ASHRAE Hellenic Chapter

TEE

ENERGY IN BUILDINGS

EMEA 2024

Europe, the Middle East & Africa

FRIDAY - SATURDAY

NOVEMBER 22-23, 2024

@ 9:00-18:00

@ ATHENS GREECE

SESSIONS:

- SUSTAINABILITY
- HEALTH & SAFETY
- DECARBONIZATION
- TECHNICAL SOLUTIONS
- DIGITAL ENVIRONMENT
- POLICIES & LEGISLATION
- ENERGY EFFICIENCY FIRST
- RESILIENCE TO CLIMATE CRISIS

GOLD SPONSOR

FUJITSU

AIRSTAGE

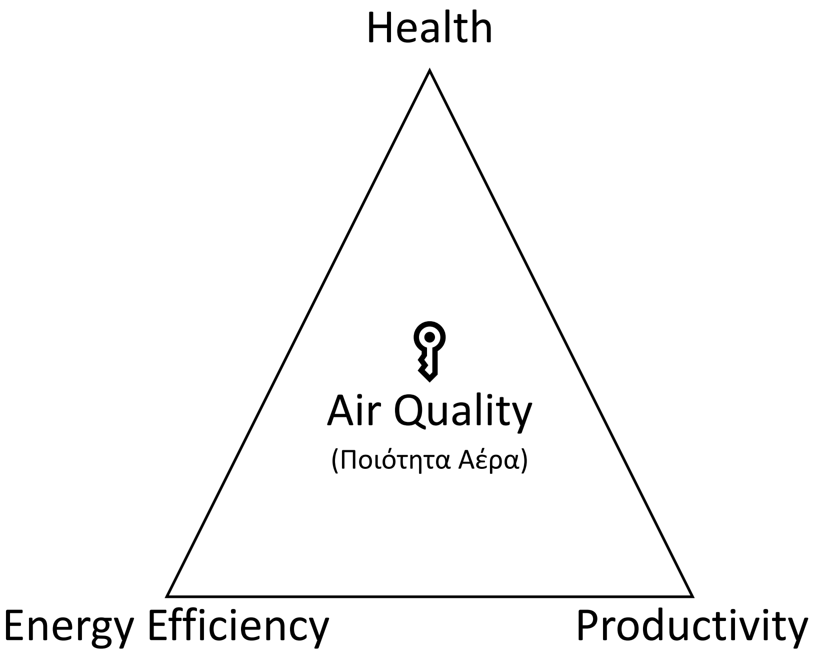
SPONSORS

AIRTECHNIC, ARISTON, AEROGRAMMI S.A., BCT GROUP, Carrier, Clima Quest GREE, CONTEC, DELPHIS, DIAMAR STULZ, dimtech, ERGOTRAK, GEBERIT, IDATOR, interplast, KNAUF INSULATION, LG Business Solutions, Mechanical Solutions AQUARK, menerga, Midea MBT, prihoda, systemair, TRANE, westnet AUX, wilo, WOLF, zeb, KOKOTAS

Creating Thriving Indoor Environments

Sotirios Papathanasiou

The Truth about IAQ



IAQ Policies & Legislation

IAQ Policies & Legislation

While the World Health Organization (WHO) has stressed the importance of Indoor Air Quality (IAQ), the European Union has not yet developed specific legislation addressing residential IAQ [1] [2].

[1] Settimo, G., Manigrasso, M., & Avino, P. (2020). Indoor air quality: a focus on the European legislation and State-of-the-Art research in Italy. *Atmosphere*, *11*(4), 370. https://doi.org/10.3390/atmos11040370

[2] European Public Health Alliance. (n.d.). *Towards better indoor air quality in the European residential context - EPHA*. EPHA. https://epha.org/towards-better-indoor-air-quality-in-the-european-residential-context/

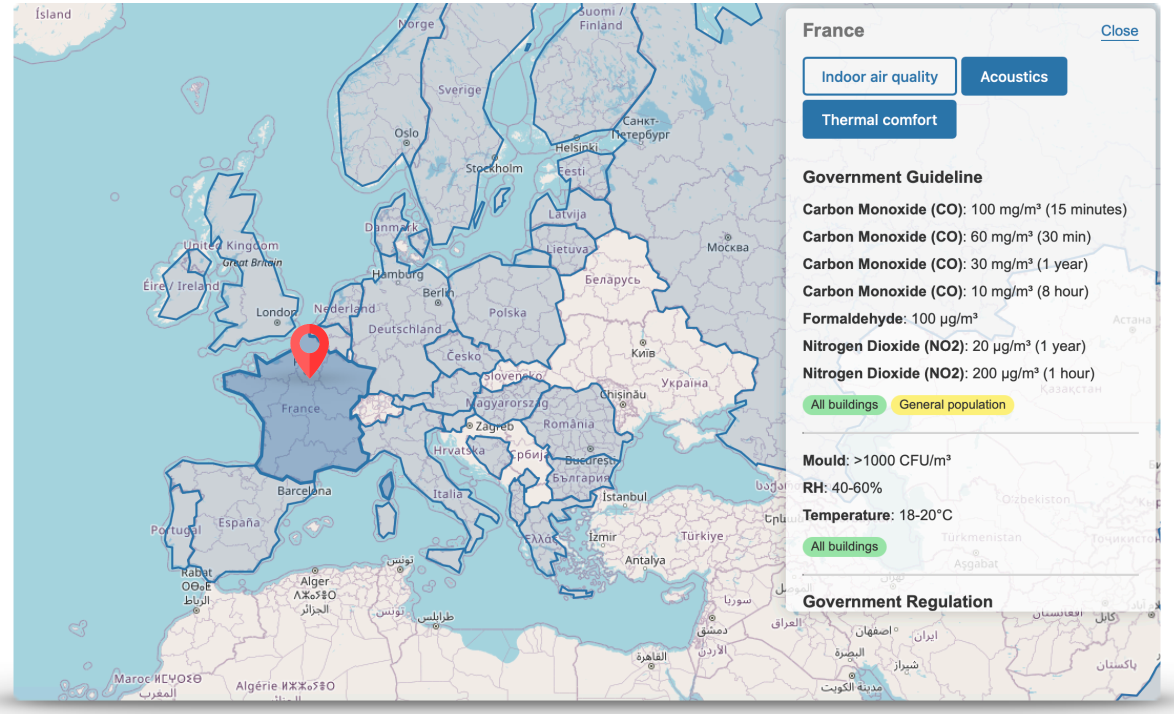
IAQ Policies & Legislation

- Despite the absence of a dedicated directive from the EU, several European countries have taken individual steps: France, Portugal, Finland, Austria, Belgium, Germany, the Netherlands, and Lithuania.
  - E.g. Italy has no specific legislation for residential IAQ, but the National Study Group on Indoor Air Pollution at the Italian Institute of Health (IIS) works to establish shared technical and scientific documents for harmonized action on IAQ.
- The Energy Performance of Buildings Directive (EPBD), primarily focused on energy efficiency, but encourages member states to consider IAQ when setting minimum energy performance requirements.
- The EN 15251 for indoor environmental provides parameters for design and assessment of the energy performance of buildings, addressing indoor air quality, thermal environment, lighting and acoustics.

IAQ Policies & Legislation

STC34

STC34 IEQ Guidelines [1]



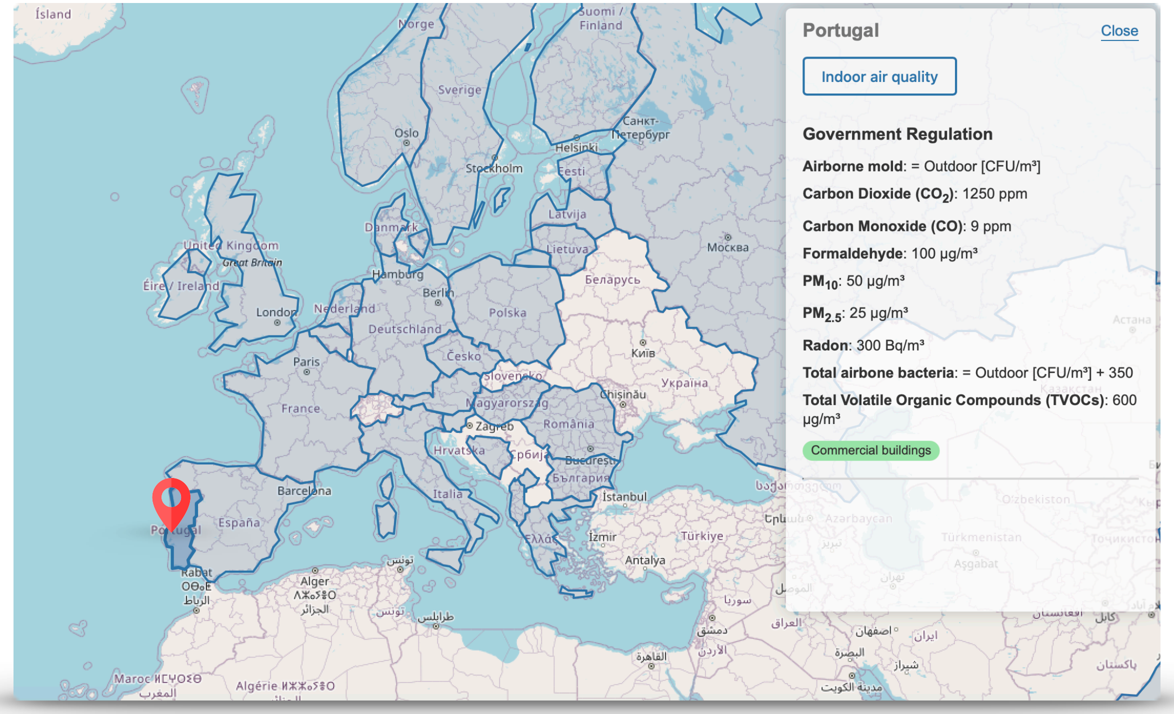
France 🇫🇷

[1] STC34 IEQ Guidelines - International Society of Indoor Air Quality and Climate. (n.d.). https://www.isiaq.org/stc34_ieq_guidelines.php

IAQ Policies & Legislation

STC34

STC34 IEQ Guidelines [1]

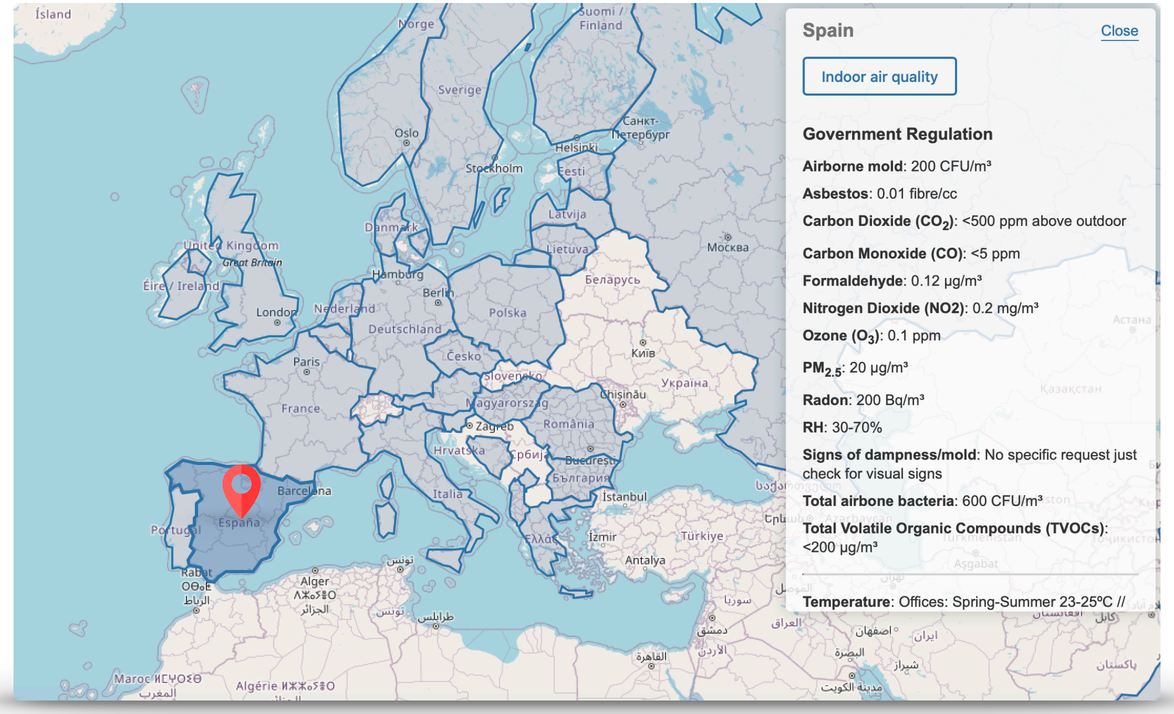


Portugal 🇵🇹

[1] STC34 IEQ Guidelines - International Society of Indoor Air Quality and Climate. (n.d.). https://www.isiaq.org/stc34_ieq_guidelines.php

IAQ Policies & Legislation

STC34 IEQ Guidelines [1]



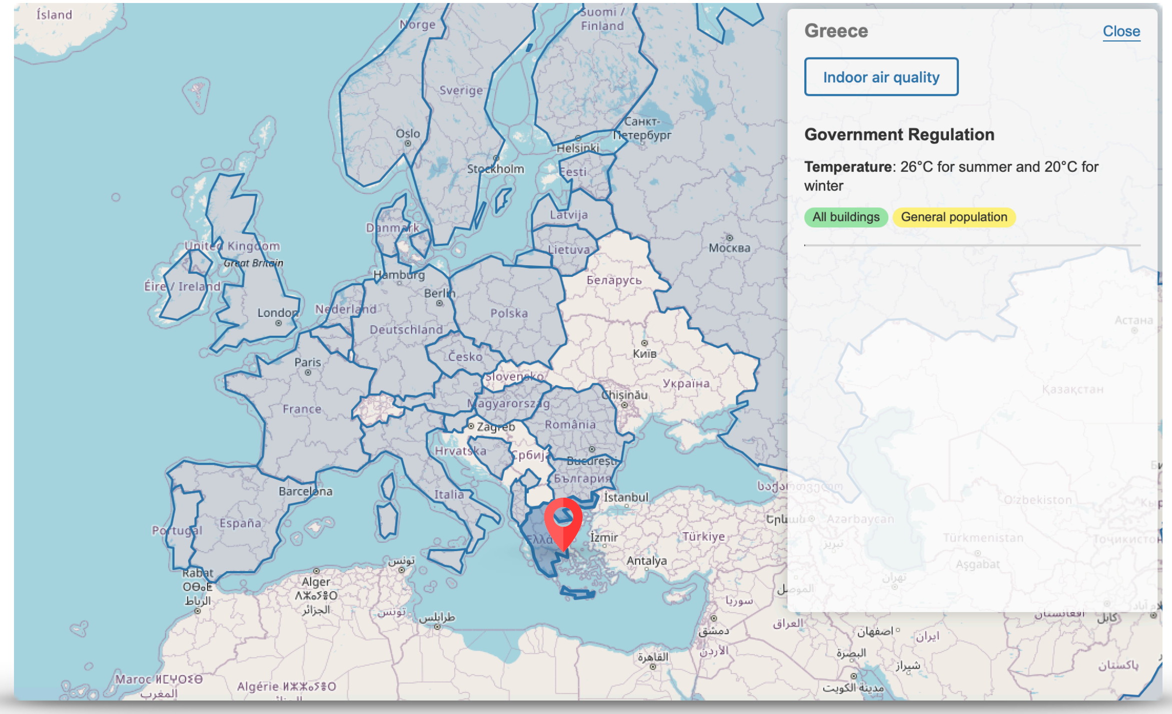
Spain 🇪🇸

[1] STC34 IEQ Guidelines - International Society of Indoor Air Quality and Climate. (n.d.). https://www.isiaq.org/stc34_ieq_guidelines.php

IAQ Policies & Legislation

STC34

STC34 IEQ Guidelines [1]



Greece 🇬🇷

[1] STC34 IEQ Guidelines - International Society of Indoor Air Quality and Climate. (n.d.). https://www.isiaq.org/stc34_ieq_guidelines.php

IAQ Policies & Legislation

According to the EU directive (Directive 2013/59/Euratom) Greece was obliged to set (by 2018) the national reference level for the average annual concentration in the air of buildings, which cannot exceed the value of 300 Bq/m³.

According to article 74 from the presidential order 101/2018, the annual mean for Radon in residential buildings is set at 300 Bq/m³ [1].

19323

ΕΦΗΜΕΡΙΔΑ
ΤΗΣ ΚΥΒΕΡΝΗΣΕΩΣ
ΤΗΣ ΕΛΛΗΝΙΚΗΣ ΔΗΜΟΚΡΑΤΙΑΣ

18 Μαΐου 2020 | ΤΕΥΧΟΣ ΔΕΥΤΕΡΟ | Αρ. Φύλλου **1881**

ΑΠΟΦΑΣΕΙΣ

Αριθμ. 43374

Εθνικό σχέδιο δράσης για την αντιμετώπιση των μακροπρόθεσμων κινδύνων από την έκθεση στο ραδόνιο.

ΟΙ ΥΠΟΥΡΓΟΙ ΑΝΑΠΤΥΞΗΣ ΚΑΙ ΕΠΕΝΔΥΣΕΩΝ - ΥΓΕΙΑΣ - ΠΕΡΙΒΑΛΛΟΝΤΟΣ ΚΑΙ ΕΝΕΡΓΕΙΑΣ

Έχοντας υπόψη:

1. Τις διατάξεις του Κεφαλαίου Ε' «Διαχείριση Πυρηνικής Ενέργειας, Τεχνολογίας και Ακτινοπροστασίας- Ελληνική Επιτροπή Ατομικής Ενέργειας (ΕΕΑΕ)» του ν. 4310/2014 (Α΄ 258) «Έρευνα, Τεχνολογική Ανάπτυξη και Καινοτομία και άλλες διατάξεις», ιδίως της περίπτωσης θ' της παρ. 3 του άρθρου 42 αυτού,
2. Τον ν. 4622/2019 (Α' 133) «Επιτελικό Κράτος: οργάνωση, λειτουργία και διαφάνεια της Κυβέρνησης, των κυβερνητικών οργάνων και της κεντρικής δημόσιας διοίκησης»,
3. Το π.δ. 101/2018 (Α΄ 194) «Προσαρμογή της ελληνικής νομοθεσίας στην Οδηγία 2013/59/Ευρατόμ του Συμβουλίου, της 5ης Δεκεμβρίου 2013,για τον καθορισμό βασικών προτύπων ασφάλειας για την προστασία από τους κινδύνους που προκύπτουν από τις ιοντίζουσες ακτινοβολίες και την κατάργηση των Οδηγιών 89/618/ Ευρατόμ, 90/641/Ευρατόμ, 96/29/Ευρατόμ, 97/43/Ευρατόμ και 2003/122/Ευρατόμ (ΕΕ L 13/17.1.2014)-Θέσπιση Κανονισμών Ακτινοπροστασίας», ιδίως την παρ. 1 του άρθρου 103 αυτού,
4. Τις διατάξεις του άρθρου 90 «Έλεγχος των δαπανών που προκαλούν οι κανονιστικές διοικητικές πράξεις» του «Κώδικα Νομοθεσίας για την Κυβέρνηση και τα Κυβερνητικά Όργανα», όπως αυτός κυρώθηκε με το άρθρο πρώτο του π.δ. 63/2005 (Α' 98) «Κωδικοποίηση της νομοθεσίας για την Κυβέρνηση και τα Κυβερνητικά όργανα»,
5. Το π.δ. 83/2019 (Α΄ 121) «Διορισμός Αντιπροέδρου της Κυβέρνησης, Υπουργών, Αναπληρωτών Υπουργών και Υφυπουργών»,
6. Τις διατάξεις της υπ' αρ. 48/18.07.2019 (Β΄ 3100) κοινής απόφασης του Πρωθυπουργού και του Υπουργού Ανάπτυξης και Επενδύσεων «Ανάθεση αρμοδιοτήτων στον Υφυπουργό Ανάπτυξης και Επενδύσεων, Χρίστο Δήμα»,
7. Τη σύμφωνη γνώμη της Ελληνικής Επιτροπής Ατομικής Ενέργειας (ΕΕΑΕ), όπως παρέχεται με την απόφαση του Διοικητικού Συμβουλίου της ΕΕΑΕ, κατά τη 266η συνεδρίαση της 20.12.2019,
8. Το γεγονός ότι, βάσει του υπ' αριθμ. 188836/ 17-02-2020 εγγράφου της Γενικής Διεύθυνσης Οικονομικών Υπηρεσιών του Υπουργείου Ανάπτυξης και Επενδύσεων, από τις διατάξεις της παρούσας απόφασης δεν προκαλείται επιπλέον δαπάνη σε βάρος του κρατικού προϋπολογισμού, αποφασίζουμε:

Εγκρίνουμε το «Εθνικό σχέδιο δράσης για την αντιμετώπιση των μακροπρόθεσμων κινδύνων από την έκθεση στο ραδόνιο (ΕΣΧΕΔΡΑ)», ως εξής:

ΕΘΝΙΚΟ ΣΧΕΔΙΟ ΔΡΑΣΗΣ ΓΙΑ ΤΗΝ ΑΝΤΙΜΕΤΩΠΙΣΗ ΤΩΝ ΜΑΚΡΟΠΡΟΘΕΣΜΩΝ ΚΙΝΔΥΝΩΝ ΑΠΟ ΤΗΝ ΕΚΘΕΣΗ ΣΤΟ ΡΑΔΟΝΙΟ (ΕΣΧΕΔΡΑ)

Περιεχόμενα

Συντομογραφίες

Α. ΣΚΟΠΟΣ ΚΑΙ ΑΝΤΙΚΕΙΜΕΝΟ

Ορισμοί

Β. ΑΡΧΕΣ ΓΙΑ ΤΙΣ ΠΕΡΙΟΧΕΣ ΠΡΟΤΕΡΑΙΟΤΗΤΑΣ

Γ. ΑΡΧΕΣ ΓΙΑ ΤΟΥΣ ΧΩΡΟΥΣ ΕΡΓΑΣΙΑΣ

Δ. ΔΙΑΔΙΚΑΣΙΑ ΕΦΑΡΜΟΓΗΣ ΤΟΥ ΕΣΧΕΔΡΑ

Ε. ΥΛΟΠΟΙΗΣΗ ΤΩΝ ΔΡΑΣΕΩΝ ΚΑΙ ΤΩΝ ΕΠΙΜΕΡΟΥΣ ΕΡΓΩΝ ΤΟΥΣ

ΔΡΑΣΗ 1. Προσδιορισμός των επιπέδων συγκέντρωσης ραδονίου στον εσωτερικό αέρα κατοικιών και χώρων εργασίας

Επιμέρους έργο 1.1. Εθνική Επισκόπηση Ραδονίου στον εσωτερικό αέρα των κατοικιών

Επιμέρους έργο 1.2. Δημιουργία του εθνικού χάρτη ραδονίου και καθορισμός των «περιοχών προτεραιότητας»

Επιμέρους έργο 1.3. Προσδιορισμός της διαδικασίας για την αναγνώριση εργαστηρίου από την ΕΕΑΕ

ΔΡΑΣΗ 2. Στρατηγική επικοινωνίας ενδιαφερόμενων μερών

Επιμέρους έργο 2.1. Ενημέρωση των οργανισμών και των εργαζομένων στους χώρους εργασίας όπου είναι υποχρεωτικός ο έλεγχος της συγκέντρωσης ραδονίου

Επιμέρους έργο 2.2. Επικοινωνία με τον πληθυσμό, εντοπισμός και ενημέρωση ειδικών ομάδων που δύνανται να συνεισφέρουν στη διάχυση της πληροφόρησης στο γενικό πληθυσμό

ΔΡΑΣΗ 3. Μείωση των συγκεντρώσεων ραδονίου στους εσωτερικούς χώρους (αποκατάσταση και πρόληψη)

Greece 🇬🇷

[1] *ΕΦΗΜΕΡΙΔΑ ΤΗΣ ΚΥΒΕΡΝΗΣΕΩΣ*. (n.d.). https://dsanet.gr/Epikairothta/Nomothesia/pd101_2018.htm

IAQ Policies & Legislation

The standard EN 15251[1] states that one way of evaluating the indoor air quality is by measuring the average CO_2 concentration in the building where people are the main pollution source, when the building is fully occupied.

Category	Corresponding CO_2 above outdoors in ppm for energy calculations
I (High level of expectation - spaces occupied by very sensitive and fragile persons)	350
II (Normal level of expectation - for new buildings and renovations)	500
III (Moderate level of expectation - for existing buildings)	800
III (Moderate level of expectation - for existing buildings)	>800

[1] E. Standards, "UNE EN 15251:2008 Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics," https://www.en-standard.eu. [Online]. Available: https://www.en-standard.eu/une-en-15251-2008-indoor-environmental-input-parameters-for-design-and-assessment-of-energy-performance-of-buildings-addressing-indoor-air-quality-thermal-environment-lighting-and-acoustics/

IAQ Policies & Legislation

The WHO[1] has consistently emphasized the significance of IAQ and the potential health hazards posed by indoor pollutants.

World Health Organization

Pollutant	Average Time	2021 AQ Guidelines
$PM_{2.5}$ (μg/m^3)	Annual	5
	24-hour	15
PM_{10} (μg/m^3)	Annual	15
	24-hour	45
O_3 (μg/m^3)	Peak Season	60
	24-hour	100
NO_2 (μg/m^3)	Annual	10
	24-hour	25
SO_2 (μg/m^3)	24-hour	40
CO (mg/m^3)	24-hour	4

[1] World Health Organization. (2021). WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. https://iris.who.int/handle/10665/345329

IAQ Policies & Legislation

The European Union [1] is working to establish a framework for achieving good IAQ across its member states. *Note: The primary responsibility for setting and enforcing specific IAQ regulations rests with national and regional authorities.*

Global Open Air Quality Standards (GO AQS) [2] is a new initiative that wants to establish a new benchmark for clean indoor air with a set of transparent, science-backed standards that all nations and integrators can strive for.

[1] *Commission Staff Working Document on Supporting Indoor Air Quality.PDF*. (n.d.). Google Docs. https://drive.google.com/file/d/1lhHwMuBopd5ho97xsb0ivuEYdSRglyEE/view?usp=share_link
[2] *GO AQS*. (2024, October 25). GO AQS. https://www.goaqs.org/

Ventilation Policies & Legislation

Ventilation Policies & Legislation

Sometimes ventilation rates are used as complementary elements in a comprehensive approach to ensuring good IAQ.

- ASHRAE Standards 62.1/62.2 are commonly use in European countries in the context of ventilation.
- ASHRAE Standard 241 is a standard aimed at reducing the risk of disease transmission through exposure to infectious aerosols in indoor spaces.
- The EN 15251 discusses ventilation rates, focusing on their role in indoor environmental quality and energy performance of buildings.
- The EN 13779 is a standard for ventilation in non-residential buildings. Includes performance requirements for ventilation, air-conditioning and cooling systems.

Ventilation Policies & Legislation

Country and Standard Reference	Standard Reference Whole Building Ventilation Rates	Living Room	Bedroom	Kitchen	Bathroom + WC	WC only
Belgium (NBN D 50-001)	3.6 $m^3/(h \cdot m^2)$ floor surface area	Minimum 75 m^3/h (limited to 150 m^3/h	Minimum 25m^3/h (limited to 72m^3/h)	Open kitchen Minimum 75 m^3/h (exhaust)	Minimum 50 m^3/h (limited to 75 m^3/h)	Minimum 25 m^3/h
Denmark (BR10)	Min. 0.3 $l/s \cdot m^2$ (supply)	Min. 0.3 $l/s \cdot m^2$ (supply)		20 l/s (exhaust)	15 l/s (exhaust)	10 l/s (exhaust)
France (Arrêté 24.03.82)	10-135 m^3/h (depending on room number and vent system)			Continuous 20 – 45 m^3/h		Minimum 15 m^3/h
Sweden (BFS2014:13 - BBR21)	Supply min 0.35 $l/s \cdot m^2$ floor area					
Germany (DIN 1946-6)	15-285 m^3/h			45m^3/h (nominal exhaust flow)	45m^3/h (nominal exhaust flow)	25m^3/h (nominal exhaust flow)
Italy (Legislative Decree 192/2005, UNI EN 15251)	Naturally ventilated: 0.3 – 0.6 vol/h	0.011 m^3/s per person for an occupancy level of 0.04 persons/m^2			4 vol/h	
Poland (Art 149 (1) – Journal of Laws 2002 No. 75, item. 690, as amended and PN-B-03430:1983/ Az3:2000)	20 m^3/h for each permanent occupant should be calculated according to the Polish standard but not less than 20 m^3/h	20 -30 m^3/h for each permanent occupant (for public buildings) For flats, it is a summary of flow from all rooms		30 m^3/h to 70 m^3/h without windows	50 m^3/h	30 m^3/h
EN 15251	0.35 – 0.49 $l/(s \cdot m^2)$	0.6 – 1.4 $l/(s \cdot m^2)$		14-28 l/s	10-20 l/s	7-14 l/s

Requirements
Recommendations
European Standard

Ventilation Policies & Legislation

ASHRAE STANDARD 62.1

ASHRAE STANDARD 241

Occupancy Category	62.1 Outdoor Air Ventilation Rate (lps/person)	241 Equivalent Clean Airflow (lps/ person)	Increase in rate ratio	Calculated Equivalent ACH	Calculated Equivalent CO_2 (ppm)
Restaurant	5.1	30	5.9	28	600
Cafeteria	4.7	30	6.4	40	600
Gym	22.9	40	1.7	3.7	770
Retail	7.8	20	2.6	4	850
Daycare	8.6	20	2.3	6.7	620
Office	8.5	15	1.8	1	790
Lecture Hall	4	25	6.3	50	620
Museum	4.6	30	6.5	16	700

Providing more acceptable rates as required in ASHRAE 241 can significantly contribute to creating safer and healthier indoor spaces.

The Hidden Cost of Poor IAQ

The Hidden Cost of Poor IAQ

Poor indoor air quality (IAQ) leads to the spread of illnesses, impacting both employee health and productivity.

A multi-country longitudinal prospective observational study found that reducing exposure to $PM_{2.5}$ and CO_2 in offices through improved ventilation and filtration can yield significant improvements in cognitive function [1].

Another study concluded that elevated CO_2 concentrations increase the aerostability of some viruses, leading to a higher risk of pathogen transmission, emphasizing the importance of ventilation to mitigate the spread [2].

(Absenteeism and presenteeism are two related concepts that impact productivity and well-being of occupants.)

[1] Laurent, J. G. C., MacNaughton, P., Jones, E., Young, A. S., Bliss, M., Flanigan, S., Vallarino, J., Chen, L. J., Cao, X., & Allen, J. G. (2021). Associations between acute exposures to PM2.5 and carbon dioxide indoors and cognitive function in office workers: a multicountry longitudinal prospective observational study. *Environmental Research Letters*, *16*(9), 094047. https://doi.org/10.1088/1748-9326/ac1bd8

[2] Haddrell, A., Oswin, H., Otero-Fernandez, M., Robinson, J. F., Cogan, T., Alexander, R., Mann, J. F. S., Hill, D., Finn, A., Davidson, A. D., & Reid, J. P. (2024). Ambient carbon dioxide concentration correlates with SARS-CoV-2 aerostability and infection risk. *Nature Communications*, *15*(1). https://doi.org/10.1038/s41467-024-47777-5

Quantifying the Economic Benefits

The economic benefits of improved IAQ go beyond just feeling better.

Reduced Sickness: Improving IAQ minimizes the transmission of illnesses, leading to fewer sick days and healthcare costs [1] [2].

Improved Focus: Studies show a link between better IAQ and enhanced cognitive function, resulting in increased productivity [3] [4].

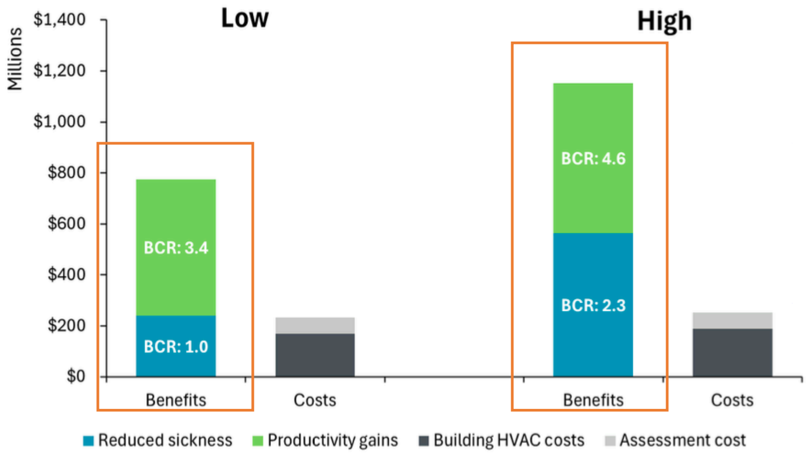
[1] *Ventilation rates and absences in offices and schools | Indoor air*. (n.d.). https://iaqscience.lbl.gov/ventilation-rates-and-absences-offices-and-schools
[2] Mendell, M. J., Eliseeva, E. A., Davies, M. M., Spears, M., Lobscheid, A., Fisk, W. J., & Apte, M. G. (2013). Association of classroom ventilation with reduced illness absence: a prospective study in California elementary schools. Indoor Air, 23(6), 515–528. https://doi.org/10.1111/ina.12042
[3] *Ventilation rates and school performance | Indoor air*. (n.d.). https://iaqscience.lbl.gov/ventilation-rates-and-school-performance
[4] *Ventilation rates and office work performance | Indoor air*. (n.d.). https://iaqscience.lbl.gov/building-ventilation-rates-and-office-work-performance

Benefit-Cost Ratio (BCR) in Offices

The return on investment for improved IAQ in offices is compelling.

BCR (sickness only): Ranges from 1 to 2.3, indicating that health benefits alone justify the investment.

BCR (sickness + productivity): Ranges from 3.4 to 4.6, showcasing the substantial combined economic and health advantages.



IMPROVING IAQ IN OFFICES, NPV OVER 10 YEARS [1]

[1] Facilities Management in New Zealand. (2024, September 25). *FMANZ - People, place, productivity*. FMANZ. https://www.fmanz.org/

Estimated Benefits in Offices

- A Harvard business review has estimated that the productivity benefits of improving air quality through ventilation are around $6,500 per person per year [1].

- Using a CO_2 based demand controlled ventilation (DCV) can reduce the energy output of HVAC systems by 70% [2].

- The Lawrence Berkeley National Laboratory concluded that improvements made to indoor air quality can boost workplace performance by 10% [3].

- Green buildings certifications in the US and other countries have been shown to consume 25% less energy, than non-green buildings [4].

[1] Research: Stale office air is making you Less productive. (2024, March 26). Harvard Business Review. https://hbr.org/2017/03/research-stale-office-air-is-making-you-less-productive
[2] Fan, Y., Kameishi, K., Onishi, S., & Ito, K. (2013). Field-based study on the energy-saving effects of CO2 demand controlled ventilation in an office with application of Energy recovery ventilators. *Energy and Buildings*, *68*, 412–422. https://doi.org/10.1016/j.enbuild.2013.09.043
[3] Wyon, D. P. (2004). The effects of indoor air quality on performance and productivity. *Indoor Air*, *14*, 92–101. https://doi.org/10.1111/j.1600-0668.2004.00278.x
[4] Benefits of green building | U.S. Green Building Council. (2016, April 1). https://www.usgbc.org/articles/benefits-green-building

A Way Forward

Standards: Industry standards, such as ASHRAE Standard 62.1, 241 and the upcoming GO AQS, provide guidelines for ventilation rates and IAQ in buildings. These standards should be consulted to ensure compliance and best practices.

Occupancy Levels: Higher occupancy levels require increased ventilation to maintain acceptable CO_2 concentrations.

Monitoring and Control: Regular air quality monitoring and the use of demand-controlled ventilation systems can help optimize ventilation rates and energy efficiency.

Conclusion

IAQ is inevitable in buildings.

Poor IAQ has significant economic and health consequences.

The economic benefits of improved IAQ far outweigh the costs, with compelling benefit to cost ratios.

A multi-layered approach involving adoption of standards, collaboration, and awareness is crucial for successful implementation.

ASHRAE® Hellenic Chapter

TEE

ENERGY IN BUILDINGS

EMEA 2024

Europe, the Middle East & Africa

FRIDAY - SATURDAY
NOVEMBER 22-23, 2024
@ 9:00-18:00

@ ATHENS GREECE

THANK YOU!
Q & A

NAME: Sotirios Papathanasiou
EMAIL: sp@seetheair.org

EMAIL ME

GOLD SPONSOR

FUJITSU
AIRSTAGE

SPONSORS

AIRTECHNIC www.airtechnic.gr, ARISTON, AEROGRAMMI S.A., BCT GROUP, Carrier, Clima Quest, GREE, CONTEC, DELPHIS CREATIVE CLIMATE, DIAMAR, STULZ, dimtech, ERGOTRAK, GEBERIT, IDATOR, interplast, KNAUF INSULATION, LG Business Solutions, Mechanical Solutions, AQUARK, menerga a systemair company, Midea, MBT, ΟΜΙΛΟΣ ΤΟΥΡΝΙΚΙΩΤΗ, prihoda, systemair, TRANE, westnet, AUX, wilo, WOLF, zeb, ΚΟΚΟΤΑΣ group, ΣΠΜ