

# BECSME

Improving the energy performance of an office building with a virtual building management system

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## Agenda

Intro to IES

Intro to IBECOME project

Case study – Helix Building

Energy Optimisation in Helix

Discussion and next steps







# **About IES**



# **Our Vision**

IES believe that every building of every city in the world can be decarbonised. Our purpose is developing the technology to make that happen.

Our ultimate aim is to create a built environment that is resource and energy efficient, eliminating global reliance on fossil fuels while promoting comfort, health and wellbeing, and fairer access to energy for every citizen in the world.



### **iBECOME** Facts

€ 4.9M with requested EU funding of € 3.7M

10 Partners – 4 countries

48 months of Project duration

Project started in June 2020

Demonstration in 4 sites

Funded under: H2020-EU.3.3.1. - Reducing energy consumption and carbon footprint by smart and sustainable use



# **IBEC SME**



**iBECOME** wants to demonstrate a combination of novel technologies for:

Reducing bills in a building or facility through energy savings and demand response while...

...improving occupant wellbeing and optimising comfort...

...by leveraging IoT, data analytics and the efficient control of a building...

...while enabling additional services such as EV charging optimisation...





# Our targets for iBECOME vBMS

Reduce the energy use and energy bills in a facility by 15%

Reduce Comfort complaints by 20% and improve Indoor Air Quality by 10%

Improve the smart readiness of buildings by 10% (SRI)

Track, prevent and reduce equipment and operational faults by 20%

Improve wellness by 20%

Generate revenue by energy savings to invest in further Energy Conservation Measures



# **iBECOME virtual BMS**



### **Services**

#### Core

**Energy-Comfort Optimisation** 

Measurement & Verification

Demand Response

Fault Detection & Diagnosis

Predictive Maintenance

What-if scenarios

### **Additional**

Healthcare Management

EV Charging Optimisation

Car sharing

Can you think more?







# Key IES achievements to fulfil iBECOME objectives:

New calibration tool for cloud, fast and accurate calibration

Bilateral integration with Schneider Electric BMS

Physics simulation engine advancements:

-deployed on the cloud

-enabled co-simulation

-developed public API

ML models for:

- -Comfort virtual sensors
- -Heating/cooling optimisation
- -Flexibility optimisation





# The Helix Building











# Audit/Survey – Current status and "problems"









- No BMS, just IoT sensors/meters
- Heating is on a weekly schedule
- No local heating control
- Temperature difference between zones
- Pre-heating not enough is very cold winter days
- Meeting rooms are either cold or overheated
- Physics Energy Model outdated (created for compliance with regulations)

IES R&D

Air quality issues in meeting rooms

**iBEC** ME



This project has received funding from the European Union's Horizor 2020 Programme under Grant Agreement no 894617



# Solution –without



# Off the shelve hardware from the market

- Portable WiFi space thermostat
- Smart TRV valves
- Window sensors
- Cloud access to Heat meters
- Cloud access to Electricity Meters

### Facility/Energy Manager Work<mark>load</mark>

- Navigate daily-weekly to 4-5 apps
- Compare past year energy bills with current one
- Receive complaints and adjust heating
- Use spreadsheets to track and report

....Call technician when something fails





# Solution – with iBECOME vBMS

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- All the live/historical sensor/meter data from all the hardware in one place
- Dashboard for the Energy/Facility manager
- Alerts for data gaps/anomalies
- CO2 alert in meeting rooms
- Utilised the old energy model used for compliance
- ML Comfort predictions
- ML Valve fault detection
- Battery degradation predictive maintenance
- Threefold Automatic control of heating
  - Data driven occupancy based in meeting rooms
  - Model based comfort-optimised in open office
  - "Smart" pre-heating based on next day weather forecast
- Demand Response advisor

IRFIAND

- Energy savings calculation using M&V
- What-if scenarios for decarbonisation.





# Focus on Energy-Comfort Optimisation in Open Office

### Objective:



Estimate energy savings, comfort improvements and payback time when applying 2 different control strategies

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Al predictive control Rule based Control

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# **Methodology: Control logics**





### Results



### Results

#### HEATING ENERGY PER ROOM



# **Results – Payback time**

Parameters	Values	Units
Boiler Efficiency	93	%
Losses	10	%
System overall eff	84	%
Cost TRVs	97	Euro
# TRVs	21	-
iot devices	186	Euro
# iot devices	3	-
gateway	350	Euro
# gateways	1	-
Unit cost biomass	0.19	Euro/kWh
Final cost of fuel &		
taxes	0.23	Euro/kWh
jan-may	15	Weeks
oct-dec	13	Weeks
heating weeks	28	Weeks

- 1. System overall efficiency
- 2. Heating energy for the season
- 3. Heating costs for the season
- 4. Energy savings in different scenarios
- 5. Investment for equipment
- 6. Payback time
- 7. Scenarios based on uncertainties



# Discussion

#### Benefits

- Proof of benefits of using operational digital twin for evaluation of control scenarios
- RL outperforms current control logic (calibrated model) and Rule-based approaches
- Estimate of payback time depending on the energy uncertainties related to energy savings

#### Issues

- RL requires time for fine-tuning (expert knowledge)
- Deployment is way more complex for RL compared to Rule-Based

#### Future work

- Understand if it is really possible to deploy RL or suggest deployment of only Rule-Based solutions
- Focus on similar use cases for iBECOME

Stay Tuned!



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