JOINT FINAL CONFERENCE

Next Generation Energy Performance Assessment, Rating and Certification

Towards a Smart and Decarbonised Future for European Buildings

Part 3: Specific Results of the 3 projects
EDYCE: DEPC protocol_PREDYCE_FUSIX

24 May 2023
Brussels and online

D2EPC ePANACEA EDYCE

DISPOSITION

EDYCE

1) EDYCE protocol - from EPC to DEPC

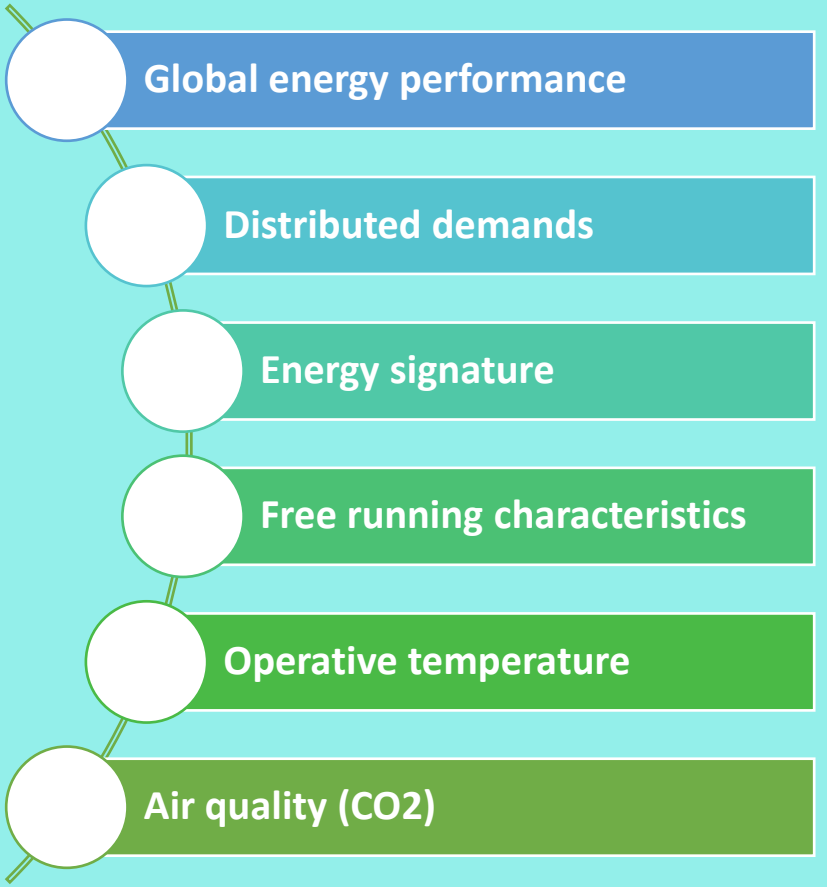
2) PREDYCE – dynamic energy simulation platform

3) FUSIX – Middleware solution to facilitate operational and dynamic modelling towards performance gap

E-DYCE PROTOCOL

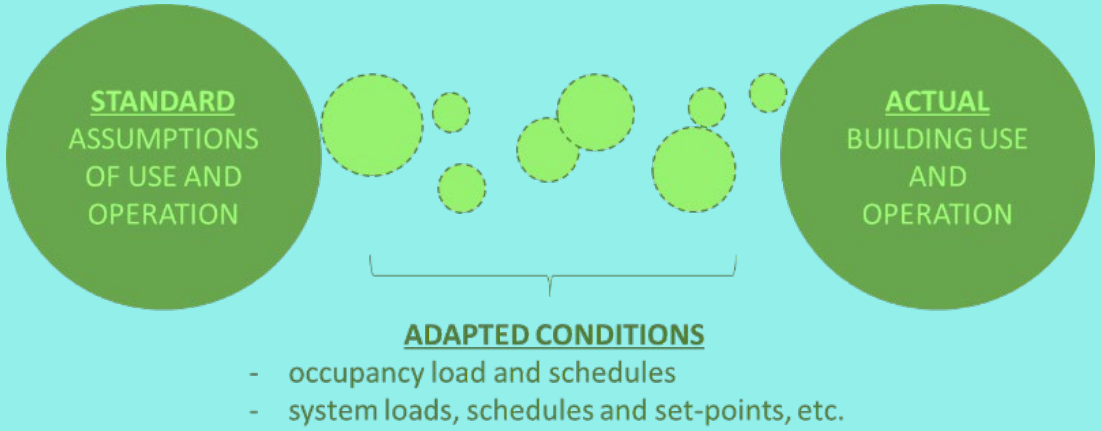
CONCEPT

- The E-DYCE DEPC certification - voluntary schema
- The E-DYCE schema is anchored in existing EPC legislation
- The E-DYCE protocol focuses on Performance Gap (PG)
- The PG in E-DYCE is evaluated through a set of KPIs:
  - Energy performance
  - Indoor Environmental quality



E-DYCE PROTOCOL

STANDARD and ADAPTED CONDITIONS

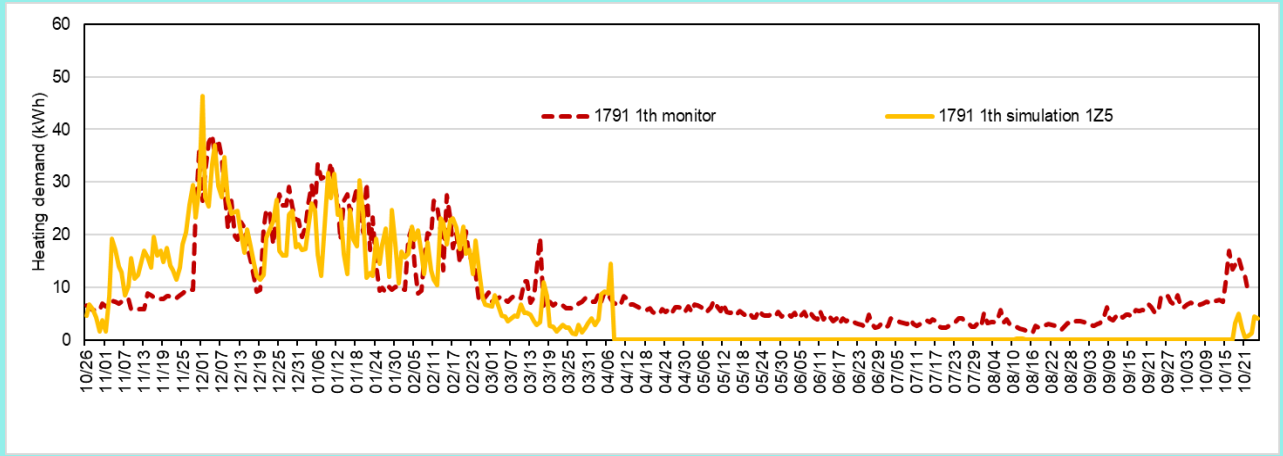


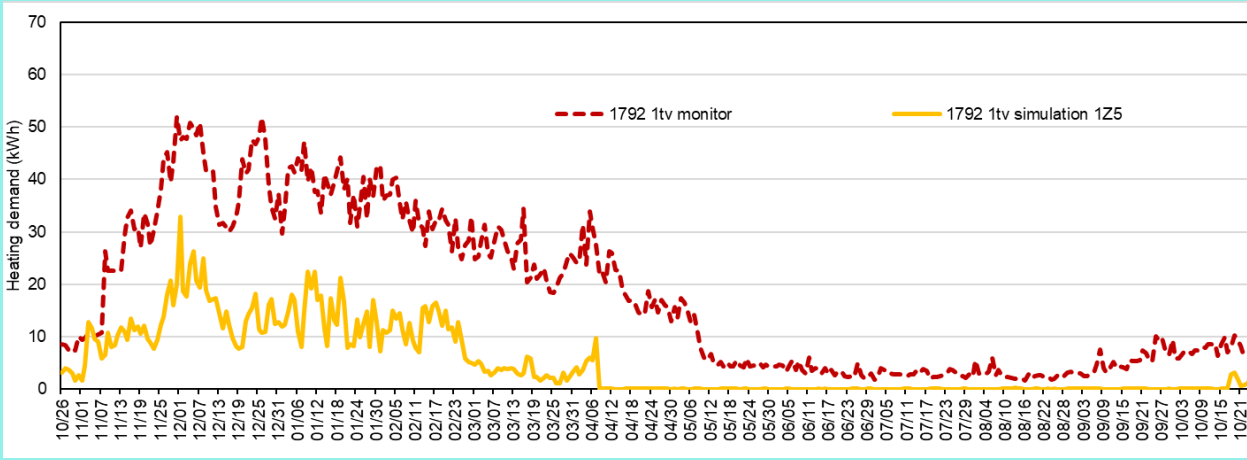
- DEPC → Dynamic calculation engine
- Standard conditions
  - EN ISO 52000-1 and EN 16798-1
- Adapted conditions
  - National or local operational guidelines
  - Building inspection
  - Building monitoring

E-DYCE PROTOCOL

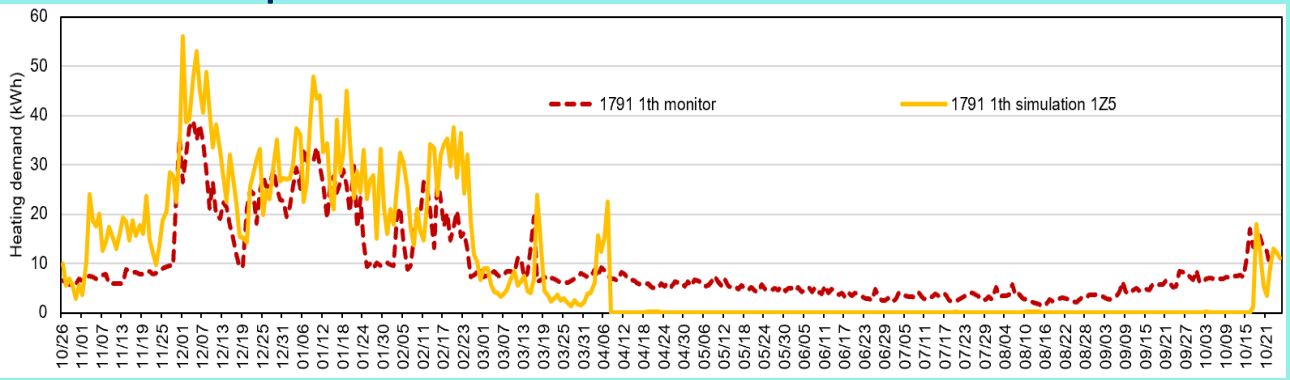
RESULTS

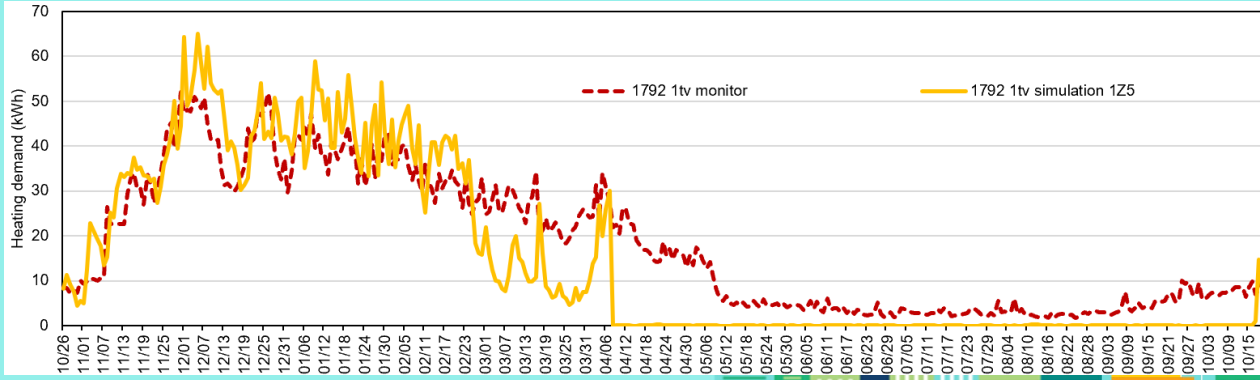
- Standard conditions





- Adapted conditons





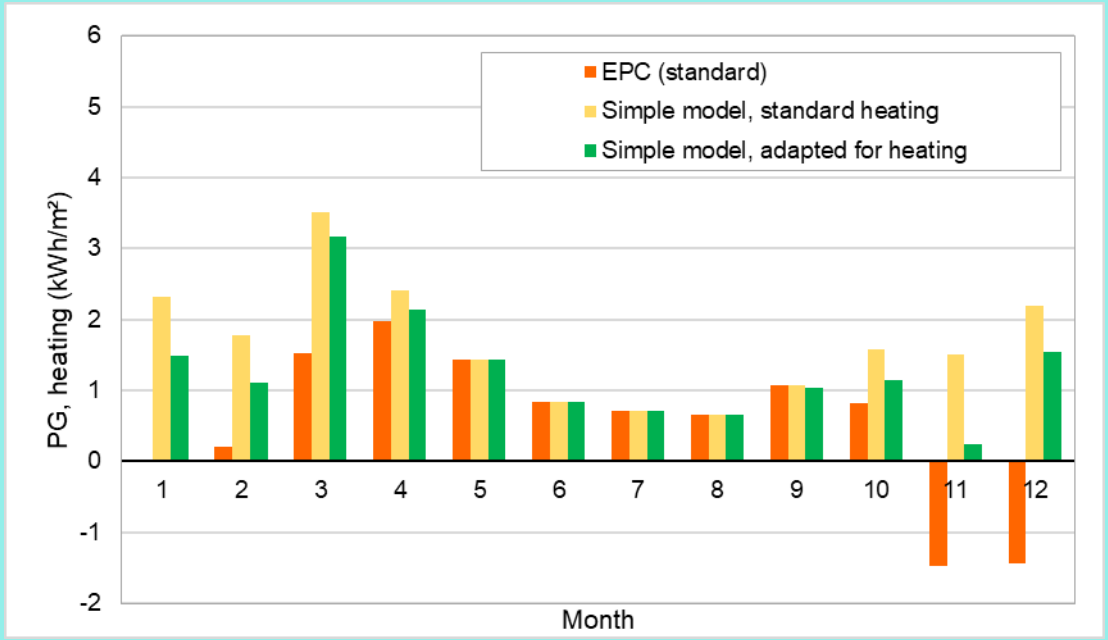
E-DYCE PROTOCOL

RESULTS

- Energy PG
  - At the building level

- Other indicators availability depends on:

  - Level of detail in the simulation model
  - Time and space resolution of monitored data

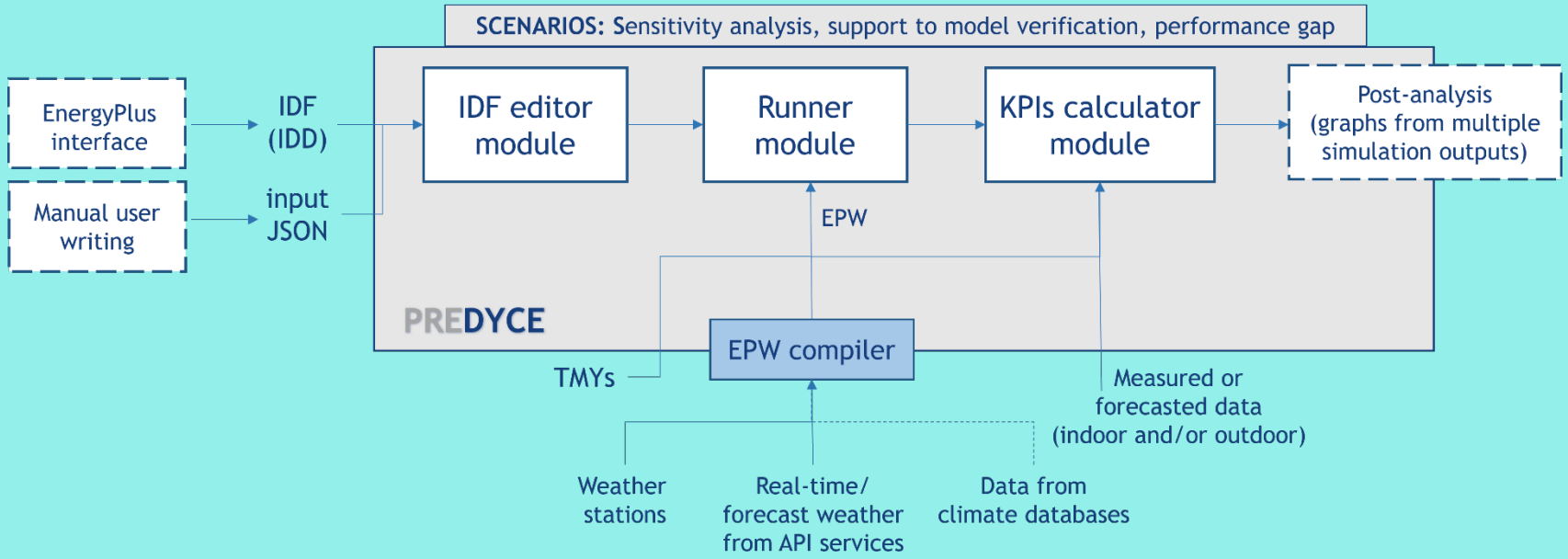


PREDYCE platform

the PREDYCE tool

Structure of the dynamic energy simulation platform

the PREDYCE (Python Realtime Energy DYnamics and Climate Evaluation) library can be used to perform: parallel runs of e+ simulations, automatic and parametric editing of input IDF files (and EPW files), and computing KPIs on simulation results and structured monitored data.



- flexible
- scalable
- modular

allows different usage scenarios

the PREDYCE tool

PREDYCE scenarios of usage

The PREDYCE's scenarios of use adopted in E-DYCE are:

Sensitivity analysis: which performs parametric analysis by automatically modifying the base building model and computing requested KPIs.

Calibration: semi-automatic scenario, requiring a human interpretation to manage several automatic progressive runs. Supports the minimisation of RMSE and MBE on defined variables comparing simulation and monitored data.

Performance gap: returns the gap between calibrated simulation (standard and realistic schedules) vs monitored data.

Calibration and *PG scenarios* exploit the PREDYCE's ability to compute KPIs on monitored data and to generate EPW from real weather data.

the PREDYCE tool

PREDYCE scenarios of usage: SENSITIVITY ANALYSIS

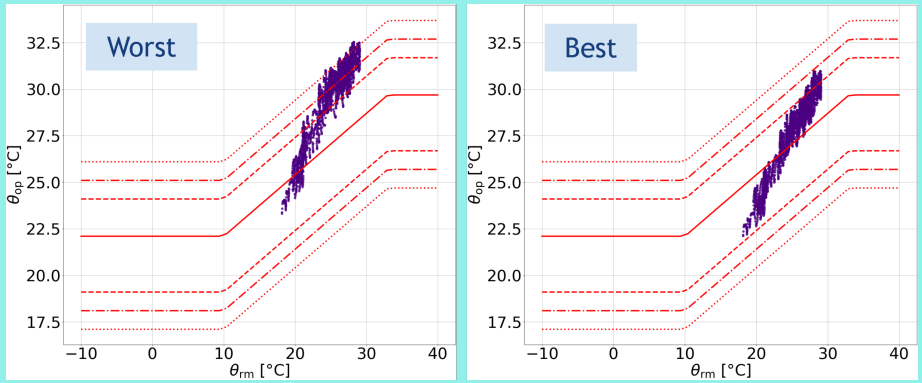
The scenario can be executed through a REST API

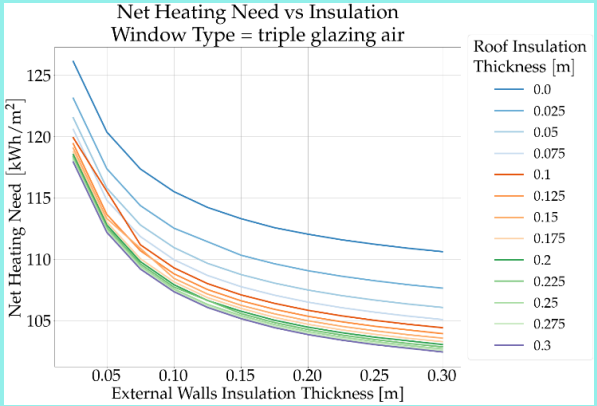
It returns a CSV file with KPIs computed on all parametrically modified building models. The relative subfolder is also available for each simulation to deepen the temporal behaviour.

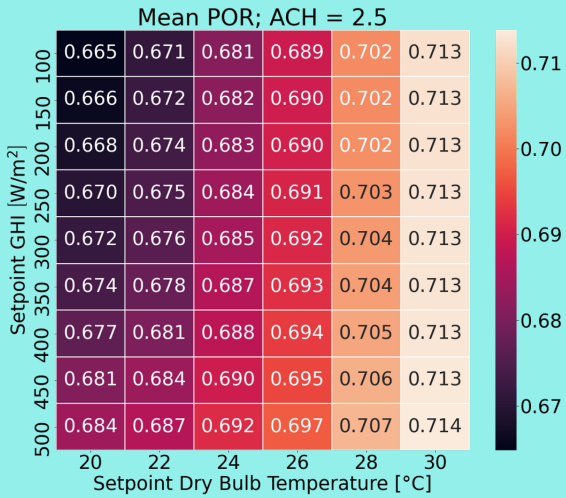
data_res.csv

#	Param 1	Param 2	KPI 1	KPI 2
0	x	x		
1	y	x		
2	z	x		

Permutations of parameters | Results







the PREDYCE tool

PREDYCE scenarios of usage: CALIBRATION - VERIFICATION

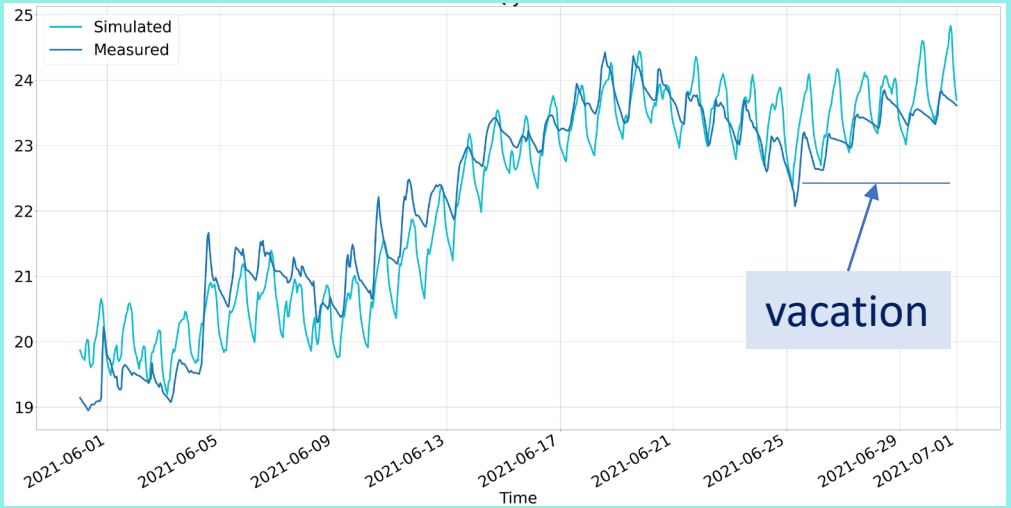
The following PREDYCE IDF editing actions are currently available:

- Change the U-value of walls, floors and roofs
- Change the U-value and SHGC of windows
- Change internal mass and equipment gains
- Change ACH ventilation and infiltration

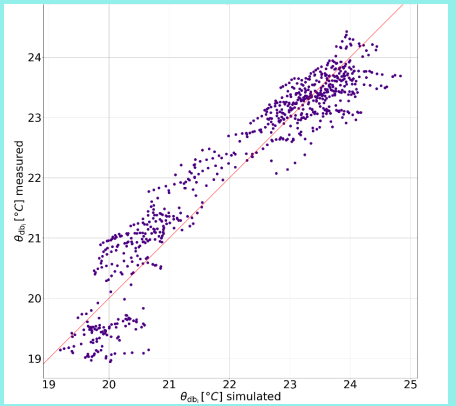
It exploits the PREDYCE EPW compiler module, generating an EPW from monitored weather data.

It uses the PREDYCE's ability to compute the same KPIs on simulation results and monitored data.

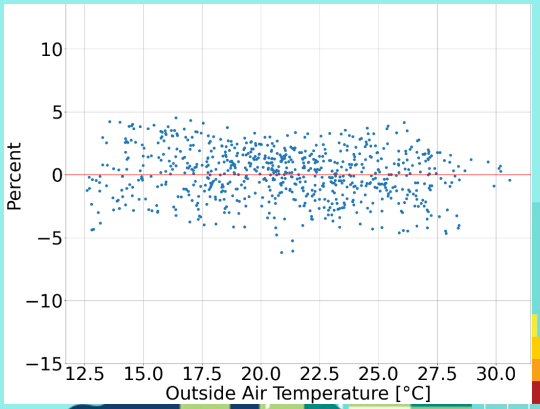
Indoor Dry Bulb Temp. measured & simulated



Indoor Tdb meas. vs simul.



Calibration signature



the PREDYCE tool

PREDYCE scenarios of usage: PERFORMANCE GAP

building model

IDF

PREDYCE input file

JSON

monitored indoor data file

CSV

(TMY) weather file

EPW

optional

monitored weather data file

CSV

The scenario can be executed through a REST API

Performance Gap

zip

CSV

	KPI 1	KPI 2	KPI 3
SIM 1			
SIM 2			
MONI-TORED			
Δ 1			
Δ 2			

...

dataframe of timeseries results

CSV

For each KPI 5 columns are generated:

Date/ Time	SIM 1	SIM 2	MONI-TORED	Δ 1	Δ 2

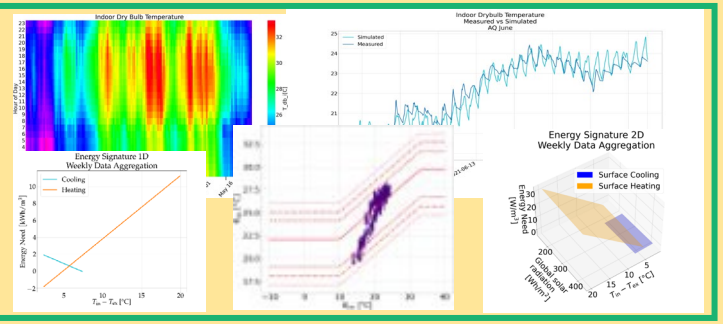
...

Not via REST

plots

PNG

*plots generated via Fusix



the PREDYCE tool

PERFORMANCE GAP - sample application

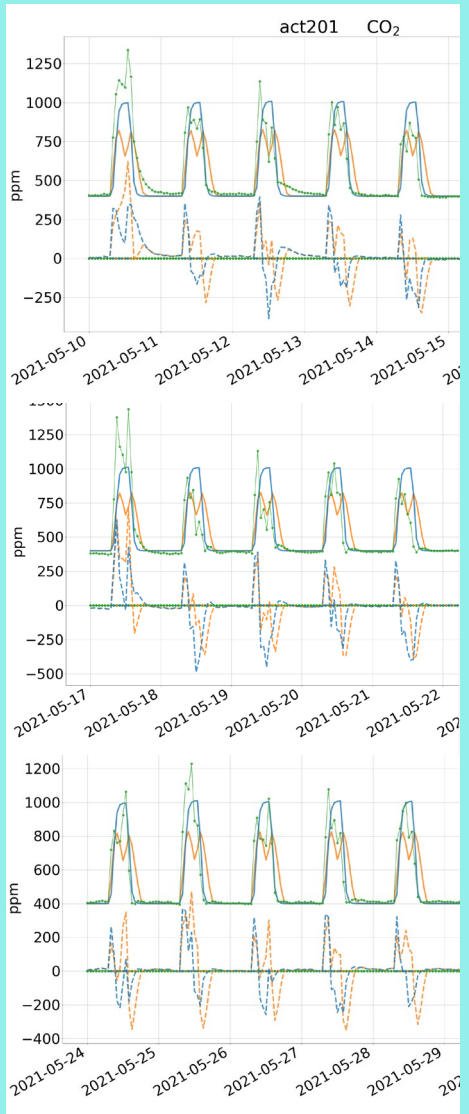
B2.1 middle school ground floor

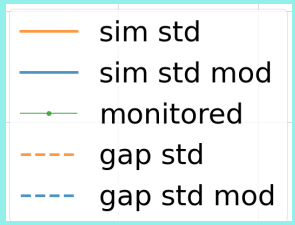
Preliminary considerations:

- A well calibrated model will be reliable even if usage patterns are modified
- Real CO2 behaviour cannot be followed unless modelling actual user behaviour with room detail and high accuracy: STD and STD adapted CO2 shapes may be too regular
- Simulated consumption is not impacted by minor usage changes (only availability changes in schedule and setpoint will strongly impact it)

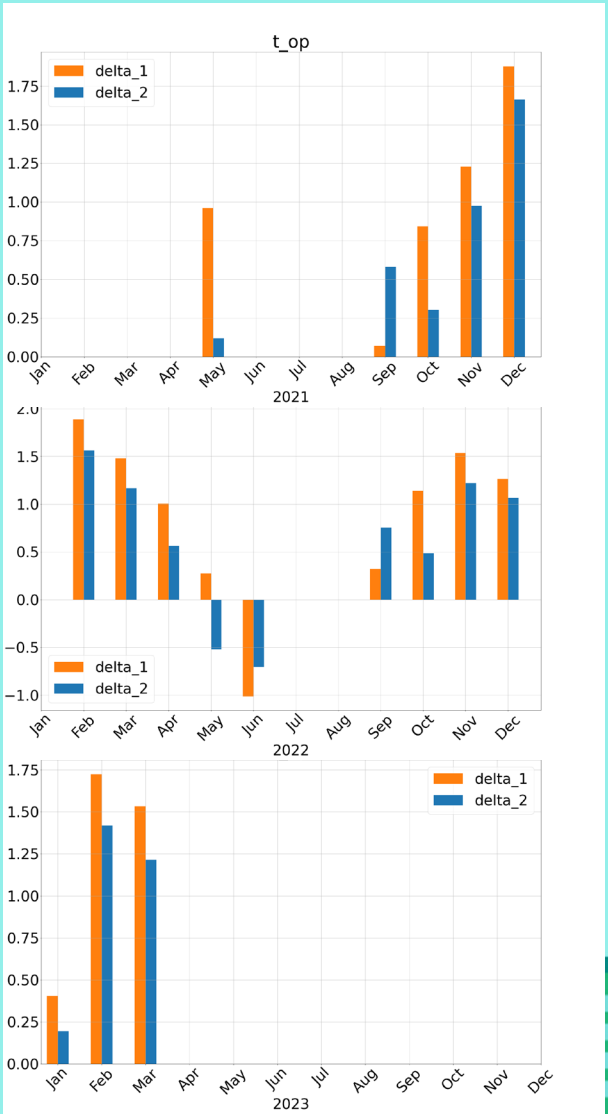
-> it may be difficult to underline strong differences between std and std adapted behaviours

CO2 timeseries weekly





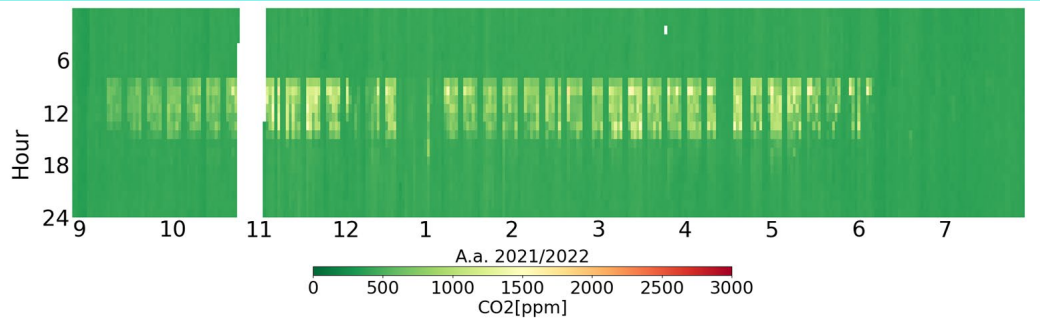
T_op monthly aggregation

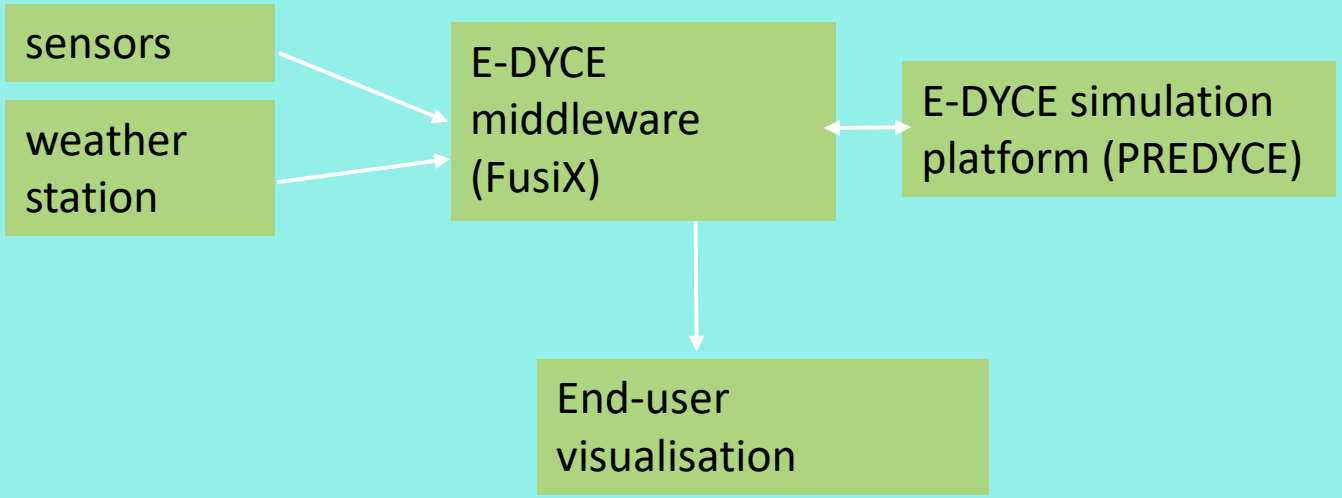


the PREDYCE tool

PERFORMANCE GAP – Current Testing & KPIs

The PG is now under testing in several EDYCE demos. This test includes the complete EDYCE platform dataflow.





The tested KPIs are aligned with the EDYCE protocol:

- Energy (monitored, std, std.adapted)
- Energy signature
- IEQ – IAQ (CO2)
- IEQ – thermal comfort and air temperature
- Free-running

FUSIX middleware

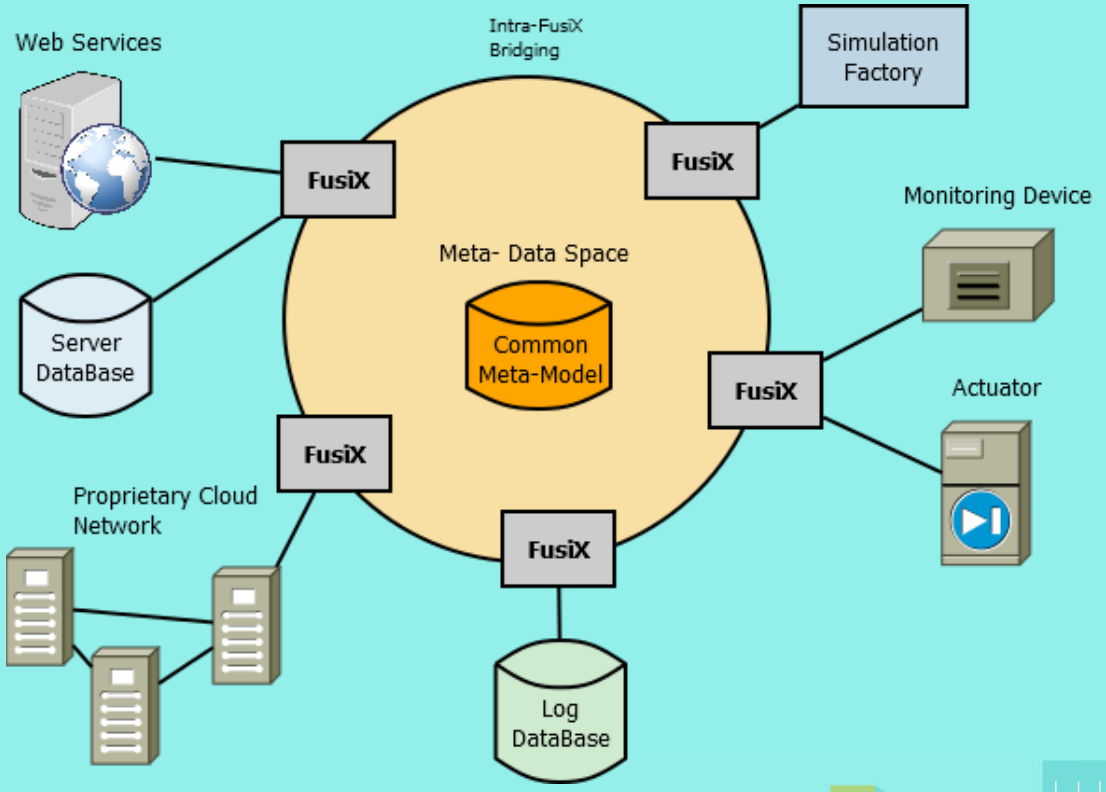
The FusiX Framework

High Level Description and Objectives

FusiX is a decision-support and Situational Awareness framework.
Initial Development under ESA-BIC for Space-Software spin-out.

It allows the following:

- Data Fusion from heterogeneous sources
- Data Management and (pre)processing
- Storage
- Smart Functionality integration and development
- User Interface Integration

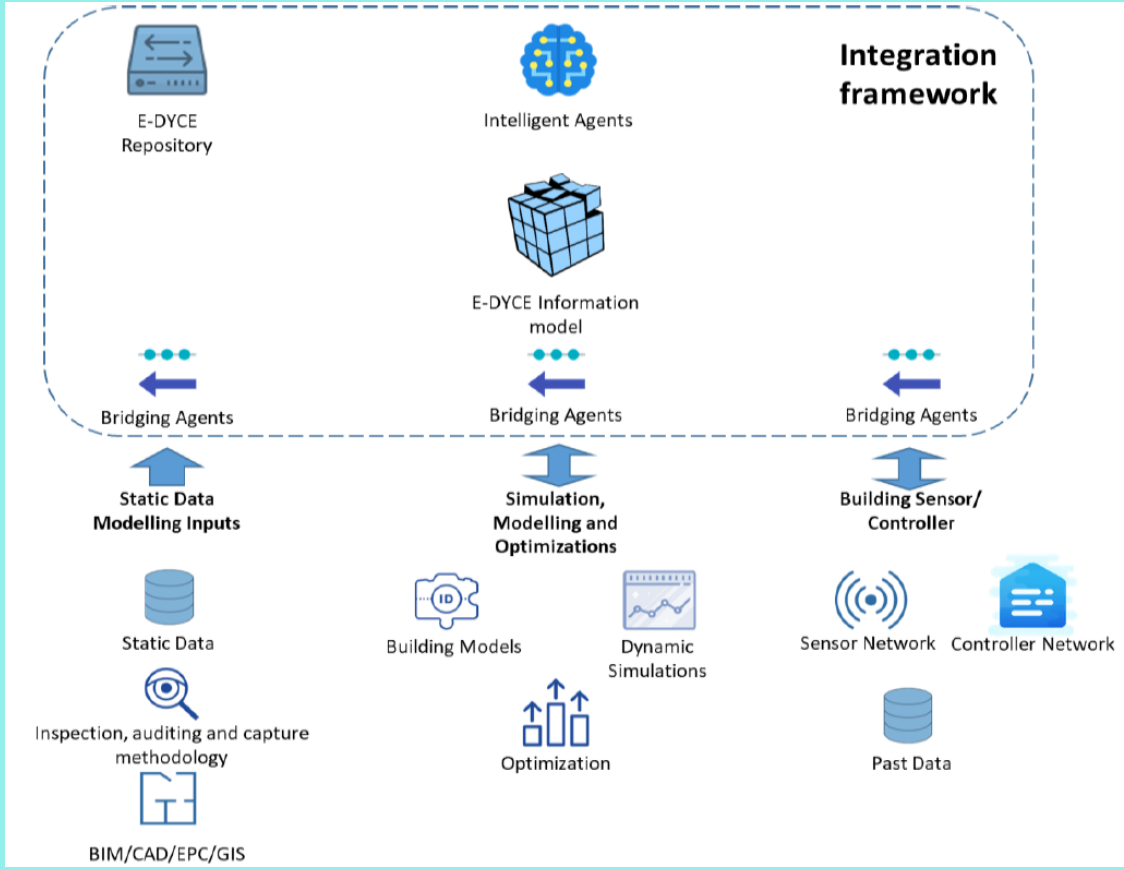


The FusiX Framework

Use in E-DYCE

FusiX in E-DYCE is used with the following goals:

- **Collect monitoring data from all sensors and buildings**
- **Perform filtering, aggregation and storage**
- **Distribute collected data to technology enablers using a unified format**
- **Collect modelling and simulation results**
- **Support and provide User Interfaces**

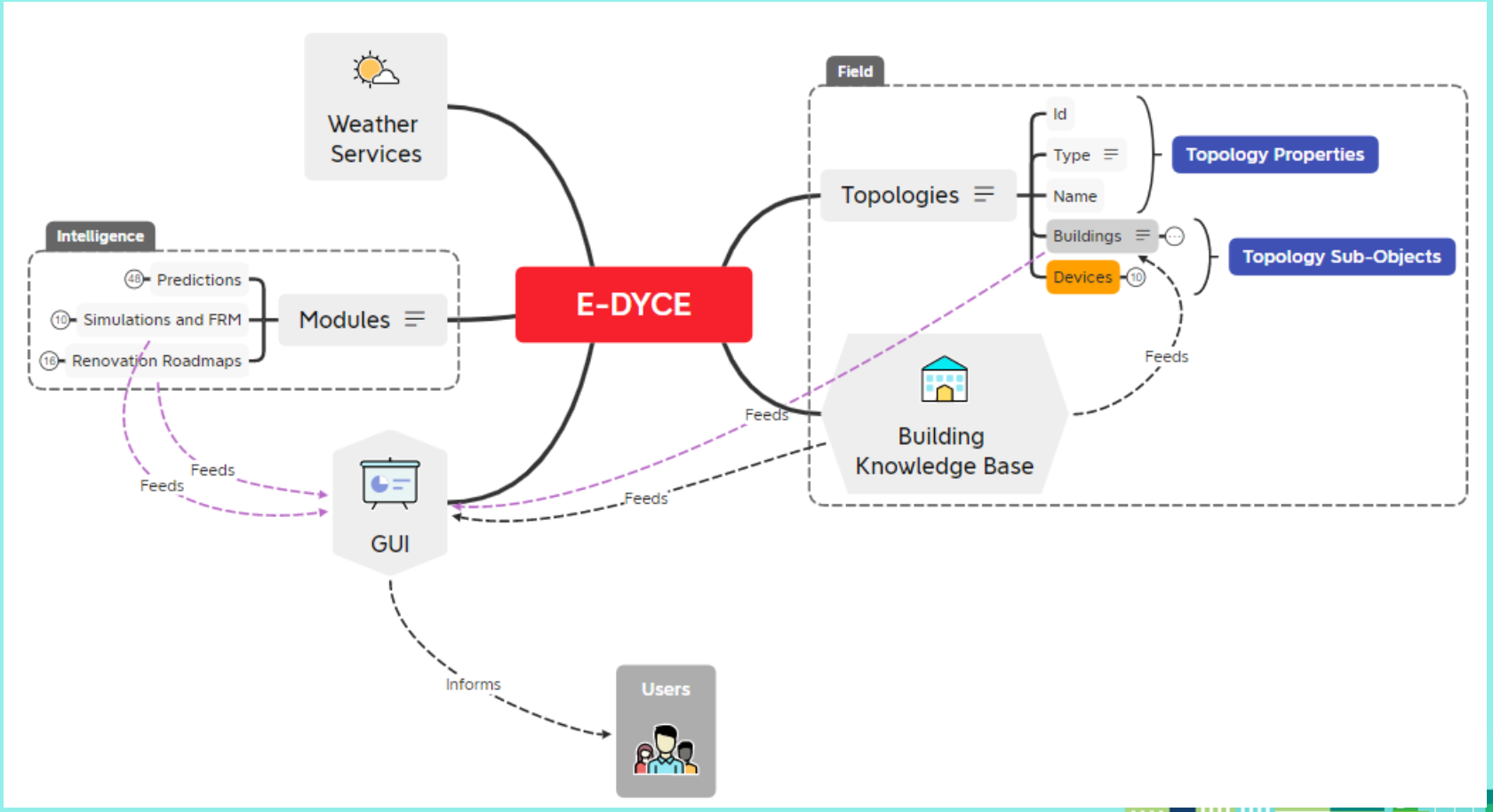


The FusiX Framework

The Application Information Model

The Application information model is:

- **Common “language” among entities**
- **Hierarchical structure**
- **Specific elements and relationships**
- **Specific units of measurement**

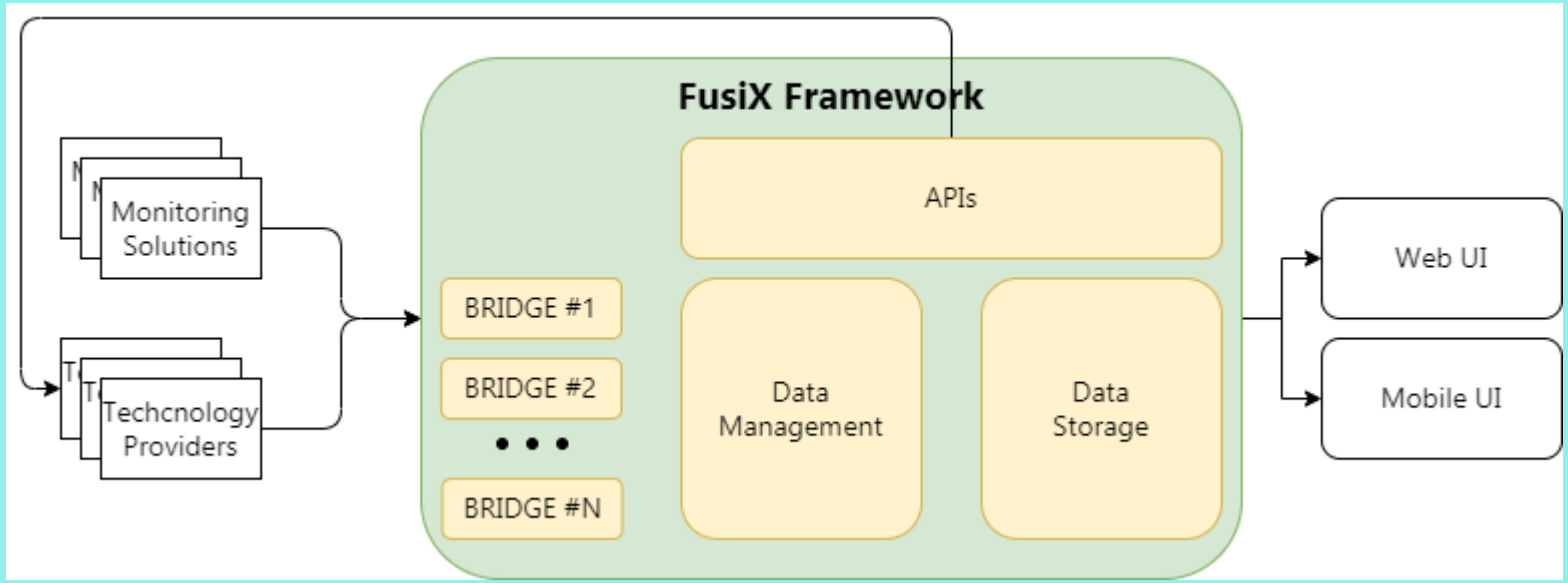


The FusiX Framework

Application Architecture and Deployment

The Application has the following high level blocks:

- **Bridges: to interact with external elements**
- **Data Management: to perform filtering, aggregation and other operations on raw data**
- **Data storage: to handle database access**
- **APIs: To allow external elements to interact with FusiX**



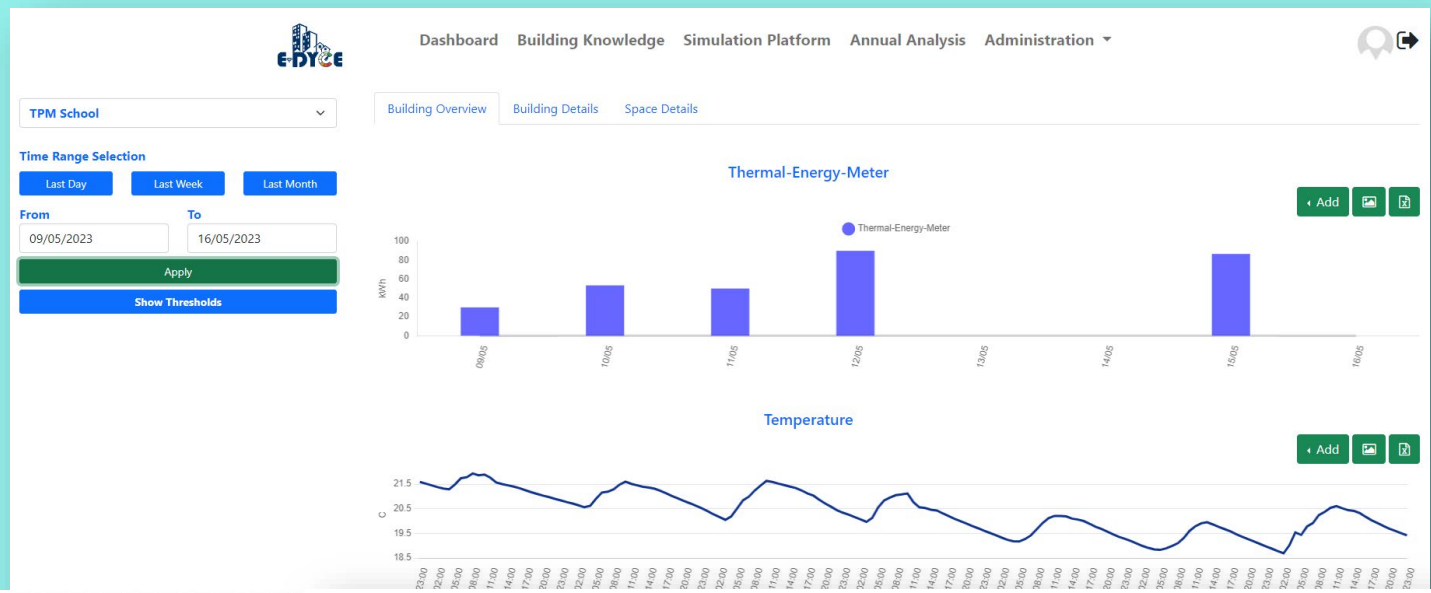
Two user interfaces are also provided but are considered external to FusiX / Simple Data Consumers

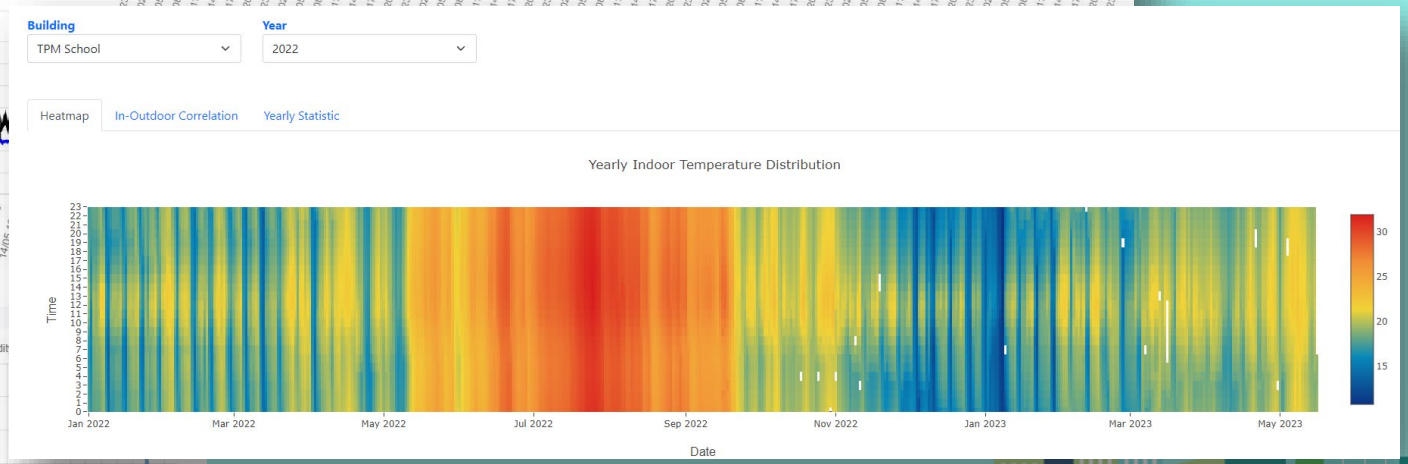
- **Web User Interface: Analytical / User Groups / Fully featured**
- **Mobile User Interface: Simple / Intuitive / Quick Information**

The FusiX Framework

Web User Interface

- Page Structure per user group
- Real Time Monitoring
- Simulation / Modelling Results
- Detailed Graphs and Plots
- Exportable data and images for further analysis

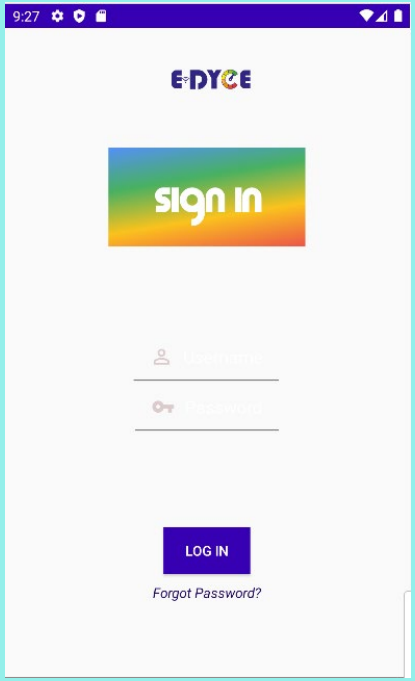


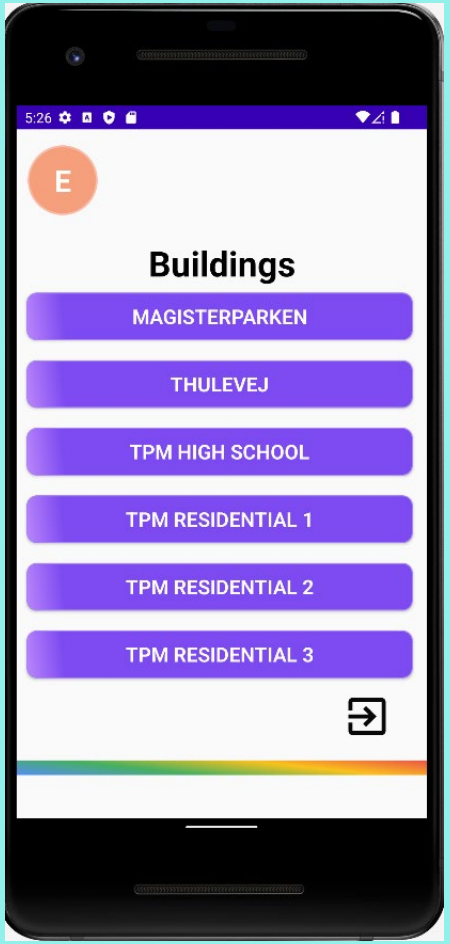


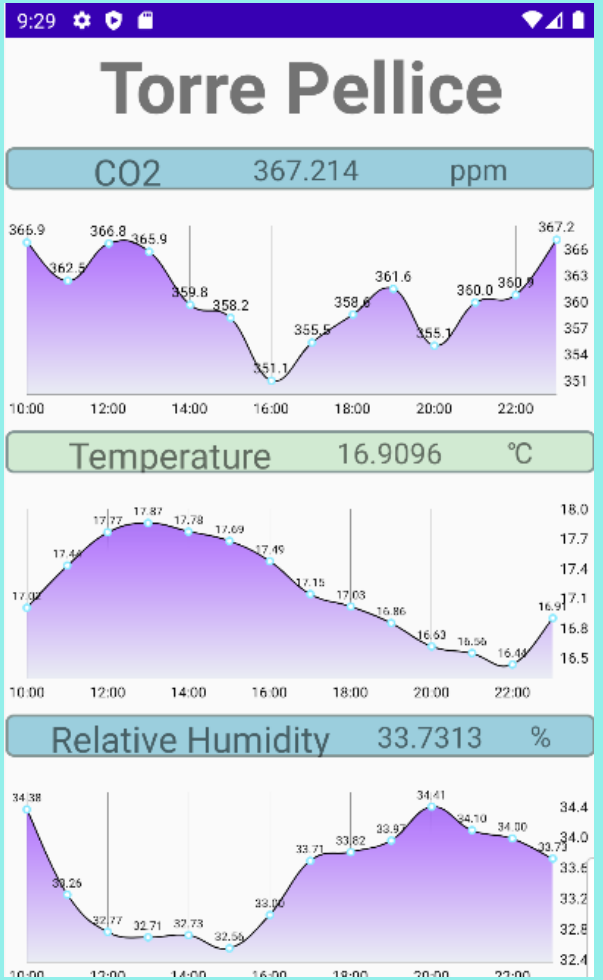
The FusiX Framework

Mobile User Interface

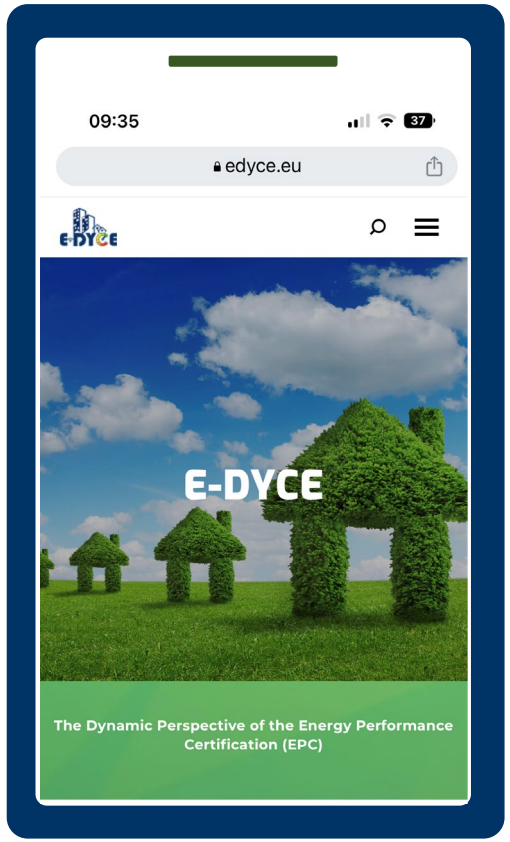
- Simple Monitoring for buildings
- Color coding based on thresholds
- Multiple buildings per user (if permitted)







Energy flexible DYnamic building CErtification



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Thank you

for your attention

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