PATHFNDR project
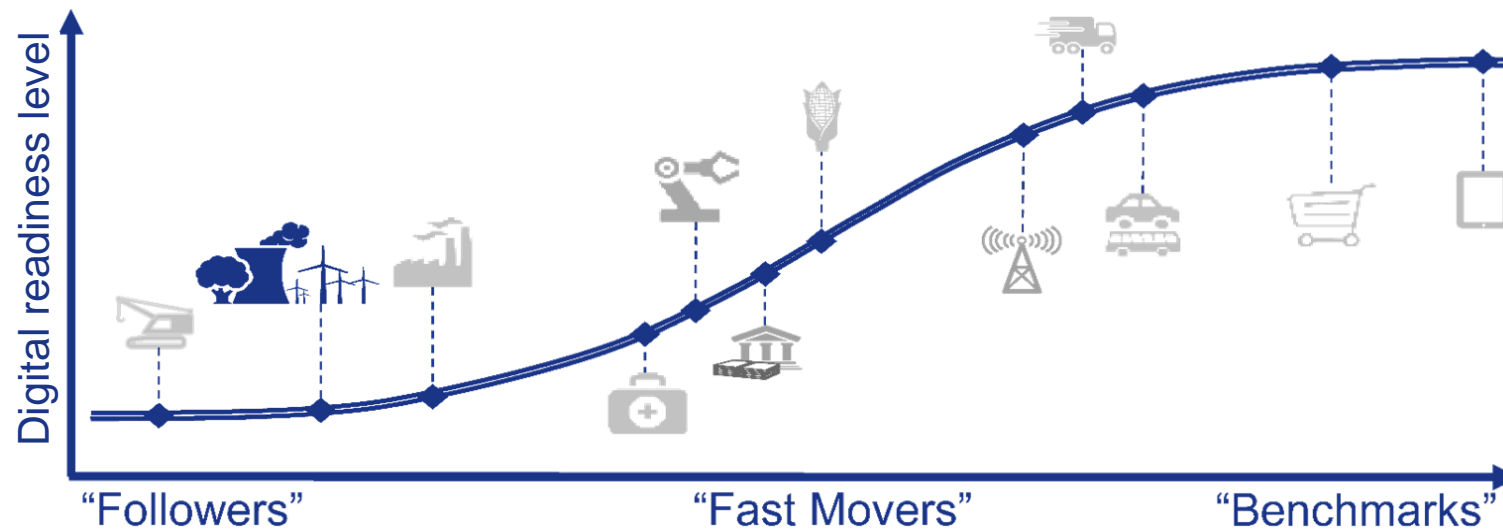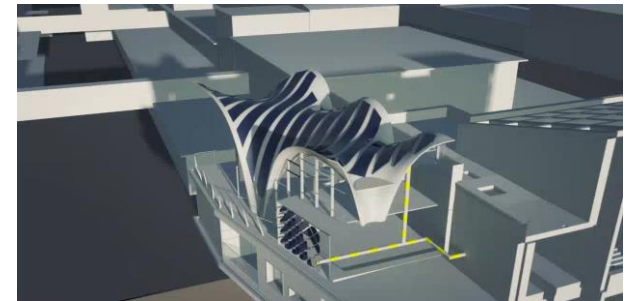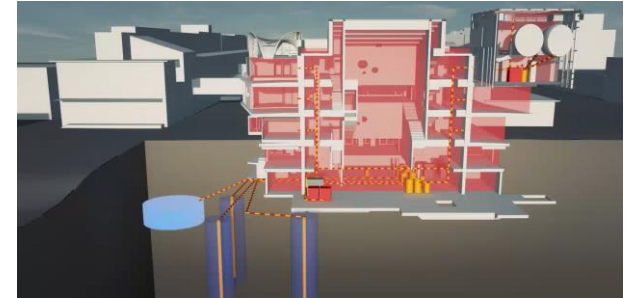
Motivation

- The energy system is in need of change
- Technological developments indicate shift to bottom up technologies
- These technologies are digitalized and have a large potential for energy flexibility.

Source: Digital Maturity Assessment; TM Forum 2018

Purpose

- Providing an open research & development platform in the area of building technology, energy and mobility.

- Show practicability of new solutions on technology, building and district scale.

- E.g. in the are of learning based control methods to foster a collaborative, resilient and sustainable use of energy.

Features of ehub

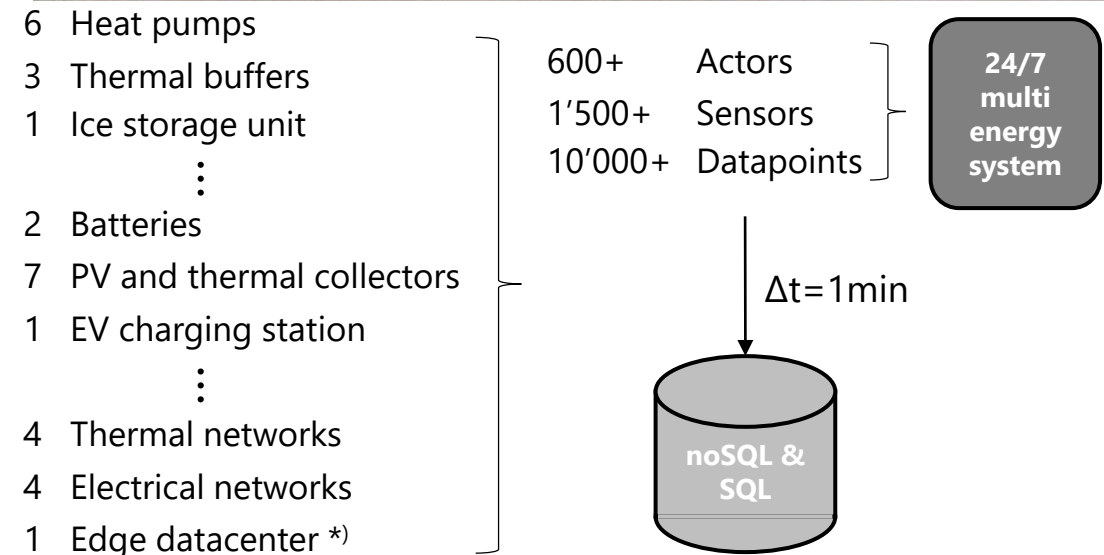Thermal measurement interval: ~20sec

Electrical measurement interval: ~10ms

Temporal resolution in the Database: 1min

Start of recording: Jan 2017

State of industry type building control outside of

      research projects

During research projects: subset controlled

      by researchers

6	Heat pumps
3	Thermal buffers
1	Ice storage unit
⋮	
2	Batteries
7	PV and thermal collectors
1	EV charging station
⋮	
4	Thermal networks
4	Electrical networks
1	Edge datacenter *)

600+	Actors
1'500+	Sensors
10'000+	Datapoints

24/7 multi energy system

$\Delta t = 1min$

noSQL & SQL

*) https://www.empa.ch/web/s604/ecoqube

PATHFNDR

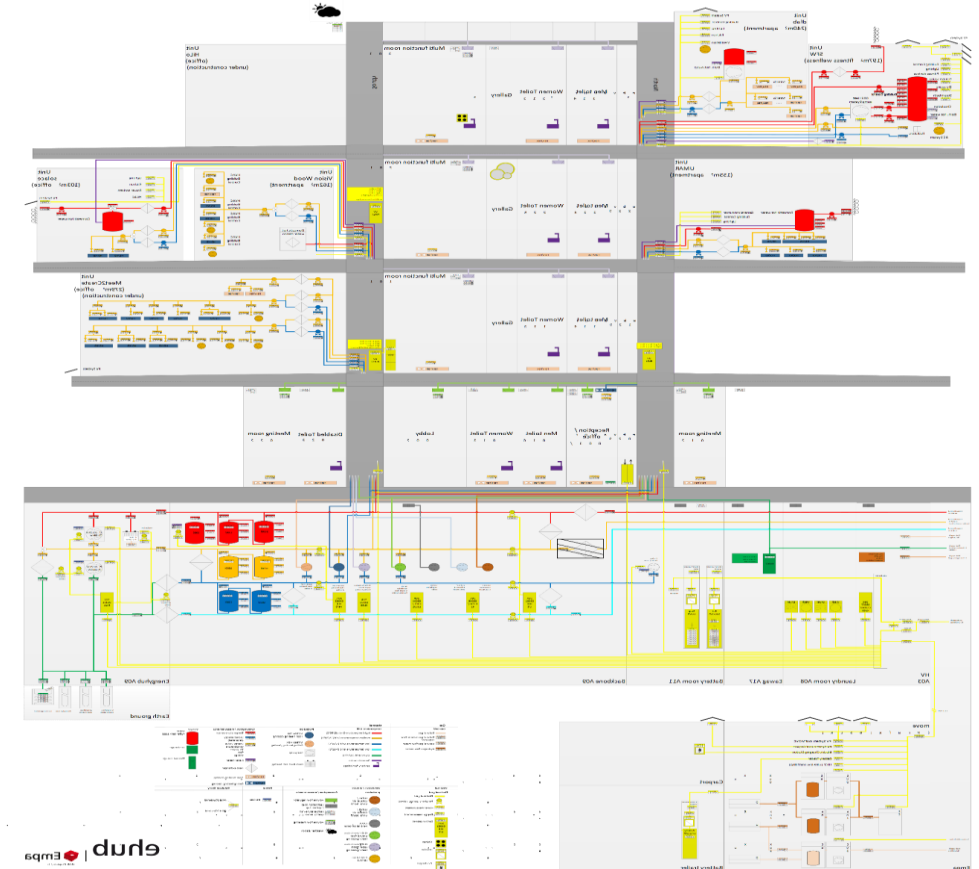# Features of ehub

Thermal measurement interval: ~20sec

Electrical measurement interval: ~10ms

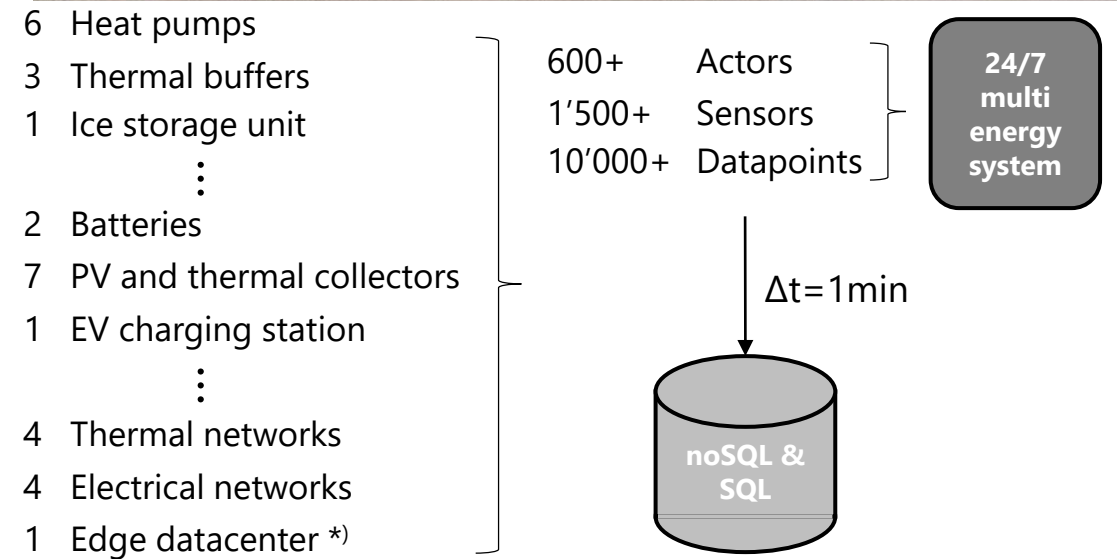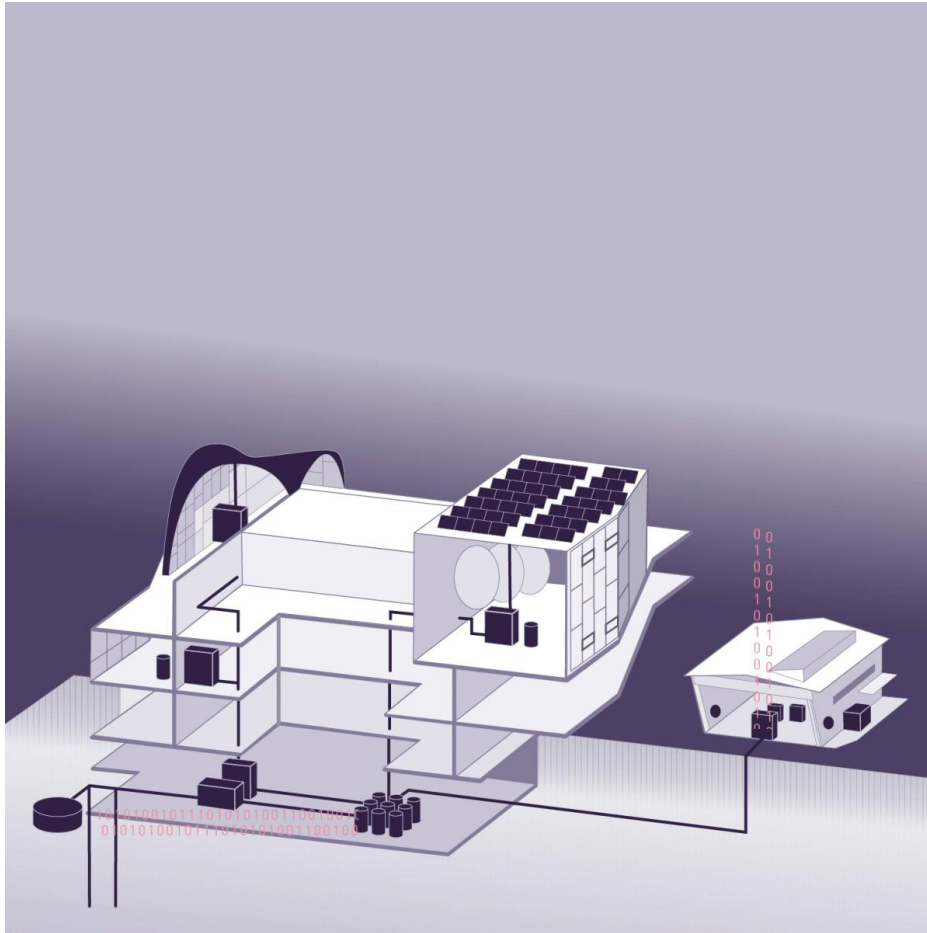Temporal resolution in the Database: 1min

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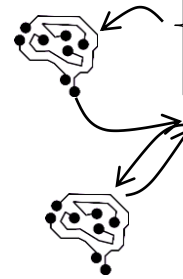noSQL & SQL

PATHFNDR

*) https://www.empa.ch/web/s604/ecoqube

Case study:
Occupancy detection

©Ingo Höhn

Sensorbeschreibung in der Datenbank	NumericId
65NT_KLI01_Y722_M01 Volumenstrom Zuluft (m^3/h)	40210002
65NT_KLI01_Y733_M01 Volumenstrom Abluft (m^3/h)	40210005
65NT_ERZ11_B872_M00 Innentemperatur (°C)	40210012
65NT_ERZ11_B872_M01 Konzentration (ppm)	40210013
65NT_ERZ11_B871_M00 Präsenz aktiv (1/0)	40210148

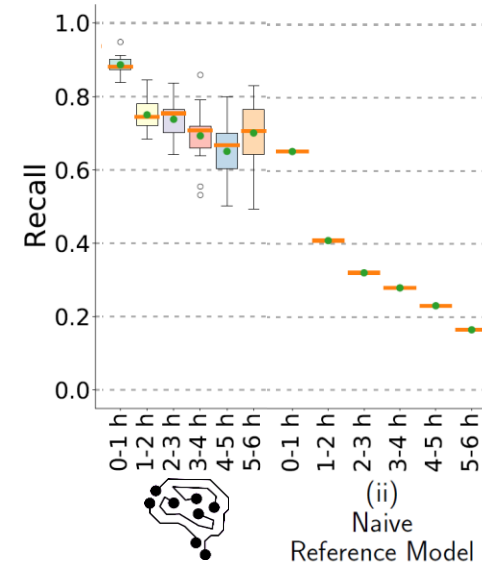49 use cases in the
«Navigating_SmartBuildings_Whitepaper»
https://crem.locatee.com/use-case-navigator

PATHFNDR

Case study:
Occupancy detection

Feasibility and comparability study

ANN configurations

RNN configurations (LSTMs)

PATHFNDR
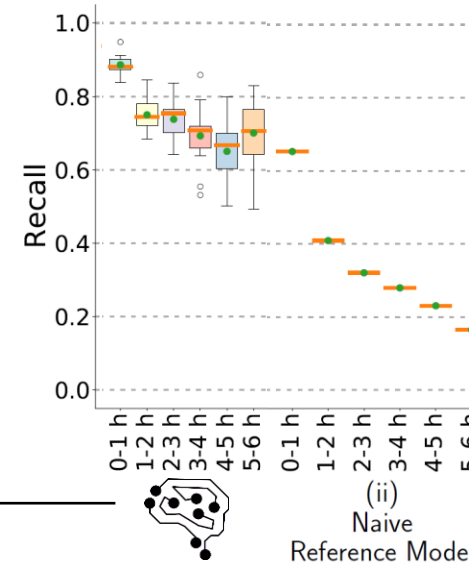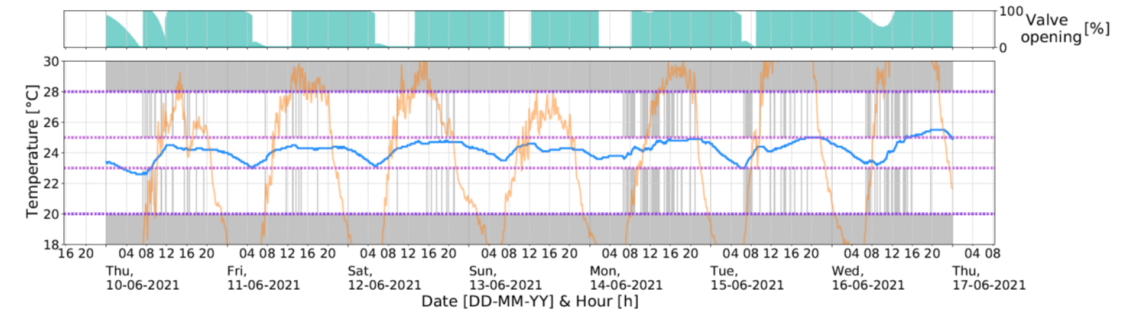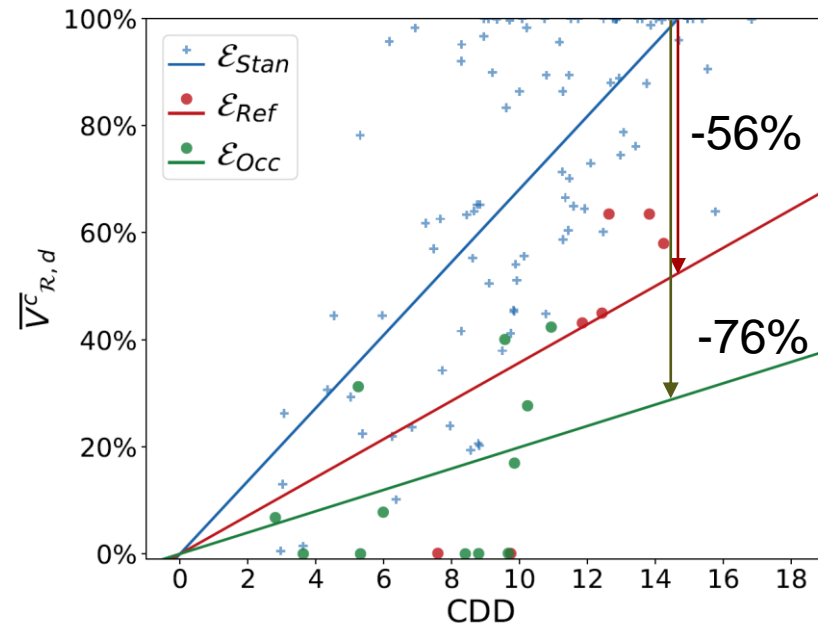
Case study:
Occupancy detection

©Ingo Höhn

Predictive room temp. control

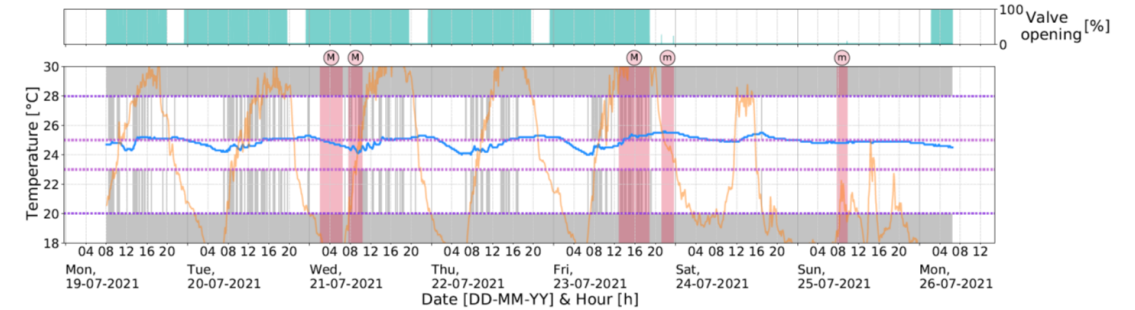(ii) Naive Reference Model

MSc Thesis Erne S. Occupancy Forecasting for Building Energy MPC. 2021

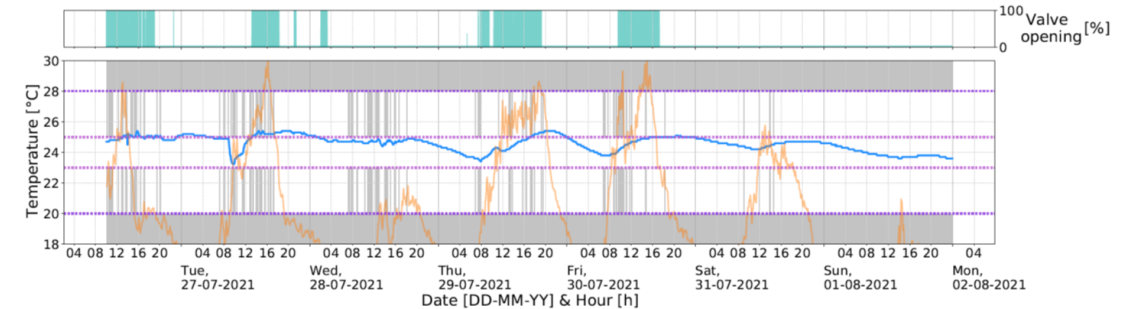PATHFNDR

Case study:
Occupancy detection

-56%

-76%

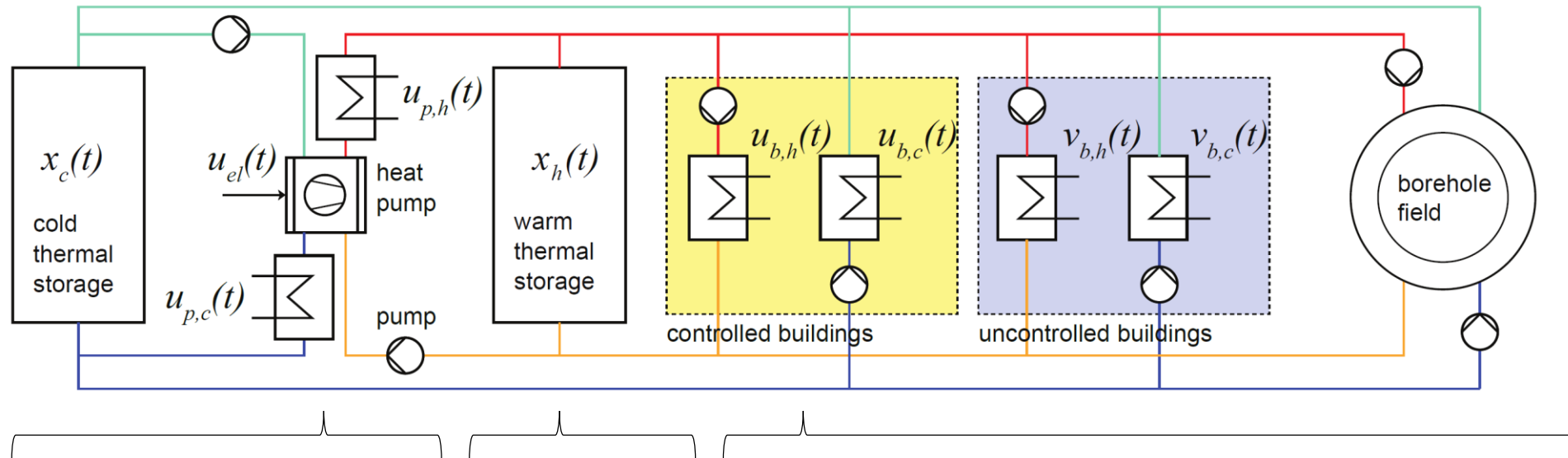(a) $\mathcal{E}_{Stan}$ for the duration of 10. June 2021 to 17. June 2021.

(b) $\mathcal{E}_{Ref}$ for the duration of 19. July 2021 to 26. July 2021

(c) $\mathcal{E}_{Occ}$ for the duration of 27. July 2021 to 2. August 2021

MSc Thesis Erne S. Occupancy Forecasting for Building Energy MPC. 2021

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Case study: Coupling district procuction and demeand consumption

Aim: Provide secondary frequency reserves utilizing thermal storages and thermal intertia of buildings

PhD Thesis Bünning F. Marrying Machine Learning and Model Predictive Control for efficient Building Energy Management. 2021

Case study: Coupling district procuction and demeand consumption

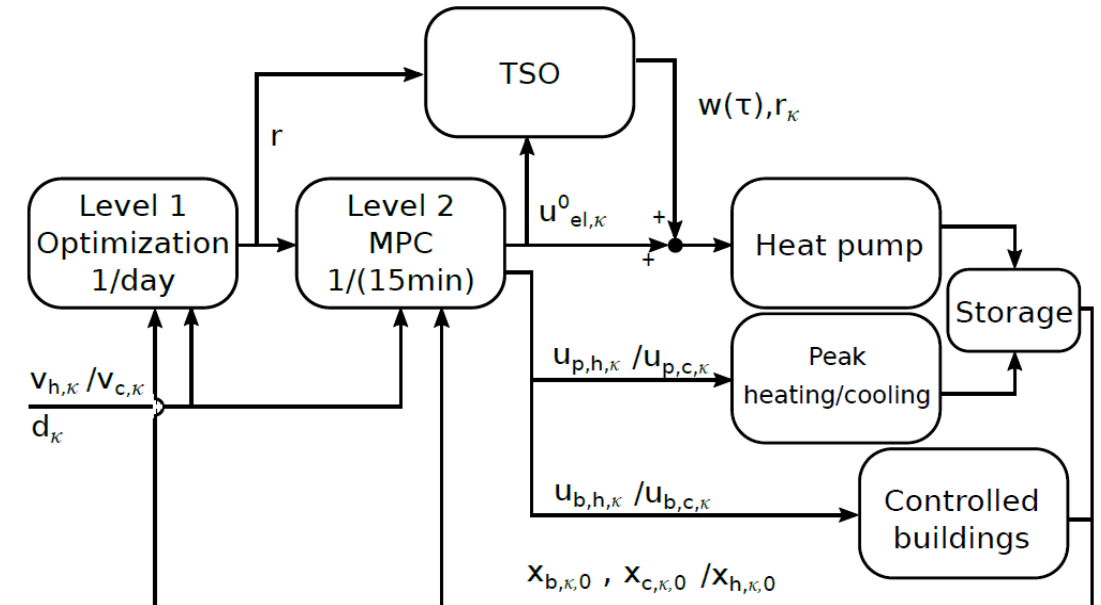Announced electrical consumption and flexibility windows

TSO signal to follow within flexibility windows
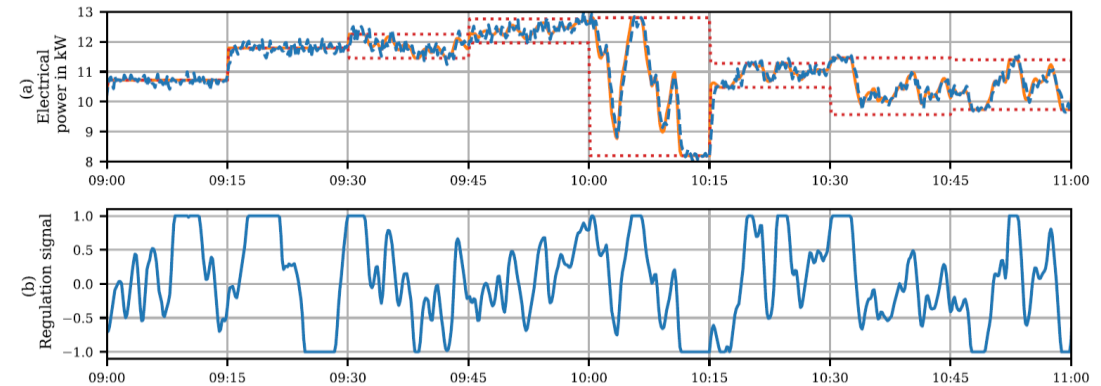
Aim: Provide secondary frequency reserves utilizing thermal storages and thermal intertia of buildings

PhD Thesis Bünning F. Marrying Machine Learning and Model Predictive Control for efficient Building Energy Management. 2021

PATHFNDR

Case study: Coupling district procuction and demeand consumption

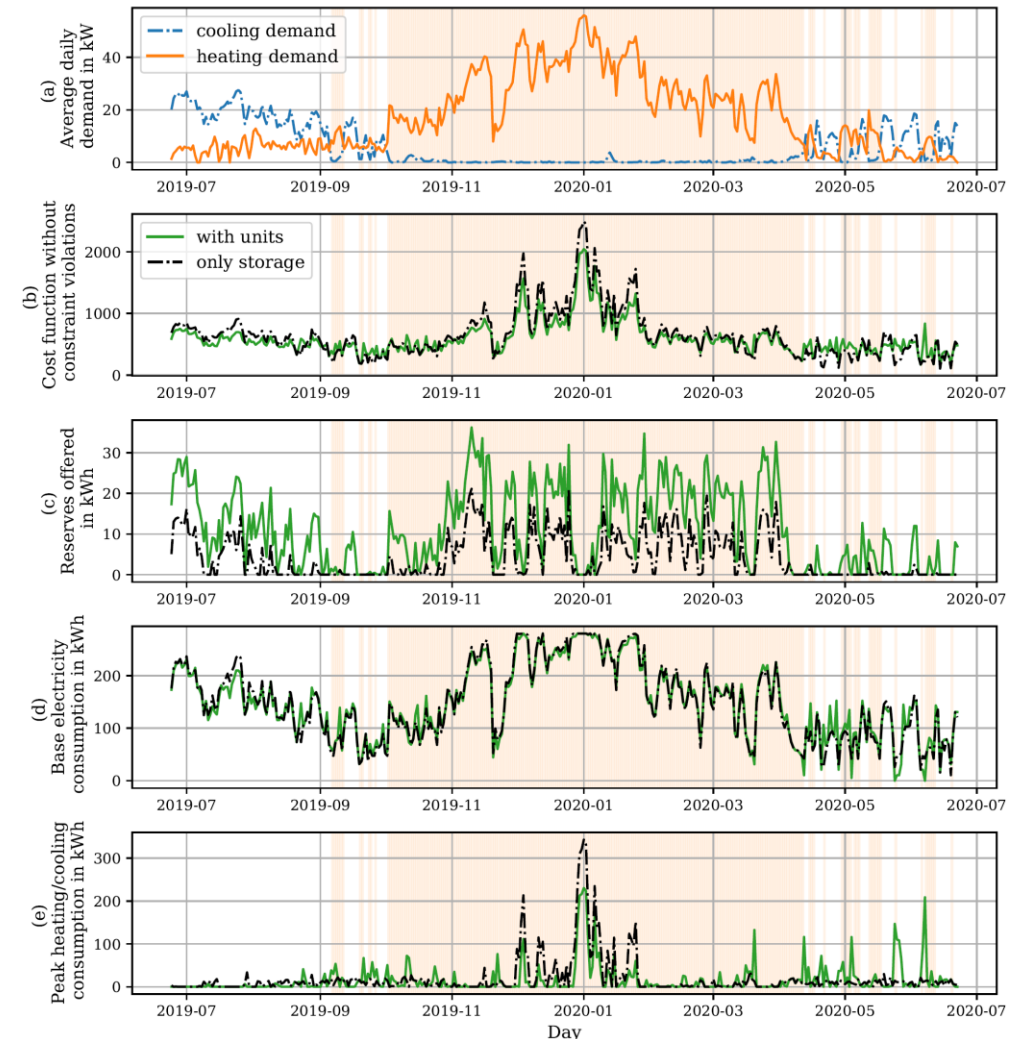FU heat pumps can track the regulation signal adequatly

Only with storage over one year: 3% of the consumed energy is flexible

Offered reserves 2.7 higher

> if 7% of the heating demand (& 12% of cooling demand) is integrated in the reserve provision

The increase in reserve provision is highest at peak demand times

Overall energy consumption increase 0.3%

PhD Thesis Bünning F. Marrying Machine Learning and Model Predictive Control for efficient Building Energy Management. 2021

User interface

How to get access:

- https://info.nestcollaboration.ch/wikipediapublic/data/process/access/

How to read/write data via clients/interfaces:

- https://info.nestcollaboration.ch/wikipediapublic/data/historicaldata/clients/

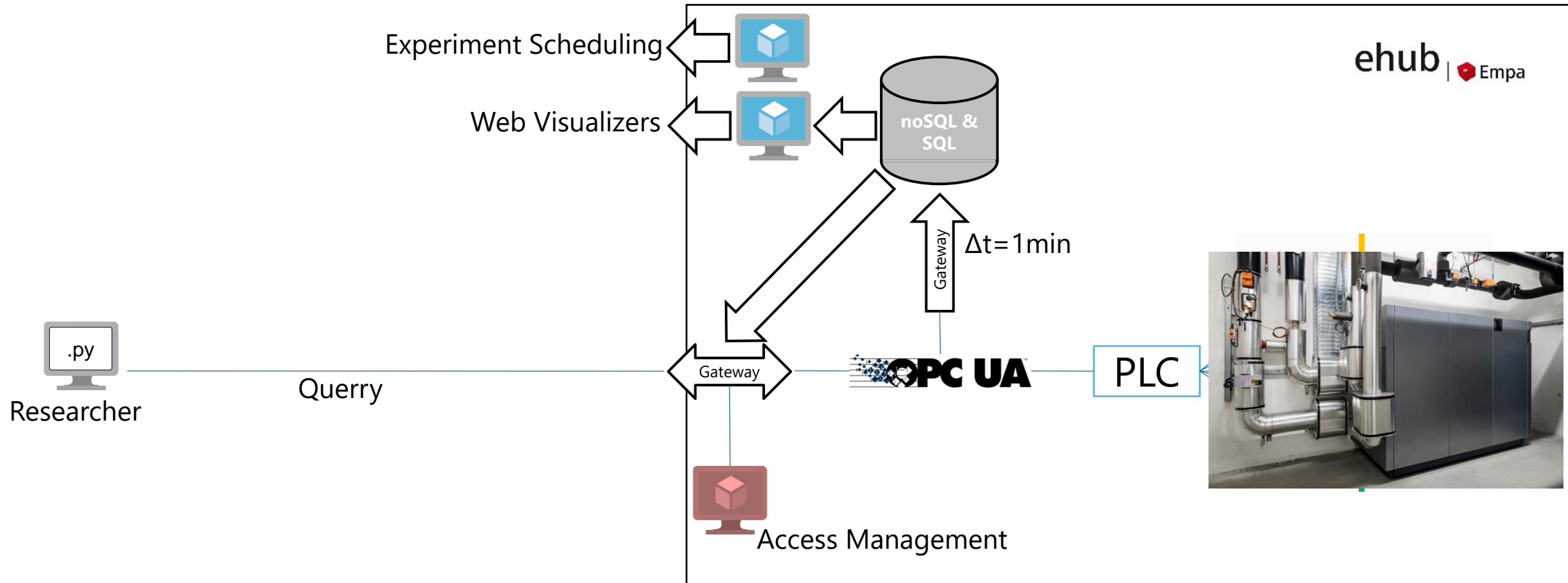- https://info.nestcollaboration.ch/wikipediapublic/data/livedata/clients/
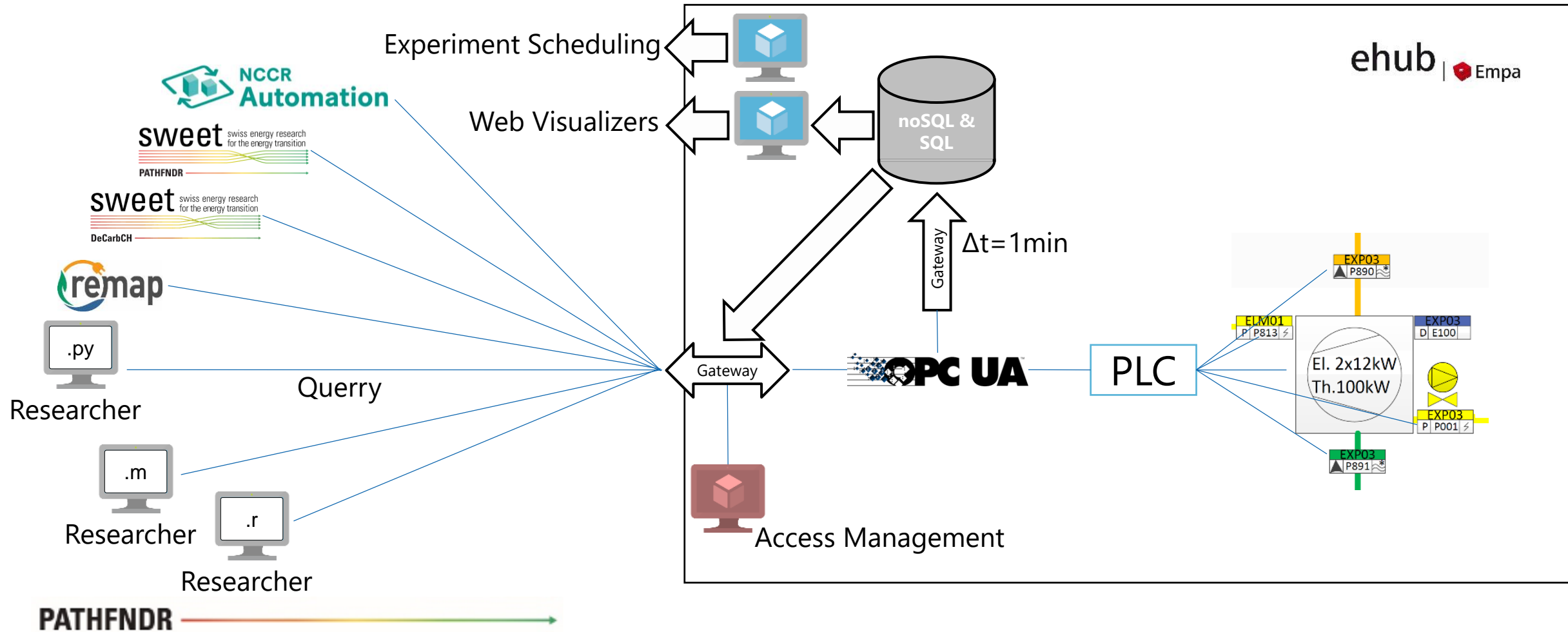

«How to» tutorial videos

e.g. https://info.nestcollaboration.ch/wikipediapublic/data/historicaldata/clients/visualizer/
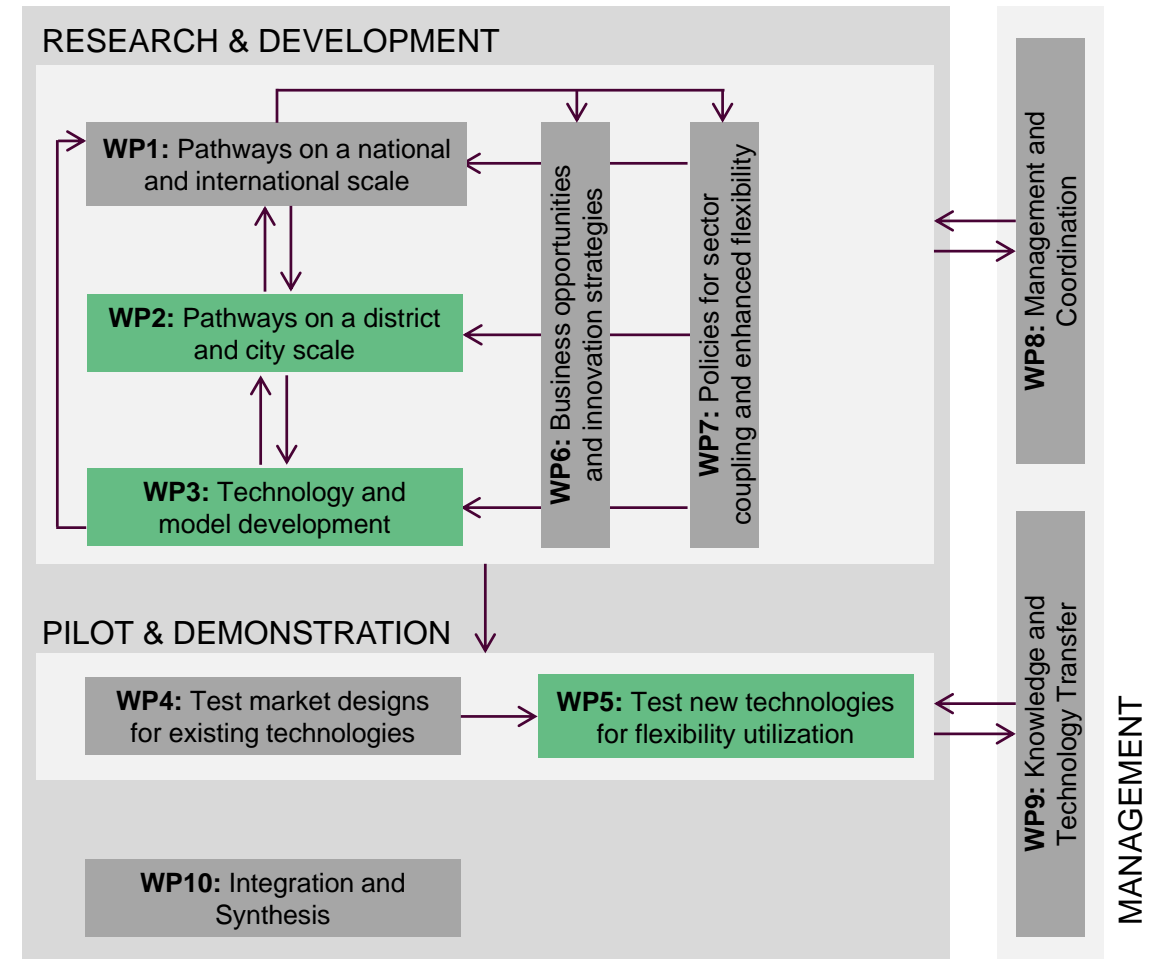
User interface

User interface

Application under the PATHFNDR project

- Data source for model generation and flexibility quantification

- District energy system management

- Location for vehicle-to-grid case studies in WP2

- Location of decentral flexibility pool for WP3 case study

- Potential sandbox location for WP5 P&D project

Limitations

- No simulation environment

- Limited / specific energy profiles   Link to ReMaP Simulation environment

- Not a lab scale playground

Users

Typical users:

- Building technology companies and IoT device and service providers
  - Device/service updates test-runs
  - Usability study
- Research Institutes (Scientists / PostDocs / Thesis students) in the area of:
  - Control,
  - Energy Management,
  - Data Science,
  - Information Technologies,
  - Sociology, Design & Arts

Typical partners:

- Building technology companies
- DSOs
- EVUs

- Digital eco system players
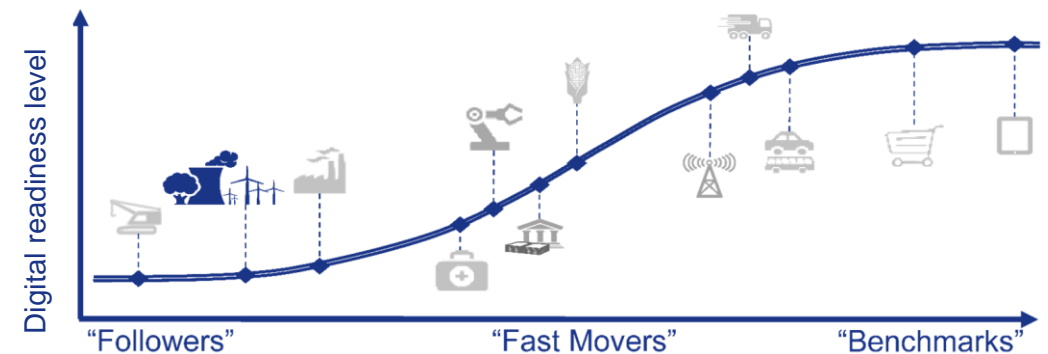
Source: Digital Maturity Assessment; TM Forum 2018

Contributors

Industry Partners

Academic Partners

Funding Bodies

Useful links

Video on NEST and ehub:

- https://www.youtube.com/watch?v=pjNdj49vmwc

Booklet on ehub:

- https://www.empa.ch/web/energy-hub/about

ehub webpage:

- https://www.empa.ch/web/energy-hub/

ehub wiki:

- https://info.nestcollaboration.ch/wikipediapublic/building/

Documentation and access to systems:

- https://info.nestcollaboration.ch

Publications on ehub

- https://www.empa.ch/web/energy-hub/publications

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ehub: https://www.empa.ch/web/energy-hub/