Conference report

2nd European Conference on Indoor Air Quality: French Schools

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Geneva Health Forum

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Authors and Acknowledgments

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- The Geneva Health Forum (GHF)
- The Institute for Global Health (ISG)
- The Center for Studies and Expertise on Risks, the Environment, Mobility, and Planning (Cerema)
- The "Ecoles et familles oubliés" (EFO) Collective
- The Molinari Economic Institute
- The "Nous aérons" Collective
- The Scientific and Technical Center for Building (CSTB)

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Executive Summary

On June 20, 2025, seven organizations—Geneva Health Forum, Institute of Global Health, Cerema, École et Familles Oubliées collective, Molinari Economic Institute, Nous Aérons collective, and CSTB—organized the Second European Conference on Indoor Air Quality (IAQ) at the Senate, with a focus on air quality in French schools. This event built upon the first meeting held in Bern in 2023 and is part of a broader European initiative to position IAQ as a key public health priority.

Overall Observation

Citizens spend over 80% of their time indoors, and children spend 10 to 15% of their lives in classrooms. However, a significant number of French schools suffer from inadequate ventilation, which facilitates the spread of respiratory infections (such as influenza, Covid-19, measles and whooping cough and worsens chronic conditions like asthma and allergies. Moreover, indoor air pollution negatively affects cognitive performance, well-being, and educational outcomes.

In France, the socioeconomic cost of indoor air pollution is estimated at €19 billion per year, contributing to nearly 20,000 premature deaths annually. The potential benefits of corrective actions are substantial: for instance, better air exchange could prevent 30,000 cases of childhood asthma each year.

Despite the wealth of scientific evidence and practical feedback, there is still a significant need for information and awareness-raising among elected officials, local authorities, educators, and families. A clearer understanding of the health, educational, and economic stakes of indoor air quality is essential to foster support and prompt concrete actions. However, numerous local and international initiatives demonstrate that simple and practical measures— such as regular CO_2 monitoring, targeted renovation of ventilation systems, and pollution source reduction—can rapidly and sustainably improve conditions in schools. The key challenge now is to disseminate these best practices, enhance training for stakeholders, and build a coordinated movement to scale up proven solutions.

Key messages from the interventions

- Insufficient science-policy link: despite robust scientific data, the translation into policy and practical decisions remains limited.
- Social inequalities: some schools in disadvantaged areas are often more exposed to indoor air pollution and suffer from poorer ventilation.
- Poorly enforced regulatory framework: monitoring obligations introduced in 2023 are frequently unmet or poorly implemented.
- Complexity of renovation: renovating existing buildings poses financial and technical challenges, is hindered by uncertainty surrounding evolving standards, and often lacks support from local authorities.
- International experience: countries like the United Kingdom, Belgium, and Italy show that structured approaches, combining standards, monitoring, public data display, and multi-year planning, are feasible but require continuous investment.
- Economic challenges: The rising costs of sick leave and healthcare related to respiratory diseases highlight the need to treat ventilation as a profitable public health investment.

Identified Approaches and Levers

- Reducing pollutants at source: limiting the use of harmful chemicals,

selecting healthy construction and furnishing materials and ensuring regular maintenance of the facilities.

- Adapted and verified ventilation: implementing properly sized, maintained, and inspected mechanical or hybrid ventilation systems, supported by regular CO_2 and VOC measurements.
- Involving users and citizens: raising awareness, publicly displaying IAQ indicators, and co-developing policies.
- Intersectoral coordination: effective collaboration between the State, local authorities, public health agencies, the education sector, research institutions and the private sector is essential.
- Integrating climate and energy considerations: IAQ improvements must be aligned with the energy performance of school buildings (addressing winter heating and summer overheating), ensuring that investments are cost-effective and sustainable.

Conclusion

The conference brought together scientific, health, technical, economic, and political experts, reaffirming that improving air quality in schools is both an urgent public health issue and a strategic long-term investment. It concluded with the formulation of 11 concrete recommendations, aimed at guiding public and private stakeholders in making indoor air quality in schools a true national priority.

Introduction

On June 20, 2025, a collective of seven organizations—the Geneva Health Forum (GHF), the Institute for Global Health (ISG), the Center for Studies and Expertise on Risks, the Environment, Mobility, and Planning (Cerema), the "Écoles et Familles Oubliées" (EFO) collective, the Molinari Economic Institute, the "Nous Aérons" collective, and the Scientific and Technical Center for Building (CSTB)—organized the Second European Conference on Indoor Air Quality (IAQ) at the French Senate in Paris, with a specific focus on French schools.

This conference forms part of a broader European initiative that began with an initial meeting held on September 20,2023 in Bern, Switzerland. That first gathering laid the groundwork by addressing the global challenges posed by indoor air quality, an increasingly urgent public health issue.

At a time when citizens spend over 80% of their time indoors, indoor air quality has become a major determinant of physical, mental, and cognitive health. In France, numerous studies have raised concerns about the poor air quality in school environments, which contributes to the aggravation of chronic respiratory conditions such as asthma and facilitates the transmission of airborne infectious diseases such as influenza, measles, and COVID-19. These conditions directly affect students' academic performance and attendance, as well as the well-being of educational and administrative staff.

This second conference sought to assess the current state of indoor air quality in French schools, drawing on the latest scientific data and showcasing practical local initiatives. A key objective was to foster constructive dialogue with parliamentarians, particularly members of the Senate and the National Assembly, to develop operational proposals at both local and national levels.

Bringing together scientific, health, economic, technical, and political stakeholders, the conference identified concrete avenues for the development of an integrated strategy to sustainably improve indoor air quality in schools. Discussions also emphasized the urgent need to align this public health priority with broader goals related to the energy transition and climate adaptation.

This report presents the key insights and lessons learned from the conference and put forwards practical recommendations to establish indoor air quality in schools as a true political priority in France.

Welcome

Bernard Jomier
Sénator

Bernard Jomier opened the session dedicated to indoor air quality in schools underscoring the long-standing nature of the issue and the renewed urgency brought to light by the Covid-19 pandemic. He emphasized that, despite the existence of a dedicated Observatory since 2001 and a robust scientific evidence, France continues to struggle with translating this knowledge into concrete public policies.

He expressed concerns over the persistent disconnect between the scientific and political spheres, a gap made particularly visible during the health crisis, when scientific facts were often downplayed or even denied. The link between air quality, health, academic performance, and school absenteeism is well established, he noted, yet action remains insufficient. This inertia, Jomier argued, points to a broader structural issue: France's systemic difficulties in implementing prevention-based policies, in part due to national culture that prioritizes curative responses over long-term preventive strategies.

He concluded by calling for a stronger alignment between scientific insight and public decisions-making, expressing hope that the work undertaken during the conference would help catalize a genuine shift towards prevention.

Introductory remarks

Hans Kluge
Regional Director for Europe of the World Health Organization (WHO)

Hans Kluge reaffirmed that access to clean air, especially in schools, is a fundamental human right. Yet millions of students worldwide, including in developed countries, continue to study in classrooms with poor indoor air quality. He drew attention to the deep inequalities in exposure, noting that certain schools, particularly those in disadvantaged areas are more likely to suffer from inadequate ventilation and higher level of pollution.

The health and economic burden of indoor air pollution is substantial: in France, for example, it already reached €19 billion in 2014.

While Kluge welcomed the growing number of local initiatives, he stresses the urgent need for a more ambitious, coordinated national response. He calls for the development of national strategies that include clear goals, intersectoral coordination, science-based roadmaps, and sustained investment in research. The WHO, he added, stands ready to supports countries by providing technical tools to help them sustainably improve air quality in schools.

Air quality issues and prevention levers

Antoine Flahault
Director of the Institute of Global Health, University of Geneva

"Prevention is the blind spot of public health policies."

Antoine Flahault highlighted that this conference marked the second European meeting on indoor air quality, following the inaugural event in Bern. He stressed the importance of bringing together scientists, civil society, and policymakers to identify realistic solutions to what he described as a major public health issue.

He reiterated that people spend approximately 80% of their time indoors and that children spend between 10 and 15% of their lives in classrooms, many of which remain poorly ventilated. In France, at least 40% of classrooms suffer from inadequate ventilation, according to data from Public Health France, ANSES, and CSTB. This poor air quality contributes to the spread of respiratory infections (COVID-19, influenza, measles, whooping cough) and the development of chronic conditions such as asthma and allergies. Flahault drew attention to the negative impact of stale air on students' academic performance.

Discussing the cost of inaction, he cited the estimated €19 billion per year associated with indoor air pollution in France. He then offered a historical analogy with the 1854 cholera epidemic in London, emphasizing that measures, like the dismantling of the Broad Street pump, were effective but temporary responses to a health crisis. Similarly, while school closures during modern health emergencies have proven effective in reducing morbidity and mortality, they have also caused significant social and psychological harm. Antoine Flahault called for action that improve air quality without disrupting access to education.

In closing, he denounced the lack of political investment in prevention, which is often overshadowed by crisis management, and called for truly learning the lessons of the pandemic by recognizing airborne transmission as a key factor in rethinking public health policies.

Exploratory study of the socio-economic cost of indoor air pollutants

The figure of €19 billion per year is an estimate of the socio-economic cost of indoor air pollution in France. It comes from a 2014 study conducted by ANSES and CSTB, in partnership with the OQAI and economist Pierre Kopp. This study is based on data relating to the population's exposure to six major pollutants: benzene, trichloroethylene, radon, carbon monoxide, particulate matter, and tobacco smoke. According to this estimate, there were approximately 20,000 premature deaths annually attributable to indoor air pollution, resulting in this overall economic cost of €19 billion per year for the community (including mortality, illness, loss of well-being, productivity, healthcare, prevention, etc.).

ANSES, Indoor Air Quality Observatory (OQAI), and CSTB; with Pierre Kopp (Panthéon-Sorbonne University). 2014. Exploratory study of the socio-economic cost of indoor air pollutants, CRD-2011-CRD-11 Report, April 9. ANSES. https://www.anses.fr/fr/system/files/AUT-Ra-CoutAirInterieurSHS2014.pdf

What is the situation in schools? Real-life data

Isabella Annesi- Maesano
Research Director at Inserm, IHU Immun4Cure

"At school, we think our children are protected. But ultimately, there are a lot of pollutants."

Isabella Annesi-Maesano emphasized that, contrary to popular belief, schools are not safe environments for children when it comes to air quality. Students are exposed to numerous pollutants, both indoors (such as viruses, bacteria, dust containing phthalates, mould and chemical emissions from cleaning products, furniture, certain flooring materials, and school activities) and outdoors (including nitrogen dioxide, fine particles, carbon monoxide, volatile organic compounds (VOCs) and biological (pollen and mould) pollutants).

She presented findings from several major French and European studies on the topic. The French 6 Cities[1, 2] study, published in 2012, revealed that one in three children were breathing air that exceeded WHO pollution standards. This exposure was linked to increased rates of respiratory, allergic, and irritation symptoms.

The HESE study[3], which focused more extensively on chemical and biological pollutants, confirmed a direct link between indoor pollution (such as carbon monoxide and fine particles) and symptoms commonly associated with asthma, including dry coughs or rhinitis.

Expanding on this, the European SINPHONIE study showed that children were also overexposed to a variety of pollutants, including benzene, formaldehyde, radon, and endotoxins—the latter primarily originating from soil and classroom waste. These exposures were not only linked to respiratory and flu-like symptoms but also to a decline in academic performance.

As a result of these findings, the study contributed to the development of guidelines for creating a healthy school environment, which were subsequently adopted by the European Commission.

Isabella Annesi-Maesano emphasized the urgent need to recognize these risks and to implement effective prevention policies.

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[1] This survey measured indoor air pollution (fine particulate matter $PM_{2.5}$, NO_2, formaldehyde, acrolein, acetaldehyde, etc.) in 401 classrooms across 108 primary schools in six French cities (Créteil, Reims, Strasbourg, Clermont-Ferrand, Bordeaux, and Marseille). While 9,654 children were included in the study, the analyses were performed on 6,590 children for whom all the necessary data were available.

[2] Annesi-Maesano, Isabella, et al. 2012. "Indoor Air Pollution and Respiratory Health in Schoolchildren: A Study in 401 Classrooms from Six French Cities." *Thorax* 67 (3): 213–220. https://europepmc.org/article/PMC/PMC3402758

[3] HESE (Health Effects of School Environment) is a study that examined the impact of indoor air quality (CO_2, PM_{10} in particular) on the respiratory health of children in several European countries.:
Simoni, M., I. Annesi-Maesano, T. Sigsgaard, D. Norback, G. Wieslander, W. Nystad, M. Cancianie, P. Sestini, and G. Viegi. 2010. "School Air Quality Related to Dry Cough, Rhinitis and Nasal Patency in Children." *European Respiratory Journal* 35 (4): 742–49. doi:10.1183/09031936.00016309.

She also discussed the SynAir G study, a new research project underway in five European countries, including France. Funded by Horizon Europe, the study, launched in September 2022, is expected to last until 2026. The project aims to better understand the combined effects (synergies) of chemical and biological pollutants such as allergens, microbes, VOCs, particles and ozone on children's health. It will also test smart monitoring technologies and ecological interventions within schools.

European study SINPHONIE (*Schools Indoor Pollution and Health: Observatory Network in Europe*)

The objective of this study was to establish a European observation network to measure indoor air pollution in schools and daycare centers and to analyze its potential impact on the health of children and staff. Conducted between 2010 and 2014, the project was funded by the European Parliament through the European Commission. A total of 5,175 students from 115 schools in 54 cities across 23 European countries, encompassing 3,195 classrooms, were included in the study.

The study showed that children exposed to concentrations above the median for PM2.5, benzene, limonene, ozone, and radon had a significantly higher risk of developing respiratory symptoms (such as cough, rhinitis), ocular or skin symptoms, and systemic disorders. Adequate ventilation and temperature control were associated with a reduction in ocular and upper respiratory symptoms.

EC DG SANTE and Joint Research Centre. 2014. SINPHONIE: Indoor Air Pollution and Health in Schools – An Observation Network in Europe. Executive Summary of the Final Report. Luxembourg: Publications Office of the European Union. https://doi.org/10.2788/96376.

Baloch, R. M., C. N. Maesano, J. Christoffersen, et al. Indoor Air Pollution, Physical and Comfort Parameters Related to Schoolchildren's Health: Data from the European SINPHONIE Study. Science of the Total Environment 739 (2020): 139870. https://doi.org/10.1016/j.scitotenv.2020.139870.

SynAir G Study (Disrupting Noxious Synergies of Indoor Air Pollutants and their Impact in Childhood Health and Wellbeing)

This study is a Horizon Europe-funded project launched in September 2022 and scheduled to run until 2026. Its main objective is to improve understanding of the combined effects (synergies) of chemical and biological pollutants (allergens, microbes, VOCs, particles, ozone and others) on children's health, and to test smart monitoring technologies and ecological interventions in schools. Innovative multi-pollutant sensors both chemical and biological are being deployed in schools across five European countries. Children's health is being monitored through a gamified application that collects health outcome data with the active participation of children affected by asthma or allergies. The ultimate aim is to develop a personalized and scalable alert system.

The project involves schools located in five European countries, with data collected in real-world environments that take into account exposure duration, pollution sources, intervention measures. SynAir-G is one of seven EU-funded projects within the IDEAL Cluster, which focuses on indoor air quality and health.

SynAir Study Overview
https://cordis.europa.eu/project/id/101057271
https://synairg.eu

IDEAL European Study Cluster Overview
https://www.idealcluster.eu/projects

Indoor air quality: an underestimated public health issue

Guillaume Boulanger
Head of the Quality of Living and Working Environments and Population Health Unit, Public Health France

"Proper air renewal could reduce nearly 30,000 cases of asthma in children each year."

Guillaume Boulanger emphasized the urgent need to take action on indoor air quality, particularly in schools. He highlighted that children spend nearly 20% of their year indoors, often poorly ventilated and densely populated, exposing them to a variety of pollutants.

He underscores the importance of understanding the diversity of pollutants. These are biological such as mould, viruses, chemical like formaldehyde, volatile organic compounds, and physical including radon and asbestos, originating both inside and outside the building.

The high density of students in classrooms exacerbates the effects of confinement.

Children are particularly vulnerable due to the immaturity of their immune and respiratory systems, as well as the incomplete development of the blood-brain barrier.

The issue is multifaceted health-related (asthma, wheezing, developmental disorders), cognitive (learning disrupted by heat and confinement), and economic. Indoor air pollution in homes is estimated to cost around €19 billion annually and is associated with nearly 20,000 deaths each year.

A study conducted by Santé publique France highlights the tangible benefits of improving air quality: enhanced ventilation could prevent nearly 30,000 cases of asthma annually, while eliminating mould in schools could avert more than 10,000 cases of wheezing each year.

Action can be taken both at the source and through improved ventilation. A study currently underway in collaboration with the cities of Lyon and Paris aims to better understand the influence of outdoor pollution on indoor air quality in schools and its impact on children's health.

Guillaume Boulanger called for schools to become centers of health education, but also refuges during heatwaves, by reversing the current logic of closing them during periods of extreme heat. Finally, he stressed the need to strengthen data collection, regulations, and monitoring of indoor air quality, which are currently far less developed than those for outdoor air.

Exploratory study of the socio-economic cost of indoor air pollutants

The figure of 19 billion euros per year represents an estimate of the socio-economic cost of indoor air pollution in France, derived from an exploratory study conducted in 2014 by ANSES and CSTB, in partnership with the Indoor Air Quality Observatory (OQAI) and economist Pierre Kopp. This study analyzed data on population exposure to six major pollutants: benzene, trichloroethylene, radon, carbon monoxide, particles and tobacco smoke. While the estimate, is intended to be illustrative rather than definitive, it suggests that approximately 20,000 premature deaths annually in France can be attributed to indoor air pollution. The overall economic cost to society encompassing mortality, illness, loss of well-being, productivity, healthcare, prevention is estimated to € 19 Billion per year.

ANSES, Indoor Air Quality Observatory (OQAI), and CSTB; with Pierre Kopp (Panthéon-Sorbonne I University). 2014. Exploratory Study of the Socioeconomic Cost of Indoor Air Pollutants, Report CRD-2011-CRD-11, April 9. ANSES. https://www.anses.fr/fr/system/files/AUT-Ra-CoutAirInterieurSHS2014.pdf

Quantitative Health Impact Assessment (QHIA) of air quality in and around schools

On January 30, 2024, Public Health France published the results of a Quantitative Health Impact Assessment (QHIA) focused on air pollution in elementary schools across France. This study is the first national- scale assessment estimating the health benefits of improving indoor air quality in classrooms attended by children aged 6 to 11.

The analysis combined data from school-based measurement campaigns with findings from established epidemiological studies focusing primarily on two key pollutants:

1. formaldehyde, used as a tracer for volatile organic compounds (VOCs),
2. the visible presence of mould in classrooms.

This modelling-based study estimates that:

- 29,100 cases of asthma could be prevented each year if formaldehyde concentrations in classrooms were reduced to a low threshold through improved ventilation. • 11,900 cases of wheezing could be avoided annually if visible mould were completely eliminated from classrooms.
- These effects affect approximately 4.4 million elementary school children in France.

The study underscores the importance of structural measures in school buildings such as ventilation, maintenance and renovation and highlight the significant public health impact of indoor air quality on children's respiratory health, particularly for those already affected by asthma or allergies.

Public Health France. Quantitative Health Impact Assessment (QHIA) of indoor air pollution in elementary schools. Saint-Maurice: Public Health France, January 2024. https://www.santepubliquefrance.fr/determinants-de-sante/pollution-et-sante/air/documents/enquetes-etudes/evaluation-quantitative-d-impact-sur-la-sante-eqis-de-la-qualite-de-l-air-dans-et-autour-des-etablissements-scolaires.-pertinence-faisabilite-et?

Findings and expectations of professionals

Catherine Nave-Bekhti
General Secretary of the CFDT Education Training Public Research Federation

"School employees are paying out of pocket for illnesses that we could very likely establish are occupational in origin, caused by their presence in the workplace."

Catherine Nave-Bekhti expressed concern about the inadequacy of public policies addressing air quality in schools. She lamented that, even during heatwaves, schools are not regarded as climate refuges, although they should provide a healthier environment than some substandard housing. She illustrated this issue with concrete examples, such as the alert raised by staff who had conducted BTS exams under conditions of extreme heat and poor air exchange.

Catherine Nave-Bekhti recalled the union's experience during the health crisis. From the outset of the COVID-19 pandemic, the organization consulted experts to anticipate the measures needed to combat aerosol transmission. Drawing on her experience in addressing pollution issues (such as asbestos and solvents), she noted that many schools remain ill-suited to these challenges: windows that cannot be opened, the absence of mechanical ventilation, and the impossibility of ensuring effective air renewal.

She emphasized that numerous schools suffer from indoor air pollution. In particular, she cited the Saint-Exupéry Middle School in Vincennes (Val-de-Marne), which was closed in November 2017 as a precaution after chlorinated solvents, tetrachloroethylene and trichloroethylene were detected in the soil and indoor air.

In the face of increasingly early and intense heatwaves, teachers are doing their best to keep students cool but are hampered by unenforceable instructions from ministries, leading to frustration and anger. She criticized the lack of genuine dialogue with authorities and lamented the disappearance of the National Observatory for School Safety, which could have facilitated co-construction of school health policies.

Finally, she called for a lasting partnership between the State and local authorities to plan and prioritize improvements in the most affected schools. She underscored the health, educational and social stakes, reminding that staff sometimes pay the price of a degraded working environment with their health or even salary.

National Observatory for the Security and Accessibility of Educational Establishments

Created by decree in May 1995, the National Observatory for School Safety was extended to higher education in 1996 and to the accessibility issues in 2007. Reporting to the Minister of National Education, it was responsible for assessing the safety, hygiene, security, maintenance, and accessibility of public and private institutions under contract.

The observatory was abolished at the end of 2020 by Law No. 2020-1525. Its dissolution drew criticism from unions and specialized associations (such as the FSU and CNCPH), which denounced the loss of an independent, collegiate body that brought together multiple stakeholders.

Its missions were gradually transferred to a "School Building Unit" within the Ministry. However, this unit operates with a reduced scope and lacks the transparency, institutional independence or pluralistic participation that characteristic the former Observatory.

The observatory's main missions included:

- Observing and assessing the condition of school buildings and facilities, as well as their safety, health, and accessibility (Article D239-25 of the French Education Code).
- Managing two national databases:
    - BAOBAC, which records injuries involving students and staff in schools.
    - ESOPE, to assesses the safety of the building stock (excluding primary schools).

Proposing concrete measures in annual reports submitted to the Minister and disseminating practical tools such as guides, factsheets and thematic reports to local authorities and institutions.

Observations and expectations of families

Céline Grassien et Isabelle Leibl
AprèsJ20-AssoCle

"No prevention is done, so contamination continues."

Céline Grassien and Isabelle Leibl discussed the ongoing risks of Covid exposure in French schools and the prolonged symptoms of pediatric long Covid.

The AprèsJ20-AssoCle association was founded in October 2020 by parents to advocate for children and young people affected by long-term Covid. It is structured around four key areas: recognition, participatory research, care pathways, and scientific communication. The association leads numerous projects at regional, national, and European levels.

It monitors hundreds of families and collaborates with European and international associations. Members of this association took part in the first international conference on pediatric long COVID held in Rome in 2024 and sit on the working group of the French National Authority for Health (HAS) responsible for developing a care pathway for children.

Pediatric long COVID is defined by the persistence of symptoms beyond 12 weeks, even after a mild or asymptomatic infection. Its prevalence long underestimated but is now estimated to affect approximately 1 to 1.8% of children. In the United States, millions of children have been affected, while in France, the number of school-aged children impacted was estimated at around 120,000, despite the absence of detailed studies.

Céline Grassien and Isabelle Leibl deplored the lack of official case counts despite a law passed in 2022 and noted ongoing infections, especially from asymptomatic children (about half of the cases). Few hospitals diagnose the condition, and most community pediatricians remain unfamiliar with it. Pediatric long COVID is a multisystem illness with varied symptoms that often worsen after exertion.

In practice, they observed excessive psychiatric treatment, the condition being an organic illness of viral origin with no curative treatment, only symptomatic management. The impact on schools has been severe: reduced attendance, dropouts, social isolation, and even suicide attempts. They also denounced the lack of training among professionals and inappropriate management practices.

They further emphasized the absence of prevention measures in schools, noting that the infection remains contagious yet is not subject to mandatory exclusion, and that mask-wearing has been stigmatized amid institutional denial. They called for training of educational and medical staff, a public information campaign, and dedicated funding for barrier measures, ventilation, and air filtration.

In conclusion, they stressed that long Covid could affect individuals of all ages and that prevention is a societal responsibility. They called for a comprehensive "Air Plan" to combat this chronic disease.

Long COVID

The World Health Organization officially recognized long COVID (also called post-COVID-19 syndrome) since 2021. It is defined as typically 3 months after the symptom onset and lasting for at least 2 months, without alternative explanation.

In France, the French National Authority for Health defines long COVID as the persistence or emergence of symptoms beyond 4 weeks post-infection, unrelated to other diseases.

Long COVID can affect multiple organs or system with the most common symptoms including:

- Extreme fatigue, exhaustion, exercise intolerance
- Neurological: brain fog, memory problems, attention deficits
- Respiratory: shortness of breath, persistent cough
- Cardiovascular: palpitations, tachycardia, chest pain
- Digestive: nausea, diarrhea, abdominal pain
- Musculoskeletal: muscle or joint pain
- Mental: sleep disturbances, anxiety, irritability, depression

Long-term COVID affects people of all ages, including those who initially had a mild infection.

In France, the CPAM (Health Insurance Fund) grants recognition as a Long-Term Illness (LTI) on a limited case-by-case basis; as of June 30, 2024, only 6,893 patients were recognised for long COVID-related LTI.

The World Health Organisation (WHO) calls on all countries to integrate long-term COVID into their public health policies, emphasizing the need for social, administrative, and medical recognition of the syndrome.

The WHO recommends the creation of multidisciplinary care pathways and the promotion of scientific research while highlighting the importance of patient involvement in research through co-construction approaches.

It also urges health ministries to collect standardized data using post-COVID-19 patient registries.

According to the APCOVID 19 study conducted by Public Health France between September and November 2022 among a random sample of the French adult population:

- 4% of adults met the criteria for a post-COVID-19 condition, representing approximately 2.06 million people affected in metropolitan France.
- 1.2% reported a strong or very strong impact on their daily activities.

Finally, air quality in schools plays a key role in preventing initial COVID-19 infection and can therefore indirectly reduce the risk of long COVID among children and school staff.

Observations and expectations of families

Elisa Zeno
Head of the "Forgotten Schools and Families" collective

"Illness is the leading cause of school absences in OECD countries, and this trend is increasing sharply."

Elisa Zeno emphasized that indoor air quality in schools has become a major concern for parents, given its impact on children's health, cognitive performance, learning, and overall well-being.

The pandemic highlighted the importance of indoor air quality indicators, such as CO2 concentration, with a recommended maximum threshold of 800 ppm in school spaces including classrooms, dormitories, cafeterias, and gymnasiums.

However, field measurements have shown that this threshold is often significantly exceeded, sometimes by a factor of two, three, or even more. These exceedances can be attributed to several factors: a lack of information and awareness, but more importantly, architectural constraints, external noise pollution, thermal discomfort in both winter and summer, and windows that are difficult or impossible to open. Such deteriorating conditions negatively affect the health of students and staff, resulting in high absenteeism that disrupts family life and, more broadly, societal functioning.

Elisa Zeno cited alarming data from OECD countries, such as Ireland, where 60% of school absences were illness-related, with a 46% increase in sick leave between 2022 and 2023. In France, secondary school students lost an average of 7 to 9% of teaching time in 2022-2023, compared with 5% in 2013-2014. This situation is particularly concerning, as it affects 12 million students and over one million staff members who are exposed to potentially contaminated air for 5 to 10 hours each day.

She also stressed that no one would tolerate unsafe drinking water in schools, yet we inhale nearly 1,000 times more air each day than the amount of water we drink. Families, already concerned before the pandemic, have seen their worries intensify. Consequently, parents' associations strongly advocate making the improvement of indoor air quality a priority in education policies.

Finally, Elisa Zeno called for a coherent and coordinated approach among all stakeholders, supported by a multi-year national strategy. This strategy should aim to systematically integrate indoor air quality considerations into all school construction, renovation, and adaptation projects, to protect the health of both children and staff in a sustainable way.

What are the consequences for children and access to care?

Michaël Rochoy
General practitioner, University of Lille

"Children are getting infected at school. This has been said over and over again, we know it."

During his presentation, Michaël Rochoy emphasized the crucial importance of indoor air quality in schools, particularly for children, a vulnerable population (including those suffering from asthma, cystic fibrosis, etc.) who spend approximately 25% of their time in these establishments. He noted that many factors, such as furniture, cleaning products, proximity to major roads), influence indoor pollution, and that CO_2 levels, an indicator of air quality, were the most easily modifiable parameter.

In 2023, 41% of schools had at least one classroom exceeding 1700 ppm of CO_2, well above the recommended threshold of 800 ppm. Poorly renewed air promotes the onset of "sick building syndrome" at levels as low as 1000 ppm, leading to irritation, fatigue, reduced concentration, cognitive impairment, and increased school absences. Public Health France estimated that 30,000 cases of asthma could be prevented among children aged 6 to 11 through improved indoor air quality.

Schools, places of daily interaction, also facilitate the transmission of respiratory infections, which then spread to families, healthcare professionals, and society at large. While active measures, such as wearing masks, exist, they remain poorly accepted. Passive measures, such as mechanical ventilation, are more effective and better tolerated.

Michaël Rochoy also highlighted the health, educational, and economic implications: a 10% reduction in respiratory infections would free up the equivalent of 600 general practitioners' workload.

However, he noted a budgetary imbalance: while the benefits accrue to the Ministries of Health and Education, the costs are borne by local authorities.

Finally, he illustrated the growing public interest in this issue: during a local participatory vote, air purifiers were chosen as a top priority by 100% of participants, confirming a rising awareness of the importance of indoor air quality.

Sick Building Syndrome (SBS)

This syndrome refers to a set of symptoms experienced by building occupants that lack a clearly identified medical cause but which appear to be related to indoor air quality or the building's environmental conditions.

The World Health Organization (WHO) introduced the term in 1983, defining it as a situation in which at least 20% of a building's occupants report persistent symptoms associated with being inside the building, which diminish or disappear when they leave.

Symptoms are often nonspecific, but they can significantly affect daily life:
• Fatigue, headaches, difficulty concentrating
• Irritation of the eyes, nose, or throat
• Dry skin, itching
• Dizziness, nausea
• Feeling of stale or stuffy air

SBS is not a single disease, but a multifactorial syndrome, caused or aggravated by factors such as:
• Poor ventilation (stagnant air, high CO_2, excessive or insufficient humidity)
• Indoor air pollutants such as:
o Volatile organic compounds (VOCs) from furniture, paints, glues, and cleaning products
o Formaldehyde, benzene, fine particles
o Mould, dust mites, biological allergens
• Psychological and organizational factors:
o Stress, thermal discomfort, noise, work overload

SBS refers to general, nonspecific symptoms with no clearly identified medical cause, unlike BRI (Building Related Illness), which involves illnesses linked to an identifiable cause within the building (e.g., Legionnaires' disease, carbon monoxide poisoning, mould allergy).

To address SBS, it is necessary to:
• Check and improve ventilation (fresh air flow, CO_2, filtration)
• Reduce sources of indoor pollution
• Monitor thermal and acoustic comfort
• Consult occupants regularly (perception survey)

Improving IAQ while respecting climate and energy issues

Valérie Leprince
Project Director for Ventilation and Indoor Environmental Quality. CEREMA (Center for Studies and Expertise on Risks, the Environment, Mobility and Planning).

"Ventilation is based solely on the goodwill of the people in the room. Even with educated teachers, the thresholds are not respected."

Valérie Leprince recalled that CEREMA supports local authorities in implementing public policies, particularly those related to indoor air quality.

She highlighted the complexity of the regulatory framework applicable to schools, situated between the French Labor Code and the 1979 Departmental Health Regulations (RSD), which contain outdated and sometimes divergent requirements. For instance, French regulations impose ventilation rates of 15 m^3/h per student, which is half the European recommendations of 30 m^3/h.

She distinguished between natural ventilation, provided through specific technical systems and manual ventilation, which relies on opening windows—an approach often impractical or ineffective in schools.

Despite the mandatory air quality monitoring requirement introduced in 2023, enforcement of the decree remains very limited. A 2023 study[4] by the DREAL (Regional Directorate for Environmental and Social Affairs) in the Auvergne-Rhône-Alpes region found that fewer than 50% of schools were complying with these requirements, with many local authorities unaware of the legislation.

Through several pilot projects, Valérie Leprince also demonstrated that even with trained and motivated teachers, simple ventilation measures were insufficient to meet the recommended CO_2 and VOCs[5] thresholds. Furthermore, only 15% of French schools were equipped with mechanical ventilation systems, which were often poorly maintained and rarely tested.

She emphasized the importance of regularly verifying systems performance and welcomed the 2024 European directive, which introduced a requirement for inspections every 3 to 5 years[6].

Finally, she showed that while the installation of mechanical ventilation systems can be costly (€3,000 to €5,000 per class), it offers a return on investment through energy savings (€6 to €7 per student per year)

[4] Indoor air quality, Radon, Asbestos: what are the regulations being applied to public buildings housing minors in Auvergne-Rhône-Alpes?
https://www.auvergne-rhone-alpes.developpement-durable.gouv.fr/qualite-de-l-air-interieur-radon-amiante-quelles-a24865.html
[5] Indoor Air Quality (IAQ) & Energy: How to reconcile IAQ and energy efficiency in the tertiary sector? Lessons from the Air Energy Hub, CAUDRON, Cécile et al., Cerema,
https://doc.cerema.fr/Default/doc/SYRACUSE/601611/qualite-de-l-air-interieur-qai-energie-comment-concilier-qai-et-efficacite-energetique-dans-le-terti
[6] European Directive on the Energy Performance of Buildings 2024
https://eur-lex.europa.eu/eli/dir/2024/1275/oj/eng

and measurable health benefits. She concluded by advocating for a regulatory review and the adoption of hybrid solutions that combine air quality improvement with energy efficiency.

Ventilation flow rates recommended by European standards

The EN 15251 standard, and its later version EN16798 3 (2017), define indoor air quality (IAQ) categories and the corresponding recommended ventilation rates:

- For moderate IAQ (IAQ 3), the recommended ventilation rate per person is 4 L/s, or 14.4 m^3/h
- For average air quality (IAQ 2) in school environments, the ventilation rate is at least 7 L/s per person, or approximately 25.2 m^3/h per person
- For superior air quality (IAQ 1, very good level), recommended for new buildings, the rate increases to 10 L/s per person, or 36 m^3/h per person

In addition to these rates, there is also a ventilation rate per square meter of floor area, intended to remove pollutants emitted by furniture and equipment.

Monitoring indoor air quality in schools is mandatory in France

Since January 1, 2023, indoor air quality monitoring has been mandatory in educational institutions across France including primary schools, middle schools, and high schools, as well as daycare centers and leisure centers. This obligation stems from Decrees No. 2022-1689 and No. 2022-1690 of December 27, 2022, which amend the provisions of the Grenelle II Act (2010) and the initial decree of 2012.

Decree No. 2022-1689 (December 27, 2022) amends the French Environmental Code and came fully into force on January 1, 2023. It broadens the scope of establishments subject to the regulations and introduces the following key requirements:

- Annual assessment of ventilation systems, including direct -reading CO_2 measurements;
- Self-assessment of indoor air quality every four years;
- Measurement campaign for regulated pollutants conducted by accredited bodies at each key stage of the building's life;
- Implementation of an action plan to correct any identified deficiencies

Decree No. 2022 1690 (December 27, 2022) provides further technical details and application conditions including:

- Definition of the CO_2 measurement methods (threshold values, measurement uncertainties and data recording);
- Establishment of pollutant thresholds (e.g. formaldehyde, benzene, etc.) that trigger measurement campaigns;
- Update of regulatory conditions related to the formaldehyde threshold value based on the High Council for Public Health (HCSP) recommendations.

Questions/Answers with the speakers

Displaying indoor air quality indicators on school gates.

The FCPE expressed concern about the contradiction between official guidelines during heatwaves, which prohibit the opening of windows, and the health consequences of overcrowded classrooms. It emphasized the importance of making the physical conditions of schools visible, including floor space per student, energy performance and indoor air quality, by displaying these indicators at the gates of primary schools, middle schools, and high school.

This proposal, already submitted to several political bodies, has met with little enthusiasm, as it would highlight the urgent need for investment in school buildings. For the FCPE, publicly displaying these indicators is essential to raise collective awareness, which is a prerequisite for concrete action by both local authorities and the State.

Mayors' questions regarding the school renovation project.

Angèle Préville, mayor of the small town of Biars-sur-Cère, shared her firsthand experience with the energy renovation of a nursery school from the 1970s and 1980s. She highlighted the difficulty of choosing between single-flow and dual-flow ventilation systems, given the additional €35,000 cost associated with dual-flow ventilation. While convinced of the health and energy benefits of such renovations, she also warned of the major financial challenges, particularly in light of reduced public funding (notably cuts to the Rural Territories Equipment Grant and the Green Fund).

She also raised concerns about the regulatory uncertainty and the risk of investing in systems that may soon become obsolete if requirements change rapidly. Furthermore, she expressed concerns about maintenance costs, particularly the €2,000 annual cost of filters, as well as the potential health risks for the municipal employees responsible for their upkeep.

Finally, she deplores a lack of clear guidance and support for local authorities, who often face contradictory instructions from different institutions, yet receive little practical assistance.

Valérie Leprince emphasizes that beyond the choice of ventilation system, the key issue is installation quality. Many municipalities, often lacking qualified technical staff, struggle to ensure proper site supervision, which can lead to poorly installed or non-functional systems, ultimately undermining the investment. She recommended investing in quality project management and contracting support, even if it increases initial costs, to guarantee the long-term effectiveness of installed equipment.

Improving air quality in schools requires strong and deliberate political decisions ensuring that the adequate financial resources are prioritized and clearly allocated to this objective.

This calls for a structured and equitable multi-year plan, jointly implemented by the State and local authorities.

The costs of such investments must be weighed against the health and social costs of inaction including:

- medical care expenses,
- work stoppages and long-term disabilities (e.g., long Covid),
- school absences for sick children, which disproportionately affect mothers and exacerbate gender inequalities in wages and careers.

The long-term costs of inaction exceed those of preventive investments. Public spending should therefore be evaluated for its overall and lasting impact rather than only its immediate budgetary effect.

Should we monitor fine and ultrafine particles inside buildings?

Fine and ultrafine particles are now integrated into indoor air quality monitoring systems, even though their measurement is costly and therefore performed less frequently.

However, these particles are not covered by the 1979 RSDT, an outdated regulation that did not account for them due to the limited knowledge and measurement tools available at the time.

Thus, despite their proven health risks ,fine and ultrafine particles are monitored but they do not yet fall under strict regulatory requirements.

Ventilation and Indoor Air Quality in British Schools: Regulations and Solutions

Benjamin Jones
Associate Professor, Department of Architecture and the Built Environment, University of Nottingham

"A school must document its ventilation system and plan a strategy for the use of and adjustments to devices in the event of an emerging health risk."

In the United Kingdom, approximately 100 million children attend school in 300 different buildings. Regulations on ventilation of school buildings are the responsibility of the Ministry of Housing (Document F, Volume 2). This document refers to the Department for Education's recommendations, notably Building Bulletin 101 (BBEL 101), a mandatory guide for schools, which lays down requirements for ventilation, thermal comfort, and indoor air quality applicable to both students and staff.

BBEL 101 sets specific limits for CO_2 concentrations during school hours. These are used as a practical indicator of air exchange, although they are not a perfect marker of overall air quality (which also depends on pollutants such as fine particles, formaldehyde, ozone, etc.).

The regulations encourage natural ventilation whenever possible, with airflow rates designed for summer comfort, well above those required for indoor air quality alone.

Different types of ventilation systems are used: natural ventilation, simple mechanical ventilation and hybrid systems combining the two, with complementary devices such as platform fans for thermal comfort. User interaction is essential, and the systems must be easy to understand and control. Furthermore, it is important to ensure proper long-term maintenance through maintenance contracts.

Benjamin Jones also mentioned his involvement in drafting a new standard (H251) related to pandemic preparedness. This standard establishes minimum requirements to limit the transmission of infectious aerosols in indoor environments by emphasising compliance with basic air quality standards.

It requires establishments to have a ventilation management and control plan, as well as a strategy for adapting the system in the event of a health risk (e.g: effective filtration, UV disinfection, reduction of occupancy rate). This approach allows buildings with limited ventilation capacities to remain compliant.

The Belgian example? A multi-stage journey

Jelle Laverge
Associate Professor in the Building Physics Research Group of the Department of Architecture and Urban Planning at Ghent University

"We must prepare for a transition that is not a revolution, but an incremental approach."

Jelle Laverge made a presentation on the situation in Belgium, where only 15% of school buildings have mechanical ventilation, the majority relying on window ventilation. The main challenge is therefore massive renovation to ensure adequate ventilation.

Since 2018, several legislative and regulatory initiatives have been implemented, notably through the Code on Well-being at Work and a recent law of 2022. The target is an airflow of 40 m^3 per hour per person, which can be achieved through various strategies such as ventilation, the use of filters, or the reduction of pollution sources.

Each establishment must now conduct a risk analysis and define an action plan to achieve these objectives. Air quality measurement, for example with CO_2 sensors, has become mandatory, with the results being publicly displayed.

However, despite this framework, the actual situation has changed little, mainly due to a lack of sufficient regular investment. During the pandemic, the priority given to air quality increased, but problems arose, particularly with poor-quality CO_2 sensors, such as in Bruges, where the devices purchased did not measure CO_2 correctly. To address these issues, strict requirements are now being defined for the quality of sensors and air purifiers, including performance and safety criteria.

Finally, Jelle Laverge discussed European cooperation, particularly with CEREMA, to harmonize indoor air quality requirements and targets across Europe.

The main lesson learned is that the transition to better air quality must be gradual and accompanied by appropriate devices and tools for all stakeholders, thus creating an "ecology" of indoor air quality.

Belgian laws and initiatives concerning air quality in schools

Law of November 6, 2022, on indoor air quality in public buildings.

- Scope: Applies to all public buildings, including schools.
- Objective: To guarantee a minimum level of indoor air quality to protect health.
- Planned measures:
  - Establishment of an indoor air quality action plan.
  - Monitoring of ventilation systems.
  - Possibility of using CO_2 sensors.
  - Obligation to provide information to the public on air quality.

This federal law provides a general framework, but its implementation depends in part on regional jurisdiction, particularly for school buildings.

Code on Well-being at Work (amended in 2018)

- Scope: Applies to schools as workplaces for teachers. Although it does not specifically cover students, this Code influences minimum infrastructure standards.
- Objective: The employer (in this case, the school governing body) must ensure sufficient ventilation and healthy air quality. • Planned measures:
  - A recommended minimum flow rate of 40 m^3/h per person, including ≥25 m^3/h of outdoor air
  - Alternatively, if there is no flow rate measurement, the use of CO_2 levels as an indirect indicator of air renewal quality is required, with thresholds:
    - Ideal: < 900 ppm
    - Acceptable: < 1200 ppm
    - Above 1200 ppm: the air is considered insufficiently fresh.

Regulations or recommendations on CO_2 levels to be respected in schools by country.

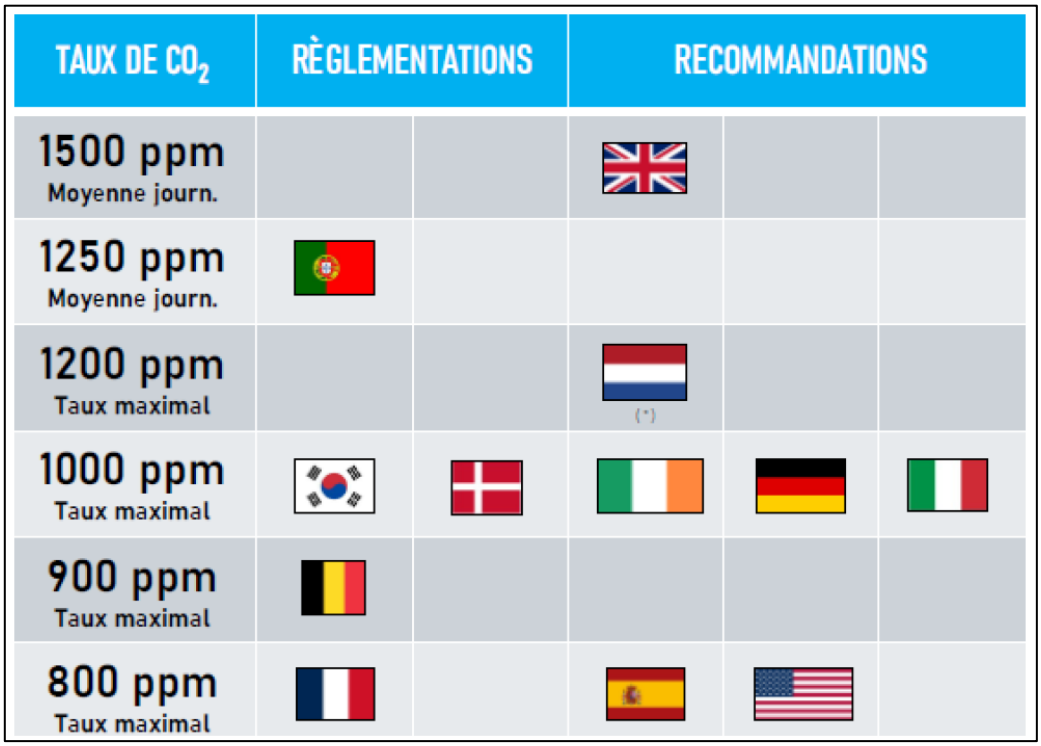

Table proposed by Pascal Morenton of the association Nous Aérons. "Nous Aérons" is a collective of multidisciplinary experts (teacher-researchers, scientists, graphic designers, etc.) active in the prevention of risks related to indoor air quality. https://letsair.org

La situation en Italie

Gaetano Settimo
Professor at the Istituto Superiore di Sanità

"We must overcome the belief that oflices, hospitals, gyms are environments free from danger and risk to the health of users."

A In recent years, national study groups on indoor pollution have produced technical and scientiOic data for Italy, particularly as regards indoor and workplace air quality and its main health determinants. The main national reference remains the Study Group on Indoor Air Quality, coordinated by the Istituto Superiore di Sanità (ISS).

Several legislative documents have been published. At the same time, training activities have been implemented for National Health Service staff, with the aim of disproving the notion that certain enclosed environments—such as ofOices, hospitals, banks, gyms, metro stations, trains, or airports—are exempt from health risks.

We now need to rethink Italian attitudes on the issue, which are largely unchanged from the age of heavy industry. The work currently underway on deOinitions, standards, and regulations has not yet resulted in the establishment of a fully operational national system. The National Prevention Plan (PNP 2020-2025), however, includes action focused on indoor air quality. Its implementation remains difOicult, particularly in schools, despite them being priority settings due to d their key role in society and the vulnerability of children.

Efforts have been made to clarify the differences between types of pollutants and risks. This work has focused in particular on identifying pollution sources, particle size, VOCs, biological agents, ventilation systems (natural and mechanical), as well as maintenance and cleaning practices, and on training professionals and users.

The measures adopted have contributed to improving indoor air quality, particularly in schools and certain professional environments.

National Working Group on Indoor Air Quality (ISS)

This group was created in 2010 within the Italian National Institute of Health.
Its mission is to coordinate research and develop shared scientific documents on indoor air quality (homes, schools, offices, hospitals, etc.).
It brings together experts at the national and regional levels, and its work aims to standardize actions nationwide, identify emission sources, assess exposures, and propose preventive measures.

The main stakeholders involved are:

- Italian National Institute of Health (ISS): coordinates the national group, which publishes technical reports, organizes workshops, and proposes guidelines
- Ministry of Health and the Environment, ISPRA (Italian Institute for Prevention and Health Education), CNR (National Research Council), regional environmental agencies, universities (Politecnico di Milano, Sapienza-Roma, Bocconi, Milano Bicocca, Molise, etc.), associations such as Federasma, Clust ER Greentech, etc. are heavily involved
- National experts such as Gaetano Settimo (ISS) participate in numerous initiatives

Air quality and health in schools: a challenge shared by public stakeholders and experts

Dominique Costagliola
Emeritus Research Director at Inserm (Pierre Louis Institute of Epidemiology and Public Health), and Member of the Academy of Sciences

"Prevention is not within the biomedical field... it will require investments from a very wide variety of sources."

Dominique Costagliola emphasized that prevention in the area of indoor air quality in schools is a complex challenge, as it is not limited to a biomedical approach. It requires the mobilization of a large number of diverse stakeholders—local authorities, departments, and regions—who are responsible for investments made. However, these stakeholders do not necessarily see the benefits of these investments, which primarily translate into gains in public health and savings on healthcare costs. This gap between the investor and the beneficiary makes it difficult to attract funding.

She recalled that the COVID-19 health crisis has highlighted these shortcomings, despite the existence of extensive scientific data on the pollutants present in school buildings: pollutants linked to the building itself, cleaning products, outdoor particles brought in by occupants, etc. These challenges also combine with that of ensuring an appropriate comfortable temperature, not only in winter when many schools are poorly heated, but also during increasingly frequent heatwaves, which require our approaches to temperature control to be reviewed.

Another important issue is the distinction between new construction and renovation. In new buildings, it is easier to meet the most modern air quality and ventilation standards from the design stage. However, renovating older buildings is more complex, and it is difficult to encourage investment when they don't know whether their work will comply with future standards, which evolve regularly. This raises questions about the sustainability of the investments made.

Dominique Costagliola therefore emphasised the need to adopt an integrated approach, combining the skills of architects, materials specialists, hygiene experts, and others, to design sustainable and efficient projects.

Furthermore, it is crucial to find solutions to address the lack of financial incentives, particularly by clarifying who invests and who beneOits, and how to ensure that these investments are sustainable despite evolving standards.

Finally, Dominique Costagliola emphasised the importance of implementing a monitoring system that not only measures improvements in indoor air quality after interventions, but also assesses their positive impacts on occupant health. This assessment is essential to justify investments and guide future actions.

Indoor Air Quality: A Look Back at Twenty Years of Progress and Challenges

Enric Robine
Director of the Pandemic and Built Environments Program, CSTB

"The main thing is certainly to involve all the school users."

Enric Robine reviews past and current challenges of indoor air quality. He recalls the creation in 2001 of the Indoor Air Quality Observatory (OQAI), initiated by Séverine Kirchner and Christian Cochet, at a time when this issue was largely ignored. Their pioneering work helped build a knowledge base on pollutants present in buildings, particularly in schools, with benchmark studies such as the one from 2013-17, which covered 300 establishments and 600 classrooms. The studies highlighted ventilation and indoor pollution problems that are still relevant today,

When the need to take action on indoor air quality is no longer a matter of debate. The real question is how to achieve it in practice. The CSTB develops practical tools and methodologies, such as the QSE (Health and Energy Quality of Renovations) method, which allows for the simple assessment of energy consumption, indoor air quality, and building comfort before and after renovation. This approach aims to equip building managers, particularly in the education sector, to scale up and make interventions more effective.

The presentation also discusses the CSTB's experience during the Covid-19 health crisis, using the example of a middle school in Hauts-de-Seine in 2020. The analysis used engineering tools to model airflow, identify congestion points (toilets, washrooms, dining areas), and propose simple solutions: reorganising movement around the building, having people move at different times, and using outdoor routes. These solutions have shown that user behaviour and involvement are as important as purely technical tools.

Finally, given the risk of future pandemics, a scientific interest group bringing together the CSTB, the Pasteur Institute, ANSES, INRAE and Paris-Créteil University has been created. Its goal is to understand better the transmission of airborne pathogens and how long they remain in the environment, in order to anticipate risks and propose rapid responses. The challenge is twofold: to limit the emergence of new pathogens through better control of the environment (zoonoses, air quality) and to prepare for future crises by strengthening research and innovation (R&I) and sharing information on environmental countermeasures without waiting for therapeutic tools and vaccines which might be slow in coming.

For cleaner air: mobilizing technology and citizens

Gaëlle Guyot
Deputy Head of the High-Performance Buildings Research Team, Center for Studies and Expertise on Risks, the Environment, Mobility and Planning (CEREMA)

"It is people and users who are driving the transformation."

Gaëlle Guyot called for a real change in the way indoor air quality is addressed, without necessarily calling it a "revolution." She emphasized that despite better regulations, regulation alone is insufficient to generate real change. Indeed, regulations are not always respected and will not be sufficient on their own. In order to avoid the proliferation of unreliable or ineffective solutions, it is essential to rely on existing technical solutions, which must be made more reliable with the help of our partners in industry,

Another key tool is the involvement of citizens and users in bringing about change. Gaëlle Guyot noted the general public's lack of awareness of the issue of indoor air pollution, which contrasts with concern about outdoor pollution. The lack of communication and of public understanding about science is a major factor here. However, providing clear information—on, for example, the impact of polluted indoor air on a child's cognitive abilities being similar to that of sleep deprivation or poor nutrition —could help raise awareness among families and decision-makers.

Furthermore, she emphasised that ventilation alone is not enough. Work must also be done to reduce pollutants at source, particularly by prescribing less medication, a concept now being discussed by some doctors. This could create direct health benefits while reducing costs for communities and, ultimately, allow for a better quality of ventilation.

Gaëlle Guyot also discussed the new European directive on the inspection of ventilation systems in commercial buildings. In France, one out of every two ventilation systems malfunctions, often due to being poorly installed. The mandatory inspections already required for residential buildings, could be extended, with a beneficial effect: the cost of this measure for the community would be offset by an improvement in building performance, thus avoiding the expense of technical failures.

Finally, she concluded that while there is no technological magic wand, a coherent set of simple actions, good practices, research, communication and regulation will make it possible to sustainably improve indoor air quality in buildings.

Investing in ventilation to reduce sick leave

Cécile Philippe
President of the Molinari Economic Institute

"Ventilation is an investment, not just an expense."

Cécile Philippe emphasised the crucial importance of considering ventilation not just as an expense, but as a real investment. According to the Molinari Institute, there are two criteria for understanding this issue : real economic data and society's view of it. A major point highlighted by other speakers is the imbalance between local authorities who finance the necessary investments, and society, which usually reaps the benefit. This imbalance hampers resource mobilisation. However, social security systems could play a key role in realigning these interests: They possesses precise data on the real cost of illness and could play a leading role in coordinating investments to improve indoor air quality and, by extension, public health.

The figures presented highlight a spectacular increase in the number of workers taking sick leave since 2019, with a 43% increase between 2019 and 2024. This trend is not specific to France, but has been observed in several European countries, such as Germany, Great Britain, and the United States, where the impact on the economy, measured in particular by a drop in GDP, are significant. This explosion in sick leave therefore poses an immediate economic and social problem. Contrary to popular belief, it cannot be attributed solely either to patients consulting doctors online or a rise in fraud. It is a real and urgent health issue, with more people falling ill, and involves a real cost.

therefore, it is essential to invest in effective solutions, particularly with ventilation, to prevent disease and limit their impact on society, especially with an aging population. Regardless of age, a healthy population is a sine qua non for maintaining productivity and social cohesion.

Cécile Philippe concluded by highlighting the need to align objectives among the various stakeholders capable of making these investments so that the expenditures incurred are perceived as structural investments and not simply as costs.

Indoor air quality: collective and shared public action

Mélanie Heard
General Delegate of Evidences, Head of the health center at Terra Nova

"Students are at school need to be safe. That's all."

COVID-19 has highlighted the complexity of challenges related to indoor air quality, revealing a significant difference among stakeholders and the issues at stake. This hampers the effectiveness of public action. Yet, and despite these obstacles, we are seeing a surge in diverse initiatives led by determined and innovative stakeholders who are beginning to reach agreement and contribute collectively to the debate. This contradictory situation fuels an equally contradictory reaction - pessimism about the likelihood of public policies being well-structured and based on evidence and optimism about the energy and creativity of the stakeholders involved.

One key point is to move beyond the traditional linear and sequential vision of public action (problem identified - solution found - solution implemented), as this approach does not reflect political and institutional realities. The development of public policy is in fact a collective process of progressively defining the problem by sharing ideas.

This includes brainstorming, which allows those involved to agree on the nature of the problem, followed by the opening of a debate on the common values that public action should uphold, and how.

In the case of indoor air quality, the problem is multi-faceted: industrial pollution, unsanitary conditions, thermal comfort, public health, child protection, energy and environmental protection. Many issues complete and overlap - housing, education, health, the environment, etc. This makes building a shared vision essential.

Political discourse plays a crucial role here in determining which values should guide collective action: keeping children safe in school, overall public health, building safety, or energy and environmental objectives. This choice is fundamental because it determines the priorities to be set and the resources available.

The debate about indoor air quality is an important step in bringing together experts, decision- makers and others and then moving everyone on to the next phase where a common narrative can be found, and a coherent plan of action agreed.

Scol'air-FR

Joan Rey
Scientilic Collaborator, School of Engineering and Architecture, Fribourg, Switzerland

"We monitored 24 schools over four years. At the same time, we measured CO_2 in 900 other classrooms."

Air Quality in Schools during the SARS-CoV-2 Pandemic and Energy Restriction Policies

The built environment of schools has a direct impact on the quality of life of its occupants, and by extension, their health. Furthermore, the presence of children in these environments makes comfort and air quality a critical issue. Launched in 2021 in the canton of Fribourg, the SCOL'AIR-FR project, led by Professor Joëlle Goyette Pernot of HEIA-FR, aims to assess air quality in Fribourg's primary schools. The air in 24 primary schools, selected based on construction (i.e., age, ventilation system) and geographic (urban context and linguistic regions) criteria, was analysed four times between October 2021 and March 2023. For each school assessed, two classrooms and one outdoor location were used for the taking of measurements. The range of parameters assessed is very broad. Weekly quantitative measurements of CO2, air temperature and relative humidity, volatile organic compounds (VOCs), and fine particles of various sizes (PM) were taken in each classroom. In addition, qualitative data were collected on classroom activities, the number of students and teachers present, and their attendance. In addition, ofOicial passive radon measurements as well as annual continuous CO2 measurements were taken in all classrooms.

Measurements taken during the pandemic and during the implementation of energy restriction policies

The health emergency and political situation during the period 2020–2023 greatly influenced the design of the SCOL'AIR-FR study. The various measurement campaigns were each influenced by specific measures, relating either to the SARS-CoV-2 pandemic or to energy restriction policies during the winter of 2022–2023. The results obtained not only make it possible to identify general trends related to construction and environmental characteristics, but also to identify the influence of measures taken and implemented quickly to address an external issue.

Generally Satisfactory Results

The results of the air quality measurement campaigns in primary schools in the canton of Fribourg proved very interesting in several respects. First of all, from a general perspective, the results were generally satisfactory. CO2 levels only occasionally exceeded values above 2000 ppm, and the VOCs identified and quantified in the various classrooms did not pose any major health risks to children and teachers.
Regarding radon, four schools measurements were above the reference level (300 Bq/m3). Regardless of the ventilation system, the levels of all pollutants tested are lower during the summer.

The type of ventilation is a determining factor. The results highlight the effectiveness of mechanical ventilation in improving air quality in schools. Indeed, total CO2, VOC, and Oine particle levels were found to be 20 to 30% lower in mechanically ventilated schools. However, we need to remain alert to operational inadequacies in certain systems. Checks on ventilation systems have highlighted excessive airflow rates, leading to dry air in winter and discomfort for occupants, unbalanced systems, and even inappropriate operating schedules leading to excess energy consumption. It is therefore essential to adapt and maintain mechanical ventilation systems to ensure optimal ventilation and energy use in the building.

Ventilate or Disinfect? (That is the Question)

The SARS-CoV-2 pandemic highlighted the need to implement measures aimed at reducing virus transmission in order to ensure the return of students to classrooms in May 2020. These measures included systematic disinfection of hands and surfaces, the wearing of masks, and increased ventilation of school premises. CO2 measurements taken during the fall 2021 and winter 2022 campaigns, when the Delta variant of Covid-19 was circulating, showed lower levels than those during the winter 2023 campaign, thus illustrating greater air renewal. However, the measured VOC levels were significantly higher. The use of alcohols (ethanol and isopropanol) used for disinfection purposes significantly contributed to an increase in total VOCs in classrooms, particularly those with natural ventilation. Paradoxically, attempts to reduce viral transmission between students using ventilation and disinfection, led to a general deterioration in air quality.

Lockdown to save energy?

Unlike during the pandemic, the measures taken during the energy restriction period (winter 2022-2023) required limiting heating to 19°C. The direct consequence of this limitation was the closing of windows to limit the intake of cold outside air. The high CO2 levels measured confirm this decrease in the air exchange rate, thus exposing children to higher levels of pollution, particularly in naturally ventilated rooms.

The SARS-CoV-2 pandemic and the energy conservation phase demonstrate the impact that pragmatic measures geared toward single, specific objectives can have on others—in this case, air quality. It is also interesting to note that while the pandemic has raised public awareness of indoor air quality issues, energy restrictions have likely led to a return to certain pre-pandemic habits. Such measures must therefore take into account the indirect impact on behaviour and, in turn, on the health of building occupants.

The results of the SCOL'AIR-FR study offer a largely positive assessment of Fribourg's primary schools, while highlighting the need for vigilance. These various elements must be taken seriously by the relevant health and energy authorities. Beyond these considerations, the SCOL'AIR-FR project provides a comprehensive overview of the air quality situation in primary schools in the canton of Fribourg, as well as key recommendations for improving these conditions while taking into account the effect of global climate change and, consequently, energy and resource restrictions.

Programme EduRénov

Alice Van Box Som
Partnerships and Promotion Officer within the EduRénov program · Caisse des Dépôts Group

"Local authorities are facing the challenge of energy transition. Energy use in public buildings is at the forefront."

The EduRénov program, launched in May 2023 by Banque des Territoires (Caisse des Dépôts group), aims to do more to manage energy use in educational institutions (primary, secondary, and high schools, daycare centers, recreation centers, etc.).

Program Objectives

- Improve energy use in 10,000 institutions by 2027.
- Achieve at least 40% energy savings for each building concerned.
- Improve the thermal comfort of students and staff, while adapting buildings to climate challenges (heat islands, adaptation, resilience).

This program aims to mobilise €2 billion in preferential-rate loans by 2027 of which €50 million will be spent on technical and legal support (audits, project management assistance, etc.). The program supports local authorities by providing guides, webinars, feedback, mapping of pilot projects, and a network of partners (the French government, ADEME, Cerema, CSTB, FNCCR, etc.).

By March 2025, after two years of the program, support had been provided to 5,000 school buildings.

Bioclimatic architecture at the service of Indoor Air Quality

Charlotte Picard
Architect and territorial engineer, deputy director of research and innovation in the city of Rony Sous Bois

"How can we build today without destroying our environment?"

The Research and Innovation Department in the town of Rony-sous-Bois has existed since 2010. Its mission is to consider municipal strategies for adapting to climate change and its social and environmental impacts.

An important point concerns the municipal obligation to offer sufficient primary school places. We are facing significant population growth, and the department has completed the construction of seven school buildings over the past ten years.

These projects include seven schools and leisure centres, the conversion of an indoor market into a nursery school, and the recent renovation of a nursery school, as Alis mentioned.

In all these projects, a simple but imaginative approach is adopted: how can we build today without destroying the environment? What room for manoeuvre do we have to regenerate our environments while continuing to provide school infrastructure capable of accommodating our children, even taking into account the IPCC's worst-case climate scenarios? Our thinking is therefore guided by this scientific data.

Another important concern is the link between the materials used (particularly bio-sourced materials) and how we use them, following good practice from the very earliest stages of the construction process.

However, due to time constraints, I will focus on the design of the buildings themselves. We favour bioclimatic design, adapted to the local conditions of the construction site.
We start by seeking out materials, emphasing bio-sourced materials such as wood or straw, which contributes to decarbonising the construction process.

We are also working on constructing high-performance and well-insulated buildings to reduce the community's energy consumption.

Regarding indoor air quality, the central topic of our meeting, we have been including CO_2 sensors to continuously monitor levels in all our buildings since the delivery of the very first in 2014.

These sensors are coupled with a ventilation system that we developed with financial support provided by ADEME through its Responsible Building program.

This solution relies on natural ventilation together with heat recovery, providing users with optimal comfort.

Depending on the building, we experiment with different variations: sometimes, natural ventilation is controlled automatically by CO_2 sensors, while in other cases, the control is manual, thus placing the user at the heart of the building's operation—an approach that, as some speakers pointed out, can sometimes pose challenges.

Our in-house team has expertise in architecture, Fluid engineering, and structures, allowing us to achieve high deficiency.

These operations were carried out over a sustained period of between 7 to 10 years. Keeping skills in-house allows us to combine research programs and construction projects.

I invite you to consult the links I have provided to learn more, and I remain available for any questions.

Finally, I also wanted to open a discussion on imagination in construction.

Although we comply with regulations, we incorporate a significant amount of research into our projects.

We seek to build differently, outside of traditional models, in order to explore new, sustainable possibilities.

Taking health as a starting point for action

Anne Souyris
Senator, Paris councillor, Deputy Mayor of Paris in charge of health, September 2017 – November 2023

"Ventilation is not a luxury."

Anne Souyris explained that she chose to approach air quality issues from a health perspective, believing it was the most compelling way to spark interest in others.

The COVID-19 health crisis has highlighted the crucial importance of indoor air quality, particularly in schools, which can affect and are affected by the health of children and that of teaching and administrative staff.

Paris already had an environmental health plan, including a focus on air quality in schools, but implementation had been slow and partial. Moreover, the issue of pollution in schools was not limited to air quality: lead, which was prevalent in most Parisian schools, was causing a lot of problems and required a comprehensive review of the conditions in school buildings.

The melting of lead during the Notre Dame fire also increased concern and emphasised the need for better monitoring.

Faced with these Oindings, the City of Paris decided to take action immediately following the Covid crisis. It initiated a policy of investing in air quality sensors, gradually installing them in every other classroom to raise awareness among teachers and students, but also to measure indoor pollution levels. Data collected led to the consideration structural changes and improvements to ventilation systems, while also taking outdoor pollution into account.

At the same time, Paris developed "children's streets," significantly reducing pollution particularly NO_2 emissions, around schools through measures to reduce vehicle traffic.

Despite these advances, Anne Souyris stressed that the fight against pollution in schools remains a work in progress, with renovation plans being prioritised on the basis of pollution levels, and the need to systematically integrate these issues into future projects.

She also emphasised the importance of no longer building schools in the immediate vicinity of the Paris ring road, a major source of pollution, and suggested merging the schools most at risk to keep children away from these high-risk areas.

Finally, she concluded by reiterating the need for increased government support, particularly through strengthened standards and appropriate planning, pointing out that while Paris had significant resources, this was not the case for all cities, which makes national coordination and support essential to ensure optimal health conditions in all schools.

The City of Paris's "Streets for Children" or "Streets for Schools" program

This initiative aims to create safe, green, and exclusively pedestrianized urban spaces around schools:

This program, launched in 2020 by the Paris City Hall, consists of pedestrianizing and greening streets around nursery and elementary schools. It aims to reduce air and noise pollution, and improve children's safety during

school trips.

As of September 2024, the city had 224 such streets, including 74 fully pedestrianised with newly planted shrubs. The city's goal is to reach 300 by 2026, with 100 of the latter. The budget allocated for this transformation between 2020 and 2026 is estimated at €110 million.

Emissions of NO_2 around these streets have dropped by 25%, and there has been a 23% drop in CO_2 concentrations inside classrooms, according to the Directorate General of Health.

A detailed presentation of the streets near schools is available on the official website of the City of Paris, with an interactive map and list by arrondissement.
https://www.paris.fr/pages/57-nouvelles-rues-aux-ecoles-dans-paris-8197/?utm_source=chatgpt.com

Health and indoor air: understanding what hinders prevention

Cécile Cenatiempo
President of the Alliance of Communities for Air Quality, Metropolitan Councillor in charge of air quality in Grenoble Alpes Métropole and Municipal Councillor in the City of Grenoble

"It is difficult to advance prevention in France."

The Alliance of Communities for Air Quality is a French network bringing together several local authorities that meet regularly to share feedback on actions taken to improve air quality.

The network's main objective is to foster mutual assistance between local authorities, particularly between those that have successfully implemented effective measures and those experiencing difficulties or seeking appropriate solutions.

The Alliance operates on a voluntary basis. It was clear that political will was a key factor in successfully taking specific action.

Three such examples were discussed:

The first, called ELCRAINS, developed in Grenoble in partnership with ADEME, aimed to integrate non-polluting materials and efficient ventilation systems into the design of school buildings, and to decontaminate the soil in order to minimise pollution related to the building itself, from the construction phase to delivery.

The second initiative, called Trouss'air, addressed pollution from school supplies. Grenoble conducted a detailed study of nearly 200 materials used by children in the classroom, including pens, to identify those that emitted little or no pollutants. The city then prioritised these supplies in its purchasing specifications, limiting the introduction of pollutants into schools.

A third example came from Roubaix, which, like other local authorities, had decided to abandon traditional household products, which are often highly polluting, in favour of natural products such as white vinegar, black soap, or baking soda. However, it was noted that this approach, while seemingly simple on paper and economical, met resistance. For example, it was reported that cleaning staff, despite adopting natural products, also continued to use scented sprays, thus limiting the reduction of pollutants.

This illustration highlighted that improving air quality requires not only technical measures but also significant work to raise awareness and gain the support of those involved or affected, which makes these transitions more complex than expected.

The ECRAINS program, Commitment to Responsible Building for Healthy Indoor Air

ECRAINS is a program developed by ADEME. It aims to sustainably limit pollutant emissions at source by integrating air quality from the project planning stage through to completion, to prevent health problems created by poor indoor air quality. It involves integrating low- or no-emission materials into the design of school buildings.

It includes a common framework and tools adapted to specific jobs (project owner, project manager, contractor) with approximately 80 mandatory and optional requirements to be met (materials management, ventilation, coastal areas, etc.).

As part of this program, the city and suburbs of Grenoble have been working together with ADEME for several years to ensure that all new schools and daycare centers meet very stringent specifications regarding indoor air quality. This includes criteria for the materials used (class A+), ventilation (25m^3/h per student, 40% more than the mandatory standard), and pre-operational over-ventilation phases.

ECRAINS program presentation brochure
https://librairie.ademe.fr/batiment/5649-ecrainsR-engagement-a-construire-pour-un-air-interieur- sain-9791029717642.html?utm_source=chatgpt.com#

It is possible to take an "ECRAINS® Coach" training course (intended for project owners or territorial advisors) provided by ADEME, with approximately 14 to 18 hours of content.
https://formations.ademe.fr/formations_batiment_devenir-accompagnateur-de-la-methode-ecrains%C2%AE_s5032.html/?

Simone Lagrange School in Grenoble

The Simone Lagrange School in Grenoble is a good example of a project that meets the ECRAINS® recommendations: healthy materials, efficient ventilation, monitoring at the reception desk, and a low-carbon energy system. It embodies an integrated approach where indoor air quality was a priority from the design phase.

Very Low-Emission Materials

- The project requires the use of A+ emission-rated materials (paints, glues, Bois des Alpes-certified solid wood) to reduce volatile organic compounds (VOCs) from the very start of the selection procedure.
- More than 250m^3 of local solid wood was used, sourced from certified sawmills, to ensure this level of health and environmental performance.

Enhanced Ventilation

- The air exchange rate is set at 25m^3/h per student, 40% higher than the regulatory standard of 15m^3/h. • In addition, an over-ventilation phase is carried out before the building is commissioned to reduce construction gases (formaldehyde, etc.).

Renewable Energy & Thermal Comfort

- The building relies on a geothermal system powered by a heat pump, using the local water table, minimising the use of fossil fuels in favour of a low-emission solution.
- It is designed in a bioclimatic manner, with a high-performance thermal envelope, skylights, and a roof equipped with photovoltaic panels, integrating comfort, energy performance, and health impact reduction.

Post-Delivery Monitoring

- Regular monitoring of indoor air quality is planned after acceptance, including at least three measurements per year, to verify the efficiency of the installations and the maintenance of expected performance.

Richard, Séverine. 2018. "Indoor Air Quality: The Simone Lagrange School in Grenoble Elevated to a Model." Place Gre'net, January 27, 2018
https://www.placegrenet.fr/2018/01/27/qualite-de-lair-interieur-ecole-simone-lagrange-grenoble/528627

Presentation of the TROUSS'AIR program

TROUSS'AIR is an initiative developed by the City of Grenoble, with the support of ADEME, CSTB, and the Medieco agency. It aims to identify school supplies that are safe for children and to incorporate health clauses into public procurement by local councils.

The study focused on 167 school products (glues, pencils, erasers, paints, etc.), analysed through bibliography and expert interviews, and then measured in a CSTB test chamber to assess their volatile organic compound (VOC) emission levels.

Based on the tests, a catalogue of low-emission products was created, along with specific health clauses to be included in school procurement contracts.

The selection of these low-emission products resulted in a reduction of approximately 10% in the overall cost of school supply purchases by the local council.

To support this approach, a practical ADEME fact sheet ("Choosing school supplies without health risks") and the TROUSS'AIR guide are available online. The TROUSS'AIR guide includes:

- the methodology,
- the results of the analysis of 167 products,
- standard clauses to be included in public calls for tender,
- awareness-raising tools for the communities and public involved.

Description of the TROUSS'AIR program
https://librairie.ademe.fr/air/4179-quelles-fournitures-scolaires-pour-une-meilleure-qualite-de-l-air-interieur-.html?utm_source=chatgpt.com

The TROUSS'AIR guide
https://territoire-environnement-sante.fr/espace-documentaire/guide-troussair?utm_source=chatgpt.com

Agence Medieco
https://www.medieco.fr

Adjust, test, correct: building an effective policy

Olivier Blond
Regional Councillor and Special Delegate for Environmental Health and the Fight Against Air Pollution in the Île-de-France Region

"We need to find something sustainable by combining indoor air quality with energy savings in buildings."

Olivier Blond pointed out that elected officials are also parents and citizens concerned about air quality issues. They are not necessarily indifferent, but they are often not fully informed. Raising awareness among elected officials is key, as their individual commitment has a significant influence on the differences between the actions taken by one region and another.

The Ile-de-France region invests approximately one billion euros per year in high schools and another billion in transportation, a major source of pollution. This accounts for approximately 40% of the total annual budget of five billion euros. The region therefore has significant potential to improve air quality.

There has been considerable trial and error in funding for air quality in schools, as there is still no consensus on the solutions to adopt. Initially, air purifiers were funded, but the region later discovered the importance of CO_2 sensors and parameters such as building openings. It is important to be Olexible and adapt action as new knowledge emerges.

Discussions between scientists, researchers, and elected officials are essential to obtain reliable data. The Office for Indoor Air Quality (OQAI), now the Indoor Environment Quality Observatory, must be strengthened to become a useful reference point for policymakers.

Schools are not the only places where indoor air quality needs to be improved. Public transportation in the Ile-de-France region, with its five million daily users, is a major, understudied issue. Nursing homes, which accommodate vulnerable elderly people, are eligible for funding from the Ixle-de-France region to improve indoor air quality in these establishments.

Finally, he presented two cross-cutting measures designed to improve indoor air quality:

- The DRIFE, a regional urban planning document that prohibits the construction of public buildings (ERP) near highly polluted roads or in areas where pollution levels exceed regulatory thresholds.
- The regional plan for compliance with the 2023 regulations includes comprehensive coverage of measures in middle schools. This aims to support local authorities, particularly smaller ones, which are often poorly equipped to address these challenges.

Olivier Blond drew attention to the need for sustainable financing, stressing that the only effective solution would be to combine indoor air quality with energy savings in buildings. For example, Lorient Agglomeration has developed a plan to optimize district heating using CO_2 sensors. This has led to significant reductions in energy consumption and ensured a return on investment. This type of integrated approach, including ventilation and energy recovery, appears to be the best way to address air quality issues in a sustainable manner.

"New Air" Plan 2023-2027

This plan was developed by the Île-de-France Region to improve outdoor and indoor air quality, particularly in

sensitive establishments such as daycare centers, schools, and nursing homes (EHPADs):

The objective is to halve air pollution levels by 2030, reaching the levels recommended by the WHO and surpassing current French standards.

The plan mobilises an initial budget estimated at approximately €900 million over five years (2023–2028). This amount may be increased if local authorities request additional funding.

The plan has eight components:

1. Clean Vehicles: increased subsidies for the purchase of electric or hydrogen vehicles (up to 5 for artisans, 10 for delivery companies), subsidies of up to €30,000 for hydrogen-powered utility vehicles.
2. Green Public Transport: significant investments to make buses cleaner, installation of anti-pollution devices in 20 metro/RER stations by 2028 with a budget of €6 million.
3. Indoor Air Quality: widespread implementation of measurement and purification systems in public buildings serving vulnerable populations (daycare centers, schools, retirement homes). All new establishments built by the Region will be equipped upon commissioning; older ones will have to meet the same standards. Communities with fewer than 20,000 inhabitants are receiving support for ventilation and the installation of CO_2 sensors or air purifiers.
4. Eliminating diesel generators: Encouraging the use of hydrogen generators or equivalents, included in the "energy efficiency" check, and supporting the manufacturing sector.
5. Limiting ammonia emissions in agriculture: Establishing a pilot program to financially support good practices identified on farms by ADEME.
6. Pollen monitoring: Installing a sensor network in partnership with the RNSA, launching "Alertes Pollens Île de France" in January 2024.
7. Réseau R: A support system for communities, managed by the Paris Region Institute, facilitating access to resources and sharing experience on air quality.
8. Innovation and governance: creation of a "LabAir," launch of calls for projects to test solutions (e.g., filtration stations, public buildings), inclusion of air quality in regional projects and in a "wood air" fund to replace old, polluting wood-fired boilers.

Focus on indoor air quality (Area 3)
1,200 CO_2 sensors and 500 air purifiers have already been installed in the Île-de-France region since 2017 in 38 municipalities thanks to previous systems under the "New Air" plan or prior agreements.

The Region is committed to:

- equipping all newly constructed establishments with an indoor air monitoring system as soon as they are commissioned,
- renovating existing establishments to ensure similar standards,
- supporting small municipalities (<20,000 inhabitants) in the installation of purifiers, sensors, and ventilation renovations in schools, daycare centers, and retirement homes.

The will to make things happen

Yannick Nadesan
President of the French Healthy Cities Network and deputy in charge of health at Rennes City Hall, Metropolitan Councillor, and member of the Delegate Office for Agriculture and Food - Rennes

"We are convinced that cities and inter-municipal authorities, because of their skills, have a direct influence on these living environments, which is important. And that we therefore have a major role to play, as one of the links that make up the chain of public health."

The French Healthy City Network brings together 120 cities and inter-municipal authorities committed to improving the health of their residents, according to a broad WHO definition that encompasses physical, mental, and social well-being. Studies have shown that 70% of an individual's health depends on his living and working environment more than on healthcare or genetics. Thus, cities, through their expertise, play a key role in public health, as health is reflected in all policies.

Yannick Nadesan explained that the main reason some cities were more advanced than others in health policies was conviction, that is, the political will to make a difference. Without this will, actions often remained small-scale, without systemic impact.

In Rennes, several specific initiatives have been taken: the opening of metro line B reduced 100,000 journeys by internal combustion engine car each day; a health center doubled the number of doctors in a working-class neighbourhood; Health mediation and prevention initiatives were developed; the new Local Housing Plan required that outdoor spaces to promote mental well-being be created, particularly post-lockdown, and housing improved. Furthermore, the city delivered free organic food baskets to pregnant women, promoting healthy eating during a child's First 1,000 days, a crucial period for future health.

The focus on children was also expressed through comprehensive health checks at school, the planting of greenery in schoolyards to improve mental health and combat heat islands, and equal use of such spaces by girls and boys.

An indoor air quality plan was adopted for 2021-2026, covering schools, daycare centers, and leisure centers, with regular analyses of pollutants and corrective measures involving management, staff, and parents taken. When measures were insufficient, they were integrated into the multi-year investment plan to ensure appropriate work was carried out.

Finally, Yannick Nadesan confirmed that despite the innovation and flexibility of local authorities, Financial issues remained a major obstacle, even though health, particularly that of children, should be a priority of importance to all.

The French Healthy Cities Network:

The French Healthy Cities Network is a national association of French cities and inter-municipalities committed to promoting public health through integrated local policies.

Officially created in 1990, it is a continuation of the WHO Europe Healthy Cities program launched in 1987. Today, it has approximately 118 members.

The French Healthy Cities Network aims to:

- Promote health in all public policies, by integrating health issues into urban planning, culture, youth, the environment, etc.
- Foster exchanges and cooperation between member communities (meetings, working groups, publications) and with the WHO European network.
- Produce resources: reports, guides, advocacy, newsletters on various topics such as indoor air quality, mental health, and youth.

In 2025, the network published a “Healthy Cities Point on indoor air quality” and since 2022 has been leading a working group on IAQ, particularly in schools, nurseries and leisure centers.

Take stock of experiences

Philippe Juvin
Member of Parliament

"If the air had been completely purified everywhere, perhaps we would not even have needed to implement a lockdown."

Philippe Juvin explained that elected officials could act differently depending on their mandates - whether they are MPs, mayors, or MEPs. Each level having its own sphere of action. He underscored the importance of making accurate assessments of the Covid health crisis, particularly with regard to air quality, the healthcare system, and public governance, which he believed were lacking in the country.
He suggested that the lockdowns, with all their social and economic fallout could perhaps have been avoided if the air had been effectively purified in all built environments.

He also recalled that infectious diseases played a central role in the genesis of chronic illnesses such as certain cancers or dementia, something that has long been underestimated. During his medical studies at the Bichat Claude Bernard Hospital, he had come to believe that the battle against infections had been won before he realised that it was still relevant today, and influences the building of hospitals.

He warned against the excessive and often unnecessary proliferation of standards, citing the high cost of certain requirements such as the requirement for red rails around fire hydrants, which he deemed disproportionate. He recalled the need to give priority to essential standards, as financial resources were limited and clear choices had to be made. There is a need to be honest with citizens about the real cost of environmental and health policies.

Finally, Philippe Juvin highlighted a contradiction over vaccination, explaining that refusing vaccination while calling for collective measures such as air purification was a form of extreme individualism.

According to him, those in public office, particularly teachers and healthcare workers, must accept the science and act accordingly, otherwise both credibility and safety would be compromised.

Priorities must be set and public spending earmarked

Angèle Préville
Mayor of Biars sur Cère

"Phthalates are endocrine disruptors, and they are found in almost every school."

A Angèle Préville said that the main obstacle to improving air quality in small rural communities is the lack of financial resources and the difficulty of obtaining grants, especially during times of budget cuts. She cited the example of her community of 2,000 residents, where energy renovations and the installation of a ventilation system in an old kindergarten have been delayed due to a lack of immediate aid.

According to her, the lack of clear priorities in public spending in the face of a multitude of projects complicates the situation, especially since the state often favors one-off savings without a coherent strategy to combat global warming and pollution.

A physical sciences professional, Angèle Préville lamented the gap between scientific advances and public understanding of pollution-related issues. She warned of the ubiquitous plastic pollution that penetrates the environment and the human body, particularly via plastic school floors, which continuously release dangerous chemical additives such as phthalates, widely distributed endocrine disruptors. She called for reducing or even banning the use of these materials in public buildings to avoid lasting health risks.

Beyond buildings, she discussed the invisible plastic pollution linked to microfibres in synthetic clothing, which contaminates all natural environments, from the Arctic to the Alps. This massive phenomenon, currently little addressed, represents a new environmental and health threat.

Finally, Angèle Préville presented a local initiative to reduce vehicle speeds in city centers to bring down levels of pollution and the number of accidents. It was adopted by the council in co-ordination with local residents, . According to her, this approach shows the importance of providing the public with precise scientific data to encourage support for speciOic public health measures.

In summary, Angèle Préville spoke of the need to better fund and prioritise environmental health actions, integrate science into public policies, reduce exposure to plastic pollutants, and involve ordinary people in these essential transformations.

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Parliamentarians have a role to play

Emmanuel Mandon
Member of Parliament

"The role of parliamentarians is of course to think, but it is also to act in contact with their fellow citizens."

Emmanuel Mandon welcomed the conference format, which brought together experts, elected officials, and European representatives, thus fostering rich and constructive discussions.

He outlined the essential role of parliamentarians, not only in engaging with citizens, but also in thinking about the issues themselves — something they don't often do because the system limits their ability to take in-depth action.

He urged people to step out of their comfort zones, particularly during times of political crisis, since they are often exactly the right time to develop and sow new ideas.

Although there is agreement in principle on the health, economic, and social costs of poor indoor air quality, viewpoints and opinions still differ, which complicates the debate.

While the debate continues, statements of intent abound but are sometimes lack consistency and have only a fleeting impact, particularly when the question of public finances comes up. He warned against unfulfilled promises, which could prove counterproductive.

He recalled that the State had set goals and issued regulations, but that understanding them remained difficult, particularly in a highly centralised country, and despite the fact that responsibility for schools is devolved to regions and departments This division of responsibilities between different local authorities actually makes it difficult to adopt uniform policies nationwide.

Officials are sometimes confronted with unexpected realities. He cited the case of a school in his constituency in Saint-Héand, which was polluted by trichloroethylene from a nearby industrial site.

Emmanuel Mandon also discussed the importance of collective learning, particularly in the wake of the Covid-19 pandemic. The pandemic raised awareness of the importance of moderation but the issue must now be addressed.

Finally, he insisted on the need to be realistic about financing and remember that new, sustainable public policies can be developed only with effort and discipline.

Trichloroethylene (TCE) Pollution in the Marie Collard Private School in Saint-Héand (Loire)

Trichloroethylene (TCE) pollution in the Marie-Collard School in Saint-Héand (Loire) was discovered in 2010, during mandatory environmental measures imposed on the neighbouring manufacturer (Thales Angénieux), a former user of chlorinated solvents.

The contamination dates back to the 1960s, caused by the activity of a Thales Angénieux industrial site that used trichloroethylene as a solvent for cleaning manufactured machine parts. The pollution is visible in the groundwater and migrated, reaching the school's foundations and then spreading into the indoor air.

In 2010, the Regional Health Agency and the Loire Prefecture started regular monitoring of the school. Since 2011, continuous environmental monitoring has been implemented by the manufacturer under the supervision of the health authorities; indoor air measurements are taken several times a year.

In 2023 and 2024, further cases of health thresholds being considerably exceeded (particularly on the ground floor of the school) rekindled concerns among families.

Work was undertaken in 2024 and 2025, that included the installation of an underfloor gas extraction system and controlled mechanical ventilation (CMV).

According to the Regional Health Agency (ARS), the levels measured "do not present an immediate risk in the short term," particularly due to the limited time spent in the rooms affected and the regular ventilation. Access to the school has not been prohibited at this stage, but if critical thresholds continue to be exceeded, relocation of the school could be considered.

Recommendations

The conference brough together experts in science, health, technology, economics and politics, who determined that improving air quality in schools is both a health emergency and a strategic investment for future. 11 recommendations emerged from the conference intended to guide public and private sector action to make indoor air quality in schools an urgent national priority.

1. Raise awareness, train, and support local decision-makers
2. Raise awareness and train educational and technical staff
3. Mobilize and involve students, parents, and associations
4. Continuously monitor air quality in schools
5. Integrate IAQ into all school renovation and construction projects
6. Promote an integrated energy-climate-health approach
7. Integrate bioclimatic construction and renovation
8. Reduce internal sources of pollution
9. Implement efficient and controlled ventilation
10. Develop national network spaces for the exchange of best practices
11. Launch a parliamentary flash mission dedicated to indoor air quality in schools

Recommandations

The conference brough together experts in science, health, technology, economics and politics, who determined that improving air quality in schools is both a health emergency and a strategic investment for future. 11 recommendations emerged from the conference intended to guide public and private sector action to make indoor air quality in schools an urgent national priority.

1. Raise awareness, train, and support local decision-makers
Implement a national training and support program for elected officials and technical managers of local authorities, in partnership with specialized agencies (CEREMA, ADEME, CSTB, ANSES, etc.), to provide them with practical tools to plan, finance, and evaluate projects to improve indoor air quality in schools.

2. Raise awareness and train educational and technical staff
Implement mandatory training modules on good ventilation practices, equipment use, early detection of problems, and communication with families.

3. Mobilize and involve students, parents, and associations
Create educational programs on air quality; involve users in monitoring and improvement projects; encourage citizen initiatives and feedback.

4. Continuously monitor air quality in schools
Deploy reliable sensors (CO_2, VOCs, fine particles, humidity) with real-time displays for users and data transmission to authorities to ensure transparency and responsiveness.

5. Integrate IAQ into all school renovation and construction projects
Include specific air quality objectives from the building design stage, consistent with energy performance and thermal comfort, to avoid unfavorable compromises.

6. Promote an integrated energy-climate-health approach
Develop and disseminate methodological guides for the design and renovation of school buildings by simultaneously integrating:

- energy efficiency.
- winter/summer thermal comfort (preventing the effects of cold and heat waves),
- indoor air quality and reducing pollutants at the source..

7. Integrate bioclimatic construction and renovation
Encourage, through financial and regulatory incentives, the use of bioclimatic design principles (orientation, thermal inertia, optimized natural ventilation, passive solar protection, healthy materials) in all new or renovated school projects, in order to reduce energy needs while ensuring healthy indoor air and optimal comfort.

8. Reduce internal sources of pollution
Choose low-emission materials, furniture, and cleaning products; eliminate mould; improve waste storage and management; and limit the use of solvents and hazardous substances.

9. Implement efficient and controlled ventilation
Install or modernize mechanical ventilation systems (single or dual flow) adapted to schools, with regular maintenance and mandatory inspections every 3 to 5 years, to maintain air exchange rates in line with European recommendations (≥ 30 m^3/h/person).

10. Develop national network spaces for the exchange of best practices.
Provide financial and logistical support for regular exchange spaces (conferences, seminars, webinars, inter-community working groups) to share feedback, proven technical solutions, and financing models, particularly through elected officials' associations and existing territorial networks.

11. Launch a parliamentary flash mission dedicated to indoor air quality in schools
Request the National Assembly or the Senate to establish a flash mission dedicated to indoor air quality in schools. The objectives of this mission would be to: explore the recommendations from the conference in depth, hear from stakeholders, and propose operational and strategic recommendations within a short period of time.

List of organizers

In alphabetical order:

- Le Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement (Cerema)
- Le Centre Scientifique et Technique du Bâtiment (CSTB)
- Le collectif "Ecole et familles oubliées" (EFO)
- Le Geneva Health Forum (GHF)
- L'Institut Economique Molinari
- L'Institut de Santé Globale (ISG)
- Le collectif "Nous aérons"

List of speakers

- **Session Chairs and Moderators**
  - **Nicolas Berrod,** Journalist, Le Parisien
  - **Louis Lebrun,** Public Health Specialist
  - **Victoire N'Sondé,** Head of the Health Section, The Conversation France

- **Speakers:**
  - **Isabella Annesi-Maesano,** Research Director at Inserm, IHU Immun4Cure
  - **Guillaume Boulanger,** Head of the Quality of Living and Working Environments and Population Health Unit, Public Health France
  - **Olivier Blond,** Regional Councillor and Special Delegate for Environmental Health and the Fight Against Air Pollution in the Île-de-France Region
  - **Cécile Cenatiempo,** President of the Alliance of Communities for Air Quality, Metropolitan Councilor in charge of air quality in Grenoble Alpes Métropole and Municipal Councillor for the City of Grenoble
  - **Dominique Costagliola,** Director of Research Emeritus at Inserm (Pierre Louis Institute of Epidemiology and Public Health) and Member of the French Academy of Sciences
  - **Antoine Flahault,** Director of the Institute of Global Health, University of Geneva
  - **Céline Grassien**, AprèsJ20-AssoCle
  - **Gaëlle Guyot,** Deputy Head of the High-Performance Buildings Research Team, Center for Studies and Expertise on Risks, the Environment, Mobility and Planning (CEREMA)
  - **Mélanie Heard,** General Delegate d'Evidences and Head of the Health Center at Terra Nova
  - **Bernard Jomier,** Senator
  - **Benjamin Jones,** Associate Professor, Department of Architecture and the Built Environment, University of Nottingham
  - **Philippe Juvin,** Member of Parliament
  - **Hans Kluge,** Regional Director for Europe at the World Health Organization (WHO)
  - **Jelle Laverge,** Associate Professor at the Building Physics Research Group, Department of Architecture and Urban Planning, Ghent University
  - **Isabelle Leibl,** AprèsJ20-AssoCle
  - **Valérie Leprince,** Project Director for Ventilation and Indoor Environmental Quality, Center for Studies and Expertise on Risks, the Environment, Mobility and Planning (CEREMA)
  - **Emmanuel Mandon,** Member of Parliament
  - **Yannick Nadesan,** President of the French Healthy Cities Network and Deputy Mayor for Health at Rennes City Hall, Metropolitan Councilor and member of the Rennes Delegate Office for Agriculture and Food
  - **Catherine Nave-Bekhti,** General Secretary of the CFDT Education, Training, and Public Research Federation
  - **Cécile Philippe,** President of the Molinari Economic Institute
  - **Charlotte Picard,** Architect and Territorial Engineer, Deputy Director of Research and Innovation at the City of Rony-Sous-Bois
  - **Angèle Préville,** Mayor of Biars-sur-Cère
  - **Joan Rey,** Scientific Collaborator, Fribourg School of Engineering and Architecture, Switzerland
  - **Enric Robine,** Director of the Pandemic and Built Environments Program, CSTB Bah
  - **Michaël Rochoy,** General Practitioner, University of Lille
  - **Gaetano Settimo,** Professor at the Istituto Superiore di Sanità
  - **Anne Souyris,** Senator, Councillor of Paris, Deputy Mayor of Paris in charge of health, September 2017 – November 2023
  - **Alice Van Box Som,** Partnerships and Promotion Officer for the EduRénov Group program Caisse des Dépôts
  - **Elisa Zeno,** Head of the "Ecole et familles oubliées " collective

Acronyms and abbreviations

ADEME	A l'origine ADEME signifiait Agence de l'Environnement et de la Maîtrise de l'Énergie. Le nom a évolué mais l'acronyme est rester le même, Agence de la transition écologique
ALD	Affection de Longue Durée
ANSES	Agence Nationale de Sécurité sanitaire de l'alimentation, de l'Environnement et du travail
ARS	Agence Régionale de Santé
BAOBAC	BAse d'OBservation des ACcidents scolaires et universitaires
BMJ	British Medical Journal
BRI	Building Related Illness
BTEX	Abréviation des composés chimiques aromatiques suivants : Benzène B; Toluène T; Éthylbenzène E; Xylènes X
CEPI	Coalition for Epidemic Preparedness Innovations
CEREMA	Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement
CERN	European Organization for Nuclear Research
CFDT	Confédération Française Démocratique du Travail
CNCPH	Conseil National Consultatif des Personnes Handicapées
CO2	Carbon Dioxide
CO_2	Dioxyde de carbone
COV	Composés Organiques Volatils
COVID-19	Coronavirus Disease 2019
CPAM	Caisse Primaire d'Assurance Maladie
CSTB	Centre Scientifique et Technique du Bâtiment
DREAL	Direction Régionale de l'Environnement, de l'Aaménagement et du Logement
ECRAINS	Engagement à Construire Responsable pour un Air INtérieur Sain
EHPAD	Etablissements d'Hébergement pour Personnes Agées Dépendantes
EMPA	Swiss Federal Laboratories for Materials Science and Technology
EPFL	École Polytechnique Fédérale de Lausanne. In English : Swiss Federal Institute of Technology in Lausanne
ÉQIS	Etude intitulée Évaluation Quantitative d'Impact sur la Santé
ERP	Etablissements Recevant du Public
ESOPE	Enquête Sécurité de l'Observatfire Pour les Etablissements d'enseignement
Etude APCOVID 19	Attitudes, perceptions et comportements de la population générale pendant l'épidémie de COVID-19
EU	European Union
FCPE	Fédération des Conseils de Parents d'Elèves
FNCCR	Fédération Nationale des Collectivités Concessionnaires et Régies
FOPH	Federal Office of Public Health
FSU	Fédération Syndicale Unitaire
GIEC	Groupe d'experts intergouvernemental sur l'évolution du climat
HCSP	Haut Conseil de la santé publique
HERA	Health Emergency Preparedness and Response Authority
HESE	Health Effects of School Environment
IAQ	Indoor Air Quality
INIVE	International Network for Information on Ventilation and Energy Performance
INRAE	Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement
Inserm	Institut national de la santé et de la recherche médicale

IHU Immun4Cure	Institut Hospitalo-Universitaire (IHU) Immun4Cure qui se consacre aux maladies auto-immunes systémiques
ISPRA	Istituto Superiore per la Protezione e la Ricerca Ambientale
ISS	Istituto Superiore di Sanità
NO_2	Dioxyde d'azote
NO_x	Oxydes d'azote
OCDE	Organisation de coopération et de développement économiques
OFEV	Office Fédéral de l'Environnement
OFSP	Office Fédéral de la Santé publique. In English : Federal Office of Public Health
OLT	Ordonnance on the Labour Act
OMS	Organisation Mondiale de la Santé
OQAI	Observatfire de la Qualité de l'Air Intérieur
OQEI	Observatfire de la Qualité des Environnements Intérieurs
ORTQAI	Observatfire Romand et Tessinfis de la Qualité de l'Air Intérieur
PCB	Polychlorobiphenyls
PCR tests	Polymerase Chain Reaction tests
PM_{10}	Particules fines d'un diamètre inférieur à 10 micromètres
$PM_{2.5}$	Particules fines d'un diamètre inférieur à 2,5 micromètres
Ppm	Parties per million
Programme EduRénov	Éducation Rénovation.
QAI	Qualité de l'Air Intérieur
QualiVentil	Association romande pour une ventilation de qualité
RNSA	Réseau National de Surveillance Aérobiologique
RSD	Règlement Sanitaire Départemental
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
SBS	Sick Building Syndrome ou syndrome du bâtiment malsain
SDRIF-E	Sschéma Directeur de la Région Ile-de-France – Environnement ()
SEARCH	School Environment and Respiratory Health of Children, 2007-2010
SIA	Schweizerische Ingenieur- und Architektenverein. In English : Swiss Society of Engineers and Architects
SINPHONIE	Schools Indoor Pollution and Health Observatory Network in Europe
Suva	Schweizerische Unfallversicherungsanstalt. In English :Swiss Institute for Accident Insurance
SynAir G	Disrupting Noxious Synergies of Indoor Air Pollutants and their Impact in Childhood Health and Wellbeing
TCE	Trichloréthylène
UK	United Kingdom
Unisanté	Center for Primary Care and Public Health
VMC	Ventilation Mécanique Contrôlée
WHO	World Health Organization

Possible technical solutions to improve indoor air quality in a school

Technical solution	Category	Description	Benefits	Limitations/Difficulties
CO_2 Sensor (Carbon Dioxide)	Air quality monitoring	measures CO_2 level in ppm	Indicates the air renewal rate; useful to know when to ventilate or activate ventilation.	Indirect: does not measure chemical pollutants but reflects human respiration and occupancy.
Total VOC Sensor (Volatile Organic Compounds)	Air quality monitoring	measures Overall VOC concentration in µg/m^3 or ppm	Detects emissions from cleaning products, glues, paints, and furniture.	"Low-cost" sensors provide indicative values; regular calibration required.
Fine Particle Sensor $PM_{2.5}$ and PM_{10}	Air quality monitoring	measures Mass or number of particles per m^3	Assesses particulate pollution (dust, smoke, pollen, spores).	Sensitive to humidity; a quality model is required for reliable measurements.
Formaldehyde (HCHO) Sensor	Air quality monitoring	measures Specific concentration in µg/m^3 or ppm	Important as Formaldehyde is a common VOC in furniture and coatings, irritant and carcinogenic.	Often more expensive; mainly useful during renovations or targeted monitoring.
Relative Humidity and Temperature Sensor	Air quality monitoring	measures % RH and °C	Helps prevent condensation and mould, and assess comfort. Low-cost, often integrated with other sensors.	
Radon Sensor (in risk areas)	Air quality monitoring	measures Bq/m^3 of radon	Detects this natural radioactive gas in some regions.	Necessary only if the school is in an area with high radon potential (according to the official map).
Centralized Data Collection	Data Analysis and Visualization	Data from sensors installed in several rooms or schools are gathered in a single database. They must be analyzed and made visible to the public.	Continuous analysis, inter-site comparison, historical tracking, real-time alerts, ventilation control, user information and engagement.	significant installation and maintenance cost

Technical solution	Category	Description	Benefits	Limitations/Difficulties
Low-emission materials (furniture, paints, floors)	Reducing Pollutants at the Source	Use certified low-VOC products.	Reduces indoor emissions of pollutants.	Gradual replacement, cost.
Choosing low-polluting products (school supplies, cleaning products)	Reducing Pollutants at the Source	Select certified products with low VOC emissions and free from toxic substances (labels such as EU Ecolabel, NF Environnement).	Improves health and comfort of students and staff.	Requires training/awareness for purchasers, sometimes higher cost, variable availability depending on product.
Mechanical Ventilation with Heat Recovery (Double-Flow VMC)	Ventilation	System that renews air while recovering heat from outgoing air.	Continuously improves air renewal, reduces heat loss.	High installation cost, major works for installation, regular maintenance.
Single-Flow Hygro-Adjustable Mechanical Ventilation	Ventilation	Extracts stale air with air inlets modulated by humidity.	Limits condensation and mould, low power consumption.	Requires clean, properly sized air inlets, possible noise.
Optimized Natural Ventilation	Ventilation	Opening doors/windows at planned intervals (e.g., breaks).	No cost, effective for quickly lowering CO_2.	Weather-dependent, may cause thermal or acoustic discomfort.
HEPA Filter Air Purifiers	Air Purification and Disinfection	Devices filtering fine particles, pollen, and microbes.	Easy to deploy, quickly effective on particles.	Noise, filter cost, limited efficiency on certain gases (VOC).
Upper-Room UV-C System (Upper-room UVGI)	Air Purification and Disinfection	UV-C lamps placed high, irradiating only upper air; natural convection or fans mix the air.	Continuous disinfection of ambient air even when occupied.	Professional installation required to prevent UV exposure; effectiveness depends on air circulation.
Fixed UV-C Lamps in Ventilation Ducts	Air Purification and Disinfection	UV-C rays integrated into ducts to disinfect circulating air.	Continuous action without direct contact with occupants, effective on pathogens.	Technical installation, need to prevent UV leaks, periodic maintenance.
Portable UV-C Surface Disinfection Devices	Air Purification and Disinfection	Mobile devices used in absence of occupants to disinfect furniture.	Effective and quick for killing surface microbes.	Strictly for use when no one is present; risk if misused.
Bipolar Air Ionization	Air Purification and Disinfection	Generates positive/negative ions that neutralize particles and microorganisms.	Can reduce viruses, bacteria, and VOCs.	Must be certified to prevent ozone production; variable cost.
Air-Purifying Plants	Air Purification and Disinfection	Plants that absorb some pollutants and humidify air.	Educational and aesthetic aspect, slight air improvement.	Limited effect, requires maintenance, possible allergy risk.

Technical solution	Category	Description	Benefits	Limitations/Difficulties
Pedestrianization and Greening of School Surroundings	Outdoor Measures	Restrict or ban car traffic around the school and create green buffer areas (trees, hedges, lawns).	Reduces infiltration of outdoor pollutants (NO_2, fine particles) indoors, improves outdoor air and sound comfort, creates a safer environment for students.	Requires local authority agreement, traffic reorganization, green space maintenance, impact on parking and local traffic.

Purification or disinfection*: Reducing sources of air pollution, aeration, and ventilation remain the preferred air quality improvement measures for decision-makers today. Purifiers that act on respiratory-transmitted pathogens are solutions that should not be overlooked for vulnerable populations or in the event of epidemics. ADEME has taken stock of the various indoor air purifier technologies:
https://librairie.ademe.fr/air/7659-9285-barometre-2024-les-epurateurs-d-air-interieur-en-france.html?utm_source=chatgpt.com

Bioclimatic Technology	Effect on air quality	Benefits	Limitations/Difficulties
Building Orientation and Layout	Optimizes natural ventilation by capturing prevailing winds.	Reduces the need for mechanical ventilation, facilitates healthy air exchange.	Impossible to modify on an existing building; requires a local climate study.
Natural Cross-Ventilation	Openings positioned to create a continuous airflow.	Improves air exchange without mechanical energy.	Depends on weather; may be problematic in winter or in noisy areas.
Canadian/Provençal Well (Air-Geothermal Energy)	Circulates outside air through buried ducts to regulate temperature.	Preheats/precools the air.	Cost and extensive work, maintenance to prevent mould.
Vegetation (Roofs, Facades, Surroundings)	Partially filters incoming air, captures dust and outdoor VOCs.	Improves air quality and thermal comfort.	Maintenance, humidity management, and possible allergies.
Selection of Low-Emission Bio-Sourced Materials	Wood, natural coatings, and plant-based insulation emit low VOCs.	Reduces indoor pollution at the source.	Sometimes higher cost, availability varies.
Passive Solar Protection (Canopies, Sunshades)	Limits overheating, reducing the need for ventilation during periods of outdoor pollution.	Increased comfort, less hot air to ventilate.	Existing buildings may have limited space or an incompatible shape for adding canopies or sunshades.

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Alice Van Box Som

- Présentation du plan national EduRénov
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- Rapport sur les premiers résultats au 1er septembre 2024
  https://www.banquedesterritfires.fr/edurenov-plus-de-2000-projets-de-renovation-decoles-engages-partout-en-france?

- Charte de rénovation du bâti scolaire
  https://www.banquedesterritfires.fr/sites/default/files/2024-09/Charte_Edurenov_reno%20b%C3%A2ti%20scolaire.pdf

Charlotte Picard

- Troisième conférence du cycle « Métamorphoser l'acte de construire », proposé par le

manifeste pour une Frugalité heureuse et créative. « Vers une conception écosystémique », avec Emmanuel Pezrès. Mardi 13 octobre 2020
https://www.youtube.com/live/G--5SIX8ANA?si=dzfqOUoDDHXnoOvl

- Innover en construction neuve - Accueil de lfisirs sans hébergement Le centre de lfisirs Jacques Chirac à Rosny-sous-Bfis.
https://youtu.be/_VW6jwuh1tw?si=8VzIA6piMLJeAMYL

- Dossier thématique sur la ventilation naturelle
https://www.ekopolis.fr/dossier-thematique-ventilation-naturelle

- Ecole maternelle des Boutours, Rosny sous Bfis
https://youtu.be/rFfAtMBeBkE?si=VS1az9dgdSk2PA3Xà

Anne Souyris

- Une présentation détaillée des rues aux écoles est disponible sur le site officiel de la Ville de Paris, avec carte interactive et liste par arrondissement
https://www.paris.fr/pages/57-nouvelles-rues-aux-ecoles-dans-paris-8197/?utm_source=chatgpt.com

Cécile Cenatiempo

- Brochure de presentation du programme ECRAINS
https://librairie.ademe.fr/batiment/5649-ecrainsR-engagement-a-construire-pour-un-air-interieur-sain-9791029717642.html?utm_source=chatgpt.com#

- Il est possible de suivre une formation « Accompagnateur ECRAINS® » (à destination des maîtres d'ouvrage ou conseillers territoriaux) diffusée par l'ADEME, sur environ 14 à 18 h de contenu
https://formations.ademe.fr/formations_batiment_devenir-accompagnateur-de-la-methode-ecrains%C2%AE_s5032.html/?

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https://librairie.ademe.fr/air/4179-quelles-fournitures-scolaires-pour-une-meilleure-qualite-de-l-air-interieur-.html?utm_source=chatgpt.com

- Le guide TROUSS'AIR
https://territfire-environnement-sante.fr/espace-documentaire/guide-troussair?utm_source=chatgpt.com

- Agence Medieco
https://www.medieco.fr

Yannick Nadesan

- Réseau français Villes Santé
https://villes-sante.com/a-propos/devenir-ville-sante

- Programme Villes Santé de l'OMS Europe
https://www.who.int/europe/groups/who-european-healthy-cities-network
https://www.who.int/europe/fr/news/item/23-11-2023-healthy-and-thriving-cities-demand-social--economic--human-and-planetary-well-being

Others

- *Agir pour l'Air*
  Développé et animé par l'Association pour la Prévention de la Pollution Atmosphérique (APPA), le site *Agir pour l'Air*, a pour objectif de partager les initiatives en faveur de la qualité de l'air, de recenser et de mettre à disposition des outils pour aider les collectivités à passer à l'action.
  https://www.agirpourlair.fr

- ADEME, *Une consommation plus sobre et plus responsable sur le territfire de la collectivité* (synthèse d'expertise, collection *Clés pour Agir*, avril 2023), 22 p.
  https://librairie.ademe.fr/consommer-autrement/6311-une-consommation-plus-sobre-et-plus-responsable-sur-le-territfire-de-la-collectivite-9791029720468.html

Main laws, decrees, and orders in France on indoor air quality in schools

Legal Framework

The legal framework for improving indoor air quality in schools stems from Article 180 of the Grenelle II Law (2010) and the decrees/orders of 2012, 2016, and 2022[7].

1. Loi n° 2010-788 du 12 juillet 2010 portant engagement national pour l'environnement. Dite aussi Loi Grenelle II (2010). Article 180. ➡️
2. Décret n° 2012-14 du 5 janvier 2012 relatif à l'évaluation des moyens d'aération et à la mesure des polluants effectuées au titre de la surveillance de la qualité de l'air intérieur de certains établissements recevant du public. Articles R221-22 à D221-38. ➡️
3. Décret n° 2022-1689 du 27 décembre 2022 modifiant le code de l'environnement en matière de surveillance de la qualité de l'air intérieur, ➡️
4. Arrêté du 1er juin 2016 relatif aux modalités de surveillance de la qualité de l'air intérieur dans certains établissements recevant du public. ➡️
5. Arrêté du 27 décembre 2022 modifiant l'arrêté du 1er juin 2016 relatif aux modalités de surveillance de la qualité de l'air intérieur dans certains établissements recevant du public. ➡️
6. Articles L221-7 à L221-10 du Code de l'environnement. ➡️

Objective of the Law

- Protect the health of children and staff by limiting their exposure to indoor air pollution.
- Monitor and improve indoor air quality in establishments serving vulnerable populations.
- Inform users (students, parents, teachers, staff) of the results.

Establishments concerned

- Daycare centers, kindergartens, primary schools
- Middle schools, high schools.
- Recreation centers

Main obligations for schools

1. Annual assessment of ventilation systems
   - Verification of the operation of windows and ventilation systems.
   - Continuous CO_2 measurement for at least 2 hours in at least one representative room. A single measurement per year is sufficient.
   - Communication of results to users within 30 days.
2. Self-assessment every 4 years
   - Identification of pollutant sources
   - Verification of the maintenance of ventilation systems and aeration equipment
   - Analysis of cleaning practices
   - Analysis of ventilation and protection methods during/after the work.
   - Assessment grids have been published by Cerema
3. Pollutant measurement campaigns
   - Carried out by an accredited organization (after the work or in the event of a problem).
   - Monitoring of pollutants, such as formaldehyde, benzene, and carbon dioxide (CO_2).
   - Must be systematically initiated within 7 months following a key stage in the building's life that is likely to impact IAQ.
4. Action plan
   - By December 2026, each school must have an IAQ action plan.

[7] Kept in the original French because this is official legal language.

- The IAQ action plan must provide an inventory of indoor air quality and list any corrective actions required (maintenance, ventilation, product replacement, etc.)
- Regular update (every 4 years) based on the results of checks and diagnostics.

Reports and parliamentary questions on indoor air quality in schools

Parliamentary reports and official documents from the Senate and the National Assembly on indoor air quality in schools or, more broadly, in public buildings (ERP), including those undergoing renovation:

Parliamentary Reports

- *Ecological Transition of School Buildings: Better Support for Local Elected Officials*
  This is the report of a Senate fact-finding mission on the ecological transition of school buildings. It raises the issues of IAQ in the context of school energy renovation. It highlights in particular the importance of measuring IAQ (with CO_2 sensors) and integrating ventilation into renovation projects. This report encourages the imperative integration of health considerations (healthy indoor air) with insulation and energy efficiency initiatives.

- *Information Report on the Evaluation of Public Policies to Combat Air Pollution*
  This is a report from the Public Policy Evaluation and Control Committee. Although not specifically focused on schools, it addresses educational establishments within the framework of more general public policies on air pollution.

Parliamentary Questions (Written and Oral Questions)

- *National Assembly, Written Question No. 4452 (25/02/2025)*
  Concerns IAQ monitoring in public buildings. Reports on ongoing deployments, but notes the absence of an expected decree.

- *National Assembly, Written Question No. 16908 (9/04/2024)*
  Concerns air pollution to which students are exposed in the classroom (formaldehyde, mould, etc.). Mentions the health impacts and recommends improving air renewal and building quality.

- *National Assembly, Written Question No. 11213 (12/09/2023)*
  Concerns the installation of air purifiers in schools. The Ministry reaffirms the importance of IAQ but does not announce any concrete measures.

- *National Assembly, Oral Question No. 1388 (30/03/2021)*
  Addresses IAQ monitoring in schools, highlighting the recommendations of the High Committee for Public Health for continuous CO_2 measurement.

- *2012 Question – Senate, Written Question No. 02541 (18/10/2012)*
  Concerns indoor pollution in classrooms (formaldehyde, PM2.5, NO_2, etc.). Calls for measures to protect children.

Further Reading

- **Support guide for implementing regulatory monitoring of indoor air quality in certain public buildings.** ➡️
  Cerema published a comprehensive guide, revised in February 2025, structured into seven volumes (introduction, assessment, self-assessment, identification of key steps, practical sheets, etc.), a valuable operational resource for developing and structuring an IAQ action plan in schools.

- **ADEME, through the ECOL'AIR program.** ➡️
  This document offers action sheets and practical guides for educational purposes, but they do not cover all regulatory requirements.

- **Indoor Environment Quality Observatory (formerly the Indoor Air Quality Observatory).** ➡️
  An independent institution that leads measurement campaigns in schools and daycare centers and produces recommendations for improving IAQ.

- **National Observatory for the Safety and Accessibility of Educational Institutions.** ➡️
  This organization publishes annual reports on safety and hygiene, including indoor air. Reporting ended in 2020, but prior reports may offer historical sources.

Regulations and standards on indoor air quality in France

In France, indoor air quality in schools is governed by several regulatory texts and standards.

1. Standards and Recommendations
Public Health France and ANSES are the main reference organizations in France for indoor air quality in schools.

The European Union issues European directives. These directives are legally binding on Member States, which must transpose them into their national law.

The European Committee for Standardization develops European technical standards. These CEN standards are not laws in the sense of directives, but technical references widely used in audits, certifications, and construction projects.

The WHO sets global health guideline values. These are references but are not binding.

In France, the main references are

1. Public Health Code (CSP)
   - Articles R.1311-1 to R.1311-5 stipulate that the indoor air in public buildings, including schools, must protect the health of occupants.
   - Pollutant monitoring and measurement may be carried out if a risk is suspected.
2. Order of April 7, 2016
   - Defines ventilation and air quality requirements in schools.
   - The air must be renewed regularly to maintain acceptable concentrations of pollutants (CO_2, particles, VOCs, etc.).
   - Decree No. 2012-14 of January 5, 2012, relating to the assessment of ventilation systems and the measurement of pollutants carried out as part of indoor air quality monitoring in certain establishments open to the public, amended by Decree No. 2022-1690 of December 27, 2022.
   - Primarily concerns concentrations of chemical and biological pollutants and requires periodic monitoring in sensitive locations.

2. Indicators to be monitored in France

Indicator	**Recommended value / limit**	Comments / Source
CO_2	< 1000 ppm	Public Health France (IAQ guide for schools) + reference to the EN 13779 standard (CEN). This is used as a practical threshold in public buildings (ERPs) (schools).
PM2.5	< 10 µg/m^3 (annual average)	Public Health France aligns with the WHO 2005/2021 guide values for indoor air. There is no strict regulatory value in French law for indoor PM2.5.
PM10	< 20 µg/m^3 (annual average)	Public Health France (recommendation), inspired by the WHO guide values. In law, only the values of European Directive 2008/50/EC apply to outdoor ambient air.
Formaldehyde	≤ 10 µg/m^3	ANSES (indoor air quality guide value, 2007 and updates). Included in national health-environment plans.
Benzene	≤ 5 µg/m^3	ANSES (IAQ guide value, 2008), consistent with the European directive on ambient air.
Toluene	≤ 260 µg/m^3	ANSES (IAQ guide value, 2009). Benchmark based on sensory

		comfort (odor, irritation), not just health.
Relative Humidity	30–70%	Public Health France (IAQ recommendations) + consistency with standard EN 15251 (CEN). Objective: comfort and mould prevention.
Ventilation	≥ 15 m^3/h/person	Public Health Code (decree and order on ERP ventilation) + Public Health France recommendations. Technical reference from standard EN 13779 (CEN), adapted for schools.

Comparative table between French, European and WHO standards

Parameters	France (in schools)	UE (EN 13779 / CEN)	OMS
CO_2	< 1000 ppm absolute	Categories Excellent: <600 ppm above outdoor CO_2 (~1000 ppm absolute) Good: <800 ppm above outdoor CO_2 (~1200 ppm absolute) Acceptable: <1000 ppm above outdoor CO_2 (~1400 ppm absolute)	No strict value, recommends sufficient ventilation to keep CO_2 close to outside air (~400 ppm)
PM2,5 (annual average)	< 10 µg/m^3	< 25 µg/m^3	< 5 µg/m^3
PM10 (annual average)	< 20 µg/m^3	< 40 µg/m^3	< 15 µg/m^3
Formaldehyde	≤ 10 µg/m^3	60 µg/m^3 (24h)	100 µg/m^3 (30 min), 50 µg/m^3 (long term)
Benzene (annual average)	≤ 5 µg/m^3	5 µg/m^3	< 1,6 µg/m^3
Toluene	≤ 260 µg/m^3	No value	No value
Relative humidity	30–70 %	30–70 %	30–60 %
Temperature	19–22 °C (winter) 23–26 °C (summer)	20–25 °C	No value
Ventilation	≥ 15 m^3/h/person	≥ 10–15 m^3/h/person	Based on CO_2, no fixed figure

Improving indoor air quality: a public health issue

We spend 80% of our time indoors, exposed to various pollutants. The COVID-19 pandemic has highlighted the importance of indoor air quality in preventing the transmission of respiratory diseases. Despite available solutions, the indoor air quality in many public places is unsatisfactory. It is urgent that this issue become a global health priority.

Driven by the Geneva Health Forum, the "Improving Indoor Air Quality: A Public Health Issue" initiative aims to:
• Demonstrate the importance of developing concrete public health strategies to combat respiratory-borne diseases and improve indoor air quality.
• Prepare for the adoption of a World Health Assembly (WHA) resolution to make indoor air quality a global public health priority, by guiding evidence-based strategies and actions.

The "2nd European Conference on Indoor Air Quality. French Schools" is an integral part of this initiative.

Supporters of the initiative

SVLW Schweizerischer Verein Luft- und Wasserhygiene

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Geneva Health Forum

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It collaborates with its partners to create synergies to address public health challenges.

Contact us at:
contact@genevahealthforum.com
irene.kostenas@genevahealthforum.com

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