ITEA 2

INFORMATION TECHNOLOGY FOR EUROPEAN ADVANCEMENT

Enerficiency

INNOVATION REPORT

Towards optimum energy management

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Energy demand, its economic consequences and the implications for climate change are probably the most significant challenges facing any government at the start of the 21st century. Huge investments are being made on the supply side in energy alternatives, renewable energies and carbon footprint reduction. Yet if these massive investments in energy resources are to deliver results, they have to be matched by improvements on the demand side in the efficiency of energy consumption. By increasing the level of intelligence on the consumer side.

The ITEA 2 ENERFICIENCY project began by identifying the end user needs of the different actors in the sector to come up with a list of user scenarios, whose solutions cover a broad field of applications beyond the current state of the art in the domain, and then implementing the use cases on a distributed platform. This required the design of innovative software modules and algorithms, the implementation of HMI modules and the development of an interoperability framework. The solutions to these requirements were based on computational intelligence, sensor networks and communication technology. These solutions are expected to significantly improve energy efficiency performance for buildings while building energy models can be used for both backcasting and forecasting as well as for optimum control scenarios. So a specific aim of ENERFICIENCY was to enable reliable modelling and prediction, even where only partial information is available, as in the case of existing buildings for which no detailed building information models may be available.

Visualisation and HMI

ENERFICIENCY focuses on the needs of the end user, so the visualisation module became a key success factor since it has to allow the modelling and intelligence to be exploited and the innovative methodologies in the multi-functional building management system or building design software to be seamlessly integrated. Furthermore, with short and medium-term business potential having been identified in the extension or creation of new energy-efficiency products, based on the integration of the newly developed energy-efficiency optimisation software modules and HMI solutions, the project provided a framework for validation and testing in the context of the user scenarios and on the basis of existing sites (Experimental Building, Office Building, University Campus).

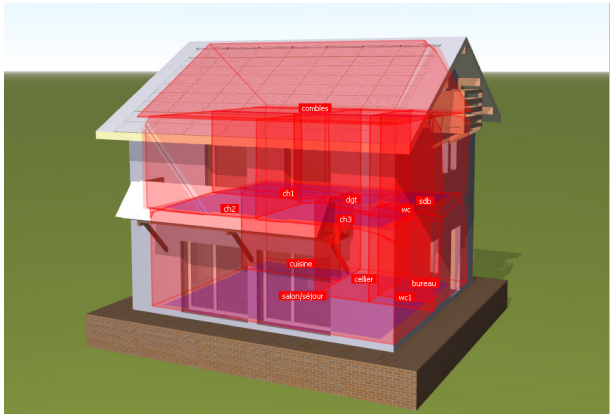

Fig 1: BIM Extraction (White Box model)

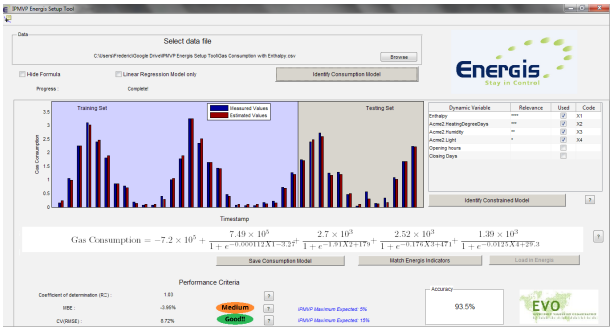

Fig 2: Correlation (Black Box model)

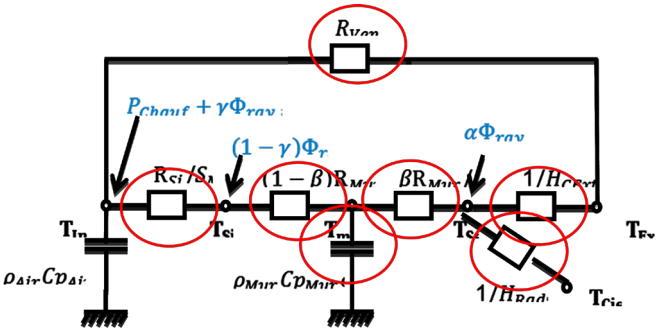

Fig 3: Analogy with electric network (Grey Box model)

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In the medium term, the interfaces developed in the context of the distributed architecture could generate service-based commercialisation models and platforms. These interfaces may even contribute to the definition of a new standard of energy-efficiency interoperability.

Innovation ... in a box

The main innovations include the real-time optimisation and integration of externally forecasted variable data (e.g. weather predictions) that impact upon the building's energy consumption patterns and, in turn, the 'energy gap'. This reduction of this energy gap has been facilitated by improved modelling of passive buildings, enhanced sensors (heat flux measurement prototype), improved predictions (grey-box self-learning models), real-life case assessments and assessments in a controlled environment (such as the INCAS platform, a full scale test facility developed since 2008 including 4 PASSYS test cells, 4 experimental houses and 10 PV-integration benches). The project also developed automatic control with grey-box (semi-physical) models incorporating a methodology and tool box for model identification and the implementation of real-time automated control in an operative building control system (including predictions based on current state and forecasted inputs, optimisation and monitoring). Black box data-driven modelling focused on measuring energy savings in compliance with the International Performance Measurement and Verification Protocol (IPMVP) standard while simulation and modelling functions for architects were developed (energy BIM platform: ArchiWizard). Through the full spectrum of white, grey and black boxes along with whole loop sensors, predictors and evaluators, the energy gap can be reduced.

Demonstrating ...

There were several demonstrations of the results of the project, including a grey-model selection system of the Belgian SME 3E whereby the number of non-physical parameters were adjusted to find the appropriate prediction model and a 3E predictive heating control based on the learnt grey-model (to achieve appropriate temperatures during working hours). The Energis demo (dashboard UI) of the Belgian SME Freemind involved a prediction model to measure the actual 17-21% energy saving achieved by various measures while CEA demonstrated results with INCAS houses test bed that allows to develop numerous strategies of global energy management and solar inputs control.

... and exploiting

Exploitation is evident in three domains. Firstly, in the integration services in the energy domain. Airbus Defence and Space has achieved progress in implementing energy and site management functionality inside the SecuriSyte situation awareness application as well as improved and extended the Airbus Defence and Space communication and interoperability asset with adapters for energy monitoring software such as the Freemind Energis product and software for architects such as HPC-SA ArchiWizard. A general trend is in clear evidence in this domain: further integration and dismantling of application silos.

INCAS platform from CEA - a full scale test facility including 4 PASSYS test cells, 4 experimental houses and 10 PV-integration benches

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In the ESCO (Energy Service Company) market, the Freemind Energis IPMVP tool developed and tested in the context of the ENERFICIENCY project will allow continuous consumption verification and savings quantification. This software will complement the range of products and services developed under the Energy Management Systems (EMS) activity in the field of Energy Performance Contracts while predictive simulations will be used to define the parameters and forecast consumption linked with thermal performance comfort in lighting. In the 3E spin-off, LESS (Local Energy Savings Solutions), energy efficiency in tertiary buildings is being targeted using the ESCO business model.

In the EMS market – the automated control and monitoring of electromechanical facilities in a building that yield significant energy consumption – the data obtained can be used to perform self-diagnostic and optimisation routines and to produce trend analysis and annual consumption forecasts. During the ENERFICIENCY project Freemind added conditional control capabilities (e.g. switch off lights, air conditioning) in its Energis product to enable buildings that do not have a Building Management System to save energy by controlling its equipment. Generally, in view of the high impact of energy use in their processes, industrial companies are early adopters of energy management initiatives while ESCO companies purchase EMS and software to combat cost and climate change (energy targets), and to track financial data.

The bottom line

The ITEA 2 ENERFICIENCY project set about developing a comprehensive, flexible and configurable open software platform able to analyse and respond to user needs in managing energy demands and consumption. The objective of enabling businesses to establish effective business models that are attractive to the market and boost competitiveness is crucial in the context of the European ‘20-20-20’ target: to reduce greenhouse gas emissions by 20% below 1990 levels, increase energy efficiency by 20% and achieve a 20% share of renewable energy in total energy consumption by 2020. Energy Management Systems will help achieve these targets by both optimising buildings’ energy consumption on the basis of predicted future consumption and by securing investments for energy savings. The ENERFICIENCY project results are not only expedient in large-scale integration solutions but, with growth in global building energy management systems expected to be strong, will also help to boost the EU’s ambition to excel in the energy efficiency domain and, in its pioneering role in relevant regulations and standardisation, create a precursor market and an opportunity for local companies.

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