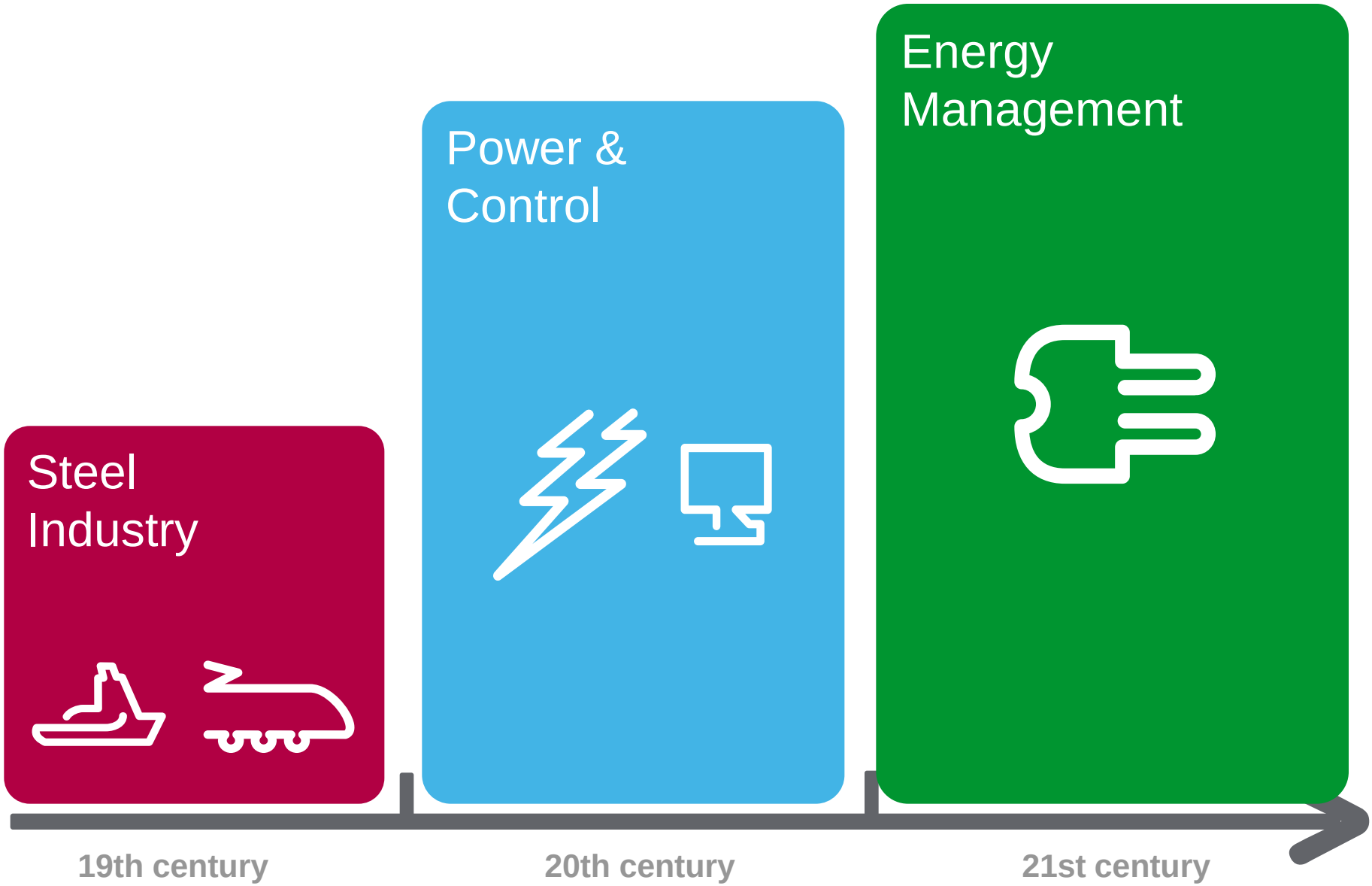
Challenges in Building Automation

Mattias Grundelius
Oskar Nilsson

Schneider Electric

More than 170 years of history



Schneider Electric at a Glance:

The global specialist in energy management

Large company

24

€bn of sales (last 12 months)

41

% of sales in new economies (last 12 months)

140 000+

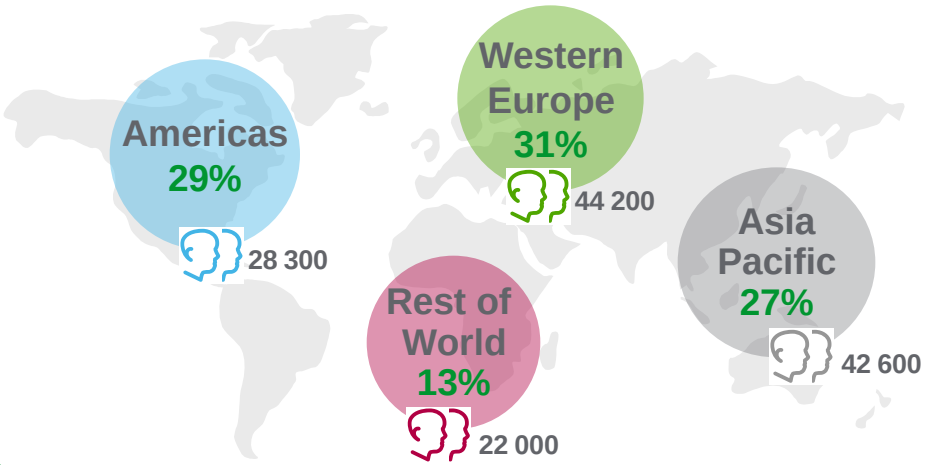
employees in 100+ countries

4–5%

of sales dedicated to R&D

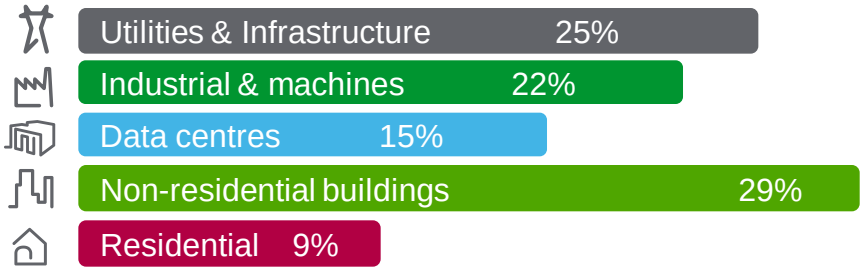
Balanced Geographies

2012 sales
Year-end 2011 employees



Diversified end markets

FY 2012 sales



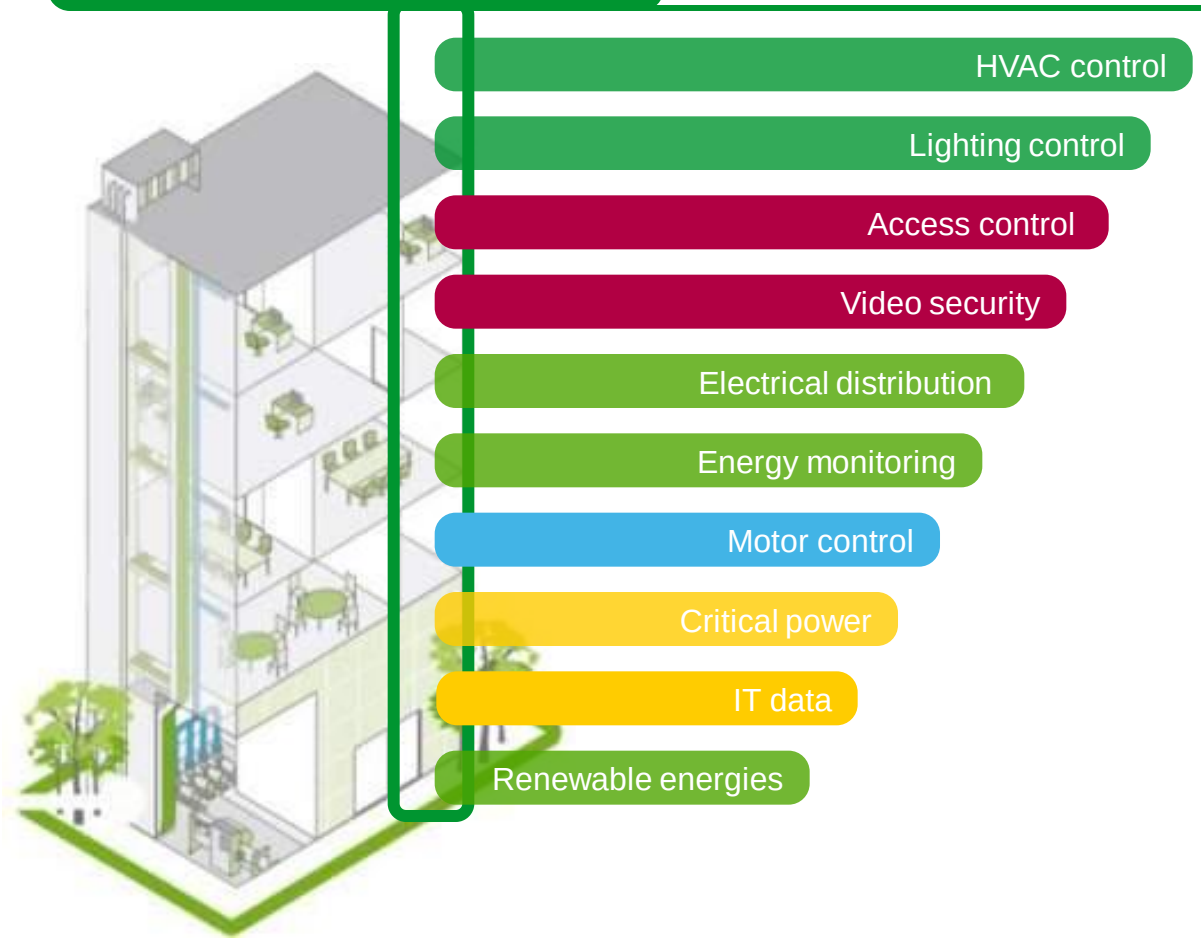
Back to TOC

Providing integrated solutions in buildings

Integration

Make energy visible
Make systems work together

EcoStruxure™



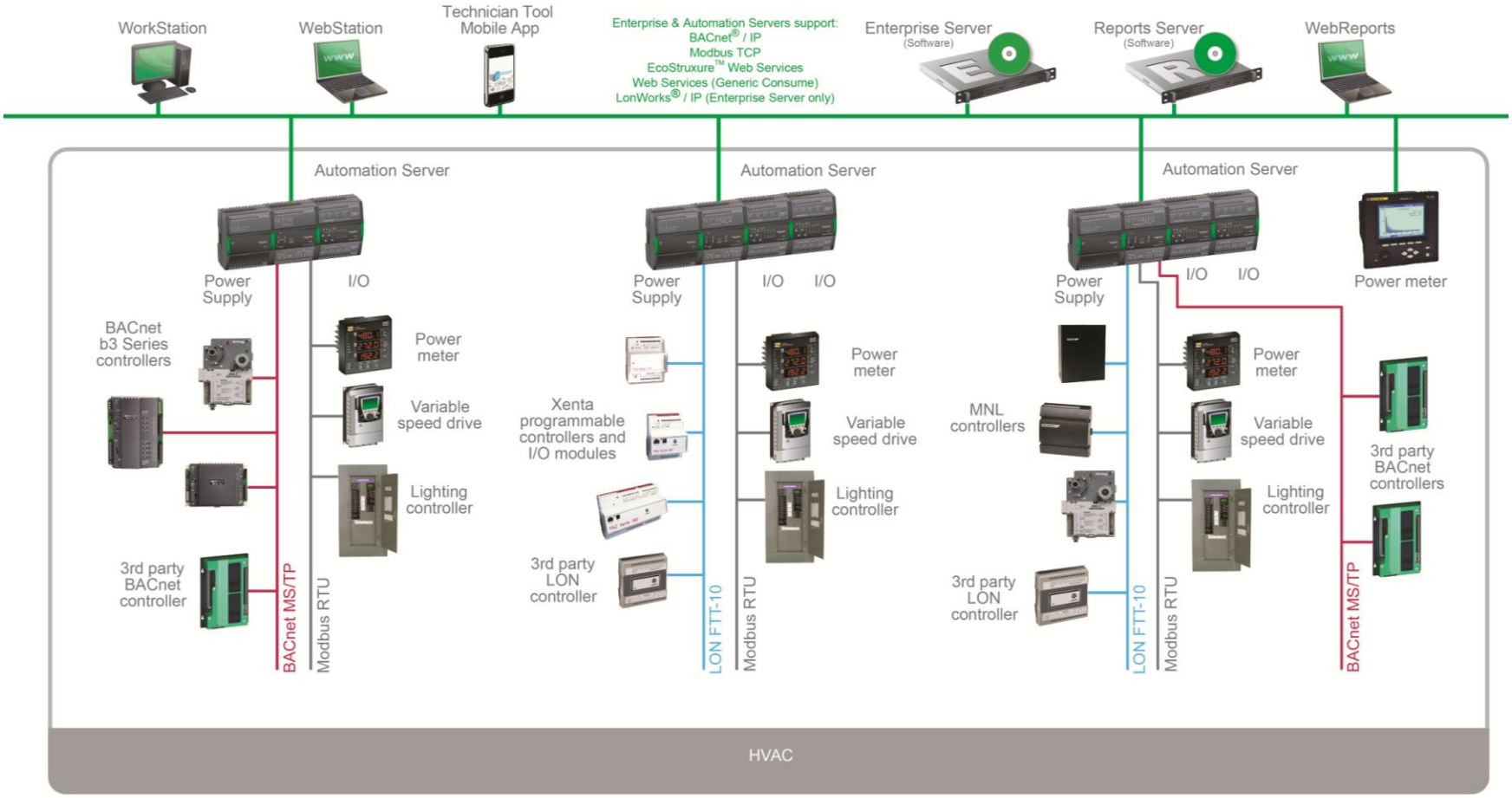
Efficient & productive:
- Measure and control energy, automate, provide relevant diagnosis
- Manage processes
- Make all the utilities of any Infrastructure more efficient

Reliable
Prevent from power outage & quality variance

Safe
- Protect people and assets
- Transform and distribute power safely

Green: Make the connection of renewable energy sources easy, reliable and cost-effective

SmartStruxure Solution



Valves

Actuators

Sensors

Trusted by customers worldwide

Europe

The Kremlin

Eiffel Tower

Byblos Bank

Harrods

Sanoma House

PID Auto-tuning

Schneider Electric

PID Control Parameters

- The parameters to be specified by the engineer are:
  - G – Controller Gain
  - Ti – Integrator Time
  - Td – Derivative Time
  - h – Control Interval
  - d – Dead-zone

- G, Ti, Td and h together with the process dynamics defines the response to setpoint changes and disturbances
- The achievable control performance is limited by the control interval and control signal limitations
  - If the control interval is small enough in relation to the time scale of the process dynamics it is no limiting factor
- The dead-zone is set to limit changes to the control signal due to measurement noise, to avoid wear in valves and actuators

PID Auto-tuning

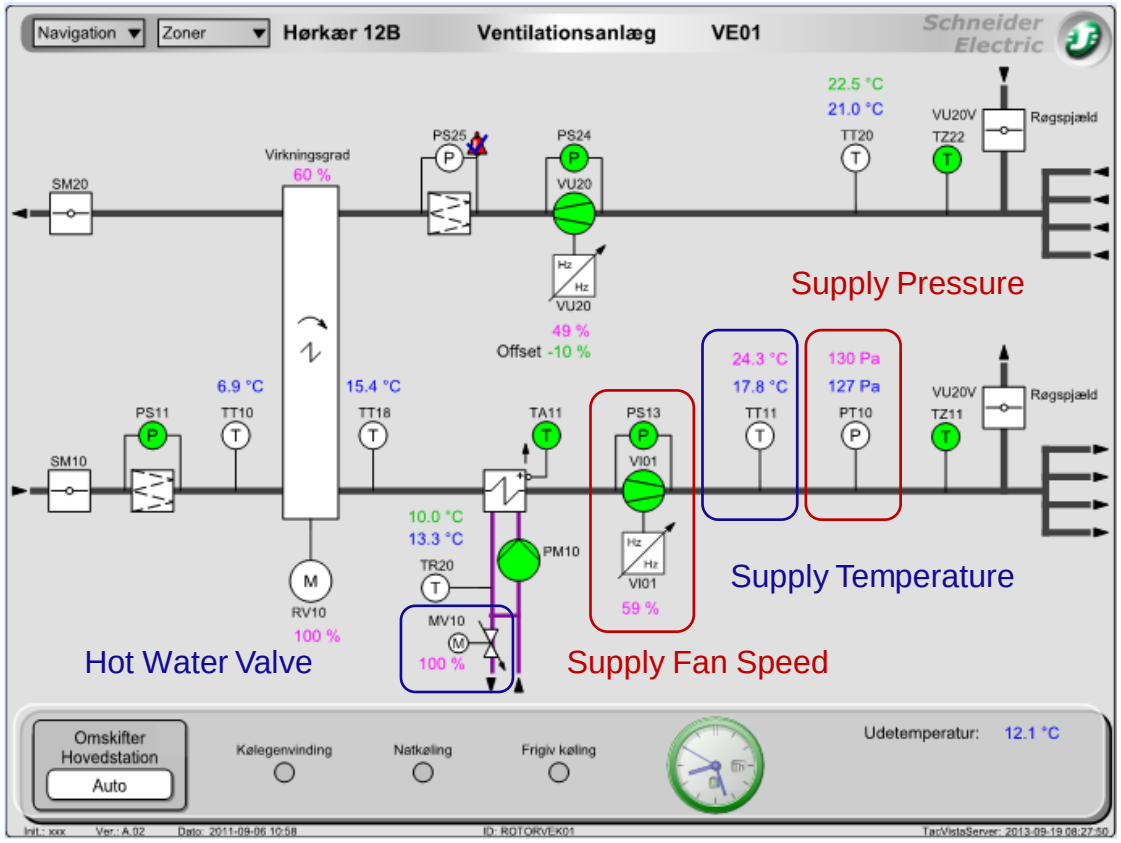
- PID Auto-tuning is a process to automatically determine the PID controller parameters
  - To determine G, Ti, Td and h information about the process dynamics and desired closed loop performance are necessary
  - To determine d information about the measurement noise and high frequency disturbances are necessary

- Information about the process dynamics and high frequency disturbances can be obtained by performing experiments
  - These experiments shall be performed by the press of a button from the engineer and not require any information about the system

- The desired closed loop performance shall be specified by the engineer in an intuitive way that can be easily understood

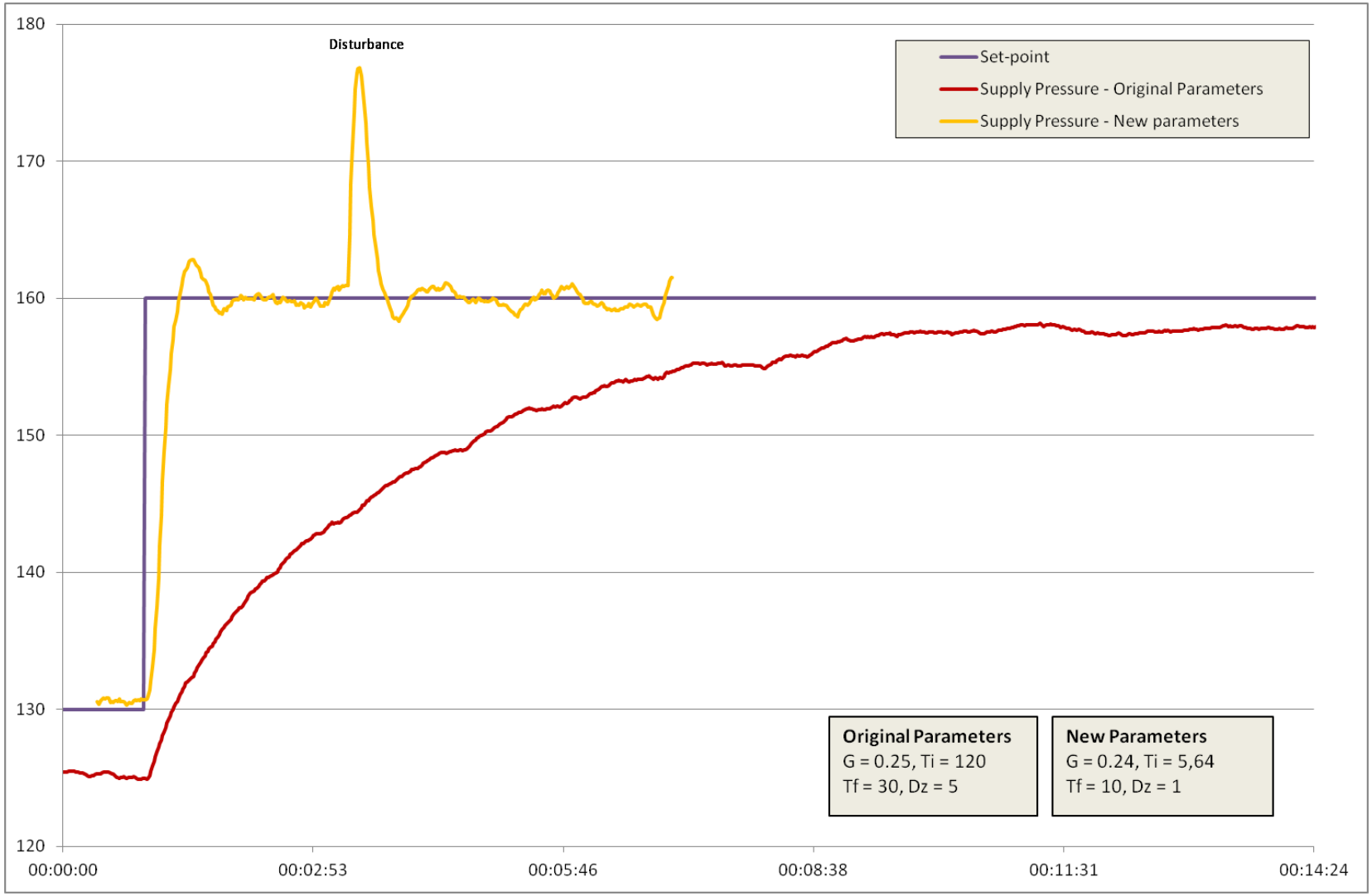
Experimental Results

- The prototype has been tested at the Schneider Electric Buildings branch office in Herlev, Copenhagen, Denmark



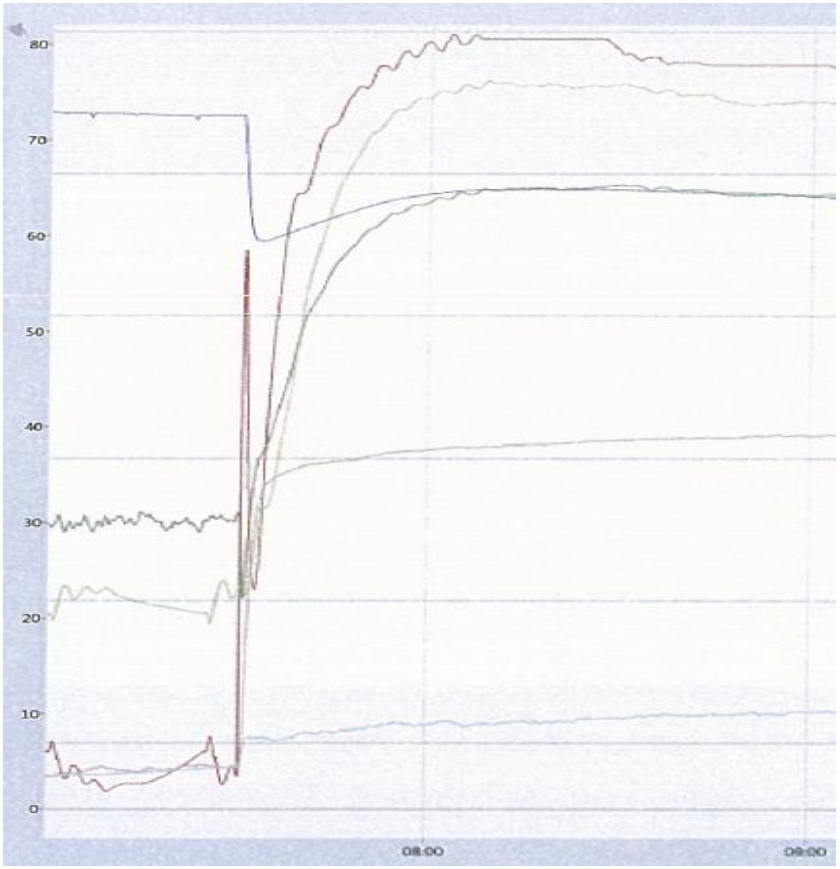
- Supply Pressure and Temperature Control in an Air Handling Unit

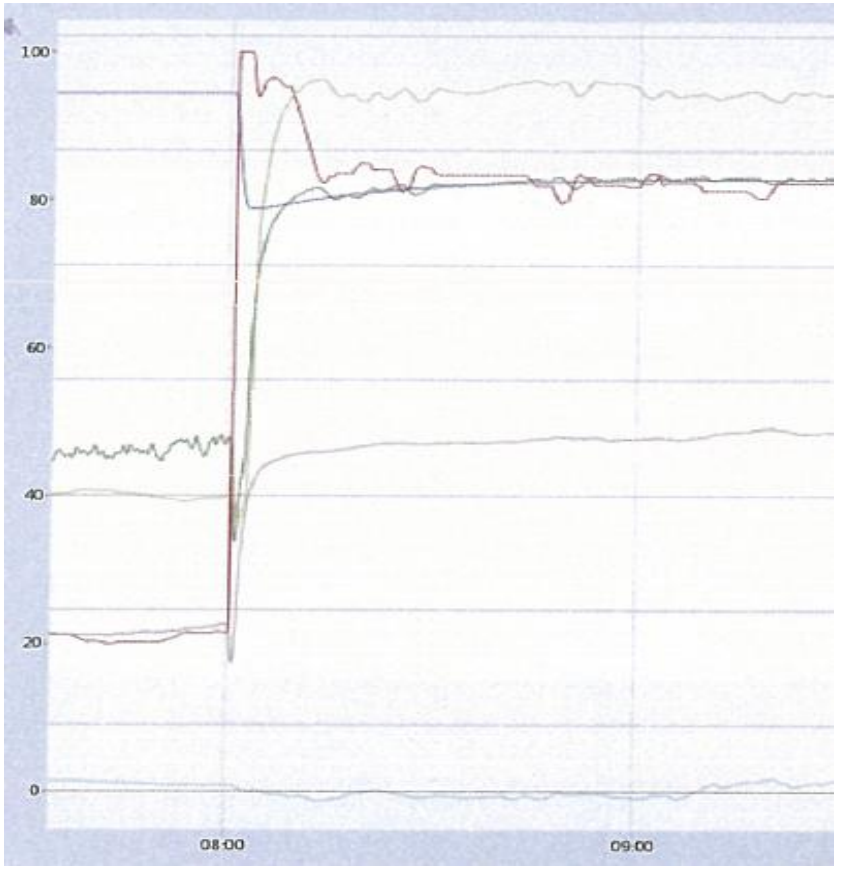
Set-point Step Response, Supply Fan Control



Start-up Response of Temperature Control

- Original PI parameters:
  - Proportional Band: 25
  - Integral Time: 5 min
- New PI parameters:
  - Proportional Band: 34
  - Integral Time: 1.27 min





Smart cities/districts

Schneider Electric

Ambassador - EU Project

- Vision: Flexible buildings to make eco-friendly districts
- Collaborative project started in 2012-11
  - lead by Schneider
  - 15 partners
- 48 months, 10 MEUR

cea
D'APPOLONIA
csem
NEUROBAT
INTERIOR CLIMATE TECHNOLOGIES
Leclanché
AMIRES
Schneider Electric
SEVENTH FRAMEWORK PROGRAMME
zedfactory ltd
www.zedfactory.com or www.zedstandards.com
ZIGOR
European Consulting Brussels
CISCO
PLANAIR
Ingénieurs conseils en énergies et environnement
IK4 TEKNIKER
Research Alliance
VTT

Ambassador ambition

- Real-time energy optimization strategies at district level
  - Integrate buildings physical behavior
  - Take into account district members' technology capabilities
  - Predict energy generation, storage and consumption
  - Take into account weather forecast
  - Leverage synergies between each District Actor

- Optimal behavior for the district can be:
  - Minimize energy cost
  - Minimize CO2 footprint
  - Mitigate energy outages

District actors

Weather data

Tariff

Storage status

Set point

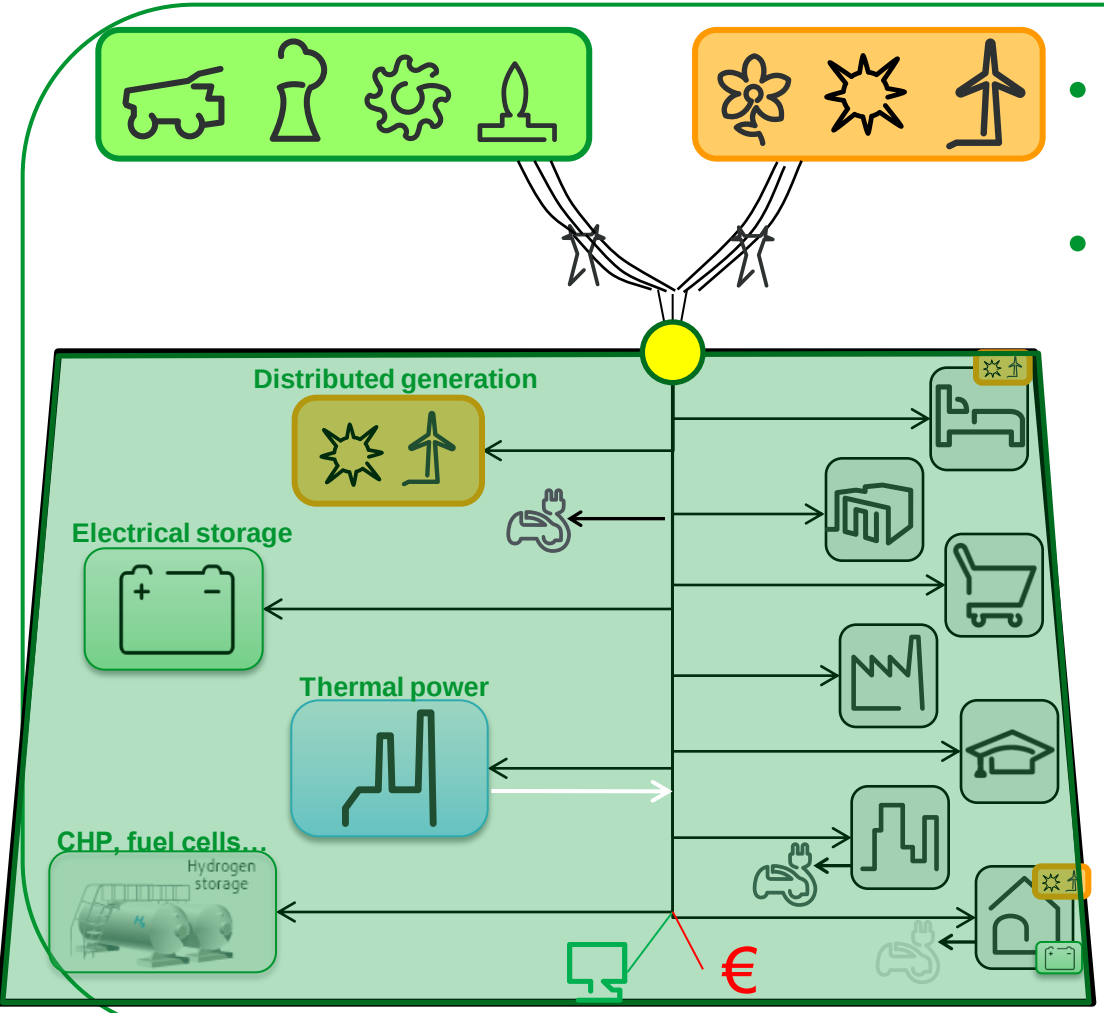
DEMIS

Energy production predictions

Tariff

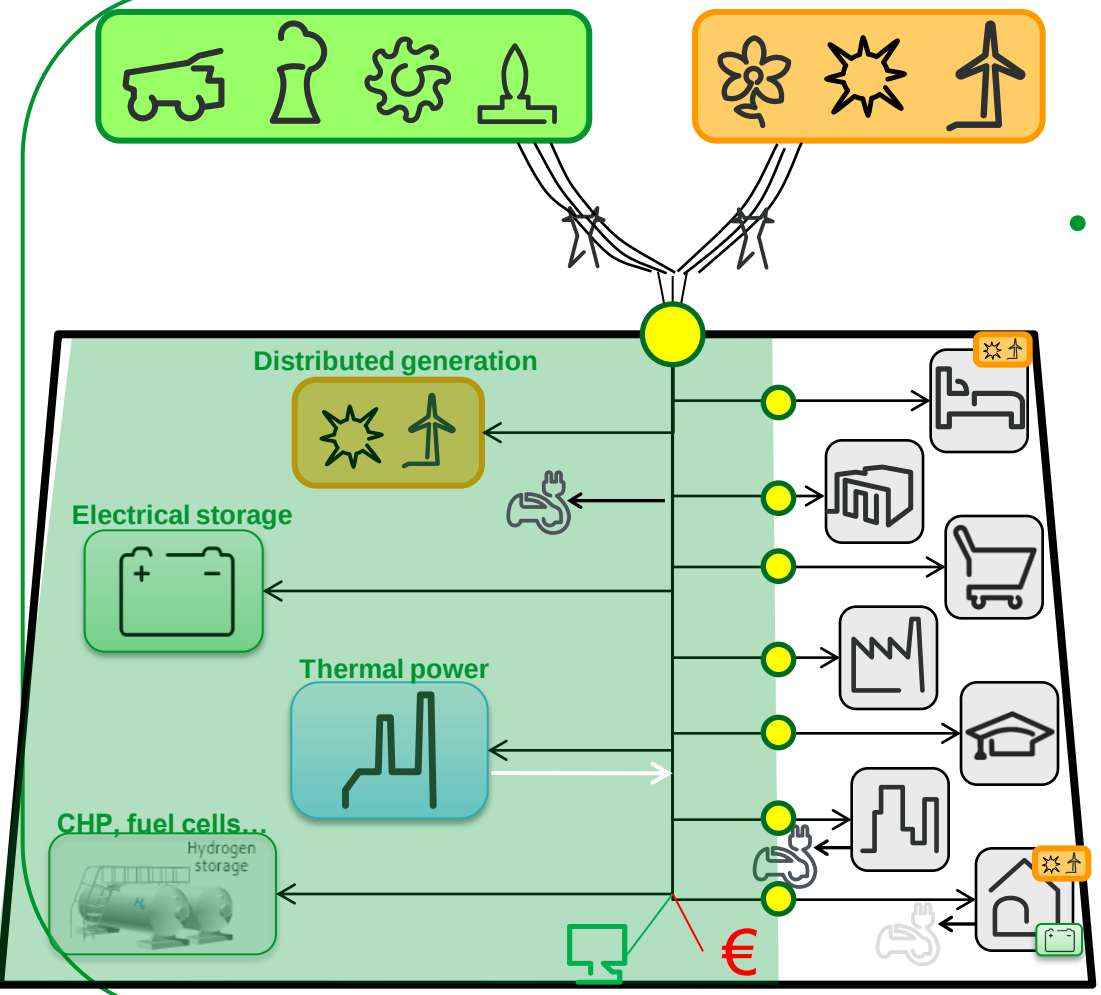
Consumption profile

The campus use case



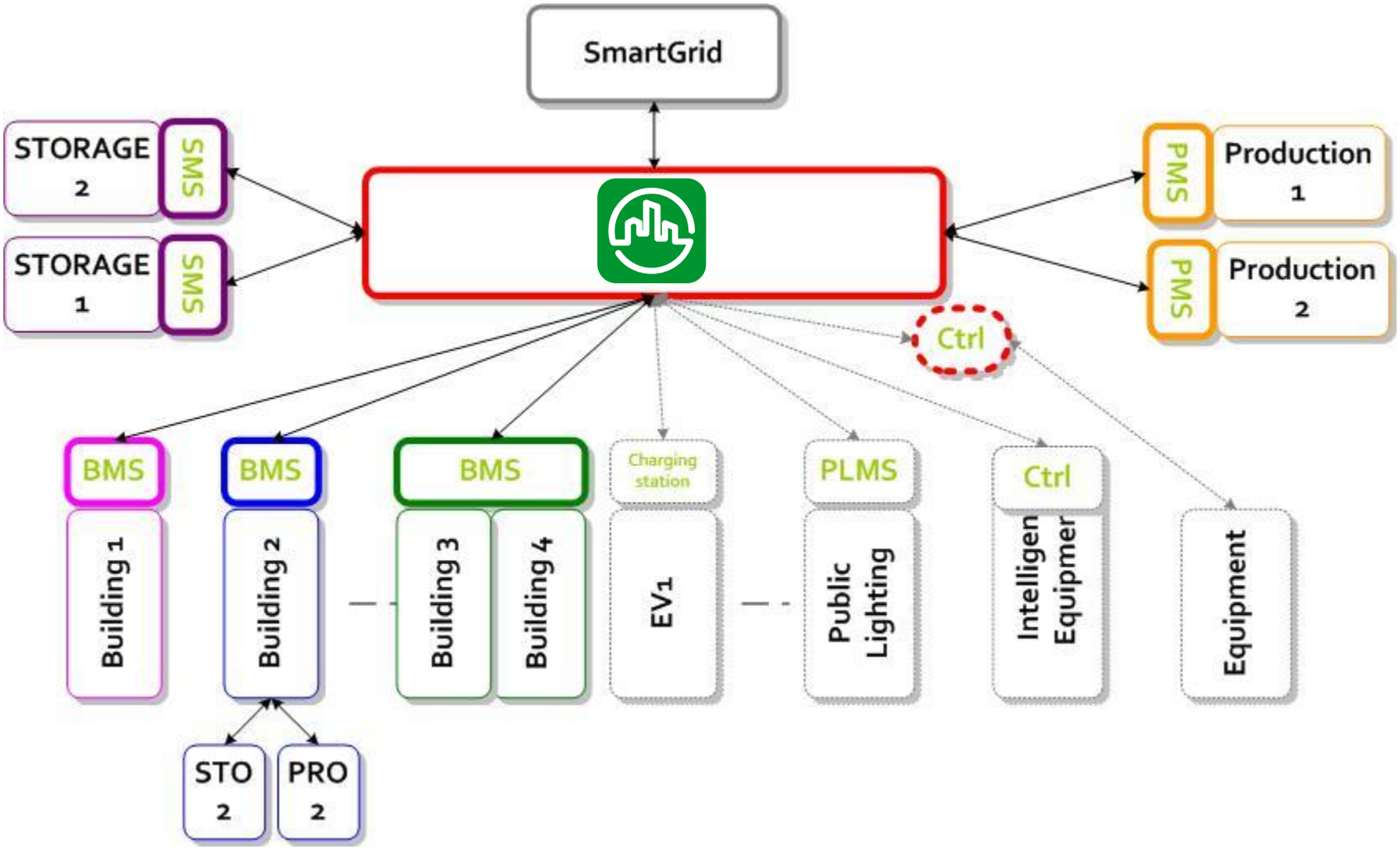
- Only one organization
- Examples
  - Private campus
  - Big Industrial site
  - Single owner district.

Local energy utility case



- General district

Logical links between district actors

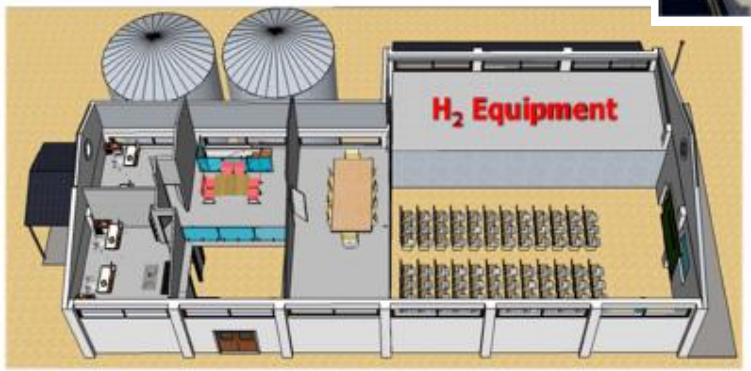


Demonstration sites

BedZed - Wallington
United Kingdom

Residential
Sustainable
community

LTPC - Athens
Greece

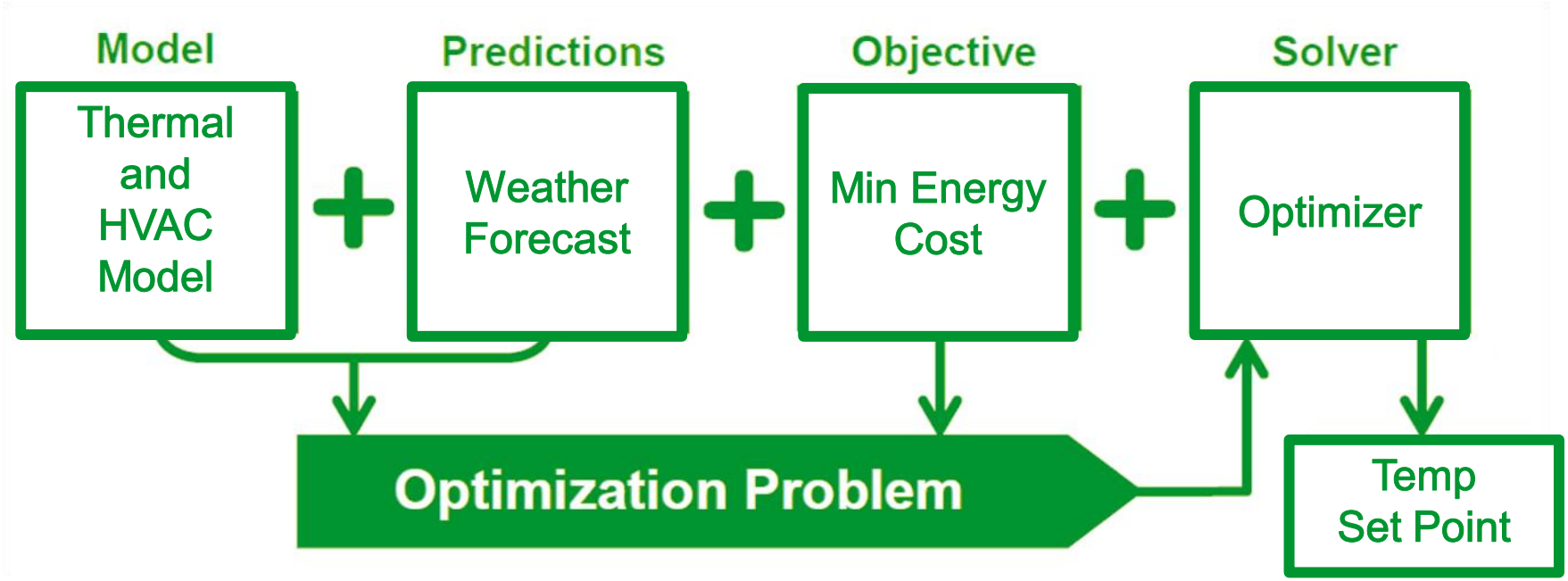


Hydrogen fuel-cell
Energy generation
and storage

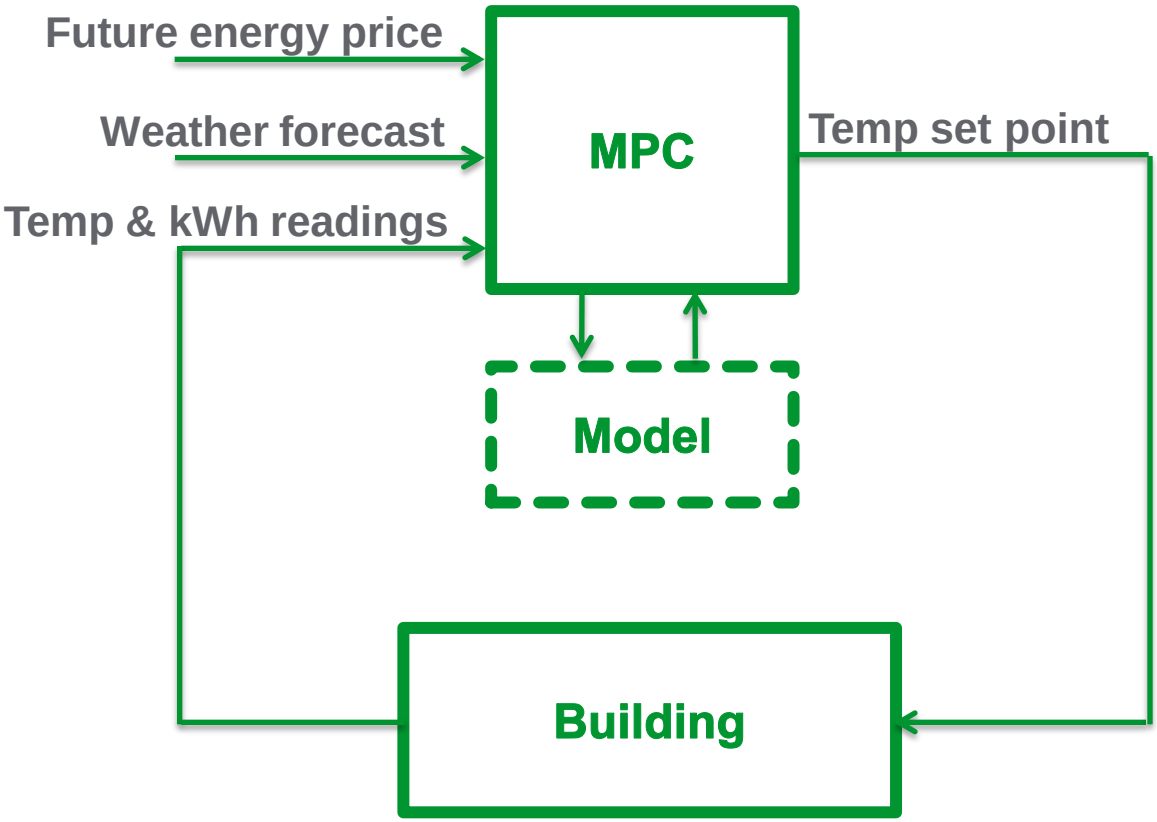
Ines – Chambery
France

Research buildings
PV, thermal panels, heat pump…

Model Predictive Control for Buildings

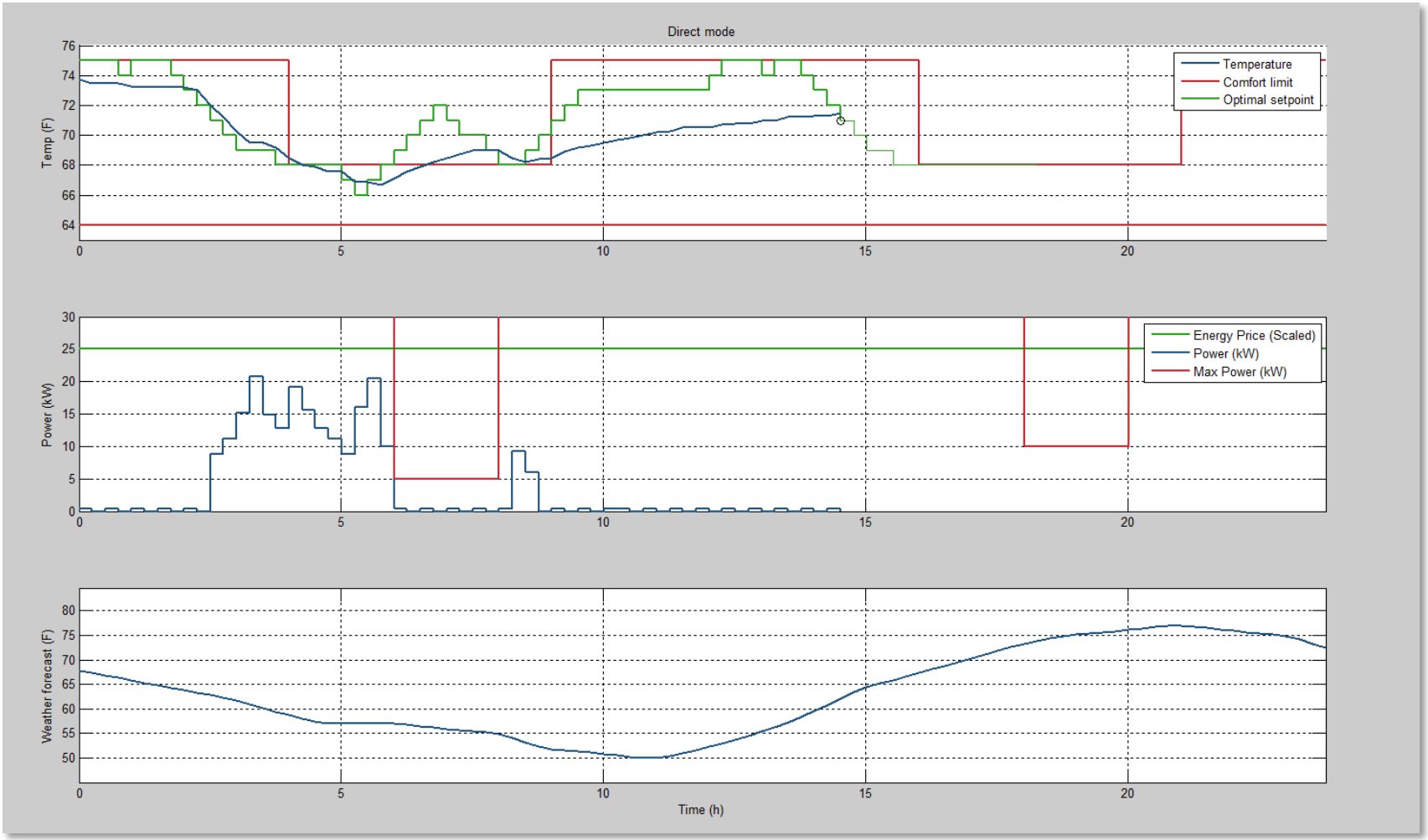


Model Predictive Control for Buildings



Experiment data

Shifting thermal power usage in time



Sustainable City Hyllie

- Collaboration with EON
- Making Malmö Arena Smart Grid ready