



# Living Lab Experiments: Smart building applications

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# What is Kropman living lab?

- **Living lab:** open innovation ecosystems in real-life environments, focus on co-creation, rapid prototyping & testing and scaling-up innovations

## Why Kropman living lab is unique?

- A real office building with 35 employees
- Has the possibility of adding individual sensors/sensor networks
- Has a platform to store and monitor the data
- Has Kropman's own SCADA system (**InsiteView**)
- Has the possibility to control/ manage energy systems
- Has the possibility to integrate user feedback



# Research/experiments carried out in the living lab...



**LET'S  
SAVE  
ENERGY**

Focus areas:

- Low-cost environmental sensors/ monitors performance testing
- Fault detection and diagnosis in AHUs
- Personalized comfort systems
- Zone level comfort systems
- Energy management
- Energy flexibility improvement (EV, PV, Battery control)
- Exploration to make buildings gas-less



# Kropman Breda Experiments for B4B activities



Focus areas:

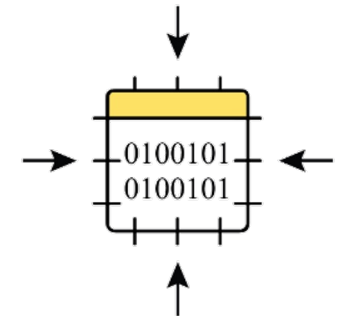
- To implement Fault Detection and Diagnose (FDD) applications
- Comfort Control Systems (CCS)
- Smart controls for energy management and improving energy flexibility

**KROPMAN**

**\* Insite Suite**



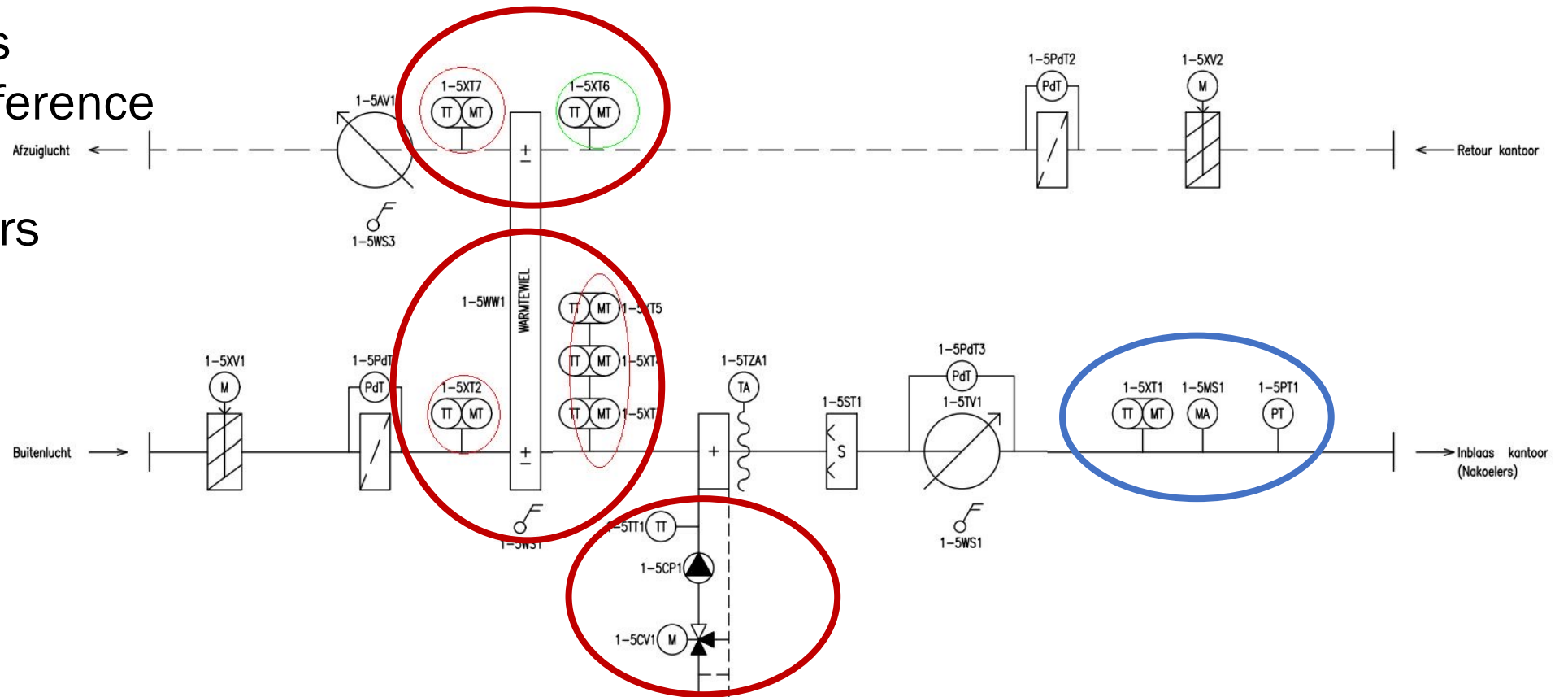
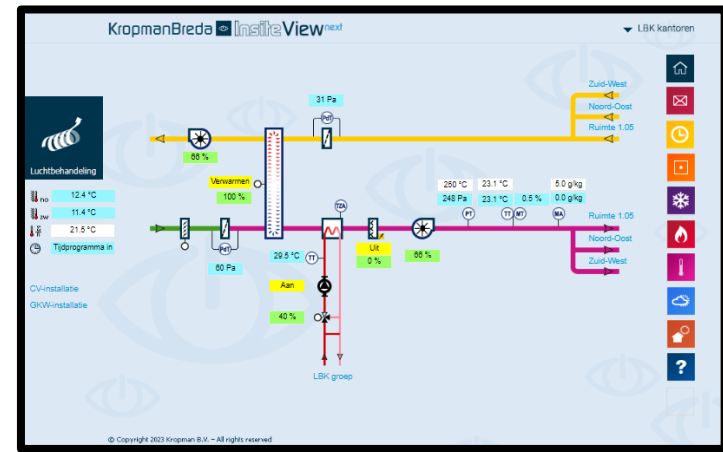
**Work Package 1**

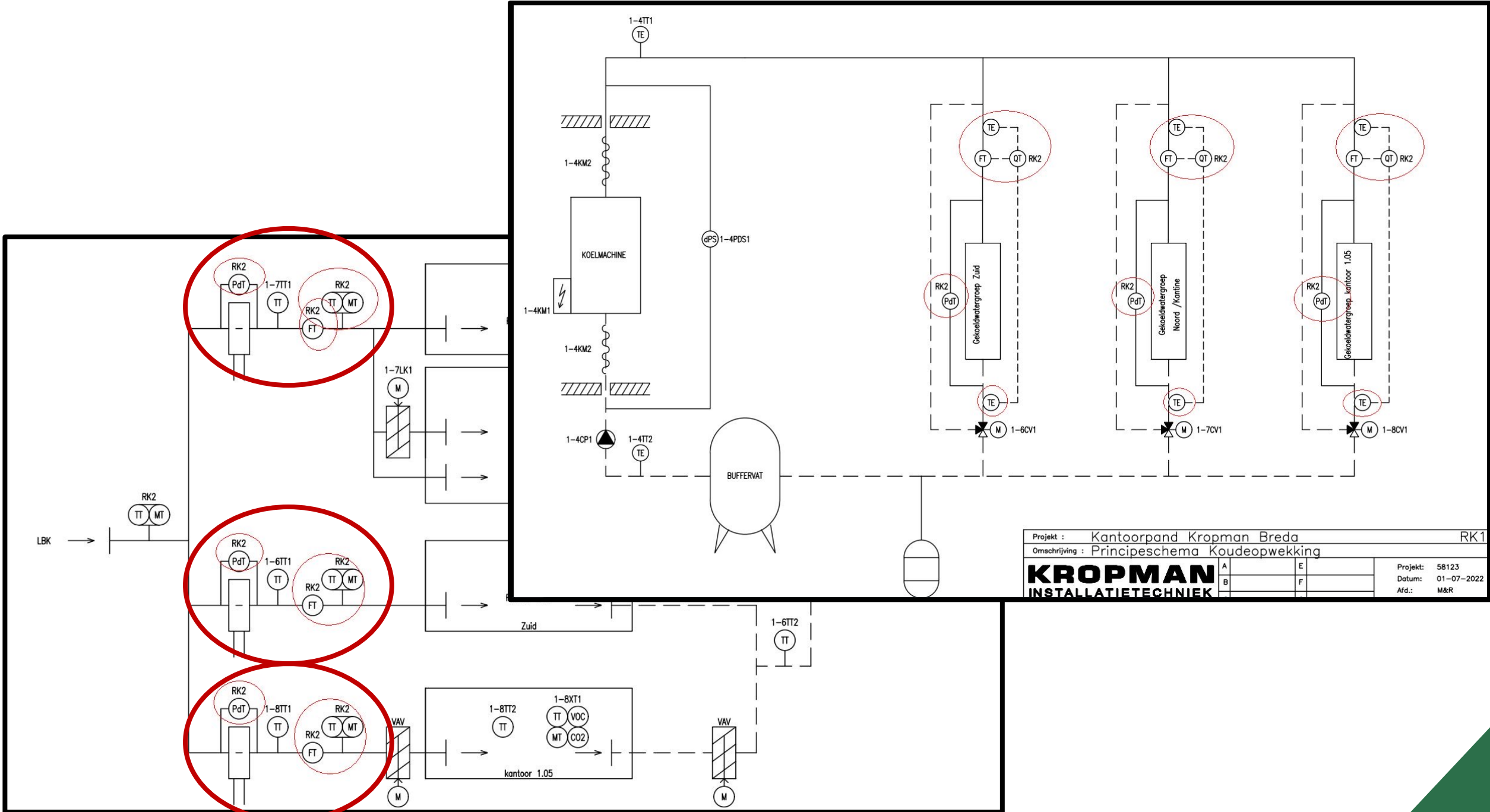


**Work Package 4**

# For FDD: AHU from sensor-poor to sensor-rich

- Temperature sensors
- Humidity sensors
- Flow sensors
- Pressure difference sensors
- Energy meters

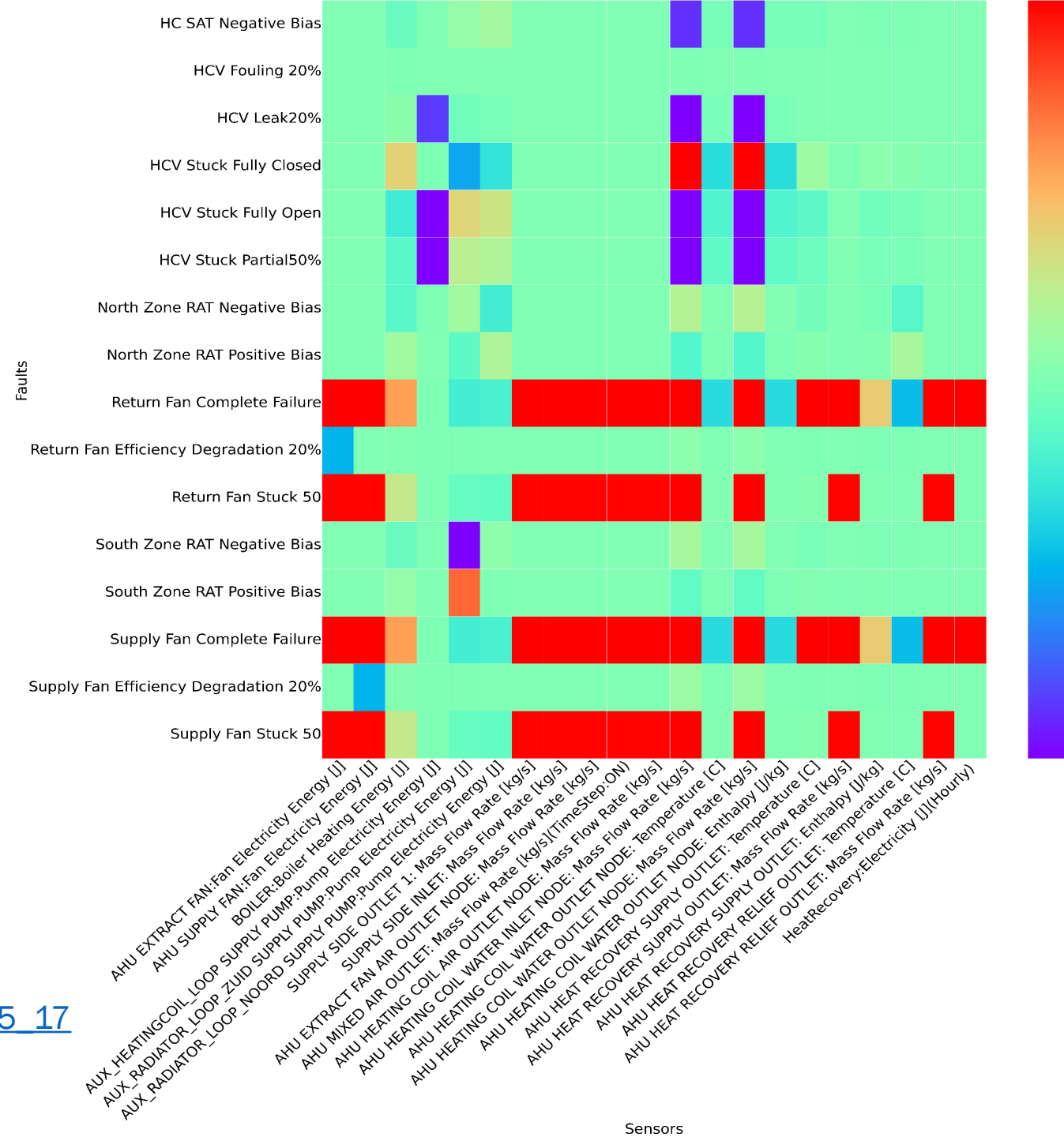




Projekt :		Kantoorpand Kropman Breda		RK1
Omschrijving :		Principeschema Koudeopwekking		
<b>KROPMAN</b>	A	E	Projekt:	58123
<b>INSTALLATIETECHNIEK</b>	B	F	Datum:	01-07-2022
			Afd.:	M&R

# Where to place sensors for FDD applications?

- Sensor performance analysis with Faults
- Generalize the FDD methods



Ref:  
[https://pure.tue.nl/ws/portalfiles/portal/203722819/2022\\_05\\_17\\_Chitkara\\_S\\_SBC.pdf](https://pure.tue.nl/ws/portalfiles/portal/203722819/2022_05_17_Chitkara_S_SBC.pdf)

# Vibration sensors installation

Vibration sensor – to complement traditional sensors

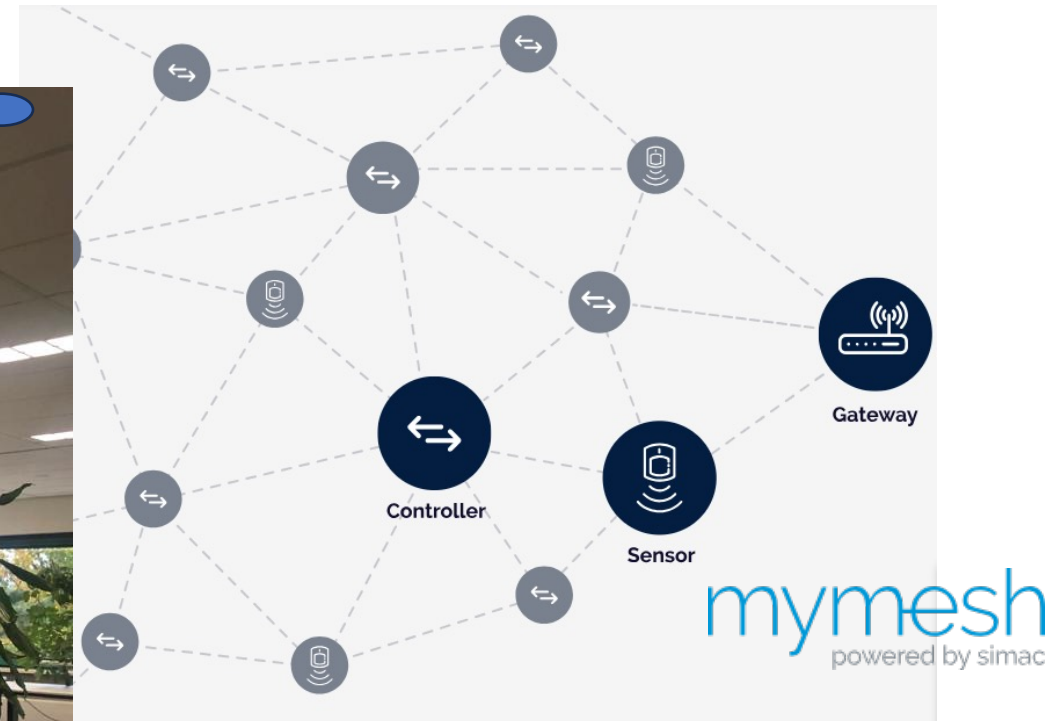




# Sensor networks installed for user centric FDD



Take human as a sensor as well – user feedback



- Temperature
- Relative Humidity
- TVOC
- Occupancy
- Sound level

# Comfort Control Systems: Where to place the sensors?



For CCS and user centric FDD:

- Is there a significant difference in measuring environmental variables among the positions tested?
- Does the sensors/monitors follow the changes in the environment?

Ref: <https://research.tue.nl/en/publications/towards-automated-personal-comfort-systems-for-heating-cooling-an>

# Sensor placement at the office environment

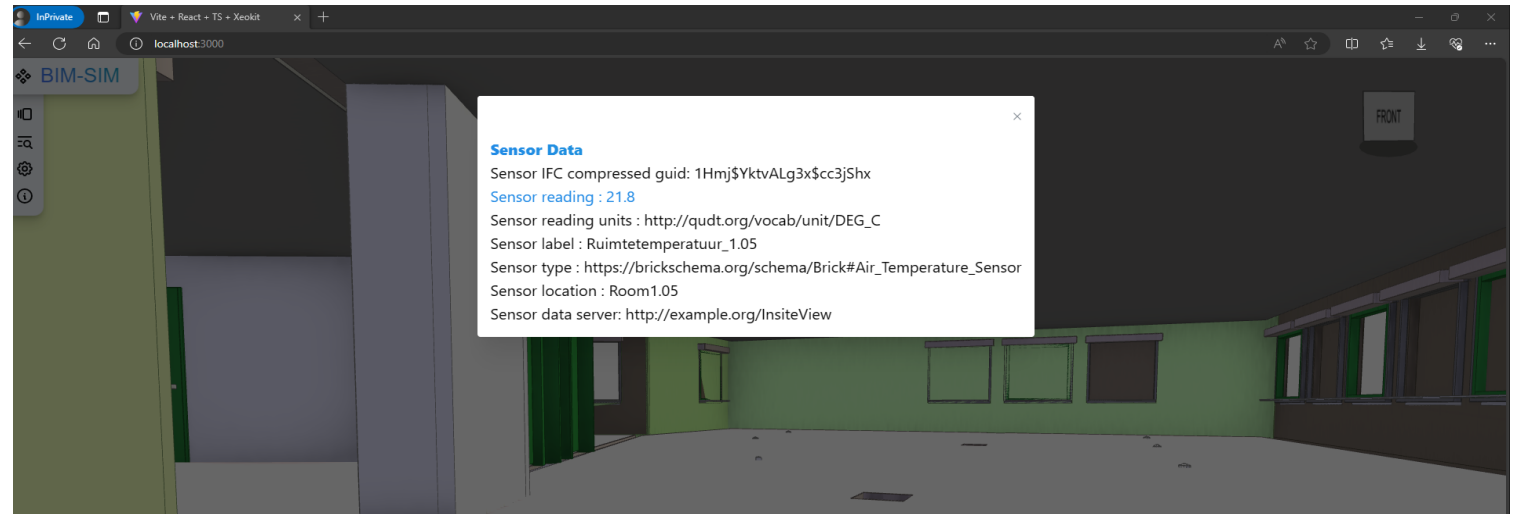


- (a) Ventilation duct
- (b) Slider controls
- (c) Heated chair
- (d) Occupancy sensor
- (e) Supply air temperature sensor
- (f) Airteq low-cost monitor

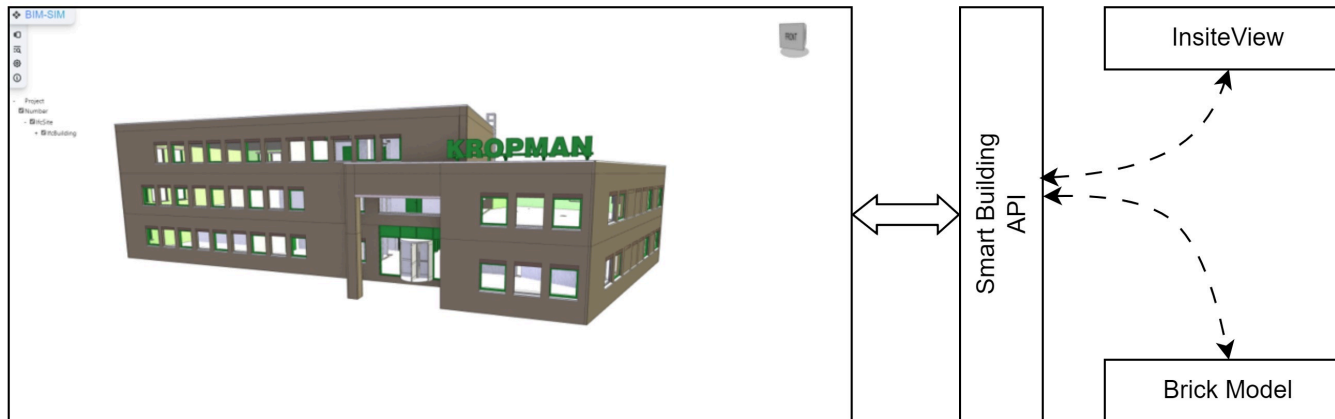


# #LiveDataAccess Test WP4

- Demonstration of live sensor data integration with the use of proposed reference architecture by WP4

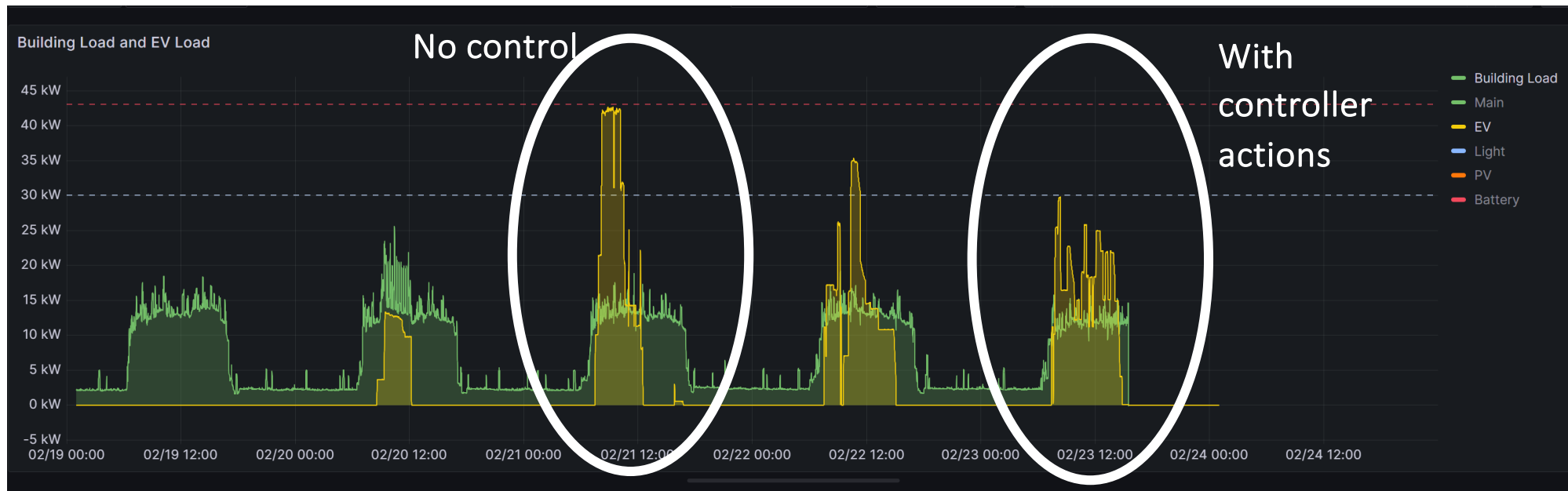
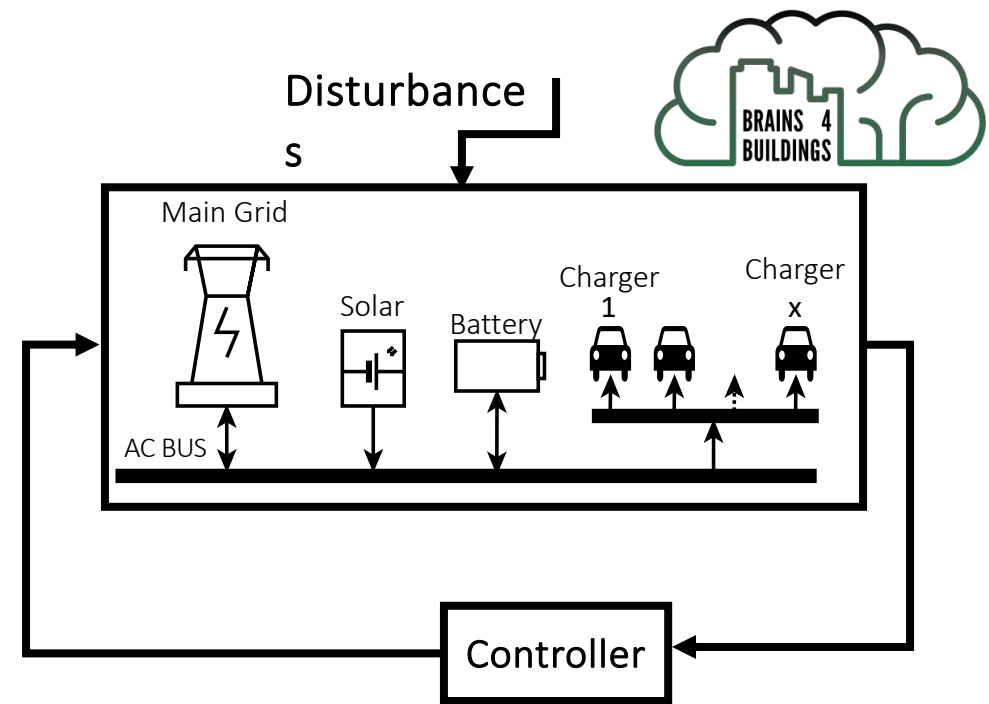


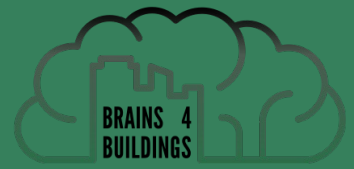
Digital Twin



# Energy flexibility related testing

- Reducing peak demands created by EVs
- Shifting the demand





**Thank you!**