

Targeting indoor air quality in sustainable patterns



A SEARCH II project working paper

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School Environment
and Respiratory Health
of Children



Targeting Indoor Air Quality in Sustainable Patterns

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Introduction

Research evidence has been produced at international, European and national level on indoor air quality (IAQ), as well as on the health risks to children and adults of exposure to indoor sources of pollution in vulnerable indoor settings such as schools (see Annex II).

Several joint environment and health initiatives have also been implemented on procedures for monitoring indoor pollutants, as well as guidelines and limit values for chemicals in the indoor air (e.g. by the World Health Organization, the EC's Joint Research Centre and the US Environment Protection Agency), and upcoming areas of research such as secondary indoor air pollutants. At EU level, the environment and health priorities contained in the final proposal for the 7th EU Environmental Action Programme (7th EAP) stress the importance of action to prevent exposure to harmful chemicals released from consumer products.¹

The SEARCH initiative was launched in 2006 to investigate indoor air quality (IAQ) in schools and the potential health risks among children (page 3). In the second phase of the SEARCH project (2010–2013), interconnections between energy use in school buildings, building management and the indoor comfort of children were also analysed, and the environment and health assessment of indoor air pollutants was extended to schools in new partner countries outside the EU.

The SEARCH II project results highlighted, among other risk factors, the significance of pollutants emitted from consumer products that are usually present in schools

and at home, as well as the impact of building design on IAQ and comfort.

It was also highlighted that, although the importance of IAQ has received a lot of attention at institutional level, at the European and national levels there is still no joint strategy that appropriately includes IAQ issues in the implementation of sectoral policies, especially those outside the traditional environment and health domain, which, via different mechanisms, may have an impact on protecting IAQ.

On the issue of IAQ management, it is generally accepted² that there are two major strategic areas in mitigating the health risks from exposure to chemicals: exposure control and source control. The first is linked to building management and design and is mainly focused on adequate ventilation to preserve IAQ and comfort, especially when upgrading energy use in buildings. The source control strategy aims to put in place measures to eliminate or minimise the release of hazardous chemicals from indoor sources such as furnishings, flooring, building materials, cleaning products and air fresheners, which are known to have an impact on the quality of the air we breathe inside schools, homes and offices.

This working paper, together with the results of the SEARCH II project, is intended to open a discussion on the role of sustainability policies related to consumer products and building design for IAQ management, in accordance with statements contained in the renewed European Union Sustainable Development Strategy (EU SDS), approved by the Council of the EU in 2006, about the prevention of unhealthy indoor emissions.³ To support further discussion on the sustainability process, the paper is ultimately intended to identify gaps in the knowledge and tools needed for effective IAQ management through source control and building design.

A brief section is dedicated to presenting recommendations, bearing in mind the potential conflict between energy efficiency policies and IAQ, in particular in connection with the retrofitting of existing buildings.

The working paper will also discuss the results of the ad hoc questionnaire (Annex I) that was sent to all SEARCH II partner countries to investigate IAQ management issues in order to share knowledge and best practices and raise awareness among local stakeholders. The information provided by the countries also contributed to creating a clear (even if not exhaustive) picture of the situation at national level, especially regarding the non-EU SEARCH II countries.

THE SEARCH INITIATIVE

The SEARCH initiative (School Environment and Respiratory Health of Children) is an international research project launched within the framework of the Children's Environment and Health Action Plan for Europe (CEHAPE), which was adopted in 2004 at the fourth Ministerial Conference on Environment and Health organised by the World Health Organization for the European Region. The initiative, supported and promoted by the Italian Ministry for the Environment, Land and Sea (IMELS), is coordinated by the Regional Environmental Center for Central and Eastern Europe (REC). During the first phase (2006–2009), IAQ and children's health were investigated in schools in six European partner countries (Albania, Bosnia and Herzegovina, Hungary, Italy, Serbia and Slovakia). Based on the SEARCH I conclusions and recommendations, the initiative was reaffirmed at the fifth Ministerial Conference on Environment and Health, held in Parma, Italy, in 2010. With the active involvement of stakeholders and experts, IMELS launched the follow-up project SEARCH II (2010–2013) to continue and extend the valuable research activities. Four new countries (Belarus, Kazakhstan, Tajikistan and Ukraine) joined the project and undertook environment and health assessments in selected schools to explore the connections between energy use in school buildings and the indoor comfort of children.

(search.rec.org)



EU sustainability policies and indoor air quality

Recent concepts such as sustainable consumption and production, eco-innovation, energy efficiency, the environmental performance of products and lifecycle thinking have enhanced the value and meaning of sustainability, bringing environmental concerns into strategic areas of the economy and establishing valuable benchmarking in market competitiveness.

This development has various implications for environmental policies and operators in terms of knowledge, skills and challenges. The present document focuses on the potential role of renewed sustainability policies in relation to the three main strategic areas related to IAQ: (indoor) source control; exposure control; and chemical safety.

In order to describe this challenging scenario, and to enable focused discussion, we propose a framework (see page 8) showing those interconnected EU policies that, via different mechanisms, can influence IAQ and chemical safety. The aim is to raise awareness of issues related to the indoor air among operators involved in different sectors of the broad (and still developing) area of sustainable production and buildings. An overview of the sustainability process will be followed by a concise analysis of key policies.

From sustainability to sustainable consumption and production

The 1992 United Nations Conference on Environment and Development (the Rio Earth Summit) called for a global sustainable development approach in order to preserve the integrity of the global environment.

As a concrete response to the Rio Summit, in 1992 the EU endorsed the Fifth Environmental Action Programme (1993–1999), which recognised the international concept of sustainable development and called for a multi-sector approach, integrating the environmental dimension into the main strategic sectors such as transport, energy and agriculture.

In 2001, the first EU Sustainable Development Strategy

(the Gothenburg Strategy) was adopted. This was a milestone in European policy and proclaimed a new approach to policy making in order to foster the integration of the economic, social and environmental dimensions. One of the specific objectives of the Gothenburg Strategy was to address health threats.

In the same year the EU also adopted the Green Paper on Integrated Product Policy (IPP)⁴, a political instrument that opened the way to a new approach in the EU that also referred to “consumer products”. Following the Green Paper, in 2003 the EC presented its Communication on Integrated Product Policy: Building on Environmental Life-Cycle Thinking, aimed at making products more environmentally friendly throughout their life-cycle. The EC communication recommended, among other things:

- the promotion of lifecycle thinking by making lifecycle data available and by promoting IPP for specific products;
- the improvement of product information aimed at consumers; and
- greater attention to environmental criteria in public procurement.

In June 2006, the European Council adopted its ambitious renewed Sustainable Development Strategy (EU SDS, 10917/06) for an enlarged EU, recognising the need to gradually change currently unsustainable consumption and production patterns and move towards a better-integrated approach to policy making.

The EU SDS established overall objectives and related concrete actions in seven areas:

- climate change and clean energy;
- sustainable transport;
- the conservation and management of natural resources;
- social inclusion, demography and migration;
- global poverty and sustainable development challenges;

- public health; and
- sustainable consumption and production.

The overall objective for public health, “To promote good public health on equal conditions and improve protection against health threats”, includes:

- improving protection against health threats by developing capacity to respond to them in a coordinated manner;
- ensuring that, by 2020, chemicals, including pesticides, are produced, handled and used in ways that do not pose significant threats to human health and the environment. In this context, the rapid adoption of the Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) will be a milestone, the aim being to eventually replace substances of very high concern by suitable alternative substances or technologies; and
- improving information on environmental pollution and adverse health impacts.

These targets are to be achieved through a list of specific actions, including the following: “The Commission should propose a strategy for improving indoor air quality, with particular attention to VOC emissions...”⁵

Operational objectives and targets were also set to promote sustainable consumption and production patterns, among them⁶:

- promoting sustainable consumption and production by addressing social and economic development within the carrying capacity of ecosystems and decoupling economic growth from environmental degradation; and
- improving the environmental and social performance of products and processes and encouraging their uptake by businesses and consumers.

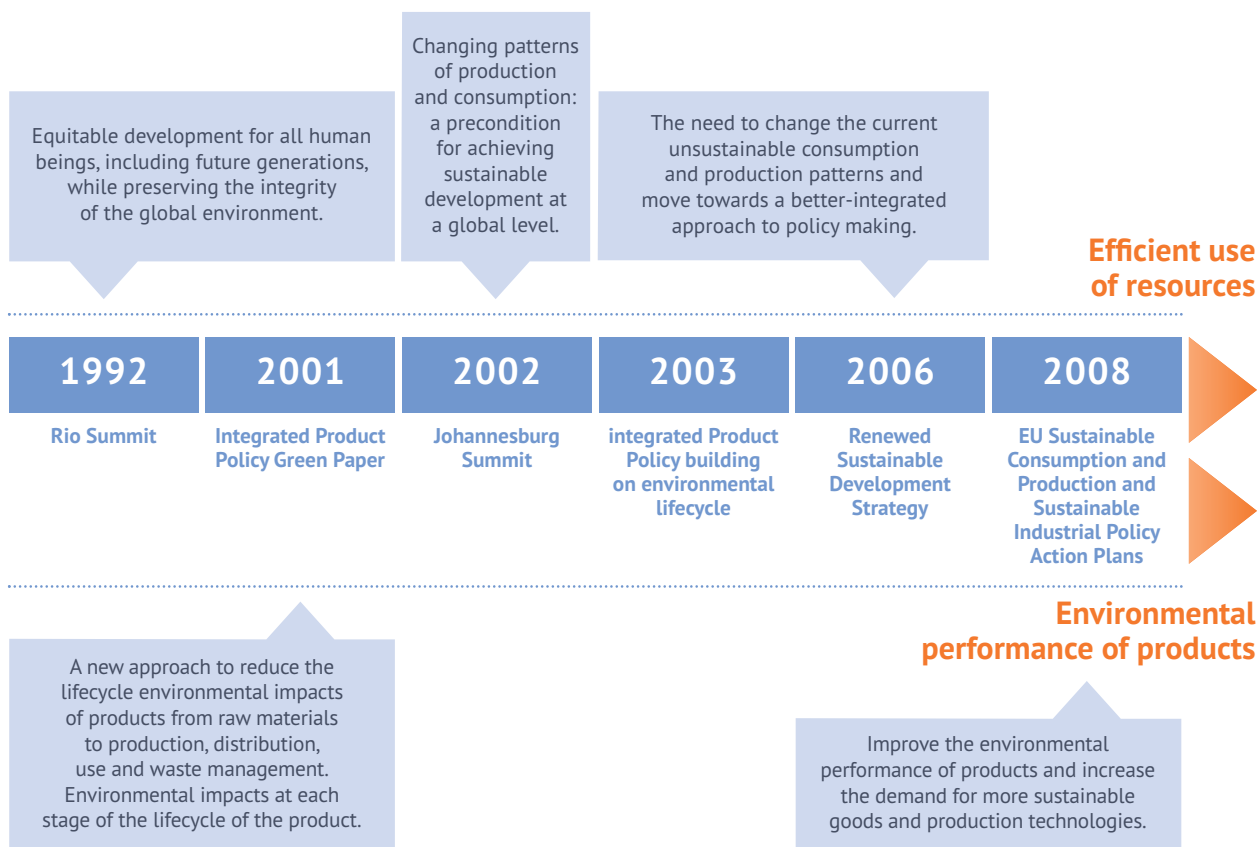
In July 2008, the EC presented the Sustainable Consumption and Production (SCP) Action Plan and Sustainable Industrial Policy Action Plan⁷, adopted by the EU Council in December 2008.

The SCP Action Plan provides a dynamic framework for many EU policies and initiatives that are an integral part of the EU's renewed Sustainable Development Strategy (EU SDS) while improving the competitiveness of the European economy and fostering good practice internationally for a global sustainable market.⁸ The final challenge of the action plan is to improve the overall environmental performance of products throughout their lifecycle⁹, to boost the demand for better products and production technologies, to help consumers to make informed choices, and, last but not least, to encourage business and industry to develop and take up environmental technologies.

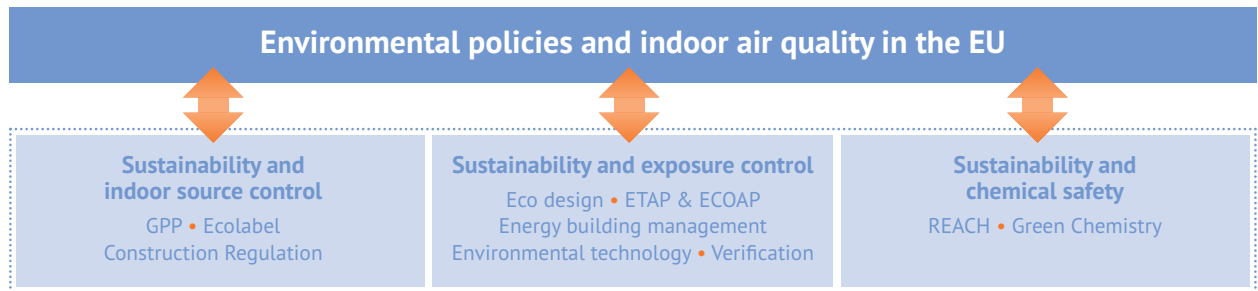
In 2010, the EC defined the Europe 2020 Strategy, the new political framework for European sustainability for the coming decade, setting ambitious objectives to be reached by 2020 for which member states are called to adopt their own national targets. The strategy also identifies key areas for action – the so-called seven flagship initiatives, including the Resource Efficiency Flagship. In 2011, the EC adopted the Roadmap to a Resource-Efficient Europe, which analyses key resources from a lifecycle and value-chain perspective.

The overall process is summarised in Figure 1.

FIGURE 1: From sustainability to sustainable consumption and production policies



Source: E. Colaiacomo



Source: E. Colaiacono, L. Sinisi

FIGURE 2: Sustainability policies and IAQ management: A framework proposal

As already mentioned, several EU policies and initiatives that act as building blocks of the EU SDS and related SCP Action Plan may have a role in one of the three main interlinked strategic areas of IAQ management: (indoor) source control, exposure control and chemical safety (Figure 2). Below, we outline the main principles and targets of these policies.

Sustainability and indoor source control

Source control strategies should be aimed at effectively preventing emissions of hazardous chemicals to the indoor air from any products or materials used in homes, schools and offices, before those products appear on the market. With respect to construction products, the 2011 Construction Products Regulation (see below) gives attention to the IAQ issue. For certain classes of consumer products (e.g. household chemicals and furniture), despite the mounting evidence already available on their health-related impacts on indoor air chemistry, and despite the statements contained in the renewed 2006 EU SDS, the role of sustainability policies to prevent unhealthy indoor emissions still needs to be further explored.

For this purpose, after a brief analysis of construction product policies we will focus on green public procurement (GPP) and the Ecolabel scheme, which may be key policy areas in preventing VOCs emissions from indoor sources.

EU Construction Products Regulation

European Commission services and researchers are working towards a harmonised framework for product labelling schemes in the EU that support the requirements related to health, safety and the environment under the former Construction Products Directive¹⁰ and the subsequent Construction Products Regulation¹¹ (CPR). A requirement of these policies is that no construction product should cause harm to the occupants of a building.

The CPR sets out conditions and harmonised rules for making construction products available on the market. Point 1 of Article 3 of the CPR establishes the basic requirements for construction work and the essential characteristics of construction products: “The basic requirements for construction works set out in Annex I shall constitute the basis for the preparation of standardisation mandates and harmonised technical specifications.”

CPR and indoor source control: Regarding VOCs emissions, until the specifications are adopted at EU level, national regulators may interpret these requirements differently. Indeed, several EU countries have their own labelling systems for VOCs emissions.



“Green Public Procurement is a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their lifecycle when compared to goods, services and works with the same primary function that would otherwise be procured.”

■ COM (2008) 400, Public Procurement for a Better Environment

Annex 1, point 3 of the CPR, on hygiene, health and the environment, states the following:

“The construction works must be designed and built in such a way that they will, throughout their lifecycle, not be a threat to the hygiene or health and safety of workers, occupants or neighbours, nor have an exceedingly high impact, over their entire lifecycle, on the environmental quality or on the climate during their construction, use and demolition, in particular as a result of any of the following:

- (a) the giving-off of toxic gas;
- (b) the emissions of dangerous substances, volatile organic compounds (VOC), greenhouse gases or dangerous particles into indoor or outdoor air;
- (c) the emission of dangerous radiation;
- (d) the release of dangerous substances into ground water, marine waters, surface waters or soil;
- (e) the release of dangerous substances into drinking water or substances which have an otherwise negative impact on drinking water;
- (f) faulty discharge of waste water, emission of flue gases or faulty disposal of solid or liquid waste;
- (g) dampness in parts of the construction works or on surfaces within the construction works.”

The Technical Committee for Construction Products of the European Committee for Standardization (CEN/TC

351) is working on harmonised rules for the assessment of releases of dangerous substances. Working Group 2 is responsible for emissions into the indoor air.

Green Public Procurement: Guiding principles and targets

Green Public Procurement (GPP) is an EU voluntary instrument to stimulate sustainable innovation in Europe. More recently, the Europe 2020 Strategy has identified public procurement as one of the key means of attaining smart, sustainable and inclusive growth.

The EC estimates approximately EUR 2 trillion annually for general expenditures by European public authorities – that is, about 17 percent of the EU’s gross domestic product. Environmentally friendly choices in terms of the public authorities’ purchasing power for goods, services and work will be an important contribution towards sustainable consumption and production. Green Public Procurement also includes expenditure (up to 50 percent for most governments) for new buildings and/or the renovation of existing buildings. Some purchased goods and/or construction materials can be a potential source of VOCs emissions, and this may affect a substantial number of public employees (about 15 million in the public administration alone) and vulnerable public settings such as schools and hospitals.

In the GPP framework, specific environmental criteria have to be met by products and services. Several Euro-

GPP and indoor air: Generally speaking, indoor air concerns are not usually built into GPP criteria. The safety of goods and materials is mainly assessed according to the Ecolabel scheme and the REACH Regulation. This approach, as discussed below, may not result in the satisfactory prevention of the release of chemicals into the indoor air from consumer products.

pean countries have already developed national criteria (so-called minimum environmental criteria). The EC regards as a new challenge the adoption of comparable criteria between member states to be applied in all public tendering processes for public authorities.

The Ecolabel scheme

The EU Ecolabel scheme is part of the efforts towards sustainable consumption and production and is intended to promote those products that have a high level of environmental performance throughout their lifecycle, from the extraction of raw materials through to production, use and disposal. In order to be eligible for the EU Ecolabel, specific criteria must be met and these criteria should take into account the latest tech-

nological developments. The specific criteria for consumer products are reviewed/updated on a regular basis, along with product group development.¹²

A recent joint initiative of the EU Ecolabel and GPP is the development of specific Ecolabel criteria for office buildings, for which a dedicated working group of the Joint Research Centre (JRC) and Italy's National Institute for Environmental Protection and Research (ISPRA) has been established.¹³

In the Sustainable Consumption and Production Action Plan, the EU Ecolabel is strictly linked with EU instruments such as GPP, the Eco-management and Audit Scheme (EMAS), the Ecodesign Directive and the Environmental Technologies Action Plan (ETAP). The same action plan stresses the need for greater coherence¹⁴ between product policy instruments and the provisions of the new Ecolabel Regulation. To support this policy target, the Product Bureau was created at the end of 2009 within the JRC in Seville. The establishment of the bureau was based on an agreement between DG Environment and the JRC. The objective of the bureau is to provide techno-economic analysis and scientific support for the policy-making process towards the development of the Ecolabel, GPP and Ecodesign schemes and other product-related and lifecycle-based policy initiatives.



“A voluntary tool to promote products with a reduced environmental impact during their entire lifecycle and to provide consumers with accurate, non-deceptive, science-based information on the environmental impact of products.”

■ Regulation (EC) 66/2010

Ecolabel and indoor air: Many considerations require further discussion among experts:

- The Ecolabel could be a key environmental tool for the control of potential indoor sources of chemicals: several categories that may be sources of indoor pollution are indeed included among Ecolabel product groups (e.g. cleaning products for homes, offices and schools; paints; furniture).
- Ecolabel assessment is based on a lifecycle approach that may require further attention to be given to IAQ issues.
- The Ecolabel is an important instrument to help consumers make eco-friendly choices. However, consumers may misinterpret information on product safety: eco-friendly products may be perceived as generally healthy, even though ratings for VOCs indoor emissions from final products are not included among the Ecolabel criteria. In terms of competitiveness, the procedure may not encourage (or distinguish) companies that place chemicals-free products on the market.

Indoor air and chemical safety policies

Chemical safety is one of the biggest concerns among consumers worldwide. The implementation of environmental policies to protect water, soil and the ambient air from chemical pollution is widely recognised as a key tool to protect the population from harmful exposure to chemicals. The inclusion of consumer products in sustainability policies, however, also requires an approach that focuses on the safety of chemicals used for various consumer purposes, including concerns about indoor air. Among the various sectoral policies, the REACH Regulation and the Green Chemistry initiative in general appear to be strategic tools to mitigate VOCs emissions to the indoor air.

Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH Regulation)

The REACH Regulation (EC 1907/2006) on chemical safety in the EU entered into force in June 2007. It provides a dynamic and articulated framework for the various procedures for the registration, evaluation, authorisation and restriction of chemicals in the EU

area. The registration process concerns all substances produced or imported into the EU in quantities above 1 tonne per year. Substances defined as priority substances according to volume of production or toxicity are subject to a more detailed risk assessment by the competent authorities. The identification of a chemical as a “substance of very high concern” (SVHC)¹⁵, and its consequent inclusion in Annex XIV, creates certain legal obligations for importers, producers and suppliers, and restrictions on the use of the chemical on the market (Article 58). The REACH authorisation procedure aims to ensure that the risks from SVHCs are properly controlled and that these substances are progressively replaced by suitable alternatives while ensuring the sound functioning of the EU internal market. Among other things, the regulation considers the intentional and unintentional release of substances/chemicals from preparations and articles (e.g. plasticisers from paints/coatings, chemicals from flooring), as well as accidental or unintentional emissions of chemicals to the indoor environment where these could present a hazard. Risk management measures must then be applied to ensure that exposure to chemical substances released by articles is kept below safe levels throughout the whole lifecycle of a product, meaning manufacture, use and disposal.

REACH and indoor air: REACH can be seen as a very dynamic process that is continuously updated with scientific evidence that allows the improvement of risk assessment procedures. With respect to indoor VOCs emissions, testing methods and protocols may need further agreement at EU level.

most hazardous substances should be substituted with less dangerous ones. A restriction applies to any substance on its own, in a mixture, or in an article, including substances that do not require registration. It can also apply to imports. A member state and the ECHA, at the request of the EC, can propose restrictions if they find that the risks need to be addressed on an EU basis.



Manufacturers and importers are required to gather information on the properties of their chemical substances in order to ensure their safe handling, and to register this information in a central database run by the European Chemicals Agency (ECHA)¹⁶. If the risks cannot be managed, the authorities may restrict the use of substances in different ways. In the long run, the

Green/sustainable chemistry

The Green Chemistry initiative provides a sustainable basis for eco-innovation to stimulate a competitive, knowledge-based, enterprise-led economy across Europe. In 2003, European technology platforms (ETPs) were established to respond to the European Council request to “strengthen the European Research Area” by creating platforms “bringing together technological know-how, industry, regulators and financial institutions

“Sustainable chemistry [...] seeks to improve the efficiency with which natural resources are used to meet human needs for chemical products and services, [...] encompasses the design, manufacture and use of efficient, effective, safe and more environmentally benign chemical products and processes, [...] stimulates innovation across all sectors to design and discover new chemicals, production processes, and product stewardship practices that will provide increased performance and increased value while meeting the goals of protecting and enhancing human health and the environment.”

■ Organisation for Economic Co-operation and Development (OECD), definition of sustainable or green chemistry

to develop a strategic agenda for leading technologies”. The role of ETPs has also been recognised in the EC’s Horizon 2020 proposal. In 2013, the EC endorsed the Strategy for European Technology Platforms: ETP 2020¹⁷ in order to identify the path towards the commercial deployment of research, provide strategic insights into market opportunities and needs, and mobilise innovation actors across the EU in order to enable European companies to gain a competitive advantage in global markets.

The Green Chemistry initiative aims to reduce the environmental impacts of processes and products while helping to meet future energy needs, reduce energy, waste and water consumption, reduce emissions of pollutants and improve quality of life in urban areas.

Sustainability policies and exposure control

Building design and the energy efficiency upgrading of buildings influence microclimate parameters such as ventilation, temperature and relative humidity, which are relevant to overall IAQ and comfort. In terms of indoor air chemistry, concentrations of chemical pollutants released by indoor sources are also affected by ventilation and temperature.

A brief overview of the targets and principles of key policies in the sustainability framework, which can have a role in preventing exposure to indoor chemicals, as well as the interconnections between those policies, is provided below.

However, since all these apply to building policies they share critical features that, in pursuit of the objective of indoor air safety, may deserve further discussion based on the following considerations:

- Building policies are among the targets of the Europe 2020 Strategy.

Green Chemistry and indoor air: Although this important EU initiative is in a very initial phase, it will be highly important in terms of reducing indoor air chemical pollution in the future.



- Even if they do not focus on energy saving and the efficient use of resources, these policies are part of the dynamic process of sustainability.
- All these policies are strictly interconnected, and are also connected with the Ecolabel scheme and, in general, follow a common lifecycle assessment approach.
- There are also interconnections with businesses and the market, which demand a transparent approach and procedures.
- Even if these policies also have a role in indoor source control, as discussed above, their targets and principles are related more to building design than to everyday consumer products. A separate discussion is therefore justified.
- While the consideration of IAQ is required in the implementation of these policies, the evaluation of indoor chemicals such as VOCs will not be included, as ventilation is the only parameter used in assessing IAQ.
- In this dynamic and modern approach to building policies, the inclusion of indoor chemicals monitoring in authorisation criteria or procedures may improve the effectiveness of preventing and controlling the exposure of occupants to hazardous substances in the indoor air.
- In relation to IAQ monitoring, many applicable tools (and knowledge) are already available at EU level, although agreements on procedures and authorisations are still under discussion at national level.

Building policies and sustainability: An overview of targets and principles

Building policies and the Europe 2020 Strategy

By 2020, buildings and infrastructure will be renovated and constructed according to high resource-efficiency levels. The lifecycle assessment approach will be widely applied. All new buildings will be nearly zero-energy and highly efficient in terms of material use, and policies will be in place for renovating the existing building stock to ensure cost-efficient refurbishment at an annual rate of 2 percent. A total of 70 percent of non-hazardous construction and demolition waste will be recycled.

The EC and EU member states will:

- continuously assess how to support skills investment plans, apprentice schemes and communication on the best resource efficiency practices in the industry;
- take measures to stimulate the demand for and uptake of resource-efficient building practices through lifecycle costing and suitable financing arrangements; further widen the scope of the Eurocodes to include criteria related to sustainability; develop incentives to reward resource-efficient buildings; and promote the sustainable use of wood in construction;¹⁸ and
- continuously assess how best to encourage private-sector innovation in construction.

Ecodesign

Directive 2005/32/EC of the European Parliament and of the Council of July 6, 2005, establishing a framework for the setting of ecodesign requirements for energy-using products (the Ecodesign Directive) covers all energy-using products in the residential, tertiary and industrial sectors.

The Ecodesign Directive does not introduce directly binding requirements for specific products, but defines conditions and criteria for setting requirements regarding environmentally relevant product characteristics (such as energy consumption). This directive applies in principle to all energy-using products and covers all energy sources.

The directive provides a coherent and integrated framework that allows the setting of mandatory ecodesign requirements for some products. Ecodesign requirements must not lower the functionality of products or their safety, or have a negative impact on their affordability or on consumer health.

In 2009, the Ecodesign Directive was extended to all energy-related products (the use of which has an impact on energy consumption):

- energy-using products – that is, products that use, generate, transfer or measure energy (electricity, gas, fossil fuels), including consumer goods such as televisions, washing machines and computers; and
- other energy-related products – that is, products that do not necessarily use energy but have an impact on energy consumption (e.g. windows, insulation materials and bathroom devices such as shower heads and taps).

According to the Europe 2020 Strategy, in order to promote further sustainable consumption and production the EC will set requirements under the Ecodesign Directive to boost the material resource efficiency of products (e.g. reusability/recoverability/recyclability, recycled content, durability), and will expand the scope of the Ecodesign Directive to non-energy-related products.

The Ecodesign Directive is intended to be used together with the Energy Labelling Directive (2010/30/EU). The effect of these two directives can be reinforced if combined with other voluntary schemes such as the EU Ecolabel scheme, Green Public Procurement and financial incentives.

ETAP and EcoAP

As a consequence of increased public awareness of environmental concerns and the related increased demand for better environmental conditions, a rise in the offer of clean technologies and environmentally sustainable products and services has been registered worldwide in recent years. In Europe, one response was

EcoAP for a sustainable future: The EcoAP was developed in the framework of the Europe 2020 Strategy, the “EU’s growth strategy” in the words of José Manuel Barroso, president of the European Commission. It focuses on smart, sustainable and inclusive growth, aimed at supporting the transition to a resource-efficient, low-carbon economy. The EcoAP is intended to expand the focus of innovation policies towards green technologies and eco-innovation; target specific eco-innovation barriers and opportunities; and highlight the role of environmental policy as a factor for economic growth.

the adoption of the Environmental Technologies Action Plan (ETAP) in 2004, an instrument for promoting “ecological” technological innovation “aimed at significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment or achieving a more efficient and responsible use of resources”. The ETAP was also intended to overcome many of the barriers (financial, economic and institutional) that hinder the development of these technologies and to promote their adoption on the market.

By making a significant contribution to the growth in the number of European industries that pay attention to environmental issues, the ETAP was undoubtedly a success. Nearly half of European companies operating in the manufacturing, agricultural, services, water and food sectors have made eco-sustainable innovations since 2004.

Following the positive experience gained through the ETAP, in 2011 the EC launched the Eco-innovation Action Plan (EcoAP) as “a step forward for eco-innovation, moving the EU beyond green technologies and fostering a comprehensive range of eco-innovative processes, products and services”. The action plan also focuses on developing “stronger and broader” eco-innovation actions across and beyond Europe.

Energy building management

In 2010, the EU adopted the Energy Performance of Buildings Directive (2010/31/EU), the primary objective of which is the upgrading of buildings to “nearly zero-energy buildings” (NZEBS). The directive requires member states to set minimum energy performance requirements for new and existing buildings and ensure the energy certification process.

On October 25, 2012, the EU adopted the Directive on Energy Efficiency (2012/27/EU), establishing a common framework of measures for the promotion of energy efficiency within the EU in order to support the energy targets set by the Europe 2020 Strategy. This directive sets out rules for removing barriers in the energy market and for overcoming market failures in the supply and use of energy, and provides for the establishment of indicative national energy efficiency targets for 2020.

Within the 2020 Strategy, the Roadmap to a Resource-Efficient Europe underlines that existing policies for promoting energy efficiency and renewable energy use in buildings “need to be complemented with policies for resource efficiency which look at a wider range of environmental impacts across the lifecycle of buildings”. To help the EU to address this need, the EC is preparing the Communication on Sustainable Buildings with the general objective of reducing the environmental impact of buildings by improving overall resource efficiency and, as a consequence, improving the competitiveness of construction businesses.

Eco-innovation

Eco-innovation is a fairly recent concept. One of its first appearances in the literature was in a 1996 publication by Claude Fussler and Peter James.¹⁹ In a later article, James defines eco-innovation as “new products and processes which provide customer and business value but significantly decrease environmental impacts”.²⁰

The EU defines eco-innovation as “any form of innovation aiming at significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment or achieving a more efficient and responsible use

of resources”. There is no consideration of health in this definition.

For our purposes, eco-innovation can be defined as the development of products and processes that contribute to sustainable development, using the commercial application of knowledge to elicit direct or indirect ecological improvements. This includes a range of related ideas, from environmentally friendly technological advances to socially acceptable innovative paths towards sustainability.

The term is most often used, in conjunction with eco-efficiency and eco-design, to refer to innovative products and processes that reduce environmental impacts. Many industrial leaders have been developing innovative technologies in the interests of sustainability. However, they are not always practical, or enforced by policy and legislation. Eco-innovation is the process by which responsible capitalism contributes to sustainability by developing products that have a generative nature and are recyclable for usage in other industries.

A VOLUNTARY PRIVATE-SECTOR CONTRIBUTION: THE GREEN BUILDING COUNCIL

The World Green Building Council (WorldGBC) is a network of national green building councils in more than 90 countries, making it the world’s largest international organisation with an influence on the green building marketplace. Green building councils are member-based organisations and businesses that empower industry leaders to bring about the transformation of the local building industry towards sustainability.

In the WorldGBC report “The Business Case for Green Building”, the chapter on workplace productivity and health states: “Research shows that the green design attributes of buildings and indoor environments can improve worker productivity and occupant health and well-being, resulting in bottom-line benefits for businesses. Despite evidence of its impact, improved indoor environmental quality has not been a priority in building design and construction, and resistance remains to incorporating it into financial decision making.”

The Leadership in Energy and Environmental Design (LEED) certification system is a green building tool and internationally recognised mark of excellence. Its goal is to deliver healthy, environmentally friendly, cost-saving buildings, homes and communities that conserve energy, reduce water consumption and improve indoor air quality through better building material choices and innovation.

The main LEED credit categories are:

- Sustainable site credits, which encourage strategies that minimise impacts on ecosystems and water resources.
- Water efficiency credits, which promote the smarter use of water and reduce drinking water consumption.
- Energy and atmosphere credits, which promote better building energy performance through innovative strategies.
- Materials and resources credits, which encourage the use of sustainable building materials and the reduction of waste.
- Indoor environmental quality credits, which promote better indoor air quality and access to daylight and views.

The LEED certification for buildings focuses mainly on ventilation requirements.

Environmental technology verification (ETV)

Environmental technology verification helps innovative environmental technologies to reach the market and enhance their environmental added value.

Under ETV, innovative environmental technologies can be assessed by an independent verification body that validates the manufacturer's claims regarding performance and environmental benefits. This public information can be used to compare performance parameters, making it a potential tool to enhance market value and acceptance.

Environmental technology verification is neither a label nor a certification scheme, and the performance of the technology is not evaluated on the basis of standards or predefined criteria. The EU is currently trying out ETV on a large scale through a pilot programme.²¹

Building policies: Relevant concepts and definitions

Biocompatibility

The most appropriate definition of biocompatibility is “the quality of not having toxic or injurious effects on biological systems” (Dorland's Medical Dictionary).

A product may be considered biocompatible if, during its entire lifecycle, from the design phase to disposal, it does not produce detrimental changes to the quality of life of the living beings with which it interacts in terms of energy and matter by issues of different physical nature, mostly gaseous.

A biocompatible building is one built with recyclable materials that are safe in terms of human health and designed to take full advantage of natural light sources and ventilation. It should be, as far as possible, self-sufficient from an energy point of view, using systems for the production of energy from renewable sources, for the recovery of water, and for the reduction of waste.

Eco-buildings

An eco-building is one constructed “in a way that does not harm the environment, for example because it is made with sustainable materials (ones that will continue to be available and not all be used up) and uses natural energy for heat etc. (Cambridge Dictionaries Online).

Green building

Green building is the practice of creating healthier structures and using processes that are environmentally responsible and resource efficient throughout a building's lifecycle from siting to design, construction, operation, maintenance, renovation and demolition. This practice expands and complements the traditional building design concerns of economy, utility, durability and comfort. A green building can also be referred to as a sustainable or high-performance building.

Green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by:

- efficiently using energy, water and other resources;
- protecting occupants' health and improving employee productivity; and
- reducing waste, pollution and environmental degradation.



The energy efficiency upgrading of buildings and indoor air quality: Suggestions for retrofitting

As inappropriate ventilation, poor maintenance and hazardous emissions from construction materials can negatively affect IAQ, energy efficiency upgrades can only improve the quality of the indoor environment and the comfort of building occupants if IAQ concerns are appropriately addressed before retrofitting work begins.

In buildings with complex and sophisticated heating, ventilation and air-conditioning (HVAC) systems, there are many possibilities for improving IAQ and comfort and for reducing energy costs, and these can also be considered in the case of new constructions.

Leading energy efficiency upgrade programmes have demonstrated the feasibility of integrating a range of IAQ and safety improvements. Two such programmes are ENERGY STAR and Indoor airPLUS, developed by the US Environmental Protection Agency,²² which provide professionals with a variety of manuals and information leaflets on construction practices and technologies in order to help address both energy efficiency and IAQ impacts from moisture and mould, pests, combustion gases and other airborne pollutants.

Some suggestions are provided below on how to protect IAQ and enhance energy efficiency in existing

buildings, especially those that have only a heating system – a situation typical in the European region, including school buildings in countries participating in the SEARCH initiative. It is important to bear in mind that the inappropriate renovation of buildings or of HVAC systems may have a negative impact on IAQ.

Overview of retrofitting measures to improve building energy performance

Retrofitting measures can be divided into two main categories:

- the renovation of the building envelope – that is, the integrated elements (whether opaque or transparent) that separate the building interior from the outdoor environment; and

- the renovation of the building's technical systems, including equipment for heating, cooling, ventilation, hot water and lighting.

Renovation of the building envelope

Window replacement

Replacing windows can contribute significantly to reducing the thermal transmittance of these building elements. An old, single-glazed window has a thermal transmittance of 4 to 5 W/m²K, while in a modern, double-glazed window this value can be as low as <1.5. The general comfort of the building occupants will therefore be improved if windows are replaced.

On the other hand, it should be borne in mind that windows that are very efficient in terms of preventing heat loss will also reduce the natural infiltration of air, which will affect the overall ventilation rate and, as a consequence, the IAQ.

If the replacement of windows is not accompanied by the installation of appropriate mechanical ventilation, stricter attention should be given to opening the windows regularly in order to ensure appropriate ventilation standards. As CO₂ levels are a commonly used indicator of poor air quality²³, a portable CO₂ detector may be useful for this purpose.²⁴

Hazardous emissions from energy efficiency building materials

The EU Construction Products Regulation (CPR) describes how building products such as insulation materials and replacement elements can improve the energy efficiency of buildings (by reducing thermal transmittance, for example). However, these products can also be a source of emissions of potentially hazardous compounds into the indoor air. As the CPR takes this into consideration, some harmonised standards for specific construction products already include this aspect.²⁵

Moisture and mould

Before renovating the building envelope, it is important to assess moisture problems including wet or damp patches, musty odour, moisture damage to windows, and condensation on both the inside and outside of walls.

The cause of moisture problems should be addressed first. Specific attention should be paid to the fact that reduced air infiltration rates can increase moisture problems, and to the fact that the properties of some building elements (such as insulation materials) can be severely altered by moisture.

Condensation problems can be caused by renovated building elements and should be appropriately managed. It is important to monitor the amount of moisture vapour within the building envelope and to prevent the dew point temperature from being reached (i.e. the temperature at which condensation first starts to form). This can be done by selecting materials, including insulating materials, with an appropriate combination of thermal characteristics and vapour permeability.

Renovation of technical systems

Lighting

Lighting represents a significant proportion of a building's general electricity consumption. Total consumption for lighting depends on occupants' behaviour, the use of energy-efficient light bulbs, and the amount of natural daylight available.

In order to make the most of natural daylight, reflective paint can be used on ceilings and the upper part of walls, which can contribute to the even distribution of daylight around a room. Such paints should not be used on the lower parts of walls, where reflection could be a nuisance, and information about the chemical safety of such products should always be obtained before they are used.

Light pipes, which transport or distribute natural or artificial light, are another potential retrofitting measure in rooms that lack sufficient natural light.

Heating

Most energy retrofitting measures related to heating systems do not have an impact on IAQ but can lead to improvements in occupants' comfort levels.

Replacing conventional boilers with high-efficiency boilers – or, where technically and economically possible, with biomass boilers or other renewable energy technologies such as heat pumps, geothermal heat pumps or thermal solar collectors – can contribute to reducing overall energy consumption.

The replacement of a boiler is also an opportunity to assess the possibility of equipment downsizing, especially in association with the renovation and improvement of the building envelope. This can contribute to reducing investment as well as energy costs. Particular attention should be given to the appropriate exhaustion of flue gases in order to protect IAQ.

The use of variable speed pumps for circulating water in heating systems can dramatically reduce electricity costs and can therefore be regarded as an essential aspect of heating system renovation. Thermostatic radiator valves are a simple and cost-effective tool for improving occupants' comfort.²⁶ As they contribute to energy savings while having no negative impacts on IAQ they have an important role in the appropriate management of indoor temperatures.

Energy efficiency and indoor air quality

The following three points can contribute to ensuring the efficient use of energy in buildings and can also be kept in mind when considering the energy retrofitting of buildings:

- Natural ventilation should not be reduced in the interests of saving energy if mechanical ventilation is not available. Ventilation standards are intended to ensure the dilution of indoor pollutants by the introduction of outdoor air. Ventilation must always be ensured, and the benefits in terms of IAQ improvement should not be affected by energy-saving measures.
- Where feasible, HVAC operations should be reduced at night and during periods when the building is not in use, but only in such a way that occupants' comfort is ensured at all times.
- In summer, the cooler outdoor air at night can be used to cool the building and exhaust accumulated pollutants (night pre-cooling). When necessary and possible, it is therefore a good idea to leave the windows open at night to “flush” the building.



The SEARCH II project partner questionnaire

Information was obtained from SEARCH II partner countries on existing legal instruments and preventive tools that can potentially be used to improve IAQ in schools. The aim was to investigate whether these instruments include an assessment of hazardous emissions from a variety of products used in school buildings.

Introduction

The aim of the questionnaire, which was sent to all SEARCH II partner countries²⁷, was to explore the various mechanisms and tools already in place in the countries (e.g. legal acts, regulations, voluntary schemes and guidelines) to support risk management in the case of indoor sources impacting on IAQ. The questionnaire was intended to identify, for example, whether chemical emissions from building materials or consumer products in the framework of labelling or certification procedures are somehow regulated before those products are placed on the market.

The questionnaire also investigated whether IAQ in relation to chemicals potentially released into the indoor environment by these products is monitored regularly or only for the purposes of research/surveys, and whether there are competent authorities for IAQ management.

The questionnaire was organised according to the different classes of products that may affect IAQ:

- construction materials;
- heating/cooling systems;
- cleaning products;
- furnishings;
- toys;
- electronic equipment;
- pest control products;
- air fresheners; and
- fireplaces.

This classification follows the database structure of the EU project Prioritisation of Building Materials as Indoor Pollution Sources.²⁸

Information was gathered from each country for each product category in order to obtain an overview of existing preventive tools that can potentially be used to improve IAQ. This information is presented in Tables 1 to 7 and discussed below.

It is important to underline that the experts were requested to give information for quite a broad field of investigation, going beyond the usual environment and health aspects. As a result, a detailed description of all (national and local) policies related to the impact of consumer products on IAQ cannot be expected. However, the gathered information was sufficient to provide an overview of the issue.

The questionnaires for each individual country can be found in Annex I to the present document, and the combined questionnaires and Excel table can be downloaded from:
www.isprambiente.gov.it/files/progetti/search
 or search.rec.org.

Overview of questionnaire results

Questionnaires were completed by seven of the 10 SEARCH II partner countries: Belarus, Bosnia and Herzegovina, Hungary, Italy, Kazakhstan, Serbia and Slovakia. The Health and Environment Alliance (HEAL), an NGO from Belgium, also kindly joined the initiative.

Due to substantial changes in the legislation to achieve compliance with the EU acquis by 2014, Albania was not able to provide specific answers in each of the categories. The Ministry of Environment is the competent authority for the existing legislation on outdoor air and, to some extent, indoor air.²⁹

Other countries are changing their environment and health framework. On July 1, 2010, for example, the Customs Union Agreement between Russia, Belarus and Kazakhstan on veterinary and public health measures

entered into force, replacing existing legislation such as the old hygiene-epidemiological certificate used in Kazakhstan (see Kazakhstan questionnaire).

Generally speaking, many countries have regulations for most of the listed product categories, even if there are differences in the type of legal act: some have public health regulations, while others use rulebooks, national decrees or technical rules, for example. Although positive answers were received in relation to consumer product regulation, it was not possible to ascertain whether chemicals were included in the IAQ definition or in the monitoring and/or assessment procedures for authorisation and labelling schemes, mainly due to language and time constraints.

Competent authorities for IAQ monitoring

The results show that only three countries have competent authorities for IAQ monitoring: Belgium and Hungary have specific regulations for schools, hospitals, workplaces, residential dwellings and leisure centres. Italian legislation provides regulations at national level for workplaces and health services. Guidelines for the school indoor environment to prevent respiratory diseases among children were approved in 2010 but are not compulsory at local level.

Construction materials

Table 1 shows the responses related to construction materials, which included the sub-categories of paints, wood, floor covering, windows, wall panels and other.

Of the eight countries, only five stated that IAQ is included in their legal acts, although they did not specify to what extent – whether monitoring, management, prevention, a combination of these, or all of them. In most cases, IAQ in sustainable building policies refers mainly to ventilation systems, microclimatic parameters in general, or in relation to outdoor air pollution, and this might also apply in the case of those countries that stated that IAQ is included in their legal acts. This issue would therefore need more detailed investigation.

Only four countries responded positively to the question regarding the existence of voluntary instruments in this category. Most of them use the Regulation on the EU Ecolabel, ISO standards and technical specifications or other certification and labelling schemes, and to some extent IAQ is considered in all of them. However, once again there is no indication of how this is done.

Four countries also use other preventive tools to improve IAQ, including projects, studies, guidelines and recommendations on the possible impacts of building materials on the indoor air. Only two of the four countries stated that impacts on IAQ were considered in this category.

Heating and cooling

Table 2 shows that seven countries have legal acts regulating this product category, and IAQ is included in only two countries.

Only one country uses complementary instruments establishing the ecological criteria for awarding the EU Ecolabel, while two countries use other tools such as guidelines and projects to improve IAQ by the prevention of heating or cooling emissions, and only one of those countries addresses IAQ through a labelling system.

Cleaning products

This category includes all cleaning products in general. Table 3 shows that seven countries have legal acts regulating this product category, and only one of these takes IAQ into consideration. Only one country uses other preventive instruments such as guidelines for improving IAQ.

Regarding voluntary certification, neither of the two countries that responded to the question considers IAQ directly.

Furnishing

Table 4 shows that three countries have legal acts to regulate this product category. One of these includes consideration of IAQ. Only three countries use complementary

instruments such as the EU Ecolabel and technical specifications, while one of those two countries considers IAQ through technical specifications. Three countries use other voluntary tools such as technical standards for textiles, which do not concern emissions into the indoor air directly, as these standards refer to the safety of products in the case of fire.

Toys

Only six countries stated that they have specific legislative acts on toys, and only one includes IAQ in the public health regulation. As shown in Table 5, only one country has voluntary instruments that contain consideration of IAQ.

Electronic equipment

In this category, only six countries stated that they have legal acts, and only one country considers IAQ. Only one country has methodological guidelines and measurement procedures for IAQ. Responses are presented in Table 6.

Pest control, air fresheners and fireplaces

These three categories were included in the same subchapter because no answers were received on voluntary and other tools (Table 7).

With respect to potential emissions into the indoor air from pest control products, six countries have legal acts. Only two countries stated that IAQ is included in these acts, but without specifying to what extent. With respect to air fresheners, four countries declared that they have legal acts, and only one of them specified that this legal act does not include IAQ. One of these four countries is developing a legal act. With respect to potential emissions into the indoor air from fireplaces, only two countries stated that they have a public health regulation, this being also within the Decision on the Customs Union, and of these only one refers to IAQ.

TABLE 1 CONSTRUCTION MATERIALS

Potential preventive tools in relation to IAQ						
	Legal (legislative acts...)	IAQ/indoor emissions included	Voluntary certification	IAQ/indoor emissions included	Other (guidelines, projects etc.)	IAQ/indoor emissions included
Belarus	<ul style="list-style-type: none"> • 5 public health regulations • 5 guidelines • 4 national laws 	YES YES YES	<ul style="list-style-type: none"> • Wall panels • Wood • Windows • Paint • Other construction materials (and rules) 	N/A	N/A	N/A
Bosnia and Herzegovina	<ul style="list-style-type: none"> • 5 national laws: 1 national law for Fed. BiH 4 national laws for Rep. Srpska • 13 technical rulebooks: 12 technical rulebooks for Fed. BiH 1 technical rulebook for Rep. Srpska • 1 rulebook on labelling of construction products for Fed. BiH • 1 rulebook on construction product certification for Fed. BiH 	YES	N/A	N/A	<ul style="list-style-type: none"> • Guidelines for Fed. BiH 	N/A
Hungary	<ul style="list-style-type: none"> • 2 national ministerial decrees • 1 national regulation • 2 ministerial decrees • 1 national regulation 	YES YES NO NO	<ul style="list-style-type: none"> • Construction materials • Ecolabel Regulation (EC) No 66/2010 • Wood and paint 	N/A YES	<ul style="list-style-type: none"> • Cleaning, ventilation, temperature and lighting in workplaces 	N/A
Italy	<ul style="list-style-type: none"> • 3 ministerial decrees • 3 legislative decrees 	NO YES	<ul style="list-style-type: none"> • Standards and specifications for paints and floor coverings • Ecolabel Regulation (EC) No 66/2010 	YES	<ul style="list-style-type: none"> • Paint • Floor covering 	YES
Kazakhstan	<ul style="list-style-type: none"> • Decision on the Customs Union 	NO	N/A	N/A	N/A	N/A
Serbia	<ul style="list-style-type: none"> • 1 national regulation • 1 national law 	N/A	N/A	N/A	N/A	N/A
Slovakia	<ul style="list-style-type: none"> • 3 EU regulations 	YES	<ul style="list-style-type: none"> • Standards and specifications for paints and wood 	YES	N/A	N/A
Belgium	<ul style="list-style-type: none"> • Royal decree (project) 	YES	<ul style="list-style-type: none"> • The Belgian Building Research Institute (CSTC) informs the public about low-emission labels 	YES	<ul style="list-style-type: none"> • Studies assessing emissions from different products and materials 	YES

TABLE 2 HEATING AND COOLING SYSTEMS

Potential preventive tools in relation to IAQ

	Legal (legislative acts...)	IAQ/indoor emissions included	Voluntary certification	IAQ/indoor emissions included	Other (guidelines, projects etc.)	IAQ/indoor emissions included
Belarus	<ul style="list-style-type: none"> • 1 public health regulation • 1 national specifications and rules 	<p>YES</p> <p>YES</p>	N/A	N/A	N/A	N/A
Bosnia and Herzegovina	<ul style="list-style-type: none"> • 2 national laws: 1 national law for Fed. BiH 1 national law for Rep. Srpska • 8 rulebooks 5 rulebooks for Fed. BiH 3 rulebooks for Rep. Srpska • 2 regulations for Rep. Srpska 	<p>YES</p> <p>YES</p>	N/A	N/A	N/A	N/A
Hungary	<ul style="list-style-type: none"> • 3 ministerial decrees 	N/A	N/A	N/A	<ul style="list-style-type: none"> • Technical standards 	N/A
Italy	<ul style="list-style-type: none"> • 1 regional legislation • 1 national law • 3 ministerial decrees (1 of which under development) • 1 presidential decree • 1 ministerial circular 	NO	<ul style="list-style-type: none"> • Commission Decision 2013/135 	N/A	<ul style="list-style-type: none"> • Technical standards • Nordic Ecolabel • Guidelines • Ministerial decree for schools • Specifications and standards 	YES
Kazakhstan	<ul style="list-style-type: none"> • Decision on the Customs Union 	NO	N/A	N/A	N/A	N/A
Serbia	N/A	N/A	N/A	N/A	N/A	N/A
Slovakia	<ul style="list-style-type: none"> • 1 national law 	N/A	N/A	N/A	N/A	N/A

TABLE 3 CLEANING PRODUCTS

Potential preventive tools in relation to IAQ

	Legal (legislative acts...)	IAQ/indoor emissions included	Voluntary certification	IAQ/indoor emissions included	Other (guidelines, projects etc.)	IAQ/indoor emissions included
Belarus	<ul style="list-style-type: none"> • 1 public health regulation • 2 technical regulations 	YES YES	<ul style="list-style-type: none"> • Technical standards 	N/A	N/A	N/A
Bosnia and Herzegovina	<ul style="list-style-type: none"> • 1 law for the State of BiH • 2 laws for Fed. BiH • 4 laws for Rep. Srpska 	N/A	N/A	N/A	N/A	N/A
Hungary	N/A	N/A	N/A	N/A	N/A	N/A
Italy	<ul style="list-style-type: none"> • REACH Regulation (EC No. 1907/2006) 	N/A	<ul style="list-style-type: none"> • Ecolabel Regulation (EC No. 66/2010) 	N/A	<ul style="list-style-type: none"> • Environmental Product Declaration • International Association for Soaps, Detergents and Maintenance Products • Guidelines on delivery rooms³⁰ • EcoBio certification by the Ethical and Environmental Certification Institute (ICEA) 	N/A
Kazakhstan	<ul style="list-style-type: none"> • Decision on the Customs Union 	NO	N/A	N/A	N/A	N/A
Serbia	<ul style="list-style-type: none"> • Rulebook on detergents 	NO	N/A	N/A	N/A	N/A
Slovakia	<ul style="list-style-type: none"> • 2 EU regulations 	N/A	N/A	N/A	N/A	N/A

TABLE 4 FURNISHING

Potential preventive tools in relation to IAQ						
	Legal (legislative acts...)	IAQ/indoor emissions included	Voluntary certification	IAQ/indoor emissions included	Other (guidelines, projects etc.)	IAQ/indoor emissions included
Belarus	<ul style="list-style-type: none"> • 2 technical regulations • 1 public health regulation 	YES YES	<ul style="list-style-type: none"> • Furniture • Textiles/carpets 	YES	<ul style="list-style-type: none"> • Textiles (cotton and polyester blends) 	YES
Bosnia and Herzegovina	N/A	N/A	N/A	N/A	N/A	N/A
Hungary	N/A	N/A	N/A	N/A	N/A	N/A
Italy	<ul style="list-style-type: none"> • 2 ministerial decrees on textiles 	NO	<ul style="list-style-type: none"> • Ecolabel for textiles (Regulation EC No. 66/2010) 	N/A	<ul style="list-style-type: none"> • OEKO_TEX Standard 100 (for textiles) 	N/A
Kazakhstan	<ul style="list-style-type: none"> • Decision on the Customs Union 	NO	N/A	N/A	N/A	N/A
Serbia	N/A	N/A	N/A	N/A	N/A	N/A
Slovakia	N/A	N/A	<ul style="list-style-type: none"> • Ecolabel for textiles (Regulation EC No. 66/2010) 	N/A	<ul style="list-style-type: none"> • OEKO_TEX Standard 100 (for textiles) • 1 government regulation on general product safety 	N/A

TABLE 5 TOYS

Potential preventive tools in relation to IAQ						
	Legal (legislative acts...)	IAQ/indoor emissions included	Voluntary certification	IAQ/indoor emissions included	Other (guidelines, projects etc.)	IAQ/indoor emissions included
Belarus	<ul style="list-style-type: none"> • 2 public health regulations • 1 technical regulation • 1 hygiene standard 	YES YES YES	<ul style="list-style-type: none"> • Technical regulation 	YES	N/A	N/A
Bosnia and Herzegovina	<ul style="list-style-type: none"> • 1 national regulation • 2 national directives 	N/A	N/A	N/A	N/A	N/A
Hungary	<ul style="list-style-type: none"> • 1 ministerial common decree 	N/A	N/A	N/A	N/A	N/A
Italy	<ul style="list-style-type: none"> • 1 legislative decree 	YES	N/A	N/A	N/A	N/A
Kazakhstan	<ul style="list-style-type: none"> • 1 technical regulation 	NO	N/A	N/A	N/A	N/A
Serbia	N/A	N/A	N/A	N/A	N/A	N/A
Slovakia	<ul style="list-style-type: none"> • 1 national directive • 1 national law • 1 government regulation 	N/A	N/A	N/A	N/A	N/A

TABLE 6 ELECTRONIC EQUIPMENT

Potential preventive tools in relation to IAQ						
	Legal (legislative acts...)	IAQ/indoor emissions included	Voluntary certification	IAQ/indoor emissions included	Other (guidelines, projects etc.)	IAQ/indoor emissions included
Belarus	<ul style="list-style-type: none"> 1 technical regulation of the Customs Union 1 technical code of good practice 1 public health regulation 1 public health regulation 	YES NO	<ul style="list-style-type: none"> Every approved technical regulation of the Customs Union includes a list of documents (methodological guidelines, procedures for measurements, instructions etc.) 	YES	N/A	N/A
Bosnia and Herzegovina	<ul style="list-style-type: none"> 2 laws 1 law for Fed. BiH 1 law for Rep. Srpska 3 rulebooks 1 rulebook for Fed. BiH 2 rulebooks for Rep. Srpska 	YES YES	N/A	N/A	N/A	N/A
Hungary	N/A	N/A	N/A	N/A	N/A	N/A
Italy	<ul style="list-style-type: none"> Ministerial decree Legislative decree on conformity of electronic equipment Law on security 	NO	N/A	N/A	N/A	N/A
Kazakhstan	<ul style="list-style-type: none"> Decision on the Customs Union 	NO	N/A	N/A	N/A	N/A
Serbia	<ul style="list-style-type: none"> Law on waste management 	NO	N/A	N/A	N/A	N/A
Slovakia	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 7 PEST CONTROL, AIR FRESHENERS AND FIREPLACES

Potential preventive tools in relation to IAQ						
	PEST CONTROL		AIR FRESHENERS		FIREPLACES	
	Legal (legislative acts...)	IAQ/indoor emissions included	Legal (legislative acts...)	IAQ/indoor emissions included	Legal (legislative acts...)	IAQ/indoor emissions included
Belarus	<ul style="list-style-type: none"> 1 public health regulation 1 hygiene standards 	YES	N/A	N/A	<ul style="list-style-type: none"> 1 public health regulation 	YES
Bosnia and Herzegovina	<ul style="list-style-type: none"> 1 national law 1 national regulation 	N/A	<ul style="list-style-type: none"> 1 law (Fed. BiH) 1 law (Rep. Srpska) 	N/A	N/A	N/A
Hungary	<ul style="list-style-type: none"> 1 ministerial common decree 	N/A	N/A	N/A	N/A	N/A
Italy	<ul style="list-style-type: none"> Presidential decree on pesticides Legislative decree on biocides 	N/A YES	<ul style="list-style-type: none"> Ministerial decree under preparation 	N/A	N/A	N/A
Kazakhstan	<ul style="list-style-type: none"> Public health regulation "Sanitary-Epidemiological Requirements for Health Facilities" 	NO	<ul style="list-style-type: none"> Decision on the Customs Union 	NO	<ul style="list-style-type: none"> Decision on the Customs Union 	NO
Serbia	<ul style="list-style-type: none"> Law on biocide products 	N/A	N/A	N/A	N/A	N/A
Slovakia	N/A	N/A	<ul style="list-style-type: none"> 1 EU regulation 	N/A	N/A	N/A
Belgium	<ul style="list-style-type: none"> Royal decree 	N/A	N/A	N/A	N/A	N/A

Conclusions

The questionnaire was designed to identify the existence in the SEARCH II countries of legal instruments and tools to support risk management in relation to indoor sources of hazardous chemicals; and of plans for voluntary labelling or certification procedures and/or indoor air monitoring, including chemicals such as VOCs. Although the gathered information cannot be considered exhaustive, bearing in mind language barriers and the wide field of investigation – which goes far beyond the traditional environment and health domain – it is nevertheless possible to draw some preliminary conclusions.

First of all, the questionnaire results show that almost all SEARCH II countries have several institutional tools

(legal and/or voluntary) that can be considered related to the safety of listed consumer goods that, potentially, may influence the indoor air chemistry.

The question remains whether the consideration of "safety" in a single regulation at national level also includes the issue of IAQ and, if so, whether an assessment of hazardous chemical emissions from consumer products is provided together with the other criteria.

However, considering the increasing knowledge of this issue, the upgrading of existing tools is desirable and might also include further discussion on the need for, and role of, an IAQ competent authority to support effective IAQ management.



Overall conclusions

The rapid integration of sustainability policies into less traditional domains such as consumer products and building policies is a challenge for environmental experts, and these policies may represent a strategic, if not the only, tool to safeguard the quality of the indoor air.

To achieve this goal, further efforts are needed on the part of researchers and policy makers, and the aim of this paper is mainly to raise awareness among them. For this purpose, we would like to share the following preliminary conclusions.

All the areas briefly analysed in this document, including the results of the partner country questionnaires, illustrate how IAQ issues need to be further considered in key policies, and also that an effective operational framework capable of addressing IAQ in sustainable consumption and production policies, as well in sustainable building policies, is both appropriate and desirable.

Ecological schemes and labelling have been very successful in preventing harmful pollution and improving resource use, but generally the indoor environment is still not widely considered as an environmental media throughout the lifecycle assessment (LCA) process, since the overall approach of such policies is to take into account only potential impacts on “traditional” environ-

mental media such as water, soil and the ambient air. The EU Ecolabel and LCA are interconnected with all policies, including those in the sustainable buildings framework, that have been discussed in this document.

The management of energy use in buildings will require further attention, apart from considerations of ventilation and other microclimate parameters, including the influence of building energy on the indoor air chemistry as well as the safety of potential emissions from materials used to produce energy.

To achieve compliance with the objectives of the renewed EU Sustainable Development Strategy, especially the goal of “improving indoor air quality, with particular attention to VOCs emissions...”³¹, in the medium term the introduction of VOCs emissions assessments could be a way to improve IAQ management at local level, boost (safe) green business, and avoid misleading perceptions among consumers with respect to eco-friendly products.



Annexes and endnotes

Annex I: SEARCH II questionnaire

Introduction to the questionnaire

The questionnaire aims to explore mechanisms and tools in your country supporting the risk management of indoor sources impacting indoor air quality, such as emissions from materials used in the building envelope and furnishings as well as other consumer products. We aim to investigate whether regulations, labelling or certification procedures related to these products include an assessment of hazardous indoor emissions released by them that can be considered harmful to IAQ and/or health.

The list of products included in the questionnaire is quite broad, although the main focus is on materials that are used in the implementation of sustainability policies such as the energy efficiency of buildings, eco-innovation or sustainable consumption and production. The product list contained in the questionnaire was inspired by the database of the EU project Prioritisation of Building Materials as Indoor Pollution Sources (BUMA).³²

For each product category, the questionnaire also investigates potential preventive tools in your country related to indoor air in order to identify whether the marketing of the products is in accordance with legal regulations (e.g. the EU Construction Products Regulation) and/or voluntary certification schemes (such as the EU Ecolabel), or, in the absence of regulations, national guidance/recommendations. The questionnaire also identified whether indoor emissions are considered in existing preventive tools by exploring whether materials produced and/or purchased as environmentally friendly or eco-friendly products also include an evaluation of IAQ and/or hazardous emissions that have an impact on IAQ.

The questionnaire also investigates whether there are competent authorities for IAQ monitoring and if this is done on a regular basis or just occasionally for research activities and/or surveys.

Country:

Questionnaire filled out by:

Institution:

Address:

Telephone/Fax:

E-mail:



General information

Do you have a competent authority for indoor air quality monitoring (IAQM) in your country?

YES

NO

If YES, for which indoor environments is the IAQM competent authority responsible?

Schools

Residential dwellings

Hospitals

Leisure centres

Workplaces (public and private)

Other (please specify)

Questionnaires sent to each country

POTENTIAL PREVENTIVE TOOLS IN RELATION TO IAQ

Product categories and sub-categories	Legal (legislative acts...)	IAQ/indoor emissions included		Voluntary certification	IAQ/indoor emissions included		Other (guidelines, projects etc.)	IAQ/indoor emissions included	
		Y	N		Y	N		Y	N
Construction materials									

Notes:

POTENTIAL PREVENTIVE TOOLS IN RELATION TO IAQ

Product categories and sub-categories	Legal (legislative acts...)	IAQ/indoor emissions included		Voluntary certification	IAQ/indoor emissions included		Other (guidelines, projects etc.)	IAQ/indoor emissions included	
		Y	N		Y	N		Y	N
Cleaning products									

Notes:

POTENTIAL PREVENTIVE TOOLS IN RELATION TO IAQ

Product categories and sub-categories	Legal (legislative acts...)	IAQ/indoor emissions included		Voluntary certification	IAQ/indoor emissions included		Other (guidelines, projects etc.)	IAQ/indoor emissions included	
		Y	N		Y	N		Y	N
Electronic equipment (only potential emissions of hazardous substances, not electromagnetic emissions)									

Notes:

POTENTIAL PREVENTIVE TOOLS IN RELATION TO IAQ

Product categories and sub-categories	Legal (legislative acts...)	IAQ/indoor emissions included		Voluntary certification	IAQ/indoor emissions included		Other (guidelines, projects etc.)	IAQ/indoor emissions included	
		Y	N		Y	N		Y	N
Furnishings (e.g. textiles, carpets)									

Notes:

POTENTIAL PREVENTIVE TOOLS IN RELATION TO IAQ

Product categories and sub-categories	Legal (legislative acts...)	IAQ/indoor emissions included		Voluntary certification	IAQ/indoor emissions included		Other (guidelines, projects etc.)	IAQ/indoor emissions included	
		Y	N		Y	N		Y	N
Heating/cooling									

Notes:

POTENTIAL PREVENTIVE TOOLS IN RELATION TO IAQ

Product categories and sub-categories	Legal (legislative acts...)	IAQ/indoor emissions included		Voluntary certification	IAQ/indoor emissions included		Other (guidelines, projects etc.)	IAQ/indoor emissions included	
		Y	N		Y	N		Y	N
Air fresheners (candles, sprays)									
Fireplaces (stoves and woodstoves)									
Pest control (herbicides, fungicides)									
Toys									
Other									

Notes:

Annex II: EU initiatives on improving IAQ

EnVIE

The EnVIE project – European Co-ordination Action on Indoor Air Quality and Health Effects (2003–2008) – developed a new modelling tool to evaluate the quantitative relationship between IAQ-related diseases (allergies, asthma symptoms, lung cancer, chronic obstructive pulmonary disease, airborne respiratory infections, cardiovascular morbidity and mortality, sick building syndrome), sources of relevant indoor exposure, and the impact of policy control measures to address these sources in order to minimise negative impacts on health in terms of achievable public health benefits, invasiveness, and political, legal, technological, economic and social feasibility. The project also recognised that there is still a long way to go before we are able to characterise all the health impacts of certain pollutants at their current indoor concentrations.

The EnVIE project identified two strategies for controlling IAQ:

- source control (eliminating or mitigating sources); and
- exposure control (ventilation).

Other EU projects

Within the framework of the EU Environment and Health Action Plan (2004–2010), several projects have been undertaken with the aim of improving air quality in indoor environments and addressing related health risks. Some of the most recent studies, arranged according to research category, are described in the following pages.

Prioritising IAQ-relevant pollutants with respect to health effects

Towards Healthy Air in Dwellings in Europe (THADE), 2002–2004

The THADE expert consultants identified the main health determinants in dwellings as tobacco smoke, indoor-generated particulate matter, carbon monoxide, carbon dioxide, formaldehyde, dust mites, pet allergens, cockroaches, mould, pollen, nitrogen oxide, volatile organic compounds (VOCs), artificial mineral fibres and radon.

Methods for preventing, reducing or eliminating the adverse effects of poor air quality were identified for each of the above determinants. The suggested measures will improve IAQ and alleviate the symptoms of allergy, asthma and chronic obstructive pulmonary disease, but they will not necessarily prevent these conditions. The measures proposed in the report will enhance quality of life for everyone.

Critical Appraisal of the Setting and Implementation of Indoor Exposure Limits in the EU (INDEX), 2003–2005

The scope of INDEX was to identify priorities and assess the need for an EU strategy and action plan in the area of indoor air pollution by:

- establishing a list of compounds to be regulated in indoor environments as a priority on the basis of health impact criteria;
- providing suggestions and recommendations on potential exposure limits for these compounds; and
- providing information on links with existing knowledge, ongoing studies, legislation etc. on a world scale.

The Scientific Committee on Health and Environmental Risks (SCHER)

The Opinion on Risk Assessment on IAQ was published in May 2007. The SCHER document:

- identifies a risk assessment strategy to support IAQ policy, taking into account potentially vulnerable population groups such as children, pregnant women and elderly people; and considers the practicability of risk assessment on combined exposure and the cumulative effects of specific air pollutants;
 - assesses current information and data requirements in order to fill gaps related to exposure/effect and dose/response relationships, existing measurement standards, and the knowledge required to help guide further research and monitoring efforts;
 - considers the risks associated with the use of air fresheners; and
 - identifies potential areas of concern in relation to:
 - specific chemical compounds, taking into account the recent INDEX report prepared by the JRC;
 - household chemicals (e.g. decorating materials, cleaners, furnishings etc.); and
 - building dampness/moisture and microbial growth (moulds, bacteria).
- and existing non-industrial buildings (offices, homes, public buildings, schools, nurseries and day-care centres), reconciling health and energy aspects;
- prevent major diseases, reduce health inequalities and promote sustainable health investments at national and regional level;
 - protect EU citizens against health risks due to poor IAQ as a result of deficient ventilation (rates, strategies and practices);
 - avoid energy investments and costs due to the operation of ventilation systems at ventilation rates not supported by tangible benefits in terms of health, productivity and welfare;
 - ensure the rational use of energy and greater energy efficiency in new and existing non-industrial buildings in Europe;
 - assist member states to revise existing building codes and practices in terms of energy efficiency;
 - assist the EU to optimise and revise policies relevant for healthy indoor air and dealing with source control, urban ambient air quality and low-energy buildings;
 - complement existing IAQ guidelines; and
 - outline for member states the possibilities for integrating IAQ in energy-related inspections and audits.

Establishing guideline values for key IAQ pollutants

Health-Based Ventilation Guidelines for Europe (HealthVent), 2010–2012

The project was launched in order to:

- develop health-based ventilation guidelines for new

Monitoring exposure patterns and health

Harmonised Criteria and Protocols for Monitoring Key Indoor Air Pollutants (INDOOR-MONIT), 2009–2010

The aim was to ensure the consistency of IAQ measurements and thus increase their comparability across the EU, focusing on:

- the design of an indoor air monitoring study;
- IAQ monitoring techniques; and
- data collection, evaluation and reporting.

European Indoor Air Monitoring and Exposure Assessment (AIRMEX), 2006–2009

The project monitored indoor, outdoor and individual exposure to selected chemical compounds (aromatics, carbonyls, terpenes and other volatile organic compounds) in Europe. The AIRMEX output was a database containing results for 23 VOCs based on approximately 1,000 samples taken from 182 different working environments (offices, classrooms, waiting rooms) in public buildings, schools and kindergartens, and from 103 private homes from adult volunteers (148 samples).

Health Effects of Indoor Pollutants: Integrating Microbial, Toxicological and Epidemiological Approaches (HITEA), 2008–2013

This collaborative project addressed indoor air pollution in Europe with the aim of identifying the role of indoor (biological) agents that lead to long-term respiratory, inflammatory and allergic health impacts among children and adults.

The project is divided into three parts:

- assessment of exposure to biological agents in schools across Europe in order to investigate the effects of multiple exposures on children's and teachers' respiratory health;
- extensive assessment of exposure to biological and other relevant agents in the indoor home environment in several regions of Europe; and

- assessment of exposure to biological agents among European population groups, emphasising long-term health impacts.

Emissions, Exposure Patterns and Health Effects of Consumer Products in the EU (EPHECT), 2010–2013

The project focused on consumer products, potential sources of hazardous air pollutants, and other air pollutants in households that are relevant to health.

The main aim was to identify a set of key indoor air pollutants and pollutants emitted by a selection of consumer product classes (personal care products, air fresheners, cleaning agents and sprays) in order to reduce the risks associated with the indoor use of such consumer products and to contribute to a healthier indoor environment.

The data will contribute to the development of the building materials and consumer products (BUMAC) database. The overall risk associated with inhalation exposure will be studied and evaluated in order to achieve appropriate risk assessment, guidance and policy recommendations on exposure reduction, with attention to vulnerable groups such as children and elderly people.

Identifying and addressing sources of indoor air pollution

Prioritisation of Building Materials as Indoor Pollution Sources (BUMA), 2006–2009

The BUMA project database is integrated into the website www.buma-project.eu and contains more than 400 building materials (floorings, wood-based panels, carpets, paints, adhesives etc.), 400 emitted substances

and 8,000 emissions data. It is intended for use by stakeholders such as policy makers, health professionals, industrial and building professionals, building occupants and building owners in order to:

- obtain up-to-date data regarding emissions from building materials;
- make comparisons between specific materials and optimum choices in terms of emissions; and
- estimate indoor levels of exposure to emissions from building materials in microenvironments.

Reducing exposure patterns to key IAQ pollutants

Clean and Resource-Efficient Buildings for Real Life (CLEAR-UP), 2008–2012

The goal was to reduce energy use in existing buildings by developing sustainable approaches to the management of the indoor environment.

The CLEAR-UP approach was to use sensors and intelligent control to provide a low-energy optimised indoor environment with active and passive systems for lighting, ventilation and temperature control using both natural and technological solutions. The approach was applied in order to improve both existing and new buildings.

Radon Prevention and Remediation (RADPAR), 2009–2012

The RADPAR project aimed to help reduce the significant public health burden of radon-related lung cancer in EU member states.

The specific objectives were to:

- help improve the strategies currently in place and reduce the health burden of radon on the EU population;
- develop radon risk communication strategies and approaches for different population groups in the EU;
- establish measurement procedures for radon control technologies and sources;
- assess the cost-effectiveness of existing and potential radon prevention and remediation strategies in the EU;
- design training courses for radon measurement, prevention, remediation and cost-effectiveness analysis; and
- assess the potential conflicts between energy conservation in buildings and radon exposure reduction.

On the Reduction of Health Effects from Combined Exposure to Indoor Air Pollutants in Modern Offices (OFFICAIR), 2010–2013

The specific objectives of the collaborative European OFFICAIR project, which received funding under the EU 7th Framework Programme, were to:

- establish a framework, including databases, modelling tools and assessment methods, that provides new knowledge towards an integrated approach to assessing health risks from indoor air pollution, focusing on modern office buildings; and
- support current EU policies, such as the Thematic Strategy on Air Pollution, and the European Environment and Health Strategy and Action Plan.

Understanding the factors affecting IAQ in specific indoor environments and the associated health of specific population groups

Schools Indoor Pollution and Health: Observatory Network in Europe (SINPHONIE), 2010–2012

The project aimed to:

- review previous research on IAQ and its impact on health in schools, and assess the policy relevance of the research objectives and conclusions;
- assess the outdoor/indoor school environment and its impact on health;
- manage risks and develop guidelines/recommendations; and
- disseminate these guidelines/recommendations to relevant stakeholders.

Integrated Exposure for Risk Assessment in Indoor Environments (INTERA), 2010–2012

This project aimed to improve understanding of human exposure to air pollutants in homes by defining optimal methodologies for predicting indoor exposure to chemical contaminants and their interrelationships.

Labelling schemes and IAQ: Harmonisation of information on indoor emissions from materials in the EU

Due to the various labelling systems in use across the EU, and in relation to emissions to the indoor air from materials (consumer products), the EC initiated an inventory of labelling schemes in 2005.³³

The report conclusions emphasise the importance of harmonising indoor material emissions labelling schemes. Ideally, each individual test would provide sufficient information for several labels.

In the interests of further harmonisation, the study recommends that labelling systems be required to use common procedures for testing and analysis (including sensory tests if relevant). Further work should also be undertaken towards the convergence of existing labelling systems. The experience gained through the establishment of existing labelling systems for VOCs emissions from building materials should be taken into consideration in the framework of implementing the third basic requirement for construction works, related to hygiene, health and the environment (see Annex I of the CPR), which replaces Essential Requirement No. 3 of the CPD.

Endnotes

- 1 7th EAP, Priority Objective 3: "In order to safeguard EU citizens from environment-related pressures and risks to health and wellbeing, the programme shall ensure that by 2020 the combination effects of chemicals and safety concerns related to endocrine disruptors are effectively addressed, and risks for the environment and health associated with the use of hazardous substances, including chemicals in products, is assessed and minimized."
- 2 See, among others, the EnVIE project (European Coordinated Action on Indoor Air Quality and Health Effects), FP6, 2003–2006.
- 3 The EU SDS was adopted by the Council of the European Union on June 26, 2006 (10917/06). It states that "the Commission should propose a strategy for improving indoor air quality, with particular attention to VOC emissions..."
- 4 COM(2001) 68 final.
- 5 Ibid.
- 6 Ibid.
- 7 COM (2008) 397.
- 8 Ibid. "Sustainable consumption and production policies will be promoted, as part of the United Nations Sustainable Consumption and Production 10-Year Framework of Programmes (Marrakesh Process)."
- 9 The "lifecycle approach" assesses the environmental impacts associated with all stages of a product's life, from cradle to grave (i.e. from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling).
- 10 Directive 89/106/EEC.
- 11 Regulation 305/2011/EU.
- 12 <http://ec.europa.eu/environment/ecolabel/products-groups-and-criteria.htm>.
- 13 <http://susproc.jrc.ec.europa.eu/buildings/whatsnew.html>.
- 14 Since 2010, criteria development has been undertaken concurrently for the Ecolabel and GPP when the product group is considered relevant for both instruments.
- 15 Substances of very high concern are defined in Article 57 of the REACH Regulation and include substances that are carcinogenic, mutagenic or toxic to reproduction (CMR); persistent, bioaccumulative and toxic (PBT); or very persistent and very bioaccumulative (vPvB). They also include substances identified, on a case-by-case basis, via scientific evidence, as causing probable serious effects to human health or the environment of an equivalent level of concern as those above (e.g. endocrine disruptors).
- 16 <http://echa.europa.eu>. The ECHA is the driving force among regulatory authorities in implementing the EU's groundbreaking chemicals legislation for the benefit of human health and the environment as well as for innovation and competitiveness. The ECHA helps companies to comply with the legislation, advances the safe use of chemicals, provides information on chemicals, and addresses chemicals of concern.
- 17 Staff Working Document (SWD) (2013) 272 final.
- 18 Communication on the Sustainable Competitiveness of the Construction Sector, 2011 (<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2012:0433:FIN:EN:PDF>); Communication on Sustainable Buildings, 2013 (http://ec.europa.eu/governance/impact/planned_ia/docs/2013_env_008_sustainable_buildings_en.pdf).
- 19 C. Fussler and P. James, 1996. *Driving Eco-Innovation: A Breakthrough Discipline for Innovation and Sustainability*. Pitman Publishing: London.
- 20 P. James, 1997. "The Sustainability Circle: A new tool for product development and design." *Journal of Sustainable Product Design* 2:52:57, <http://www.cfsd.org.uk/journal>.
- 21 For more information, see <http://iet.jrc.ec.europa.eu/etv/about-etv>.
- 22 <http://epa.gov/iaplus01/index.html>.
- 23 According to several documented studies, proper ventilation in schools has been shown to increase productivity and learning performance, and was included in the SEARCH II assessments.
- 24 See, for example, www.CO2Meter.com.
- 25 <http://ec.europa.eu/enterprise/construction/cpd-ds/index.cfm>; <http://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/3018.pdf>
- 26 Temperature measurements show that average temperatures in different classrooms within the same school may differ significantly, and thermostat valves may help to address this problem.
- 27 Albania, Belarus, Bosnia and Herzegovina, Hungary, Italy, Kazakhstan, Serbia, Slovakia, Tajikistan and Ukraine.
- 28 <http://www.uowm.gr/bumaproject/>
- 29 Environmental Framework Law No. 10431 of June 9, 2011, on the Protection of the Environment; Framework Law No. 8897 of May 16, 2002, on the Protection of Air from Pollution, as amended; and CMD No. 1189 of November 18, 2009, on Rules and Procedures for the Development and Implementation of the National Programme of Environmental Monitoring.
- 30 Preventive guidelines on safety and hygiene in the delivery room, especially related to risks associated with glutaraldehyde.
- 31 Council of European Union, June 26, 2006 (10917/06).
- 32 www.uowm.gr/bumaproject.
- 33 European Collaborative Action on Urban Air, Indoor Environment and Human Exposure (ECA), Report No. 24, "Harmonisation of indoor material emissions labelling systems in the EU. Inventory of existing schemes." http://ihcp.jrc.ec.europa.eu/our_activities/public-health/indoor_air_quality/eca/eca_report_24

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