

# Cenaero



## **Building-to-grid services based on monitoring systems and grey-box models**

**Webinar – Energy Communities 16/03/2021**

**Charlotte Marguerite**  
Senior research engineer

Contact: [charlotte.marguerite@cenaero.be](mailto:charlotte.marguerite@cenaero.be)

- **Introduction of Cenaero**
- **Opportunities in the construction 4.0**
- **Presentation of the Wal-e-cities project**
- **Overview of innovative demonstrators from building to city level**
- **Focus on the development of a building energy management system**

## From plane to buildings...



### ✓ Advanced Products & Processes

Energy (Boiler, Ventilation, Fuel cell, ...)  
Structural/thermal composites & parts



Energy & Buildings team	1 Pilot city (Charleroi)
30+ companies collaboration (75+ % PME)	10+ PPP R&D projects
2 key partnerships (T&P, CSTB)	Construction 4.0 demo building

### ✓ Smart Buildings

Support to Certification  
Control & data analytics  
Software & App



### ✓ Factories 4.0

Precast performance assessment tools  
BIM-to-manufacturing lines (HMI)  
Quantity take-off management (ERP)

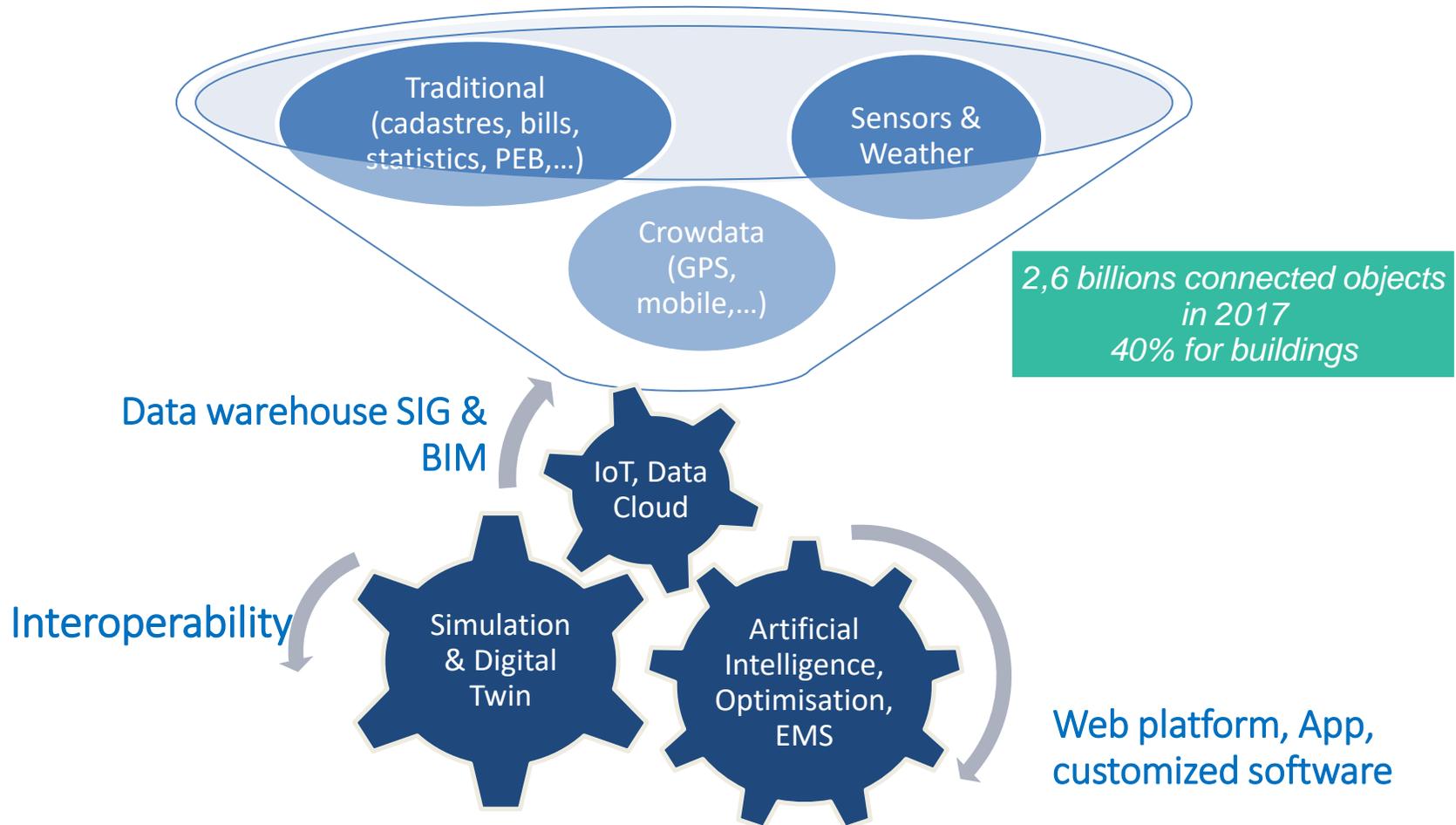


### ✓ New built environments

Microclimate in districts  
Energy in building stock & grid  
Big/geo-data analytics



## Availability of data...



PROD-F-015-02

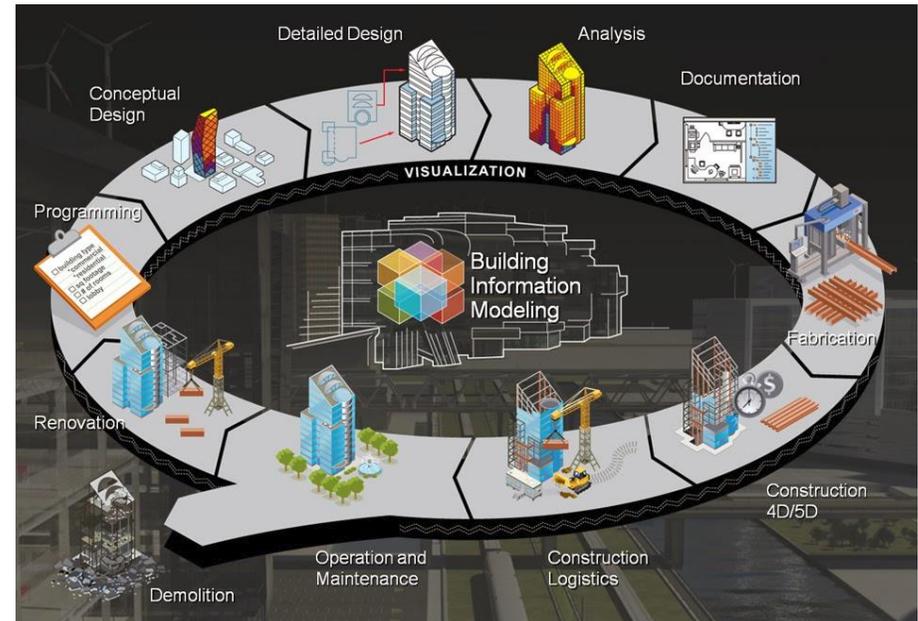
# Construction 4.0 - opportunities

...Combined with :

- Design & operation tools
- AI & optimisation methods
- Smart technologies (IoT, Blockchain, etc.)
- Energy technologies

... opens up possibilities for:

- **Smart buildings:** connected, efficient, etc.
- **Energy communities (EC):** local energy, pollution reduction, interesting energy prices, new business models, etc.



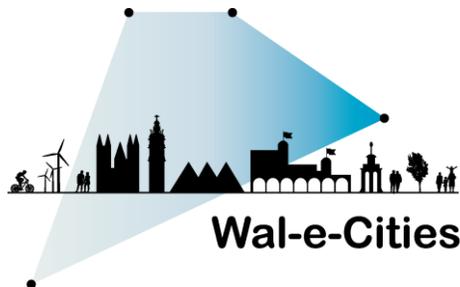
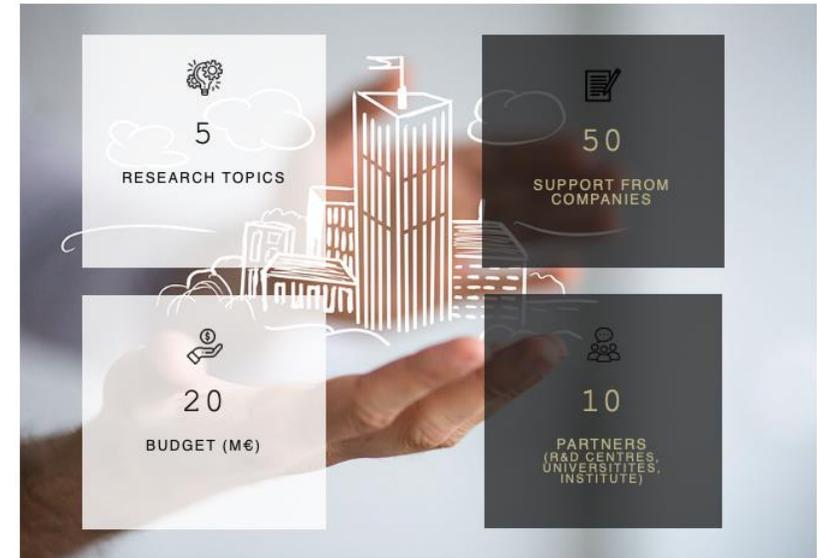
# Wal-e-cities project

Develop innovative citizen oriented solutions in:

- Mobility
- Energy & Environment
- Governance
- Urban environment & social well-being
- Telecommunications Infrastructure

Development of innovative ecosystems:

- driving technological breakthroughs
- addressing societal challenge
- fostering start-ups
- promoting Walloon companies



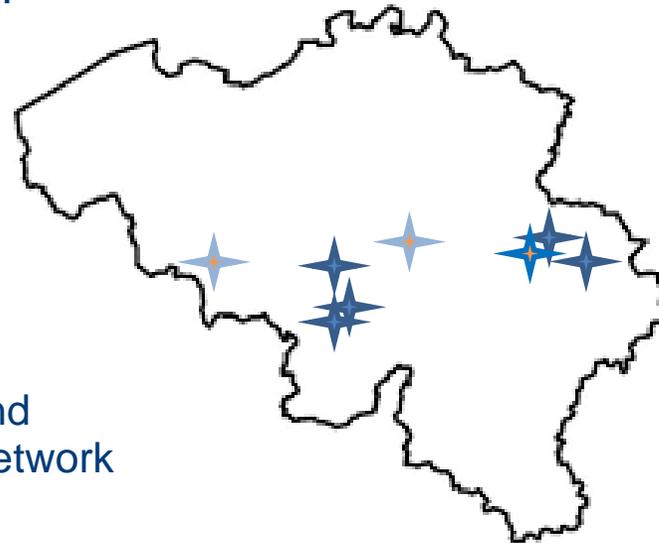
# Our demonstrators

## Nivelles:

Web platform for facility management in multi-storey building: energy billing, dynamic data visualisation and predictive maintenance applications.

## Mortsel:

Tools for design and operation of an multi-energy community with hybrid storage



## Charleroi:

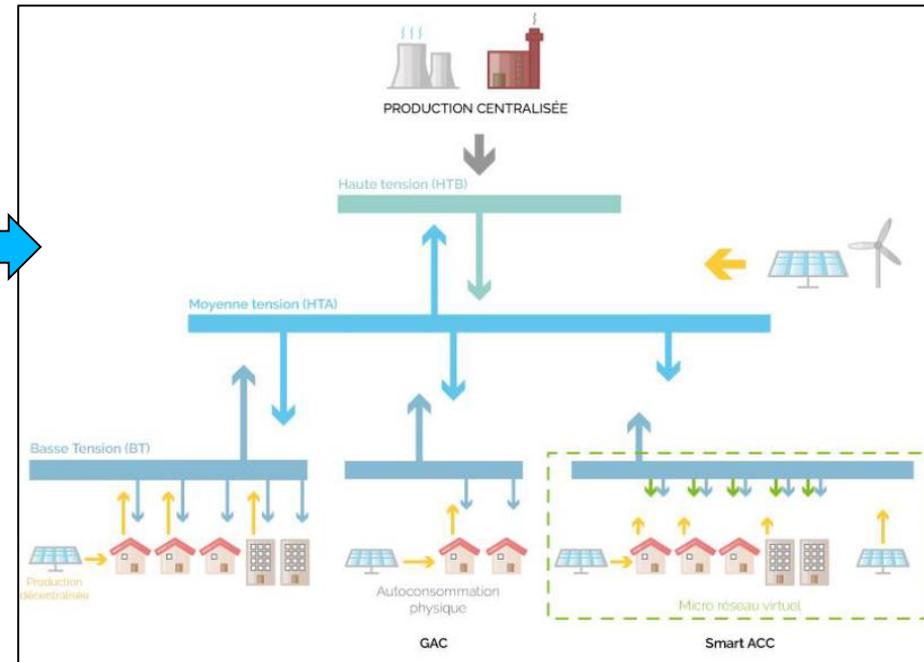
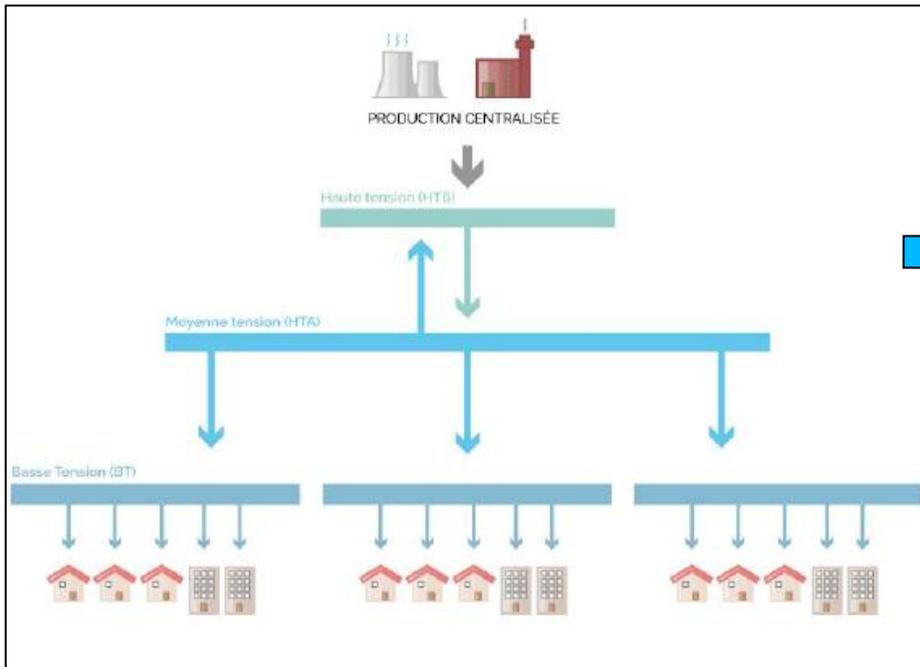
Retrofitting of public buildings and assessment of district heating network extension scenario.

## Wavre:

Energy management platform for an energy community

## Gosselies:

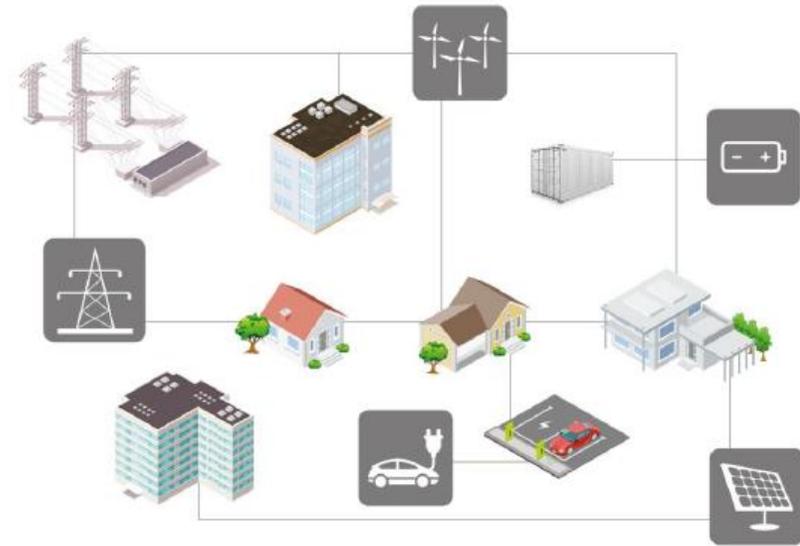
OpenDATA for Smart building for BIM-based innovation, virtual design, and IoT in operation.



- **Centralised energy source**
- **Low flexibility of demand and production**
- **Unidirectional energy flows**

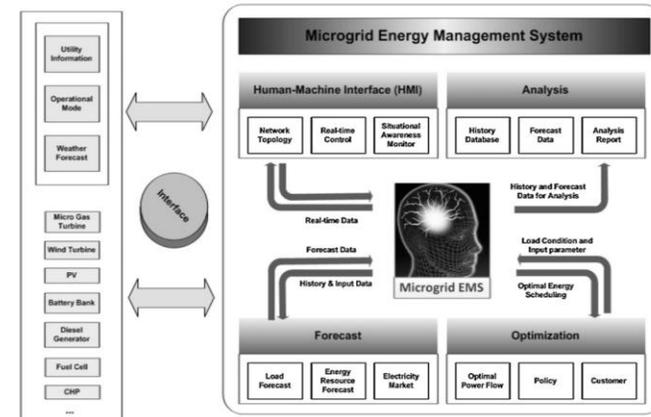
- **Diversity of energy sources and consumers**
- **High flexibility of demand and production**
- **Bidirectional energy flows**
- **IoT**
- **EMS**

- **Optimising self-consumption in a LEC:**
  - **Hardware solutions:** existing IoT electricity data set
  - **Software solutions:** energy models & optimisation algorithms for predictive control
- **Platform for:**
  - **Electricity providers, network operators and consumers**
  - **Planning, active management of consumption and dynamic tariffs within a virtual micro-grid.**



## Design & operation tools for a multi-energy community with hybrid storage:

- **Sizing tool: for local consumption, production & storage of multiple energy sources**  
→ techno-economical optimisation
- **Micro-grid Energy Management System (EMS)**  
→ optimisation of control strategies



W. Su, J. Wang. Energy management systems in microgrid operations. The electricity journal, 2012, 25-8.

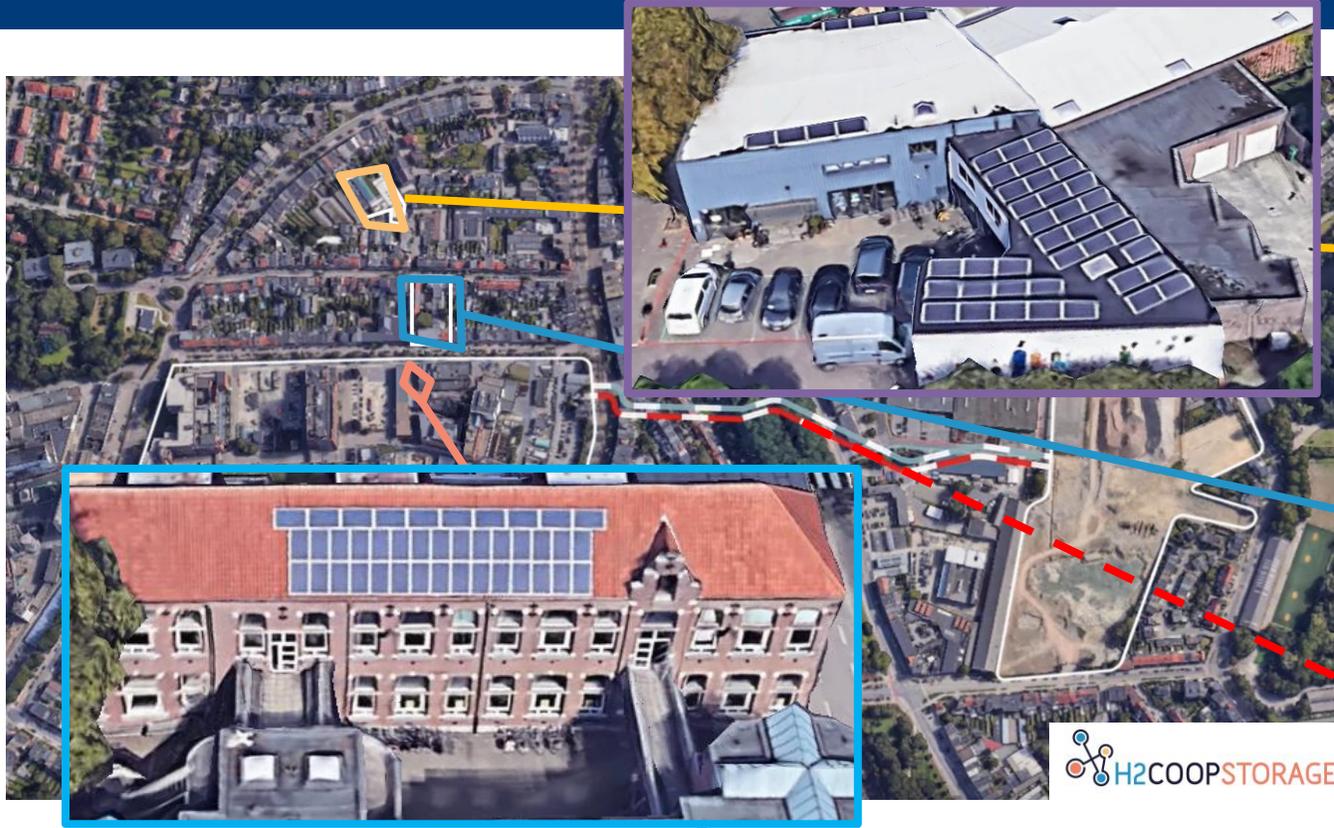


Responding to the challenges posed by the deployment of renewable energy production means

- ✓ By improving local balancing.
- ✓ By reducing renewable intermittences.
- ✓ By intensifying the production of renewable energy.



# H2CoopStorage (Mortsel)



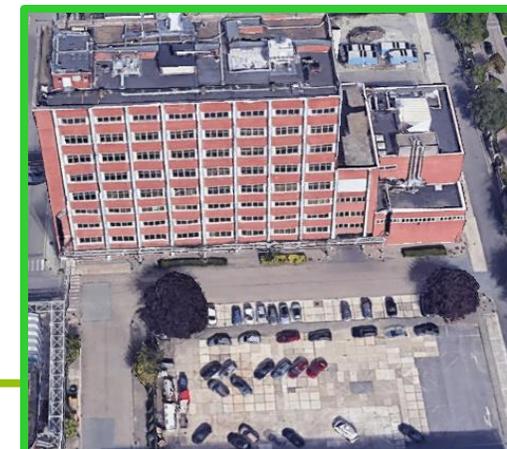
## Projet Deeldezon interreg – Design of an Energy Community

- **Installed equipment:**
  - 13kwp solar PV
  - Electrochemical battery Greenrock
  - Electric charging station (plug and play for shared electrical car)
- **Opportunity:**
  - Install more PV

### School

- **Opportunities:**
  - More solar PV
  - Connection with the fuel cell located on the AGFA site

### District heating network



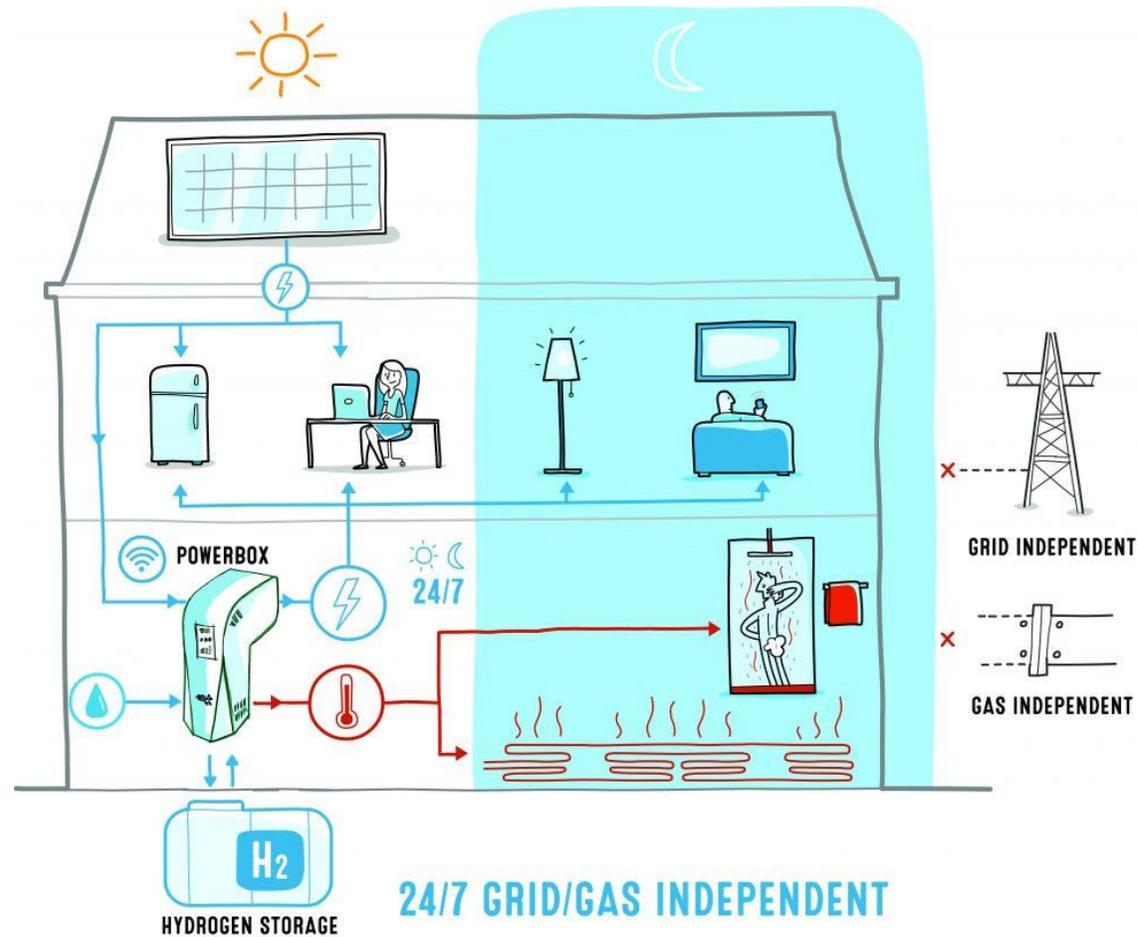
## Container on the industrial site of AGFA

### Opportunity :

- Set up of reversible fuel cell
- Heat production to be supplied to the DHN and balance of the electricity grid

PROD-F-015-02

- Reversible fuel cell

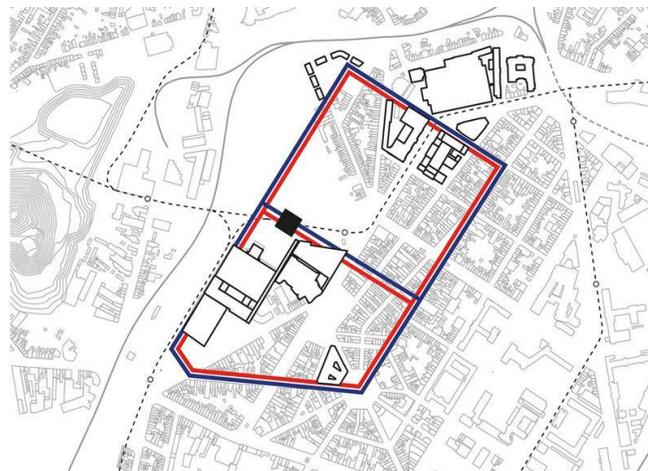


<https://www.solencopower.com/powerbox/>

- A data repository based on simulation, IoT, audit and statistical data
- A GIS based ICT platform for energy awareness: public buildings retrofitting and district heating network extension scenarios

The screenshot displays the ORES SmartAccueil web interface. On the left, a sidebar menu lists various infrastructure categories under 'Smart Electricité', including 'CHARLEROI', 'ACADEMIE DES BEAUX-ARTS', 'CASERNE TRESIGNIES', 'CECS LA GARENNE + COMPLEXE SPORTIF...', 'CIMETIERE DU NORD', 'COMPLEXE HELIOS', 'COMPLEXE SPORTIF DES OLYMPIADES + S...', 'ECOLE DE LA DIGUE', 'HOTEL DE VILLE + FONTAINE', 'MANSION DU TORREME', 'NOUVEL HOTEL DE POLICE', 'STADE DU PAYS DE CHARLEROI', and 'STADI JONET'. The main content area shows a table titled 'Smart Accueil' with columns for 'Votre contrat', 'Depuis', 'Au', 'Type', 'Energie', and 'Nombre d'EAN'. Below the table is a map of the district with numerous red location pins indicating smart meter locations.

Votre contrat	Depuis	Au	Type	Energie	Nombre d'EAN
201500003000-ProjetSmart	01/01/2015	01/09/2021	SMR	Eau	331
201500003000-ProjetSmart	01/01/2015	01/09/2021	AMR	Electricité	25
201500003000-ProjetSmart	01/01/2015	01/09/2021	SMR	Electricité	189
201500003000-ProjetSmart	01/01/2015	01/09/2021	SMR	Gaz Naturel	228



PROD-F-015-02



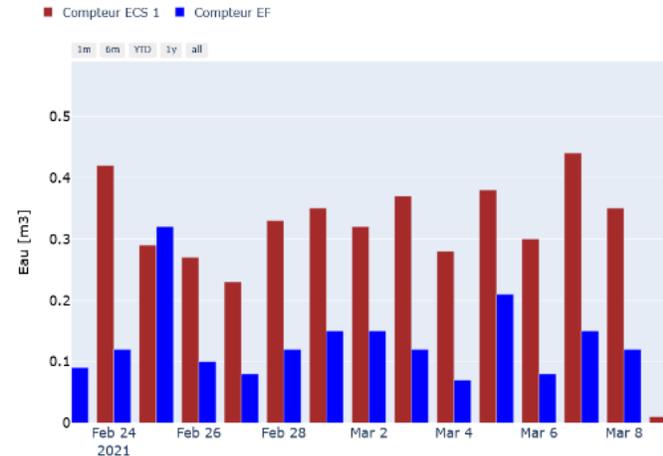
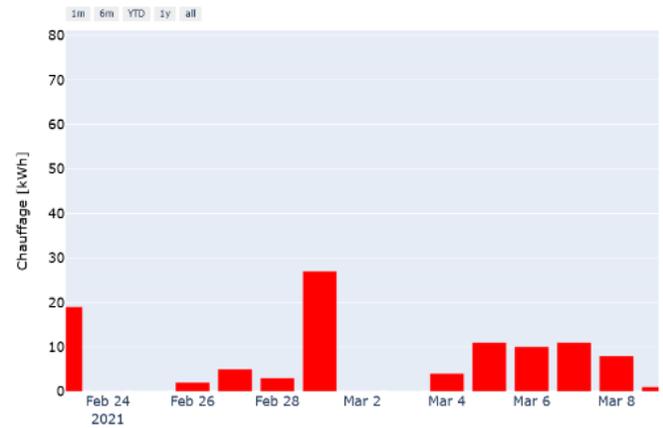
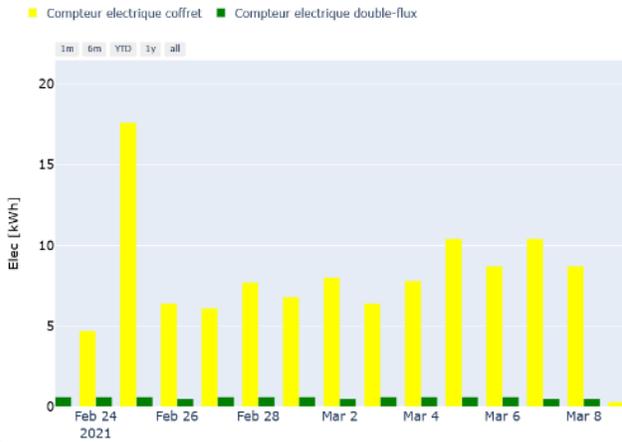
- **Use building data for:**
  - Improvement of new projects in terms of “energy, health and comfort”
  - Data visualisation and energy billing
  - Predictive maintenance

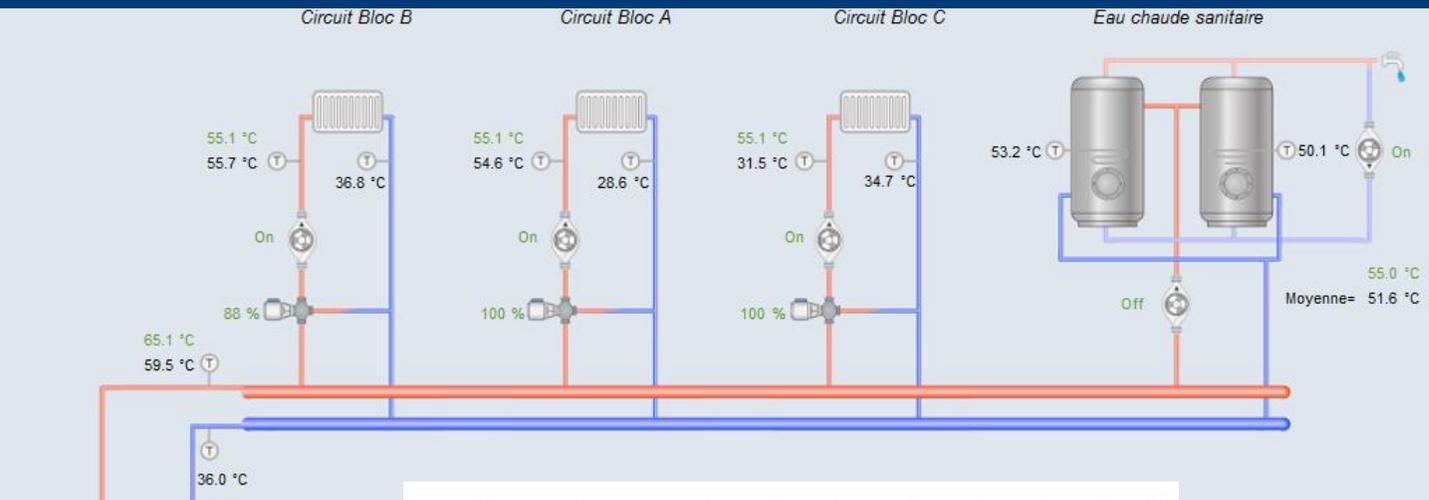
→ **Development of an EMS for facility management in multi-storey building equipped with common energy systems.**



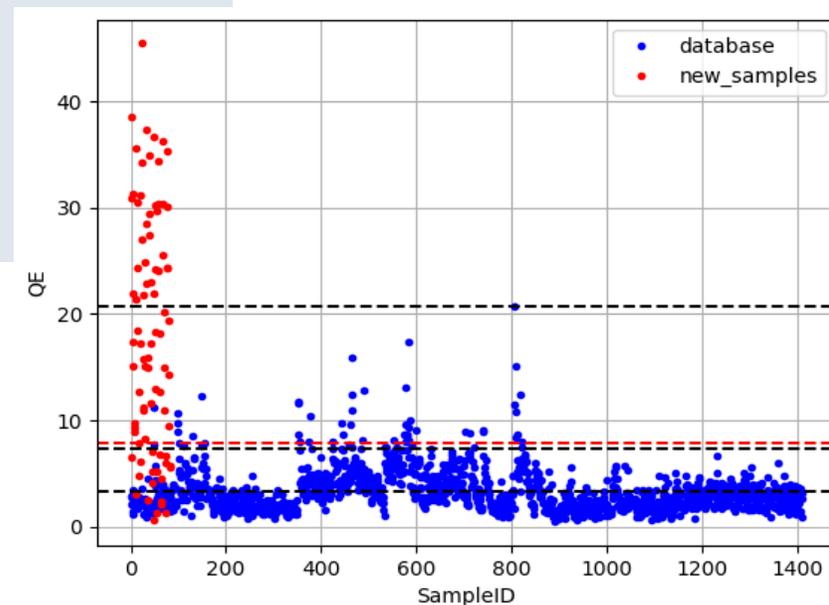
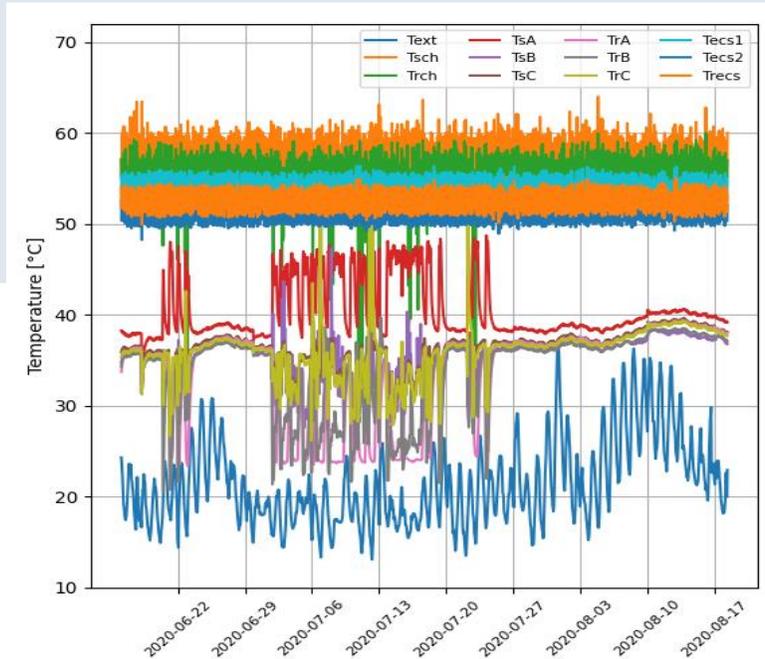
- 40 apartments, 1 triplex
- 2 gas boilers, 1 thermal storage
- Building is monitored with: Smart meters & Sensors

PROD-F-015-00



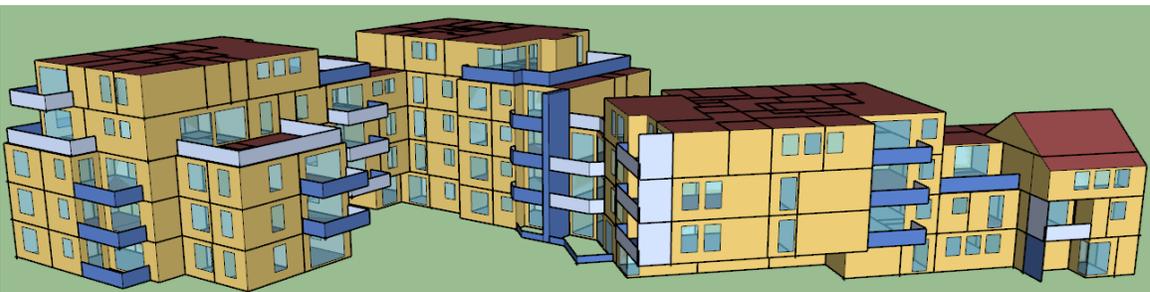


- Real-time monitoring of technical installations for fault detection

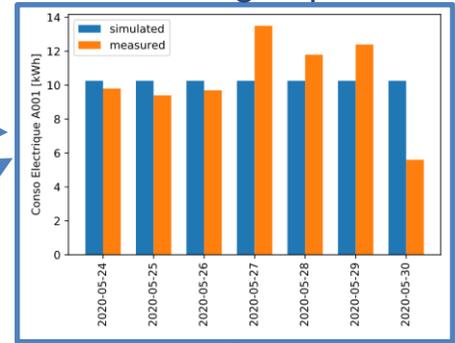


PROD-F-015-02

## Calibration through optimisation



Energy building model



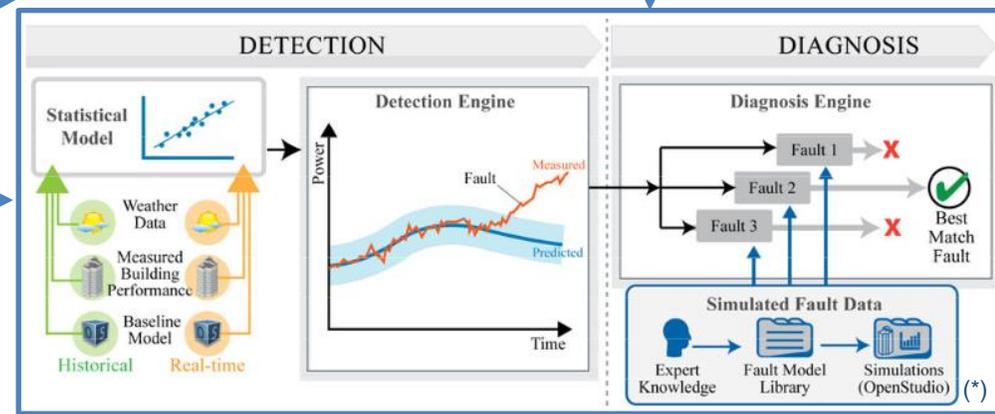
Monitored data



Weather data

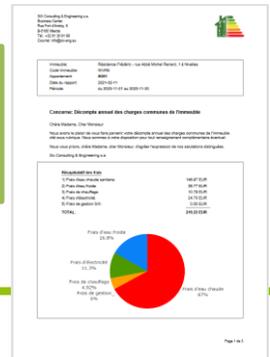


Database



- Data analysis
- Visualisation
- Automated billing

Alerts



PROD-F-015-02

(\*) S. Frank et al. Hybrid Model-based and Data-driven Fault Detection and Diagnostics for Commercial Buildings. ACEEE Summer Study on Energy Efficiency in Buildings, 2016.