM2.5 are "fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller;" PM10 are "inhalable particles, with diameters that are generally 10 micrometers and smaller."[27] PM2.5 affect the lungs more quickly than PM10, which means that all people are at risk of negative health effects from PM2.5 contamination.

Resources:

"Particulate Matter (PM) Basics," US Environmental Protection Agency (May 30, 2025).

ASHRAE 241 establishes minimum requirements to reduce the risk of airborne disease transmission in buildings like single and multi-family homes, offices, schools, and healthcare facilities. The standard applies to new and existing buildings and major renovations and provides requirements for many aspects of air system design, installation, operation and maintenance.

### *Radon*

Radon is a carcinogen that is naturally occurring. It is not a byproduct of industrial activity. The Maine Center for Disease Control and Prevention Radiation Control Program is responsible for radon testing and mitigation. Maine CDC regulates the testing for radon (Chapter 224).[28]

Resources:

---

[25] *See* "Ozone," NIOSH (last reviewed June 22, 2019; archived at https://archive.cdc.gov/www_cdc_gov/niosh/topics/ozone/default.html).
[26] "Particulate Matter (PM) Basics," US Environmental Protection Agency (May 30, 2025).
[27] *Id.*
[28] Chapter 224, Section 1 provides "these regulations apply to all persons or companies located within or outside the State of Maine that intend to conduct air or water radon services, including but not limited to radon testing, evaluation of radon detection devices, radon mitigation consultation, or radon mitigation in the State of Maine persons or companies located within or outside the State of Maine that intend to conduct air or water radon services, including but not limited to radon testing, evaluation of radon detection devices, radon mitigation consultation, or radon mitigation in the State of Maine."

"Protocol for Conducting Measurements of Radon and Radon Decay Products in School, Commercial and Mixed-Use Buildings," American National Standards Institute et al. (2023).

"Radon in Workplace Atmospheres," OSHA (updated September 2019).

### *Sulfur Dioxide*

Sulfur dioxide is produced from burning fossil fuels and some industrial processes. Exposure to sulfur dioxide in the workplace can cause respiratory problems and chronic lung disease (emphysema, bronchitis, pulmonary fibrosis, etc.).[29]

Resources:

"Sulfur Dioxide," NIOSH (June 21, 2019).

### *Volatile Organic Compounds*

Volatile Organic Compounds (VOCs) are organic chemicals, including formaldehyde, toluene, benzene, and other substances. Given the variety of chemicals included in this category of contaminants, it will be essential to educate public employers and facility managers about the differences between them, how the fumes from each chemical are produced, how to identify the source of VOC fumes, and how to remedy the contamination.

Resources:

"Technical Overview of Volatile Organic Compounds," EPA (September 8, 2025).

Volatile Organic Compounds' Impact on Indoor Air Quality, EPA (July 24, 2025).

## General Recommendations

*Indoor Air Quality Surveillance*: Managers of public facilities should install air quality meters capable of measuring and alerting to unhealth levels of contaminants. Minimum requirements for air quality meters should be that they effectively measure and provide a direct reading for carbon monoxide, carbon dioxide, and PM2.5.[30] Facilities should also have meters capable of measuring and providing a direct reading for temperature and humidity.

Public employers should adopt an Indoor Air Quality Surveillance Plan that includes policies and procedures. The Indoor Air Quality Surveillance Plan should include a procedure for routine

[29] *See* Statement of Edward Baier, Deputy Director, NIOSH to US DOL Public Hearing on Occupational Standard for Sulfur Dioxide, (May, 1977).

[30] "Mandating indoor air quality for public buildings," L. Morawska et al., Science (March 22, 2024).

calibration of meters based on manufacturer recommendations, The Plan should be made available to employees upon request. The Plan should be reviewed and updated periodically.

*Air Filtration:* Public buildings should use at least a MERV 8 filter in HVAC systems, and optimally a MERV 13 if the HVAC system allows. Public hospitals and health care facilities should have at least MERV 13 filters.

New construction and major retrofit of public buildings should include ventilation systems that meet standards set by Maine Uniform Building and Energy Code.

In public buildings, including out buildings, without HVAC systems, or where systems are too old to use a MERV 8 or higher filter, facility managers should install air purifiers in areas where public employees are actively working.

Facility managers should follow the manufacturer guidelines and document scheduled inspection and changing of filters unless specified more frequently in a lease or occupancy contract.

In the event of a public health outbreak, facility managers should consider and follow ASHRAE Standard 241 (2023).

*Emissions from Combustion:* Several of the pollutants addressed by the Advisory Group relate to combustion and the burning of fossil fuels. These include carbon monoxide, sulfur dioxide, and nitrogen dioxide. The presence of one of these pollutants makes it likely that the others are present. Public employers operating buildings in which combustion occurs should evaluate the location, cleanliness, and state of repair for air intakes and emission discharge systems. Facility managers should evaluate and mitigate sources of emissions from combustion that may enter a building from outside sources, like parking lots where vehicles/planes/trains/boats idle, wood smoke from fires, industrial operations, etc. If any of these pollutants are present, the facility manager should evaluate and identify the source of the emissions and mitigate the problem if it persists or is systemic.

*Temperature:* OSHA recommends that indoor office temperature be within the range of 68-76 degrees Fahrenheit. The State of Maine policy is that workplaces should be between 68-75 degrees Fahrenheit.[31] OSHA is reviewing comments for an indoor/outdoor heat standard.

*Economic Impact:* Policymakers, public employers, facility managers, and enforcement agencies should all consider the economic impact of indoor air quality standards. The costs associated with monitoring air quality are not insubstantial, even before mitigation and remediation of any air quality hazards. The benefits of regulating indoor quality are also substantial.

The Advisory Group relied heavily on the experience and outcomes from the Boston Public School System's (BPS) in crafting their recommendations. BPS received $6.7m federal funding in 2021 to install indoor air quality sensors in over 4,000 classrooms as part of an indoor air quality

[31] State of Maine Facilities Operations and Maintenance Manual, Section IV (updated May, 2022).

initiative.[32] Boston University experts partnered with BPS to analyze the data from the sensors, supported with an initial $30,000 in grant funds.[33]

The Advisory Group, with support from the Bureau of General Services, attempted to estimate the cost of implementation of an Indoor Air Quality Surveillance Program by public employers. Air quality meters range in effectiveness and cost. The Advisory Group used cost information for a meter that effectively measures particulate matter, temperature, humidity, carbon monoxide, carbon dioxide, and VOCs.[34]

The Advisory Group estimates that the initial cost for installing sensors that meet the basic measurements recommended will depend upon the size of the public building, Installing an average of 6 basic sensors in a public building of 1,000-5,000 square feet is estimated to cost $6,360, with an annual maintenance costs of $2,760. Public buildings over 100,000 square feet would require an average of 25 sensors, costing $26,500 to install and $11,500 annually to maintain. The total cost to the State of Maine to install basic air quality sensors in the 68 core buildings it maintains would be $788,640 in year one and $342,240 annually after that. The 197 leased buildings would cost almost $1.5m in year one and $644,920 each year after that. For the 1,045 agency owned buildings, the cost would be nearly $6m in year one and $2.5m annually. The cost to school districts would be nearly $16m to install sensors, and $6.9m annually to maintain them.[35]

These estimates are just the cost to monitor the air quality in public buildings. They do not include the costs of data collection and analysis or mitigation or remediation when air quality hazards are found. They do not include the costs associated with upgrading HVAC filters, installing air purifiers when HVAC systems are insufficient or buildings rely on other forms of ventilation, or other changes needed to comply with indoor air quality standards.

The cost of public enforcement, even with a focus on education and voluntary compliance, would be at least $239,000 in personnel, professional development, and operations costs, plus $22,000 for air quality monitoring equipment. This could be greater depending on the scope of regulation adopted by BOSH.

There is substantial economic benefit associated with improving indoor air quality in workplaces. Reduced viral transmission and reduced exposure to PM 2.5 decreases costs associated with employee illness and absences. Employees working in buildings with healthy air have higher rates of productivity than those in buildings with poor air quality. Improving indoor air quality can result

[32] Boston Public Schools received grant funds through the Elementary and Secondary School Emergency Relief Fund.
[33] "Professor Partners with Boston Public Schools to Study Classroom Air Quality," by Megan Jones, Boston University School of Public Health (February 9, 2024).
[34] Cost estimates are based on the TSI AirAssure-4 and AirAssure-6 sensors.
[35] Estimates based on data from the Bureau of General Services. BGS based the cost estimates on a meter that measures particulate matter, temperature, humidity, carbon monoxide, carbon dioxide, and VOCs.

in benefits of $1,100 to $4,800 per employee per year, due to reductions in morbidity and mortality.[36]

*Enforcement:* As with its other enforcement efforts, the Bureau should continue to prioritize and support voluntary compliance. SafetyWorks! should develop sample policies and procedures, training materials, and classes on indoor air quality. Workplace Safety and Health enforcement should establish a grace period during which public employers can develop and implement an Indoor Air Quality Surveillance Program. The Bureau should consider suspending any monetary penalties for non-compliance for three years, if the public employer agrees to a remediation plan.

### Specific Recommendations

The Advisory Board's recommendations for specific pollutants meet or exceed the protections established by OSHA. The recommendations align with the range of standards and guidelines established by public health and professional organizations.

| Carbon Dioxide | |
|---|---|
| **Best Practice** | 0-1,000 ppm |
| **Self-Evaluation and Mitigation** | 1,000-2,000 ppm |
| **Public Enforcement** | greater than 2,000 ppm |
| **Reference Standards** | ASHRAE 2025 Position Document on Indoor Carbon Dioxide: 1,000 ppm "target concentration level. . . to be measured at the time of occupancy" as an indicator of "comfort."<br><br>NIOSH best practice: 5,000 ppm over 8 hours; Short-Term Exposure Limit (15-minutes) 30,000 ppm.<br><br>OSHA: 5,000 ppm over 8 hours. |

[36] *See* Costs and Benefits of The Model Clean Indoor Air Act, Richard Bruns, Johns Hopkins Center for Health Security (April 23, 2024). Available at SSRN: https://ssrn.com/abstract=4805018 or http://dx.doi.org/10.2139/ssrn.4805018.

| Carbon Monoxide | (measured over 8 hours unless specified) |
|---|---|
| **Best Practice** | less than 9 ppm |
| **Self-Evaluation and Mitigation** | greater than 9 ppm |
| **Public Enforcement** | greater than 25 ppm |
| **Evacuation** | greater than 100 ppm |
| **Reference Standards** | NAAQS: 9 ppm 8-hour average; 35 ppm 1-hour average not to be exceeded more than once per year.<br><br>WHO Air Quality Guidelines: not to exceed 24-hour average 4mg/$m^3$, 8-hr average 10mg/ $m^3$, 1-hour average of 35 mg/$m^3$, and 15-minute average of 100mg/$m^3$.<br><br>NIOSH best practice: recommended exposure limit 35 ppm 8-hour average; 200 ppm ceiling. |

| Humidity | |
|---|---|
| **Best Practice** | 30-60% |
| **Self-Evaluation and Mitigation** | less than 30% or greater than 60% |
| **Public Enforcement** | complaint-based |
| **Reference Standards** | ASHRAE: 30-60% humidity for workers performing mostly sedentary tasks. |

| Nitrogen Dioxide | |
|---|---|
| **Best Practice** | 0-50 ppb |
| **Self-Evaluation and Mitigation** | 50-100 ppb |
| **Public Enforcement** | greater than 100 ppb |
| **Evacuation** | 13,000 ppb |
| **Reference Standards** | NAAQS: 100 ppm 1-hour level; annual average level 53 ppb.<br><br>WHO Air Quality Guidelines: levels not to exceed 5.23 ppb annual average, 13.08 ppb 24-hour average.<br><br>OSHA Ceiling: 5,000 ppb.<br><br>NIOSH Recommendation: 1,000 ppb. |

| Ozone | (measured over 8 hours) |
|---|---|
| **Best Practice** | .08 ppm |
| **Self-Evaluation and Mitigation** | .08-0.1 ppm |
| **Public Enforcement** | 0.1 ppm |
| **Evacuation** | IDLH 5 ppm |
| **Reference Standards** | WHO Air Quality Guidelines: 24-hr level of 40 µg/m$^3$ or less measured over 24 hours; 500 µg/m$^3$ or less measured over 10 minutes.<br>NAAQS: 70 ppb.<br>NIOSH: 0.1 ppm (0.2 mg/m$^3$, or 200 µg/m$^3$).<br>OSHA: 0.1 ppm measured over 8 hours (0.2 mg/m$^3$, or 200 µg/m$^3$). |

| Particulate Matter – PM 2.5 | (measured over 8 hours) |
|---|---|
| **Best Practice** | 0-12 µg/m$^3$ |
| **Self-Evaluation and Mitigation** | 12-35 µg/m$^3$ |
| **Public Enforcement** | greater than 35 µg/m$^3$ |
| **Reference Standards** | NAAQS: 12 µg/m$^3$ annually (average of daily amounts over 3 years).<br>WHO Air Quality Guidelines: annual average of 5 µg/m$^3$ and a 24-hour average of 15 µg/m$^3$.<br>OSHA Standard: 5mg/m$^3$ measured over 8 hours. |

| Particulate Matter – PM 10 | (measured over 8 hours) |
|---|---|
| **Best Practice** | 0-50 µg/m$^3$ |
| **Self-Evaluation and Mitigation** | 50-100 µg/m$^3$ |
| **Public Enforcement** | greater than 100 µg/m$^3$ |
| **Reference Standards** | NAAQS:150 µg/m$^3$ average over 24 hours.<br>WHO Air Quality Guidelines: recommended not to exceed 15 µg/m$^3$ annual average or 45 µg/m$^3$ 24-hour average.<br>OSHA Standard: 15mg/m$^3$ (15,000 µg/m$^3$) over 8 hours. |

| Radon | (measured over 48 hours) |
|---|---|
| Best Practice | less than 4.0 pCI/L |
| Self-Evaluation and Mitigation | 4.0 pCi/L |
| Public Enforcement | greater than 4.0 pCi/L |
| Reference Standards | WHO Recommendation: less than 2.7pCi/L for long term exposure<br>OSHA: 100pCi/L averaged over a 40-hour work week. |

| Sulfur Dioxide | (measured over 8 hours) |
|---|---|
| Best Practice | less than 2 ppm |
| Self-Evaluation and Mitigation | 2-2.5 ppm |
| Public Enforcement | greater than 2.5 ppm |
| Reference Standards | WHO Air Quality Guidelines: less than 40 µg/$m^3$ average over 24 hours; less than 500 µg/$m^3$ average over 10 minutes.<br>NAAQS: 75 ppb average over 1 hour; 10 ppb average over 1 year.<br>NIOSH: 2 ppm measured over 8 hours; 5 ppm measure over 15 minutes.<br>OSHA: 5 ppm. |

| Volatile Organic Compounds | (includes formaldehyde and benzene) |
|---|---|
| Best Practice | 0.3 mg/$m^3$ |
| Self-Evaluation and Mitigation | 0.3-0.5 mg/$m^3$ |
| Public Enforcement | 0.5 mg/$m^3$ |
| Evacuation | Benzene IDLH at 500 ppm (1,594mg/$m^3$)<br>Formaldehyde IDLH at 20 ppm (24.49mg/$m^3$) |
| Reference Standards | Benzene - OSHA: 1 ppm measured over 8 hours; 5 ppm measured over 15 minutes.<br>Formaldehyde - OSHA 8-hr Action Level: 0.5 ppm (0.61mg/m3)<br>NIOSH: 0.016 ppm measured over 8 hours |

## Appendix A – Indoor Air Quality Member Roster

Richard Bruns, PhD, MS, John Hopkins Bloomberg School of Public Health

Christy Crocker, Executive Director, Maine Indoor Air Quality Council

Glenn Cummings, Director of Green Schools, Maine Department of Education

Todd Cummings, Director of Facility and Property Management, Maine Department of Labor

Jonathan Dyer, Radon Coordinator, Maine DHHS

Nick Ferrala, Occupational Health and Safety Compliance Assistance Specialist, Bureau of General Services

Eric Frohmberg, Senior Health Program Manager, Maine CDC

Gigi Gronvall, PhD, Paula Oisiewski, PhD, John Hopkins Bloomberg School of Public Health

Martha Kluzak, Director of Facilities Management, Maine DHHS

Steve Martel, Mechanical Engineer

Lidia Morawska FAA FTSE, Queensland Company University of Technologies

Virginia Mott, Retired Teacher, representing Maine Education Association

Paula Oisiewski, PhD, John Hopkins Bloomberg School of Public Health

Joel Straus, John Hopkins Bloomberg School of Public Health

Dr. Leslie Walleigh, Public Health Physician, Maine DHHS

Barbara Wilk, Environmental Health and Safety Compliance Assistance Specialist, Bureau of General Services

Bureau of Labor Standards Staff:

J. Kate Burkhart, Director

Steve Greeley, Director, Workplace Safety and Health Division

Tammy Gross, Chief Safety and Health Inspector

Rebecca Guppy, Secretary Associate

Michele King, Compliance Assistance Specialist

Mary Matthews, Program Manager

John Rioux, Deputy Director

Allison Smith, Occupational Health