Smart Building Control

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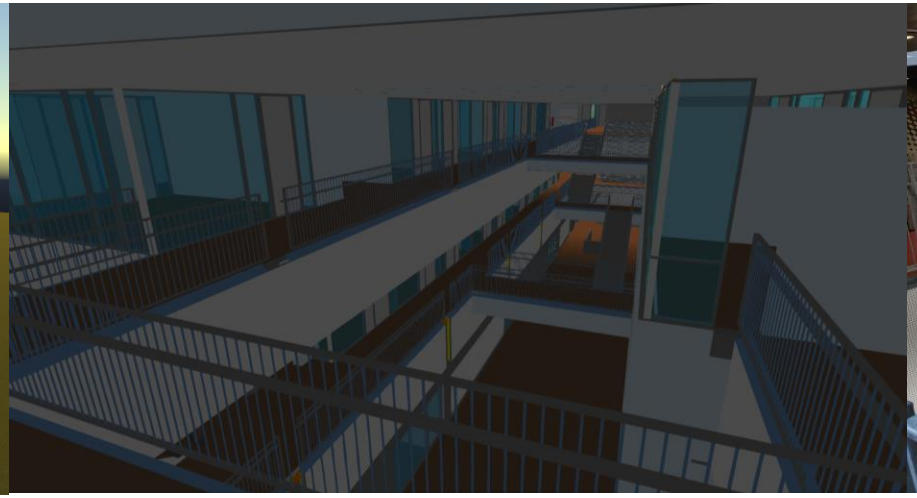
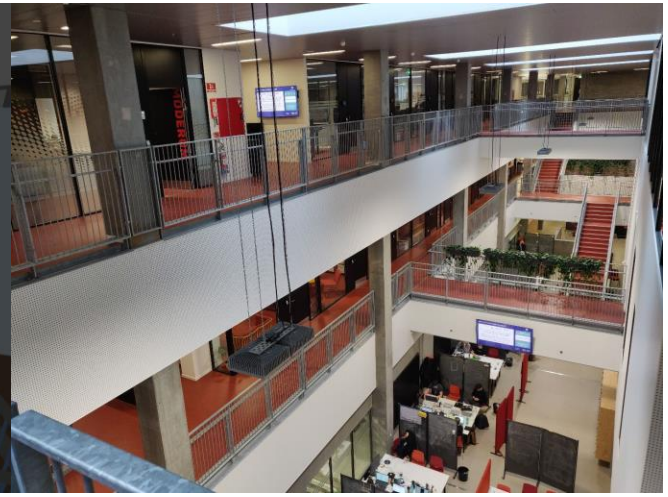




The building

Is one of the most controlled buildings.

Current situation

- The building is equipped with a large number of sensors for light, temperature, CO2 levels, etc.
- Highly automated, providing interfaces for automated control.
- Every room has around 25 sensors and controllers.
- In general, controllers from each room do not communicate with other room's controllers.

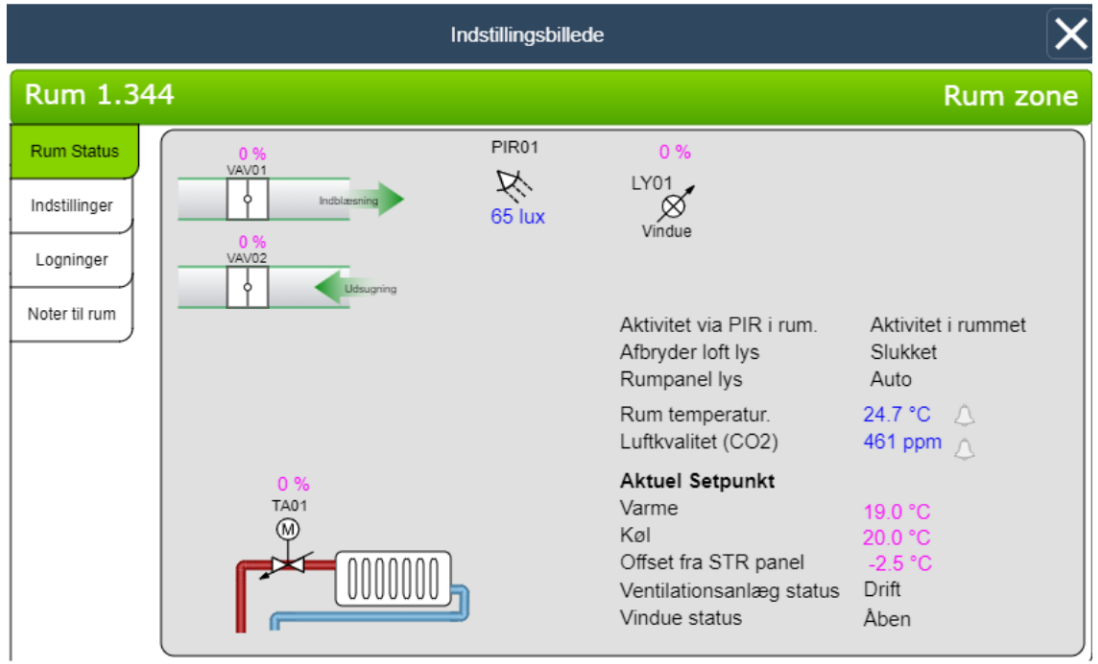
But..

- High energy consumption.
- The automation controllers are challenged by many conditions, such as weather or unexpected heat sources.
- The controllers don't react based on the other ones.

Building Energy Management System

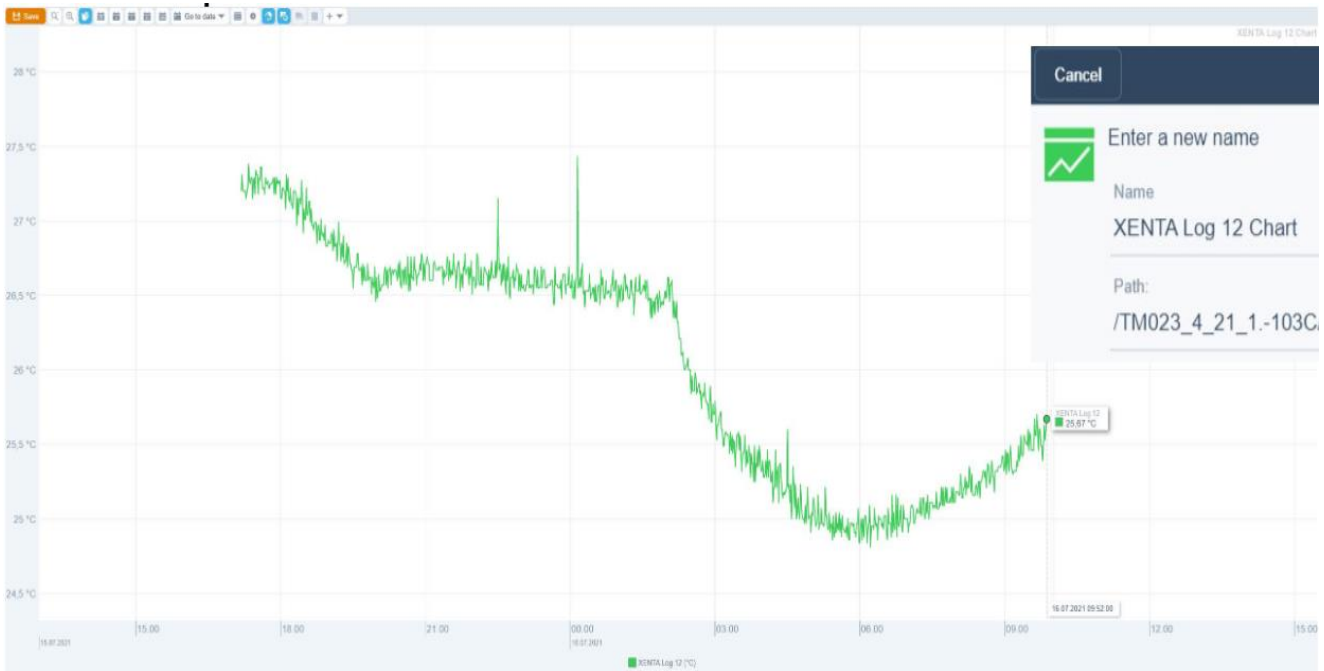
Schneider Electric EcoStruxure

Web-based control panel owned by Campus Service, used to monitor and configure the current control system

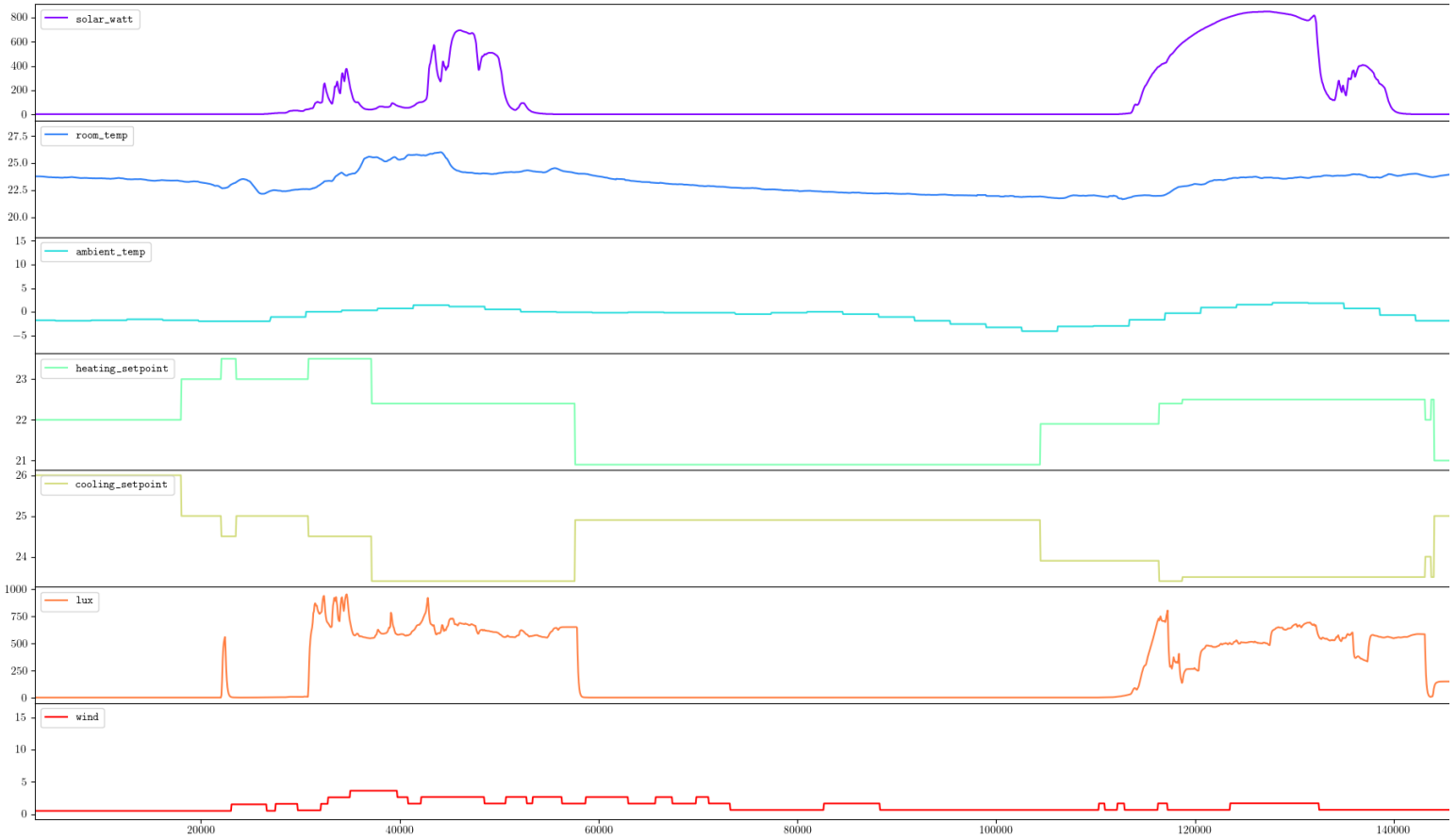


Ground truth source

Can be used to collect time series data for any sensor, actuator and configuration element, and serves as an audit trail for administrators



The Data



Relational database

The data is stored in a SQL database with accurate historical data going back as far as 2022.

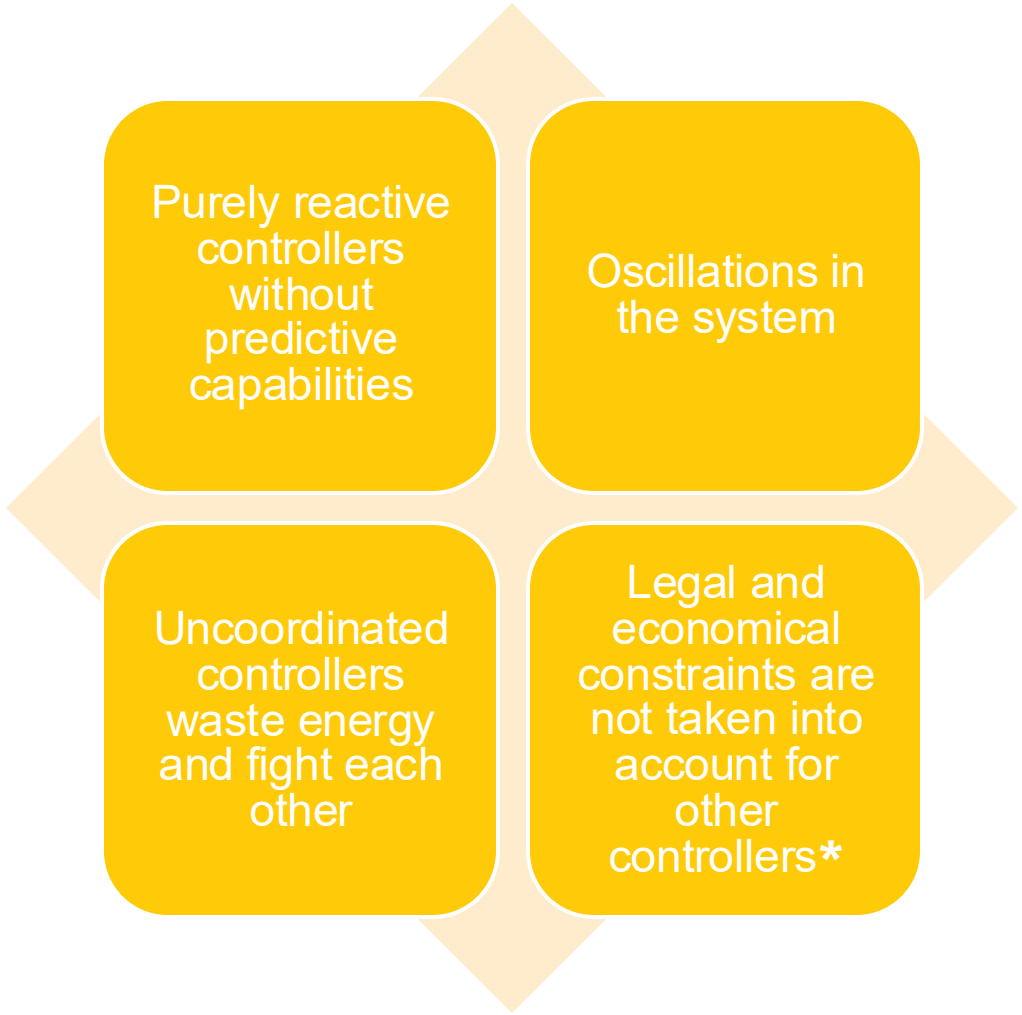
Log points

All the data is collected by log points that allow the collection in time intervals to the DB.

Data volume

The amount of available data is considerable and opens up possibilities regarding analysis methods.

The Problems



*Outgoing water must be cooled down a set amount before going back into the municipal water system. Recirculated water must be kept above a safe temperature at all times.

Possible approaches

Use industry tools to model whole-building thermodynamics

Combine the current datapoints from blueprints, sensor/actuator specifications and 3D models to rebuild a whole-building thermodynamics simulations using off-the-shelf tools like

EnergyPlus, OpenStudio, Modelica.

Black box multi-room thermodynamics modelling

Using the huge amount of sensor/actuator data collected from the system to train Machine Learning models as means of modelling the thermodynamics of a small subset of rooms.
This approach would enable predictions and simulations of the system.

Pytorch, TensorFlow

Alarm system for anomaly detection

Compliment the current user-submitted report system with an automated anomaly monitor. (system oscillations, misconfigured controllers, broken equipment)

Python, Scikit-learn, Grafana/Prometheus.

Predictive control and globally coordinated controllers

Implement new smart controllers with predictive and collaborative capabilities, jointly controlling heating supply, ventilation rates, window blinds, etc. to minimize cost (energy + comfort + actuator wear).

Model Predictive Control and SINDy-PI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Thank you