AIVC April Workshop

Benjamin Hanoune
co-lead ST5
IEA-EBC Annex 86

Series of four webinars
organised in collaboration with
IEA-EBC Annex 86 ‘Energy efficient IAQ management’

April 1,	Building ventilation: How does it affect SARS-CoV-2 transmission?	
April 8,	IAQ and ventilation Metrics	
April 13,	Big data, IAQ and ventilation	- part 1
April 21,	**Big data, IAQ and ventilation**	**- part 2**

Previous webinars available on www.aivc.org

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EBC
Energy in Buildings and Communities Programme

IEA-EBC Annex 86

Energy Efficient IAQ Management in residential buildings

2

EBC Annex 86

Energy in Buildings and Communities Programme

Scope and Goals

Provide a framework to improve energy efficiency of IAQ management for

residential buildings

both new construction and refurbishment

To select metrics to assess energy performance and indoor environmental quality of an IAQ management strategy and study their aggregation
To improve the acceptability, control, installation quality and long-term reliability of IAQ management strategies by proposing specific metrics for these quality issues
To set up a coherent rating method for IAQ management strategy that takes into account the selected metrics
To identify or further develop the tools that will be needed to assist designers and managers of buildings in assessing the performance of an IAQ management strategy using the rating method
To gather existing or provide new standardized input data for the rating method
To study the potential use of smart materials as (an integral part of) an IAQ management strategy
To develop specific IAQ management solutions for retrofitting existing buildings
To benefit from recent advances in sensor technology and cloud-based data storage to systematically improve the quality of the implemented IAQ management strategies, ensure their operation and improve the quality of the rating method as well as the input data
To improve the availability of these data sources by exploring use cases for their providers
To disseminate about each of the above findings.

EBC Annex 86

Energy in Buildings and Communities Programme

Partners

42 institutes from 24 countries

Open to new partners

Active participation by companies encouraged!

List of annex participants per country:
Australia: CSIRO
Austria: University of Innsbruck
Belgium: UGent, KUL, BBRI, University of Antwerp
Brazil: Pontfical Catholic University of Parana
Canada: NRC
Chile: PUC
China: Nanjing University, BUCE and Tsinghua University
Denmark: DTU and Aalborg University Copenhagen
Finland: Aalto University
France: La Rochelle University, ENS PSL, CEREMA, Université de Lille, UPJV and CETIAT
Germany: TH Rosenheim
Ireland: NUIG
Italy: EURAC research center
New Zealand: BRANZ
Netherlands: Technical University of Eindhoven, BBA/TUDelft and Zehnder
Norway: Oslo Metropolitan University and SINTEFF
Portugal: University of Coimbra, Polytechnic Institute of Viseu and University of Porto
Singapore: National University of Singapore
Spain: Eduardo Torroja Institute for Constructon Sciences – CSIC
Sweden: Chalmers University and KTH
Switzerland: ETH
Turkey: TTMD
United Kingdom: University of Strathclyde, Lancaster University and University of Nottingham
USA: Syracuse University, UMD, UTexas and LBL

EBC Energy in Buildings and Communities Programme

Annex 86

Workplan

6 Subtasks

ST 1 and 2: methodology

ST 3 and 4: application to technology

ST 5: new opportunities through IoT

ST 6: dissemination and management

Subtask 1 Metrics and development of an IAQ management strategy rating method

This subtask is devoted to the development of a general rating method for the benchmarking of the performance of IAQ management systems. In addition to relevant metrics, a set of appropriate tools, consistent modeling assumptions and monitoring protocols are also proposed.

Subtask 2 Source characterization and typical exposure in residential buildings

This ST creates consistent input values for the assessment method developed in ST 1 and control strategies in ST 4. It starts from information available in literature, adding new experimental results where needed and reviewing and developing models (empirical, semi-empirical or physical models) for characterizing relevant residential sources.

Subtask 3 Smart materials as an IAQ management strategy

This ST identifies opportunities to use the building structure and (bio-based) building materials (focussing on hemp concrete) and the novel functional materials inside it to actively/passively manage the IAQ, for example, through active paint, wallboards, textiles coated with advanced sorbents or hemp concrete, and quantifies their potential based on the assessment framework developed in ST 1.

Subtask 4 Ensuring performance of smart ventilation

This subtask focuses on practical conditions that assure reliable, cost effective and robust implementation of smart ventilation. This includes both installation and operation. A poor performance of smart ventilation systems can not only lead to waste of energy and aggravated IAQ. It can also create a bad reputation of smart ventilation among relevant stakeholders - designers, installers as well as occupants. This, in the end, can lead to adoption of more primitive, less efficient (in terms of energy use) and less effective (in terms of IAQ) forms of IAQ management. The subtask defines a smart ventilation according to the AIVC

Subtask 5 Energy savings and IAQ: improvements and validation through cloud data and IoT connected devices

This subtask is exploring the potential of the new generation of IoT connected devices (both standalone and embedded in eg. AHU's) for smart IAQ management. What can we learn from big data? Can we benchmark system energy and IAQ performance based on this data? How can we make sure that the data is available and can be accessed? Can we update what we think we know about what happens in dwellings based on what we see in big data rollouts? What are the best protocols and ontologies? How to create viable services out of the data/business plans? How can we integrate data with smart grids?

Subtask 6 Dissemination, management and interaction

The final subtask assures the close alignment of the activities within the annex and the interaction with the AIVC. This subtask includes the outreach of the annex, eg. by managing the dedicated section of the IEA EBC webpage. It uses the different platforms that the AIVC provides to interact with the broader target audience. This task will also ensure the continuation of the link with (the results from) other ongoing and ended annexes, especially annex 68.

EBC Energy in Buildings and Communities Programme

Annex 86

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ST 3 and 4: application to technology

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Annex 86 ▸ ST 5

Energy savings and IAQ: improvements and validation through
cloud data and IoT connected devices

- **Smartness**
  (e.g. smart ventilation incl. continuous commissioning & optimization, use of remote data, ST4)
- **Knowledge & data-sets**
  (e.g. for defining metrics (ST1), typical exposures (ST2)

- **Applications**
  real-time & delayed, on-line & off-line, new business cases?

- **Challenges**
  - real-life, uncontrolled environments (cause/effect?)
  - data quality: often limited number and lower cost sensors
  - GDPR
  - IT
  - …

AIVC April Workshop

Series of four webinars

April 1, Building ventilation: How does it affect SARS-CoV-2 transmission?

April 8, IAQ and ventilation Metrics

April 13, Big data, IAQ and ventilation - part 1 (academics)

April 21, Big data, IAQ and ventilation - part 2 (industry)

Objectives:
To address
- **the applications** of IoT devices and big data in IAQ and ventilation
- discuss **the possibilities** they provide **for industry**.

To set the starting stage for subtask 5 of IEA-EBC Annex 86

Big data, IAQ and ventilation – part 2

webinar
2021.04.21

09:00 | Introduction
Benjamin Hanoune – Université de Lille, France

09:10 | Data analytics at Renson: from airflows to dataflows
Steven Delrue – Renson, Belgium

09:25 | CO_2 : a reference point for ventilation standards
Sandra Chochod & Marcin Mezynski – Netatmo, France

09:40 | rCloud – Geolocation and Cloud Storage of Airtightness Test results and Real-time Pressure Logging
Ben Walker – Retrotec, Canada

09:55 | Sensors and machine learning to improve HVAC control
Inouk Bourgon – Foobot, Luxemburg

10:10 | Questions and Answers
10:30 | Closing & End of webinar

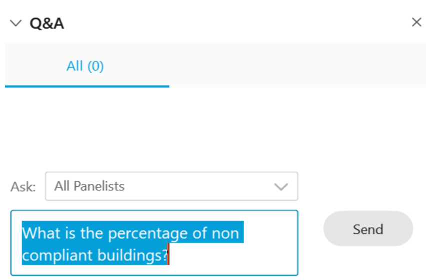
webinar
2021.04.21

How to ask questions during the webinar

Locate the **Q&A box**

Select **All Panelists** | Type your question | Click on Send

Note: Please DO NOT use the chat box to ask your questions!



webinar
2021.04.21

NOTES:
- The webinar will be **recorded and published** at www.aivc.org in a few days, along with the presentation slides.
- After the end of the webinar you will be redirected to our **post event survey**. Your feedback is valuable so take some minutes of your time to fill it in.

Webinar management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(INIVE, BE)


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(INIVE, BE)

Organized by: www.aivc.org

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Big data, IAQ and ventilation – part 2

webinar
2021.04.21

Q&A

?

12

Data Analytics at Renson: From airflows to dataflows

Steven Delrue – R&D Manager Data Analytics

RENSON®

Creating healthy spaces

VENTILATION | SUNPROTECTION | OUTDOOR

Webinar

AIVC Air Infiltration and Ventilation Centre

AIVC Workshop Webinar 4

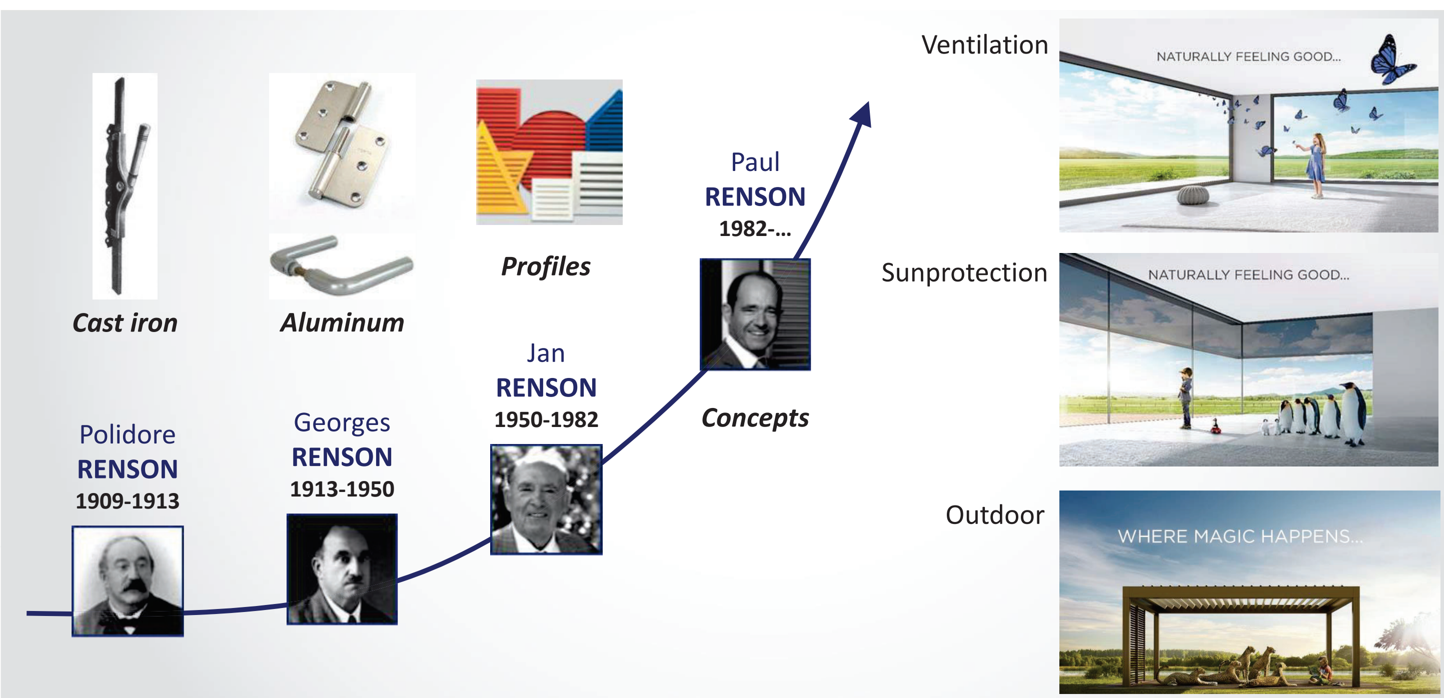
Big data, IAQ and ventilation – part 2

21/04/2021

Introduction

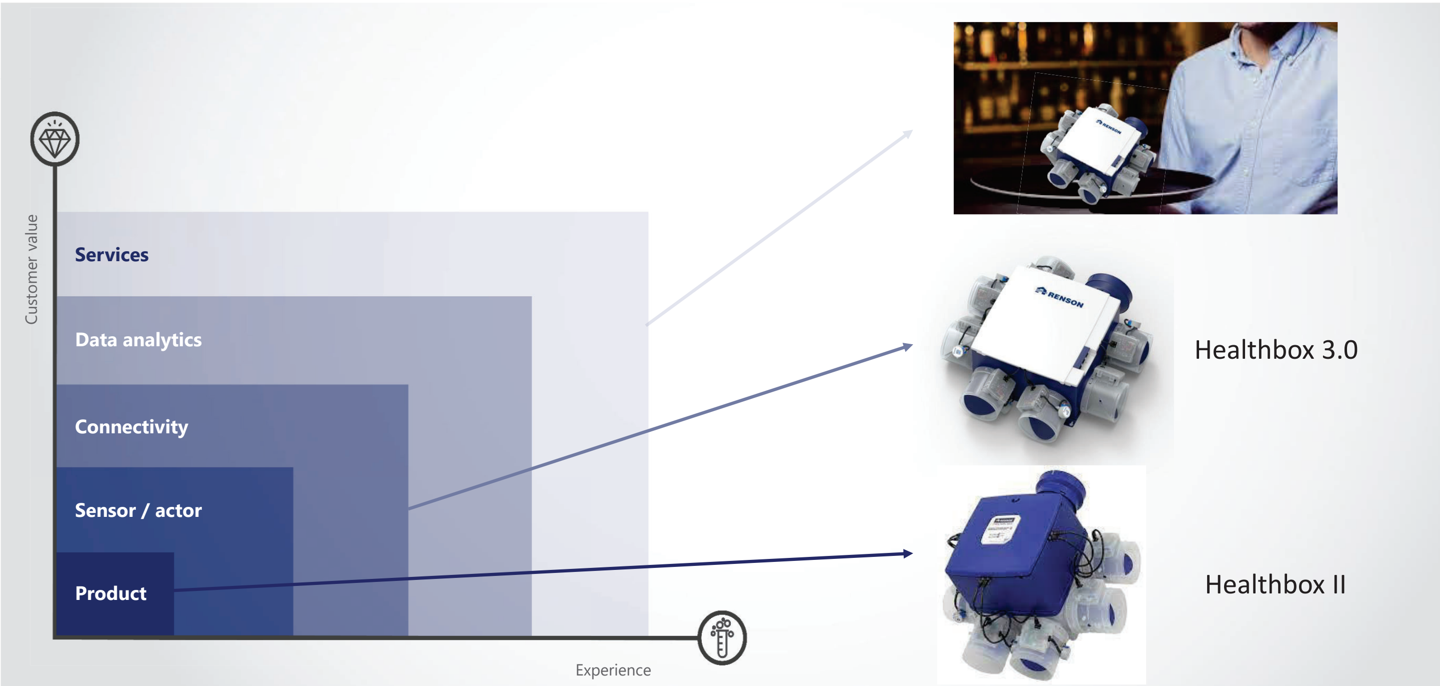
Introduction

RENSON THROUGH THE YEARS



Renson confidential
Creating healthy spaces

Introduction
DIGITAL INNOVATION ROADMAP



Renson confidential
Creating healthy spaces

Introduction
RENSON CONNECTED DEVICES

Healthbox 3.0	Waves	Sense	Outdoor	Screens
				
2018	2019	2020	2021	2022
± 8500	± 700	± 2100		

Data analytics at Renson

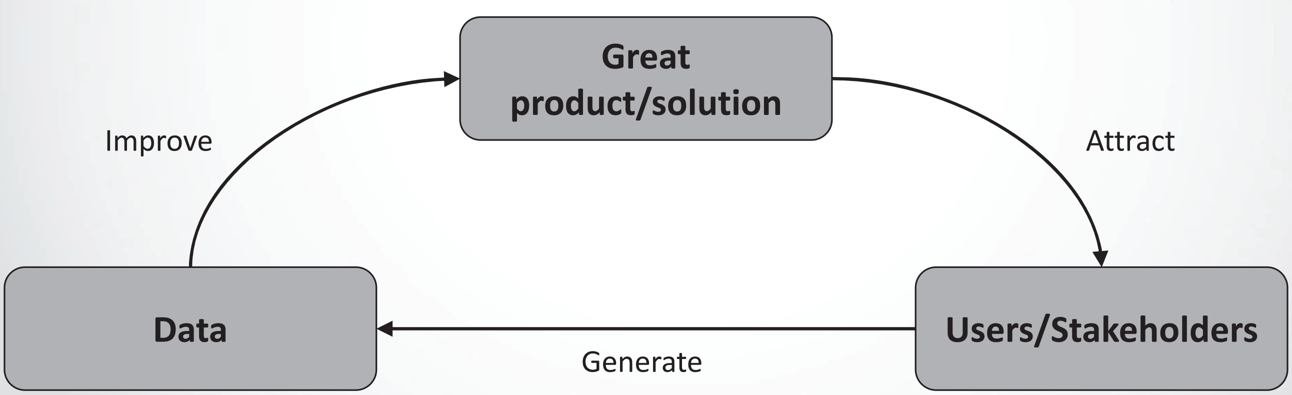
Data analytics at Renson
THE LOGICAL NEXT STEP

Vision

Take the concept of 'Creating Healthy Spaces' to the next level using product data.

Mission

Develop data tools and methods to assist the company in creating innovative concepts and products for healthy and comfortable living.



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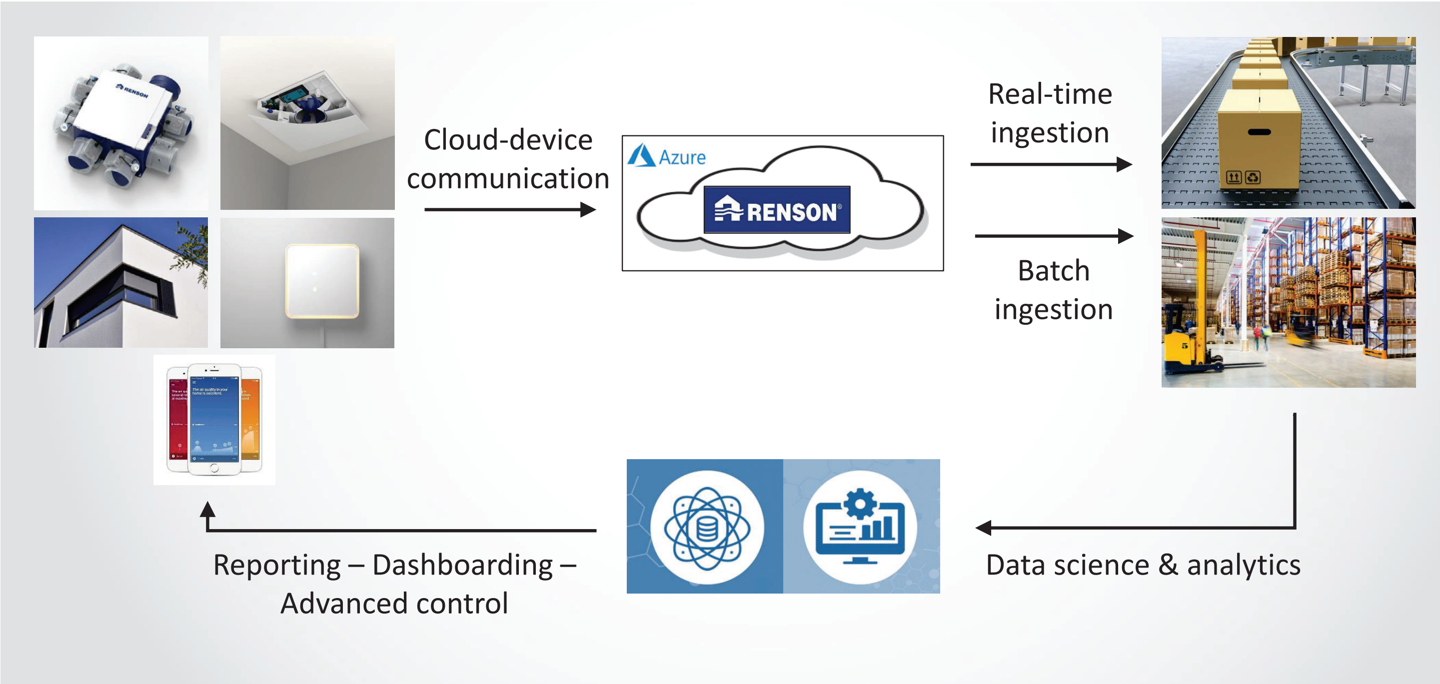
Creating healthy spaces

Data analytics at Renson
A MODERN DATA PLATFORM



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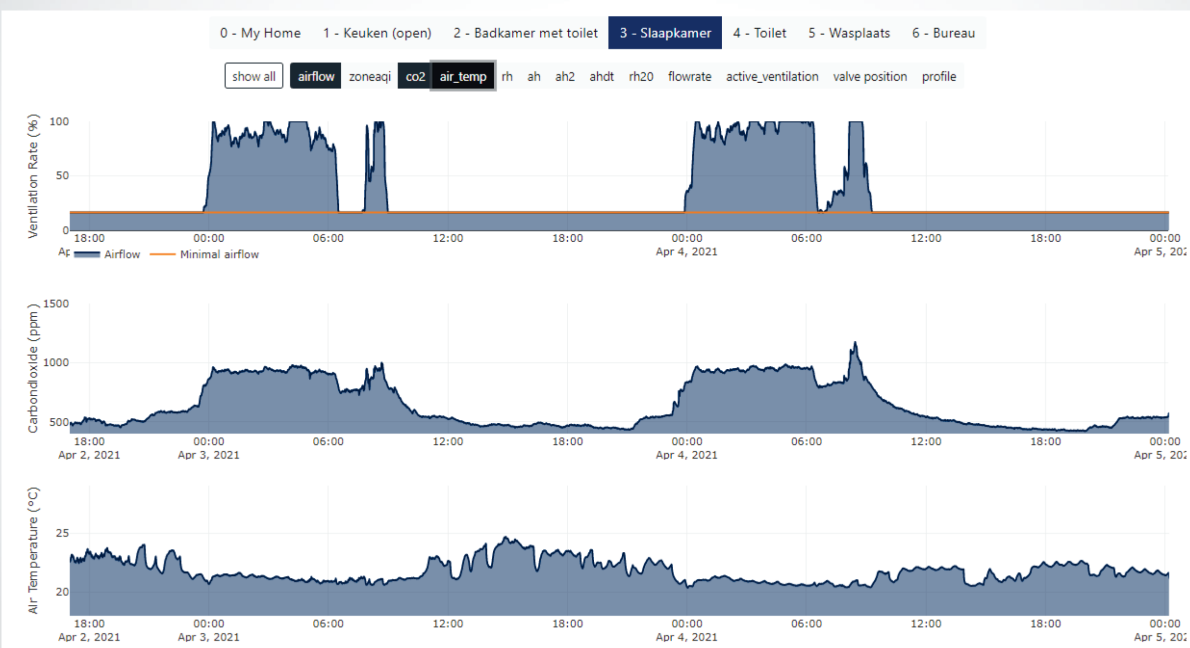
Creating healthy spaces

Data analytics at Renson
SOME EXAMPLE DATA



Data analytics at Renson
SOME EXAMPLE DATA

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RENSON®
Creating healthy spaces

Data analytics at Renson
USE CASES

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Creating healthy spaces

- Research and decision-making
- Improved customers engagement
- Product improvement
- Service development

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Creating healthy spaces

Data analytics use cases

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Creating healthy spaces

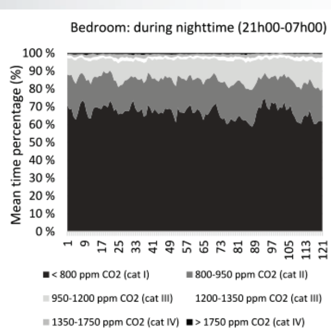
Data analytics use cases

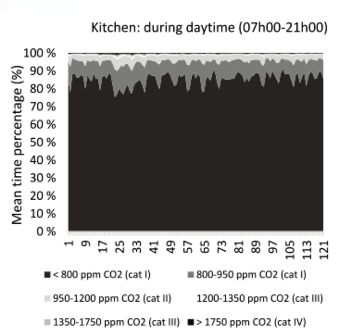
RESEARCH AND DECISION-MAKING

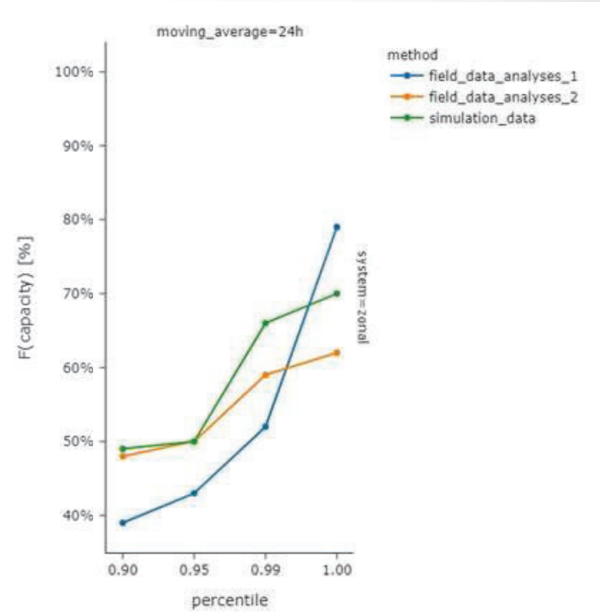
Articles

This article is based on a paper presented at the 40th AIVC - 8th TightVent & 6th Venticool Conference "From energy crisis to sustainable indoor climate" 15-16 October 2019, Ghent, Belgium

Cloud based large-scale performance analysis of a smart residential MEV system







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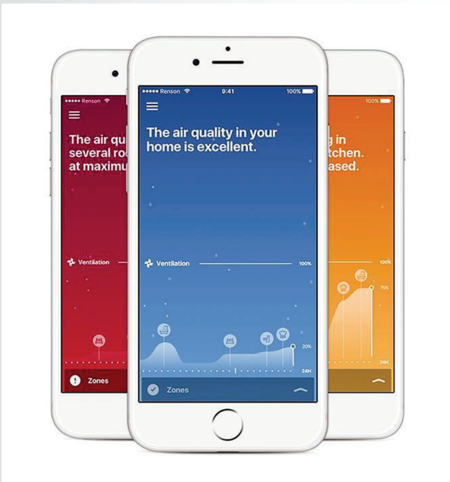
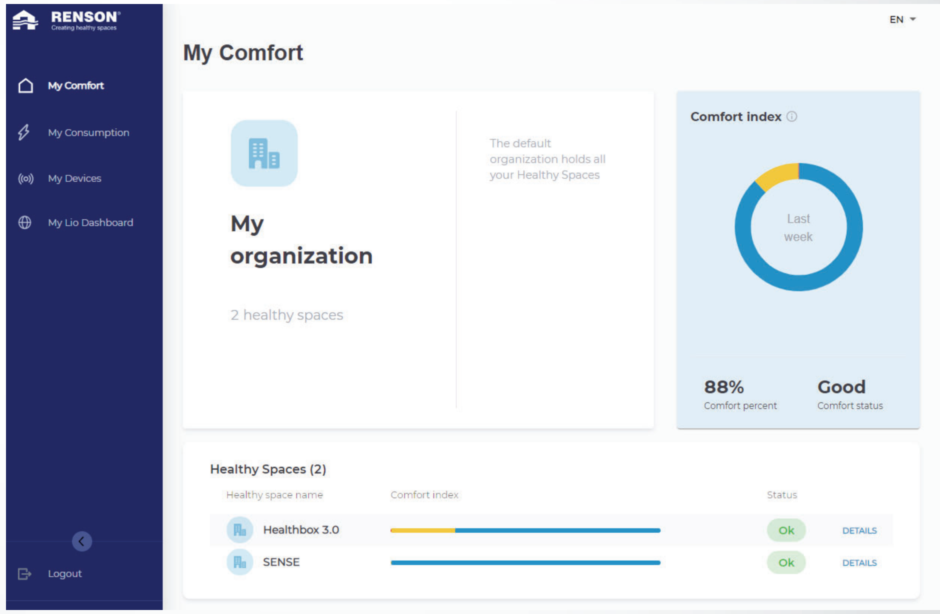
Creating healthy spaces

Data analytics use cases
IMPROVED CUSTOMER ENGAGEMENT





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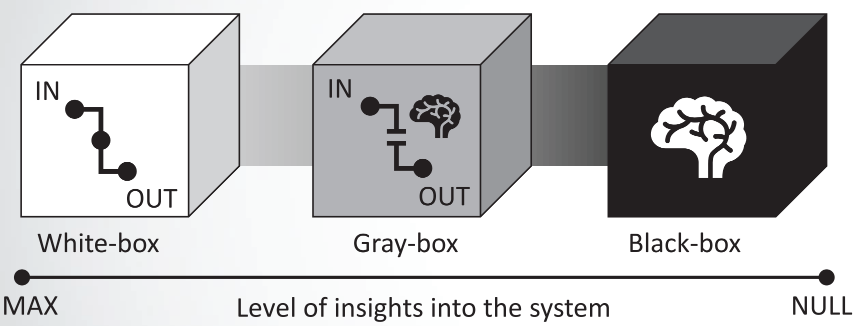
RENSON
Creating healthy spaces

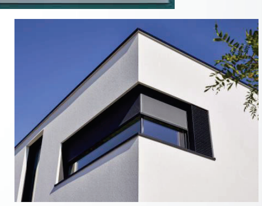
iCO-SY2
Intelligent Connected Comfort System

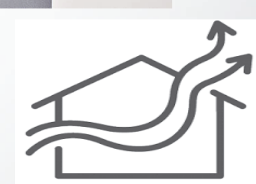
Data analytics use cases
PRODUCT IMPROVEMENT - RENSON COMFORT CONTROLLER

System identification



Preference identification



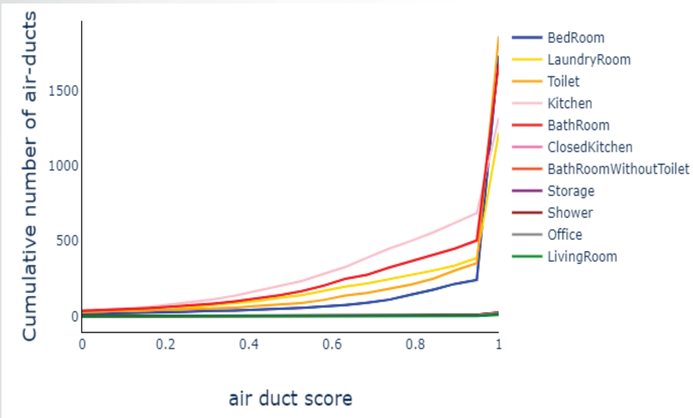


THE CELEBRITY EXPERIENCE

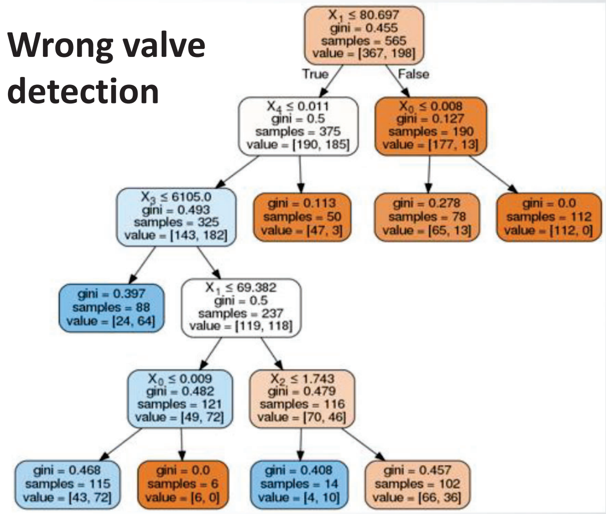
Data analytics use cases

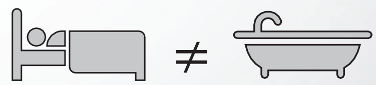
SERVICE DEVELOPMENT

Installation score



Wrong valve detection





Key take aways

Key take aways

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- Data analytics is on the rise for managing and maintaining healthy and comfortable indoor environments
- Data analytics can be used to create awareness
- Data analytics allows optimization of the performance of HVAC systems
- Data analytics is key to unlock various insights of your system (comfort, energy efficiency, maintenance, …)
- …

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Creating healthy spaces

VENTILATION | SUNPROTECTION | OUTDOOR

CO2 : a reference point for ventilation standards

Netatmo
Same home, just smarter

Sandra Chochod / Marcin Mezynski – Product Management / Marketing – April 21

Agenda

- Netatmo vision
- Key facts in Europe

Netatmo vision

- **Which sensors to measure Indoor Air Quality?**
  - CO2 sensor on our products
  - Other sensors on the market: VOC, Formaldehyde, PM etc…
- **Is CO2 a good indicator for Indoor Air Quality?**
  - CO2 is a good indicator of stuffiness[1].
    - It means that CO2 measurements can be used to evaluate the adequation between air exchange rate and room's occupancy density. When there is too much CO2 in a room, it means this room is not ventilated enough.
    - If there are other pollutants, they are not evacuated and therefore they might be highly concentrated.
  - CO2 is a worldwide well-known indicator (increased consideration with the current situation, legislation…)
  - CO2 sensors are reliable

Netatmo

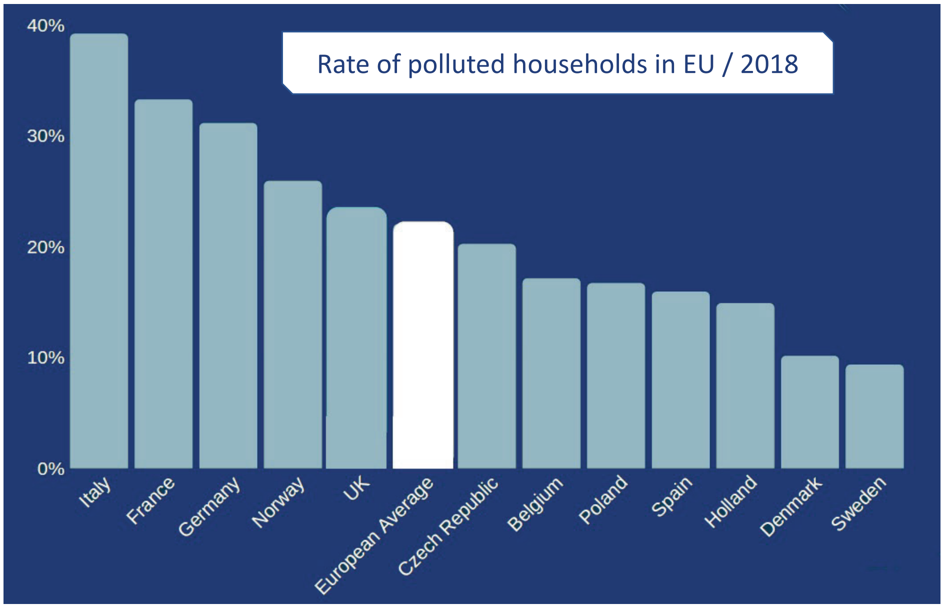
Source:
- (1) « Avis » of the French Agency for Food, Environmental and Occupational Health & Safety. Topic: « concentrations de CO2 dans l'air intérieur et effets sur la santé » (17 juillet 2013)

Netatmo vision

- **Can CO2 alone be considered as the perfect indicator of the Indoor Air Quality?**
  - Other pollutants can be high in the room even with a low CO2 level (domestic activities like cleaning, maintenance, DIY, painting that can induce COV production).
  - A high concentration of CO2 means a bad Indoor Air Quality but the opposite is not true.
- **CO2 is the best indicator of Indoor Air Quality and more over of the need to ventilate a room.**
  - CO2 being naturally produced by humans they are the main source in indoor environment. It gives an indicator of the level of air containment in a room at the most important time: when there are people in it.

Netatmo

User behaviour in Europe



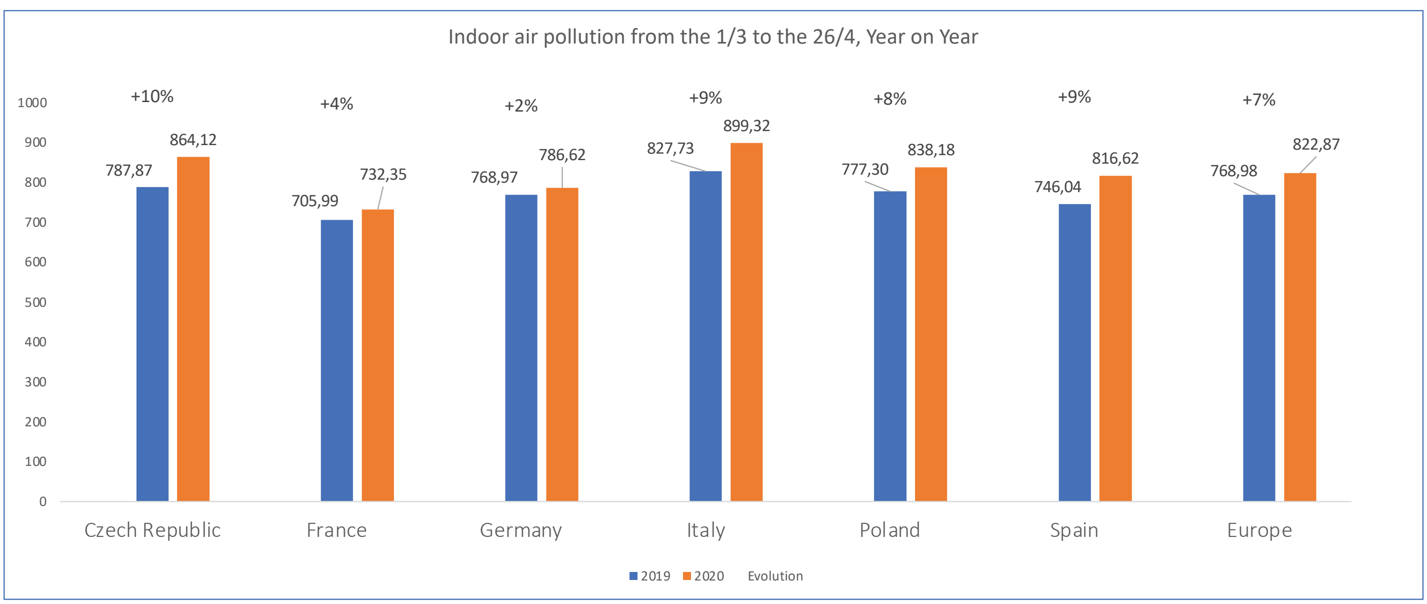
Methodology:

- CO_2 measurements from a minimum of 1,000 Netatmo Weather Stations per country
- GDPR compliant with anonymous data
- Proportion of Stations exceeding the limit of 1,000ppm of CO_2 at least once per day.
- Error margin: 4%

Netatmo

CONFIDENTIAL External

User behaviour in Europe during 1st lockdown



Netatmo

Methodology:
- CO_2 measurements from a minimum of the same 1,000 Netatmo Weather Stations per country, on two consecutive years - GDPR compliant with anonymous data
- Average ppm measured -Error margin: 4%

CONFIDENTIAL External

Why is it relevant for individual households?

- As it's not yet mastered by the users
  - Figures shown are for Netatmo clients, who have a device monitoring this gas, what about other clients who don't have it?

- As it's a common factor for other pollutants/elements: Covid-19 has proven it

- As behaviours will change in the next years
  - For example, we believe that the remote work will keep its growth, which was real even before Covid[1]

Netatmo

Source:
- (1) Joint research center, Telework in the EU before and after the COVID-19: where we were, where we head to, EU Commission

Contacts

- Sandra Chochod - Weather & Air Care R&D PM: sandra.chochod@netatmo.com

- Marcin Mezynski – Weather & Air Care Marketing PM: marcin.mezynski@netatmo.com

Netatmo

Netatmo

Same home, just smarter

1

Co-CEO of Retrotec for past 3 ½ years.

Prior role as technical director and lead the company's development efforts in both hardware and software for air tightness testing.

Email: ben@retrotec.com

Ben Walker
Co CEO at Retrotec

2

Todays Key Topics

- rCloud Walk Through – Airtightness Test Data
    - Remote Logging Digital Pressure Gauges

3

- Mobile Test Platform
- GEO Location
- Cloud Storage
- Data Integrity
- Results Analysis

4

Walk Thru (Demo)

5

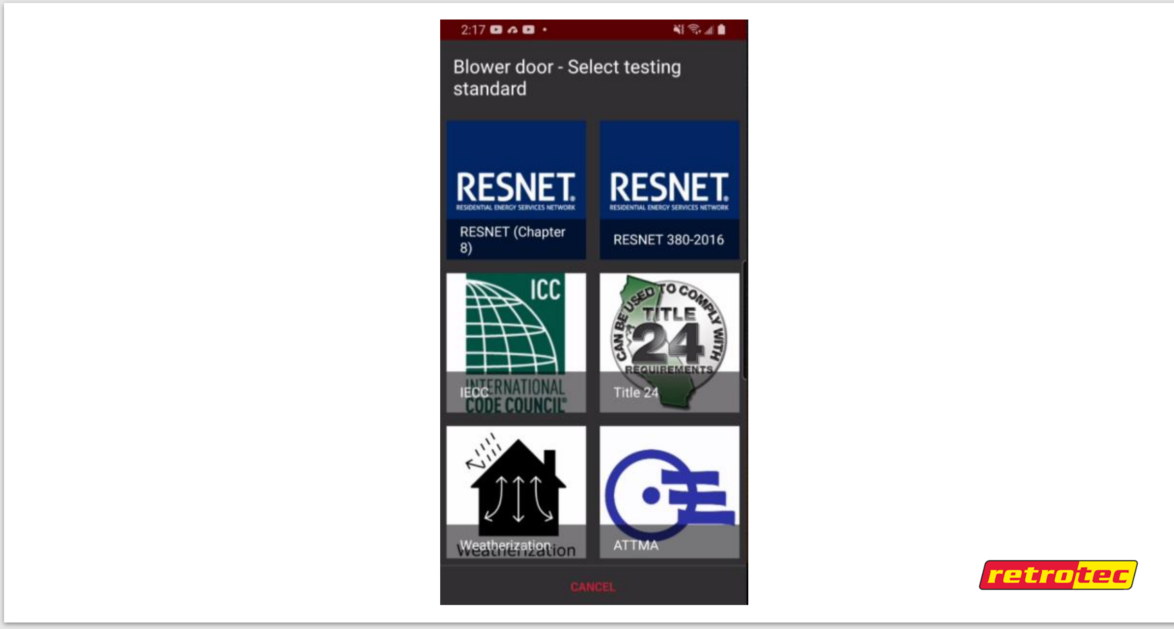
Blower Door Setup

6

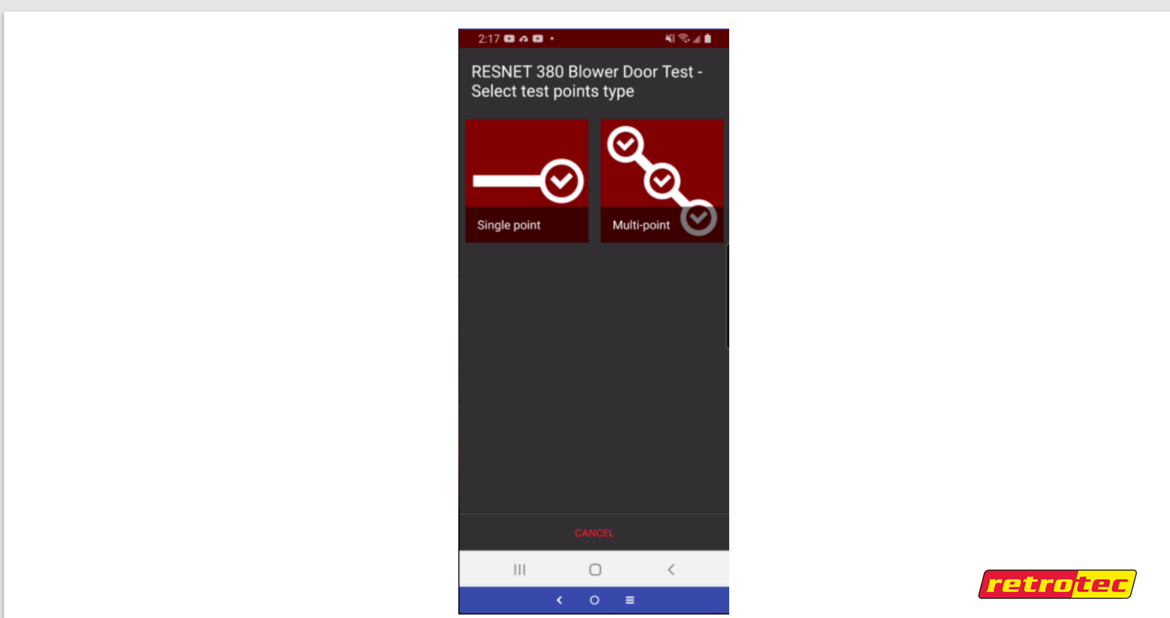
Test Location

7

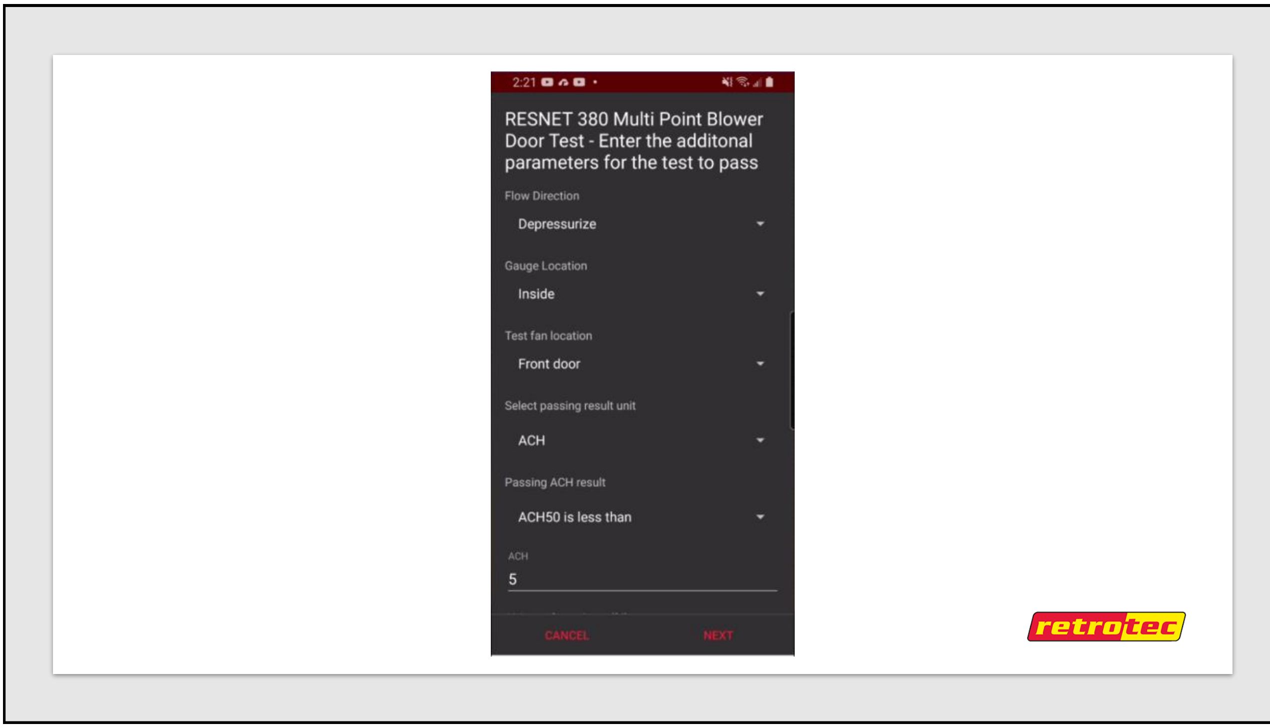
8


2:17
Blower door - Select testing standard
RESNET
RESIDENTIAL ENERGY SERVICES NETWORK
RESNET (Chapter 8)
RESNET
RESIDENTIAL ENERGY SERVICES NETWORK
RESNET 380-2016
ICC
INTERNATIONAL CODE COUNCIL
IECC
CAN BE USED TO COMPLY WITH TITLE 24 REQUIREMENTS
Title 24
Weatherization
Weatherization
ATTMA
CANCEL
retrotec

9


2:17
RESNET 380 Blower Door Test - Select test points type
Single point
Multi-point
CANCEL
retrotec

10


2:21
RESNET 380 Multi Point Blower Door Test - Enter the additonal parameters for the test to pass
Flow Direction
Depressurize
Gauge Location
Inside
Test fan location
Front door
Select passing result unit
ACH
Passing ACH result
ACH50 is less than
ACH
5
CANCEL
NEXT
retrotec

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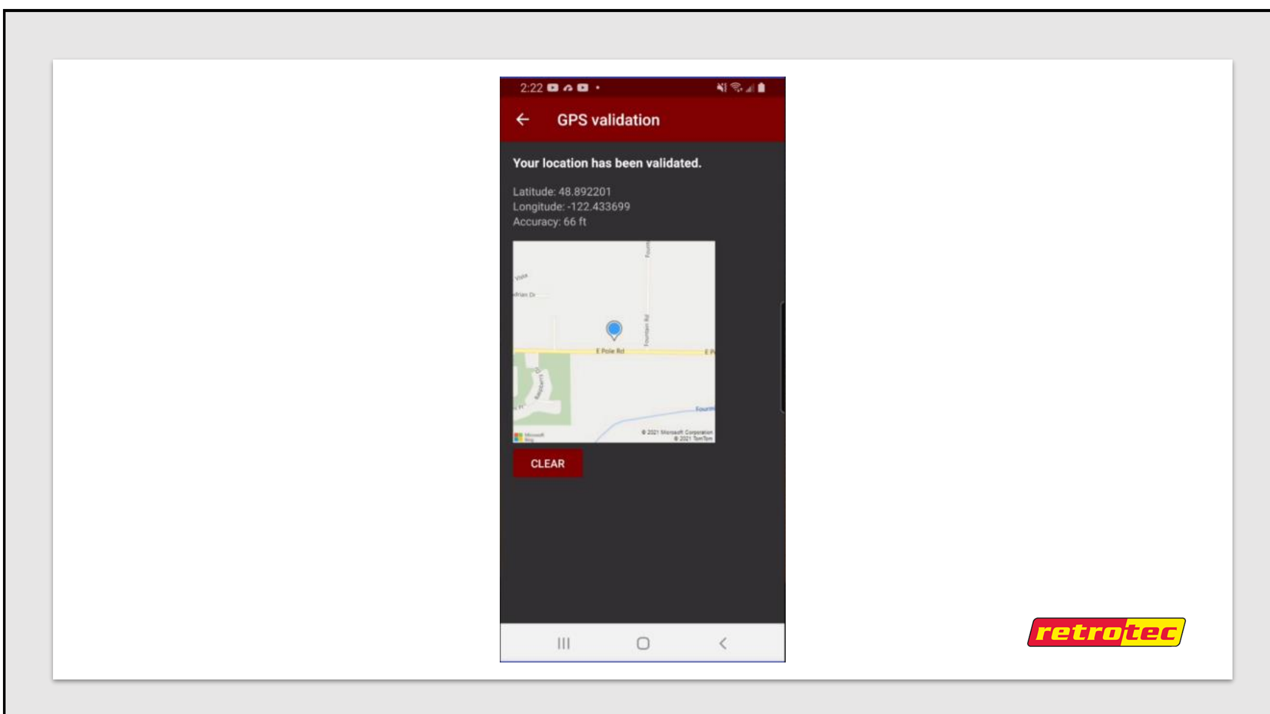
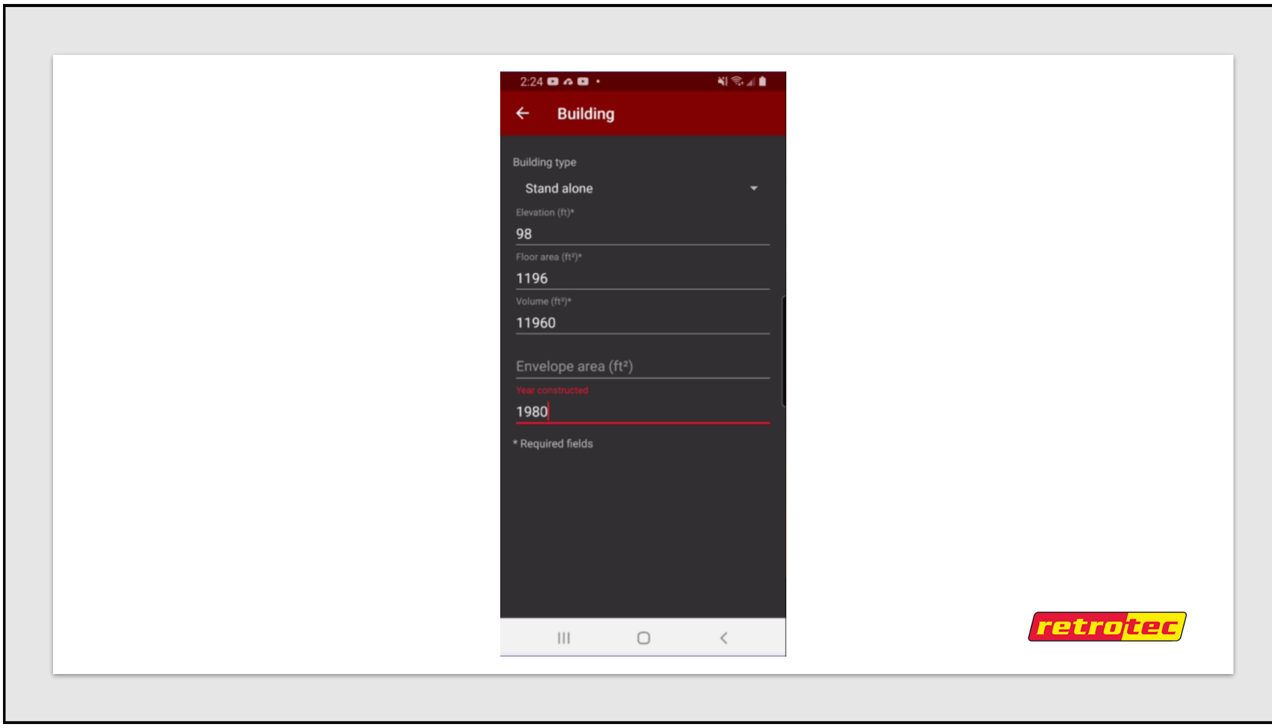
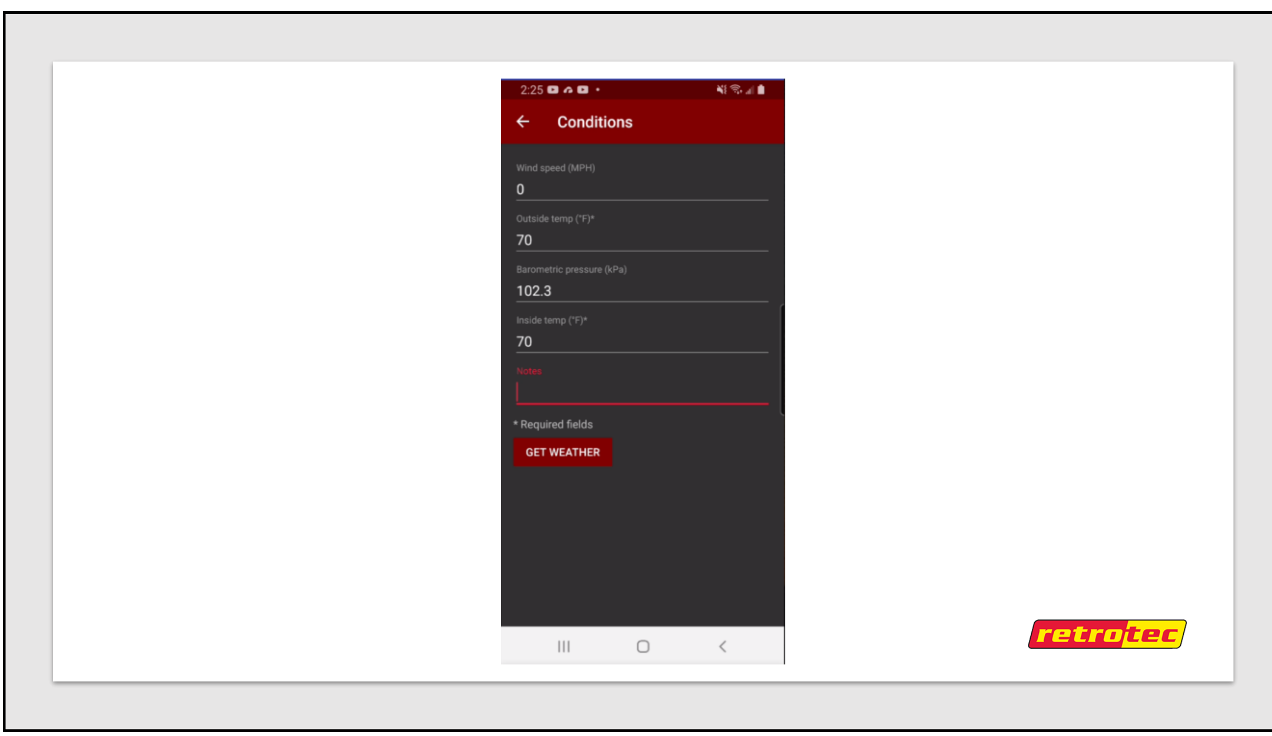

2:22
GPS validation
Your location has been validated.
Latitude: 48.892201
Longitude: -122.433699
Accuracy: 66 ft
CLEAR
retrotec

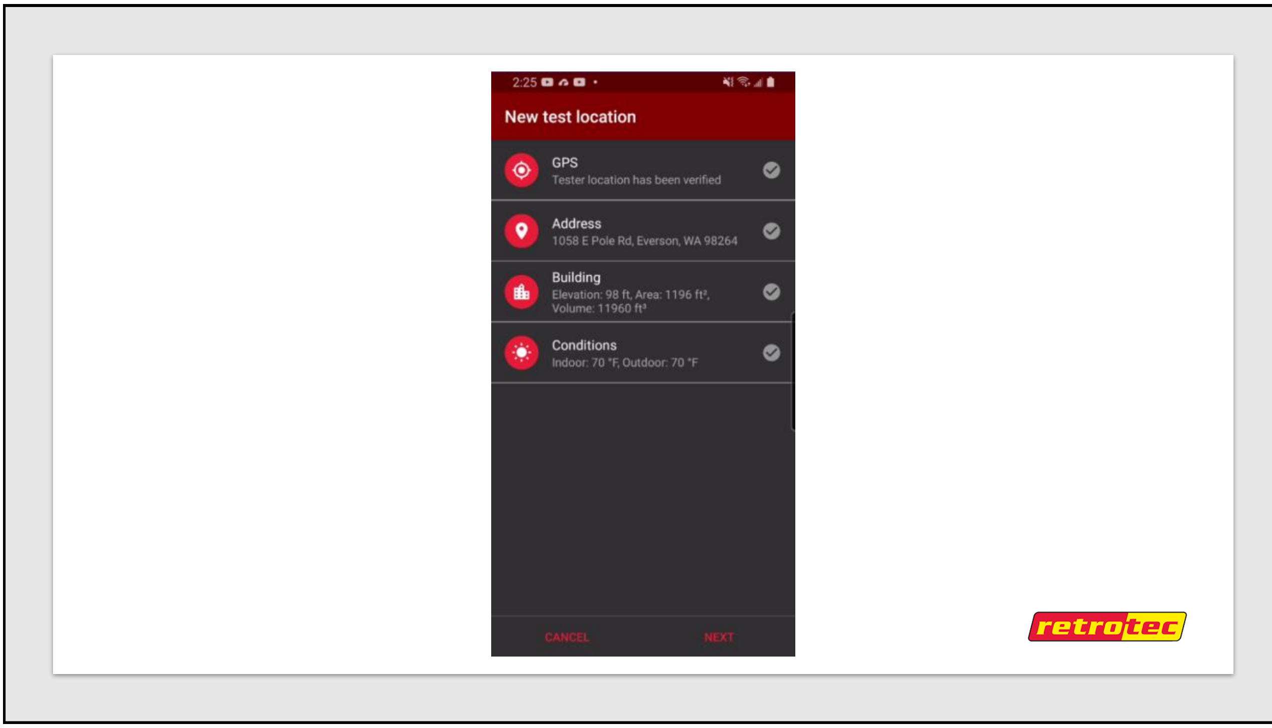
12


Building
Building type
Stand alone
Elevation (ft)*
98
Floor area (ft²)*
1196
Volume (ft³)*
11960
Envelope area (ft²)
Year constructed
1980
* Required fields
retrotec

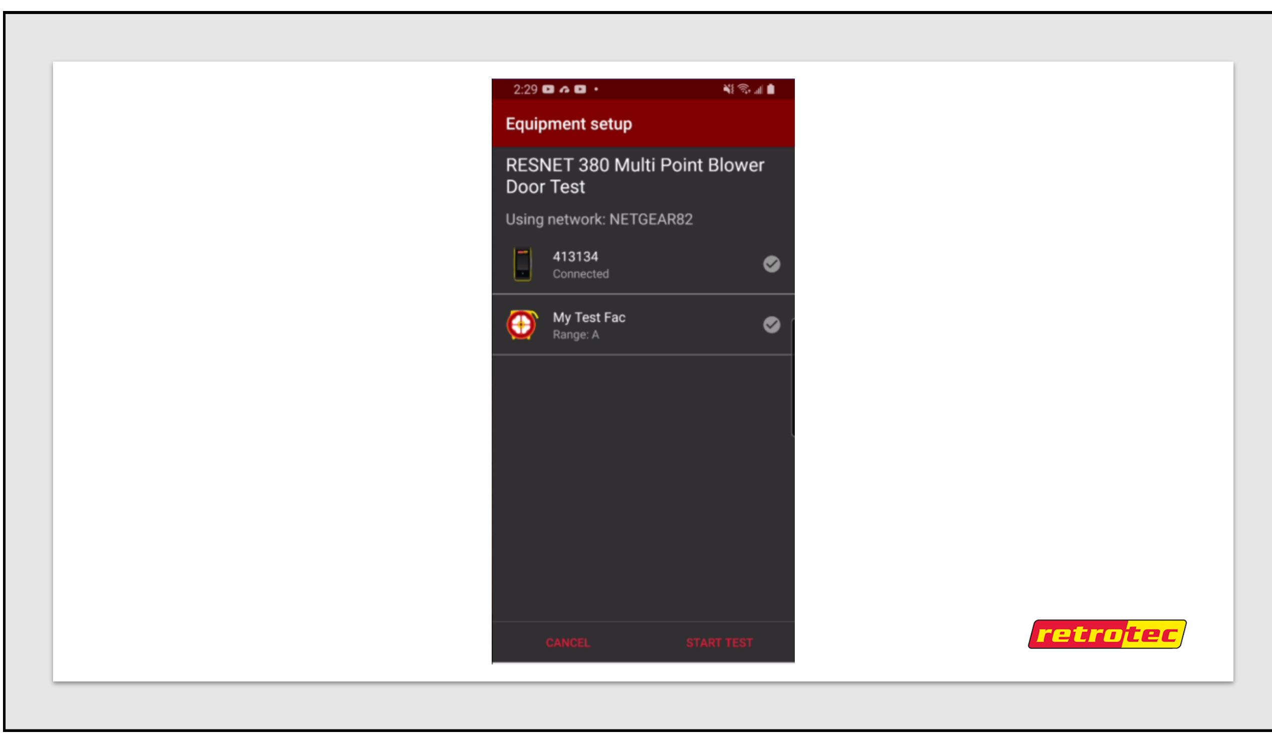
13


Conditions
Wind speed (MPH)
0
Outside temp (°F)*
70
Barometric pressure (kPa)
102.3
Inside temp (°F)*
70
Notes
* Required fields
GET WEATHER
retrotec

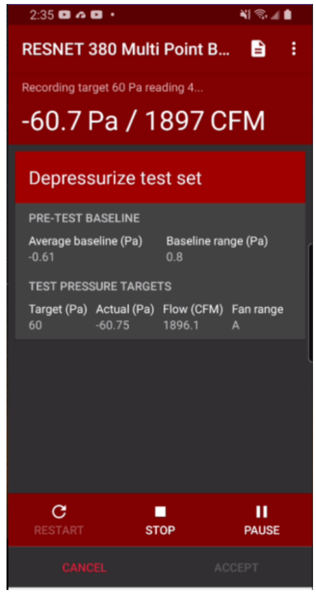
14


2:25
New test location
GPS
Tester location has been verified
Address
1058 E Pole Rd, Everson, WA 98264
Building
Elevation: 98 ft, Area: 1196 ft², Volume: 11960 ft³
Conditions
Indoor: 70 °F, Outdoor: 70 °F
CANCEL
NEXT
retrotec

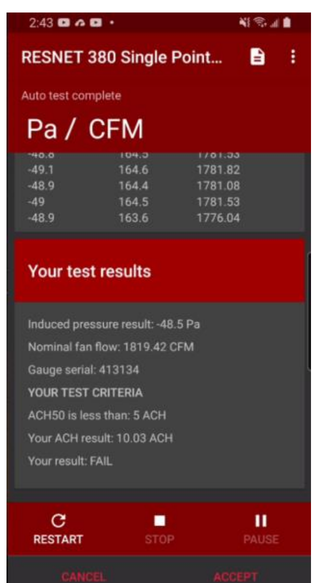
15


2:29
Equipment setup
RESNET 380 Multi Point Blower Door Test
Using network: NETGEAR82
413134
Connected
My Test Fac
Range: A
CANCEL
START TEST
retrotec

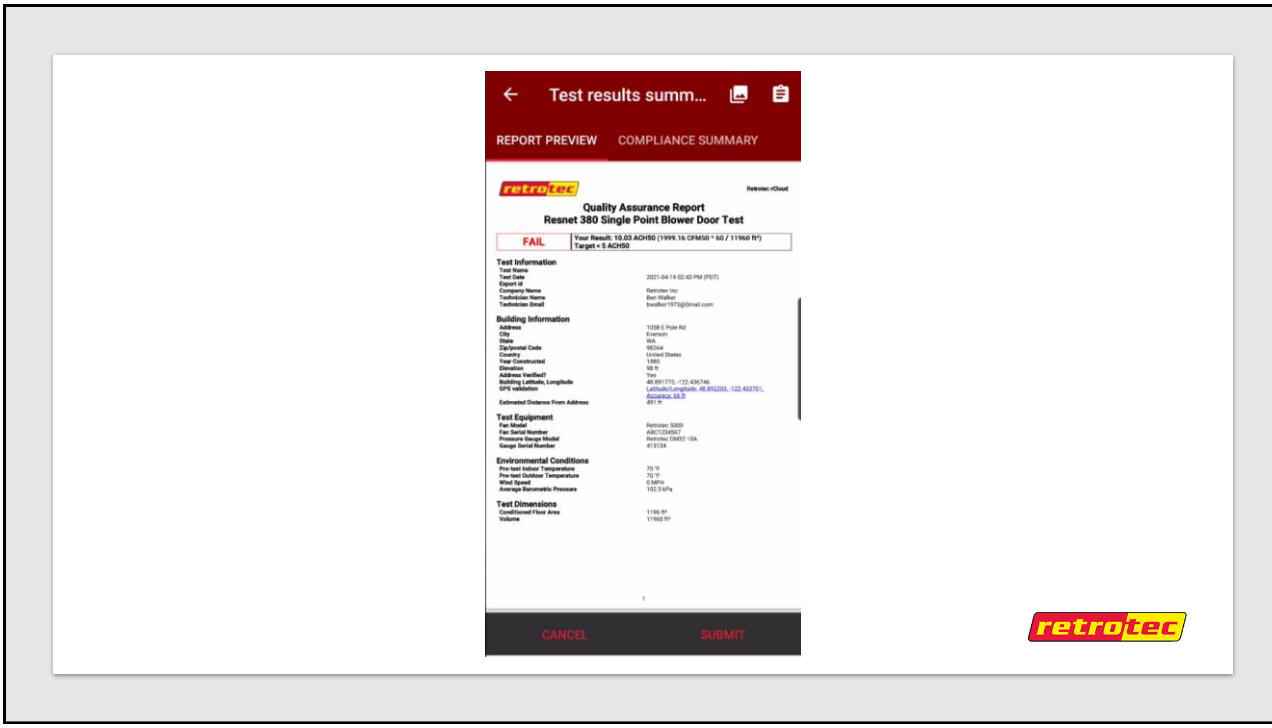
16


2:35
RESNET 380 Multi Point B...
Recording target 60 Pa reading 4...
-60.7 Pa / 1897 CFM
Depressurize test set
PRE-TEST BASELINE
Average baseline (Pa) -0.61
Baseline range (Pa) 0.8
TEST PRESSURE TARGETS
Target (Pa) 60
Actual (Pa) -60.75
Flow (CFM) 1896.1
Fan range A
RESTART
STOP
PAUSE
CANCEL
ACCEPT

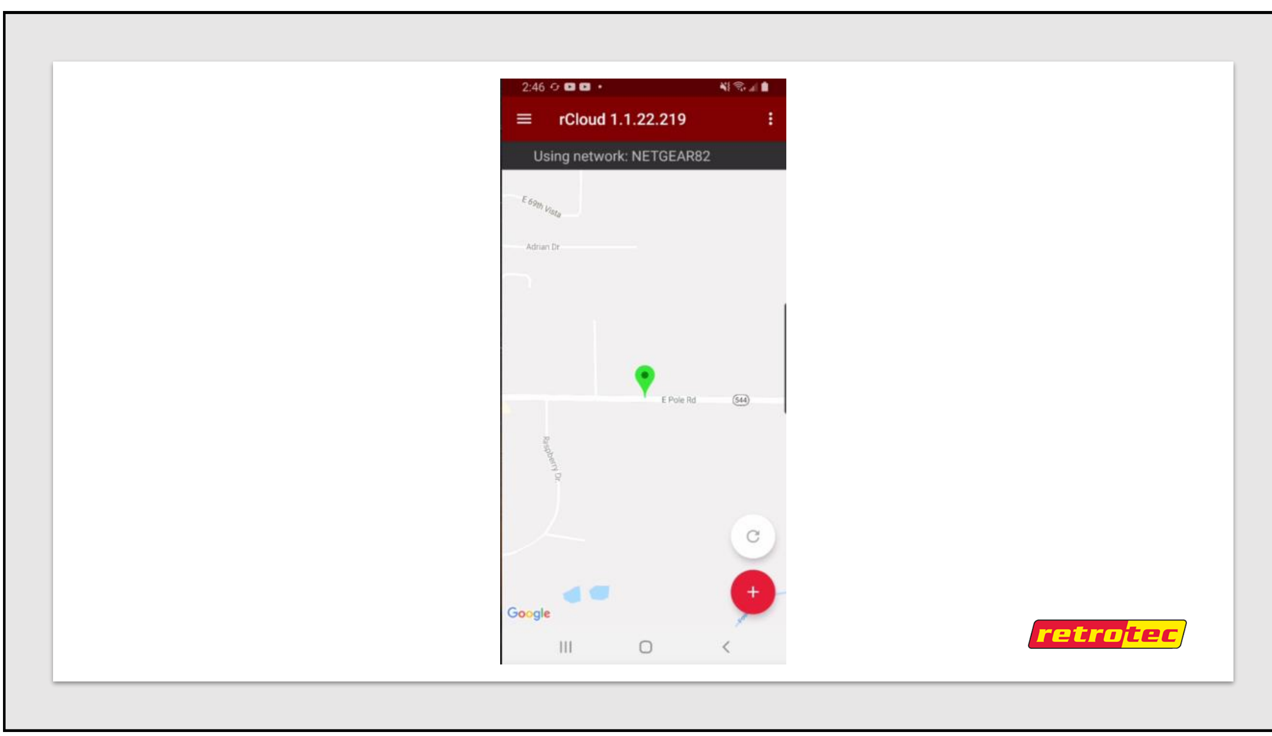
17


2:43
RESNET 380 Single Point...
Auto test complete
Pa / CFM
-49.1 164.6 1781.82
-48.9 164.4 1781.08
-49 164.5 1781.53
-48.9 163.6 1776.04
Your test results
Induced pressure result: -48.5 Pa
Nominal fan flow: 1819.42 CFM
Gauge serial: 413134
YOUR TEST CRITERIA
ACH50 is less than: 5 ACH
Your ACH result: 10.03 ACH
Your result: FAIL
RESTART
STOP
PAUSE
CANCEL
ACCEPT

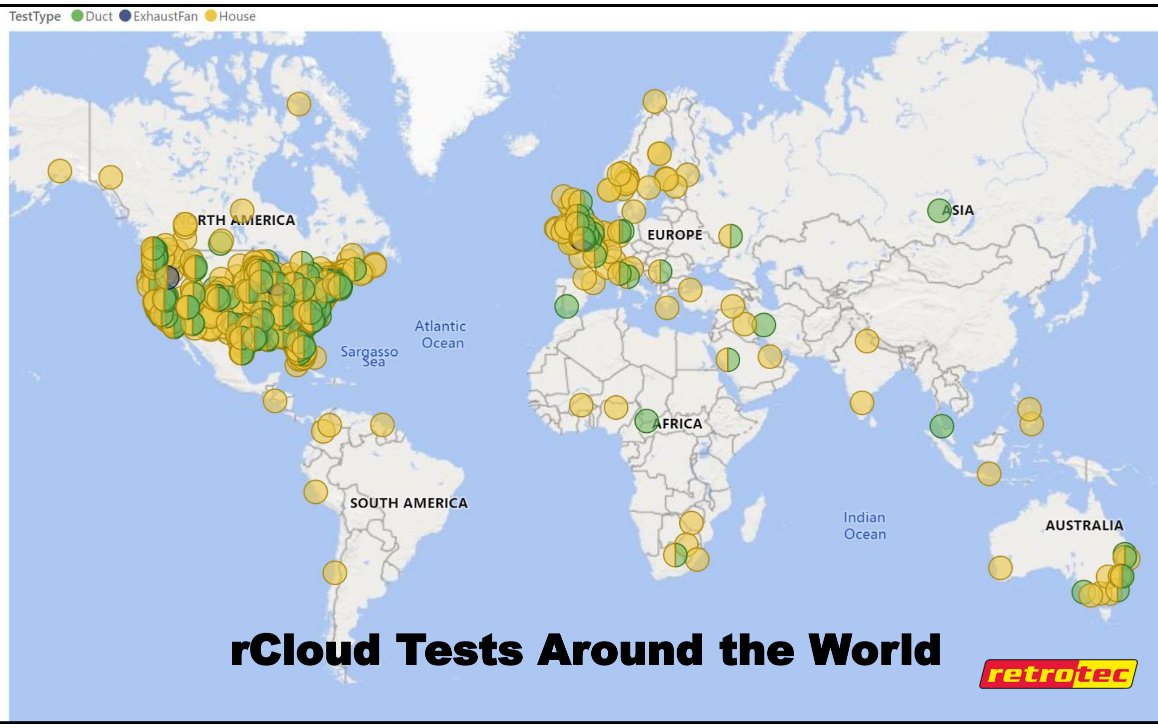
18


Test results summ...
REPORT PREVIEW
COMPLIANCE SUMMARY
Quality Assurance Report
Resnet 380 Single Point Blower Door Test
FAIL
Test Information
Building Information
Test Equipment
Environmental Conditions
Test Dimensions
CANCEL
SUBMIT
retrotec

19


2:46
rCloud 1.1.22.219
Using network: NETGEAR82
Adrian Dr
E Pole Rd
Google
retrotec

20



21

Realtime Remote Pressure Logging

22

Thank You!

ben@retrotec.com

retrotec

foobot
SAB

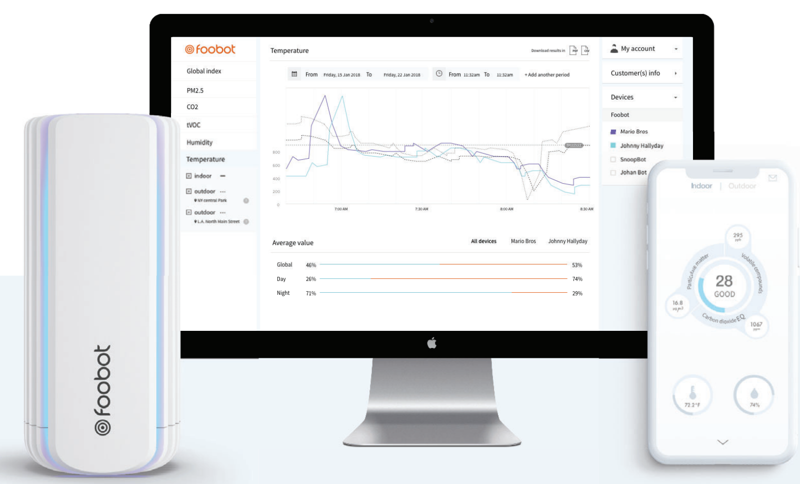
Sensors & machine learning to improve HVAC control

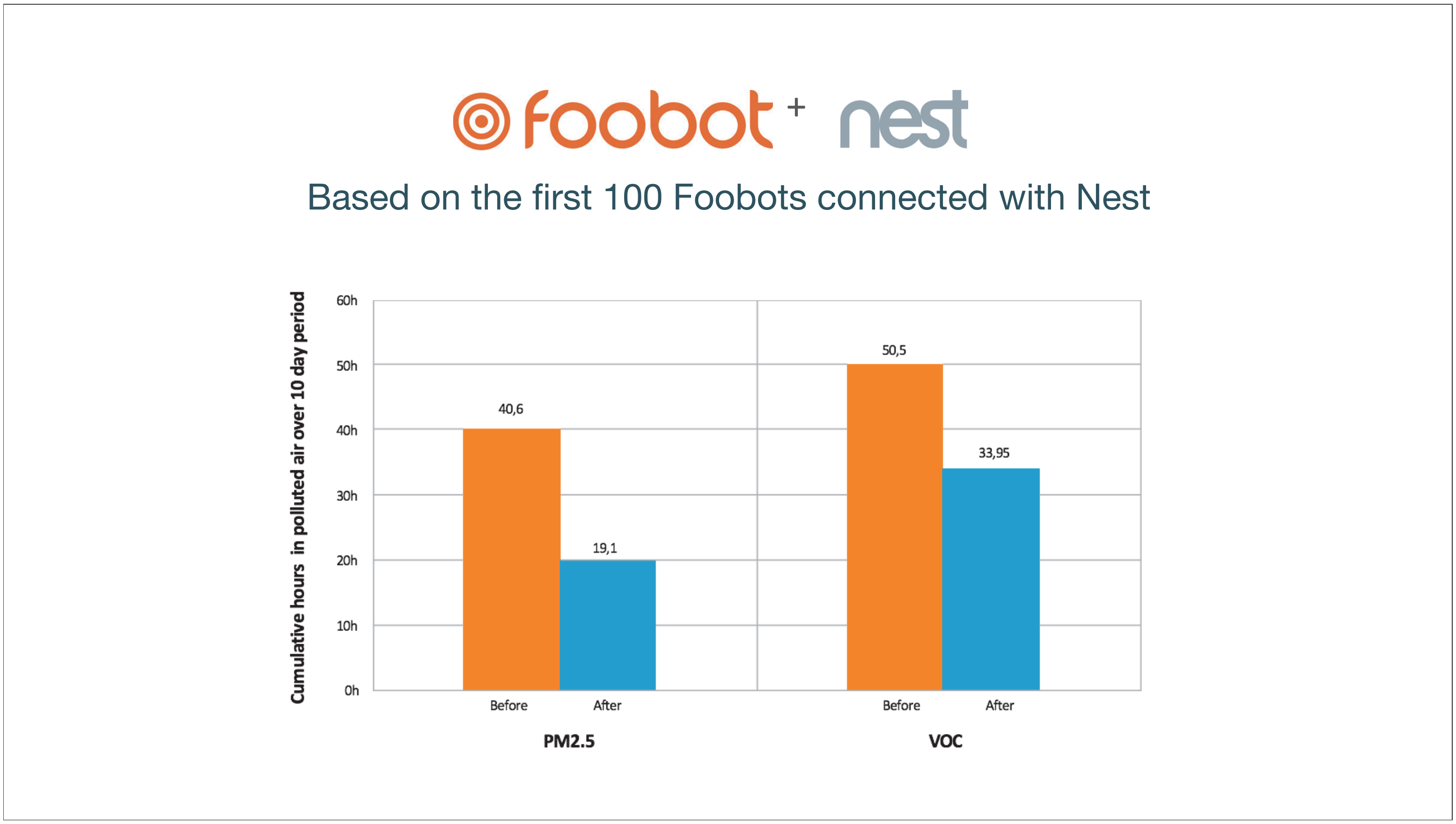
https://foobot.io/offices

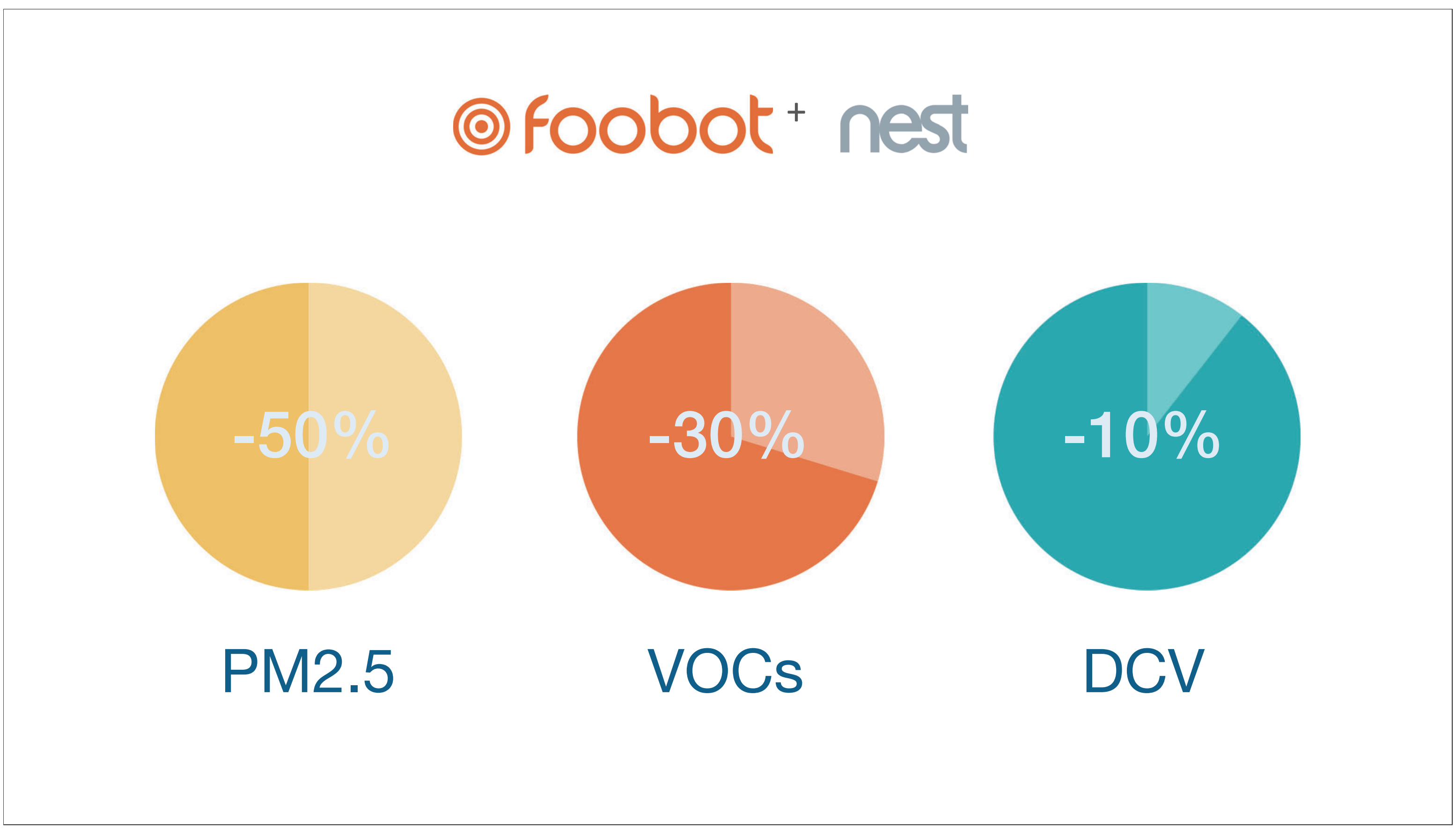
Inouk Bourgon, cto | inouk@foobot.io

Our first product, Foobot

First connected air quality sensor measuring beyond CO2




foobot + nest
Based on the first 100 Foobots connected with Nest
Cumulative hours in polluted air over 10 day period
60h
50h
40h
30h
20h
10h
0h
40,6
19,1
50,5
33,95
Before
After
Before
After
PM2.5
VOC


foobot + nest
-50%
-30%
-10%
PM2.5
VOCs
DCV

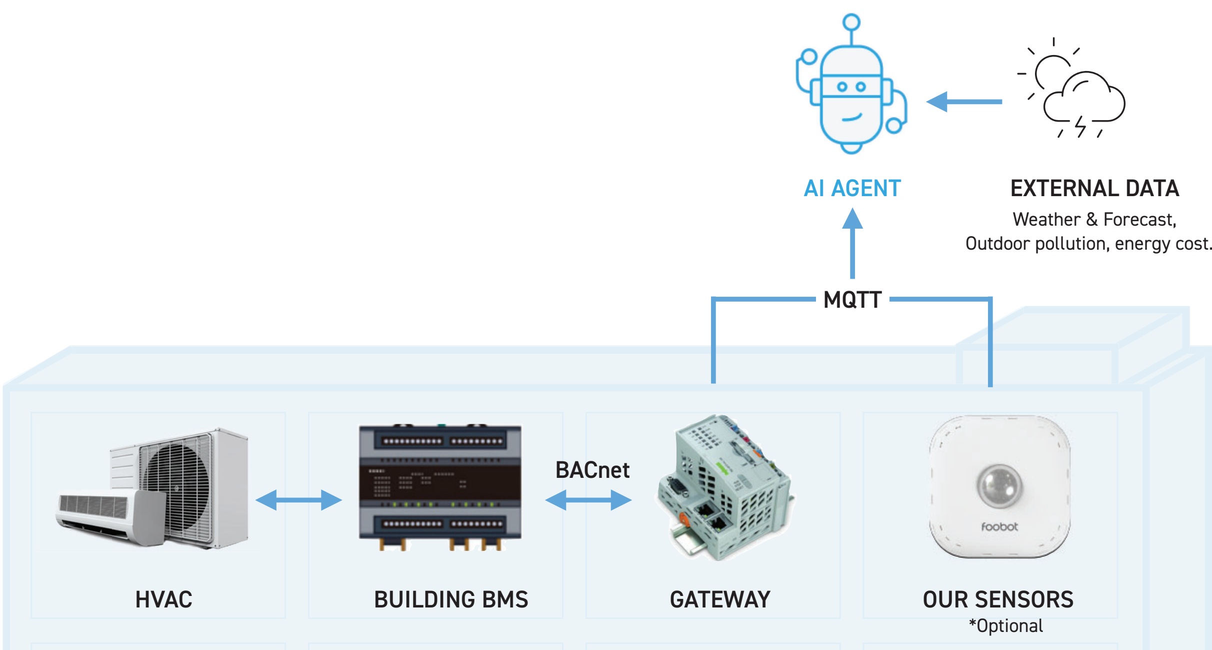
foobot
SAB

Smart Air Building

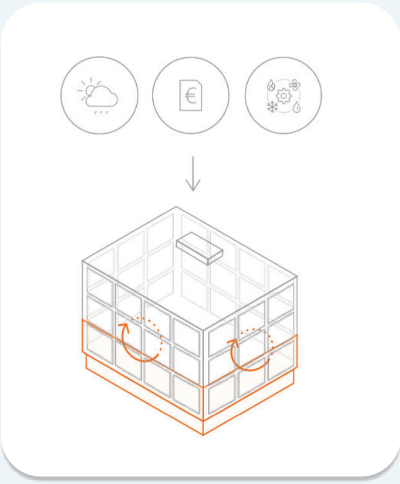
HVAC Optimization for

- ↘ Carbon Footprint
- ↗ Indoor Air Quality

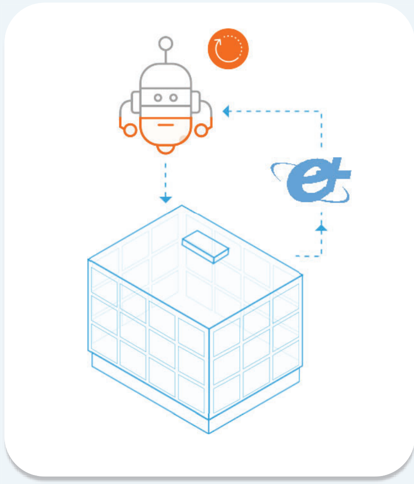
Deployment of SAB



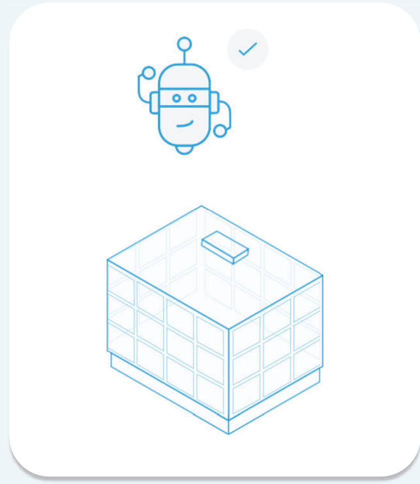
Pre-Training Technology



Building model

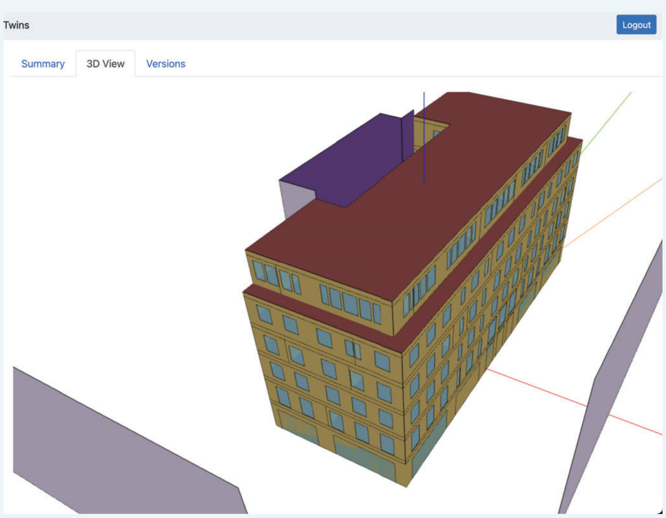


Simulation



AI agent trained

Building Model > Digital Twin



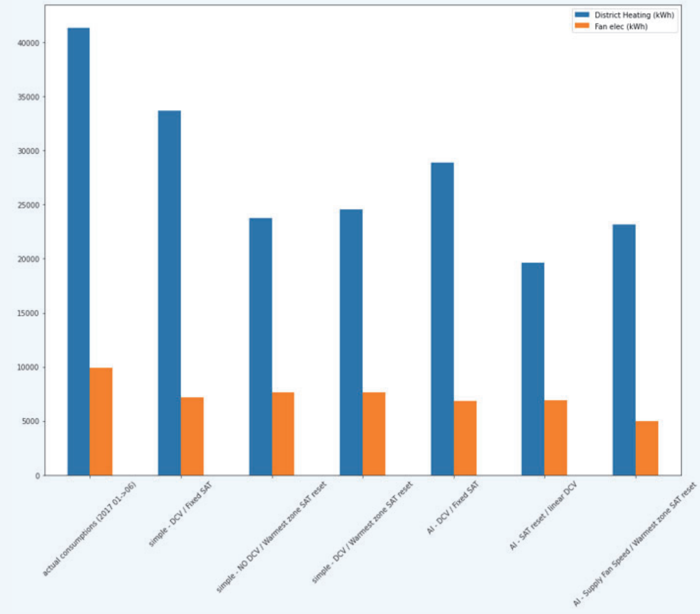
Open Studio model

Building envelope, HVAC system, local outdoor conditions

Model Calibration

Align real life data with model data, following ASHRAE 14 standard

Reinforcement Learning



EnergyPlus simulation

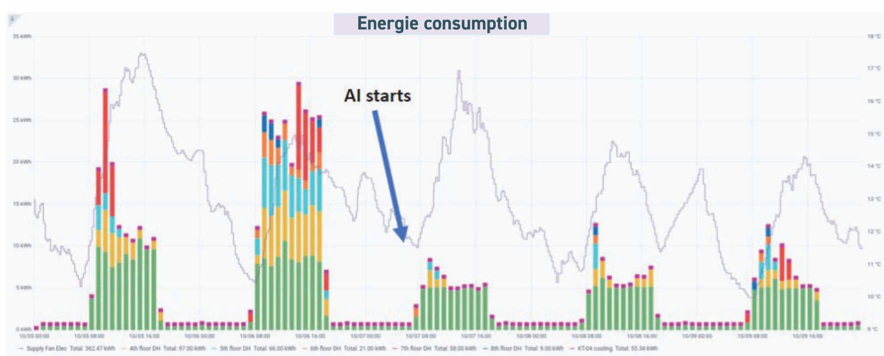
Digital twin, OpenAI Gym

Agent selection

Benchmark control strategy and agents

Ability to predict results

Results in our first building



52.6 %
Energy savings
From HVAC

98.9 %
Thermal comfort
Delivered

100 %
CO_2 & IAQ
Below threshold*

Indoor Air Quality

measured by FoobotSAT

Sensors

tVOC
PM1 / 2.5 / 10
CO2
T/H
Motion

Connectivity

BLE / WiFi / Ethernet

Power

AC adaptor /POE

8 real-time measures of Indoor Air Quality and Thermal Comfort

Smart Air Building result summary

3.35€/m²
SAVED
over 12 months

62 tCO_2
AVOIDED
over 12 months

5 months
RETURN
on investment

- 51 625€ energy savings over 12 months

foobot
SAB

https://foobot.io/offices

Before we go

- Reach out if you want SAB deployed in your building!
- Check our tech article explaining how we can save so much energy: http://bit.ly/foobot-ai

Inouk Bourgon, cto | inouk@foobot.io