



Status quo IEQ in schools, health & learning performance effects

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REHVA

REHVA is:

- Federation of European Heating, Ventilation and Air Conditioning Associations
- representing network of > 100.000 engineers from 27 countries

REHVA's mission is:

- to develop and disseminate economical, energy efficient and healthy technology for mechanical services of building
- to serve its members and the field of building engineering (heating, ventilation and air conditioning) by facilitating knowledge exchange, supporting the development of related EU policies and their national level implementation.

For more information, see: www.rehva.eu

My roots



Back in 1999...

• **Crisismaatregel is geen succes**

Ventilatie scholen functioneert niet

Ondanks miljoenen aan subsidie voor luchtverversing is het binnenklimaat in veel scholen nog steeds belabberd.

door Ellen van Gaalen

DEEN HAAG. Filters en batterijen worden niet op tijd vervangen. Storingen blijven onopgemerkt. Systemen zijn nooit goed aangesloten. Of de ventilatie maakt zoveel herrie in het klaslokaal dat leraren het systeem uitzetten of liever de ramen openzetten.

Honderden basis- en middelbare scholen hebben hightech ventilatiesystemen, maar leerlingen zitten lang niet altijd in een fris lokaal. „Scholen kunnen er niet goed mee uit de voeten”, stelt Marco van Zandwijk van landelijk kenniscentrum Ruimte-OK.

Het gebeurde onlangs op een locatie van De Haagse Scholen. Tijdens een controle bleek de ventilatie niet te werken. Het systeem stond al weken op storing, maar niemand die het had gezien. „De leraren zeiden wel dat ze het binnen benauwd vonden”, vertelt Dierwerke Spaans, projectleider nieuwbouw en renovatie van schoolgebouwen. De link met een defect ventilatiesysteem legden ze niet, het rode storingsknopje bleef onopgemerkt.

Spaans: „Docenten zijn zo gewend dat het klimaat beroerd is, dat ze niet weten hoe het aanvoelt als alles wel goed werkt.”

Het ontbreekt onderwijsorganisaties vaak aan kennis over het gebruik en beheer van die technische snufjes. Het gevolg is dat sommige oude, tochtige scholen nog frisser zijn dan de moderne gebouwen met hightech apparatuur. Dat constateerde adviseur Bas Knopper in een onderzoek op ruim veertig scholen. „Als je zo’n gebouw potdicht maakt en de ventilatie niet goed gebruikt, is het gehalte kooldioxide (CO₂) te hoog”, verklaart hij.

Het kabinet-Balkenende IV stak in 2009 tientallen miljoenen euro’s in de verbetering van het binnenklimaat. Het was een ‘crismaatregel’: schoolgebouwen werden energiezuiniger en frisser en bedrijven hadden weer wat werk. Installatiebedrijven legden voor ruim 71 miljoen euro ventilatiesystemen aan. Die worden in nieuwe schoolgebouwen standaard geplaatst. „Er wordt gekozen op basis van geld, niet op kwaliteit”, constateert Wim Lengkeek van de PO-Raad (vertegenwoordiger basisscholen). IJst goedkopere systemen slurpen energie. Ook moeten scholen duizenden euro’s per jaar opbrengen voor het onderhoud van de systemen. Het gaat bijvoorbeeld om filters die vervangen moeten worden. Kosten die niet worden vergoed.

De Rijksdienst voor Ondermend Nederland (RVO) ziet ook dat er veel misgaat. „Het is zonde van het geld, want goed werkende ventilatie maakt de klaslokalen gezonder en de leerprestaties beter”, erkent Irma Thijssen.

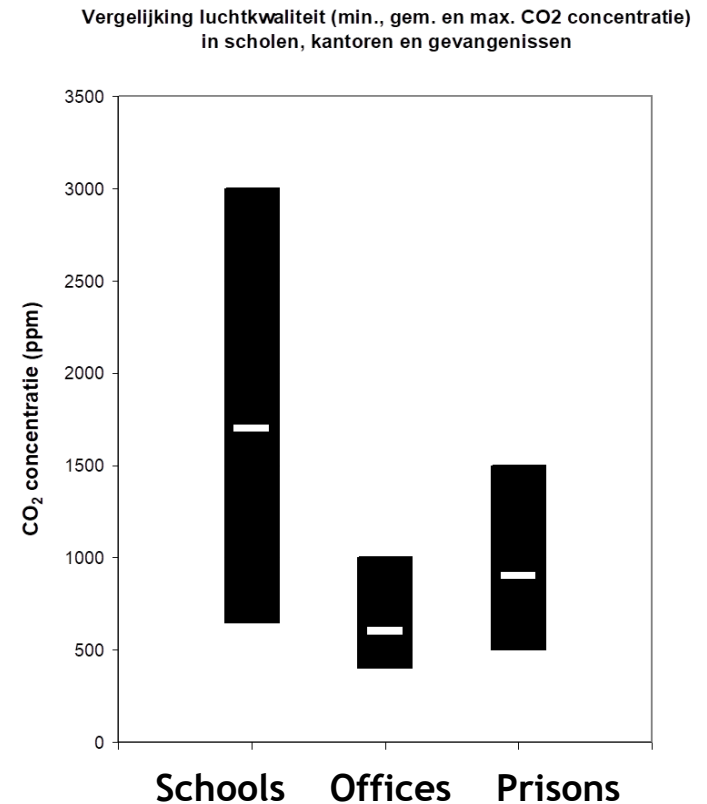
“

First they ignore you, then they ridicule you, then they fight you, and then you win.

M K GANDHI

What triggered our politicians...

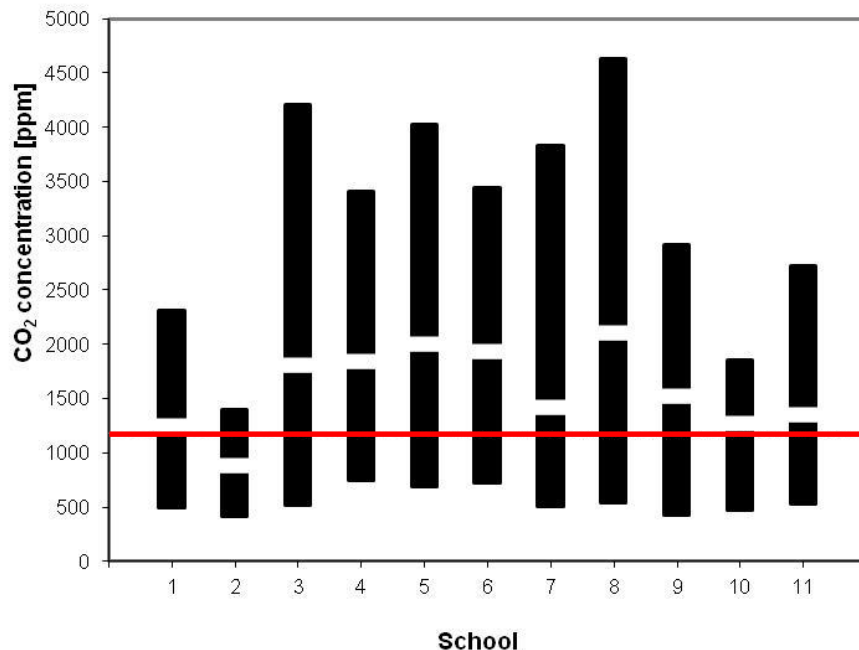
- Hundreds of studies about Sick Building Syndrome in offices and no-one is paying attention to Indoor Air Quality at school??
- Air Quality in prisons is way better than Air Quality in prisons, can somebody explain that??
- Voters don't care about children, health and learning performance??



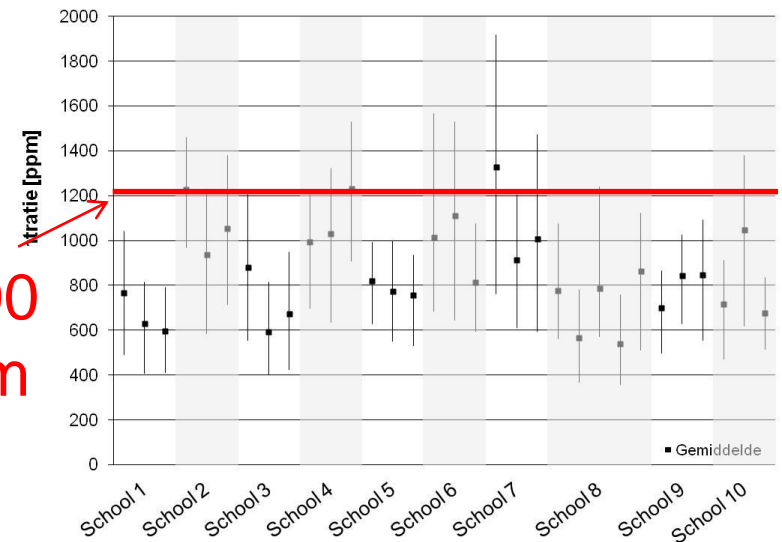
NL / EU situation

CO₂-concentrations in schools

- Around 2005: Insufficient ventilation in > 80% of Dutch schools
- Improvement in last 10 years!



1200
ppm



Van Dijken (TU/e), 2004

BNA survey newly built schools
i.s.m. BBA Binnenmilieu, 2010

Why is good IAQ@school so important?

Direct effect:

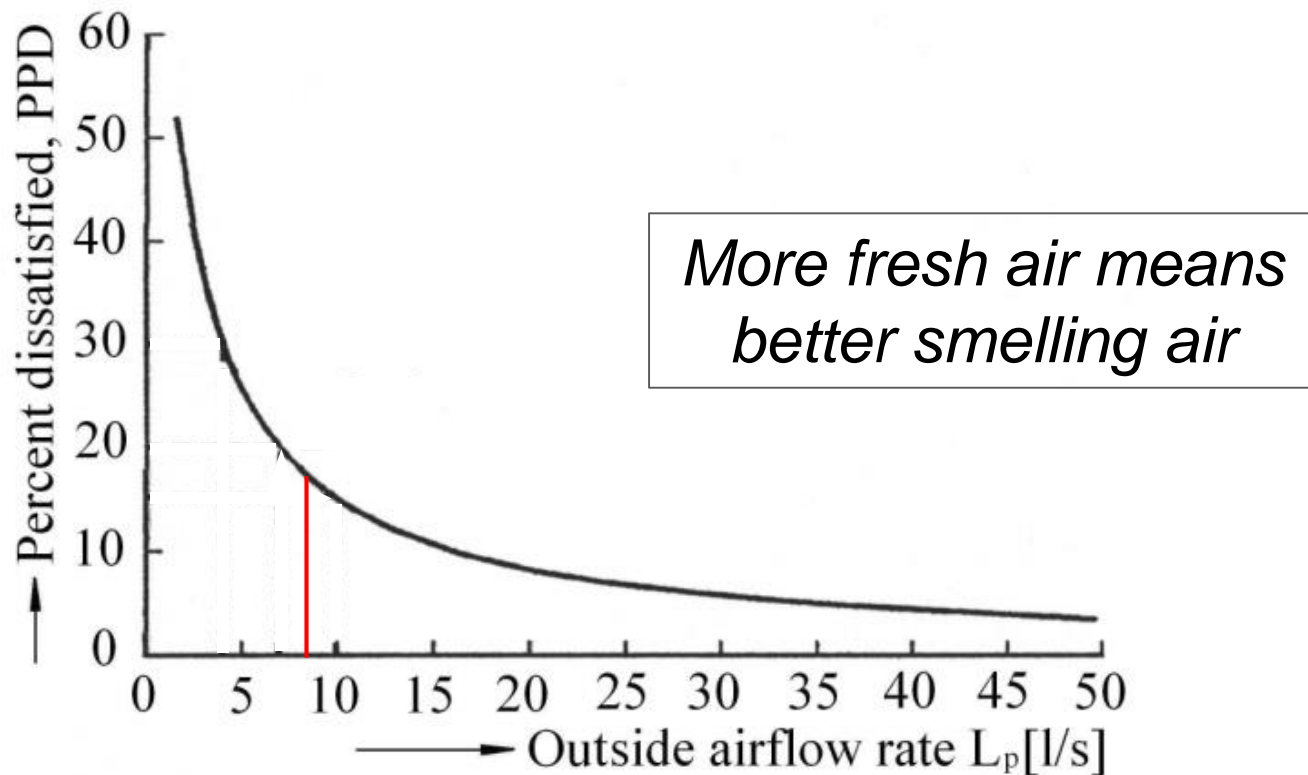
- discomfort (for example odor, health)
- headache, tiredness and drowsiness
- mucosa irritation ('dry air')
- transmission of infectious diseases

Resulting in:

- olfactory discomfort
- absenteeism students & teachers
- poorer learning performance
- hidden costs

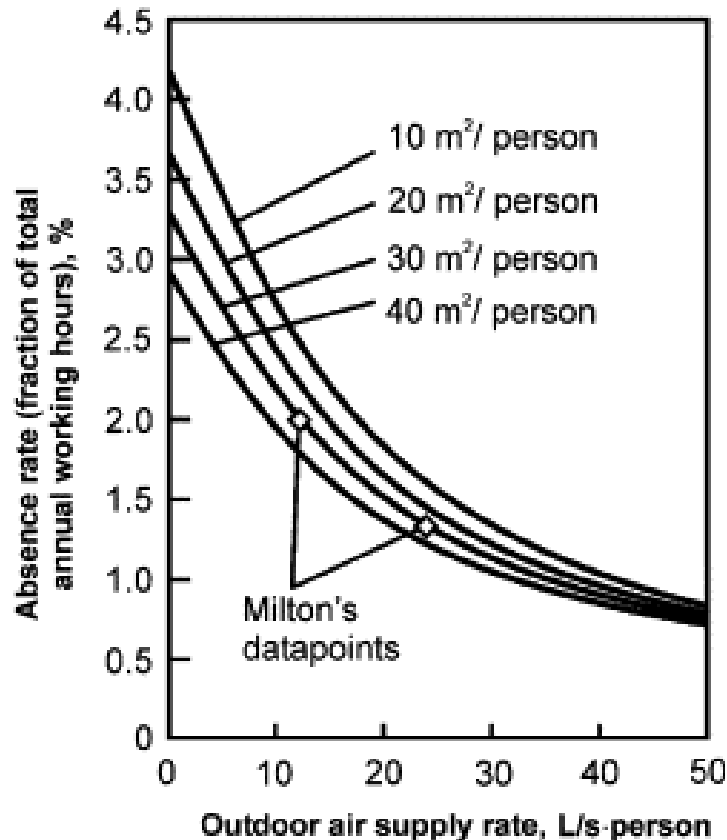


Ventilation & olfactory comfort



Source: Fanger & Berg-Munch, 1983

Ventilation, infectious diseases & absenteeism



More fresh air means less kids ill at home

Source: Milton et al., 1999

Some field study results

Kolarik et al., 2015:

- 635 children in 20 Danish daycare centers
- decrease of absenteeism with 12% when ventilation rate is increased by a.e.r of 1.



Shendell et al., 2004:

- 434 classrooms in 22 American schools
- in classrooms with CO₂-concentration >1000 ppm above outside concentration
-> 10 to 20% more absenteeism of students

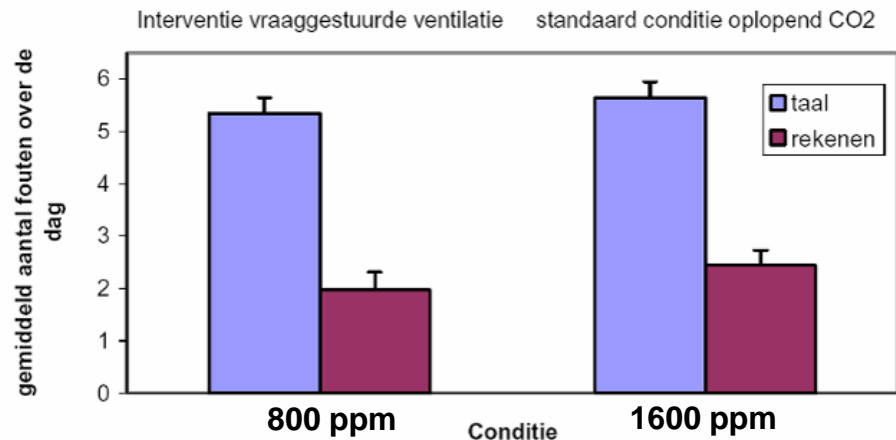


Ventilation & learning performance effects

TNO (De Gids, 2006):

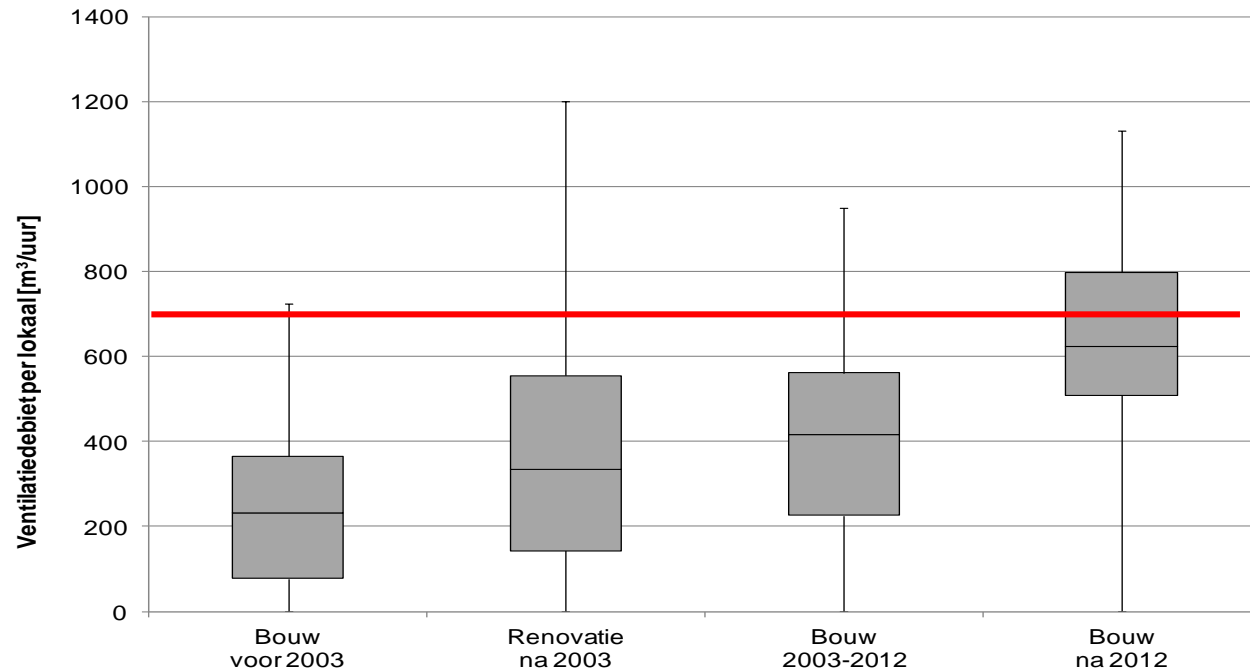
- Comparison between learning performances in classroom with sufficient ventilation (CO₂-controlled) & classroom with 'standard' ventilation (CO₂ concentration 1600 vs 800 ppm)
- Effect on learning performances strongest for MATH TESTS
- At 800 ppm 6% less mistakes on language tests and 23% less mistakes for math testst

*More fresh air means
better learning!*



Good news: it is improving!

New NL classrooms have substantial higher ventilation rates:



India situation

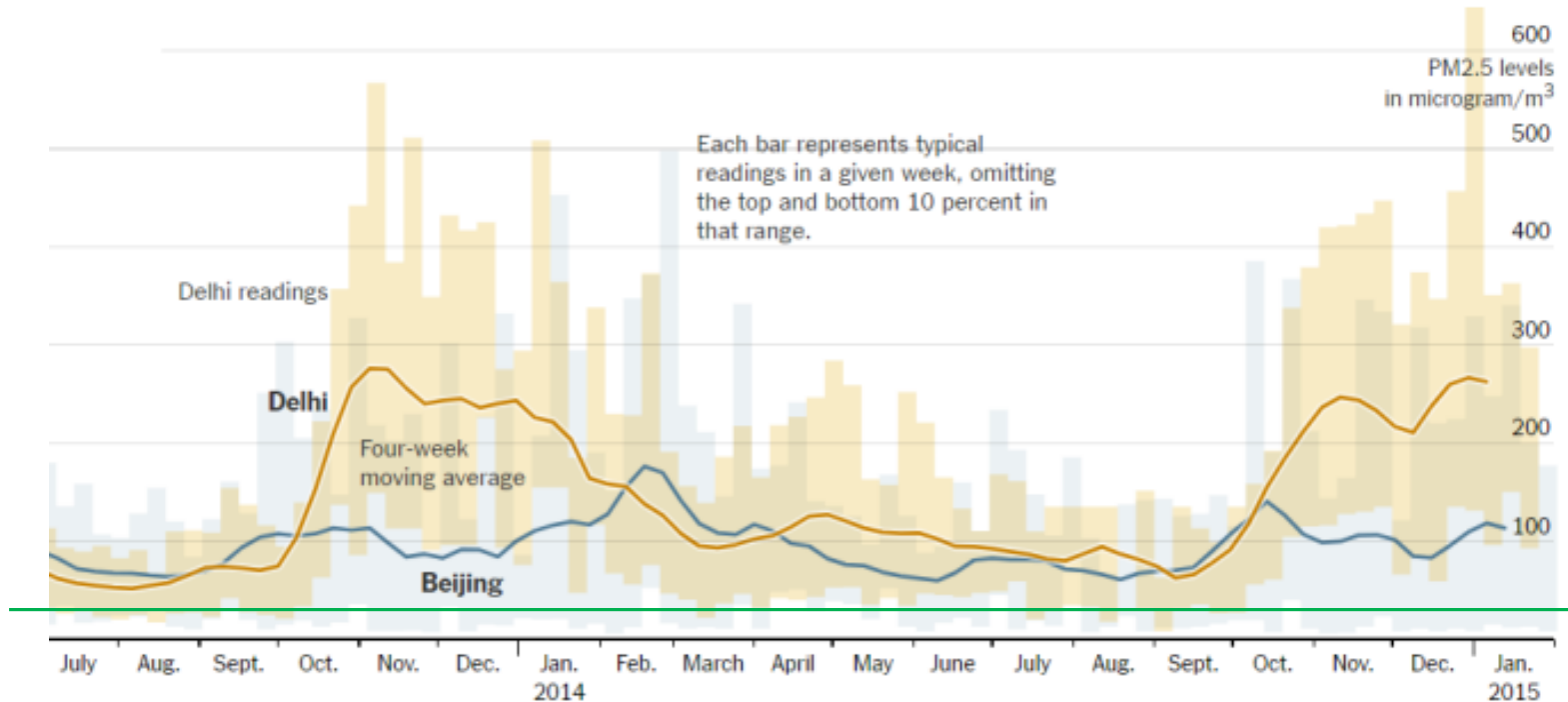
Context quite different e.g. Outdoor Air Quality



© AFP/Getty Images



Fine particles (PM2.5)



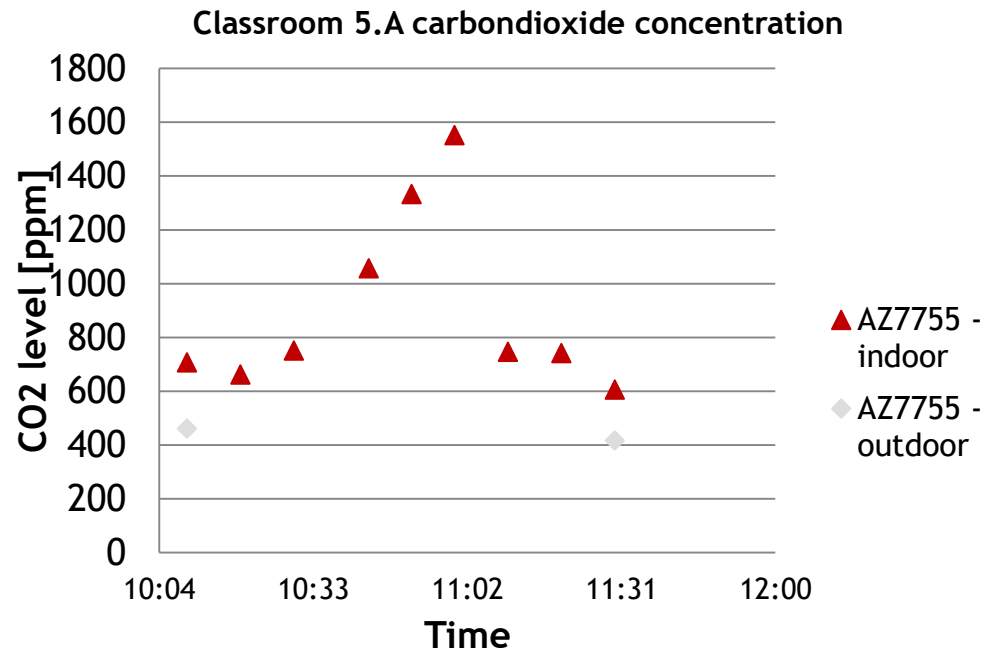
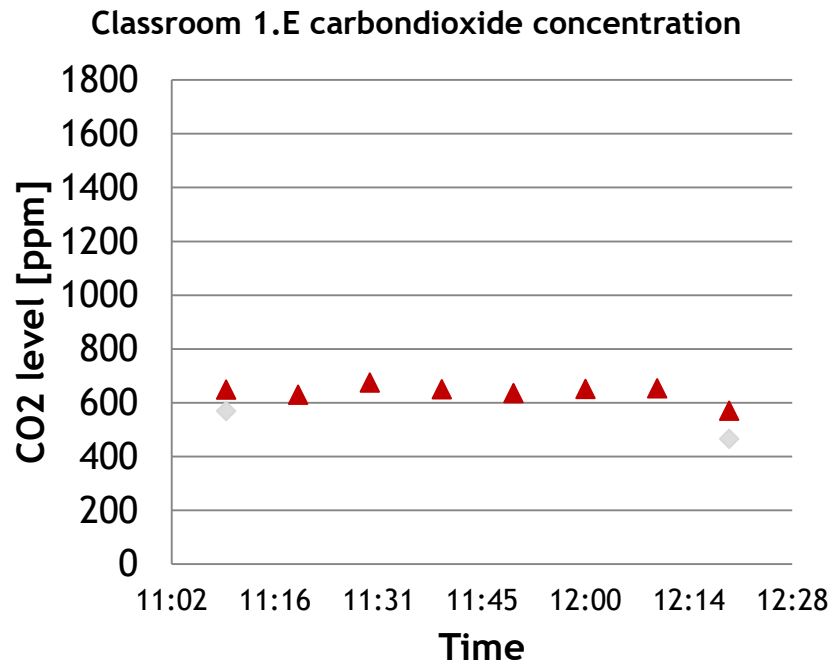
Source: Delhi Pollution Control Committee (four monitors); U.S. Embassy in Beijing (one monitor); Joshua S. Apte, University of Texas at Austin

Field study TUE / Jill Vervoort

IEQ 5 schools in Delhi (with Santrupti)

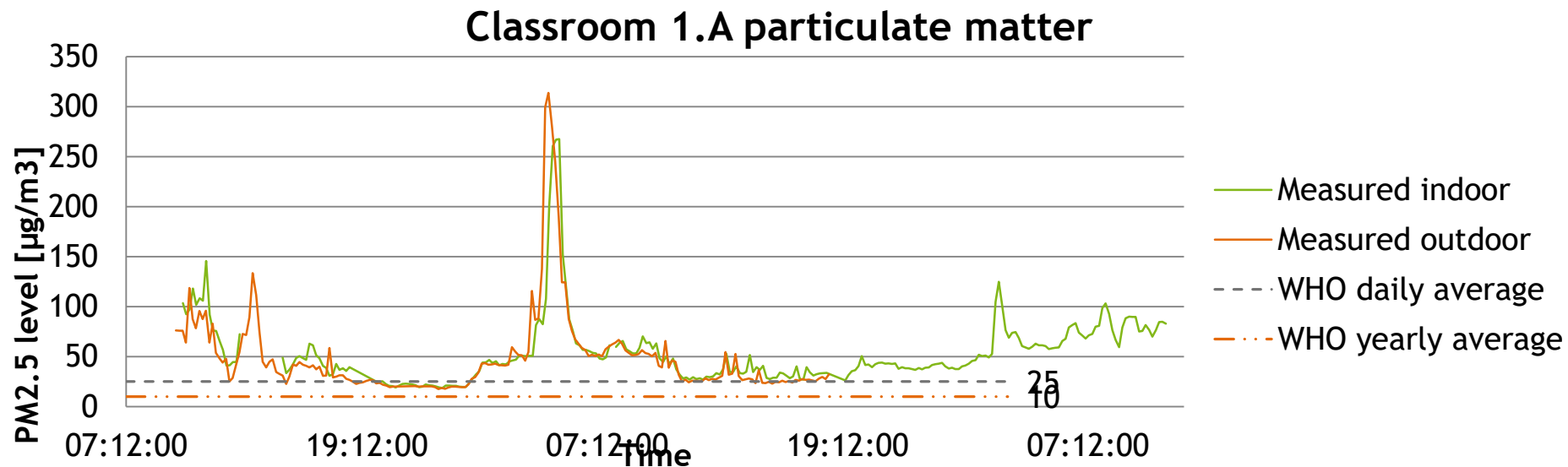


CO₂ concentrations (avg. 2 hrs)



Source: Eindhoven University of Technology, 2017

PM2.5 concentrations (indoors & outdoors)



Source: Eindhoven University of Technology, 2017

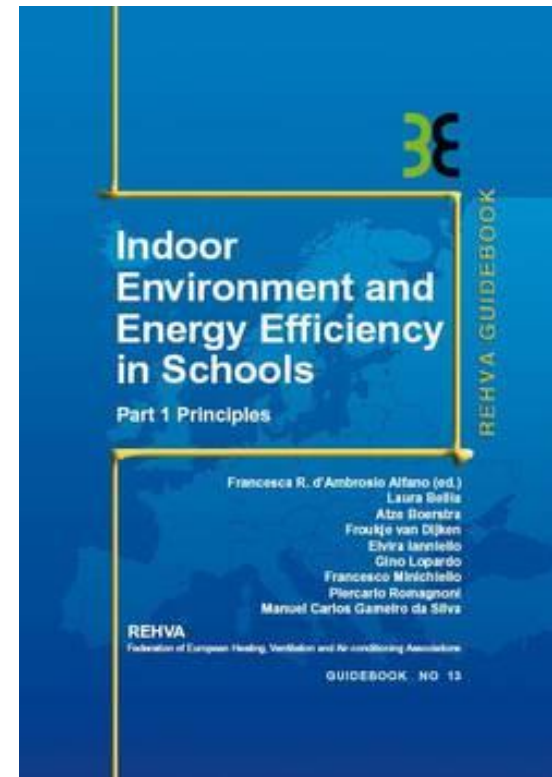
Conclusions field study

- IAQ in Indian schools totally DIFFERENT than IAQ in European schools
- Often NO WINDOWS (just shutters, bars etc) - therefore indoor fine particle concentration = momentary outdoor concentration
- High PM 2.5 concentrations (> 10 times WHO limit) therefore serious health risk! And possibly learning performance effect too
- CO2 concentrations generally LOWER than in Europe
- Limited use of mechanical systems (apart from ceiling fans)
- Thermal comfort esp overheating risk needs attention too
- **Need for improved ventilation / facade systems that keep 'bad' outdoor air out - huge OPPORTUNITY for HVAC sector**

What's next?



- ISHRAE-REHVA cooperation
- Kickoff: this seminar
- **Concept paper**
- New, joint version of school guidebook
- Coordinated action to create awareness at the political, schoolboard, community side
-



REHVA-ISHRAE concept paper



REHVA
Federation of
European Heating,
Ventilation and
Air Conditioning
Associations

CONCEPT PAPER



the REHVA-ISHRAE concept paper

Indoor Environmental Quality (IEQ) is an important determinant of health and wellbeing. This is true for adults, but even more so for **children**. Children are continuously developing their lungs and other organs, which explains why they are more susceptible to e.g. air pollution. Traditionally, research and policy have been focusing on the environmental quality *outdoors*, while missing to address the fact that most people, including children, spend most of their time indoors. The

According to the World Health Organisation everybody has the **right to breath in healthy air indoors**¹.

in recent years many office buildings have been transformed from 'sick' to 'healthy' buildings. However, similar interventions are still missing in school buildings, where scholars are often not consulted with regard of their satisfaction about indoor comfort conditions. Without intervention, fine particles and CO₂ concentrations in schools could be higher (even three times or more) than in offices. Similarly, indoor temperatures in classrooms are often uncomfortably warm or cold and lighting conditions are far from optimal, while office buildings have well-filtered, airconditioned, well-illuminated and acoustically insulated spaces.

Several studies have shown that poor IEQ reduces children's **learning performances**. Furthermore, we know that suboptimal air quality in classrooms can have severe health consequences, like the development of chronic **respiratory diseases** and (indoor climate-related) allergies. In many European countries more than 20% of children have developed such diseases by the age of 12. This number in India is probably similar or even higher.

To warrant a healthy indoor environment, especially at school, we need to use energy for heating, cooling, ventilation or lighting of classrooms. **Energy performance** of schools should be optimized ensuring proper air quality, thermal, acoustic and visual comfort as mandatory goals. To have a proper balance between the initial investment and the recurring energy bills, the comprehensive approach of carefully designed school envelope and HVAC system should be

Just a dream?

How online crowdfunding is changing ignored govt schools

Ishita.Bhatia@timesgroup.com

Meerut: Every time Priyanka Singh, a teacher at Upper Primary School, Barabanki had to explain to her students complex scientific concepts that required colour coding to differentiate between ideas, she would wish for a whiteboard instead.

STEPS TO GET FUNDS

- A teacher registers online mentioning the item that is needed
- IIM interns take campaign forward, mentioning commodity with best price
- Public is encouraged to contribute



locals but in vain. Then someone told her about an online fundraising platform. She started a campaign for a whiteboard and to her surprise the crowdfunding for it got completed in just a week.

"I now have a whiteboard. I even got a projector for them later," Singh told **TOI**. Crowdfunding is slowly getting po-

Let's do this. Thank you.