



# BRESAER

## A FUZZY-BASED BUILDING ENERGY MANAGEMENT SYSTEM FOR ENERGY EFFICIENCY



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JOSÉ L. HERNÁNDEZ, FUNDACIÓN CARTIF

28-30 June

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# INTRODUCTION

- **Full title**
  - “BREakthrough Solutions for Adaptable Envelopes in building Refurbishment”
- **GA #637186**
  - Project start Date: 01/02/2015
  - End Date: 31/07/2019
  - Project Coordinator: Acciona Infraestructuras
- **Aim**
  - The overall objective of BRESAER project is to design, develop and demonstrate an innovative, cost-effective, adaptable and industrialized envelope system for buildings refurbishment including combined active and passive prefabricated solutions integrated in a versatile lightweight structural mesh

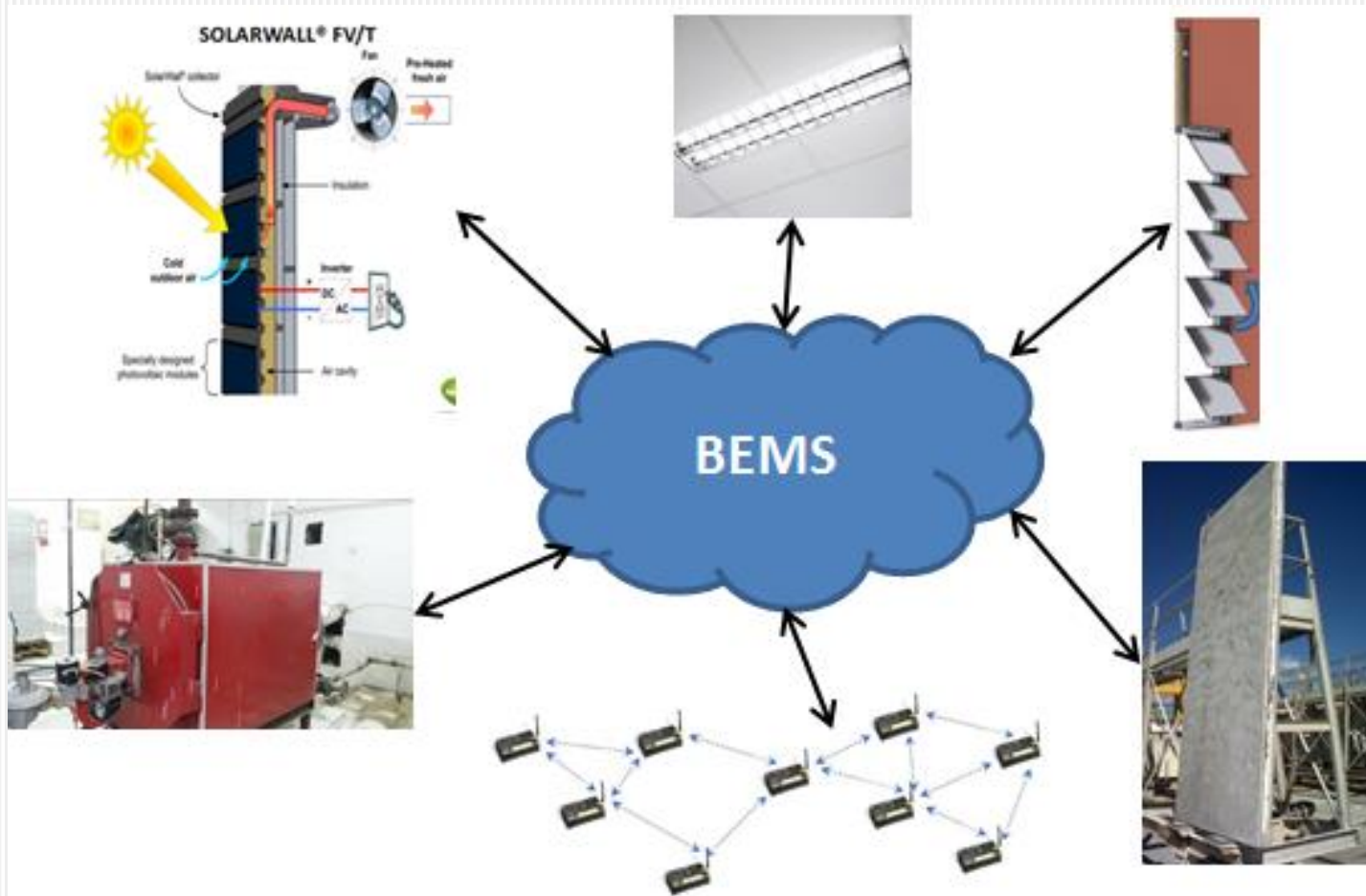
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# INTRODUCTION



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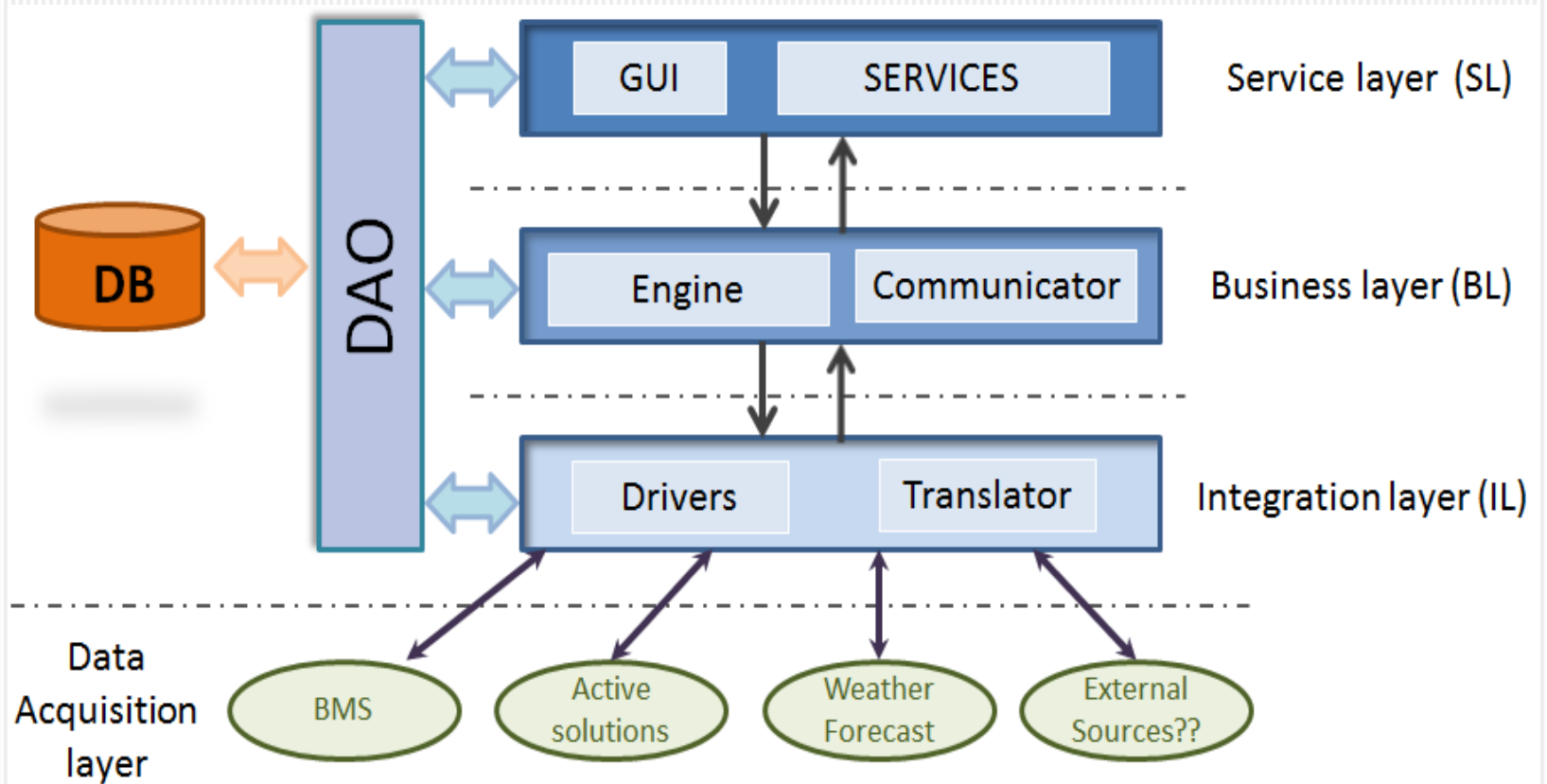
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# BEYOND STATE OF THE ART

	Smarkia	NETxAutomation	OpenDomo
Multiprotocol	yes	yes	yes *
Automated reports	yes	yes	yes
Data analysis (KPI)	yes	no	no
Internet of things	no	yes	no
Advanced control	yes **	no	no

- **BRESAER BEMS**
  - Inclusion of data analysis (KPIs) in the control loop
  - Advanced control strategies (not basic control rules)
  - Prediction techniques
    - Simulation engine
    - Solar estimators

# BEMS ARCHITECTURE



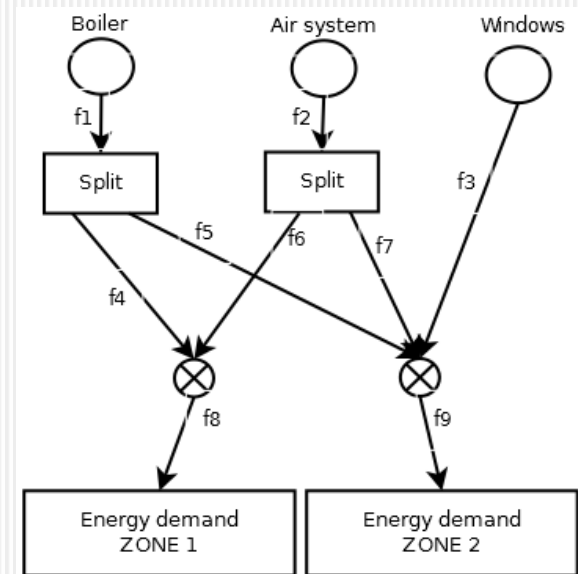
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# FUZZY-BASED CONTROL ALGORITHM

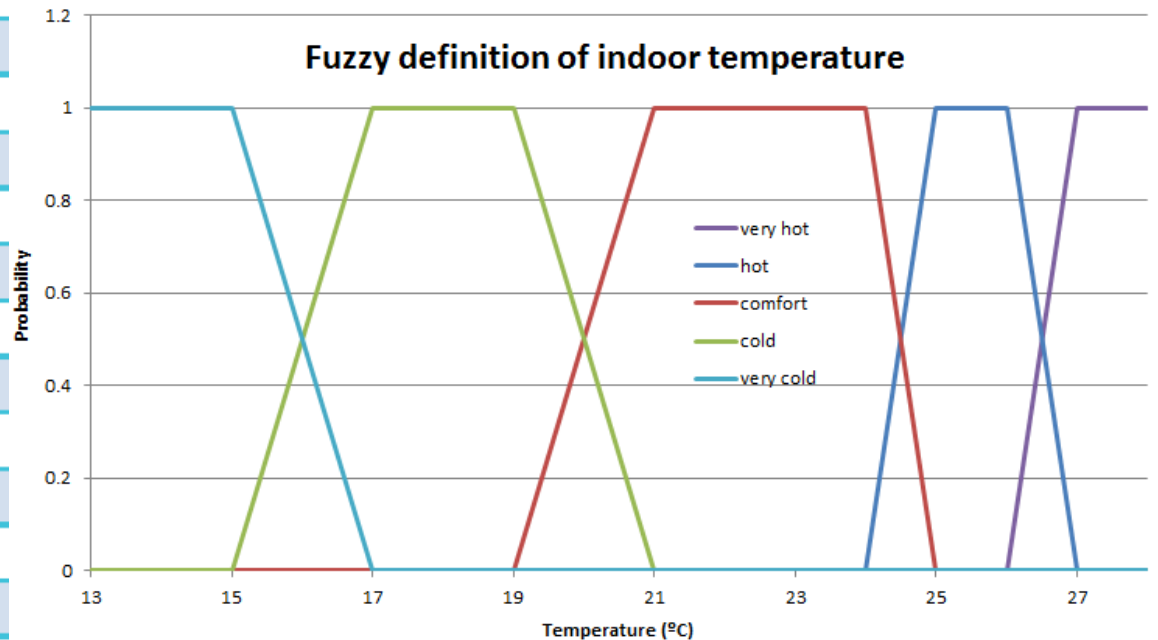
- **Control scenarios**
  - Winter thermal production by solar thermal air system
  - Passive cooling air SOLARNIGHT
  - Summer thermal production
  - Blind control in REMOTE mode for temperature control
  - Blind control in REMOTE mode for lighting control
- **Control algorithm technologies**
  - Neuronal networks (training)
  - Energy flow analysis
  - Fuzzy logic





# FUZZY-BASED CONTROL ALGORITHM

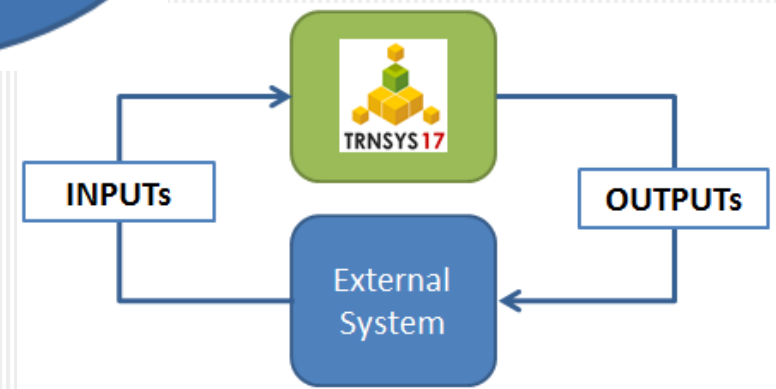
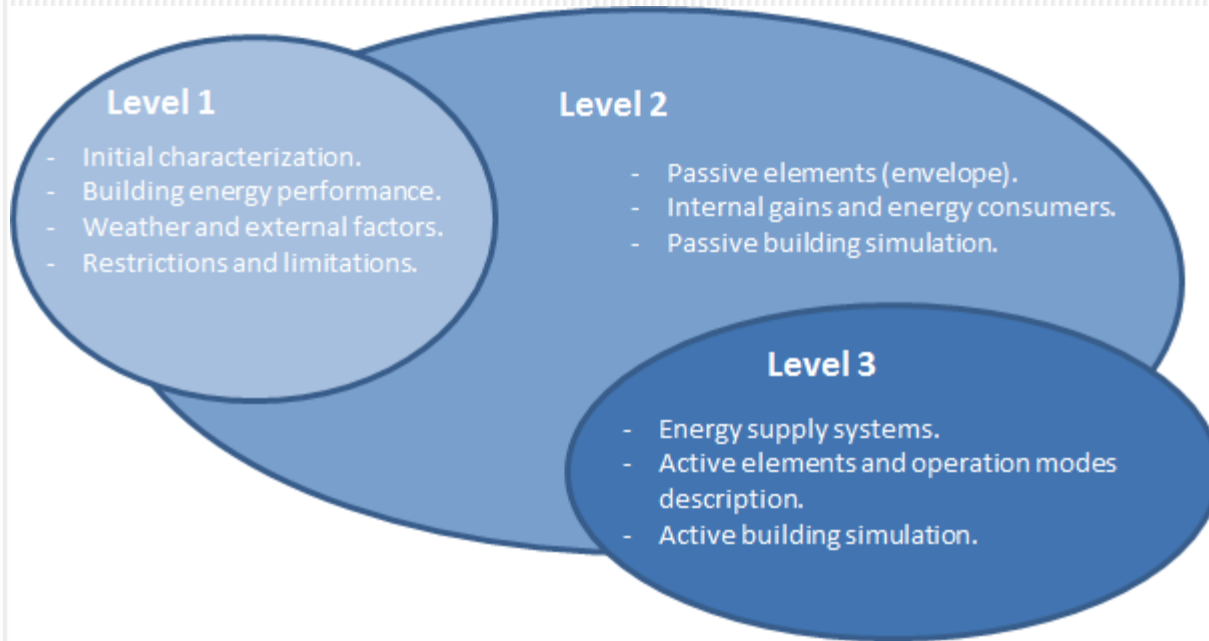
Input	Solar air system	Dynamic windows	Boiler
Indoor temperature	X	X	X
Blind angle status		X	
Blind position status			
Radiation forecast	X		
Energy demand	X		
AHU status (fan)	X		
Indoor luminosity			
External luminosity			
Indoor occupancy			
Temperature forecast	X		
Sky forecast	X		
Solar angle			
Boiler status			
Schedule	X	X	X
Blind remote/manual		X	
Inlet temperature	X		X



# PREDICTION TECHNIQUES

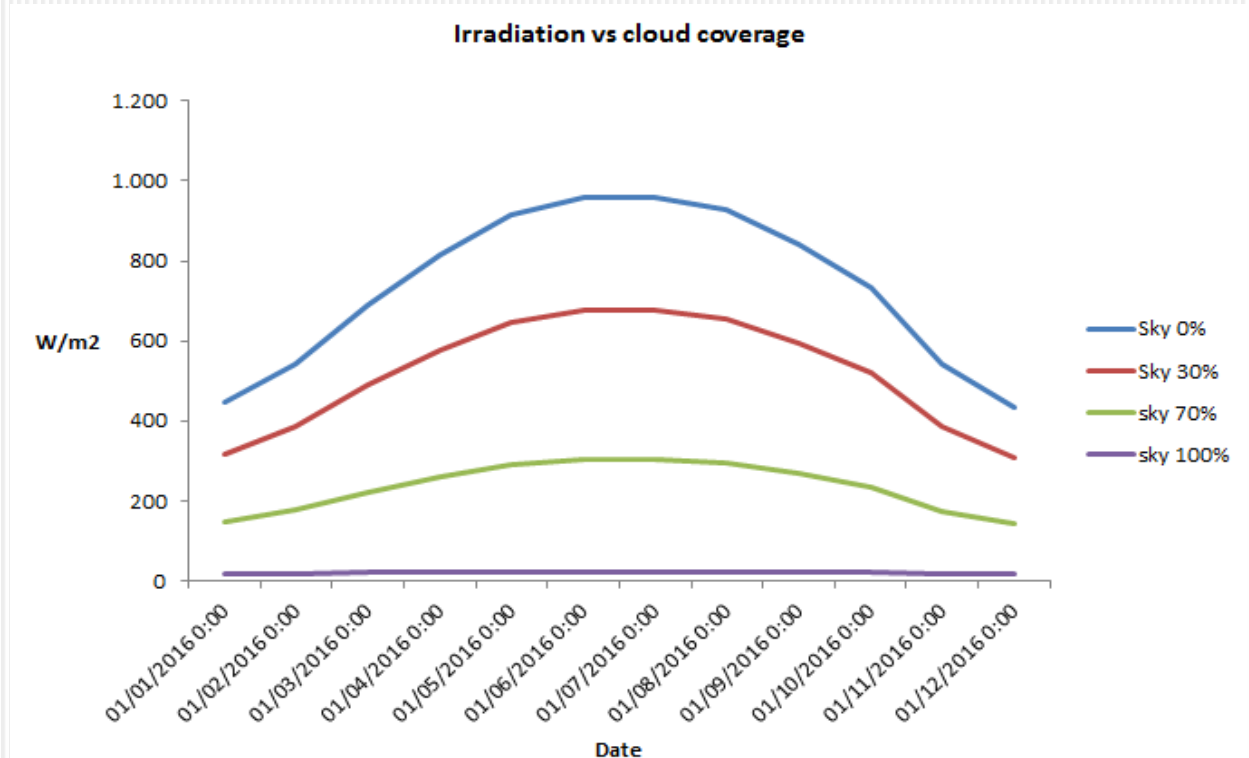
- **Advantages**
  - Estimation of the energy demand of the building
  - Anticipate the occurrences
    - Determine the amount of energy available
  - Ensure comfort conditions by pre-heating/pre-cooling
- **Techniques**
  - Weather forecast
  - Simulation
  - Solar tracker estimator

# PREDICTION TECHNIQUES: SIMULATION



# PREDICTION TECHNIQUES: SOLAR TRACK

- Equations from solar trackers
- Based on
  - Epoch – Date and time
  - Sky cover
  - Location



# CONCLUSIONS

- **New trends in buildings and control systems**
  - More complex solutions
  - Necessity of control elements to manage them
- **Advances techniques**
  - Increase the complexity
  - Increase the accuracy
  - Ensure better comfort levels
  - Anticipate occurrences
  - Increment energy savings

Thank you for  
your attention

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Isabel Lacave

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