IMPROVING IAQ IN SCHOOLS AND NON-RESIDENTIAL BUILDINGS – CASE STUDIES

AIVC – Workshop

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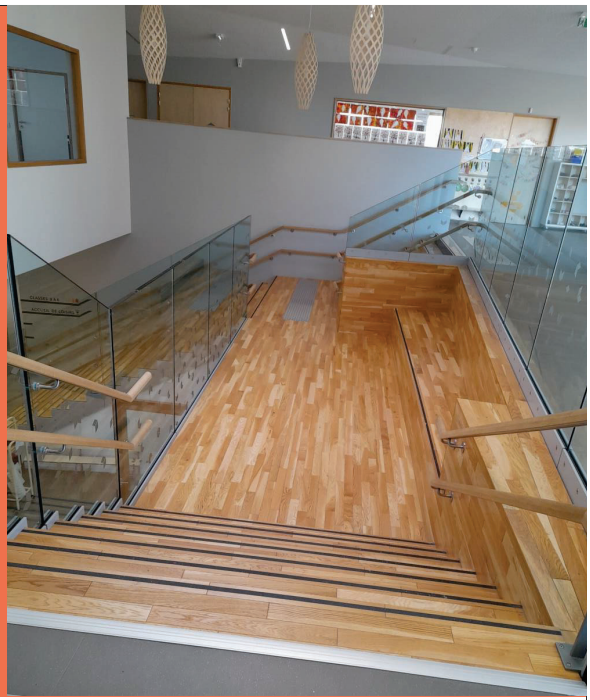
SUMMARY

- ✓ Reasons behind those projects
- ✓ The Hub Air Energie project
- ✓ The CleanAirBouw project



Objectives of the Hub Air Energie and the CleanAirBouw projects

⇒ **Improving the way to communicate on IAQ**

⇒ **Spurring action, especially in schools**

⇒ **Determine the achievable level of performance by only changing behavior: could it be enough or not**

⇒ **Determine whether additional investment are necessary in existing schools (installation of a ventilation system)**

The Hub Air Energie project – improving IAQ encouraging behaviour changes

The Hub Air Energie project

A **gathering** of public and private stakeholders to **improve indoor air quality** (IAQ) while **taking into account Energy Performance of Buildings** (EPB)

Schools, offices and a shopping mall

Method

Participatory diagnosis	Actions plan	IAQ check - Workshops	Analysis of results	Experience sharing
Understanding the challenge and improvement levers for IAQ in light of EPB	Implementing tangible actions and measuring progress	IAQ monitoring and carrying out pedagogic workshops in each building	Checking changes in pollutant levels and indoor air parameters in light of the technical characteristics of buildings	Facilitating the gathering of participants 4 times per year / publishing results

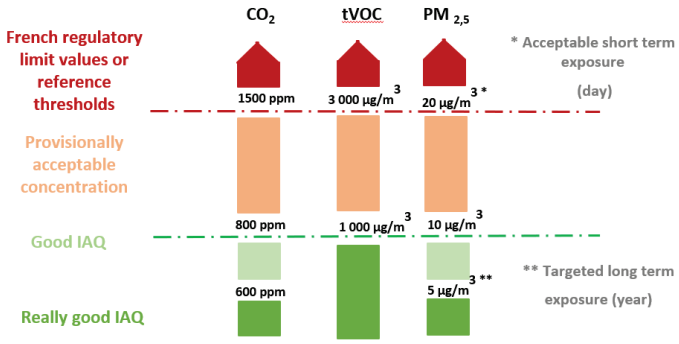
* *Project co-funded by ADEME and the French Ministry of Ecological Transition (for schools)*

IAQ evaluation and display

- Characterizing the objectives of a good IAQ around **3 compounds**:
  - carbon dioxide – CO_2,
  - total volatile organic compounds – tVOC,
  - fine particles – $PM_{2.5}$

  ⇒ gives an indication of the IAQ in the site,

  ⇒ easily understandable by stake-holders, easily measurable

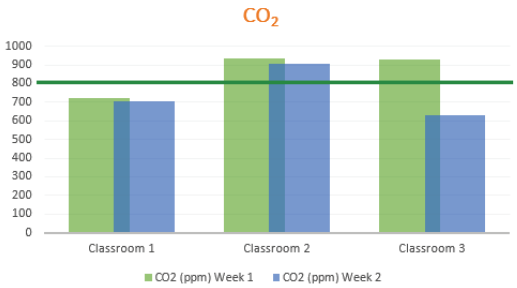


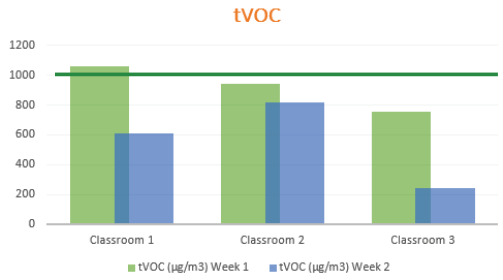
Improving IAQ only with behaviour changes?

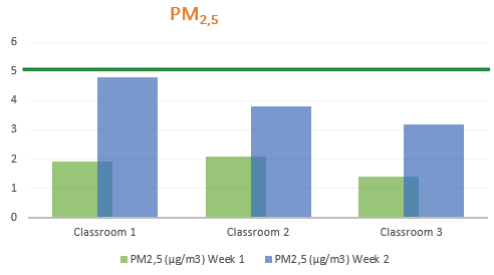
Example

Week 1 (december 2023 in Paris):
- Normal behaviour

Week 2 (december 2023 in Paris):
- Enhanced airing protocol following strict rules of window opening







A **moderate impact on CO_2** level was observed when the reinforced airing protocol was applied (between 2.5% and 32.5% reduction between weeks 1 and 2, depending on the classroom): **previous awareness**

An important reduction in tVOC levels was observed (from 13% to 67.5%)

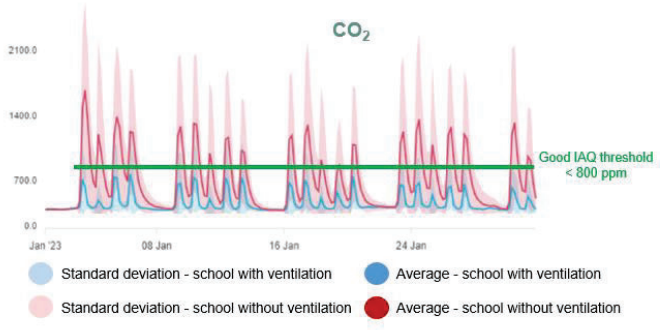
Concentrations of fine particles ($PM_{2.5}$) increased (from 81 to 152.5%), while remaining below the 5 µg/m³ threshold.

On this example, the reinforced aeration protocol has had a significant impact **=> Could be enough over few weeks, and if the protocol becomes a habit (not so easy)**

Results: impact of ventilation system

Comparison of IAQ levels in the schools with and without ventilation system – CO_2

Average divided by up to 3



Average and standard deviation in schools in January 2023 for the CO_2

** Data mining with OctopusLab and the Indalo tool*

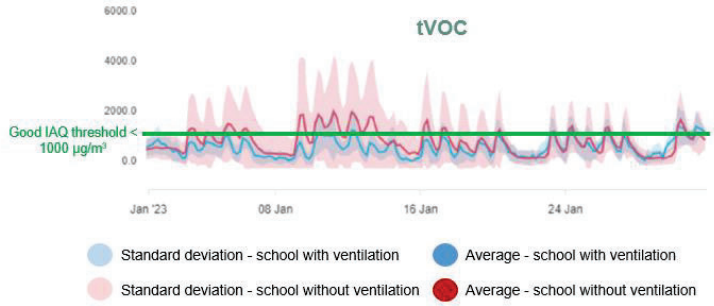
Schools with ventilation system (x4)

Schools without ventilation system (x6)

- Average levels and CO_2 peaks are **much lower (average is divided by up to 3) in schools with mechanical ventilation systems** in winter
- Even with well thoughtout aeration strategies, CO_2 levels are in average way over the thersholds, showing the incapacity of occupants to maintain an adequate air renewale without ventilation system

Results: impact of ventilation system

Comparison of IAQ levels in the schools with and without ventilation system – tVOC



Average and standard deviation in schools in January 2023 for the tVOC

** Data mining with OctopusLab and the Indalo tool*

Schools with ventilation system (x4)

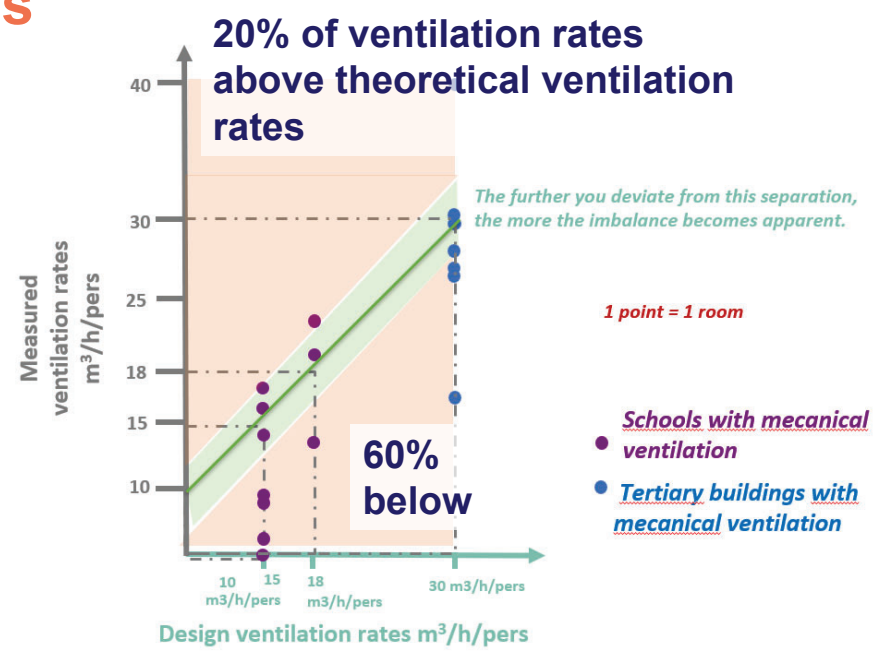
Schools without ventilation system (x6)

- Average results with and without ventilation system are close to each other, but without ventilation, the variability is much higher while with ventilation it remains most of the time below threshold
- **Better IAQ and constant threshold compliance with a mechanical ventilation system**

Results: Comparison between design and actual ventilation rates

Significant discrepancy between theoretical and actual ventilation rates

On 4 buildings



Key results – on the panel

- IAQ was quite good on the panel of 15 *Hub Air Energie* buildings, but:
  - buildings with mechanical ventilation achieved better overall IAQ than buildings without ventilation system
  - buildings using only airing through windows for air-renewal, but implementing a reinforced airing protocol, achieved IAQ levels, in some rooms, close to those of sites with defective mechanical ventilation systems (design, implementation, maintenance).

	CO_2	tVOC	$PM_{2,5}$	Ventilation system
School 1				NO
School 2				NO
School 3				NO
School 4				NO
School 5				NO
School 6				NO but reinforced airing protocol
School 7				YES
School 8				YES
School 9				YES
School 10				YES
Tertiary building 1				YES
Tertiary building 2				YES
Tertiary building 3				YES
Tertiary building 4				YES
Tertiary building 5				YES

36 % of sites comply with IAQ thresholds

Keys results – on the panel

- A mechanical ventilation system has a significant effect on the reductions of CO_2 concentrations, but its impact on tVOCs concentration was not as significative on the panel studied

- **Energy efficiency must be a lever for progress in IAQ**:
  - Economically more accessible to integrate IAQ criteria alongside energy criteria right from the design stage.
  - The same contact person should be able to handle both subjects in synergy.

- Setting up a commissioning for a new ventilation system helps to ensure that fresh air is delivered to the right place at the right time.

The Hub Air Energie project

Key results:

Publication

To find the document (in French), follow this link

The CleanAirBouw project

An Interreg France-Wallonie-Vlaanderen VI Project

8 partners involved

Interreg
Cofinancé par l'Union Européenne
Medegefinancierd door de Europese Unie
France - Wallonie - Vlaanderen
CleanAirBouw

Objectives of the CleanAirBouw project for the Cerema

A project to improve air cleaning systems in buildings

In this project, a work package lead by the Cerema to disseminate knowledge on IAQ:

- To students => at least 80
- To professionnals => at least 30
- To pupils => 20 schools and 2 classes per schools

WP3 : Sensibilisation and formation (civil society & professionnal)

Cerema, UGent

⇒ Based on the experience of the Hub Air Energy for schools
⇒ To improve the way to communicate in schools
⇒ An IAQ Challenge, to spur action

Objectives of the CleanAirBouw project for the Cerema

An IAQ Challenge, to spur action, with those objectives:

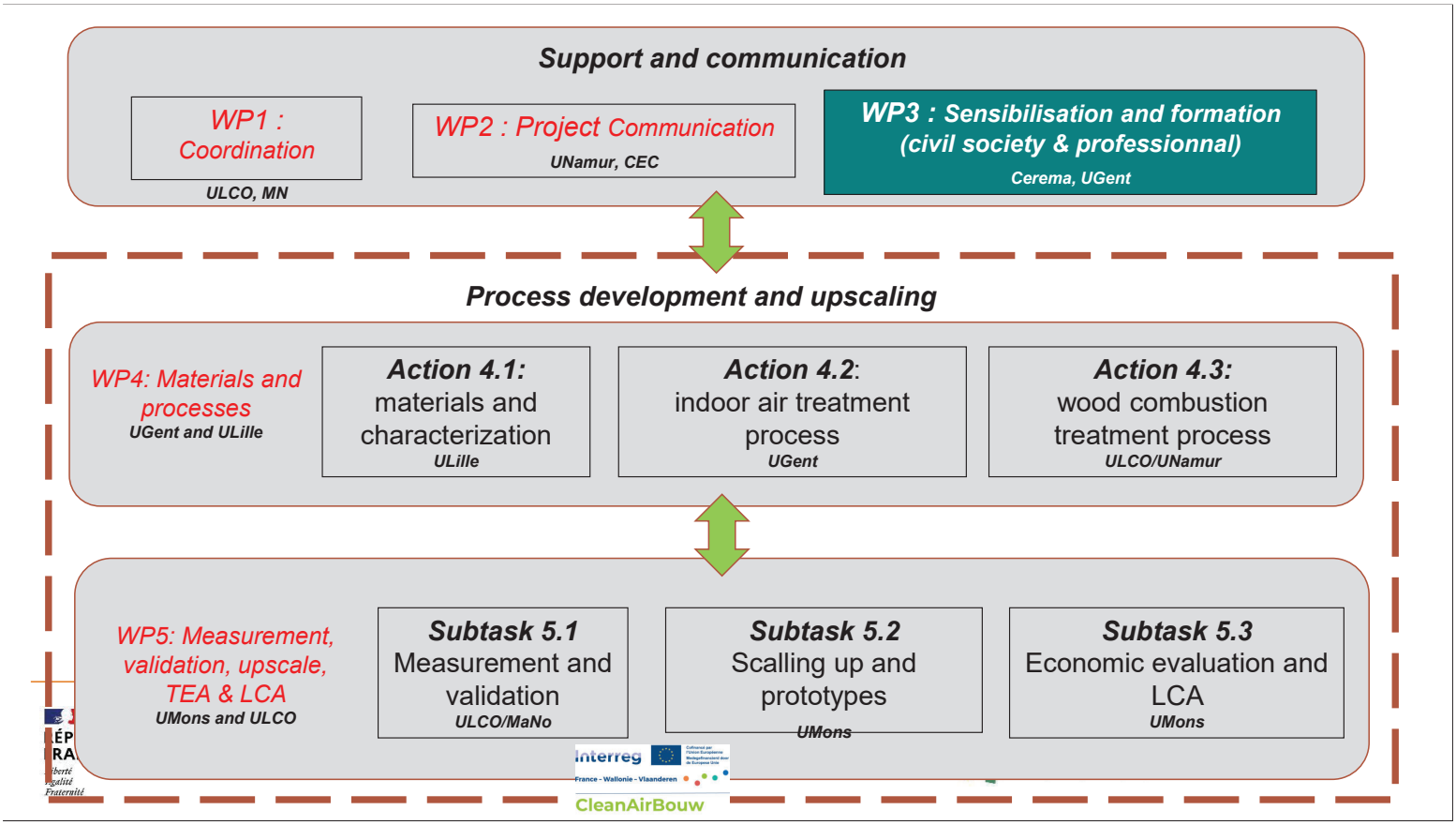
- the **best possible IAQ** over the duration of the challenge,

- the **best progress**,

- and the **best communication** with non-participating classes in their school.

Objectives of CleanAirBouw project for the Cerema

- What are the sub-tasks:
  - **Sub-task 3.1. :** Setting up a panel of schools, students and professionals to raise awareness / to train => leader = Cerema
  - **Sub-task 3.2. :** Development of teaching materials and organization of interventions for professionals and students => leader = Cluster ECO-CONSTRUCTION
  - **Sub-task 3.3. :** Development of teaching materials and intervention in schools (from CP (1st primary) to CM2 (6th primary)) => leader = Cerema
  - **Sub-task 3.4. :** Organization of IAQ challenge between schools, of the IAQ monitoring and of the feedback day => leader = Cerema
  - **Sub-task 3.5. :** Evaluation parameters for air purification systems => leader = University of Gant


Support and communication
WP1 : Coordination
ULCO, MN
WP2 : Project Communication
UNamur, CEC
WP3 : Sensibilisation and formation (civil society & professionnal)
Cerema, UGent
Process development and upscaling
WP4: Materials and processes
UGent and ULille
Action 4.1: materials and characterization
ULille
Action 4.2: indoor air treatment process
UGent
Action 4.3: wood combustion treatment process
ULCO/UNamur
WP5: Measurement, validation, upscale, TEA & LCA
UMons and ULCO
Subtask 5.1 Measurement and validation
ULCO/MaNo
Subtask 5.2 Scalling up and prototypes
UMons
Subtask 5.3 Economic evaluation and LCA
UMons
interreg
France - Wallonie - Vlaanderen
CleanAirBouw