

Chapter 16

Web and Cloud Management for Building Energy Reduction: Toward a Smart District Information Modelling

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ABSTRACT

ICT is recognized as being a key player against climate change: pervasive sensors and actuators can efficiently control the whole energy chain. On the other side, advances on 3D modelling, visualization, and interaction technologies enable user profiling and real-time feedback to promote energy-efficient behaviours. The study presented in this chapter illustrates the development of a Web service-oriented, open platform with capabilities of real-time district level data processing and visualization. The platform will allow open access with personal devices and A/R visualization of energy-related information to client applications for energy and cost-analysis, tariff planning and evaluation, failure identification and maintenance, energy information sharing. The expected results are a consistent reduction in both energy consume and CO₂ emissions by enabling more efficient energy distribution policies, according to the actual characteristics of district buildings and inhabitants as well as a more efficient utilization and maintenance of the energy distribution network, based on social behaviour, users lifestyles, and singular demands.

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INTRODUCTION

According to the EU directive on the energy performance of buildings (EPBD-recast 2010), more than 40% of energy consumption in Europe is due to the operations of heating, cooling and lighting in buildings. Although an innovative technological approach in recent years has allowed the construction of more efficient buildings, we must point out that an increase in demand and energy (EC, 2010) consumption by end-users shows a total energy consumption on the rise since 1990.

Despite the significant progresses achieved in newly constructed buildings, existing buildings, and the historical ones in particular, still need special-purpose attention, as well as methods and tools for increasing their energy efficiency and for their proper automation. Moreover, the district/quarter level is still not sufficiently addressed and integrated with the other levels.

Energy efficiency is at the heart of the EU's Europe 2020 Strategy for smart, sustainable and inclusive growth and of the transition to a resource efficient economy. More specifically, the Union has set itself a target for 2020 of saving 20% of its primary energy consumption compared to projections and this objective was identified in the Commission's Communication on Energy 2020 as a key step towards achieving our long-term energy and climate goals (Lombardi and Trossero, 2013).

Although substantial steps have been taken towards this objective, recent Commission estimates suggest that the EU is on course to achieve only half of the 20% objective. Responding to the call of the European Council of 4 February 2011 to take 'determined action to tap the considerable potential for higher energy savings of buildings, transport and products and processes', the Commission has therefore developed this comprehensive Energy Efficiency Plan (COM/2011/0109 final).

This will be pursued consistently with other policy actions under the Europe 2020 Strategy's Flagship Initiative for a Resource Efficient Europe, including the 2050 roadmap for a low-

carbon economy, to ensure policy coherence, assess trade-offs between policy areas and benefit from potential synergies. The strategy focuses on instruments to trigger the renovation process in public and private buildings and to improve the energy performance of the components and appliances used in them. It proposes to accelerate the refurbishment rate of public buildings through a binding target and to introduce energy efficiency criteria in public spending. It also foresees obligations for utilities to enable their customers to cut their energy consumption.

European Commission is stressing the importance of ICT for energy reduction and sustainability (Lombardi, 2011). ICT is a key player against climate change offering the possibility of 7,8 Gt reduction of CO₂ emission in 2020. ICT systems can efficiently control the whole energy chain, from production, to consumption, transportation and storage (Kelly, 2010). For the above mentioned reasons, ICT has been identified as one possible means to design, optimize, regulate and control energy use within existing and future (smart) buildings.

Existing activities and softwares are mentioned to understand gaps and opportunities to be implemented, such as 3D modeling, visualization and interaction technologies that enable user profiling and real-time feedback to promote energy efficient behaviours.

To unlock the potentiality of these technologies, the study focuses on the development of a "smart" integrated unique digital network and cloud archive for the city, using existing Smart Grid that comprises the networking and control of intelligent generation, storage, consumers and interconnected elements of energy distribution and transmission systems by the means of ICT. A specific objective of the study is to experiment a co-designing approach to adapt the existing information platform to householders needs in order to facilitate their habit changing. The co-design approach oriented to consumer practices asks for innovative solutions to stimulate behav-

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