Smart buildings & interfaces for managers of buildings and facilities, and intelligence needed for occupant-HVAC interfaces at room level

BRAINS 4 BUILDINGS

CLIMA 2022 Workshop
May 23, 2022

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Sander van der Harst (Unica)

Frans Joosstens (HHS)

Mirjam Harmelink (TU Delft)

TUDelft

B4B: Summary

- B4B is a multi-year, multi-stakeholder project focused on developing methods to harness big data from smart meters, building management systems and the Internet of Things devices, to reduce energy consumption, increase comfort, respond flexibly to user behaviour and local energy supply and demand, and save on installation maintenance costs.
- This will be done through the development of faster and more efficient Machine Learning and Artificial Intelligence models and algorithms.
- The project is geared to existing utility buildings such as commercial and institutional buildings.

B4B: Key figures

- 39 partners
- Coordination TU Delft
- 5 work packages
- 7 living labs & multiple use cases
- 6.9 million subsidy from RVO (MOOI)
- Start: May 1, 2021
- Duration: 4 years

B4B ambition: providing (future) solutions to main challenges of building operation

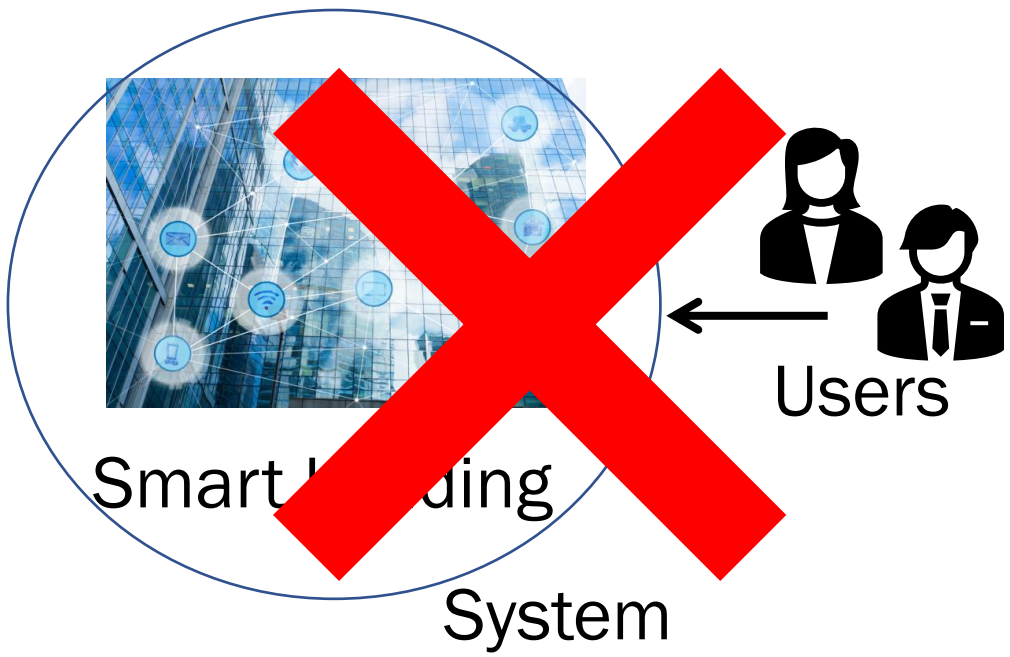
- Energy wastage due to improper operation & component failure
  - Costs & Time for Building & Facility Managers
- Energy wastage because of mismatch with user (Facility Manager & Occupant) preferences
  - Costs & Time for Building & Facility Managers
  - Dissatisfaction & Complaints of Occupants & Facility Managers
- Integration of building into renewable E-infrastructure (smart grids)
  - Be ready for ongoing developments in grids
- Data integration for multiple platforms
  - Work towards future standards to share and communicate data

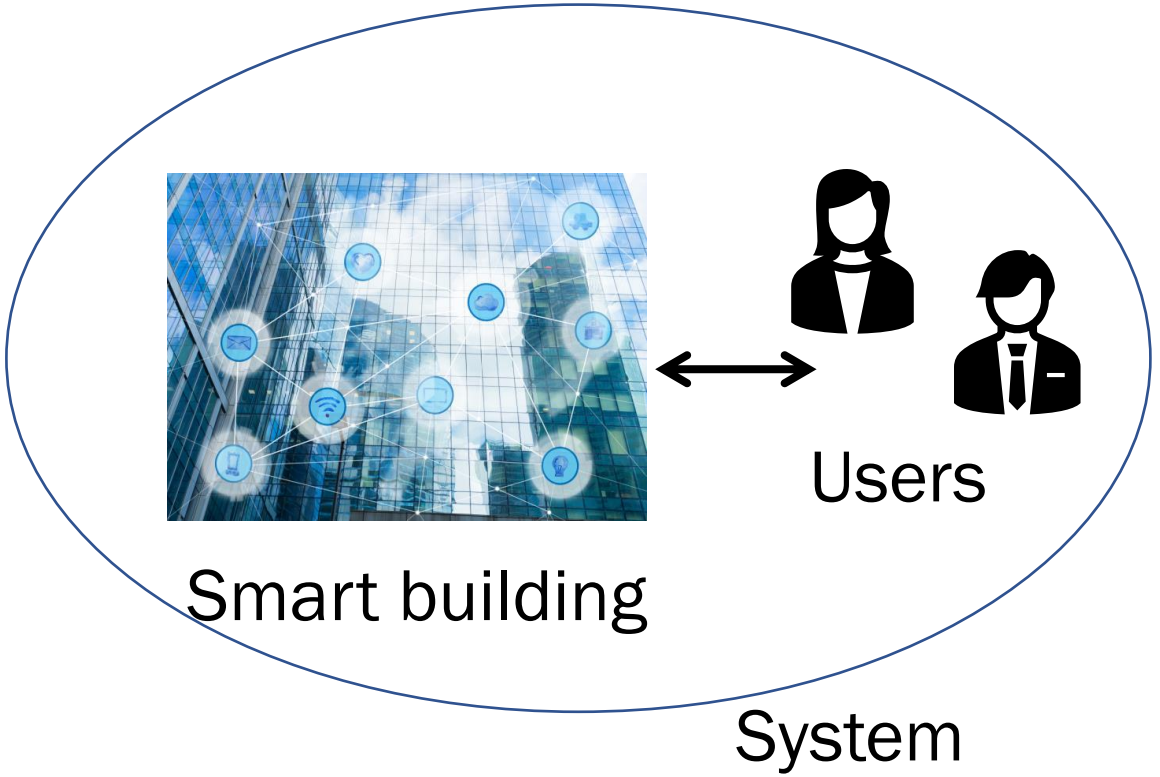
Program for today

- Introduction to the workshop by Marleen Spiekman (TNO)
- Presentation by Frans Joosstens (HHS)
- Presentation by Sander van der Harst (Unica)
- Interactive with different Mentimeter questions
- Interactive workshop (questions and post-it’s session)

Aim

- Making smart buildings more user centred

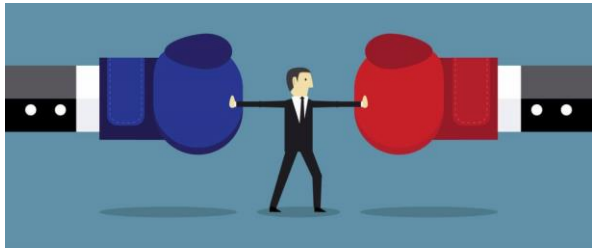




Background

Smart building systems

→ automatic control



Manual adaption
to personal needs

Possible conflicts:

- Users are unaware what, when or why the system acts
- Users are unaware how they can intervene
- Users are unaware about the consequences of their actions
- Users take actions that are counterproductive

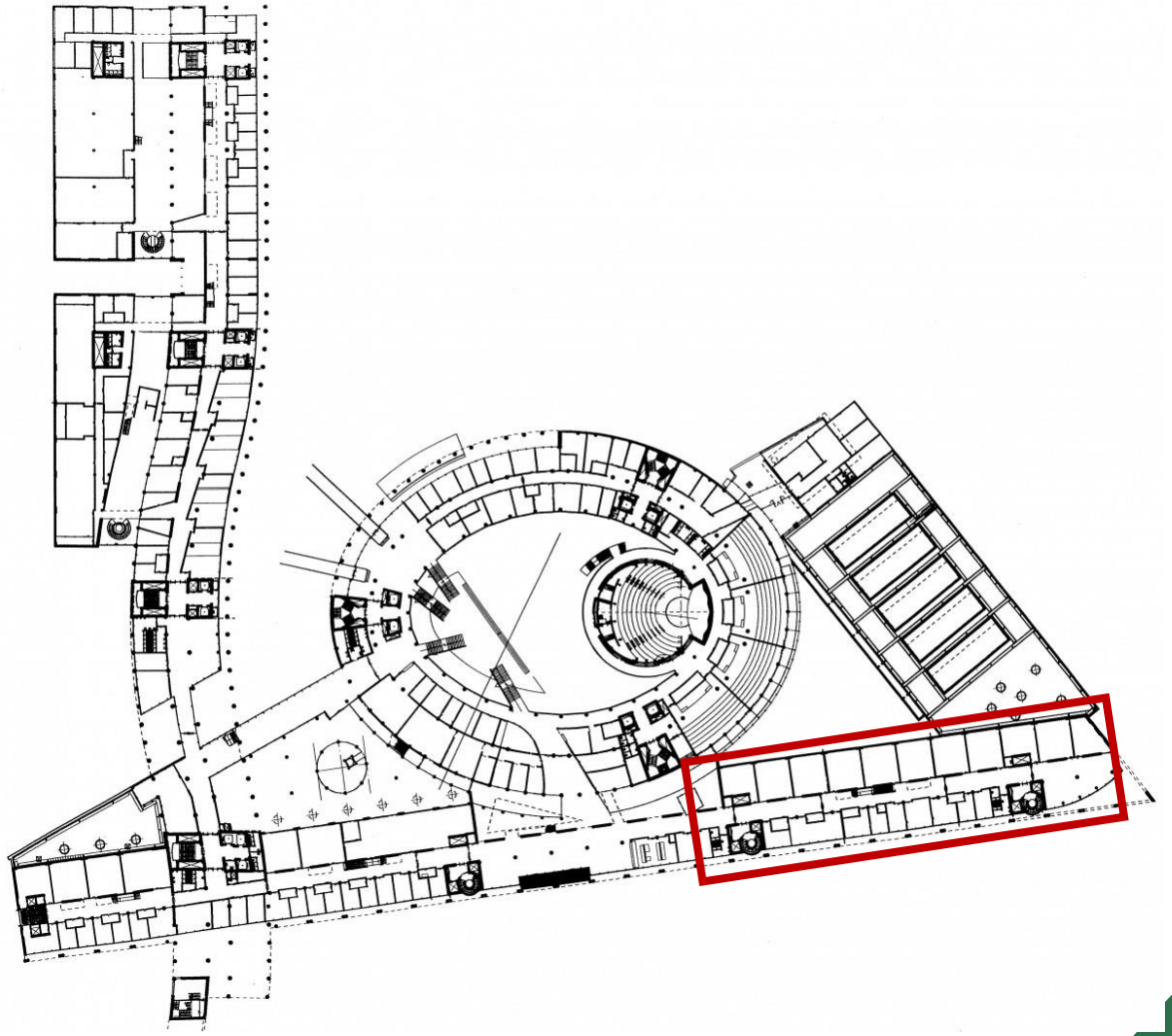
Objective of the workshop

- Discuss how we can make buildings more user centred
- How can feedback help, which feedback is usefull?
  - Various types of feedback: via BMS, apps, displays, thermostat, etc
- Feedback to whom? Facility manager, office user?

Clima conference Rotterdam 2022

Smart buildings & interfaces for managers of buildings and facilities

Living Lab HHS - Facility Management studies



Presentation B4B

Sander van der Harst & Frans Joosstens

May 23th 2022

To start with a question

"What is your profession?

"What information do you need from the building?"

Get your smart phone →

- Scan the QR-code:

- Or go to: menti.com Code: 17 18 40 3

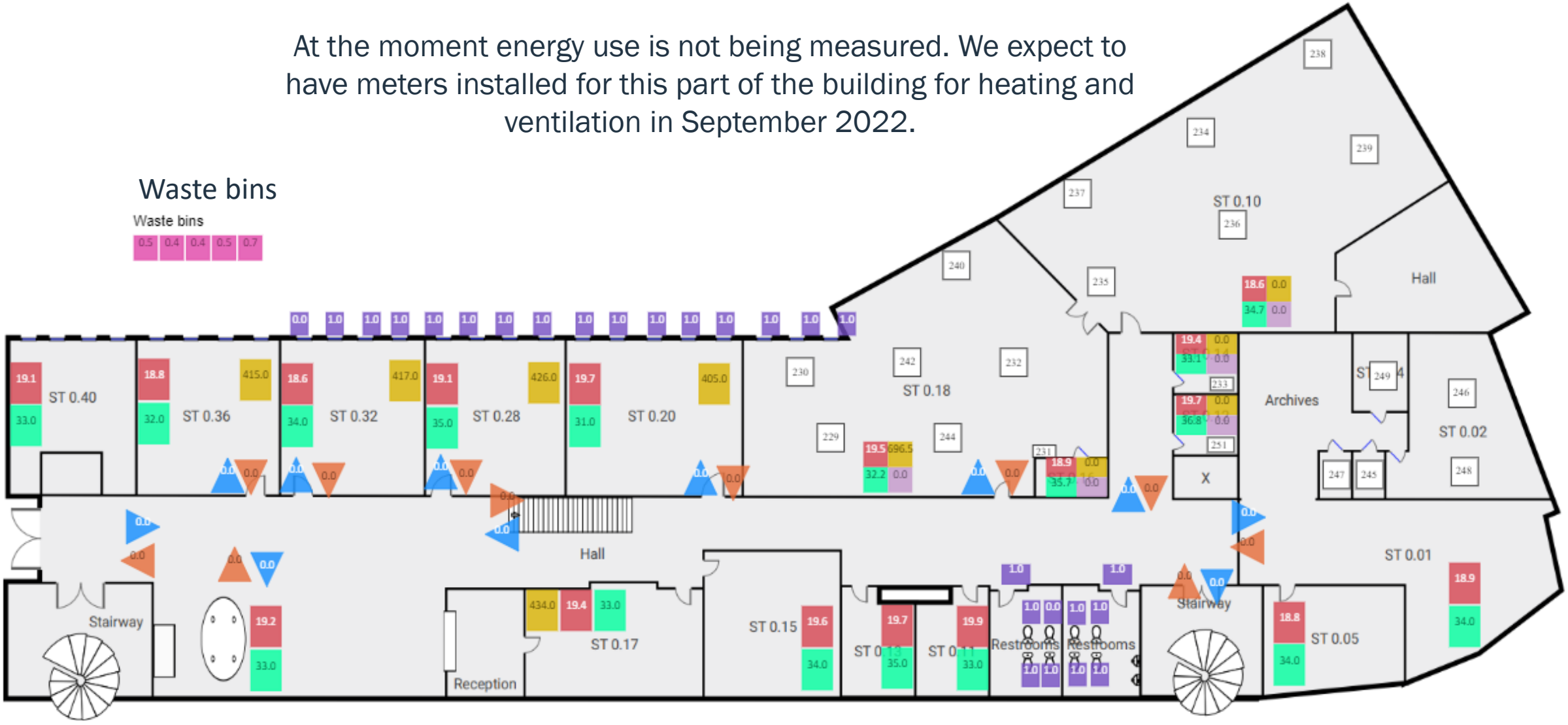
DE HAAGSE HOGESCHOOL unica Facility Management Living Lab

Facility Map

The FM living started to record comfort and occupancy data in January 2021, but because of renovation works the sensors were removed in June 2021 and replaced in February 2022.

At the moment energy use is not being measured. We expect to have meters installed for this part of the building for heating and ventilation in September 2022.

Waste bins



DE HAAGSE HOGESCHOOL unica **Facility Management Living Lab**

Date Range Selector

01/02/2022 09/04/2022

Room Selector

All

Average Temperature

19.38

Average Humidity

35.45

Temperature sensors

- Select all
- 229-internalTemperat...
- 229-irTemperature
- 229-occupantTemper...
- 230-internalTemperat...
- 230-irTemperature
- 230-occupantTemper...
- 231-internalTemperat...
- 231-irTemperature
- 231-occupantTemper...
- 232-internalTemperat...
- 232-irTemperature
- 232-occupantTemper...
- 233-internalTemperat...
- 233-occupantTemper...

Humidity sensors

- Select all
- 229-occupantHumid...
- 230-occupantHumid...
- 231-occupantHumid...
- 232-occupantHumid...
- 233-occupantHumid...
- 234-occupantHumid...
- 235-occupantHumid...
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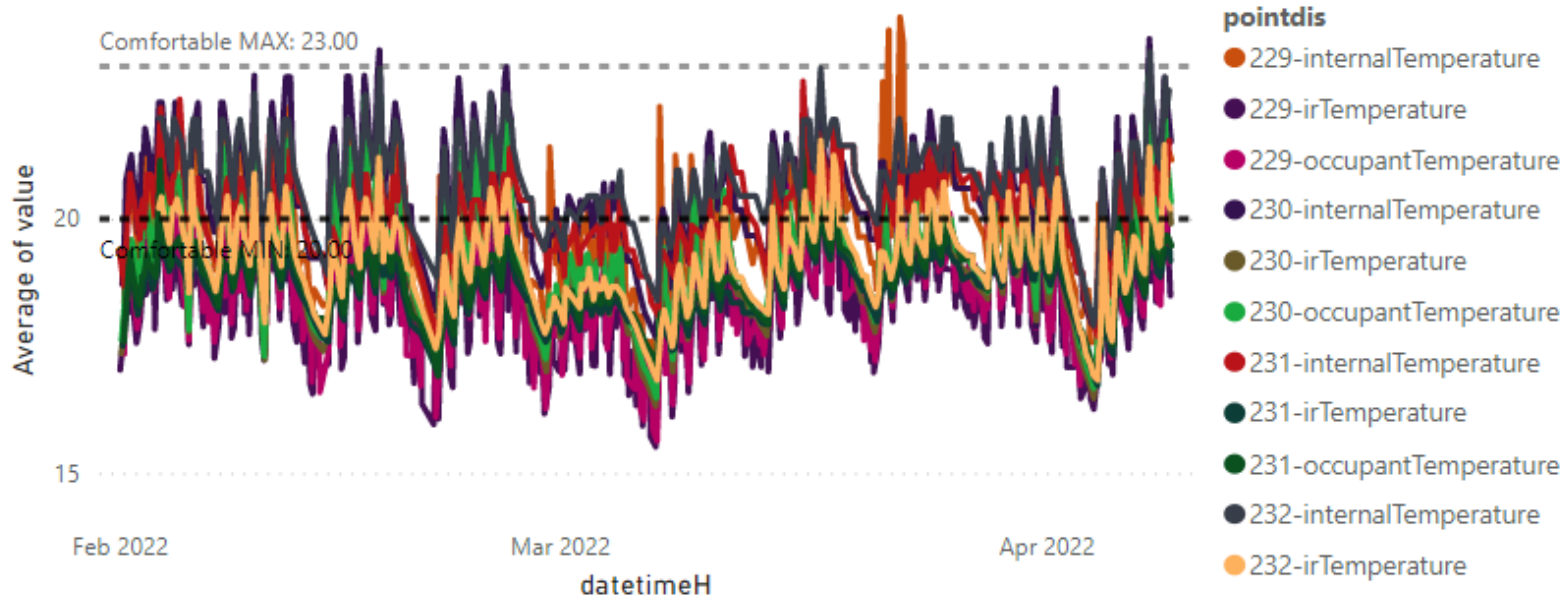
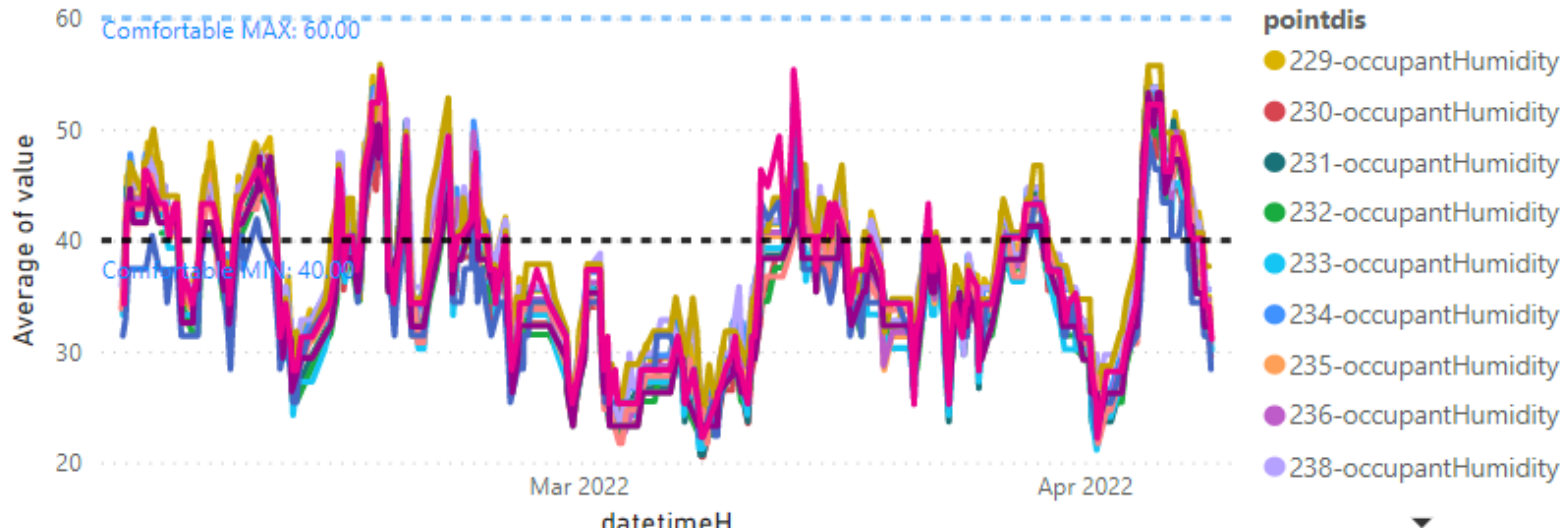
- 238-occupantHumid...
- 239-occupantHumid...
- 240-occupantHumid...

Temperature level



Humidity level



DE HAAGSE HOGESCHOOL unica **Facility Management Living Lab**

Select data range

23/01/2022 12/02/2022

Hour Range Selector

0 23

Export data locally from table

1. Hover the table and click on the 3 dots
2. Export data (.xlsx)

Select Room

- [x] Select all
- [x] Damestoilet
- [x] Gang tweede trappenhuis
- [x] Herentoilet
- [x] Ingang FM terras
- [x] Strip 0.01
- [x] Strip 0.05

Select sensor

- [x] Select all
- [x] 229-CO2
- [x] 229-combinedOccupancy
- [x] 229-internalTemperature
- [x] 229-irTemperature
- [x] 229-lightLevel
- [x] 229-occupantHumidity

Select type

- [x] Select all
- [x] batteryVoltage
- [x] CO2
- [x] count_LidOpen
- [x] distance
- [x] humidity
- [x] illuminance

pointdis	value	unit	type	date	time	datetime	tz	equipdis	sitedis
Strip 0.28 CO2	3,923.00	ppm	CO2	01/02/2022	17:50:23	01/02/2022 17:50:23	Amsterdam	Strip 0.28	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,316.00	lx	illuminance	08/02/2022	10:14:57	08/02/2022 10:14:57	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,316.00	lx	illuminance	28/01/2022	10:30:47	28/01/2022 10:30:47	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,316.00	lx	illuminance	28/01/2022	10:45:47	28/01/2022 10:45:47	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,316.00	lx	illuminance	28/01/2022	11:05:47	28/01/2022 11:05:47	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,315.00	lx	illuminance	28/01/2022	10:55:47	28/01/2022 10:55:47	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,314.00	lx	illuminance	08/02/2022	10:24:57	08/02/2022 10:24:57	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,314.00	lx	illuminance	28/01/2022	10:25:47	28/01/2022 10:25:47	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,314.00	lx	illuminance	28/01/2022	10:35:47	28/01/2022 10:35:47	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,314.00	lx	illuminance	28/01/2022	10:40:47	28/01/2022 10:40:47	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,314.00	lx	illuminance	28/01/2022	10:50:47	28/01/2022 10:50:47	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,314.00	lx	illuminance	28/01/2022	11:00:47	28/01/2022 11:00:47	Amsterdam	Strip 0.17	Haagse Hogeschool
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Strip 0.17 CO2-Illuminance	2,313.00	lx	illuminance	28/01/2022	11:10:47	28/01/2022 11:10:47	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,312.00	lx	illuminance	11/02/2022	10:24:44	11/02/2022 10:24:44	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,312.00	lx	illuminance	11/02/2022	10:29:44	11/02/2022 10:29:44	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,311.00	lx	illuminance	28/01/2022	10:20:47	28/01/2022 10:20:47	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,311.00	lx	illuminance	30/01/2022	10:35:38	30/01/2022 10:35:38	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,311.00	lx	illuminance	30/01/2022	10:40:38	30/01/2022 10:40:38	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,311.00	lx	illuminance	30/01/2022	10:45:38	30/01/2022 10:45:38	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,310.00	lx	illuminance	05/02/2022	10:45:12	05/02/2022 10:45:12	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,309.00	lx	illuminance	11/02/2022	09:54:44	11/02/2022 09:54:44	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,309.00	lx	illuminance	05/02/2022	10:25:11	05/02/2022 10:25:11	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,309.00	lx	illuminance	30/01/2022	10:25:38	30/01/2022 10:25:38	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,309.00	lx	illuminance	05/02/2022	10:30:12	05/02/2022 10:30:12	Amsterdam	Strip 0.17	Haagse Hogeschool
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Strip 0.17 CO2-Illuminance	2,309.00	lx	illuminance	05/02/2022	10:40:12	05/02/2022 10:40:12	Amsterdam	Strip 0.17	Haagse Hogeschool
Strip 0.17 CO2-Illuminance	2,308.00	lx	illuminance	11/02/2022	10:19:44	11/02/2022 10:19:44	Amsterdam	Strip 0.17	Haagse Hogeschool

Student results Senordata analytics with Power BI

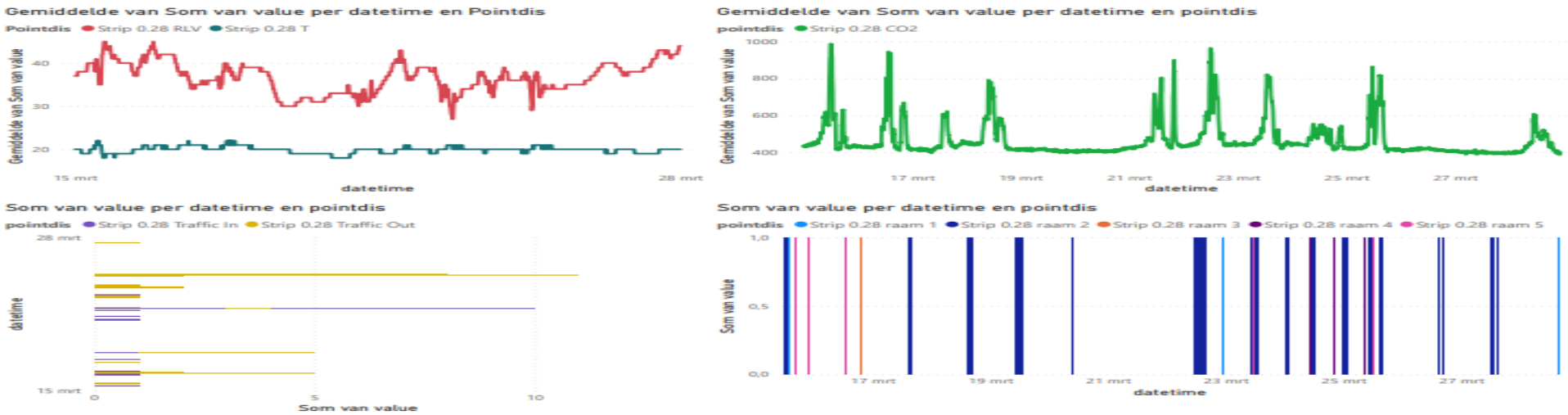
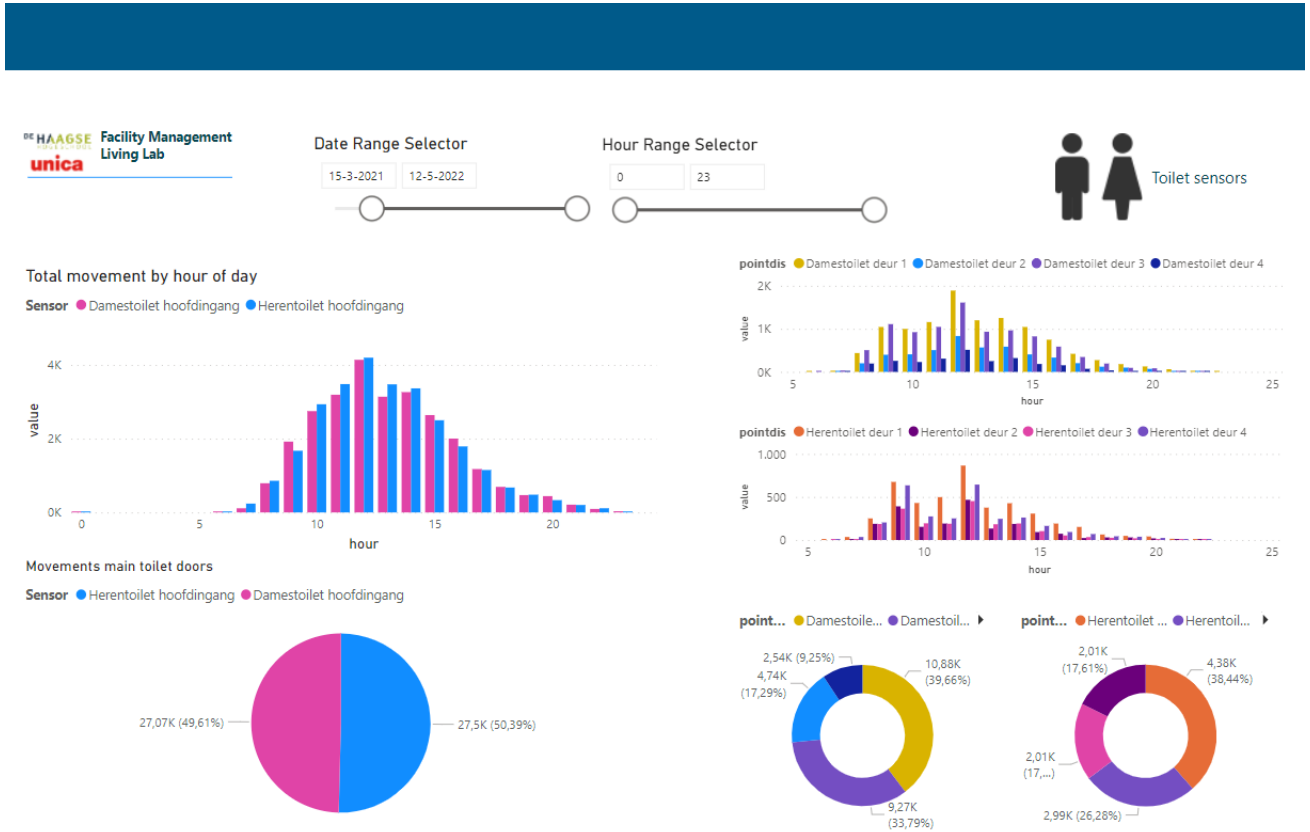


Figure 1: sensor data-analytics strip 0.28 from: temperature&humidity / Occupancy / PPM CO2 & Windows open-close

Classroom ST028: Temperature between 18 and 21°C. Humidity is between 27% Rf and 45% Rf. Air quality CO_2 is between 400 and 1000 ppm. Temperature higher humidity is also higher. Windows open: temperature, humidity and CO_2 lower. Medium occupancy and windows often open (22 March): average 420 ppm CO_2 , more occupied and not so often open windows (25 March): average 580 ppm CO_2.

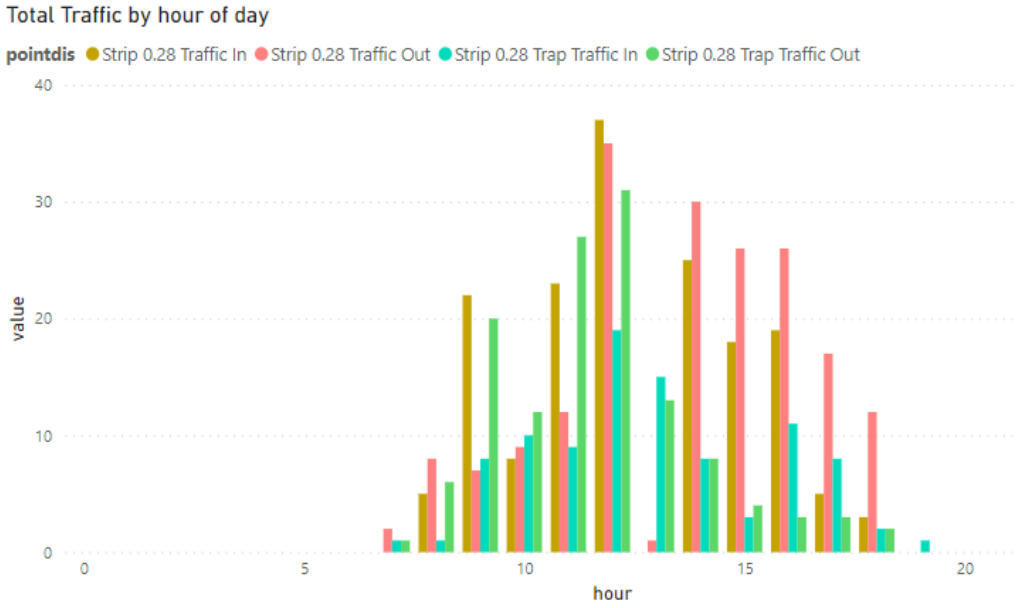
Sensor data and management of cleaning

- Ours sensor data of the use of the toilets gives a signal via TopDesk (FMIS) to the cleaner when a toilet needs to be cleaned. Periodically processed reports could be uses to manage the contract and cleaning quality (SLA's).
- We will put sensors on the towels, soap dispensers en toilet paper dispensers in the future and we will also install a feedback box for the freshness of the toilets



Sensor data and management of the occupancy rate

- Periodically produced reports gives information of the effective use of spaces and where we can improve our occupancy rate.
- And for the use energy usage: no use of the space no heating or cooling and ventilation
- Also, daily information for cleaning
- Or for the end-users to find a not occupied workplace
- Or for safety and security….. etc.

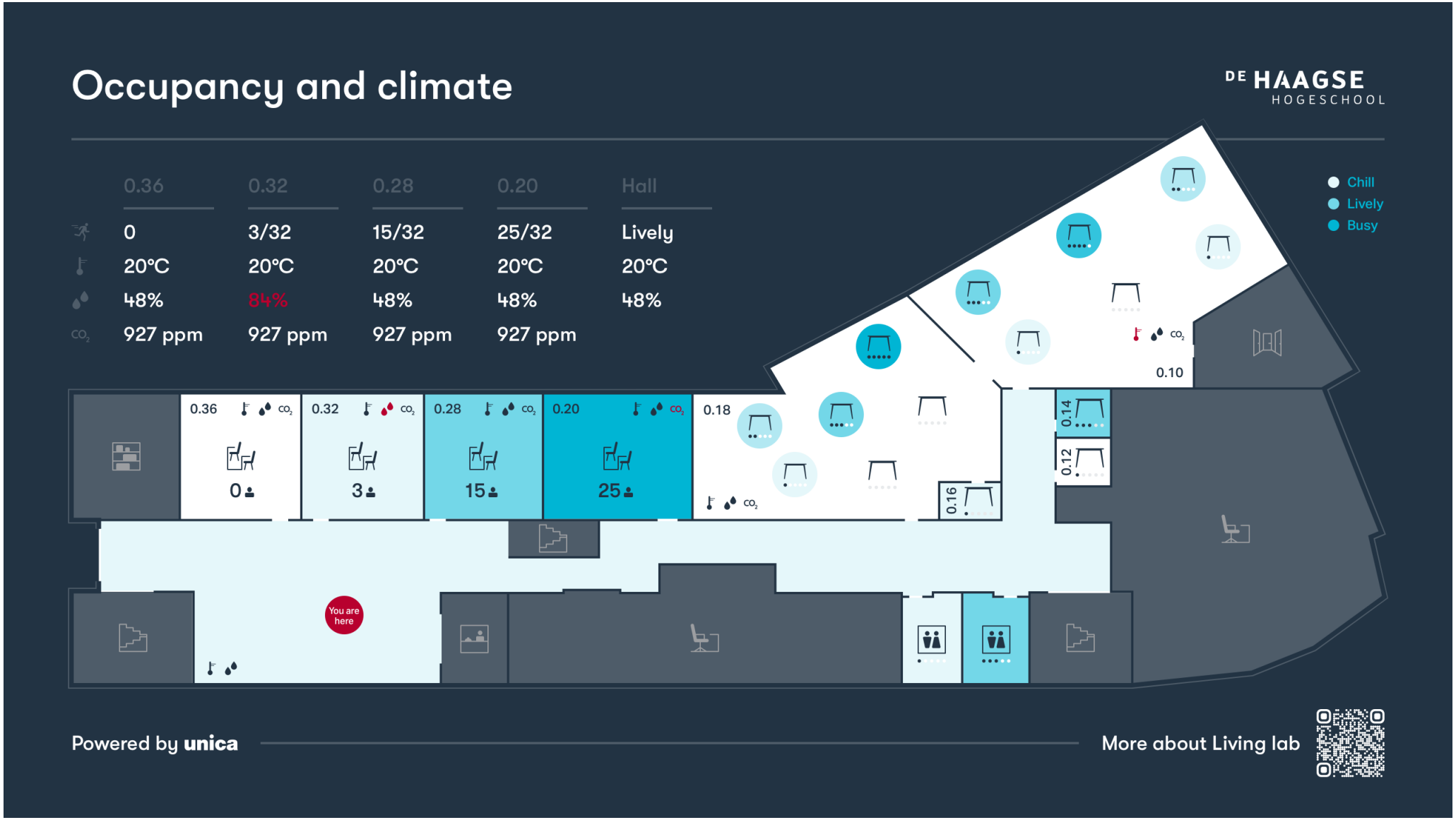


How do end-users experience indoor comfort?

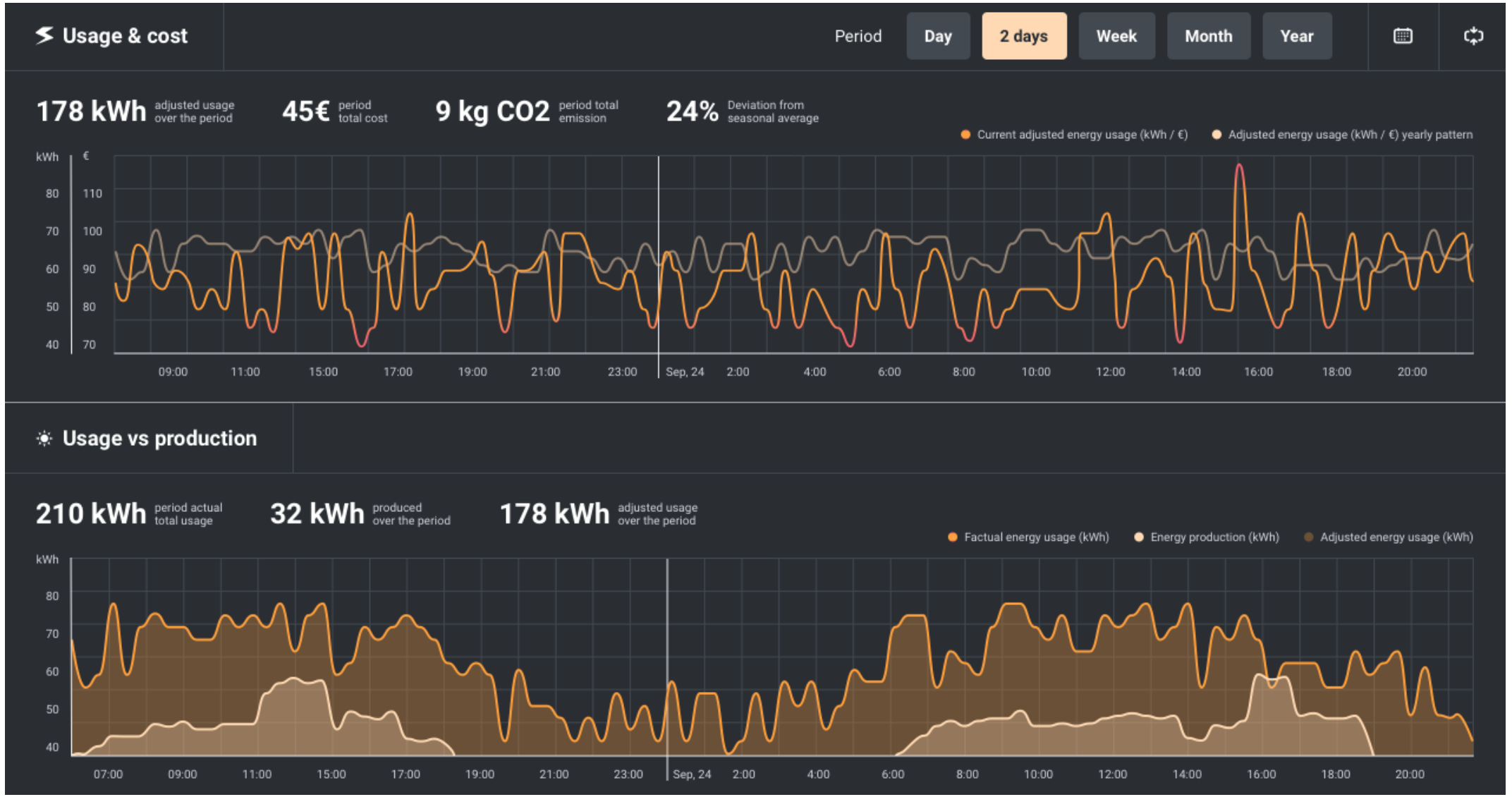
Please scan this QR-code and give use your feedback about the indoor comfort you experienced right now. As a reward you will get feedback from our senor about the measured comfort levels in this room.

Did the sensor values match your expectations?

Narrow casting on large displays to inform end-users



Next addition to the living lab: energy monitoring



Information for the facility manager, technical service provider or end-user?

To end with a question

"What interaction do you want with the building?"

Go back to your smart phone→

- Scan the QR-code:

- Or go to: menti.com Code: 17 18 40 3

Thanks for your attention!

If you have questions about the possibility to carry your research in the HHS living labs you can get in contact with Frans Joosstens f.g.l.Joosstens@hhs.nl or Sander van der Harst svdharst@unica.nl

Workshop

Questions and post-it session

Workshop questions

1. What do end-users (office workers) do that they shouldn't do in buildings to causes high energy use and a poor indoor climate? What are the consequences?
2. How could we avoid these unwanted situations? By what means?
3. How do we provide effective feedback to the building occupants?
4. What are the requirements for user-interfaces?
5. When do user-building interfaces become a business case?

Coloured post-its per profession:

- Facility managers
- Installation/design engineers
- Academics
- Other

Brains4Buildings project

More information:

www.brains4buildings.org

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