Wi-Box +

An Integrated Sensing Systems

for Real-Time Indoor Air Quality

& Energy Monitoring
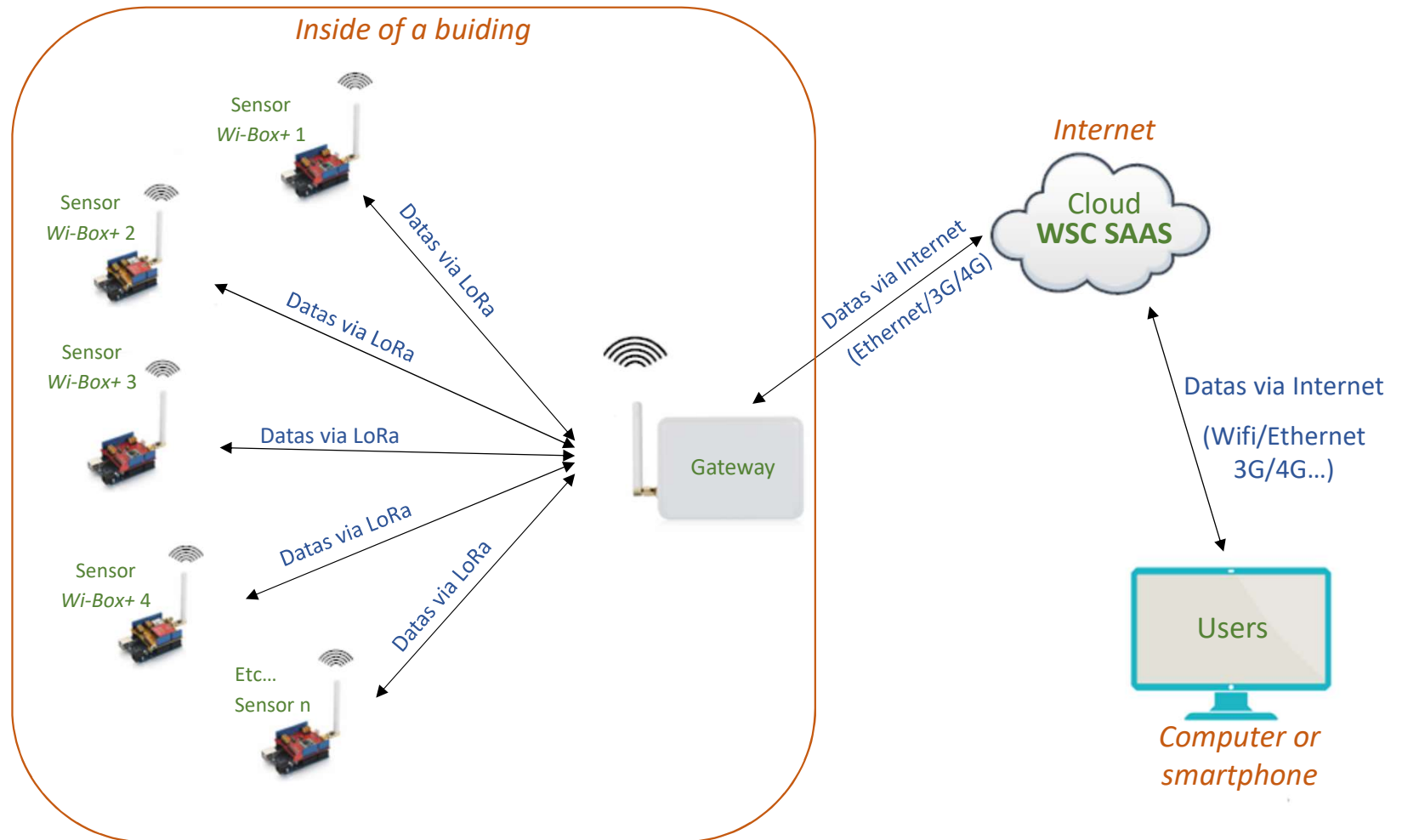
What is the Internet Of Things (IoT), and how does it work?

LoRaWAN

Networking protocol designed to wirelessly connect battery operated 'things' to the internet in regional, national or global networks, and targets key Internet of Things (IoT) requirements.
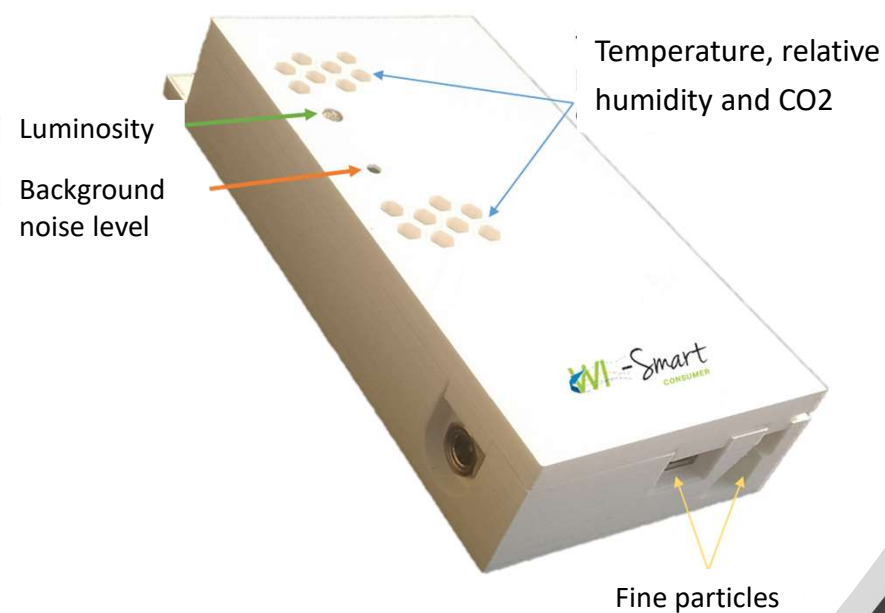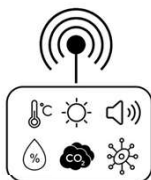
☑ Long range

☑ Wireless communication :
→ Fast and low-cost installation (Only an electric plug is needed)

☑ Radio waves : health safe
    ≠ Wifi

Inside of a buiding

Sensor
Wi-Box+ 1

Sensor
Wi-Box+ 2

Sensor
Wi-Box+ 3

Sensor
Wi-Box+ 4

Etc…
Sensor n

Datas via LoRa

Datas via LoRa

Datas via LoRa

Datas via LoRa

Datas via LoRa

Gateway

Internet

Cloud
WSC SAAS

Datas via Internet
(Ethernet/3G/4G)

Datas via Internet
(Wifi/Ethernet
3G/4G…)

Users

Computer or smartphone

2

1 / Wi-Box + sensors

Presentation and functioning

WI-BOX + : 1 device, 6 measurements

LoRa™

Luminosity

Background
noise level

Temperature, relative
humidity and CO2

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CONSUMER

Fine particles

- ☑ Temperature
- ☑ Relative humidity
- ☑ Luminosity
- ☑ Noise level
- ☑ CO_2 concentration
- ☑ Fine particles concentration

- ☑ Fast and easy to install : wireless connexion, power supply on mains

- ☑ frequency of measurements at your choice

- ☑ Real time data restitution

Product designed and developed in-house

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LoRa™

MIKROTIK - LtAP LR8 LTE Kit

GATEWAY

☑ Provides the link between sensors and the Cloud :

- This device recovers data from wi-boxes, and sends them to our servers.

- It also allows to configure sensors remotely.

☑ Connection in patch panel on RJ45 or in autonomy with a SIM card

☑ Theoretical link capacity up to 300 Wi-Box + sensors

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Wi-Box + benefits
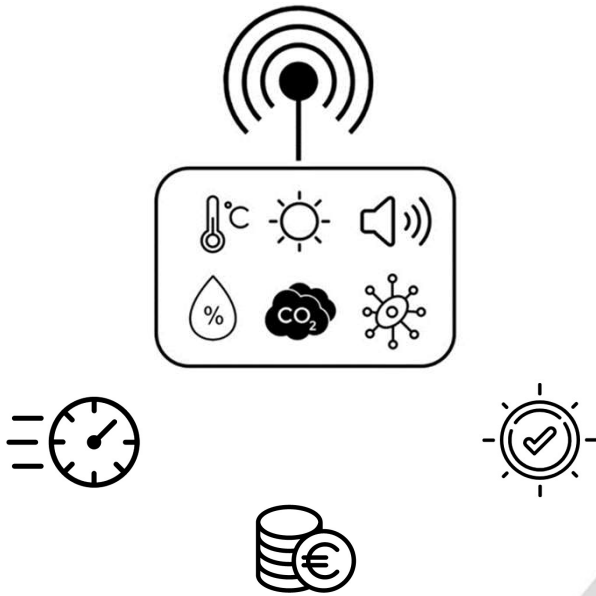
- Continuous and real-time monitoring of temperature, air quality and energy use

- If an anomaly occurs, an ALERT sms, mail, or Telegram is immediately sent

- Identification and immediate localization in case of drifts: origins (clogged ventilation filters...), bad practices...

- Data history automatically generated

- Communication to involve, reassure and build loyalty :

  → Visitors & occupants : continuous supervision of the air
  → Staff : energy saving challenges...

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2 / Indoor Air Quality

What variables to monitor ?

Data interpretation

Corrective actions

Indoor air quality

Temperature & relative humidity:

What are the recommended values?

The couple temperature / humidity is determining for the good quality of the air

*Risks if neglected: "**sick building syndrome**" [1], microorganisms proliferation...*

Recommendation for response to the COVID-19 : «In winter, maintain a sufficient hygrometry to limit the dehydration of droplets, their transformation into aerosols and their diffusion in the indoor air »

- Humidity [30 % - 60 %] **Alert if it exceeds 70%**
- Temperature [19 °C – 23 °C]

HUMIDEX

Index number used by Canadian meteorologists to describe how hot the weather feels to the average person, by combining the effect of heat and humidity. It indicates the perceived comfort.

[1] *Sick building syndrome on Wikipédia*

Indoor air quality

HUMIDEX index

	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
42°	48	50	52	55	57	59	62	64	66	68	71	73	75	77	80	82
41°	46	48	51	53	55	57	59	61	64	66	68	70	72	74	76	79
40°	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75
39°	43	45	47	49	51	53	55	57	59	61	63	65	66	68	70	72
38°	42	44	45	47	49	51	53	55	56	58	60	62	64	66	67	69
37°	40	42	44	45	47	49	51	52	54	56	58	59	61	63	65	66
36°	39	40	42	44	45	47	49	50	52	54	55	57	59	60	62	63
35°	37	39	40	42	44	45	47	48	50	51	53	54	56	58	59	61
34°	36	37	39	40	42	43	45	46	48	49	51	52	54	55	57	58
33°	34	36	37	39	40	41	43	44	46	47	48	50	51	53	54	55
32°	33	34	36	37	38	40	41	42	44	45	46	48	49	50	52	53
31°	32	33	34	35	37	38	39	40	42	43	44	45	47	48	49	50
30°	30	32	33	34	35	36	37	39	40	41	42	43	45	46	47	48
29°	29	30	31	32	33	35	36	37	38	39	40	41	42	43	45	46
28°	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
27°	27	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
26°	26	26	27	28	29	30	31	32	33	34	34	35	36	37	38	39
25°	25	25	26	27	27	28	29	30	31	32	33	34	34	35	36	37
24°	24	24	24	25	26	27	28	28	29	30	31	32	33	33	34	35
23°	23	23	23	24	25	25	26	27	28	28	29	30	31	32	32	33
22°	22	22	22	22	23	24	25	25	26	27	27	28	29	30	30	31

Interpretation :

1- When the temperature is 25 °C and the relative humidity is 50 %, the Humidex shows 28, which indicates a very good perceived comfort.

2- With the same temperature (25 °C), but a 60 % relative humidity, the Humidex is 30, which means that people might feel slight suffocation.
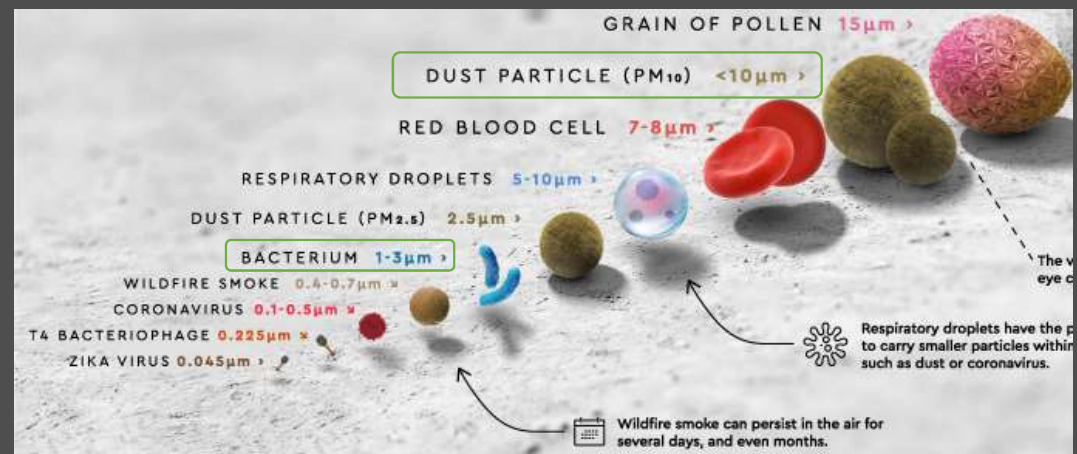
Indoor air quality

Focus on fine particles

The danger they represent comes from they can penetrate human organisms through the respiratory tract.

They also serve as vehicles for microorganisms.

Wi-Box + can measure 4 particle sizes :

- **PM 10** : diameter < 10 micrometers. They are called "respirable" because they can enter the bronchial tubes.

- **PM 4** : diameter < 4 microns; they approach the alveolar fraction.

- **PM 2,5** : diameter < 4 microns; they can penetrate the pulmonary alveoli.

- **PM 1** : Diameter < 1 micron (e.g. some bacteria). They can cross the alveolar-capillary barrier (which is used for gas transfers between the blood and the pulmonary alveoli).

As a comparison, the diameter of a human hair is about 60 µm, the equivalent of PM 60 !

Indoor air quality

Fine particles and air conditioning

Air conditioner filters are mechanically destined to clog up over time.

After a while, if they have not been cleaned or renewed, some of the pollutants they should retain will tend to escape.
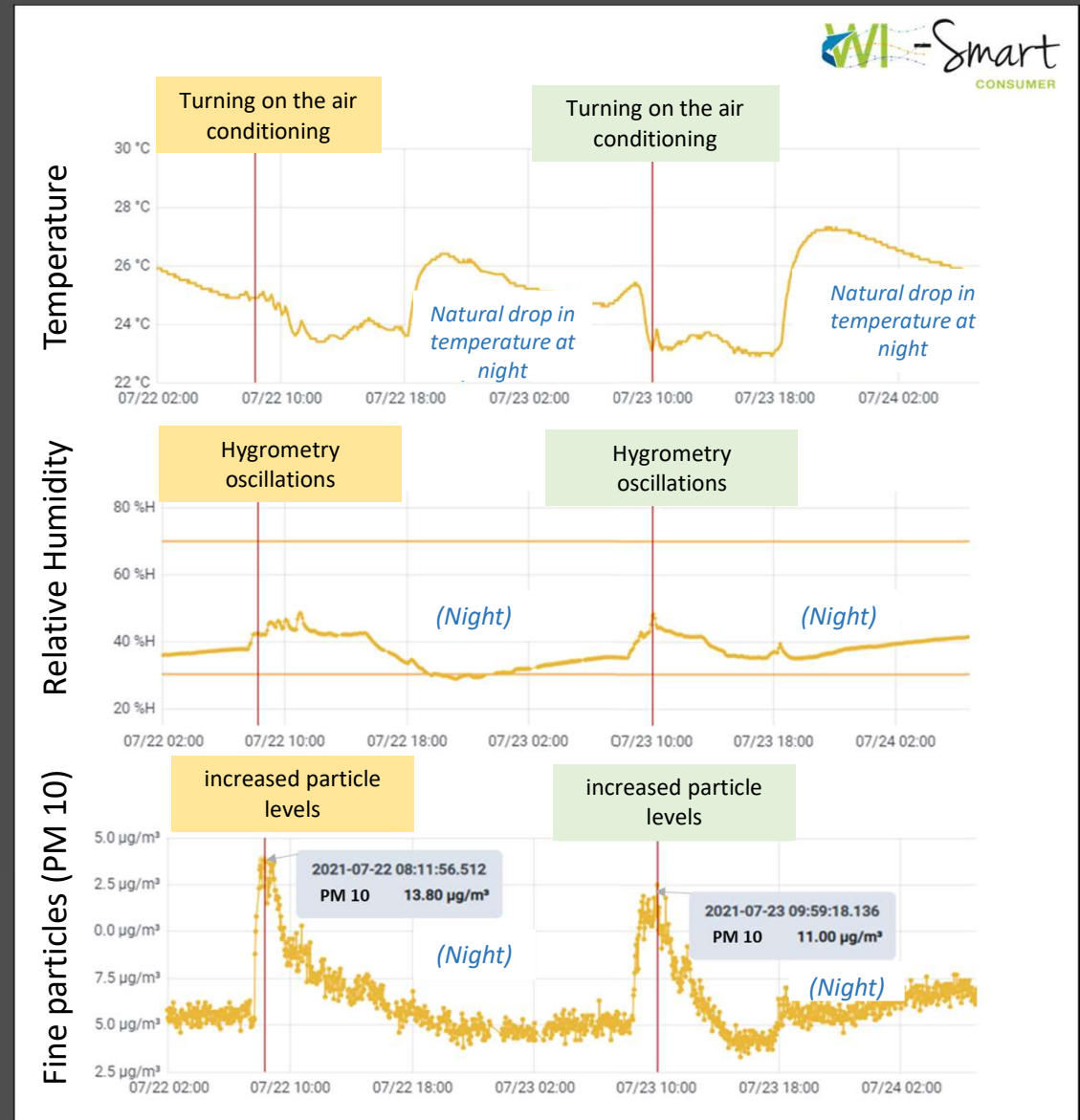
Indoor air quality

Classification of HVAC* filters

Filters play an essential role in the quality of the air we breathe in buildings.

They act as barriers to fine particles.

Focus on G4 and F7 filters in particular.

* heating ventilation air conditioning

Production Area	Pre Filter Grade	Secondary Filter Grade	Final Filter Grade
Low Care			
Acc. to EN 779:2012 & EN 1822:2010	G4		F7 F8
Acc. to ISO 16890	ePM Coarse 60%		ePM 2.5 70% ePM 1 65%
High Care			
Acc. to EN 779:2012 & EN 1822:2010	G4	F7 F8	F9
Acc. to ISO 16890	ePM Coarse 60%	ePM 2.5 70% ePM 1 65%	ePM 1 80%
High Risk			
Acc. to EN 779:2012 & EN 1822:2010	G4	F7 F8	H11
Acc. to ISO 16890	ePM Coarse 60%	ePM 2.5 70% ePM 1 65%	H11

G4 filter, installed upstream of the ventilation network, retains large particles at the extraction point and prevents clogging of the air handling unit and the Controlled Mechanical Ventilation (CMV) circulation.

G4 filters particles > 10 µm (0.01 mm) such as sand grains or hair, it is classified Iso Coarse.

F7 filter, in addition to the G4, is used to purify the indoor air when blowing fresh air into a CMV.

F7 filters particles > 2.5 µm (0.0025 mm) such as bacteria, fungi, pollen, toner dust... it is classified Iso ePM 2.5.

Indoor air quality

4.8 μg/m³

Sensor 8

CO2 ppm
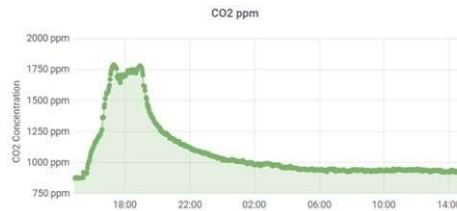
CO2 & fine particles :

Recommended values

1- Particulate matter (PM) : W.H.O. Guidelines

	PM 2,5	PM 10
24-hour mean	15 μg / m3	45 μg / m3
Annual mean	5 μg / m3	15 μg / m3

2 – CO2 as an indicator of the effectiveness of ventilation

Good IAQ	< 800 ppm
Medium IAQ	800 – 1200 ppm
Low IAQ	1200 – 1400 ppm
Bad IAQ	> 1400 ppm

European standard EN 13779

"In the context of SARS-CoV-2 transmission, measurement of CO2 may be used as an indicator of poor ventilation. Spaces where there is potential for high aerosol generation should aim for CO2 at least below 800 ppm, and even this may not be sufficient to mitigate transmission (medium confidence). "

Source : REHVA

3 / Energy use

Detect wasteful situations

Alerting the referent in the field

Save energy without investment

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Example of energy waste

Example of detected anomaly :
Air conditioning on in an office during a weekend

Temperature
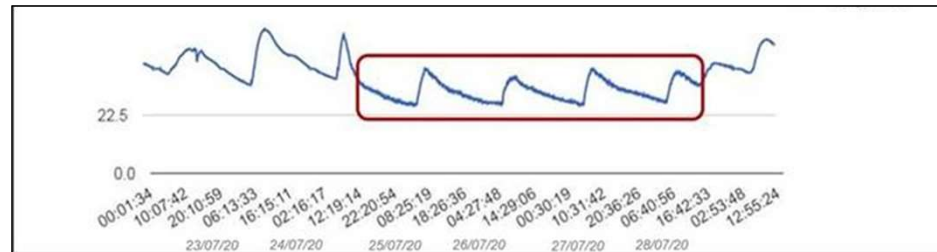
Cooling is triggered at 25 °C and suspended at 23c°C :
→ Signature of the air conditioning thermostat

Humidity
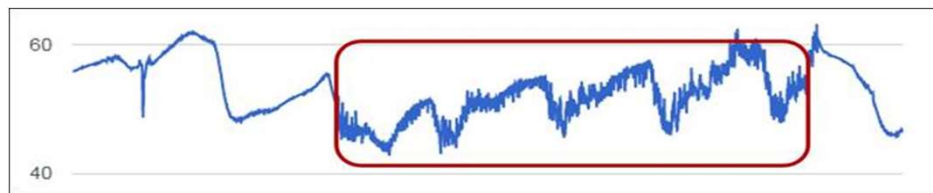
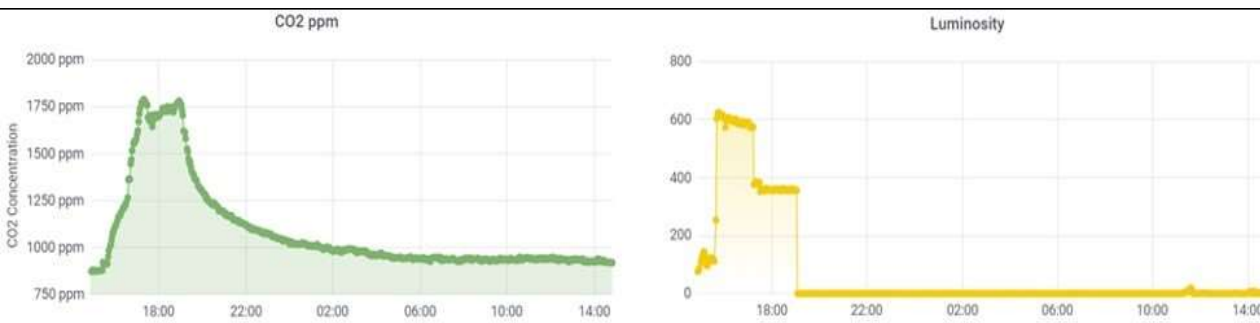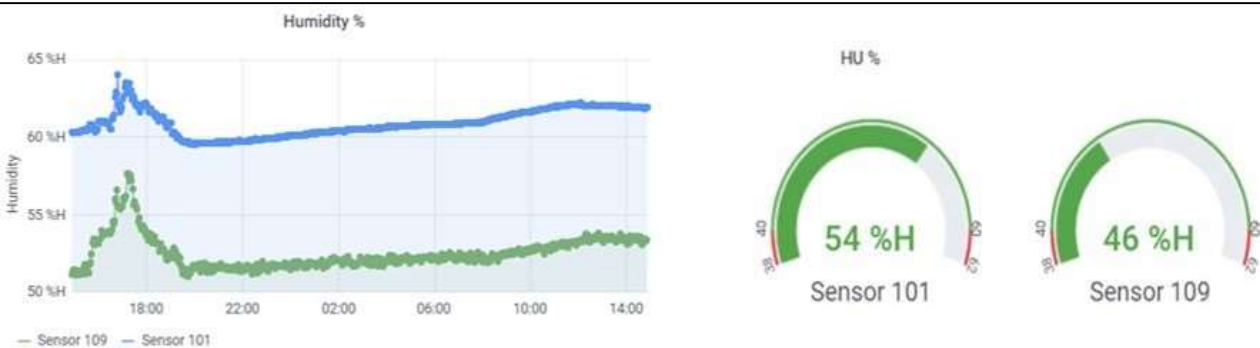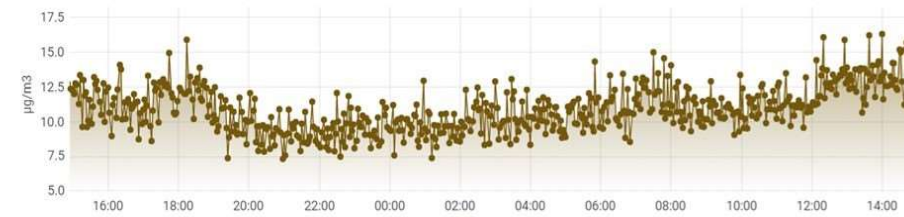The oscillations of the humidity curve are suddenly stronger

Background noise level

The regularity of a sustained background noise correspond to the blower of the ventilation

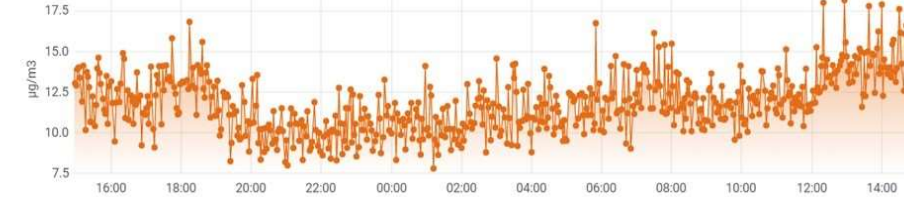**Typical case of a situation requiring the programming of an alert !**
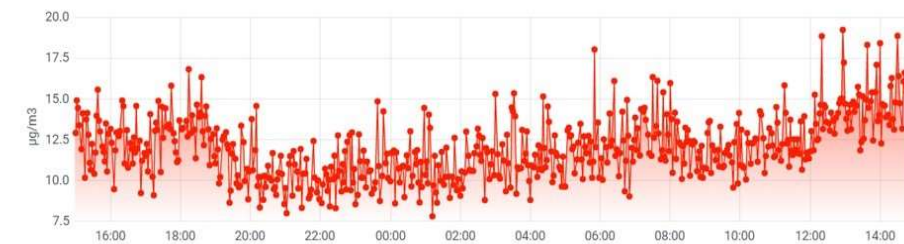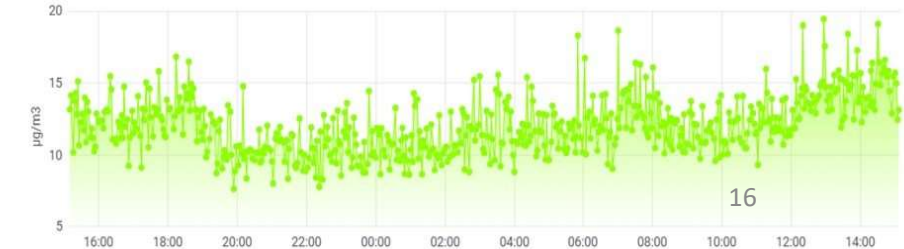
Wi-Box + multi-function sensors :

CONTACTS

Frédéric LACARELLE – Founding partner
f.lacarelle@wismartconsumer.eu
+336.03.84.19.19

Alexandre VIAL – Founding partner
a.vial@wismartconsumer.eu
+336.23.09.45.70

Fabien ROCHAIX – business manager
f.rochaix@wismartconsumer.eu
+336.29.95.20.92

Courrier :   Immeuble le Kiaora
                  50 – 52 avenue Chanoine Cartellier
                  69230 Saint-Genis-Laval

Site :   www.wismartconsumer.com