ENCOURAGE Project

A distributed platform for an efficient energy management in the residential and tertiary context

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Advanced Research & Technology for Embedded Intelligence and Systems

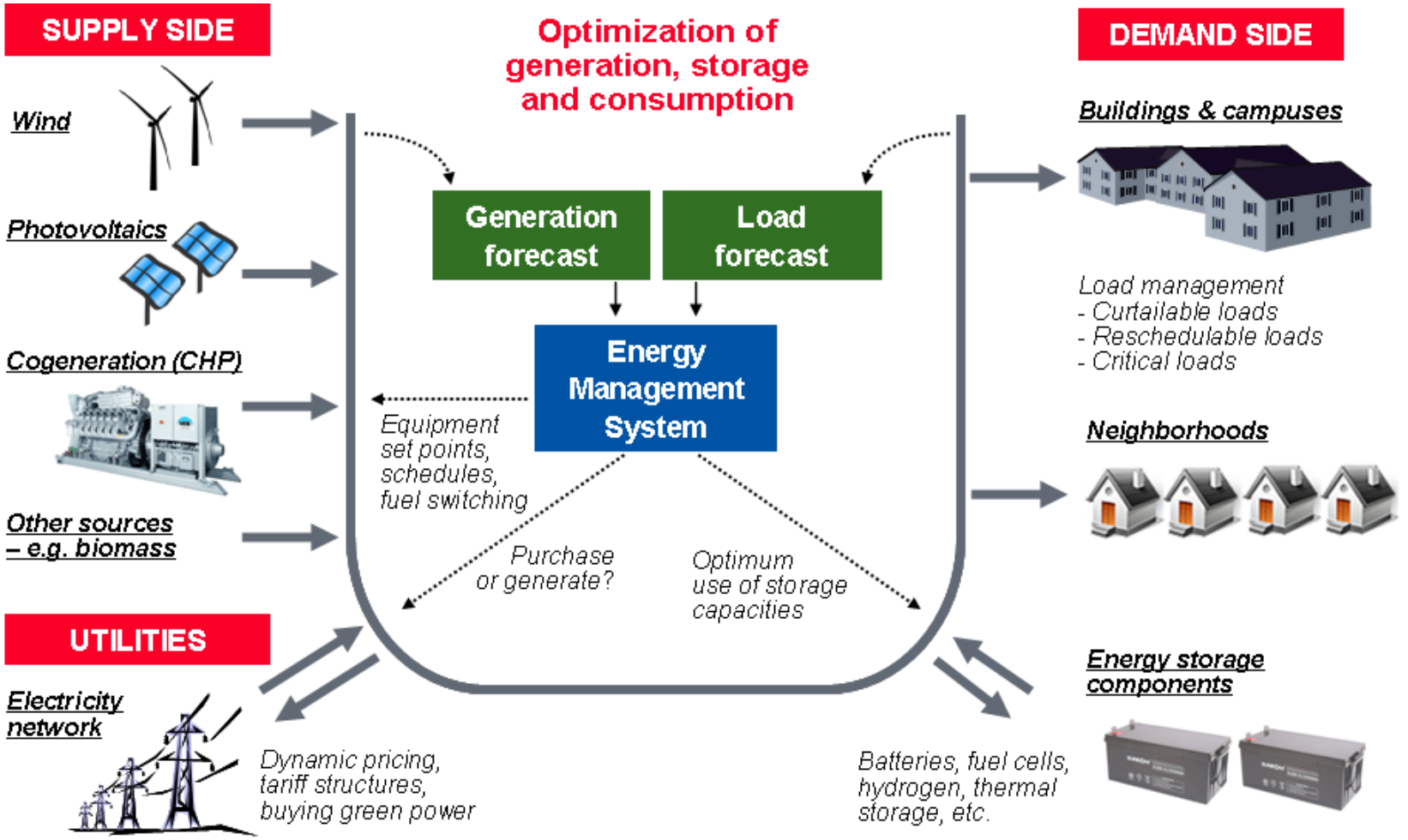
ENCOURAGE Project

- Embedded iNtelligent COntrols for bUildings with Renewable generAtion and storaGE
  - Artemis call 2010
  - Start date: June 1st, 2011, 36 months project
  - Partners:

Concept

- Embedded iNtelligent COntrols for bUildings with Renewable generAtion and storaGE
  - directly optimize energy use in buildings
    - optimal control of internal sub-systems
  - enable active participation in the future smart grid environment.
    - effective interaction with external world, including other buildings, local producers, or electricity distributors.

Vision


SUPPLY SIDE
Wind
Photovoltaics
Cogeneration (CHP)
Other sources – e.g. biomass
UTILITIES
Electricity network
Dynamic pricing, tariff structures, buying green power
Optimization of generation, storage and consumption
Generation forecast
Load forecast
Energy Management System
Equipment set points, schedules, fuel switching
Purchase or generate?
Optimum use of storage capacities
DEMAND SIDE
Buildings & campuses
Load management
- Curtailable loads
- Reschedulable loads
- Critical loads
Neighborhoods
Energy storage components
Batteries, fuel cells, hydrogen, thermal storage, etc.

Technological Innovation

- Technological innovations at device level
  - Non-intrusive monitoring and control
- Scalable processing and inference of complex events
  - Use of cloud computing capabilities
- Optimal energy management and control
  - Energy efficiency at system level and not individual appliance / sub-system
- Reduction of costs of system development
  - Open architectures
  - Complexity increase with effort reduction

Market Innovation

- Enable innovative products and services in the whole chain
  - Non-intrusive management of energy in Buildings
  - Standards for communication Utilities / Buildings
- Tackle distributed energy generation
  - Control and forecast algorithms
  - Energy brokerage mechanisms

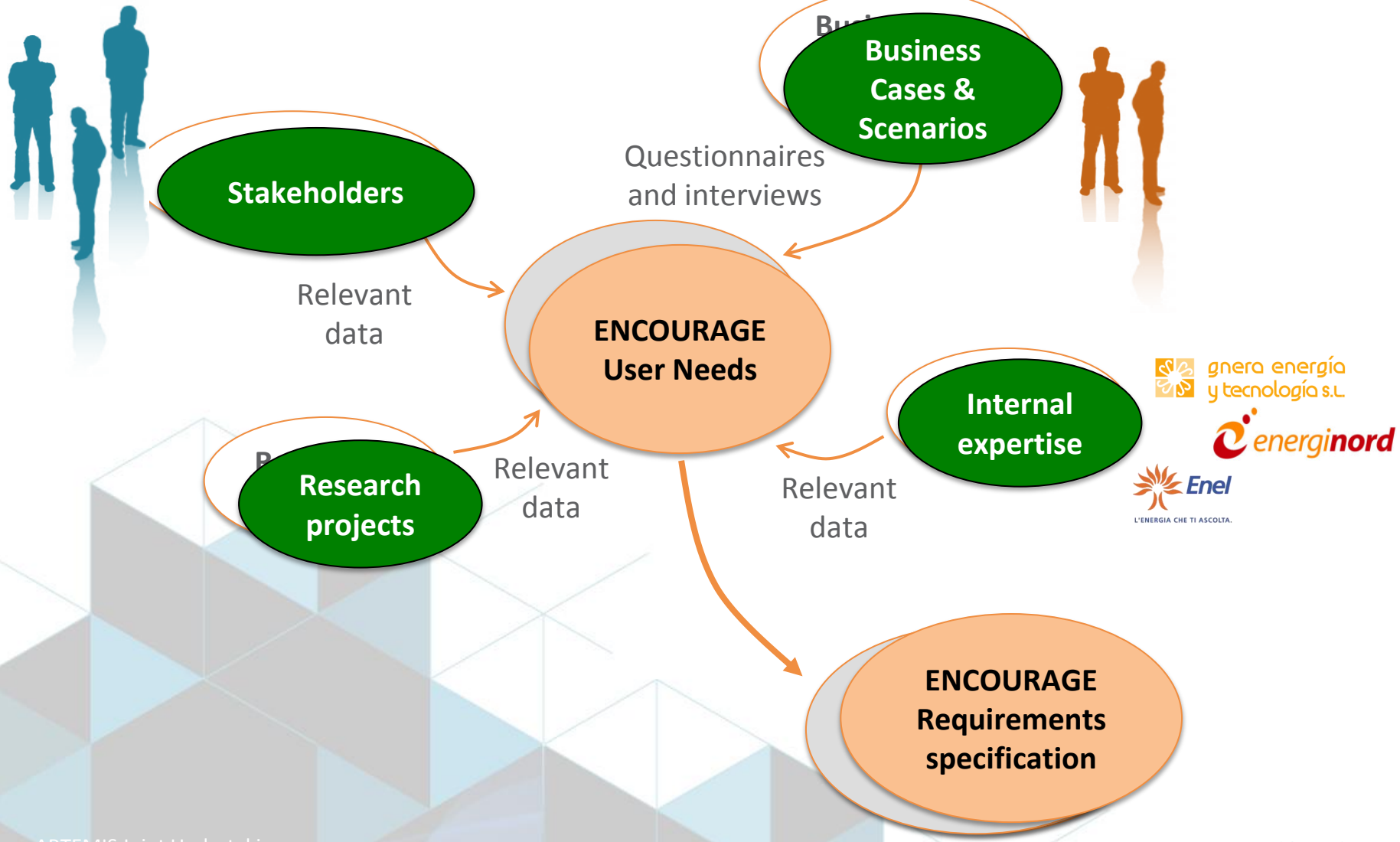
Approach

- Developing supervisory control strategies that will be able to coordinate larger subsystems
- Development of an intelligent gateway with embedded logic supporting inter-building energy exchange
- Developing novel virtual sub-metering technologies and event-based middleware applications that will support advanced monitoring and diagnostics concepts

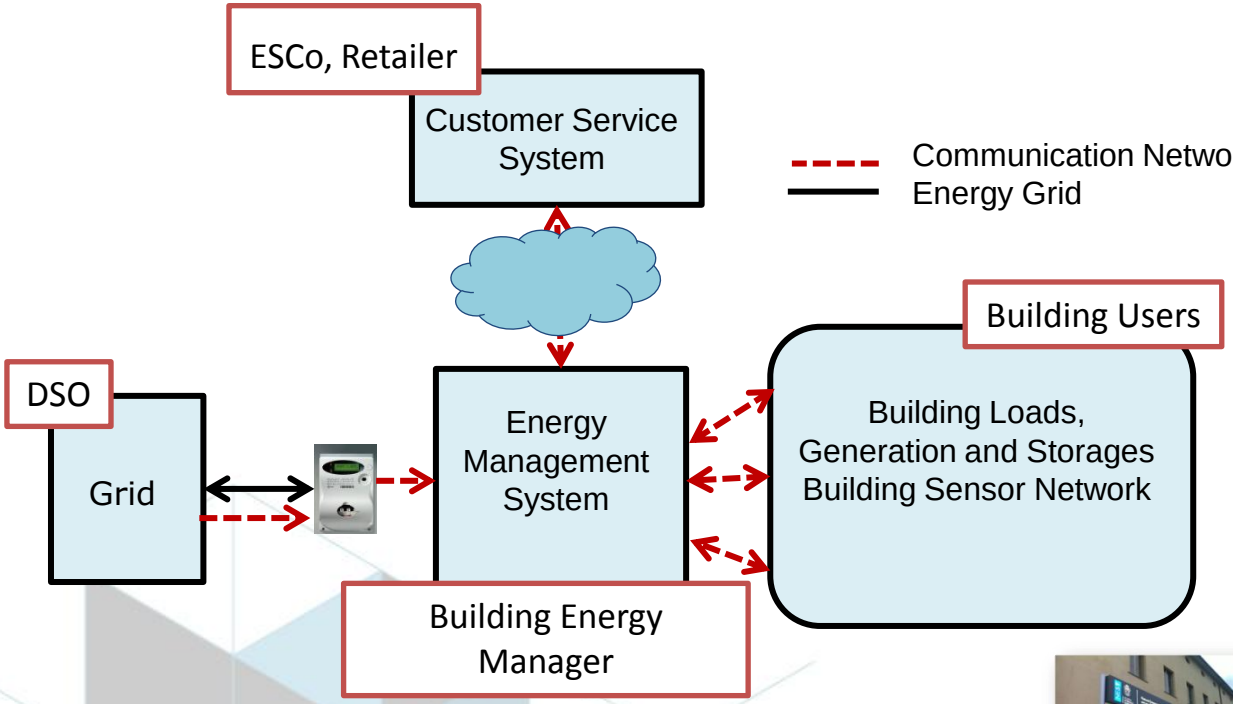
Users' needs, Business cases

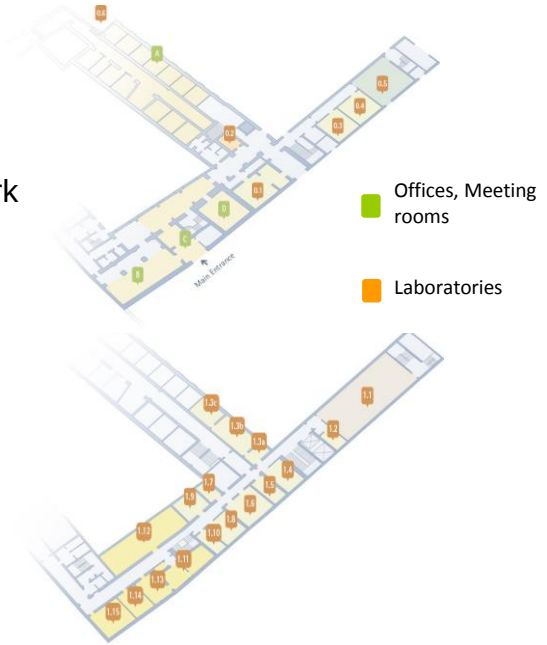
- Identification of stakeholders: parties benefiting from the whole project and their characteristics.
- Development of business cases for the ENCOURAGE platform, providing a description of target markets, technology enablers, system boundaries, regulatory context, energy-efficiency, saving scenarios, costs and metrics to measure the degree of success.
- Identification of customer needs.

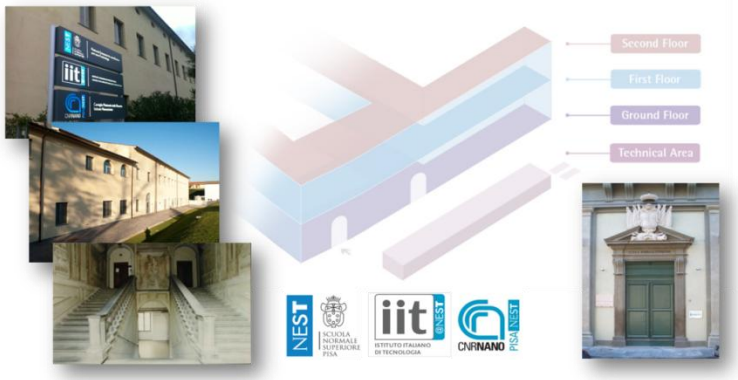
Users' needs, Business cases



Users' needs, Business cases

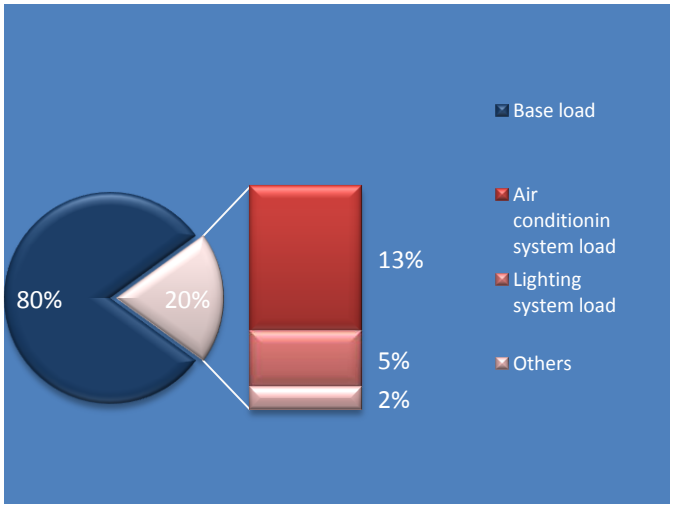


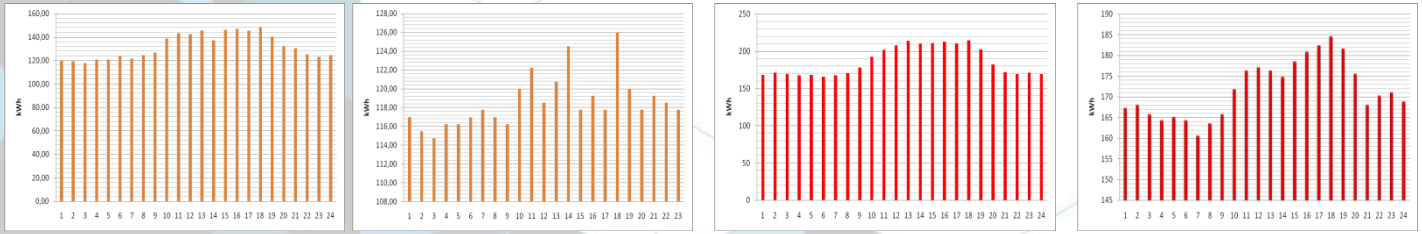




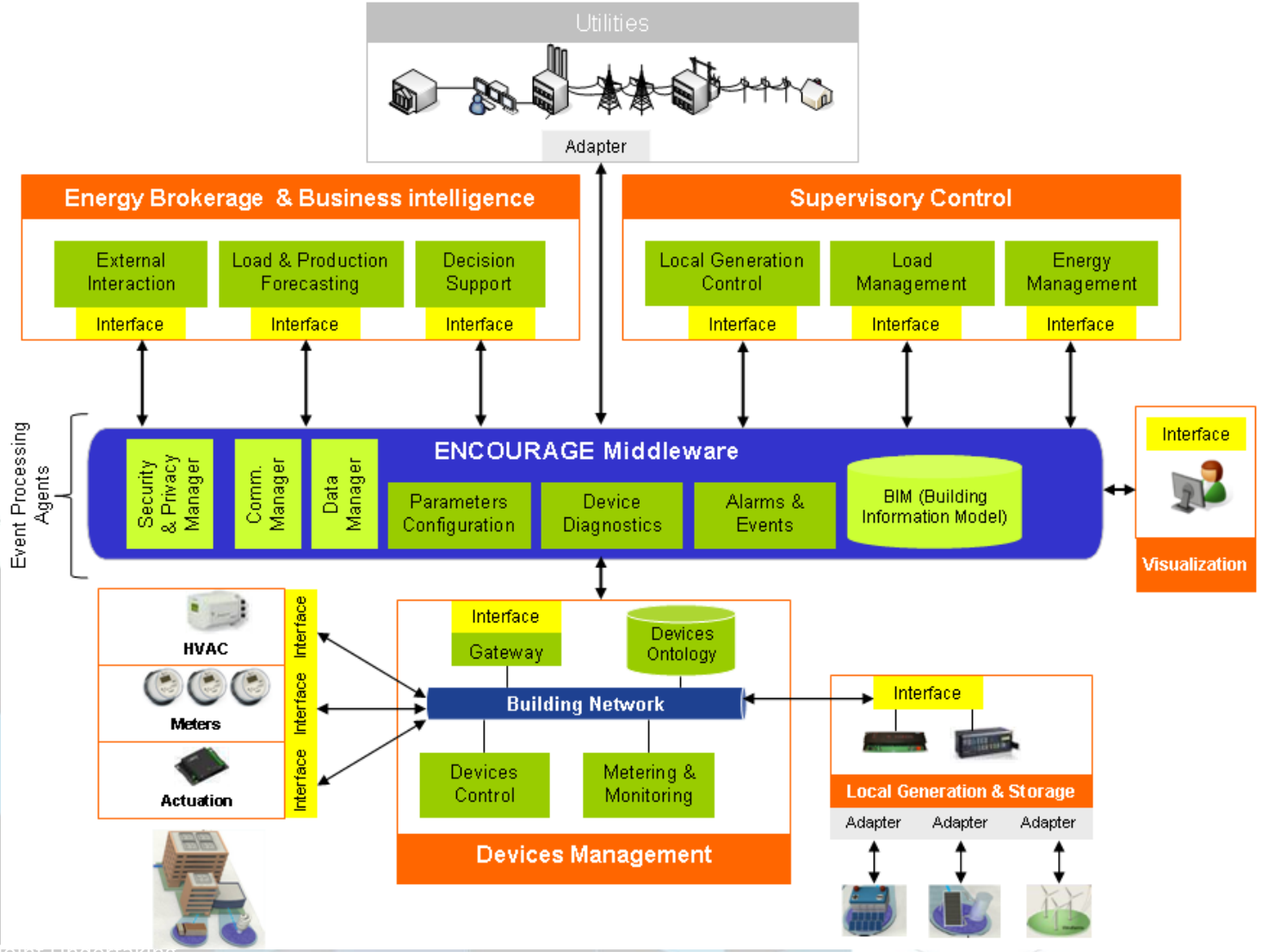
Users' needs, Business cases

Business Goal/Objective	Description
Load monitoring and diagnostic of laboratories device	Expensive and high technology
Increase of energy efficiency	Economic management and environmental commitment of the institution as well
Optimization of electric bill	High energy expenditure; optimization of electric bill is important, (new tariffs or mechanisms of active demand)
Quality and reliability of energy supply	Reliability and the quality of energy supply is one of the most important targets : avoided outages and quality of power supply





Architecture



Architecture

- Interoperability
  - Based on standards
  - Scalable
  - Decentralized components (and publish/subscribe)
    - Specifying interfaces with other blocks
  - Allowing multiple gateways at the house
    - Metering is outside of scope

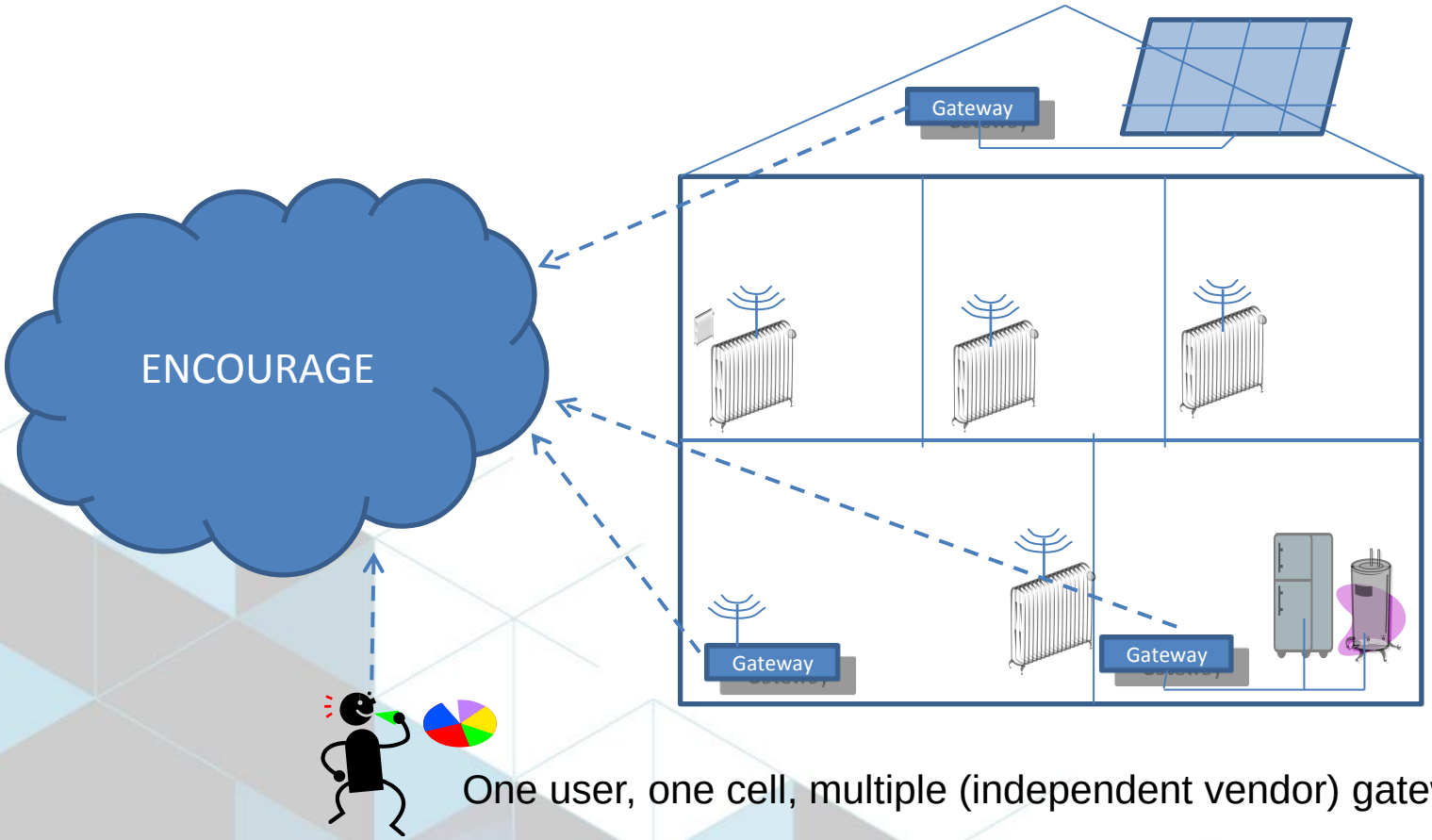
Architecture

- Based on the definition of Cell/Macro-Cell:
  - Cell aggregates multiple gateways, that control consumption and production equipment, within a living/working (environment)
  - Macro-cell aggregates several cells, which may exchange energy, thus with a joint Energy Brokerage functionality (an ENCOURAGE domain)

Architecture

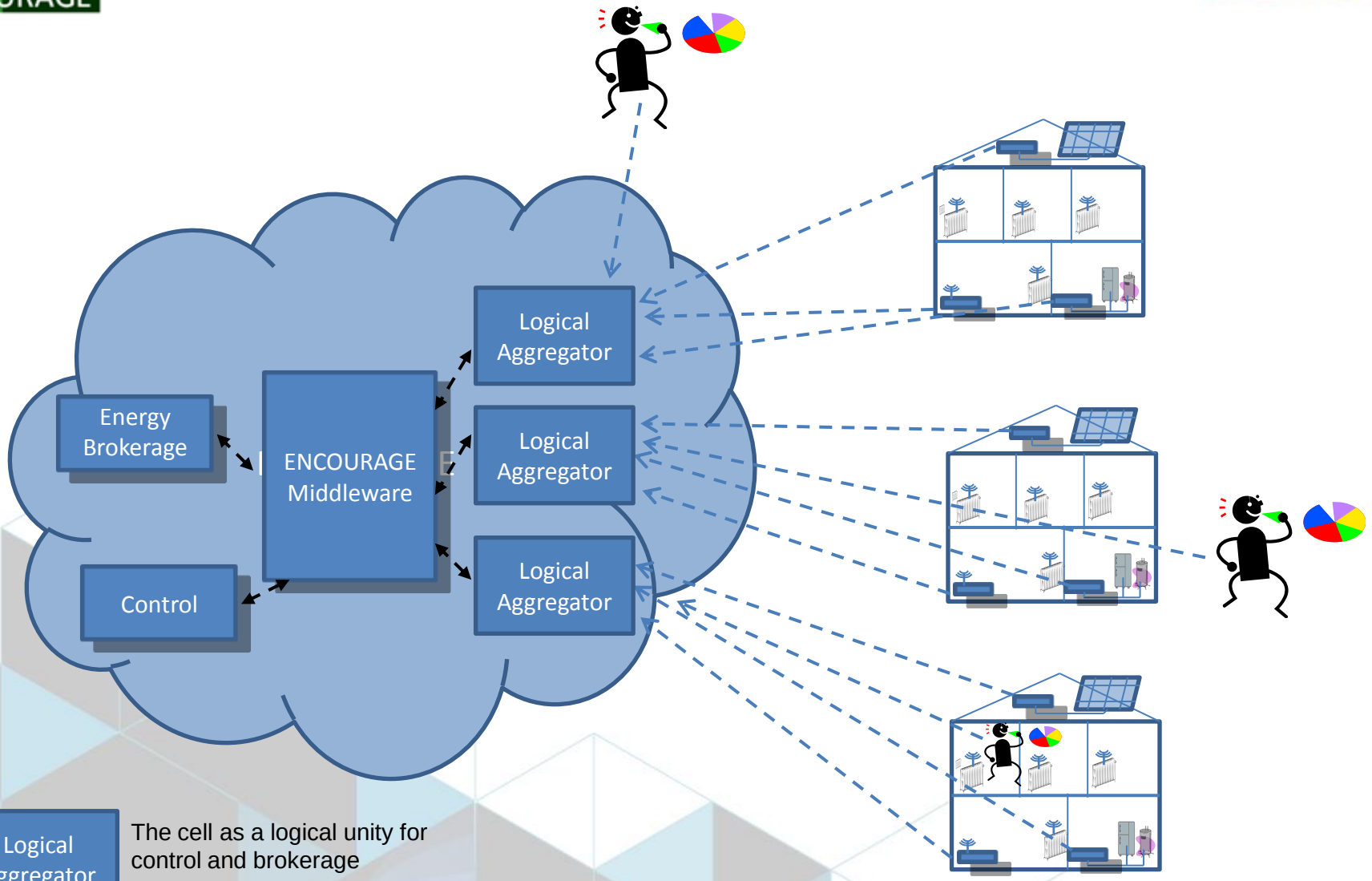
- Examples
  - One house is a cell, and multiple houses that want to share energy production are one macro-cell
  - One indivisible building (from control perspective) is a cell and multiple buildings are a macro-cell
  - One building with multiple individual units (e.g. apartments) can be a macro-cell. Each unit is a cell with individual consumption control
  - The same in buildings with multiple offices, where each office has its own control

Architecture



One user, one cell, multiple (independent vendor) gateways

Architecture



Demonstrators

- Private homes and office buildings in the city of Aalborg, Denmark
  - A housing co-operative with 8 homes, which recently installed 8 solar panel units. The buildings have electric heating.
  - A building with heat pump and solar panel

- Energy-Efficient Campus in Terrassa, Barcelona, Spain
  - This real life campus district will allow validation of the ENCOURAGE architecture as well as the social network.

- Laboratory building of Scuola Normale Superiore di Pisa, Italy
  - 4000 m^2 in a recently refurbished ancient building: energy efficiency and cost optimization, reliability and quality of energy supply

Analysis of the Monitoring Data

- Select ENCOURAGE concepts and technologies to be tested.
- Monitor specific demonstrators:
  - Define the data to be monitored and its characteristics (format, periodicity, etc.).
  - Organize the monitoring campaign.
  - Start monitoring
  - Analyse the collected energy monitoring data.
  - Refine the number and types of devices to be installed during the pilot set-up and to define any additional measurement points.

Thank you for your attention!

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