



Development of novel assessments for indoor air quality monitoring and impact on children's health

D8.2 Participatory policy making: situational assessment

LEARN

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Project Details

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Project aim

LEARNing about the status of air quality in schools and its impact on the cognition of children is a major cornerstone in LEARN. For that, we want to overcome the barriers of the currently existing technologies and take a bold step towards developing and deploying novel sensors to detect the presence of possibly harmful air pollutants such as volatile organic compounds and ultrafine particles.

We will measure and characterize indoor and outdoor air pollutants and evaluate the presence of biomarkers of exposure and their effect on children's cognition while trying to recapitulate those effects using *C.elegans* as a biosensor. Moreover, we will use advanced human-based in vitro models of lung and skin coupled with a revolutionary multi-sensing device to investigate their mechanisms of toxicity in real time.

Novel remediation strategies will be explored to improve air quality and promote children's quality of life and life expectancy. For that, we will mobilize a group of eleven leading research teams, unrivaled in their respective fields (environmental epidemiologists, toxicologists, air quality specialists, systems biology, engineers, and citizen/social scientists).

The scientific achievements expected to result from LEARN will unlock a large technology potential in IAQ for decades to come, leading to disruptive societal and economic impacts steaming from a radical improvement in the quality of life of children in Europe.

Project LEARN is part of the European indoor air quality and health cluster.

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The following table describes the main changes done in the document since it was created.

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Executive summary

This deliverable is part of Work Package 8 'Exploitation, Communication and Dissemination', Task 8.2 'Development of participatory policy making processes'. The aim of this task is to set up participatory processes between diverse stakeholders around indoor air quality (IAQ) guidelines and management plans. Through these processes, we aim for fair treatment, meaningful involvement and social inclusion of the most vulnerable populations, and specifically youth, in decision making processes around IAQ.

This first deliverable of the task outlines the methodology for participatory policy making, i.e. the PAR4-P methodology, and its first results. This methodology consists of five different phases: (1) problem definition, (2) stakeholder mapping, (3) participatory action I, (4) participatory action II and (5) formulating guidelines. The results of phase 1 and 2 are reported in this deliverable, and the final results of phase 3 to 5 are reported in the consecutive deliverable.

For phase 1 'problem definition', a situational assessment was conducted through a literature and policy review of IAQ guidelines and directives on the global, European and national level. The situation assessment specifically looked for notions and guidelines in the texts for vulnerable groups, specifically for children, and indoor air quality in school environments. The results of the situational assessment are reported in Chapter 4.1. Furthermore, the three pilot partners, i.e. UHASSELT (Belgium), Aarhus Universitet (Denmark) and Envirometrics (Greece) conducted a first stakeholder mapping. The identified stakeholders will be invited for the further phases on the PAR4-P methodology and will be involved through two co-creative workshops. The results are reported in Chapter 4.2.

The outcome of this task will further serve as inputs for task 8.4 "Policy recommendations for IAQ monitoring and standards", led by NIA. In task 8.4, a final workshop with policy makers will also be organised. As such, we guarantee that various efforts are taken to effectively involve all stakeholders in the formulation of guidelines for indoor air quality management in school environments.

1. Introduction

Good indoor air quality is an essential component for a healthy school environment. It affects the human health and well-being, and good air quality can result in reduced absence rates, improved test scores and overall productivity of pupils. It may also affect the performance, alertness, ability to concentrate and the comfort of pupils and teachers (Sadrizadeh et al., 2022). Children breathe in more air per unit weight, they breathe more often through their mouth, and they are more sensitive to moisture. Their vulnerability is thus higher than adults. The health symptoms caused by indoor pollution are non-specific symptoms rather than well-defined diseases. Such symptoms may include eye, nose, throat, and skin irritation, coughing and sneezing, headaches, and fatigue, etc.

The indoor environment in a school building is a complex system involving many parameters that can affect health, e.g., there are several spaces used for different purposes and with different requirements related to heating and type of ventilation. Overall, the major sources for pollution in a school building are related to (i) outdoor pollution due to traffic and industrial activities that enter the school building, (ii) school building materials and furnishings, (iii) the technical processes that occur within school buildings, such as heating, ventilation and (iv) the behaviours of the school building occupants themselves, such as usage of cleaning products, chalk, cooking, etc. Overall, it should also be noted that still a large part of the school buildings in Europe are quite old and need to be renovated to comply with the latest energy-performance requirements set by the EU (Kephalopoulos et al., 2014).

There are several measures that can be taken to improve the indoor air quality at school, ranging from implementing guidance on ventilation requirements for school buildings, air pollution source management (with e.g., strategies of source removal or substitution), better guidance on exposure control strategies, and awareness raising through education and communication. Overall, the awareness around the need for proper ventilation, with national and international guidelines, has increased since the start of the COVID-19 pandemic (World Health Organization, 2021).

The approach taken in Work Package 8 is to raise awareness among the school building occupants about the causes and effects of indoor air pollution as well as mitigation strategies. In this context, an educational toolkit is being developed (in collaboration with T8.1) and this deliverable specifically focusses on involving the school occupants on indoor air problems through a participatory approach. By effective listening and setting up collaborative processes, the school occupants will be involved in participatory policy making processes for healthy indoor school environments. Their current situation, concerns and problems will be discussed, and based on the results of the clinical trial it can help in establishing a specific indoor air quality management plan¹ at the local school with help of ventilation mechanisms developed in this project.

¹ American example: [Indoor air quality plan](#) with actions kits for schools with a coordinator guide, checklists, etc. that can be used by school administrators, designers, construction and facility managers

2. Methodology

This chapter outlines the methodological framework for Task 8.2, which is implemented and reported throughout this and the consecutive deliverable.

3.1 Participatory Action Research

Participatory Action Research (PAR) encompasses a range of participatory approaches to action-oriented research that have particularly emerged since the 1990s (Kindon et al., 2007). It is an approach that differs significantly from traditional, positivist science (See Table 1 "Distinct features of PAR" based on Baum, 2006). To put it simply, it is a collaborative process of research, education and action aimed at co-creating knowledge and social change (Chevalier & Buckles, 2019; Cornish et al., 2023; McTaggart, 1997). It typically involves collaboration between a community with lived experience of a social issue, marginalized and vulnerable groups, and professional researchers. Together they collaborate in a joint research endeavour to tackle problems caused by unequal and harmful social systems with the purpose to change something. PAR projects can produce actions across a wide range of scales, small or large-scale, or structural actions for change. What counts as action and change is different for each project, e.g., examples are policy reforms, influencing policy makers through artistic works, institutional or systematic societal changes, empowering participants through sharing experiences, mobilizing collective action, etc.

Distinct features of PAR

- Focuses on research with the purpose to enable action. This is realized through a cyclical process of research, reflection, and action.
- Participants are actively involved in the research process: they select the research topic, collaborate in the data collection and analysis, and decide on the actions as a result from the research findings. The degree of participation in the research process is defined at the start of the project.
- Shared power and deliberation between researchers and the participants.

Table 1: Distinct features of PAR (based on Baum et al. (2006)).

Central to PAR, is the **cyclical process of research, reflection and action** throughout the research project. Researchers and participants initiate research that trigger relevant actions. After implementing the actions, lessons are learned, which can lead to a new cycle of research, action, and reflection. During this process, flexibility is adapted by researchers and participants in order to be responsive to learnings and adjust plans accordingly. This iterative cycle of action and reflection can enable a more diverse and contextually rich theory building (Pain et al., 2007) and can eventually result in change (Liebenberg, 2018). As such, PAR is not a research process to generate knowledge for scientific processes, but rather a process for generating 'knowledge-for-action' and 'knowledge-through-action' in service of specific communities (Cornish et al., 2023).

The methodologies used throughout these research processes are diverse, and most often include qualitative methods, such as storytelling, interviewing, ethnography, group work and discussions, collaborative analysis, etc. (Kindon et al., 2007).

At the start of the research project, it is important to establish **common working practices** among the researchers and participants, e.g., what are the implementation roles, how will meetings be structured and chaired, what means of communications will be used, etc. The project's aim and research questions should be commonly defined and, if required, necessary training should be provided by professionals for collecting and analysing data with the participants (Cornish et al., 2023) in order to enable full participation in the research as the participants need to be aware and understand the process. Researchers need to find ways of sharing information that is necessary to make informed decisions and move between an in-/outbound positionality. A participation continuum might be present in the research project, whereby various degrees of participation might be valid at different times. This continuum should be negotiated with the participants, who might not desire full participation in all stages of the research process (Kitchin, 2001).

Overall, PAR should be a **collaborative approach** to research and learning. If effectively executed, the process of PAR should be empowering for the participants and lead to increased control, reduced inequalities, and less power differences in access to resources (Labonte, 1994). By including community perspectives into the research, it certainly strives to be more democratic, build capacity and encourage self-determination (Baum, 2006). In this respect, PAR can be applied in a huge **variety of contexts**, such as in health-care research with people in poor health to improve their situation, in environmental sciences in order to support communities to take action to protect their environments, in youth studies for empowering the voices of young people, in community psychology – and specifically for social issues related to social identity, gender, class, sexual orientation, etc.

In the next sections, we investigate PAR for policy development, specifically for the context of indoor air quality and health guidelines in school environments with young people.

3.2 Participatory Action Research for Policy Development

Within PAR, a wide set of participatory techniques can be used to collect information and gather knowledge. In the LEARN project, we will apply the methodology of **Participatory Action Research for Policy Development**, or short the **PAR4P-method**. We define PAR4P as *the inclusion of citizens and/or organisations in a participatory approach for (re)-defining problems and formulating solutions with an eye on achieving more sustainable policy making*. The added 'P' expresses thus the explicit intent to conduct research for actions related to policy development, such as informing and influencing policy makers, formulating policy recommendations, wide dissemination of policy guidelines, etc. This methodology is being developed by the VUB, research group imec-SMIT, and is being used in various policy domains, such as in media and communication, mobility, urban greening, digital policies, etc. (cfr. Laenens et al., 2019; Van Leeuwen et al., 2022).

The PAR4P-method is a mixed-method approach, with specific methods such as stakeholder consultations, interviews, policy analysis, brown paper method, focus groups, etc. Through collaborative learning and action, PAR4P aims to deepen participation in policy development and, if participants desire, take specific actions towards policy change.

The overall methodological framework will be operationalized by VUB and implemented in the three pilot locations. Therefore, VUB will provide specific support online and on-the-ground to the pilots in Belgium (UHASSELT), Denmark (Arhus University) and Greece (Envirometrics). The PAR4P-method will be implemented through five phases:

- (1) **Problem definition:** In this phase, the issue is being identified and defined: what is the scope of the problem? Who experiences the problem? What are the causes? In the LEARN project, a problem definition around indoor air quality in school environments will be researched and described by the VUB. Therefore, a literature and policy review are conducted, as described in Chapter "3.2.1 Situational assessment". The outcome of this phase is reported in this deliverable, in Chapter 4.1.
- (2) **Participants identification:** In this phase, the individuals affected by the issues are identified. In the LEARN project, the pilot partners perform a stakeholder mapping, as described in Chapter 3.2.2 Stakeholder mapping. The outcome of this phase is reported in this deliverable, in Chapter 4.2 Identification of stakeholders.
- (3) **Problem re-definition:** In this phase, the participants identified in phase 2 are invited for the first participatory action: to what extent are participants experiencing the problem, and/or do they wish to re-define the problem? If so, how and with what consequences? The outcome of this phase is reported in the consecutive deliverable of Task 8.2.
- (4) **Solutions identification:** In this phase, the same participants identified in phase 2 are invited for a second participatory action: desirable and achievable solutions are identified for solving the problem, together with the (policy) actor that can carry on the activity. The outcome of this phase is reported in the consecutive deliverable of Task 8.2.
- (5) **Solution formulation:** In this final phase, the formulated solutions are put into practice, and a concrete scenario is drafted. Researchers and participants

also reflect about future potential research projects, and further learnings. The outcome of this phase is reported in the consecutive deliverable and will further serve as inputs for Task 8.4 "Policy recommendations for IAQ monitoring and standards". In Task 8.4 a final workshop with policy makers will be organised.

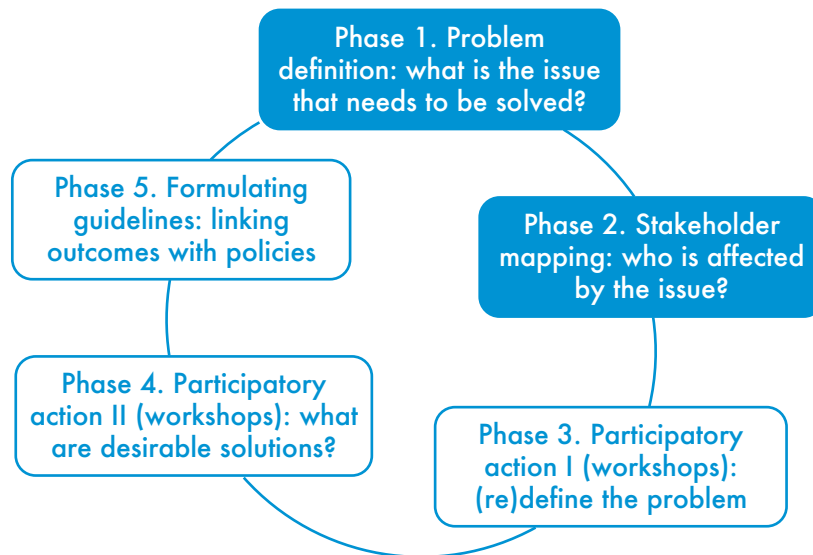


Figure 1: PAR4P-method: Phases 1 and 2 are reported in this deliverable, phases 3-5 in the consecutive deliverable.

3.2.1 Situational assessment

For the situational assessment, i.e. the definition of the problem, a quick scan analysis of existing policy documents on indoor and outdoor air quality was performed. The following selection criteria were applied for searching policy documents: (1) global, European, or national policy documents in the countries case studies were held in (Belgium, Greece, and Denmark) on indoor and outdoor air quality, (2) air quality guidelines related to specific indoor air pollutants. The pilot sites helped in searching and identifying the relevant documents. If policy documents were not available in English, then these were translated using the online translation system [DeepL Translator](#). A full list of the reviewed documents is available in Annex I.

For the analysis of the policy documents, we used the methods of "**quick scanning**" and "**close reading**". The quick scan analysis is a fast and systematic way of identifying a set of relevant elements within a large body of text (Lordache et al., 2017). Based on the scope of the project and this specific task, i.e., the inclusion of schools' occupants in the formulation of guidelines for a healthy indoor environment, we identified four relevant categories of indicators to investigate in the policy documents:

Table 1: Categories of coding in the policy documents.

Target groups	Context	Susceptibility	Policy
• Child(ren) • Young people	• School • Indoor • Outdoor • Ambient	• (Environmental) equity • Justice • Vulnerable • Susceptibility • Sensitive • Low socio-economic • Socio-demographic	• Interventions • Awareness raising, communication and education

In a second step, a close reading was conducted on each retrieved text segment. The method of close reading is useful for capturing underlying meanings (Schur, 1998). Each retrieved segment, after having been assessed for relevance, was then analysed to provide an overview of the situation of indoor air guidelines for school environments in the specific pilot locations.

More specifically, the analysis of the documents focused on:

- An analysis from social sciences perspective: awareness raising, and communication guidelines were retrieved.
- Gaining better insights into the objectives of these documents, and specifically the directives and guidelines for school environments and vulnerable groups, such as youth. As such, the scoping review is **not** focussing on technical descriptions of the methodologies, but rather on **how the different directives and guidelines are paying attention to the inclusion of vulnerable groups, specifically children, in a school setting.**
- Assess if current policies are sufficiently feasible and innovative to deal with current IAQ challenges in school environments.
- Compare the air quality directives and guidelines across the three pilot countries and assess the situation to identify opportunities for improvement for healthy school environments.

3.2.2 Stakeholder mapping

For the stakeholder mapping, each pilot country was requested to identify stakeholders who have an interest in policy-making processes around indoor air quality for school environments. In total, a minimum six and maximum 10 stakeholders dealing with indoor air quality and healthy school environments were identified. These stakeholders were classified in the categories: society, academia, public sector, and private sector:

- **Societal stakeholders:** representative of a parent committee, community-based organisation working in the domain of indoor health, a neighbourhood association working on the topic of climate change, individuals such as concerned parents, interested neighbours, etc.
- **Academia:** university-based researchers in disciplines such as health, bioengineering, etc.
- **Public sector:** local policy makers in the domain of health, environment, mobility, urban planning, etc., working groups on indoor air quality.

- **Private sector:** facility managers of the school, designers and architects, ventilation specialists, etc. (which might also be regarded as 'public', if working in consultation for a public school).

The pilots were requested to recruit diverse profiles and to keep a balance between the categories of stakeholders, with societal stakeholders as the most important.

3.2.3 Participatory action I & II

During phase 3 and 4 of the PAR4P-method, workshops will be organised at each pilot location. In total, two interactive workshops will take place per pilot location, with minimum of six to a maximum of ten participants. The participants will be offered a voucher of 15 euros per workshop (in case they are allowed to), and/or a free LEARN educational toolkit.

The first workshop will take place at the start of the clinical trial. This workshop has the objective to discuss the findings of the situational assessment with the stakeholders and to (re)define the problem. The results will be presented to them in an interactive and accessible format, and stakeholders will be able to share their perspectives on it. During the discussion, gaps, opportunities, and challenges related to indoor air quality management in school environments will be collected. A draft invite is provided in Annex II – Draft invite for the workshops.

The second workshop will take place at the end of the clinical trial with the same participants (if possible). During this workshop the results of the clinical trial will be discussed with them, and together solutions will be formulated for improving indoor air quality in school environments, and the health and well-being of children.

The workshops will be organised in collaboration with Work Package 7, in specific Task 7.3 "FAIR data principles adaptation and ethics". As such, efforts will be combined into one workshop.

3.2.4 Formulating guidelines

Based on the outcomes of the second workshop, guidelines will be formulated that can be linked with existing policies on indoor air quality management. The outcomes will be shared and discussed with policy makers in the field (cfr. Task 8.3). Overall, it can be discussed whether national policies are sufficient, or if specific actions plans are necessary for school environments. For the latter, the [Indoor Air Quality Tools for Schools Program](#) of the Environmental Protection Agency in the U.S. can be regarded as an example. This program helps teachers, school nurses, administrators, and other relevant school-based professionals to develop and implement good IAQ practices in schools. It helps to identify and resolves IAQ issues and prevent future problems. A model plan is involved to help establishing an appropriate policy for individual schools, or on district level. Together with the involved stakeholders in the workshops, the solutions will be collaboratively defined.

4 Results

This chapter presents the results of phase 1 and 2 of the PAR4P-method. Phase 1 focusses on the situational assessment with the quick scan analysis of directives and guidelines for indoor and outdoor air quality, the second phase presents the stakeholder mapping.

4.1 Phase I – Situational assessment

4.1.1 WHO guidelines

Global air quality guidelines

The World Health Organisation (WHO) has published a series of guidelines related to air quality. These **air quality guidelines** are evidence-based, and *non-binding* recommendations for protecting public health from the adverse effects of air pollutants. National and local authorities can be *guided* by these recommendations in their risk management decisions. Unlike an air quality guideline, **air quality standards** are enforceable. Air quality standards are '*the acceptable levels of air pollution, in terms of potential impact on public health and the environment that are adopted by a regulatory authority as enforceable standards*' (World Health Organization, 2006). In the EU, they are often referred to as limit values, or as national ambient² air quality standards. They act as regulatory instruments that specify how to monitor, evaluate, and comply with the regulatory standard. In the formulation of an air quality standard the measurement technique and standard should thus be included, as well as the data handling procedures including quality control and statistics from the measurement to compare with the standard. In defining the air quality standards, the decision makers will be faced with questions about the types of pollutants, who should be protected, and what level of risk is acceptable. Air quality standards should protect the general population, and some governments state that standards should also protect specific sensitive or vulnerable population subgroups. It is thus up to decision-makers to evaluate the evidence and decide who should be protected by air quality standards.

For the indoor environment, the [WHO 2005 guidelines](#) outline potential policy actions and interventions that can be taken, i.e. in the definition of air quality standards and guidelines, in source control and dilution control (in building codes and ventilation regulations, regulating on consumer products, smoking restrictions), through information and education (ventilation, smoking, heating, cooking, etc.) and market-driven instruments (e.g. bans or labelling of products) (World Health Organization, 2006). The most important micro-environments for indoor air pollution exposure are defined as those where people spend the majority of their time, and include home, places of work, schools and traffic corridors, while the main sources of indoor air pollution are combustion of solid fuels, tobacco smoking, outdoor air pollutions, emissions from construction materials and furnishings, and improper maintenance of ventilation and air conditions systems. The focus of the WHO 2005 guidelines for indoor air pollution mostly lies on the definition of guidelines for developing countries, whereby the usage of traditional fuels, such as biomass, charcoal and coal are being discussed. Hereby, the usage of solid fuels in open or

² Ambient air pollution is the air pollution in the outdoor environment, that is, in outdoor air, but which can enter or be present in indoor environments (World Health Organization, 2021a)

poorly ventilated stoves can lead to a high concentration of particulate matter (PM) and gases.

In the [WHO 2021 guidelines](#), an update was released on the air quality guidelines with interim targets. Between the release of the guidelines and 2005 and 2021, new epidemiological studies have documented the adverse health effects of exposure. The update of these guidelines are not legally binding standards. However, they provide the WHO member states with an evidence-informed tool that can be used to inform national legislation and policy. The levels were defined based on evidence assessed as having high or moderate certainty of an association between a pollutant and a health outcome (See Table 2). The guidelines do not include recommendations about pollutant mixtures or the combined effects of pollutant exposures, neither recommendations on location or individual specific policies or interventions (World Health Organization, 2021).

The guidelines are both applicable for both indoor and outdoor environments, but are not applicable to occupational settings³. In this 2021 edition, it is mentioned that indoor air pollution is mostly generated by combustion sources, such as cooking and heating with polluting fuels, and using candles, incense, and kerosene lamps. Tobacco smoking is also listed as a significant source, as well as sources and processes that generate volatile and semi-volatile organic compounds, such as renovation of houses, usage of cleaning products, pesticides, electric devices such as laser printers. Another significant source, specifically for school environments, is dust resuspension due to human movement. Last, it is also mentioned that indoor air pollution can be caused by outdoor air pollutants that are brought indoors in the processes of ventilation and penetration.

Table 2: Air quality guidelines WHO (edition 2021).

Pollutant	Averaging time	Air quality guideline – WHO
PM _{2.5} , µg/m ³	Annual	5
	24-hour	15
PM ₁₀ , µg/m ³	Annual	15
	24-hour	45
O ₃ , µg/m ³	Peak season	60
	8-hour	100
NO ₂ , µg/m ³	Annual	10
	24-hour	25
SO ₂ , µg/m ³	24-hour	40
CO, mg/m ³	24-hour	4

³ Due to the specific characteristics of the relevant exposures and the potential differences in population susceptibility of the adult workforce in comparison with the general population (guidelines 2021, p. 55)

Apart from the general guidelines, WHO has also published specific series of guidelines for indoor air quality which provide recommendations on a selected set of pollutants:

- **WHO guidelines for indoor air quality: dampness and mould (published in 2009)**

In this edition, indoor air pollution from dampness, mould, chemicals, and other biological agents are mentioned as a major cause of morbidity worldwide, and especially among women and children in low-income countries. Research studies are mentioned that dampness is more likely found in houses which are overcrowded, lack appropriate heating, ventilation and insulation; which have a higher prevalence among households with a low education level. Dampness is associated with a wide range of respiratory infections, such as asthma, wheezing, coughing, respiratory infections, etc. In the report, many studies are mentioned that report health effects on children, such as asthma development. School environments are also mentioned to have similar health risks associated, although no systematic surveys have been conducted at that point in time to assess the prevalence of dampness and mould in schools (World Health Organization, 2009).

- **WHO guidelines for indoor air quality: selected pollutants (published in 2010)**

This edition focusses specifically on indoor air quality management and health risks associated with benzene, carbon monoxide, formaldehyde, naphthalene, nitrogen dioxide, etc. Since people spend a lot of their time in buildings, including also special environments such residences, day-care centres and retirement homes, this edition provides a uniform basis for the protection of human health from adverse effects of indoor pollution. Specifically for school environments, it was for instance found that the distance between buildings from roadways and traffic density appear to have a significant impact on indoor nitrogen dioxide levels. The presence of a gas heater was also found to have a significant influence on lower respiratory symptoms and school absence (World Health Organization, 2010, p.223).

- **WHO guidelines for indoor air quality: household fuel combustion (published in 2014)**

This edition is mostly focussed on the combustion of solid fuels for cooking and heating, such as wood, animal dung, charcoal, crop waste and coal, in low-income countries. The burning of solid fuels leads to premature deaths among children and adults and another health risks, such as lung cancer, child poisoning, respiratory infections, asthma, etc. (World Health Organization, 2014).

Environmental equity

The WHO global guidelines clearly pay attention to the susceptibility of vulnerable groups to air pollution exposure. In their 2005 guidelines the concept of '**environmental equity**' is introduced and refers "**to principles of social justice that promote the equitable distribution of the burdens and benefits of society**" (World Health Organization, 2006). Several studies are described in their guidelines that showcase clear evidence for inequities among the population in adverse health effects due to air pollution. It has been widely noted that persons with a **lower socio-economic profile** may experience a disproportionately higher health burden caused

by air pollution. It may be explained by inadequate nutrition, limited access to health care, psychological stress, exposure to indoor air pollution, smoking, educational attainment, exposure to factors at the workplace, etc. There is also evidence that there is a link between the spatial distribution of pollution sources and the presence of certain population subgroups. The evidence suggests that people who live, attend school and/or work near local sources such as traffic may be more exposed, and tend to have a lower socio-economic profile. These groups may be more responsive to air pollution and often have a lower baseline level of health (World Health Organization, 2006). Other populations at risk who are more likely to experience higher exposures and are most susceptible to it include **young children, the elderly and the immunocompromised**.

Consequently, the principles of social justice introduce an **ethical component** into **air quality management**. Considerations of environmental equity may arise in air pollution policy contexts, such as in the enforcement of air quality management plans, land-use regulations, the assessment of health impacts, and air quality standards itself. Hereby, they put the priority on reducing exposures and risks for populations living, learning and working close to concentrated traffic and other local resources. For instance, **hotspots**, which are areas within a city where long-term average concentrations of one or more pollutants are consistently higher than in other areas, are especially relevant to address. These areas have a disproportionate burden and are often affected by socio-economic factors.

The WHO global 2005 guidelines state that especially at the **local level** there is room for incorporating environmental equity into standards implementation, land-use planning, transportation, and urban planning. Policies and programmes related to environmental equity are best communicated and coordinated with diverse actors and affected communities, such as with agencies that are charged with protecting health or the environment, housing, transportation, etc. For the protection of vulnerable groups, research studies can look specifically into the response to pollutant exposures, or through a conservative review and interpretation of the evidence to ensure adequate protection. Furthermore, considerations of environmental equity can be considered in the development of policies for the control of air pollution sources. This may include emission limits, air standards and risk assessments. In the edition of 2005, it is mentioned that environmental equity has not been typically part of air pollution risk assessment due to the coarse spatial scales at which air quality models typically operate. In most cases, this also means that **a single concentration response function** is used to determine the adverse health outcomes, regardless of the socio-economic or demographic variables of the population (World Health Organization, 2006). Further research is needed to enable emerging environmental equity data to be incorporated into air pollution guidelines, and also policy actions.

In the next global edition of the WHO guidelines, i.e. the edition published in 2021, environmental equity and also health equity are points of attention (World Health Organization, 2021a). Again, it is stressed that issues of environmental equity, that affect disadvantaged segments, may be accounted for when deriving air quality standards. However, this edition is **more careful in claiming that interventions** deliver reduced health inequalities. Indeed, some studies have demonstrated a successful result in reducing air pollution in urban areas, but only a few studies have reported results on equity. The studies are also less straightforward to interpret, with mixed results; with more, equal, or less good-off counterparts for vulnerable groups.

The updated WHO global air quality guidelines of 2021 are based on serious health effects in a general population (including vulnerable and sensitive groups). They are designed to serve as a global reference for assessing whether, and how much, exposure to various levels of the considered air pollutants result in health concerns. When using the WHO air quality guidelines as a starting point, the development of standards involves the considerations of various aspects. They give the freedom to the national and local authorities to define (i) which pollutants should be regulated, (ii) the adverse health effects against which the population needs to be protected, (iii) what level of risk and costs are acceptable, (iv) what uncertainties remain in the evidence based, (v) the feasibility of complying with the proposed standards and (vi) which individuals or subgroups are the most at risk. The definition of susceptible populations or groups in the air quality standards will thus differ, since these will differ across countries – and are linked with other influencing factors such as the quality of health care, lifestyle factors, economic aspects, etc. It is thus a political choice to adopt a rigorous standard, one that it is designed to account for individuals or populations who might be more susceptible to the effects of air pollution, such as children, older adults, people with a lower health profile, etc.

Specific types of **interventions** are recommended in the WHO global guidelines of 2021 for protecting the population: (1) **early warning systems** set up by the relevant authorities to inform the general population and also specifically vulnerable populations about behavioural measures to minimize the risk of exposure, (2) **broad dissemination of alerts** of the early warning system through media, website, social media dedicated smartphone apps, etc; (3) the involvement of **health professionals** who can rapidly identify susceptible individuals for disseminating alerts (e.g. messages that may appear are: stay indoors, follow asthma plans, refrain from exercise, etc.) and raise awareness (e.g. actions to reduce exposure, explaining the risks, etc.). The table below summarizes the main interventions, both on the national and local level:

Overview of potential interventions to promote environmental equity

National level:

- Emission limits for vulnerable groups
- Air standards for vulnerable groups
- Risk assessment of vulnerable groups
- Early warning systems and short-term air pollution actions plans
- Broad dissemination of alerts

Local level:

- Standards implementation for vulnerable groups
- Siting decision, transportation and urban planning: with priority on reducing exposure and risks for vulnerable groups living, learning, and working close to concentrated traffic and other local sources
- Involvement of health professionals to identify susceptible groups and raise awareness

4.1.2 The European Ambient Air Quality Directives

Based on the standards, guidelines and programmes of the WHO, the EU has developed the "The Ambient Air Quality Directives" for 12 pollutants. These directives define common methods to monitor, assess and inform on ambient air quality in the EU, and establish objectives to avoid, prevent and reduce harmful effects on human health and the environment. The most important directives are:

- **Directive 2008/50/EC on ambient air quality and cleaner air for Europe**
This directive lays down measures for the member states, in recommended "air quality plans", for ambient air quality (outdoor air in the troposphere) to attain the limit values or target values, excluding the workplace. Together, the directive aims at harmonizing the methods for air quality monitoring and assessment. It is requesting the establishment of a network of measurement stations and sampling points, and establishment of air quality zones. Furthermore, member states should ensure that air quality information is made available to the public, and that good air quality is maintained or improved when it is not good enough. Article 23 of the directive stipulates that if in the event of exceedances of the limit values for which the attainment deadline is expired, air quality plans of the member states should set out appropriate measures, so that the exceedance period is as short as possible. The air quality plans may additionally include specific measures aiming at the protection of sensitive population groups, including children. It is requested that these (short-term) air quality plans are made available to organisations representing the interests of sensitive population groups, or other relevant health-care bodies to inform them on the implementation of these plans, as well as the feasibility of the content. Furthermore, in article 26 of the directive, the members states are requested to adequately inform the public as well as appropriate organisations about the air quality plans. The information should be made available free of charge by means of any easily accessible media format and containing information on e.g., information on limit values, target values, information thresholds, alert threshold, effects of the exceedances, specific measures taken to protect the health of children or other sensitive groups etc. The directive does not mention anything in particular for school environments but does pay attention to children as a vulnerable group.
- **Directive 2004/107/EC** relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air. In this directive, there is also a specification to reduce pollution levels to minimise harmful effects on human health and paying particular attention to sensitive populations. Member states are also requested to ensure that clear and comprehensible information is accessible on these types of pollutants and send to organisations representing the interests of sensitive populations. The directive does not specify anything for school environments.

- Commission Directive (EU) 2015/1480 amending several annexes to Directives 2004/107/EC and 2008/50/EC (no amendments for sensitive populations).
- 2011/850/EU: Commission Implementing Decision of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality (no amendments for sensitive populations).
- EU Directive 2009/125/EC on the Eco-design requirements for ventilation units: This directive sets energy efficiency and environmental performance requirements for ventilation systems, which indirectly impacts indoor air quality. There are no specific amendments for sensitive populations or school environments in the directive.

Currently in preparation, there is an ongoing revision of the ambient air quality directives; with the ambition to align more closely with the air quality standards of the WHO (guidelines of 2021). The European Environment Agency made a comparison between the EU standards and the WHO guidelines. In general, the WHO sets stricter values than the ones agreed in the EU (See Table 3).

Table 3: Comparison between the EU Air Quality Directives and the WHO Air Quality Guidelines (source: European Environmental Agency)

Pollutant	Averaging period	EU Air Quality Directives			WHO Air Quality Guidelines					
		Objective	Concentration	Comments	Concentration				Comments	
					Interim targets				Reference level	
					1	2	3	4		
PM ₁₀	24-hour	Target value	50 µg/m ³		75	50	35.3	25	15 µg/m ³	95th percentile (i.e. 3-4 dec. Days/year)
PM ₁₀	Annual	Limit value	25 µg/m ³		35	25	15	10	5 µg/m ³	
PM _{2.5}	Annual	Indicative limit value	20 µg/m ³							
PM _{2.5}	24-hour	Limit value	50 µg/m ³	Not to be exceeded on more than 35 days/year	100	100	75	50	25 µg/m ³	95th percentile (i.e. 3-4 dec. Days/year)
PM _{2.5}	Annual	Limit value	40 µg/m ³		70	50	35	25	15 µg/m ³	
O ₃	Max. daily 8-hour mean	Target value	120 µg/m ³	Not to be exceeded on more than 25 days/year (averaged over 3 years)						
O ₃	Max. daily 8-hour mean	Long-term objective	120 µg/m ³							
O ₃	8-hour	Target value			100	100	—	—	100 µg/m ³	95th percentile (i.e. 3-4 dec. Days/year)
O ₃	Peak season *	Target value			100	75	—	—	60 µg/m ³	
NO ₂	hourly	Limit value	100 µg/m ³	Not to be exceeded on more than 18 hours/year					100 µg/m ³	
NO ₂	Annual	Limit value	40 µg/m ³		40	30	20	—	20 µg/m ³	
NO ₂	24-hour	Target value			120	90	—	—	25 µg/m ³	95th percentile (i.e. 3-4 dec. Days/year)
NO ₂	hourly	Limit value	100 µg/m ³	Not to be exceeded on more than 24 hours/year						
NO ₂	24-hour	Limit value	125 µg/m ³	Not to be exceeded on more than 3 days/year	125	90	—	—	40 µg/m ³	95th percentile (i.e. 3-4 dec. Days/year)
CO	Max. daily 8-hour mean	Limit value	10 mg/m ³						10 mg/m ³	
CO	24-hour	Target value			7	—	—	—	8 mg/m ³	95th percentile (i.e. 3-4 dec. Days/year)
CO ₂	Annual	Limit value	5 ppm						5.7 ppm	Reference level
BaP	Annual	Target value	1 ng/m ³	Measured as content in PM ₁₀						
Pb	Annual	Limit value	0.5 µg/m ³	Measured as content in PM ₁₀					0.5 µg/m ³	
As	Annual	Target value	6 ng/m ³	Measured as content in PM ₁₀					6.5 ng/m ³	Reference level
Cd	Annual	Target value	5 ng/m ³	Measured as content in PM ₁₀					5 ng/m ³	
Al	Annual	Target value	20 µg/m ³	Measured as content in PM ₁₀					25 µg/m ³	Reference level

In the [proposal](#), the EU wants to set zero pollution targets for air by 2050, and will reduce the annual limit value for fine particulate matter (PM_{2.5}) by more than half. The revisions also foresee a regular review of the air quality standards, which are in line with the latest scientific evidence. Furthermore, it will improve the legal framework, providing more clarity on access to justice and better information to the public on air quality. It will merge the two directives into one to clarify and simplify the rules. It aims to minimise the harmful effects on human health, and to pay particular attention to sensitive populations and vulnerable groups. In comparison with the directives, the proposal consequently uses the terms 'sensitive populations and vulnerable groups'. The proposal does not mention anything specific for school environments.

From the listing of the above-mentioned directives, it is clear that the focus is specifically on ambient air, and not on indoor air. There is no specific reference directive on indoor air quality in European legislation, or for school environments. There are related initiatives and documents which lay down harmonized conditions for monitoring, e.g., the [Parma Declaration](#) (preventing disease through improved outdoor and indoor air quality, with healthy indoor environments in childcare facilities, kindergartens, schools, etc.), the CEHAPE programme (Children's environment and health action plan) to develop and implement national plans and policies to reduce the burden of disease among children caused by environmental risk factors and for which indoor and outdoor air pollution is a key pillar, European standards such as the [CEN European standard EN 16798-1:2019](#) on the assessment of the overall indoor environmental quality, this standard provides a framework for assessing multiple aspects of indoor environmental quality, including air quality (CO₂ measurement), lighting, and temperature, and noise levels for school environments, and the ISO 16000 series for IAQ. However, currently, there is no European indoor specific harmonized reference values for school environments, although in some member states there are specific legislations for each pollutant and the relative reference ISO standards to be used (Settimo et al., 2020).

Risk communication of ambient air pollution in Europe

Under the umbrella of the Sharing Knowledge on Air Pollution and Health in Europe project, a [review](#) of air quality indexes and general risk communication practices from 37 countries took place (Cromar & Lazrak, 2023). Their report highlights that there is a high variety in how air quality risks are reported to the public in the European region, with most member states using a country-specific indexes instead of the European Air Quality Index (EAQI).

The quality of health messages, accompanying the index values, are widely varied across the European members. Some good examples were found that provide information on the affected subpopulations, with a description of symptoms likely to be experienced and with specific recommendations on how to reduce exposures and health risks. Given the wide range of pollutant concentrations and risk observed, the report states that it is critical to provide tailored health messages.

In the report there are no specific mentions about risk communication about indoor air pollution specifically or for school environments, however, there are a few examples of health messages focusing on vulnerable groups. In this respect, the Georgian health messaging system (See Figure 2) is being put forward as a good example of informing sensitive populations (e.g., for people with asthma). They provide recommendations to change behaviours based on the index level and the specific pollutant. Another good example that is being put forward is the detailed health messaging system in Iceland for SO₂, which is mainly due to volcanic activity. The system provides recommendations for three group of sensitive individuals along with information on symptoms, and specific guidance on behaviour (e.g., turning off the ventilation system).

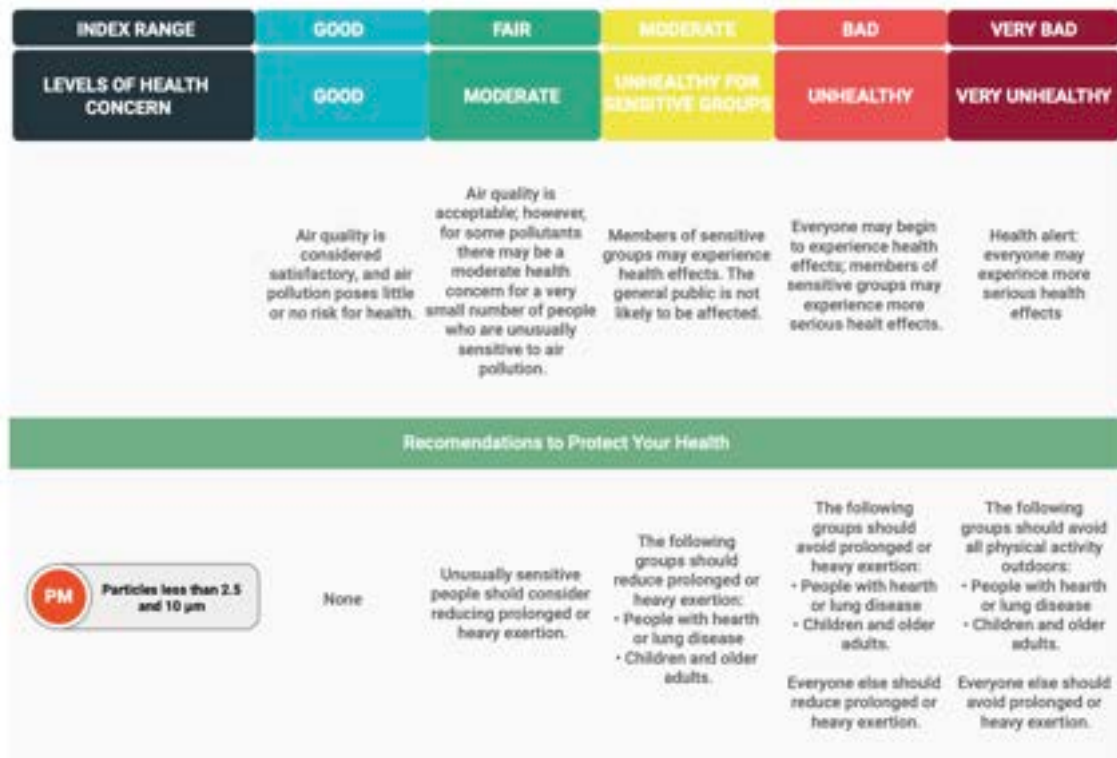


Figure 2: Health messaging system of Georgia (Cromar & Lazrak, 2023)

Proposal – Guidelines for healthy environments in European schools

Based on the work within the SINPHONIE project, funded by the European Parliament and supported by the Commission, a framework for healthy environments within European schools was developed. Their [report](#) is being put forward as a basis to support the potential development of an EU coordinated programme for a healthy school environment, and to enrich and enforce existing national and local guidance. The document is specifically targeting policy makers at the national and local level, as well as school-building designers, managers, schoolchildren, their parents, teachers, and school staff. It is hereby advised that readers should first consult their relevant national guidance and then use this report to access supplementary information.

In the report, it is highlighted that policy measures for healthy environments in schools differ by country. Some countries do not have policy measures in place, in other cases the scope and level of detail of these measures differ. Some of the policy measures in place are also not directly related to improved IAQ in schools, e.g., they deal with hygiene measures to take care of cleaning practices, food safety, etc. Others have more technical measures in place that are related to the design of the school buildings, e.g., about the mechanical ventilation. France and Germany are hereby mentioned as examples of good practice, having specific guidelines and recommendations on IAQ for schools in place.

The report makes the following recommendations to establish an effective policy:

- Make it part of a comprehensive, internally and externally consistent management strategy involving governments, institutions, professional bodies and individuals.
- Recommendations should target both new and existing buildings, with actions at local and national levels.

- Important considerations to take into account: outdoor climate and air quality, building materials and styles, behavioural patterns of the occupants, energy and sustainability policies, and building-system technologies.
- Evaluate the school environment in a holistic and coherent way.

For implementing the guidelines, the report also lists four criteria to help policy makers to judge which policy measures could be in place: effectiveness (i.e. in terms of risk-reduction capacity whereby it is recommended to distinguish between the impact on a general population and at sub-populations, such as for vulnerable groups), the proportionality (i.e. the costs versus benefits in terms of health gain), practicability (i.e. the assessment of the implementability, enforceability and manageability of the guidelines), and the monitorability. The report provides further extensive guidance on prevention, control, remediation, and communication strategies, as well as ventilation requirements. These requirements will serve as a further basis during the PAR4P workshops to reflect on the current problem definition and formulation of solutions. Some of these strategies are included into the design of the LEARN educational toolkit.

4.1.3 Air quality guidelines in Belgium, Denmark, and Greece

Belgium

- **Decree of the Flemish government (14/01/2011) environmental legislation**

This decree follows the European directive 2008/50 on ambient air quality. In the decree it is mentioned that air quality is a responsibility on the regional level, whereby the Flanders Environment Agency (Vlaamse Milieu Maatschappij) is appointed for the risk communication approaches. In the (short-term) air quality plans specific measures can be taken for vulnerable groups, including children.

- **Flemish Indoor Environment Decree on IAQ (6/11/2022)**

This decree is applicable to closed indoor environments for the public and stipulates limit values for indoor air quality (specifically CO₂). The reference values are non-binding. The decree also regulates the usage of an air quality meter, a risk assessment, an action plan if corrective actions are necessary, and a certificate procedure. In the decree, the launch of a 'platform indoor air quality' is announced to bundle all expertise on the topic. There are no specific references for school environments, although school environments are applicable to the definition of public spaces (as well as catering establishments, theatres, hospitals, residential care centres and sports infrastructure) and so the regulations for the placement of a CO₂ meter, with risk assessments and action plans. The decree does not have specific articles on vulnerable groups.

- **Code of practice: indoor air quality in workplaces (2019)**

This code of practice is applicable to working spaces, including conference rooms, laboratories, closed working spaces and classrooms. The code of practice is directed to the employer of an organisation or prevention advisor to ensure a healthy indoor environment and safeguard the health of workers. There are guidelines written in the code of practice on how to conduct a risk assessment for existing and new buildings (e.g., ventilation rate in the building, pollution caused through behavioural activities, through materials, appliances, etc.). There are no specific references for school environments, although school environments are applicable to the definition of workplaces. The decree does not have specific guidelines for vulnerable groups.

Denmark

- **Executive order on air quality assessment and management BEK nr 1472 of 12/12/2017**

This executive order follows the regulations set in [Directive 2008/50/EC](#). It also follows the guidelines to develop (short-term) actions plans when limit values are exceeded, and that necessary measures for vulnerable groups (including children) may be considered. It also mentions to make the action plans available to organisations representing the interests of sensitive populations groups, and that these organisations are adequately and in good time informed.

- **Limit values for substances and materials (2007)**

This document regulates the usage of substances and materials in the workplace. It is not applicable to context of school environments.

- **Executive Order on the Conditions at Permanent Places of Work**

This executive order applies to any place of work at which work is performed for an employer. It stipulates guidelines on ventilation, temperature, lighting, etc. There are no specific references to school environments (although the definition might be applicable of 'workplace') nor for vulnerable groups.

Greece

- **Measures to improve ambient AQ based on the DIRECTIVE 2008/50/EC ([KYA HN 14122/549/E103](#), [ΦΕΚ 488B/30.3.11](#))**

This executive order follows the regulations set in [Directive 2008/50/EC](#). It also follows the guidelines to develop (short-term) actions plans when limit values are exceeded, and that necessary measures for vulnerable groups (including children) may be considered. It also mentions to make the action plans available to organisations representing the interests of sensitive populations groups, and that these organisations are informed in a timely and adequate way.

- **Short-term action plans to combat particulate air pollution (KYA 70601, [ΦΕΚ 3272B/23.12.13](#))**

In case short-term action plans are needed, this decision stipulates the communication guidelines and precautionary recommendations to take to reduce emissions. There are specific notions to take measures to protect the population, and specifically vulnerable groups, when the 24-hour average concentrate value of PM₁₀ is exceeded:

- There should be a suspension of public or private nurseries, nurseries, kindergartens, and primary and secondary schools.
- To reduce emissions, the decision stipulates to reduce emissions from combustion sources and interruption of operation of central heating facilities, with the exclusion of spaces for care and social welfare, such as health centers, hospitals, orphanages, nurseries, schools, etc.
- To limit outdoor any intense physical activity outdoors for adults with respiratory problems, adults with heart diseases and children (with respiratory diseases). People with asthma may need more frequent inhalations of reliever medicine.
- Traffic ban of all school busses in the areas specified in the announcement.

Table 4: Overview of policy measures in place for Belgium, Denmark and Greece.

Country	Policy measures in place	Guidelines for school environments	AQ index / risk communication	Awareness raising about healthy school environments
Belgium	• Decree of the Flemish government (14/01/2011) environmental legislation (ambient AQ) • Flemish Indoor Environment Decree on IAQ (6/11/2022) • Code of practice: indoor air quality in workplaces (2019)	• Placement of a CO₂ meter in schools is recommended (phased-based approach of mandatory roll-out) • Risk analysis and mitigation plan (phased-based approach of mandatory actions)	Belgian air quality index (no specific communications for vulnerable groups, although measures can be taken)	• gezondeschool.be • milieuzorgopschool.be • Lekker Fris • Binnenluchtbrigade
Denmark	• Executive order on air quality assessment and management BEK nr 1472 of 12/12/2017 • Limit values for substances and materials (2007) • Executive Order on the Conditions at Permanent Places of Work (February 2001)	No specific guidelines are mentioned for school environments, although the executive order on the conditions at permanent places of work might be applicable	Denmark has chosen to simply report the concentrations of each pollutant , without calculating a combined index. This straightforward approach allows the public to clearly see the monitored concentrations of each pollutant without having to learn how these concentrations are converted into a complex index value. (No specific communications for vulnerable groups)	No information found

Greece	- Measures to improve ambient AQ based on the DIRECTIVE 2008/50/EC (KYA ΗΠ 14122/549/E103, ΦΕΚ 488B/30.3.11) Short-term action plans to combat particulate air pollution (KYA 70601, ΦΕΚ 3272B/23.12.13) - Presidential decree 338/2001 Protecting the health and safety of workers at work from risks due to chemical agents	No information found	Greek air quality index (no specific communications for vulnerable groups, although specific measures are listed in the action plans)	No information found
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4.2 Phase II – Identification of stakeholders

This chapter presents the results of the stakeholder mapping conducted by the pilot countries. Since the clinical trials are just at the starting phase, the pilots identified potential stakeholders and will further on complete the contact list once activities received permission from the relevant authorities.

4.2.1 Belgium

The table below lists the potential stakeholders for the PAR4-P workshops in Belgium. Depending on the confirmation of recruited schools, parents and the school staff will be invited as the most important stakeholder in the process.

In conjunction, stakeholders from the federal and Flemish policy level can be invited, for instance:

- At the Flemish level, the Flanders Environment Agency ('Vlaamse Milieumaatschappij') developed an [educational package](#) for 9 to 11 years old about air quality and also a game called 'Clean Air Quest'.
- At the Flemish level, the department on Health ('Agentschap Zorg en Gezondheid') is also preoccupied with health indoor environments, and developed an educational package called '[binnenluchtbrigade](#)'.
- At the federal level, the Agency for Public health, Food chain safety and the environment ([Federale overheidsdienst Volksgezondheid, Veiligheid van de Voedselketen en Leefmilieu](#)) has launched a platform on indoor air quality with a group of academics and policy makers. This group is preoccupied with formulating policy recommendations on indoor air quality.

Furthermore, the following initiatives were also identified:

- The expertise centre 'Vlaams Instituut Gezond Leven' is preoccupied with healthy school environments and already invested in awareness raising materials (e.g. [lekkerfris.be](#) and [air@school](#)).
- '[Luchttraining in de klas](#)' (air filtration research project in the classroom): is a building physical-virological study of air purification in classrooms with academic partners, and public and private stakeholders as supporting partners.

Table 5: Stakeholder mapping – Belgium.

Name organisation	Category	Domain
Flanders Environment Agency (Vlaamse Milieumaatschappij)	Public	Environment
Sciensano	Public	Health
Parents, students, school council	Societal	/
Kind en Gezin	Public	Health
Centrum voor leerlingenbegeleiding (CLB) /Centre for student guidance	Societal	Health
Steunpunt omgeving en gezondheid /environment and health support centre	Public	Environment and health
Mutualities	Public	Health



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<u>IDEWE</u>	Private consultancy	Health, hygiene and safety
<u>Federale overheidsdienst (FOD) Volksgezondheid, Veiligheid van de Voedselketen en Leefmilieu</u>	Public	Environment and health
<u>Vlaams Instituut Gezond Leven</u>	Private expertise centre	Health at school
<u>Luchtreiniging in de klas</u>	Academia / public and private	Health at school
Agency for Health and Care / <u>Agentschap Zorg en Gezondheid</u>	Public	Health at school

4.2.2 Denmark

The table below lists the potential stakeholders for the PAR4-P workshops in Denmark. Depending on the confirmation of recruited schools, parents and the school staff will be invited as the most important stakeholder in the process.

Another relevant association to invite is 'RealDania', they are a non-profit organization that supports projects in Denmark around sustainable development. They launched a campaign '[School's indoor climate](#)' and published a [report](#) on it with recommendations.

Table 6: Stakeholder mapping – Denmark.

Name organisation	Category	Domain
<u>Miljøstyrelsen/ The Danish environmental protection agency</u>	Public	Environment
<u>Sundhedsstyrelsen/ The Danish National Board of Health</u>	Public	Human health
<u>Kommunernes landsforening/ Kommunernes Landsforening (kl.dk)</u>	Public	Municipality
<u>Danmarks lærerforening/ Danish Teachers' Association</u>	Public	
<u>Børne og undervisningsministeriet/ The Danish Ministry of Children and Education</u>	Public	
<u>Realdania</u>	Societal	Philanthropic organization
<u>Aarhus kommune</u>	Public	
<u>Skole og Forældre</u>	Societal	School and parents

4.2.3 Greece

The table below lists the potential stakeholders for the PAR4-P workshops in Greece. Depending on the confirmation of recruited schools, parents and the school staff will be invited as the most important stakeholder in the process.

Table 7: Stakeholder mapping – Greece.

Name organisation	Category	Domain
<u>Institute of Child Health – Greece</u>	Public	Children's Health
Parents, students, school council	Societal	/
<u>Environmental Radioactivity & Aerosol technology for atmospheric and Climate impacT Lab (N.C.S.R. "DEMOKRITOS")</u>	Public	Air Quality
<u>Institute for Environmental Research and Sustainable Development</u>	Public	Environment and health
<u>Together for Children</u>	Societal	Philanthropic organization
<u>Laboratory of Atmospheric Physics (A.U.Th.)</u>	Academia	Environment and Health
<u>Hellenic Society for the Protection of Nature – ecoschools</u>	Societal	Educational organization



5. Conclusions

This deliverable reports the results of the first phase 'situational assessment' and the second phase 'identification of stakeholders' of the PAR4P-method:

- **Situational assessment**

The situational assessment provided insights into the global, European, and national guidelines related to outdoor and indoor air quality management.

On the **global level**, the WHO published guidelines related to ambient air pollution which are stricter than the ones of Europe. The WHO also published specific guidelines for indoor air quality management for dampness and mould, household fuel combustion and specific indoor air pollutants. Great importance was gained to the environmental justice principles in their guidelines (especially in the 2005 edition, and in the combustion of fuels indoors), with a clear definition on social justice principles. For the protection of vulnerable groups, the WHO defines that it is up to the national and local policy makers to decide who should be protected by the air quality standards, and if specific measures should be taken. Specific measures can include specific risk assessment studies, air quality standards for vulnerable groups, communication and awareness-raising, specific health-based messages through warning systems, involvement of health care and professionals, etc. For school environments, several sources of pollution were listed in their guidelines such the distance between buildings from roadways and traffic density, the presence of a gas heater and dust resuspension due to human movement. Several studies with the polluting sources and consequences were reported for schools, although no specific action plan or guidelines were provided for the school environment. In general, the definition of 'occupational settings' is also not that straightforward to understand in the selected documents of the WHO.

On the **European level**, the most important guidelines for air quality management are to be found in [Directive 2008/50/EC](#) on ambient air quality and cleaner air for Europe. In this directive, it is stipulated that (short-term) action plans can include specific measures for the protection of sensitive population groups. At the current stage of writing, the European Commission has the ambition to revise the Ambient Air Quality Directives which will align more closely with the WHO guidelines; to meet zero pollution for air at the latest by 2050 and enforcing climate neutrality efforts. Regarding indoor air quality management, no specific directive was found, although guidelines are provided in related directives on ventilation and initiatives that work towards standardisation (CEN and ISO standards). As such, there is also no specific action plan for school environments, although the SINPHONIE project reported important guidelines to consider. This project supported future policy actions by guidelines on indicators, tools and protocol for monitoring indoor air quality at schools, and guidance on prevention, control, remediation and communication strategies.

On the **national level**, the Flemish government in Belgium has recently released the '[Flemish Indoor Environment Decree on IAQ \(6/11/2022\)](#)'. It is applicable to closed indoor environments for the public and stipulates limit values for indoor air quality (specifically CO₂), which are non-binding. This decree is applicable to school environments, and regulates the usage of a CO₂ meter, risk analysis and an action plan. The Flemish and federal government in Belgium has also invested in various awareness raising campaigns and educational materials for indoor air quality management in schools. Similar examples could not be found in Greece or Denmark. Relating risk communication, Greece and Belgium follow the example of the

European Air Quality index, although Denmark has opted to report the concentrations of each pollutant separately, without calculating a combined index. In terms of short-term action plan, Greece has implemented a specific directive on this with clear measures to be taken for vulnerable groups e.g., limitation of outdoor activities, banning of school busses for the polluted zones, etc. This was not found for Belgium and Denmark.

- **Stakeholder mapping**

The three pilot countries performed a first stakeholder mapping of organizations and individuals that can be invited to the workshops. Since the pilot countries are still in the ethical approval or preparatory phase of the clinical trials, the list of stakeholders remains to be further discussed. Other potential stakeholders can be further involved along the processes of the clinical trial. In terms of next steps, a first draft agenda and invited is prepared by VUB (See Annex II). This document can be disseminated and promoted in the pilot countries in case the clinical trials are ready to start. The workshops are planned for winter-spring 2023-2024, and will align with the status of the clinical trials in each country.

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Annex I – List of policy documents

Global guidelines

- WHO, 2005, Air quality guidelines, Global Update 2005
- WHO, 2009, WHO guidelines for indoor air quality. Dampness and Mould
- WHO, 2010, WHO guidelines for indoor air quality. Selected pollutants
- WHO, 2014, WHO guidelines for indoor air quality. Household fuel combustion
- WHO, 2021, WHO global air quality guidelines
- WHO, 2023, Risk communication of ambient air pollution in the WHO European Region; Review of air quality indexes and lessons learned.

European guidelines

- COMMISSION IMPLEMENTING DECISION of 12 December 2011. Laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality
- COMMISSION DIRECTIVE (EU) 2015/1480 of 28 August 2015 amending several annexes to Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council laying down the rules concerning reference methods, data validation and location of sampling points for the assessment of ambient air quality
- DIRECTIVE 2004/107/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air
- Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe
- Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on ambient air quality and cleaner air for Europe (recast) {SEC(2022) 542} - {SWD(2022) 345, 542, 545}
- Guidelines for healthy environments within European schools
- COMMISSION REGULATION (EU) No 1253/2014 of 7 July 2014 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for ventilation units

National guidelines – Belgium

- [Decree of the Flemish government \(14/01/2011\) environmental legislation](#)
- Code of practice indoor air quality
- Law of 6 November 2022 on the improvement of indoor air quality in closed spaces accessible to the public)

National guidelines – Denmark

- Limit values for substances and materials
- BEK nr 1472 of 12/12/2017 (Applicable). Executive order on air quality assessment and management

National guidelines – Greece

- Measures to improve ambient AQ based on the DIRECTIVE 2008/50/EC
- National Air Pollution Control Programme - based on Directive (EU) 2016/2284
- Legislation 1650/86 Environmental protection (incl AQ)

Annex II – Draft invite for the workshops

CLEAN AIR IN SCHOOL INVITATION TO OUR WORKSHOP

Come and join us to discuss indoor air quality and health at school!

The LEARN project

The "LEARN" project is a European funded project, which runs from May 2022 till April 2026. This project develops novel sensors to measure the air quality and the presence of harmful air pollutants in schools. At your school, a clinical trial is conducted to investigate the impact of air pollution on children's health, specifically their cognition. To improve the air quality indoors, novel ventilation mechanisms will be tested. To realise these activities, eleven research teams are mobilized from different fields (air quality specialists, biology, engineers, social scientists, etc.)

The workshop

You are invited to participate in co-creative workshops about indoor air quality in schools. The workshops are open to everyone, and invite participants from different fields, e.g. parents, teachers, school nurses, support or cleaning staff of the school, local policy makers in the domain of health, researchers or experts on indoor air quality, etc.

The goal of the workshops is to discuss the current indoor air quality at school and talk about current concerns or challenges. We also dive deeper into existing guidelines about indoor air quality management and together we define recommendations for a healthy indoor environment at school.

In total, there are two co-creative workshops. You are invited to join both workshops, which take place at the starting and end phase of the clinical trial. If you attend both workshops, you receive a voucher of 30 euros. A free exemplar of the educational game 'Clean air in school! Play & LEARN' is available to you as well.

Agenda

Part I:

- Presentation of the LEARN project and its goals. Overview of the current guidelines around indoor air quality management.
- Interactive discussion about indoor air quality: concerns, challenges and opportunities for improvement
- A break with refreshments

Part II:

- Presentation of the LEARN Data Hub: a platform for visualising information about indoor air quality
- Interactive brainstorming about concerns, challenges and opportunities for improvement of the Data Hub

Date: to be determined

Location: to be determined

Language: English / Danish / Dutch / Greek