Friendly Intelligent Energy Management System for Existing Residential Buildings

R&D projects review
(in terms of information modelling)

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SEVENTH FRAMEWORK PROGRAMME

Objective

- **Comparative survey of on-going work on data modelling for Building Energy Management Systems (BEMS) through an analysis of relevant European R&D projects**
- **Take into account R&D project outputs for FIEMSER data modelling work**
- **Get preliminary insights on the appropriateness of FIEMSER model to meet specific needs of other projects**

Selection of projects

+ DEHEMS
The Digital Environment Home Energy Management System

European Workshop on ICT for Energy-Efficient Buildings, UCD, Dublin, 8th June 2010

UCD DUBLIN

Methodology

- **Use of a common template to describe projects, from the "data" perspective:**
  - Short summary
  - Targeted buildings
  - Information modelling w.r.t.:
    - Building physics
    - HVAC, lighting equipments and other devices
    - Sensors, actuators
    - Control strategies
    - User profiles
    - Weather and energy prices
  - Communication protocols
  - Databases
  - Information displayed to end-users

Main outputs

- **Two main categories of projects:**
  - Monitoring the building operation and usage → to provide services such as energy analysis & audit, performance evaluation, decision-support to energy management, or simply energy awareness and suggestions for energy efficiency improvement and energy conservation.
  - Also including active control modules → to control some individual appliances or provide more holistic and efficient energy management systems, reducing primary energy demand and/or energy costs.

    Integration of user behaviour and weather prediction models to anticipate energy needs and optimize control.

Main outputs

- **Many points of commonality, but FIEMSER follows a more holistic approach with some specificities:**
  - Addressing thermal & electrical energy, passive & active components (PV, CHP, windmills, windows, blinds, shutters, etc.)
  - Anticipating energy demand by taking into account not only weather forecast, but also usage profiles from dwellers, with the capability to revise its energy management strategy in real-time
  - Developing an IPv6-based infrastructure (6LowPan)
  - Making large use of digital TV for interacting with the end-user

Main outputs

- **Targets of analyzed projects**
  - Range from residential to industrial and commercial buildings of large size (private or public like offices, schools or hospitals).
  - New or existing buildings
  - Connection to the grid is most often considered for the global optimization of resources
  - Groups of buildings are also sometimes addressed in the context of grid-connected buildings.

Main outputs

- **Main groups of data**
  - Building physics, possibly extracted from BIM representations (IFC files or other standardized formats), and including the description of equipments
  - Sensor-based monitoring of the building
  - Building environment, including weather data (and weather forecast if relevant) and economical data (real-time energy prices for electricity, fuel, gas, water, etc., based on a hourly or daily variation)
  - Control strategies & rules
  - Building energy performance
  - User profiles and activities (associated to usage patterns)
- **Other data models may be defined depending on the specific applications targeted in the projects e.g.:**
  - scenario data model, prediction model, decision model, renovation solution model, etc.

Main outputs

- **Sensing devices**
  - temperature, air quality (CO2), water flow meter, gas flow meter, electric power or energy meter, humidity, luminosity, movement, pressure, noise, rain gauge, solar & UV irradiation, wind direction and speed, etc.
  - Wired or wireless
  - Communication protocols: 6LoWPAN, IEEE 802.15.4, Zigbee, ModBus, PLC protocols, DALI, etc.
- **Equipments**
  - Energy generators, including the use of renewable energy sources: boilers, solar panels, photovoltaic panels, CHP, wind turbines, geothermal, heat pumps
  - Energy consumers: heat emitters, air conditioning, ventilation system, domestic hot water, lighting, household and other electrical appliances (wash machines, dishwashers, driers, fridges, cooking ovens, fans, heat pumps…)
  - Energy stores: batteries, water tank, fuel cells, phase changing materials (more rarely considered)
  - Other types of equipment taking part in the energy demand: windows, blinds… (manually or automatically controlled)

Main outputs

- **User preferences**
  - Comfort settings
  - User behaviour (i.e. building usage), when taken into account, most often results from the identification of pattern usages.
- **Weather forecast**
  - Use of external web services providing hourly values for temperature, humidity, solar irradiation (sometimes extrapolated from information on cloud cover), wind speed and direction, etc.
- **User interfaces**
  - Most often desktops, sometimes TV and mobile applications are also envisaged
  - End-users: building occupants (in the first place), facility managers, and utility companies
  - Displayed information: current and aggregated consumption data (globally or detailed by appliance), energy prices and savings, carbon fingerprint, electricity usage for households, suggestions for improvements, etc.