ICT 4 E2B Forum - European stakeholders' forum crossing value and innovation chains to explore needs, challenges and opportunities in further research and integration of ICT systems for Energy Efficiency in Buildings

Deliverable D1.4: Updated analysis of the state-of-the-art and research projects

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SEVENTH FRAMEWORK PROGRAMME

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1 Introduction

1.1 Purpose of this Document

This report is the result of the work performed in the Task 1.4: "Updated analysis of the state-of-.the-art and research projects" of the EC-FP7 project ICT4E2B Forum.

The main objectives of this deliverable are the following:

- to update to March 2012 the international State-Of-the-Art (SOA) in industry and research taking in particular account the input coming from D1.2 *"Initial analysis of the state of the art"*;

- to update to March 2012 the relevant information on the available results from ended and ongoing projects within FP7 programmes (ENERGY, ENV, ICT, NMP, SME) and CIP programmes (ICT-PSP and IEE) related to the impact of ICT for Energy Efficiency in Buildings, taking into account the results obtained in D1.3 *"Initial Analysis of Research Projects*" ;

- to extend to March 2012 the reference to European National Research and Technology Development frameworks and International Research and Technology Development framework on ICT for Energy Efficiency in Buildings started since 2007 developed in D1.3 *"Initial Analysis of Research Projects*. Finally, this analysis has been extended to a larger number of countries both at European and Internationa level; in particular we added the distinction between European countries belonging to EU-27 and European countries not belonging to EU-27.

1.2 Document Structure

The present document is structured as follows:

- Chapter 2 presents the updated state-of-the-art analysis of Scientific Literature on ICT for Energy Efficiency in Buildings

- Chapter 3 shows the updated state-of-the-art analysis of the industrial sector on ICT for Energy Efficiency in Buildings

- Chapter 4 presents the analysis on RTD Projects funded by European Commission in the area of ICT for Energy Efficiency in Buildings

- Chapter 5 presents the analysis on National RTD Framework at European and international scale on ICT for Energy Efficiency in Buildings

- Chapter 6 reports some key conclusions about the result of the performed analysis.

1.3 Contribution of Partners

D'Appolonia had the main responsibility to prepare this document. D'Appolonia performed a quantitative and qualitative analysis of the scientific literature. In the meanwhile the other partners have identified relevant industrial cases, allowing to analyse different aspects related to industrial state-of-the-art for the different thematic areas namely:

- the actual state of the art in term of technologies adopted at industrial level;
- the available standards that can support the adoption of such technologies;
- the actual adoption of the State-of-the-Art technologies, both in term of breadth and sophistication;
- the industrial needs that can foster the adoption of these technologies;
- the non-technological barriers that can prevent the adoption of State-of-the-Art technologies.

Furthermore, the preparation of project reviews and National R&D Frameworks reviews has been divided between partners according to their facility to gather information or specific interest:

- **DAPP**
    - Assigned Projects: BEAMS, BUILDSMART, CASCADE, CAMPUS21, CLEAR-UP, COST-EFFECTIVE, E3SOHO, EASE, ECOGRID EU, EDISON, E-HUB, ENERGY WARDEN, FIEMSER, GE2O, GENESI, H2SUSBUILD, HEAT4U, , GREEN@Hospital, INTASENSE, S4EEB, SEEDS, SEEMPUBS, SMARTSPACES, SMART BUILD, SPORTE2, V-CITY, VERYSCHOOL;

    - Assigned Countries: AUSTRIA, BELGIUM, GREECE, HUNGARY, IRELAND, ITALY, UNITED KINGDOM, BRASIL, SOUTH KOREA, ARAB EMIRATES, SERBIA AND SWITZERLAND;

- **ATOS**
    - Assigned Projects: 3e-Houses, BEST ENERGY, BEYWATCH, eDIANA, ENERSip, ENCOURAGE, HOBNET, H-KNOW, MEEFS RETROFITTING;

    - Assigned Countries: BULGARIA, PORTUGAL, ROMANIA, SPAIN, SOUTH AFRICA, PERU, MEXICO AND ISRAEL;
- **VTT**
    - Assigned Projects: BE AWARE, BRIDGE, CLIMAWIN, DEHEMS, ECO-LIFE, HESMOS, HOSPILOT, INTUBE, IREEN, ISES, LITES, PICODICON, POBICOS, REEB, REVISITE, SAVE ENERGY;

    - Assigned Countries: FINLAND, LATVIA, LITHUANIA, LUXEMBRUG, USA, CANADA, NEW ZEALAND, RUSSIA;

- **SAP**
    - Assigned Projects: AIM, CETIEB, ECHO2ECO, ESESH, NOBEL, PIME'S, SMARTCODE, SMARTHOUSE/SMARTGRID;

    - Assigned Countries: CYPRUS, GERMANY, MALTA, SLOVAKIA, JAPAN, INDIA, MALAYSIA, SAUDI ARABI;

- **SCHNEIDER**
    - Assigned Projects: ENRIMA, GREENERBUILDINGS, NICE, PEEBLE,SCHOOL OF THE FUTURE;

    - Assigned Countries: DENMARK, FRANCE, NETHERLANDS, SLOVENIA, SWEDEN, CHINA, NORWAY, ICELAND AND VENEZUELA;

- **MOSTOSTAL**
    - Assigned Projects: ENPROVE, FC-DISTRICT, MOBI3CON, KNOHOLEM, TIBUCON;
    - Assigned Countries: CZECH REPUBLIC, ESTONIA, POLAND, AUSTRALIA, ARGENTINA, TURKEY, CROATIA.

2 Scientific Literature State-of-the-Art Analysis

The exploration of the relevant articles was based on the study of the scientific literature Database, retrieving and analysing relevant papers and scientific information sources. In particular we chose the **Elsevier Compendex Database**[1] as information source, which is the most comprehensive bibliographic database of scientific and technical engineering research available, covering almost 200 engineering disciplines. It includes over 12,6 millions of bibliographic citations and abstracts from thousands of engineering journals and conference proceedings; combined with the Engineering Index Backfile (1884-1969), Compendex covers well over 120 years of core engineering and scientific literature. The database collects papers on different languages, but most of the non-English articles offer also a translated version. To simplify the search and to avoid risk of repetitions, we chose to perform the search only in English language.

Once the queries were set, we performed a deeper analysis on different levels:

1) Articles on ICT4E2B sector from September 2001 up to now (Section 2.1): to focus on the most recent achievements.
2) Articles on identified priority areas from September 2001 up to now (Section 2.2): to deeply analyse each priority area; here we present also a collection of particularly relevant articles found.

2.1 Scientific Literature Analysis on Overall ICT for Energy Efficient Buildings Sector

In order to update the Scientific Literature State-of-art analysis regarding ICT for energy efficiency in buildings from the year 1970 up to now we used the following query identified taking into account the results obtained in the deliverables D1.2 *"Initial analysis of the state of the art"*.

To cover this large domain within the literature database, after a long iterative definition process, it was selected a generic search criteria based on the main keywords of the analysis topic itself.

The process definition of this search criteria aims to retrieve only the papers related to the cross domain of **building**, **ICT** and **energy efficiency** and excluding (i.e. not harvest) the irrelevant sources, as described in the following steps:

- First of all, only the papers in English language have been considered
- The building sector was defined using the following terms: **building, buildings,** and **residential** .
- The ICT domain was described using the following terms: **ICT, information, technology, software, and automation** ;

[1] http://www.engineeringvillage.com/

- The energy efficiency topic was defined considering a pair of keywords composed by the term **energ*** placed near the term **effic***;

- Finally, many keywords like **mobile, "power station", vehicle, sound, nuclear, cortical, “call center”, green, and student** were not considered because they are too generic or borderline, with the aim of deepening the results by removing the unwanted articles among a well defined domain of literatures.

This was the elaborated strategy to get the highest chance of retrieving relevant papers, leaving irrelevant ones out of the ensemble.

The resulting query has been extensively tested in the period from year 1970 up to now.

2.1.1 ICT4E2B from 1970 up to now

After a solid definition of the query, we analysed the papers regarding ICT for energy efficient buildings recorded from year 1970 up to now. In Figure 1 it is shown the trend of the number of publications from 1974 to 2011. It is interesting to note that in 2011 there have been published 107 more papers by respect to 2010, the largest increase in the whole series corresponding to about 200% percentage increase.

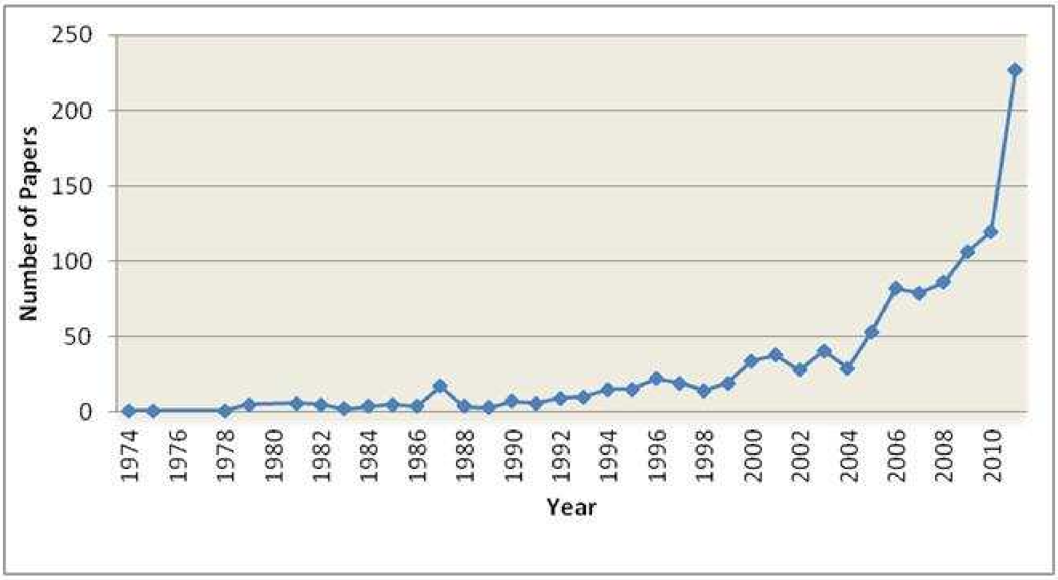

Figure 1: Yearly Trend of Scientific Publications on Energy Efficient Buildings

From the country distribution analysis in Figure 2: Publications in the World it is evident the United States predominance followed by China. It is worth to notice that China published almost two thirds of its papers in the last two years.

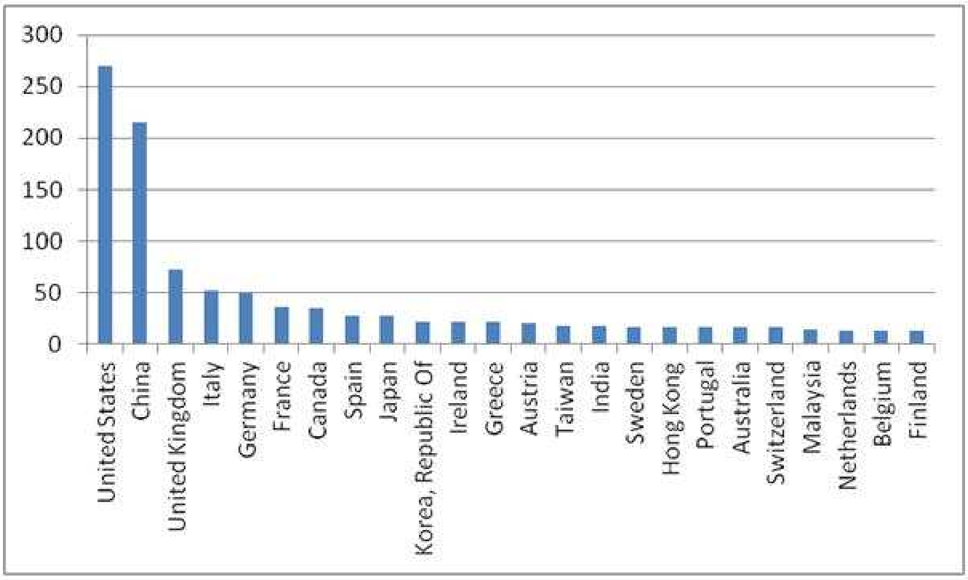

Figure 2: Publications in the World since 1970

Within this bulk of 1196 scientific publications, despite the predominance of US considering single countries, it is interesting to underline the relevant role of European Union as a whole, as shown in Figure 3.

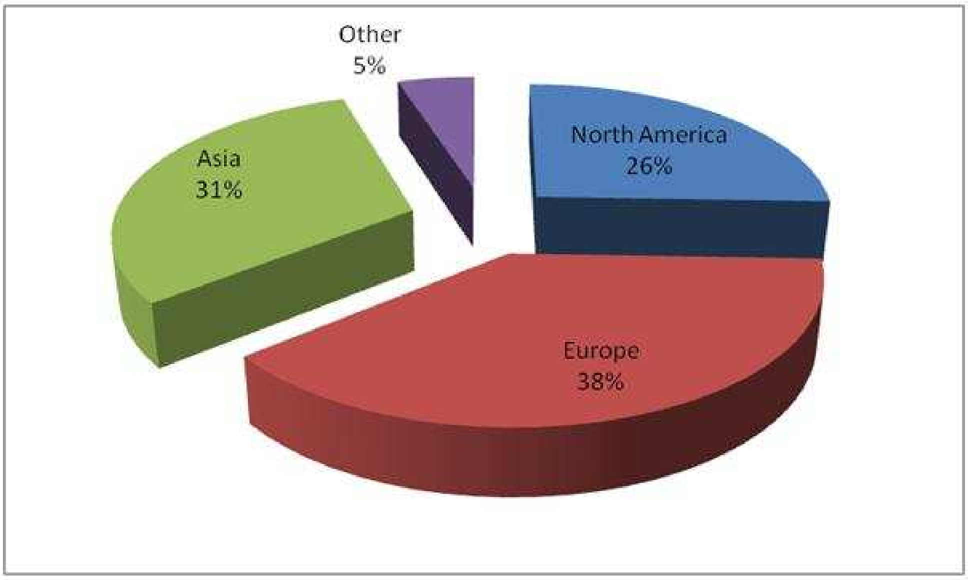

Figure 3: Publications by Continent since 1970

Figure 4 **Error! Reference source not found.**displays data on EU 27 countries only, and it shows that, among European countries, UK clearly leads the way before Italy, Germany and France. These four countries alone published more than half of the whole number of papers published in Europe since 1970.

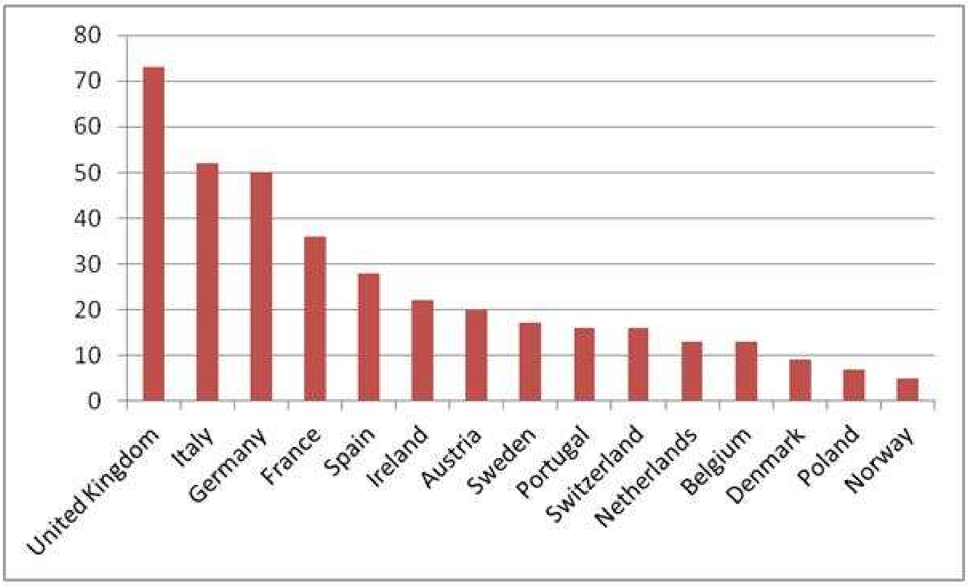

Figure 4: Publications in Europe since 1970

The result of this overall analysis confirms the continuous level of global involvement toward the area of ICT for energy efficiency in buildings in the last 40 years and more particularly in the last two-years period, where improvement of old technologies and investigation of new approaches are necessary to face the challenge.

2.2 Scientific Literature Analysis on Identified Priority Areas

With reference to the previous deliverables and to perform an update of the scientific literature analysis over the five ICT4E2B Forum priority areas, the general result ensemble, that allowed identifying the whole ICT for Energy Efficient Buildings research field, acted as baseline to address the involved technologies on each priority area.
In fact, by considering relevant keywords, it has been possible to define specific ensemble for each area as described in the following paragraphs.

2.2.1 Scientific Literature Analysis on Tools for Energy Efficient Design and Production Management

In this paragraph, we developed, for the priority area “Tools for Energy Efficient Design and Production Management”, an “ad hoc” query able to clearly cover the information domain.

It is important to underline that the keywords identified are based on the ICT4E2B classification itself, and that their whole semantic family is considered by Natural Language Processing algorithms instead of the literal word (e. g. the word “efficiency” is considered together the word “efficient”).

With reference to the above consideration, in order to provide a quantitative description of the influence of this priority area in the whole energy efficiency in buildings scenario and after the analysis of a restricted domain of relevant keywords, only terms like **design, modelling, develop,** and **simulation** have been added to characterize the search criteria.

Considering the classification by country, 44 countries are involved in innovation and research activities related to these topics as described by the published scientific literature. In this scenario, China and United States are the country leader (see Figure 5**Error! Reference source not found.**) while Europe continent holds the leading (see Figure 6).

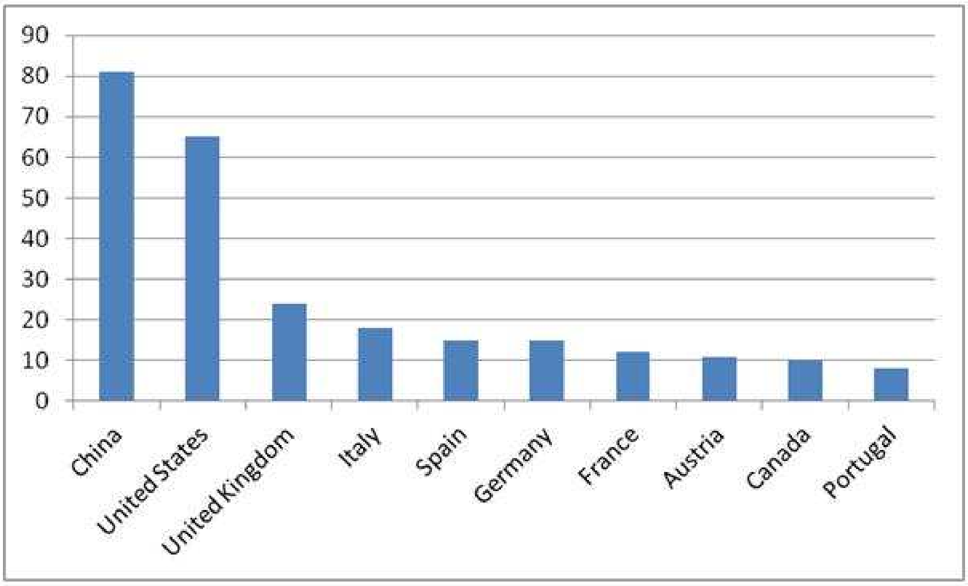

Figure 5: Tools for Energy Efficient Design and Production Management in the World (countries with more than 5 papers)

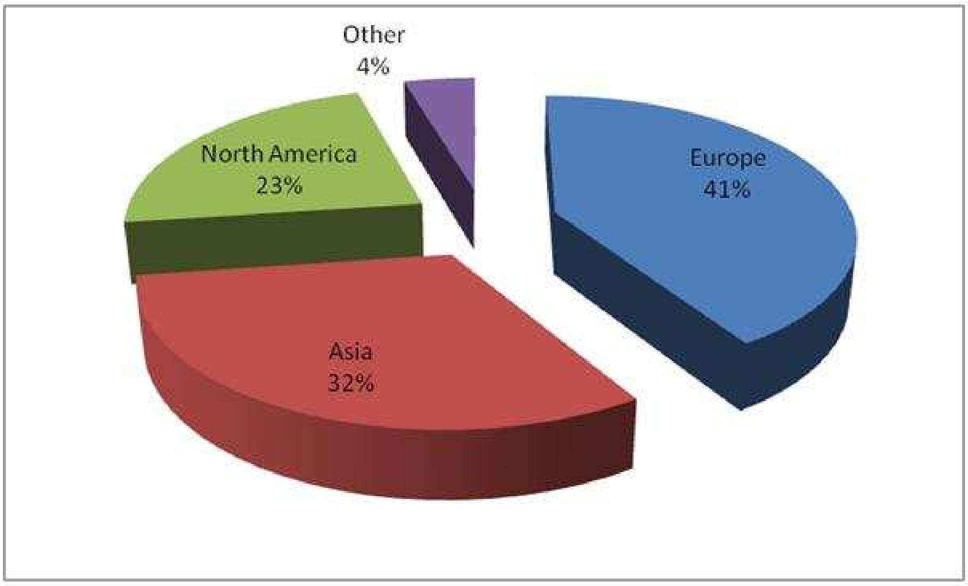

Figure 6: Tools for Energy Efficient Design and Production Management by Continent

Among EU 27 United Kingdom leads the research followed by Italy and Spain (see Figure 7).

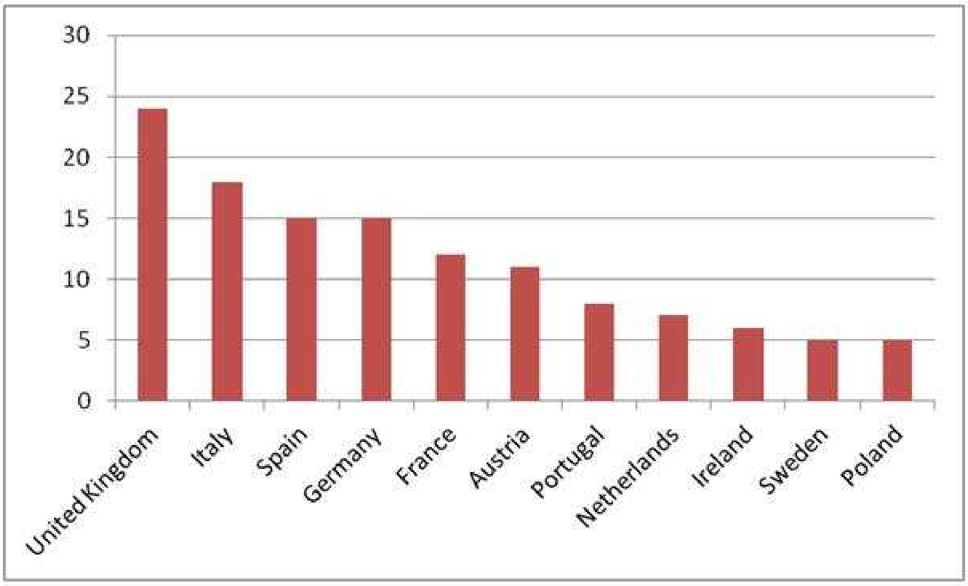

Figure 7: Tools for Energy Efficient Design and Production Management in EU 27

The following graph (Figure 8) shows the most representative classification codes occurred in the literature analysis of the first identified priority areas.

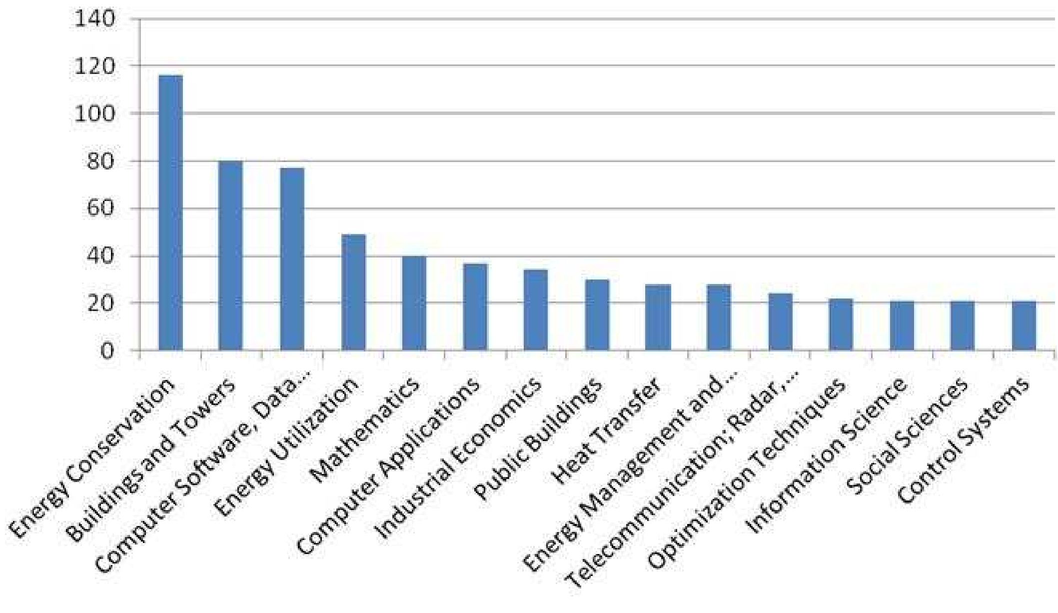

Figure 8: Most relevant Classification codes of Publications on Tools for Energy Efficient Design and Production Management

2.2.1.1 Relevant Identified Papers

In this section we present the two most relevant papers identified during the analysis of the current priority area. The selection process has been performed reading each paper abstract and finding out those that explain the impact of the technologies research activities currently adopted.

2.2.1.1.1 A semantic representation of energy-related information in future smart homes

With the ever increasing device count and the introduction of pervasive computing in residential homes, naturally also the energy demand constantly rises. Currently, much effort is put in counteracting this development by making appliances more energy efficient. However, a still widely neglected potential for energy savings resides in the use, control and interaction of facilities. To reach their full efficiency during operation, a comprehensive software system that orchestrates all energy facilities in the home is needed. Such a solution also provides an integration point for decentralized energy production systems and smart grid applications. To operate successfully, the system has to be aware of a multitude of different energy parameters and facilities as well as providers in order to make energy efficient decisions on behalf of the user, thus aiding in the realization of an eco-friendly operation of the smart home.
In this work, written by Kofler Mario J. from Vienna University of Technology, Automation Systems Group, such a smart home knowledge base is realized following the Web Ontology Language (OWL) standard. Its structure makes all knowledge easily available to the smart home system and considerably supports the control processes with its inherent logic [1].

The paper fits completely with the research topics related to “Tools for Energy Efficient Design and Production Management” priority area and in particular well addresses the research topic related to the development of specialized ontology for multi-system integration of BIM.

2.2.1.1.2 Feasibility study and numerical simulation of a ground source heat pump plant, applied to a residential building

The evaluation of the efficiency of ground source heat pump (GSHP), is studied in a residential building divided in two independent apartments blocks.

The numerical results are produced by using the software tool TRNSYS 16. The results include the trends of the thermo-climatic variables and a comparison between conventional and geothermal systems analyzing operational and capital costs.

The GSHP studied in this paper produces a thermal power output of 29 kW in winter and a cooling power output of 26 kW during summer time.

The numerical simulations have highlighted that with such a system, the GSHP has a winter coefficient of performance of 4.9, and a warm season coefficient of performance which reaches 2.3. The simulations show that the best plant configuration consists of a winter heating GSHP system and a summer free-cooling bypass. The thermo-climatic variables inside the building provide good comfort conditions [2].

Mr Desideri, from the Department of Industrial Engineering, University of Perugia, presents this paper that fits completely with the research topics related to “Tools for Energy Efficient Design and Production Management” priority area.

2.2.2 Update of the Scientific Literature Analysis on Intelligent Control

In this paragraph, we developed an “ad hoc” query able to clearly cover the information domain for the priority area “Intelligent Control”.

Using as basis the taxonomy presented in Deliverable D1.1 and D1.3 about “Intelligent Control” domain, we performed a careful analysis of paper abstracts representing this domain with several iterations.
Considering the classification by country, 36 countries are involved in innovation and research activities related to these topics as described by the published scientific literature.
In this scenario, China has by far the greatest number of papers published, followed by United States (see Figure 9). These two countries together published more than half of the total number of articles, while the continents that gave the largest contribution are Europe and Asia (Figure 10).

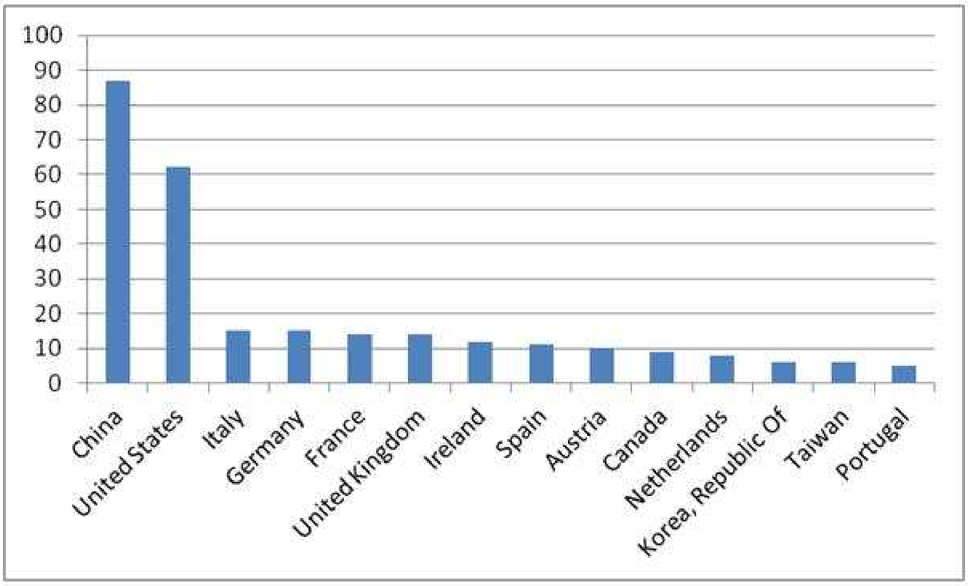

Figure 9: Intelligent Control in the World (countries with more than 5 papers)

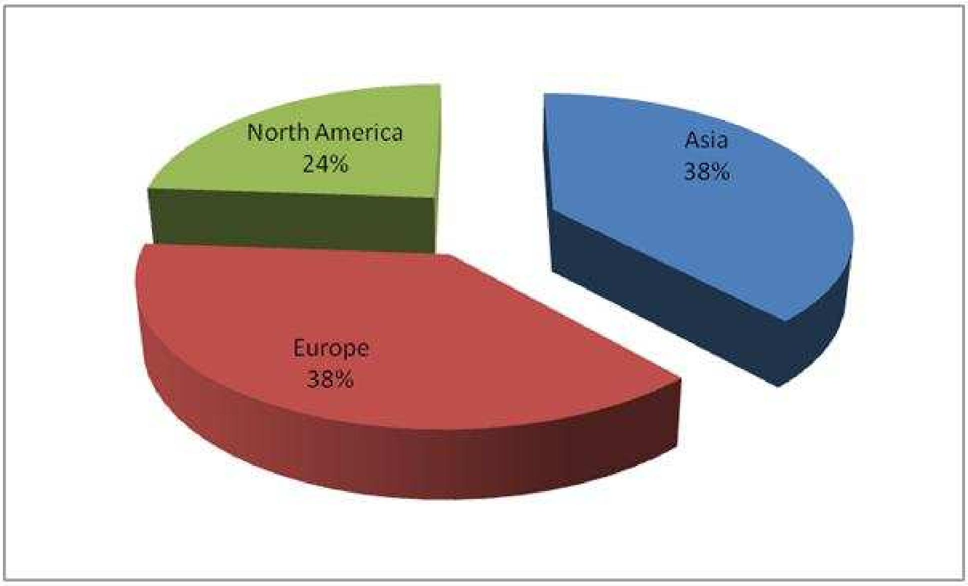

Figure 10: Intelligent Control by Continent

Regarding the publications for the Intelligent Control priority area for EU 27 (see Figure 11), Italy is on top of graph together with Germany followed by France, overall, the number of EU publications does not vary much across the different countries.

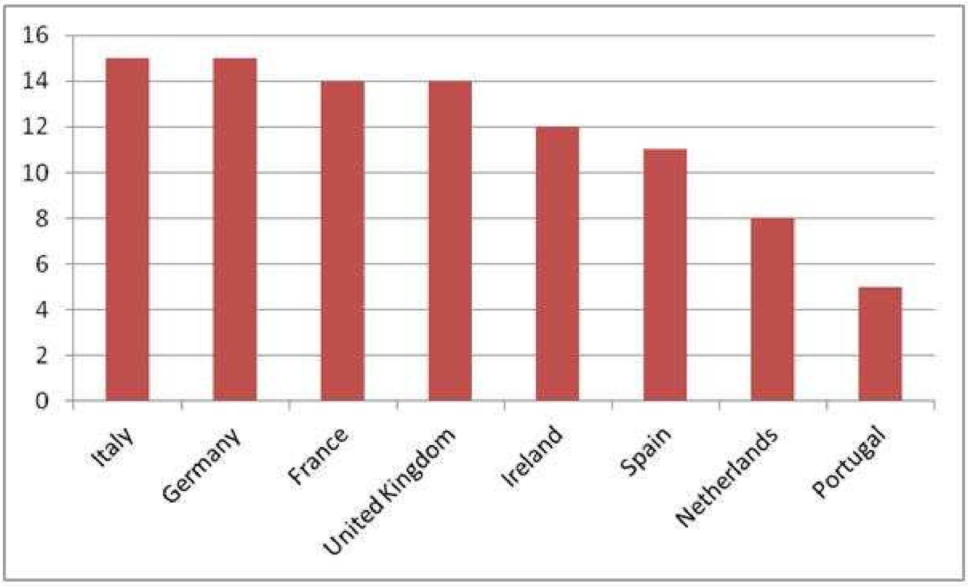

Figure 11: Intelligent Control in EU 27

2.2.2.1 Relevant Identified Papers

This section presents an overview of the analysis performed by reading abstracts of the relevant papers previously identified in the area of Intelligent Control.

2.2.2.1.1 <u>Wireless energy meters for distributed energy efficiency applications</u>

Considering that European and national statistics on energy consumptions show that buildings have a significant energy impact and their consumptions approximately amounts 40% of the total energy and, according to forecasts, they trend up during next years, it is known that the application of energy smart metering tools can boost energy savings in buildings, leveraging on enhanced awareness.

This work, written by Fattoruso Grazia; Di Palma Ciro; De Vito Saverio; Casola Valentina and Di Francia Girolamo from ENEA and University of Napoli Federico II, presents a pervasive power usage monitoring system based on a wireless energy meter network which can be easily deployed to monitor energy consumptions of appliances in households or computing hardware and related infrastructures in data centers. Two wireless energy meters, as base units of a sensor network, has been designed and developed: a power adapter energy meter and a clamp based energy meter. The adapter is to be employed for monitoring devices that can be plugged to a power outlet while the clamp for heavy loads and devices that cannot be safely or easily unplugged. A base station receives data gathered through all sensors of the network, acting as a gateway to the internet. Ad-hoc web based GUIs provide users with relevant information about real time and aggregated energy consumptions in the selected application [3].

The paper fits completely with the research topics related to “Intelligent Control” priority area.

2.2.2.1.2 <u>A smart lighting control to save energy</u>

In Europe the amount of the electrical energy used in illuminating the interiors of medium and large buildings is considerable of about 40%. Energy saving actions could follow two basic directions: efficiency and effectiveness. Efficiency, by new more performing equipment (lamps, control gear, etc.) and by utilization of improved lighting design practices (localised task lighting systems). Effectiveness by improvements in lighting control systems to avoid energy waste and by adopting a technical building management system (maintenance and metering). By controlling the lighting in such a way that the lighting level is always accurately matched to the actual need allows to save on the energy costs and to improve the human comfort and efficiency. Establishing an integrated lighting control concept is a very important part of the lighting design process. Directly controlling and managing energy consumption it is possible to reach high effectiveness in energy management [4].

The main research topics related with this paper are different and from different priority areas.

This paper also is relevant for "Intelligent Control" priority areas: in particular it fits in Smart Lighting and Monitoring research topics from this priority areas.

2.2.3 Scientific Literature Analysis on User Awareness and Decision Support

In this paragraph, we identified an ensemble covering the information domain for the priority area "User Awareness and Decision Support",.

This research area has been deeply analysed, since there are available tools/applications, which exploit real time energy consumption information and help the different stakeholder to define the level of efficiency of the building. Visualisation of energy use will be ensured by using Internet-enabled, smart, and usable interfaces e.g. smart phones, and intelligent applications which provide useful suggestions to change habits to adjust energy consumption and costs. Moreover, all the three main areas identified in D1.3, Performance Management, Visualisation of Energy Use and Behavioural change by real time pricing, were equally covered.

Considering the classification by country, 33 countries are involved in innovation and research activities related to these topics as demonstrated by the number of scientific publications. Indeed United States is the top publisher on these topics, followed by China (see Figure 12). The distribution of publications among Europe, Asia and North America is quite homogeneous, showing a slight predominance of Europe (Figure 13).

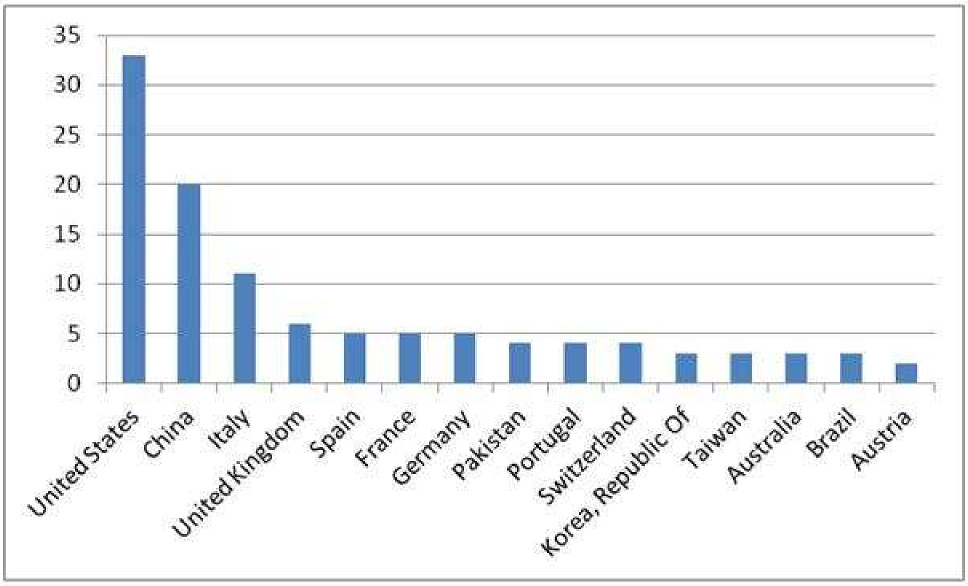

Figure 12: User Awareness in the World

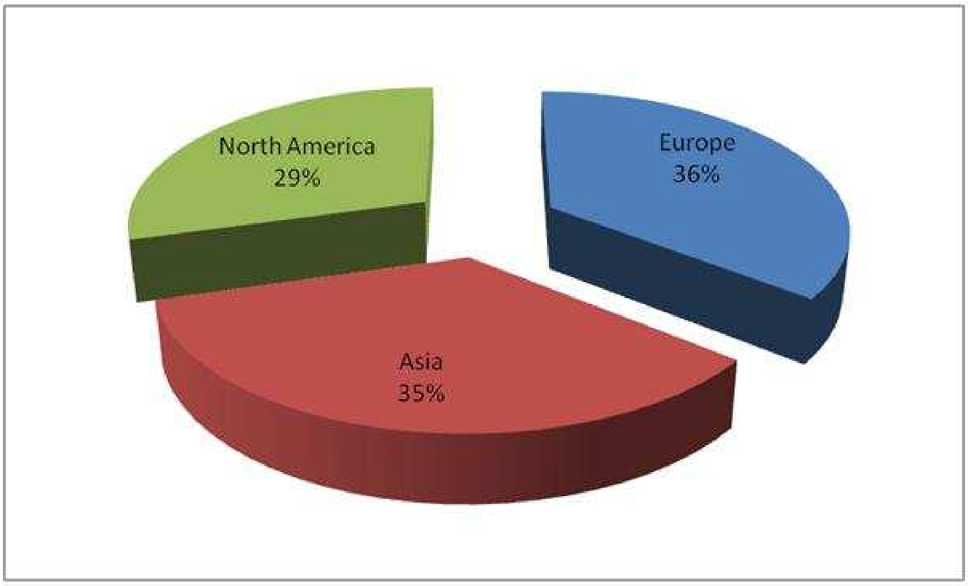

Figure 13 : User Awareness by Continent

Regarding the EU 27, Figure 14 shows that Italy is at the top of the graph for the User Awareness priority area followed by United Kingdom. The overall number of EU publications does not vary much across different countries.

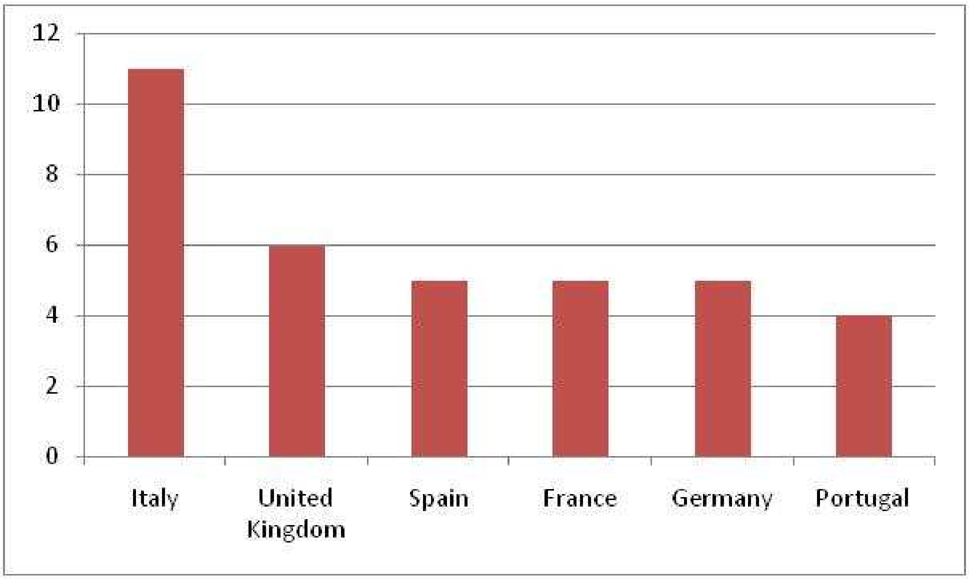

Figure 14: User Awareness in EU 27

2.2.3.1 Relevant Identified Papers

This section presents two papers that are relevant for the User Awareness priority area. The selection process has been done reading each paper abstract in the period from September 2011 up to now and selecting the most relevant ones for this area.

2.2.3.1.1 Energy Star appliance label awareness and uptake among U.S. consumers

The Energy Star label program to promote the diffusion of energy efficient home appliances is arguably the most significant government effort to reduce U.S. residential energy consumption. Program effectiveness requires that consumers are aware of the labelling scheme and also change their purchase decisions based on label information. This paper examines the factors associated with consumer awareness of the Energy Star label of recently purchased 'white' major appliances and the factors associated with the choice of Energy Star labelled appliances. The paper finds that household characteristics have a much stronger association with consumer awareness of labels than with the choice of Energy Star appliances. Renting the home, Hispanic ethnicity, being poor or near poor, and living in regions with lower ACEEE scores do, however, decrease the propensity for households to purchase Energy Star appliances. Eliminating these gaps in Energy Star appliance adoption would result in house electricity cost savings of $ 164. million per year and associated carbon emission reductions of about 1.1. million metric tons per year [5].

This paper collects all the main characteristics of this priority area. Indeed the user has at their disposal the immediate information about energy consumptions as well as the current and cumulated money expense: thus Visualisation of energy use research topic is fully covered. The Behavioural Change by Real-time Pricing research topic directly follows from the Visualisation one, while the automatic scheduling framework envisaged in the project deepens the affiliation in this area as well as with the Performance Management research topic.

The paper is written by Murray Anthony G. and Mills, Bradford F., of Virginia Tech, USA.

2.2.3.1.2 Metrics to assess design guidance

The paper presents that heightened sustainability concerns and emerging technologies give building professionals the desire and ability to explore more alternatives for more objectives. As design challenges become more complicated, and as strategies become more advanced, the need and opportunity emerges to measure processes and to compare the guidance afforded. Through literature review and industry observations, synthesize a comprehensive framework of definitions and metrics. We apply the metrics to an industry case study to illustrate how they help communicate information about challenges, strategies, and explorations present in the domain of energy efficient design. Measurement and comparison are necessary to evaluate the guidance provided by applying two strategies to one challenge. The ability to measure guidance marks a valuable step for prescribing design process improvement [6].

The topics tackled by this article clearly cover different thematic areas such as User Awareness and Tools for Energy Efficient Design and Production Management.

Authors of this article are Clevenger Caroline M.and Haymaker John from Colorado State University, USA.

2.2.4 Scientific Literature Analysis on Energy Management and Trading

This paragraph describes the results obtained during the analysis of the priority area “Energy Management and Trading”, for which the corresponding paper ensemble has been identified.

The results are not particularly satisfying and for the priority area Energy Management and Trading we only found a small amount of papers. The following graphs show the predominance of United States as single state, and the absolute predominance of Europe as continent (see Figure 15 and Figure 16 respectively).

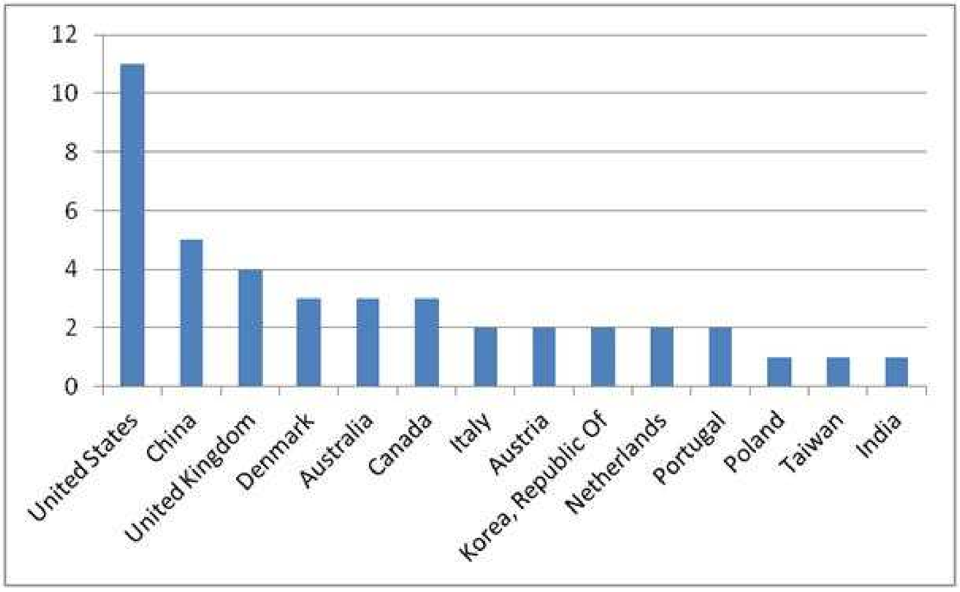

Figure 15: Energy Management and Trading in the World

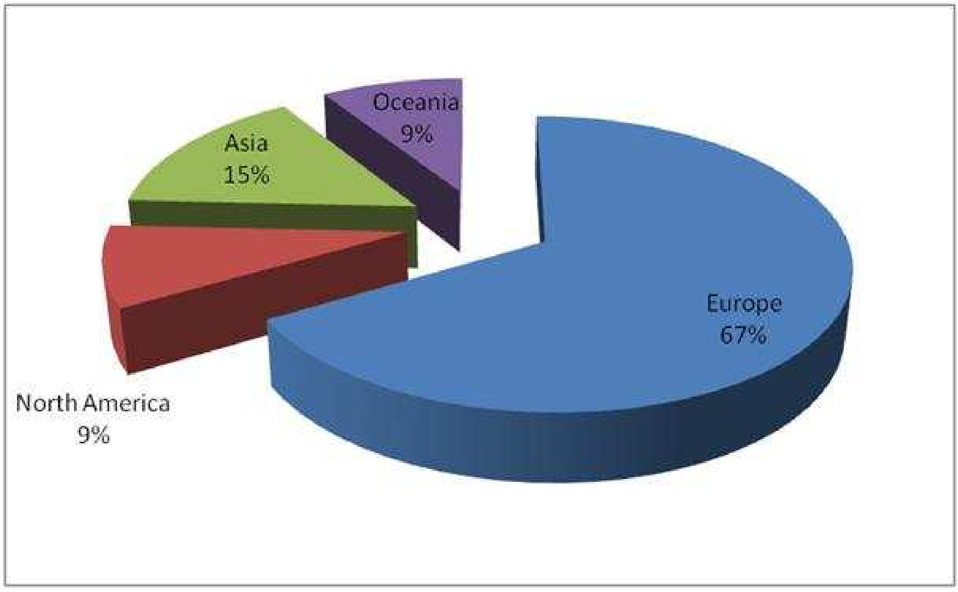

Figure 16: Energy Management and Trading by Continent

2.2.4.1 Relevant Identified Papers

In this section is presented only one paper for the current priority area. The selection process has been done reading each paper abstract in the period from September 2011 up to now and selecting those that best fitted the Energy Management and Trading priority area.

2.2.4.1.1 Algorithmic acquisition of diagnostic patterns in district heating billing system

Kiluk Sebastian in this article proposes an application of algorithmic exploration of billing data for fault detection, diagnosis (FDD) based on evaluation of present state and detection of unexpected changes in energy efficiency of buildings. Large data sets from district heating (DH) billing systems are used for construction of feature space, diagnostic rules and classification of the buildings according to their energy efficiency properties.
The algorithmic approach automates discovering knowledge about common, thus accepted changes in buildings' properties, in equipment and in habitants' behavior reflecting progress in technology and life style.

In this article implementation of Data Mining and Knowledge Discovery (DMKD) method in supervision system with exemplary results based on real data is presented. Crucial steps of data processing influencing diagnostic results are described in details [7].

2.2.5 Scientific Literature Analysis on Integration Technologies

This paragraph describes the results obtained during the analysis of the priority area "Integration Technologies", for which an "ad hoc" query has been identified.

Considering the classification by country, only 19 countries are represented. United States has by far the greater number of papers published, with China following (see Figure 17).

These two countries together published about one third of the total number of articles. In this priority area Europe, Asia and North America have a similar level of activity (see Figure 18), with a slight predominance of Europe.

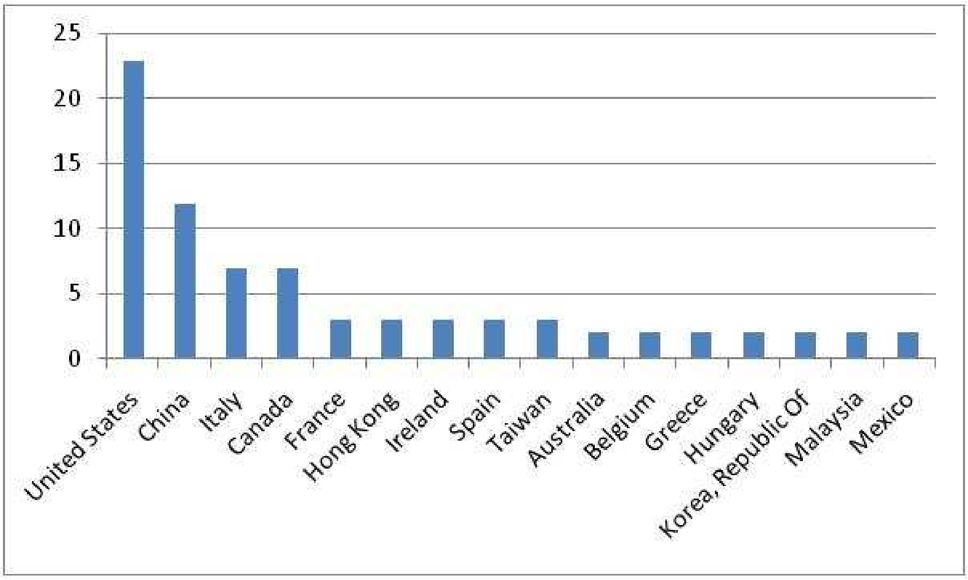

Figure 17: Integration Technologies in the World (Countries with at least 2 papers)

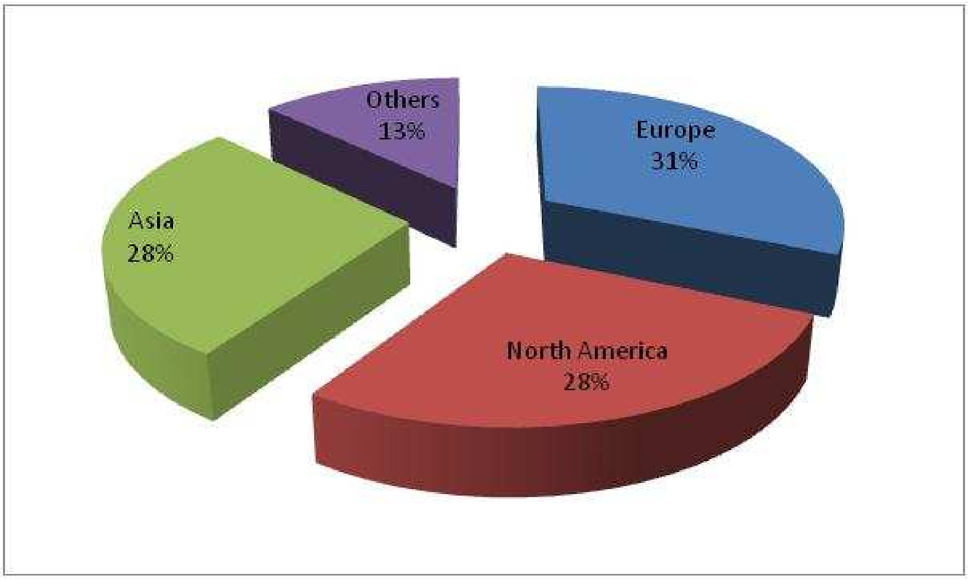

Figure 18: Integration Technologies by Continent

In Europe Italy has the greater number of papers published while the other countries are at a similar level as it is noted from Figure 19.

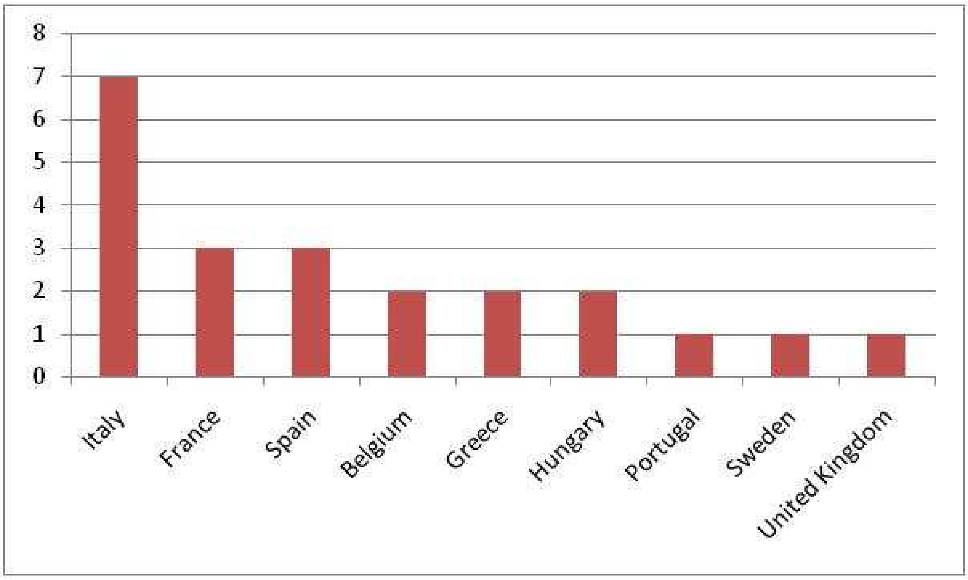

Figure 19: : Integration Technologies in EU 27

2.2.5.1 Relevant Identified Papers

As representative for the Integration Technologies priority area the following two papers have been selected. The selection process has been done reading each paper abstract in the period September 2011 up to now and selecting those that best fitted the priority area.

2.2.5.1.1 Knowledge based integration of sustainability issues in the (re)design process

The research work described by Erbas Irem; Stouffs Rudi and Sariyildiz Sevilaims from Delft University of Technology aims to contribute to the issue of sustainability of buildings by improving the architectural design process with the development of a decision support tool for the architect. In particular, the research adopts the improvement of existing designs, namely encouraging energy-efficient redesigns while improving indoor environmental quality as its strategy to promote sustainability. Redesign strategy is considered not only to extend the life cycle of a building but also to contribute to the realization of the overall transition towards an efficient and clean climate. The starting point for this research is the question of how to develop an integral framework which enables the modelling of design knowledge through more energy-efficient dwellings with acceptable indoor comfort in the sustainability context so that it would be possible to deal with qualitative, quantitative, complex and contradictory information at the same time and integrate these into design decision-making processes. This modelling approach is considered to provide a link to developing a tool or a link to be embedded in an existing tool. In the development of such an approach, how Artificial Intelligence (AI) can facilitate an integral understanding of the aspects is raised as a methodological question in terms of information processing and knowledge integration in the form of a design decision support tool. By this way it will be possible to assess the performance of the end result with respect to design choices, beforehand [8].

The system proposed in the paper is representative of Process Integration main area since it achieves Integration and also addresses the Tools for Energy Efficient Design and Production Management priority Area.

2.2.5.1.2 A novel sensor network architecture for intelligent building environment monitoring and management

Authors of the work are Huang, Qian; Li Xiaohang; Shaurette Mark and Cox Robert F. of Purdue University, from US. The paper presents that innovations in the design and construction of sustainable green buildings have gained significant interest in recent years. It has been estimated that the deployment of an intelligent monitor and control systems can result in around 20 savings in energy usage and play a crucial role in green buildings. Among various emerging technologies, wireless sensor network (WSN) for building management has been becoming an increasingly feasible approach. However, because of the extreme constraints on system size (and hence the battery capacity), frequent battery recharging or replacement for a sensor node is unavoidable and suffers from unaffordable labor cost. Thus, limited energy availability in a WSN poses a big challenge and obstacle to wide deployment of WSN based building automation and management systems. In this paper, the authors introduce and discuss two emerging techniques (i.e., energy harvesting and power line communication) that have potentials to be integrated together and provide a significant improvement on cost, performance, convenience and reliability. To achieve low-cost high-efficiency building automation and management, a hybrid system diagram and operation mechanism is proposed in this paper. A case study is also provided to demonstrate how the proposed system mitigates the inherent weakness of WSN systems [9].

The paper represents thus the System Integration main area and the Simulation and Interoperability Research Topics as defined in D1.3. Other priority area tackled by this article is Intelligent Control.

3 Industrial State-of-the-Art

The focus of this chapter is on the update of the Industrial State-of-the-Art, taking as reference the work already performed in D1.2.

3.1 Industrial State-of-the-Art on Tools for Energy Efficient Design and Production Management

3.1.1 Review of State-of-the-Art of EE design and Production Management in Industry

Table 1: Overview of the State-of-the-art on EE design and Production Management

Design	Discipline-oriented analysis & dimensioning tools. General purpose CAD with discipline oriented add-ons.
Production management	Tools for contract & supply chain management, procurement, logistics, on/off site production management.
Integrated engineering	File exchange, email, web-based document management systems, collaboration support.
Modelling	Mostly document oriented tools. Model based tools are emerging (e.g. BIM-CAD).
Performance estimation	Numerous distinct tools for cost estimation, life cycle assessment and simulation.

Design

Design tools: There is a huge variety of applications for the design of buildings, technical equipments, urban plans. In this document we address only the generic aspects of these tools without going into specific details of each application. The methods and tools are mainly developed in parallel and independently. Many tools are made in-house by user companies or are provided by SME developers, often on national basis. General purpose CAD tools are provided by major software companies. Most tools address mainly detailed design, while only few support other design phases.

Although advanced tools and methods are available for each discipline, they are mainly stand-alone, designed for experts, with limited flexibility and lacking interoperability concerning models and design cultures.

Special purpose tools need to be used for energy related issues as these are not covered by mainstream tools.

Integration: Most tools are turn-key with limited data interfaces concerning energy aspects. The basic problem is that a common model and interoperability methods are missing. A horizontal integrated information chain is not real and many error prone and time consuming information hand over procedures are still needed. Information sharing is mainly via web-based document/file management systems. Mature collaboration and concurrent engineering tools for the one-of-a-kind buildings are missing. Vertically integrated life cycle design is still missing due to the lack of sufficiently powerful data models, inadequate interoperability and fragmented design cultures across various disciplines.

Theory: The interaction of climate, building construction and occupancy, in relation to heating, ventilation and air conditioning is very complex and not yet fully understood. A detailed exploration of the complex physics involved requires analysis of the effects of design decisions on energy consumption, comfort, equipment and enclosure durability of buildings.

Production management

It is considered that today about 10% of all CO_2 emissions globally come from the production of building materials. In particular steel, concrete/cement, bricks and glass require very high temperatures that can only be reached today by the burning of fossil fuels. Construction activities account for about 5% of energy used, including construction related transport [11]. Construction and demolition waste account for about 22% of all waste [12]. Therefore as for design, a large variety of software tools are used for process and production management in construction. These tools are therefore dedicated also to evaluating CO_2 emissions, but many tools are developed in-house or by SMEs. Often these are for national markets due to local regulations and contractual practices. Thus only a few tools are from major international software companies e.g. scheduling and resource planning. This issue causes the existence of many different formats that are usually not compliant with each other. The main aspects addressed for production management are related to timing, costs and contracts. Energy efficiency and sustainability in general, is an emerging concern.

Integrated engineering

Currently integration of processes is mainly based on digital files that are shared by the different stakeholders that take part in the definition, realization and use of the building. At the same time, workflows are manually managed, email being the main tool to support the interaction among the stakeholders. Although more advanced tools exist and in some cases they are being successfully used in other industrial sectors as automotive or aeronautic ones, these tools have not been adopted by the construction sector because they need many modifications and also due to the fact that licensing conditions are not suitable for one-off projects involve multiple organisations.

Although the interaction among the stakeholders is mainly supported by digital systems, it is very common that the final version of the documents (contracts, plans, etc.) is requested in paper version, as a mechanism to avoid interoperability and compatibility problems and to satisfy legal requirements.

<u>Standards:</u> Definition of a common Building Information Modelling (BIM) for energy efficiency in buildings is needed, integrating the building design and bridging the gap with building operation tools. This extended BIM should be complemented with standardization of building components catalogues, in such a way that any building component can be automatically searched and integrated in the BIM.

<u>Community forums:</u> These instruments support people in sharing both good and bad experiences with different energy efficiency solutions and practices. They could also serve as breeding environments for new ideas.

<u>Catalogues:</u> Intelligent digital catalogues of building materials, products, and services. They should contain substantial product/service information (much more than simple geometry) in parametric format. As an example, they could contain configurable design solutions with embedded design logic . Domain knowledge is available in reusable form from catalogues including for instance energy efficiency related attributes. Examples: best practices, materials, products and components, suppliers, guidelines.

Modelling

Building Information Modelling (BIM) has become the key technology for representing data about products within the Architecture, Engineering and Construction (AEC) and Facilities Management (FM) industries for design, energy simulations and performance estimation. It is used also in building automation and control. Ideally BIM consolidates available product data from different sources to provide high quality and up-to-date information about buildings. Thus it has the potential to act as a single point of information that can be used by various applications avoiding time consuming, error-prone and costly re-entering of data. The current use of BIM is mainly for file based data exchange while data sharing using model servers in under early development. The existing data models still miss most concepts needed for EE analyses. Due to the limited scope of existing models and lack of supporting tools, expertise on BIM and laborious efforts are often needed to achieve interoperability.

Data validation: Whereas the benefits of BIM-based energy analysis have been demonstrated in several research projects, there are still problems related to data quality and maturity. Methods for data validation are needed. Using BIM data for energy calculations still requires a lot of manual work. This becomes critical in particular if several iterations are needed for energy optimization purposes.

Performance estimation

ICT tools for performance estimation consist of numerous distinct tools targeting cost estimation, life cycle assessment, simulation of energy usage and indoor conditions, and visualisation of these analyses for decision support. These tools are mostly based on local standards and simple static methods, leading to just basic approximation. Many tools are expensive, laborious to use and require special expertise. The estimation results can vary essentially depending on the used tools. This reduces their reliability and use as conformance criteria in contracts and regulations. The consequence is over- or under-dimensioned building service equipment i.e. increased whole life energy cost or excessive initial investment cost.

Poor integration of BIM-CAD tools, insufficient interoperability between all tools forming the chain of performance estimation, and the lack of appropriate data flows transporting the required semantic information, lead to a situation where the likely future performance of the building under design is hard to evaluate, especially in the early planning and design phases.

Gaps in current practices are not only due to technological barriers such as insufficient ICT means. Already available tools are often not used because of lacking incentives to make additional efforts and to adopt enhanced responsibilities. It is also necessary adjust the contractual conditions between the involved stakeholders, in this context especially designers and the client.

3.1.2 Relevant standards and regulations

The international IFC-Standard (ISO-PAS 16739) developed by the non-profit building SMART initiative [13] is supported by all major CAD software vendors in the Architecture, Engineering and Construction (AEC) market. However, also other data models, such as gbXML [14] or proprietary formats from software vendors, are relevant. In order to deal with multiple data models the following extensions to the overall BIM concept have been established:

- Information Delivery Manual (IDM) specifies business needs independently from any particular data model. An IDM defines processes and exchange requirements between domains such as architecture, building services engineering (HVAC) or facility management [15];

- Model View Definitions (MVD) provide mappings to specific data models, such as the IFC 2x4 release, including further implementation agreements [16].

An energy subgroup of building SMART supports exchange scenarios between building modelling and thermal/energy analysis.

EPBD, Energy Performance of Buildings Directive: According to the EU communication (COM (2008) 780 final) describing the impact assessment foreseen for the recast of the EPBD (Energy Performance of Buildings Directive, 2002/91/EC), energy use in residential and commercial buildings represents the lion's share, about 40%, of the EU's total final energy consumption and CO_2 emissions. Activities related to buildings represent a large part of the EU economy, about 9% of EU GDP and 7-8% of EU employment, and the importance of the sector in terms of social, cultural and historic value is enormous. Therefore, the EU buildings sector can play a key role in achieving EU growth, energy and climate policy objectives, while contributing to an improved level of comfort and lower energy bills for citizens.
The recast of the EPBD was published on 18 June 2010. The new legislation underlines the importance of creating an energy efficient building stock as a pivotal part in the creation of a sustainable urban environment.

The aim of the recast is to clarify, strengthen and extend the scope of the current directive, as well as to reduce the large differences between Member States' practices in the building sector. Overall, its provisions cover energy needs for space and hot water heating, cooling, ventilation and lighting for new and existing, residential and non-residential buildings.

The proposal for a revision of the EPBD was presented by the European Commission in November 2008 with the aim of contributing to the EU's target of reducing energy consumption.
The following table highlights the most relevant directives related with energy issue within European legislation, briefly describing the course that EU legislation has undertaken in the last years.

Table 2: European Directives

Energy Performance of Buildings Directive 2002	Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings
Eco-design of Energy-using Products Directive 2005	DIRECTIVE 2005/32/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 July 2005 establishing a framework for the setting of eco-design requirements for energy-using products
Energy End-use Efficiency and Energy Services Directive 2006	DIRECTIVE 2006/32/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 April 2006 on energy end-use efficiency and energy services
Eco-design 2009	Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of eco-design requirements for energy-related products

Recast of EPBD 2010	DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the energy performance of buildings (recast)
Regulation supplementing EPBD	Comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements (16 January 2012)

The key legal requirements of the EPBD are the following:

Comparative methodology (Article 5)
The methodology differentiates between new and existing buildings and between different categories of buildings. Member States will have to calculate minimum energy requirements according to the benchmarking methodology set out in Article 5 and taking into consideration factors such as climatic conditions, accessibility of energy infrastructure, etc.

Setting of minimum energy performance requirements (Article 4)
Member States will have to calculate minimum energy requirements according to the above mentioned benchmarking methodology.

Existing buildings (Article 7)
Extends the scope of the provision requiring Member States to set up minimum energy performance requirements when a major renovation is to be carried out (no 1000m2 floor area threshold anymore).

'Nearly zero energy' buildings (Article 9)
By 1 January 2021, all new buildings, including existing buildings undergoing major renovation, will have to meet 'very high energy performance' standards. The public sector should assume a leading role by ensuring that all new buildings they own or occupy meet the nearly zero energy standards as of 1 January 2019.

Financial incentives (Article 9a)
The legislation required Member States to list incentives from technical assistance and subsidies to low-interest loans by 30 June 2011 for the transition to nearly zero energy buildings.

Certification (Articles 10-2)
Certification will be mandatory for any buildings constructed, sold or rented out, as well as for buildings where over 500 m^2 is occupied by a public authority and frequently visited by the public. Five years after the legislation takes effect, this threshold will be lowered to 250 m2. Additionally, EPCs will provide detailed recommendations for improvements.

Public awareness and communication (Article 19)
Member State shall inform owners or tenants on certification and inspection, as well as possibilities to improve energy performance.

Penalties for non-compliance (Article 22)
Member States will lay down the rules on penalties applicable for non-compliance.

EPBD related standardisation

To support the implementation of the Energy Performance of Buildings Directive (EPBD) after it became law on 4 January 2003, the European Commission issued early 2004 a mandate (M/343) to CEN for the development of standards covering 31 work items. This mandate asked CEN to elaborate and adopt standards for a methodology, calculating the integrated energy performance of buildings and estimating the environmental impact, in accordance with the directive. With the exception of one, all mandated EPBD standards have been approved and published. Five CEN technical committees have been assigned the task of developing the required standards:

- CEN/TC 89 - Thermal performance of buildings and building components
- CEN/TC 156 - Ventilation for buildings
- CEN/TC 169 - Light and lighting
- CEN/TC 228 - Heating systems in buildings
- CEN/TC 247 - Building automation, controls and building management

3.1.3 Industrial Needs

Design

EE enhancements: Existing design and CAD tools should be enhanced concerning energy related data models and information.

Applications for early design stage of buildings must be made available combining a concise building model description and modelling & simulation capabilities as basis for decision making considering building energy performance and the quality of indoor environment. Simple tools are needed for users who are not necessarily energy experts and only need preliminary guidance on feasible options.

Interoperable interfaces: Improved interoperability to support optimal energy efficient design of a building in continuously evolving cycles between architectural and energy engineering design: selection of the basic principles of energy mix and the basic energy systems, design of the energy distribution system and components and specifying the technical details. Model consistency checkers, e.g. as web services, are needed to validate interoperability.

Guidelines for integrated design are needed to encourage the use of available new technologies and adoption of new ways of working.

Production management

Material and product tracking systems: Adoption of unique identification of products and systems to track their life cycle. Linking information about installed products with specifications in the BIM.

Catalogues of materials, products, suppliers: E-catalogues need to be enhanced with energy aspects: embedded energy in materials and products, energy requirements of production methods, operation and maintenance, energy-related qualifications of manufacturers and suppliers etc.

Integrated engineering

The main short term RTD priorities will aim at improving the current file based workflows to allow information server based workflows, which integrate multiple collaboration mechanisms, as multimedia documents sharing and live editing, comments annotation, etc., in such a way that interactions among the stakeholders can be automatically archived and managed in a holistic way [12]. The main research topics to achieve this goal are:

Adaptive user interfaces that adapt to the terminal, capabilities, access rights and current context of the user.

System security such as protection against threats and attacks, as Denial of Service and Intrusion detection, privacy of the members of the community, identity management and trust in service based systems.

Model Management tools. Many stakeholders participate to building design, execution and operation of a building, but everyone has a specific role that defines what he is allowed to see and edit. Model management tools need to make possible the interaction among this large and dynamic group of stakeholders during the building life cycle and support multimedia contents. Model management tools need to be based on open standards that guarantee their interoperability with other ICT tools (see section 2.5.3 Interoperability and standards).

Integration of synchronous and asynchronous collaboration tools. Although many collaboration tools exist (email, file servers, blogs, social networks, document sharing and life editing, etc.), there is no link among them. All these tools should be integrated in order to share the same configuration data and to easily track the evolution of the building.

Modelling

Take up of model based methods: The industry should take up and learn already available model based tools. The roles, responsibilities and workflows need to be adjusted for optimal use of these tools.

Attribute extensions of BIM: The BIM, more precisely IFC, has to be extended, because it was originally developed for architectural design, meanwhile opened to other domains, like structural analysis, HVAC or Facility Management (FM). The existing BIM objects have to be enhanced with energy information. This can be done mainly by enhancing attributes with minimal introduction of new object definitions to the IFC schema.

Model tuning based on feedback from building operation: Continuous commissioning during building operation has a big influence on energy savings. It provides valuable feedback for adjusting the algorithms and models of the applied optimization tools and BIM-based design (www.buildingeq.eu).

Performance estimation

Energy estimation in early design stage: Best practice guidelines and ICT tools should be provided for energy related design, analysis and decision making in early planning phases for new buildings or renovation of buildings –providing information to architects and clients who are usually not energy experts. For this purpose, both BIM-CAD and energy simulation applications have to be extended with appropriate data, interfaces and visualisation capabilities.

Models for reliable and comprehensive life cycle cost calculation should include investment, maintenance and energy aspects.

Metrics: Definition of building energy performance indicators and methods to assess them using available information from various ICT based systems.

Validation & certification of SW tools: Standardised methodologies are needed to validate performance estimation tools. Monitored data from real buildings should be used to validate and improve performance estimation models and to fine-tune the underlying theory.

Virtual testing environment: Important impact on energy and emission reduction is through improvement of building components (products), processes (e.g. building operation processes) and services, because they can be applied to many buildings (new and the existing stock). As the testing and evaluation of all products and services may be quite complex and expensive, there is a need to test them virtually before their realization according to different application cases regarding building types, user scenarios and climatic scenarios. A simulation based Virtual Energy Lab may be done with small effort to provide input for new products, processes and services.

Simulation: In particular, new tools for building energy performance simulation and methods for interfacing between design tools and simulation models for whole buildings and building envelope parts need to be developed.

3.1.4 Non-Technological Barriers

There are several non-technological barriers for exploitation of ICT in design and production management of energy efficient buildings.

First one can identify barriers such as the lack of experts and labour for extensive EE renovation of the European building stock. Moreover, short term project orientation of the building sector does not allow the adoption of long term strategies. These two barriers are the main issues hampering the design process of energy efficient buildings.

Altogether the causes that directly affect the development and use of ICT in design and production management can be identified as the following:

- Specialised ICT tools, extra efforts and special competences are needed for EE design, analysis & planning.
- Lack of interoperability: using many special tools and exchanging data between them requires extra efforts for EE considerations.
- Lack of knowledge about building life cycle costs and future energy prices.
- The fragmentation and “project oriented approach” of building sector and complexity of dealing with existing buildings, as well as the fragmentation of the value chain in the construction sector. A lot of stakeholders take part in the building life cycle, many of them are SMEs or even micro-SMEs, thus there is a missing role dedicated to the holistic management of the overall process.
- For existing buildings, a significant amount of effort is required to first retrieve all relevant information, and to then compile and structure it in meaningful form to be used by new solutions.
- Lack of precision of the current simulation tools reduces their credibility and the interest of stakeholders on them.

3.2 Industrial State-of-the-Art on Intelligent Control

3.2.1 Review of State-of-the-Art in Industry

The field of building automation is not a fast moving one. Since the last state-of-the-art report, less than a year ago, there has not been any game-changing news. However, one can identify some trends.

Table 3: Overview of the State-of-the-art on Intelligent Control

Automation & control	Existing automation and control algorithms are most often restricted to sub-systems (heating, light, ventilation, microgeneration), independent from each other, and hard-coded in the devices with little possibility to update or modify them by a centralized control instance.
Monitoring	Existing Smart Meters enable real-time electricity consumption reporting and visualization as well as bidirectional communication with Smart Grids. All needed sensors, with the required sensitivity and accuracy, are not available at reasonable cost for a large scale deployment.
Quality of service	Some self-diagnosis systems exist in the HVAC and lighting domains. Some sensors can also monitor their own functioning, and communication protocols also include error detection in the data frame. For communication protocols, many open or proprietary de facto standards co-exist with different properties.
Wireless sensor networks	Some “Plug & Play” sensors already exist, whose features can be automatically taken into account by WSN-based BMS to optimize control of the related actuators.

Automation & control

EN 15232 is the standard that concerns the energy impact of building automation, controls and building management. It gives a good overview of common off the shelf control functionality in a Building Management System (BMS). This is also reflected in common building control products, see [17] and [18]. These references describe building management systems and the functionalities they support, such as:

- **Schedules**
  An occupancy schedule can dictate when heating or cooling should be applied to meet comfort requirements.
- **Closed loop control**
  Low level control such as temperature control for one room or pressure control for a ventilation air-duct.
- **Occupancy based control**.
  The use of presence detectors to control light and indoor climate.
- **Optimal start**
  A technique to decide when to start heating or cooling before occupancy start. Too early start would imply energy losses and too late discomfort.

An issue that is common for all the functionalities is that they in are generally independent for each building dimension:

- Heating, cooling and ventilation
- Lighting control
- Blind control
- Access control
- Security
- Power distribution
- µ-generation and corresponding storage systems

Energy reductions are made possible, for example, by combining heating, lighting and blind-control that are commonly not exploited.

Although it is still far from being common there are some emerging applications of model predictive control applied on buildings. In this case a conventional Building Management System (BMS) is managing the building but at the basis of this system there is an optimizing software that operates the BMS, e.g. changing the temperature set point within a comfort interval. This operation is performed taking into account e.g. weather forecast, real-time energy pricing and with this data it makes an optimal trade-off between energy consumption, comfort and economy.
In the last year there has been an increase in activities around high-level energy management such as model predictive control and building control based on weather forecast.

Monitoring
Monitoring is a standard component in a modern BMS, see e.g. [17] and [18]. Measurements used for building control are also stored in trend logs and signals such as energy consumption and temperatures supports information for user interfaces and automatically generated reports.
Over the last year several offers around "building analytics" has surfaced. The functionality of such analytics is energy benchmarking of buildings and detection of malfunction. Many are software-only solutions which are not necessarily running on premises.

Quality of Service
Some basic self-diagnosis is commonly available in automation control products: for instance the controller may detect if the wire of the temperature sensor breaks and will be able to set up a procedure to fix the problem. When a building automation system is available, there is usually a large quantity of self diagnosing functionality with associated alarms. An alarm can be issued if for instance the equipment is faulty or the temperature is out of range, etc. See [17] and [18]. There are also more advanced services that attempts to identify failures based on historical building data. This service could for example identify causes of increases in energy consumption and other kinds of failure [19].

Wireless sensor networks
There are some wireless technologies for building automation currently on the market. So far, none of them shows interoperability between different vendors, however there is significant standardization ongoing, predominantly in ZigBee Alliance, see [20].

3.2.2 Relevant Standards

Important standards for building control are communication protocols such as LonWorks, BACnet, KNX, Modbus, ZigBee that are full-fledged technologies with protocol stacks and functional profiles above the application layer of TCP/IP transport protocols (see Internet Protocol version 4 and Internet Protocol version 6).
Standards like these facilitate interoperability between devices.

As mentioned in a previous paragraph the Energy Performance of Buildings Directive (EPBD) was a very important step in the effort of the European Union to improve the energy efficiency of the large building stock in Europe. As a result of the EPBD about 40 EN standards were developed to harmonize the energy calculation methods concerning buildings..

The Energy-Using Products (EuP) directive also deserves to be mentioned. So far, not much attention has been put on energy consumed by the control equipment itself but this will probably be addressed in the future. There are currently discussions about whether e.g. zone controllers (as they are sold in large numbers) should have an idle or sleeping mode with lower power consumption.

The most relevant standard for intelligent building control is EN 15232. It concerns the energy impact of building automation, controls and building management. There is a new version of the standard, EN 15232:2012, soon to be released. Another relevant and active standardization area is around the smart grid concept.

3.2.3 Adoption of Industrial State-of-the-Art in the Building Lifecycle

It is not easy to understand the level of acceptance of Intelligent Control in the existing European building stock, in particular considering the fact that it can happens that installed systems may not be activated.

Within the research program HOMES, which is focused on energy performance in buildings, it is estimated that 4% of the European building stock is equipped with a Building Management System or lighting control system, see [21]. Those 4% of the building stock represents around 40% of the surface area as larger buildings tend to be better equipped. If a Building Management System is present then acceptance of the before mentioned functionalities such as optimal start and alarms are well established. This would imply that 96% of buildings lack a networked control system with a corresponding more than half of the surface area. If manufacturing and installation cost could be reduced there is a very large portion of buildings that would benefit.

Nowadays, taking into consideration the need of cost reduction, the payback period for advanced control in small buildings is too high. A way of lowering the cost could be to have the functionality as cloud-based services and therefore lowering the need for local capital investment.

3.2.4 Industrial Needs

Automation & control

The smart grid concept tries to balance the energy flow between the producers and consumers. Since buildings are the largest energy consumers it is important that they have the connectivity and functionality to interoperate with the smart grid.

On the contrary, with the advent of renewable sources it may happen that there is an oversupply of energy, thus decisions should be reached on how to exploit the amount of energy that is produced. The optimization of the building behaviour should take into account this case to perform an optimization of energy management for the building.

Monitoring
The first step for decreasing energy consumption is to understand where the energy is being consumed. Instruments dedicated to the monitoring and systems for efficient communication should be implemented with high resolution to allow stakeholders and user to increase their awareness on energy consumption. Adequate tools for making more visible this information to the stakeholder have to be identified and widely applied.

Quality of service
The challenge in to improve quality of service: in other words this means not only to detect the cause of a problem but also to adequately describe it. An equipment failure can often result in energy losses but even though it is detected by the system it may not get repaired unless the tenant complains about comfort. A typical alarm message could be "Alarm: Part1 is faulty". It is recommended that this message is completed with an information on the amount of cost per month that this failure may cause. This message will really raise greater attention in the house-tenants since it is more comprehensible from the view point of money saving. This will require that the system has the capability of evaluating rough cost estimate.

Wireless sensor networks
Wireless communication for building control devices are considered as promising tools but building specific standards have to be developed to ensure interoperability. In addition, protocols addressing sleeping devices have to be considered to ensure long life time of battery-less devices.

3.2.5 Non-Technological Barriers

The main issue highlighted by this chapter is that stakeholders should become aware of the economical benefits they could have thanks to increased energy efficiency. Cost is a non-technological but a very powerful psychological barrier. Moreover, the decision criteria of the stakeholders, even of commercial parties, during the actual period of economical crisis are strictly related to the initial investment and not to the return of the investment period. This gap could be bridged by increasing energy awareness, by developing simulation-based estimation of energy savings, and by the growing number of competitors in the market of energy service contracts. Finally, it is relevant to notice that there are cases in which the responsible of the control system is not who pays the energy bill. For example, a building owner has no direct economical incentive to invest in intelligent control when the tenants are paying the energy bill. In particular, he has little incentive to verify that his building is performing well. In this context the need of cost decrease of BMS systems is another important issue that could be considered as barrier.

3.3 Industrial State-of-the-Art on User Awareness and Decision Support

3.3.1 Review of State-of-the-Art in Industry

ICT supports understanding, capturing and formalising customer/client anticipations into requirements, conveying them to all stakeholders and validating compliance. The impact of ICT on EE is well understood via model-based evidence. Standardised methods and indicators are available for assessing and benchmarking the energy performance of buildings, systems and components. Performance audits, labelling and continuous commissioning are supported by recorded data of real time performance.

The main role of ICT in awareness and decision support is to inform users of buildings what is the current energy consumption, what they can do to decrease it and how their activities will influence energy use in short and long term perspective. Information is the key issue in supporting decisions and creating awareness. Information should be easily available, comprehensible and useful for further operations. It is possible to gather information about many environmental factors (temperature, humidity, CO_2 concentration, solar radiations, etc.) and predict possible energy use.

Personal control systems	Control level for individual users.
Energy labelling	Role of energy performance certificates in user awareness.
LCA Software	Use of Life Cycle Analysis Software to disseminate knowledge about building properties.
Economic feasibility	Need of cost decrease of BMS systems.
“Real-time” pricing	Use of smart meters in creating aware use of energy.
ICT tools in existing buildings	Possibilities of applying ICT solutions in existing or retrofitting buildings.

Personal control systems

In office buildings central unit will control different devices in order to avoid increase of energy use, however in residential buildings, the decision belongs to the user. To take a proper decision the user has to know, the more precisely, the better, how his activities will influence energy use and how much he can save or lose money on that. Therefore most of the systems in residential buildings focus on visualisation of energy use and simple control of some of the devices available for inhabitants. Controlling of devices allows also to operate them in the periods when power is cheaper and use only necessary devices in the peak hours. This is possible with varied electricity tariffs. Another tool is a demand response mechanism used to encourage consumers to reduce demand, thereby reducing the peak demand for electricity. In most cases demand response allows customers to curtail their consumption when the productive or convenience of consuming that electricity is worth less to them than paying for the electricity. Demand response mechanism is more popular in United States, but it is predicted that will be implemented more widely in Europe in upcoming years. This mechanism is implemented by companies focused on this type of activity. They conclude agreements with final consumers regulating maximum demand for the electricity by the users. Having many users they can manage peak demand and cooperate with electricity providers on preference prices.

The main drivers, described above, are so summarized:

- increasing user awareness
- increasing regulatory requirements
- shift towards performance based contracts.

All these increase emphasis on whole life time performance of buildings.

3.3.2 Relevant Standards

Designers, architects and civil engineers can use different software tools supporting their decisions, however mostly they are not operating with the same format standard. There is a general trend to uniform data standards as much as possible, however some of the formats need to be translated into another by special engine software tools (like FME - Feature Manipulation Engine).

3.3.3 Adoption of Industrial State-of-the-Art in the Building Lifecycle

Energy labelling

In terms of user awareness and decision support in the building lifecycle, building certificates (energy labelling) might be helpful. Certificates like LEED, BREEAM, Green Star or CASBEE take into account the most of the life cycle of the building and present it in a consistent way. Recent ideas on uniforming standards and calculation methods led to preparing project called "Open House"[2] which aims to develop and to implement a common European transparent building assessment methodology. Methodology will be consistent with EPBD directive and can be used all over the Europe. Currently, Open House methodology is elaborated and is being evaluated on existing buildings in more than 50 case studies.
Using classification in certificates allows to explain in a simple manner standard and quality of the building. High class obtained by the building cause that inhabitants are more aware and proud of novel techniques used in order to increase energy efficiency and somehow they promote solutions among their family and friends. Comparing to situation when inhabitants get a set of bare numbers informing about energy use in the building, certificates are easier to understand for non-technical and there are more convenient to present to public.

LCA Software

Following certificate path, software that can give full overview on the carbon footprint of the building is Life Cycle Analysis (LCA) programs (i.e. SimaPro, GaBi, Gemis). They can give more detailed calculations about influence of the building, starting from the materials used, construction works, use and disassembly of the building. Scheme below presents approach of LCA technique for the whole process, starting with planning, through construction, use and disposal. Energy for the each process and material is taken into account.

[2] FP7 project, Theme 6 Environment, Grant Agreement No. 244130

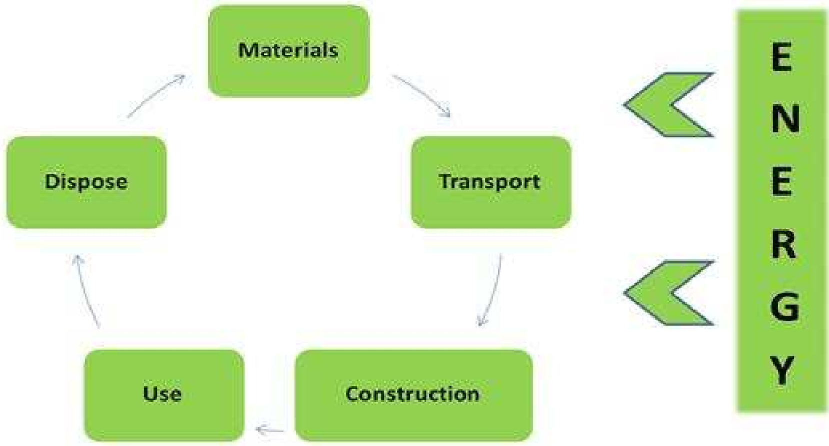

Figure 20. Scheme of Life Cycle Analysis approach.

Common unit used in LCA software is emission of CO_2 to atmosphere. This simple unit, understood by many, can be used in dissemination materials distributed to the building inhabitants.

3.3.4 Industrial Needs

Economic feasibility
One of the most important technological need in improving user awareness is cost decrease of equipment allowing for visualisation and control of energy use. Building Management Systems are still very expensive for typical user and practically not available for inhabitants. A proper and real ROI factor is very important for investors and users who have to know how actually their behaviour influences energy use and what savings they can count on. In order to provide this information real time energy costs and payback simulation must be implemented into the system and easily presented to the user. A good idea is to provide advices (communicates) how to influence energy use and decrease its level by simple solutions and actions that can be performed by the user with small effort and almost instant results.
Another important issue is the intuitive interface and ease to operate the equipment. Use of local language is a must. Otherwise, inhabitants will not be eager to learn and use the system.

“Real-time” Pricing
Behavioural change will be stimulated by “real-time” pricing. So far, the business model of “real-time pricing” in the residential market is only used in a few regions, such as in California. It is more common in business models offered to “bulk” energy consumers in industry.
To support real-time pricing smart meters must be installed as a prerequisite. Additionally, it is essential that end-users are seamlessly provided with easy understandable overall consumption data. Additionally, it is required that users can choose between different options how to adjust their current behaviours “real time”. Demand response mechanism goes along this solution and allow for real savings for the customers.
Sub-metering and interoperable information exchange between sub-meters and major consumers (end-devices) is required. Currently, we are lacking appropriate business models to stimulate information exchange about demand/supply profiles.
It is also essential that commonly agreed standards are developed describing how to exchange energy-related information. There are few systems of communication developed

by different institutions and organization. One of these systems should be chosen as principal, in order to allow standardization of the grids.

ICT tools in existing buildings

One of the technical issues is implementation of BMS and ICT tools in existing buildings. While installation works can be easily performed while constructing buildings, it is difficult to implement system in already existing buildings. Retrofitting of building might be a good opportunity to install some of the BMS features. If implementation of active controlling system is not possible, at least measuring devices for visualisation of energy use are very helpful in creating user awareness. Systems with wireless communication and even self-powering might be an answer for existing buildings, where installations works cannot be performed in full scale. A FP7 research project TIBUCON deals with development and tests of self powered wireless sensor network for HVAC system energy improvements[3].

3.3.5 Non-Technological Barriers

There can be specified few non-technological barriers in terms of user awareness in the ICT for E2B sector.

One of the most important non-technological barrier is that people are usually not willing to change their behaviour and learn how to do new things. They have had gained habits through the years and it is not easy to convince them to change them. Therefore presented solutions has to be user friendly as much as possible, relevant and effective as well. In this context the development of intuitive and easy-to-use interfaces is essential.

Another issue, there might be feeling that one is losing full control on the surrounding environment and assumption that 'computer' does not know better what is good or not for inhabitants. Education and training of inhabitants should be answers for these doubts, proving that ICT systems are useful and does not really influence negatively on the quality of living in the building.

Lack of awareness exists also at the education level in Universities in which not enough attention during engineering courses is put on BMS and ICT solutions. Teaching program for architects and civil engineers should be updated in order to explain to students how ICT is easily improving energy efficiency in buildings and can influence users behaviour.

Following educational issues, law regulations are another filed that has to be reviewed. Possible changes in regulations concerns technical designs, solutions for infrastructure network as well as assuring proper energy efficiency (obtained by different means, also by using ICT) and providing information for end-users (i.e. smart meters).

[3] TIBUCON: Self powered wireless sensor network for HVAC system energy improvements. Ref. No: 260034, FP7 EU.

3.4 Industrial State-of-the-Art on Energy Management & Trading

3.4.1 Review of State-of-the-Art in Industry

Future smart cities are expected to be very large and complex ecosystems, where interactions among the various involved entities may lead to emergent behaviours (system of systems characteristic). Managing better the energy footprint is one of those challenging goals, and the smart grid in conjunction with energy efficient buildings may provide a key tool in achieving that.

The energy market is changing rapidly worldwide. Many markets have just recently been deregulated. As such the business model of a vertical integrated utility is challenged in many markets and one must now differentiate the roles as such. Unbundling requires the formation of new types of companies. In the following these can be network operators, energy suppliers and power plant operators (producers) to name a few.

Market-driven interactions have been proposed as a promising potential interaction method due to the monetary incentives involved for the participants. In the Internet era an online marketplace is a thriving concept as it overcomes potential accessibility issues. Marketplaces where smart grid stakeholders may interact are envisioned in smart grid roadmap ([SmartGridsSRA2012], [BDI2010]) however it is not clear how they should be structured, operated, what their limits, conditions and benefits might be. Several projects make investigations towards this direction; as an example, the NOBEL project (www.ict-nobel.eu) envisions that neighbourhood/district-wide energy marketplaces could be considered within a smart city where prosumers may trade portions of their prosumed energy [Karnouskos2011].

Today energy management is done mostly at standalone mode among the stakeholders within a smart city. This means that for instance a smart building is trying to optimize its behaviour internally towards better use of its energy footprint, a smart house is trying to optimize the use of its devices, and a distribution system operator (DSO) is trying to predict and manage the energy on the smart city neighbourhood. However overwhelmingly all of these efforts today are disconnected from each-other, and do not cooperate while in the best case some Demand Response (DR) mechanisms are in place.

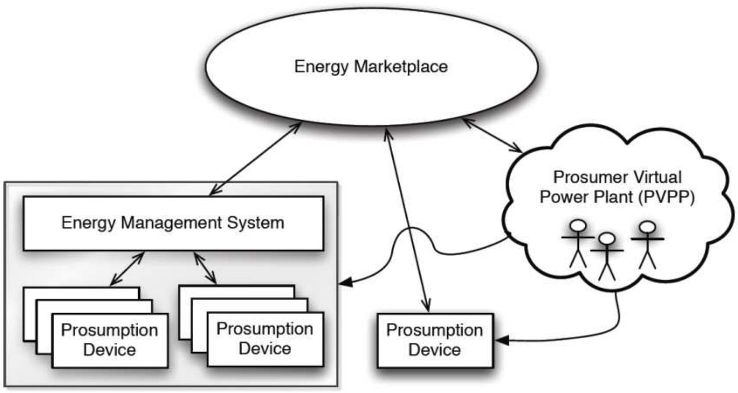

Figure 21 – Future Energy Management and Trading

In the future smart city context DSM will get more challenging as the energy prosumers are expected to exist and hold distributed energy production (e.g. PV panels) or presumption (e.g.

electric cars) facilities, which once "aggregated" and operated intelligently may be treated as virtual power plants (VPP) whose resources are distributed within the city. The key lies on the emergence of such groups and the effective interaction with them. As depicted in Figure 21, energy management and trading will be more strongly coupled with potentially real-time interactions. Additionally buildings are expected to be an integral part of VPPs and participate in internal and external energy management schemes by regulating their energy signature flexibility according to a multitude of objectives including energy trading benefits. The optimal usage of local resources and the benefits they offer e.g. negligible transmission costs due to physical proximity may provide a promising element for the success of local stakeholder interactions e.g. via a local energy marketplace (Karnouskos 2011).

In the following we will focus on how energy management can be applied to procure, apply and potentially reuse energy in an economic, secure and sustainable manner. This requires that we outline relevant stakeholders with their business needs, which shall be outlined as follows:

energy producer	A producer of energy may use renewable or none renewable sources of energy to transform energy from one energy type to another. As such he may need to exploit or procure natural resources to operate his generation facility. When no resources are needed for his generation system (i.e. wind generation / photovoltaic / geothermal, etc.) the producer is confronted with other needs that specifically relate to the generation system.
energy retailer	The role of the retailer is to purchase electricity on the wholesale market and resell the procured electricity on the retail market. The end user is usually not capable to buy electricity on the wholesale markets, as such. This refers to the fact that there are various constraints to be active on a wholesale market and that under current understanding the transaction costs outweigh the value of possible advantages in the wholesale market. Further the complexity and volatility of a wholesale market can be better tackled by an entity which can reduce transaction costs with economies of scale, further applying a procurement strategy to deal with the risks that exist in wholesale markets.
energy user	The role of the energy user is to procure and apply energy in his energy related applications. If the energy user also has his own generation capacities installed he may use this to supply energy for his own energy applications or feed the energy into the grid. For using energy various strategies exist to secure a sustainable, secure and economic usage of energy.
Demand side management operator	A market role that has evolved in various forms in the last years is the demand side management provider. In other cases this role is defined as a demand side manager (DSM), demand response (DR), contracting provider, etc. The individual business scenarios are very different in their individual approach. Overall the demand side management provider interacts very closely with the customer in a way that he evaluates the energy situation of a customer with the customers energy related applications. Once having understood the situation and potential

[redacted]	future needs the provider applies various technical and non technical methods and systems to help his customer apply energy.

Energy producer

Overall an energy producer transforms energy from one kind to another. As such various business processes are needed along the individual value chain of an energy producer that may be described as follows:

- acquire, build, maintain and operate a generation system
- procure resources
- sell energy to end-users or wholesale markets

Within this value chain the following business needs can be identified that represent the state of art:

- Fuel Management
- Plant Life Cycle Management
- Plant Operation
- Environmental and Operational Compliance
- Resource Management
- Energy Capital Management – Generation

Energy retailer

An energy retailer usually may procure energy from the wholesale market and resell it to customers on the retail market. The value chain can therefore be described as:

- acquire, maintain and support customers
- manage, procure and sell energy
- manage energy portfolios

Within this value chain different businesses needs are addressed that are needed to operate as a retailer this involved:

- selling energy and services
- customer management
- preparation of energy supply products and services
- handling of device and measurement data
- customer financials management
- billing for energy products and services
- risk based collections management

Energy user

An energy user procures energy from a retailer and applies the energy within his facilities. As such the following elements along the value chain have been identified:

- procure energy from a retailer
- procure energy from a wholesale market with support of a retailer
- supply applications with energy
- manager energy consumption in a way to reduce peak loads, general base load
- energy optimization: Manage energy costs via planning, risk management, and process improvements

Within this setup it is becoming increasingly important to apply new business applications that assist the energy user in using energy in a more rational manner, this herby may include:

- understand the energy portfolio for one or multiple sites of the energy user
- identify strategies to improve various energy related applications i.e.:
  - procurement of energy and resources by bundling, diversification
  - establish a meter infrastructure and / or integrate a metering system – building management system
  - asses & interpret meter data
  - design, procure, implement, operate and maintain energy systems at the customers site
  - management of emissions
  - certifying energy savings
  - applying a certified energy management system for the customers of the provider

3.4.2 Relevant Standards

In this section it is important to identify the most relevant standards that influence this area, directly and/or indirectly.

- **DIN EN 16001;** energy management; Energy management norm in Germany mainly for industrial and commercial stakeholders (this standard will be completely substituted from 2012 with the new **ISO 50001**).
- **DIN EN ISO 14001**; environmental management; environmental management norm that aimed at any organizations to: identify and control the environmental impact, improve its environmental, performance continual, implement a systematic approach to setting environmental objectives.
- **ISO 23045:2008;** Building environment design -- Guidelines to assess energy efficiency of new buildings; ISO 23045:2008 gives guidelines related to energy efficiency in buildings as introduced in ISO 16813. The objectives of ISO 23045:2008 are to assist designers and practitioners when collecting and providing the useful data that are required at different stages of the design process and to fulfil the definitions of the building as prepared by building designers. This International Standard applies to new buildings and is applicable to space air-conditioning equipment and the heating plant in new buildings.
- **ISO 16813;** Building environment design - Energy efficiency; ISO 16818:2008 gives terms and definitions for use in the design of energy efficient buildings. ISO 16818:2007 is applicable to new buildings and retrofitted existing buildings.
- **ISO 13790:2008;** Energy performance of buildings ISO 13790:2008 gives calculation methods for assessment of the annual energy use for space heating and cooling of a residential or a non-residential building, or a part of it
- **IEC 60730-1 Ed. 4.0 b:2010;** Automatic electrical controls for household and similar use; The standard applies to automatic electrical controls for use in, on, or in association with equipment for household and similar use, including controls for heating, air conditioning and similar applications.
- **ISO 15686-3:2002;** Buildings and constructed assets -- Service life planning; The norm is concerned with ensuring the effective implementation of service life planning. It describes the approach and procedures to be applied to pre-briefing, briefing, design, construction and, where required, the life care management and disposal of

buildings and constructed assets to provide a reasonable assurance that measures necessary to achieve a satisfactory performance over time will be implemented.

- **OASIS Energy Interoperation;** Energy Interoperation describes an information and communication model to coordinate energy supply, transmission, distribution, and use, including power and ancillary services, between any two parties, such as energy suppliers and customers, markets and service providers. Energy Interoperation Version 1.0 Committee Specification [4] is now complete and published in the OASIS archives.
- **OASIS Energy Market Information Exchange (eMIX) TC;** Energy Market Information Exchange (EMIX[5]) Version 1.0 is now complete and published in the OASIS archives.
- **Other:**
  - **Standards Catalog - Smart Grid Interoperability Panel:** This document[6] provides a catalog which is a compendium of standards and practices considered to be relevant for the development and deployment of a robust and interoperable Smart Grid.
  - **An IEEE web site** provides links to several agreed[7] and proposed[8] standards.

3.4.3 Adoption of Industrial State-of-the-Art in the Building Lifecycle

Today energy trading is taking place at large scale worldwide but for major actors only. As such it is today impossible for buildings or private users without the critical mass to directly take part in energy markets. Electricity and carbon markets have been set at country / cross-country level. However there is no strong coupling with the building lifecycle management. We consider that we are still at early stage in this direction.

Energy management in buildings has a long tradition and is done mostly with isolated proprietary systems that do not allow strong cooperation and information exchange with other entities. To that sense we are still at the dawn of an era where the building will go beyond managing its energy as a standalone entity and exchange information and collaborate with other actors (e.g. buildings, smart cities, smart grid, 3rd party service providers etc.) to achieve common energy efficiency goals. Finally there is hardly any integration with existing business processes, their key performance indicators and business goals at enterprise level.

Generally we would like to point out that:

- Real-time measurements: significant effort is invested towards monitoring of energy consumption
- Real-time response and predictive management: several solutions exist, however they are limited within one vendor and only with a specific building (or part of it)
- Design and integration: network planning and plug&play integration is still not cross-vendor although it partially exists in isolated solutions

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[4] http://docs.oasis-open.org/energyinterop/ei/v1.0/energyinterop-v1.0.html
[5] http://docs.oasis-open.org/emix/emix/v1.0/emix-v1.0.html
[6] http://collaborate.nist.gov/twiki-sggrid/pub/SmartGrid/SGIPGBDocumentsUnderReview/Standards_Catalog_Process_and_Structure_V0_9_20110401.pdf
[7] http://smartgrid.ieee.org/standards/approved-ieee-smart-grid-standards
[8] http://smartgrid.ieee.org/standards/proposed-standards-related-to-smart-grid

- Decision support: is mostly supported, however not at fine grained level and with very limited flexibility.
- Distributed generation and demand response: some initial efforts exist, however most of the work is still planned (according also to the smart grids vision)
- Standards: the majority of standards deals with connectivity technologies, however application interactions for energy management and trading are still not adequately covered (on-going processes in several standardisation organisations and fora).

3.4.4 Industrial Needs

Several industrial needs were already identified by the REEB project in deliverable D4.4. For energy management and trading the focus is on:

- Better interoperability and reliability of the technologies and systems
- Migration towards fully service-based infrastructures
- Adoption of collaboration tools for open cross-industry information exchange
- New technologies for real-time energy management
- Enhanced energy prediction models and tools
- Energy optimisation and control models and tools
- Real-time consolidated reporting and integration with business processes
- Intelligent energy-aware and adaptable devices/appliances etc.
- Models and methods for assessment and comparison of energy footprint during the whole lifecycle
- Tools for security, privacy and trust assessment
- Scalable integration with SmartGrids and Smart Cities
- Internet based energy services for smart buildings
- Easy integration with online energy marketplaces
- Easy integration of alternative energy resources and demand-side management
- Tools for the assessment of approaches during their whole lifecycle including cost, environment impact, maintenance etc.

3.4.5 Non-Technological Barriers

Energy Management and trading faces some non-technological roadblocks. Privacy is a major issue, as fine grained energy consumption measurements may reveal user activities within a building. The lack of understanding how energy management and trading can fit towards measurable KPIs as well as their interdependency with other goals of the enterprise is not clear. For enterprises there are several barriers towards the adoption of energy efficient technologies. The three main areas identified are depicted in Figure 22. Understanding how innovation can be achieved and its impact would be needed for the whole lifetime of the approach. Additionally legal, financial, cultural and social barriers might need to be further investigated to assess the impact as well as possible strategies to efficiently tackle their blockers.

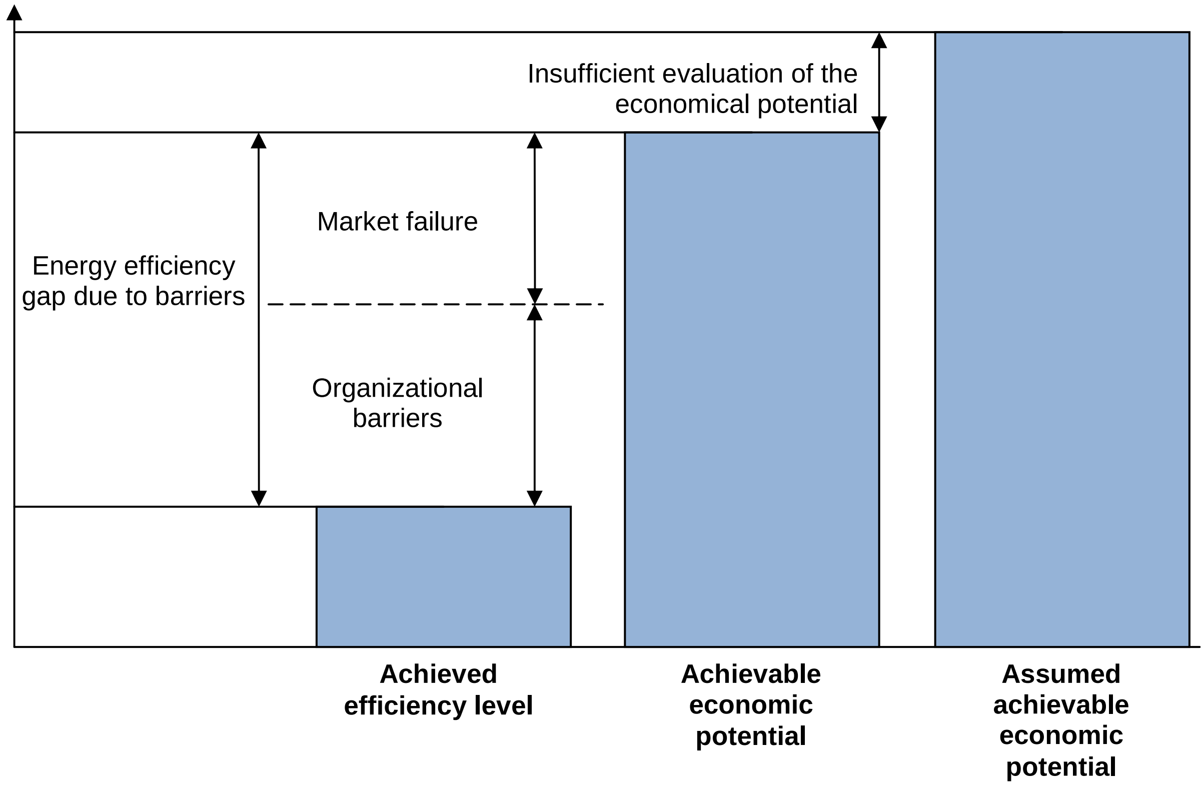

Figure 22 – Energy Efficiency in Companies [Schmid2004]

Potential road blockers include:

- Lack of awareness on innovation for energy management as part of an ecosystem
- Lack of demonstrating clearly the benefits in real-world lighthouse projects
- Lack of market availability and openness
- Lack of policies and incentives at national and European wide level
- Difficulty overcoming established energy systems and providing migration solutions to next generation open collaborative energy management
- Inadequate workforce skills and training
- Lack of meaningful stakeholder participation.

3.5 Industrial State-of-the-Art on Integration technologies

3.5.1 Review of State-of-the-Art in Industry

The importance of collaboration between different design disciplines has been widely recognised by the building industry. Traditionally this is achieved through physical meetings between the representatives of different design groups. However, this is facing more challenges when dealing with large and complex design problems. Various approaches have been introduced to face this problem, such as multi-agent systems (MAS) and the multi-disciplinary design optimisation (MDO) approaches. The former represents an advanced, ICT-based framework which facilitates collaborative design through communication, data and knowledge sharing and negotiation while the latter represents a theoretical modelling approach which facilitates collaborative design through a thorough analysis of the technical problems.
To be effective organizations need not only to negotiate their migration from a knowledge sharing (first generation) to a knowledge nurturing (second generation) culture, but also to create sustained organizational and societal values. The latter form the third generation of knowledge management and represents key challenges faced by modern organizations in the Architecture, Engineering and Construction (AEC) industry. This value creation is grounded in the appropriate combination of human networks, social capital, intellectual capital, and technology assets, facilitated by a culture of change.
The modern vision consider Building Automation (BA) domain and Building Management Systems (BMS) as "*Open Systems*" for a full comprehensive building control network, designed on several types of bus systems, that:

- encompasses every building system,
- enable competitive bidding and allow best-in-breed product selection,
- have a dynamic application, being able to utilize enterprise technologies and present new opportunities and added value for manufacturers, system integrators and owners alike.

The challenge is in the market. There are many system technologies available that claim to be an *open system technology*: each one has its peculiarity and standards, but only few of them have gained wide acceptance and application.
However, they have very different network, software (communication protocol and configuration tools) and hardware requirements. For all practical intents, integration will solve the mutually exclusive solution approaches of co-existing different technologies, by relegating the sharing of information through a gateway.

To evaluate the best technology experts suggests considering the following main goals:

- **Open system**, by implementing an End-to-End solution that is Open, Interoperable and Multi-Vendor. The device level of interoperability (and inter-changeability) affects the network architecture and the ability to create multi-vendor solutions. Independent product distribution provides system integrators and owners the opportunity to select the best-in-breed products without being tied to a manufacturer specific solution.

- **Market presence**, to illustrate the influence each has on the market. It involves evaluating user community activity and the extent of the installed base.

- **Solution approach**, which reveals the strengths and weaknesses of each. Common similarities of each are identified in the delivering of complete End-to-End solutions, with several own control devices and operator interface options. Focusing on differences, significant divergences are in device interoperability, network management, product distribution and integration of new technology.

- **Product distribution** and the integration of new technology are vital areas for commercial success and market influence.

- **Network management** functions are used in every control solution to design, configure, commission and install devices. In proprietary solutions these functions are tied to a proprietary network database and are either distributed among several software applications or bundled with the operator interface application. Often network management functions appear invisible or operate automatically in the background during system/device configuration.

Selecting an appropriate Open System as BMS solution, it will be capable of delivering an End-to-End solution, with a great product availability, product diversity, vendor choice, significant market lead, being on the state-of-the-art and updated upon the latest technology.
Among the overall BMS, LonWorks, BACnet and the European Installation Bus (EIB/KNX) are the leading contenders in the Open Systems with bus technology domain, while DALI is nowadays increasing its popularity in the lighting control domain.
Again, in this area, it seems clear how IPv6 technology will enable the integration of various subsystems within buildings.
With IPv6 protocol, in practice, it is possible to assess how an IP backbone is built and how other protocols are used at the (sub)system level. If each individual component would end an IP address this ultimately means that each of them needs dedicated supplement hardware at additional cost. For instance, in the case of lighting, where the number of light points is already substantial and will increase due to the use of LEDs, nobody can afford this practice, not now and probably also not in the foreseeable future. The same would also apply to control of the individual comfort level through HVAC and blinds, the added cost are in most cases not affordable.
Despite the drawbacks described above, with the expectation to improve and reach maturity stage of this protocol, an example of that is the ongoing project called “Smart IPv6 Building”.
A summary of this project from their homepage web says: “Information and Communication Technologies (ICT) have reshaped our world. The emergence of the new Internet Protocol version 6 (IPv6) will be essential to further transform and improve our environment. It will enable billions of devices to have their own IP address, to be interconnected and to work together. It is paving the way to the future Internet of things, in which sensors, actuators and devices will be directly connected to each other, with an almost unlimited scalability. The Smart IPv6 building project intends to explore this IPv6 potential in built environments. It will test innovative forms of interactions, by transforming buildings into smart and interactive environments, with pervasive and distributed intelligence. It will also develop the potential of IPv6 to improve buildings' energy efficiency and to reduce greenhouse gas emissions through a smarter building management. The Smart IPv6 building[9], coordinated by Mandat International with the support of the IPv6 Forum, provides an international platform for research, academic and industrial partners.

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[9] www.smartipv6building.org

With reference to the above consideration, the Smart IPv6 building project will be deployed and tested in a real situation with an existing building, and latter with a new construction in the middle of the international organizations area in Geneva: the "International Cooperation House". This building will provide budget accommodation and support for experts and delegates with limited resources coming from developing countries to attend international conferences, as well as offices for organisations working with the UN system. The central location and high visibility of this new building will be used to showcase and promote IPv6 based technologies."
The fondness of an ICT based approach is a collaborative briefing framework to extend key stakeholder engagement is proposed, aiming to improve the efficiency and reliability of project briefing for megaprojects. Authors introduce an innovative collaborative approach to promote stakeholder involvement by enhancing the efficiency and effectiveness of managing a large group of stakeholders, harnessing collaboration technology. Drawing parallels with biological neural networks in humans, a conceptual collaborative briefing framework is proposed to demonstrate how briefing team members can work collaboratively as a virtual organisation through a shared digital workspace. The proposed framework supplements face-to-face discussion with computer mediated discussion, depending on the type, flexibility and interaction needed for different aspects in briefing. This "hybrid briefing method" maximises the benefits to costs ratio of expanded stakeholder engagement in project briefing. This kind of framework will promote the accuracy and transparency of 'requirements identification' processing, the effective engagement and appropriate integration of more stakeholder inputs and finally, will improve the efficiency and reliability of briefing outputs.

3.5.2 Relevant Standards

This paragraph indentifies the technical standards related to the crossing priority area of "Integration Technologies" of ICT4E2B classification.
In order to better understand the relevant standards and how these are involved in each of the architecture layers of the integration technology area, in the following it is provided a classification overview of these standards as well as brief descriptions:

- **Devices:**

  - **RS-232** (Recommended Standard 232) is the traditional name for a series of standards for serial binary single-ended data and control signals connecting between a DTE (Data Terminal Equipment) and a DCE (Data Circuitterminating Equipment). It is commonly used in computer serial ports.

  - **RS-422** is a common short form and former official title of American National Standards Institute (ANSI) standard ANSI/TIA/EIA-422-B and its international equivalent ITU-T Recommendation T-REC-V.11, also known as X.27. These technical standards specify the electrical characteristics of the balanced voltage digital interface circuit

  - **EIA-485**, also known as TIA/EIA-485 or RS-485, is a standard defining the electrical characteristics of drivers and receivers for use in balanced digital multipoint systems

- **Interface:**

- **IEEE 1451** is a set of smart transducer interface standards developed by the IEEE Instrumentation and Measurement Society's Sensor Technology Technical Committee that describe a set of open, common, networkindependent communication interfaces for connecting transducers (sensors or actuators) to microprocessors, instrumentation systems, and control/field networks.

- **Communication:**

  - **LonWorks** is a standard communication protocol for building automation developed by Echelon SNVT and approved by ISO and IEC as ISO/IEC 14908-1 standard and by ANSI as ANSI/CEA-709.1-B. It enables peer-to-peer data exchange at the field level and with the supervisory/management level, creating flat network architecture with the potential for multi-vendor interoperable networks. To proliferate these networks, the LonMark® Association has established physical and application layer guidelines and functional profiles. The functional profiles facilitate device-to-device communications by defining a set of functional characteristics for specific device types. This enables owners to choose, substitute, and integrate products from multiple vendors, thereby providing competition and competitive bidding.

  - **BacNet** is a communication protocol for Building Automation (BA) and control networks. It is an ASHRAE, ANSI and ISO standard protocol. This standard defines how devices can exchange information, but leaving manufactures and system integrators free to choose which BACnet functions to implement within devices. This results in devices from competing manufacturers that may not communicate device-to-device or be freely substituted with one another. Device-level BACnet data is typically exchanged through supervisory devices creating a tiered network architecture. Future network expansion is dependent on manufacturer specific applications to interface with supervisory devices.

  - **EIB/KNX** is a standardised (EN 50090, ISO/IEC 14543), OSI-based network communications protocol for intelligent buildings. KNX is the successor to, and convergence of, three previous standards: the European Home Systems Protocol (EHS), BatiBUS, and the European Installation Bus (EIB or Instabus). The KNX standard is administered by the KNX Association.

  - **Modbus** is a de facto industrial standard representing an application-layer messaging protocol (Modbus Application Protocol, level 7 of the OSI model) and a communication protocol (Modbus Serial Protocol, level 2 of the OSI model). It provides client/server communication between devices connected on different types of buses or networks. There are many variants of Modbus protocol, e.g. Modbus TCP (communication over TCP/IP networks), Modbus RTU, Modbus ASCII, etc.

- **Cyber security and system integrity:**

  - **Internet Protocol Security** (IPsec) is a protocol suite for securing Internet Protocol (IP) communications by authenticating and encrypting each IP packet of a communication session. IPsec also includes protocols for establishing mutual authentication between agents at the beginning of the session and negotiation of cryptographic keys to be used during the session;

- **Hypertext Transfer Protocol Secure** (HTTPS) is a combination of the Hypertext Transfer Protocol with the SSL/TLS protocol to provide encrypte communication and secure identification of a network web server.

- **Network and system management:**

  - **Ethernet** is a IEEE standard (IEEE 802.3 and ISO 8802) that uses Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method to physically monitor the traffic on the line at participating (transmitting/receiving) stations. Using Ethernet, there is not need to learn proprietary protocols allowing at the same time the reduction of the total cost of setting up and the maintenance of the communication network.

  - **IEEE 802.11** is a set of standards for implementing wireless local area network (WLAN) computer communication in the 2.4, 3.6 and 5 GHz frequency bands. They are created and maintained by the IEEE LAN/MAN Standards Committee (IEEE 802). The base current version of the standard is IEEE 802.11-2007

  - **IEEE 802.15.4** is a standard which specifies the physical layer and media access control for low-rate wireless personal area networks (LR-WPANs). It is maintained by the IEEE 802.15 working group. It is the basis for the ZigBee, WirelessHART, ISA SP100, and MiWi specification, each of which further attempts to offer a complete networking solution by developing the upper layers which are not covered by the standard. Alternatively, it can be used with 6LoWPAN and standard Internet protocols to build a Wireless Embedded Internet.

  - **IETF 6loWPAN** (IPv6 over Low-Power Wireless Personal Area Networks) will work closely with the Routing Over Low power and Lossy networks (roll) working group which is developing IPv6 routing solutions for low power and lossy networks (LLNs). The IEEE 1451.5 standard for wireless transducers has a chapter for 6LoWPAN and the ISA SP100 standard for wireless industrial networks has adopted 6LoWPAN for their network layer.

- **Power system operations**:

  - **DNP3** (Distributed Network Protocol) is a set of communications protocols used between components in process automation systems. Its main use is in utilities such as electric and water companies. The IEEE adopted DNP3 as IEEE Std 1815-2010 on the 23rd of July 2010.

- **Application**:

- **Service Oriented Architecture** (SOA) following W3C (World Wide Web Consortium) standards and guidelines, for example, SOAP for the Web Service interface. SOAP (Simple Object Access Protocol) is a W3C standard for structured information interchange (based on XML standard for the message format) relying on HTTP (Hypertext Transfer Protocol) for message negotiation and transmission.

- **ISO 13790:2008**, Building energy performance – Energy use for space heating and cooling, one of the key standards for the EPBD.
- **Various parts of ISO 15927**, published in six parts under the general title, Hygrothermal performance of buildings – Calculation and presentation of climatic data.
- **ISO 16813:2006**, Building environment design – Indoor environment – General principles.
- **ISO 16818:2008**, Building environment design – Energy efficiency – Terminology
- **ISO 16814:2008**, Building environment design – Indoor air quality – Methods of expressing the quality of indoor air for human occupancy.
- **ISO 23045:2008**, Building environment design – Guidelines to assess energy efficiency of new buildings.
- **ISO 6946:2007**, Building components and building elements – Thermal resistance and thermal transmittance – Calculation method.
- **ISO 13789:2007**, Thermal performance of buildings – Transmission and ventilation heat transfer coefficients – Calculation method.
- **ISO 13370:2007**, Thermal performance of buildings – Heat transfer via the ground – Calculation methods.
- **ISO 10211:2007**, Thermal bridges in building construction – Heat flows and surface temperatures – Detailed calculations.
- **Parts 1 and 2 of ISO 10077** published under the general title, Thermal performance of windows, doors and shutters – Calculation of thermal transmittance.
- **ISO 14001**, requirements for an Environmental Management System (EMS) which can be employed by an organization to measure and document their environmental impact.
- **ISO 50001**, energy management systems – Requirements with guidance for use.
- **Internet of things platforms,** which facilitates the usage of sensors to control various kinds of measures and take decisions with the data obtained.

3.5.3 Industrial Needs

Nowadays one of the main problems for the European industry is the presence of a lot of different consortiums and initiatives able to certificate standards.

This fragmented situation produces a certainly big disparity of certification and makes more difficult the selection process of the most relevant standards that we have to take into account in order to compare performances in buildings for different regions in our continent.
The present scattered approach in the market proves that industry sees no business advantage in a harmonized approach even if we could conclude that the harmonization of these different standards was needed.
If we make a quick and not exhaustive research, we can awake that a large variety of different products regarding energy management in buildings compete for a place in the market. This means that every software application is competent in some parts and not others due to the complexity that involves the process of energy management in buildings.
Therefore there is the need of a reference architecture that covers the main key points in this field to have a robust tool to operate this process.
Regarding systems integration, each company or vendor uses their own technology depending on their know-how or expertise. This situation produces a wide variety of different technologies coexisting, and the integration of all of them is made really tough. As such, it’s a necessity of the industry to develop SOA based Integration Service Platform (ISP) and a definition of the gateway installed in each building.

3.5.4 Non-Technological Barriers

The main barrier to the adoption of the new technological developments by the building sector is its fragmentation and “project oriented approach”. A lot of stakeholders take part in the building life cycle, many of them SMEs or even micro-SMEs, and usually, no one leads the overall process. Also the “project oriented” approach of building sectors makes complex the adoption of long term strategies.
Another important barrier is the complexity of dealing with existing buildings: general lack of data, the few existing data are available only on paper, very simple and no automated installations, etc.
From the economical point of view, the current static energy price implies long amortization periods, which discourage investments in energy efficiency. However, it is expected that in a near future energy price will be real-time changing and more close to the real one.

4 European RTD Projects on ICT for Energy Efficiency in Buildings

In this chapter it is presented an updated overview of European Research and Technology Development projects on ICT for Energy Efficiency in Buildings.

With reference to the RTD projects, considering the ICT4E2B domain (FP7-ICT, FP7-EeB PPP, ARTEMIS, ICT-PSP) inside FP7 and CIP were accounted 78 projects, distributed as shown in Table 4.

Table 4: Research Projects Framework Distribution

Framework	Thematic Area	Number of Projects
FP7	Cooperation and Capacities programme	54
	Energy Efficient BuildingPublic and Private Partnerships (EeB PPP)	6
	ARTEMIS	2
CIP	Information Communication Technologies Policy Support Programme (ICT-PSP)	12
	Intelligent Energy Europe	4

A schematic representation of the identified projects, based on the contribution given by each project partner, is provided in the Appendix to this document.
The survey has been based on the Thematic Areas defined by REEB project and further analysed in Deliverable 1.1 "*Classified Research Areas*". These are organised into five thematic areas:

- **Tools for integrated design and production;**
- **Intelligent & Integrated Control;**
- **User awareness & decision support;**
- **Energy management & trading;**
- **Integration technologies.**

The 4 first ones are application domain oriented while the 5th one is cross-cutting.:

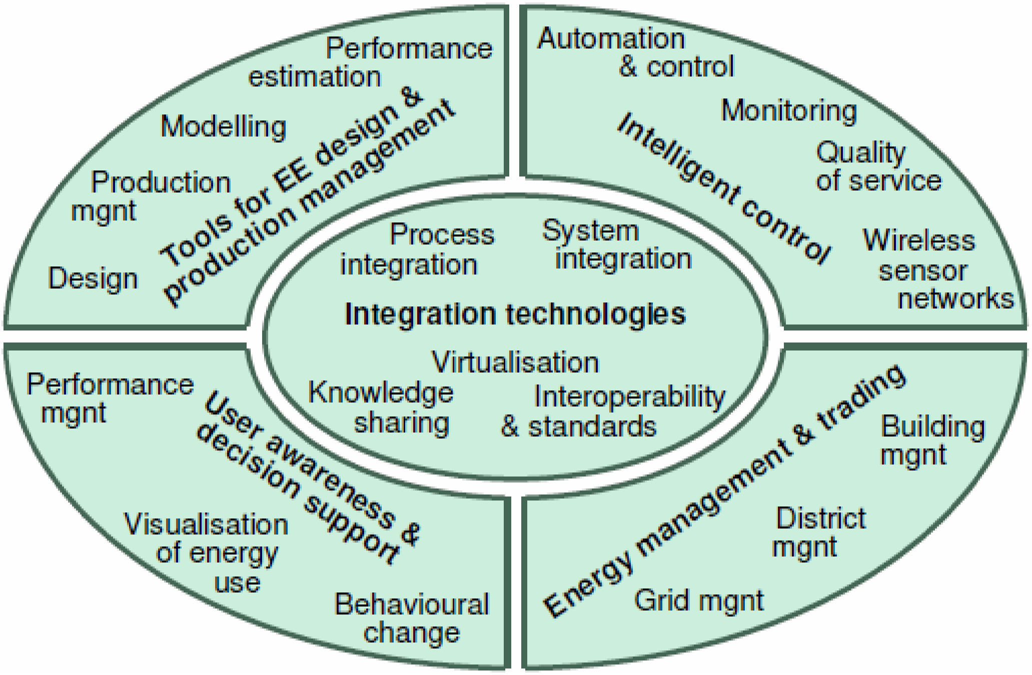


Figure 23: REEB Classification with Subcategories (source "D4.1 Vision..."[10])

The main outcomes of the performed analysis are useful in order to identify:

- which of the mentioned thematic areas are the most covered by the RTD projects on ICT for Energy Efficiency in Buildings at European level.
- results, such as processes, organisation models, prototypes, methodologies and all new knowledge created by the identified projects on ICT for Energy Efficiency in Buildings.

With reference to the bulk of 78 identified projects (62 within FP7 programme and 16 within CIP programme), Figure 24 presents the level of coverage of the five thematic areas of ICT4E2B Forum classification.

[10] http://www.ict-reeb.eu/objects2/REEB_D41_Vision_m19_released.pdf

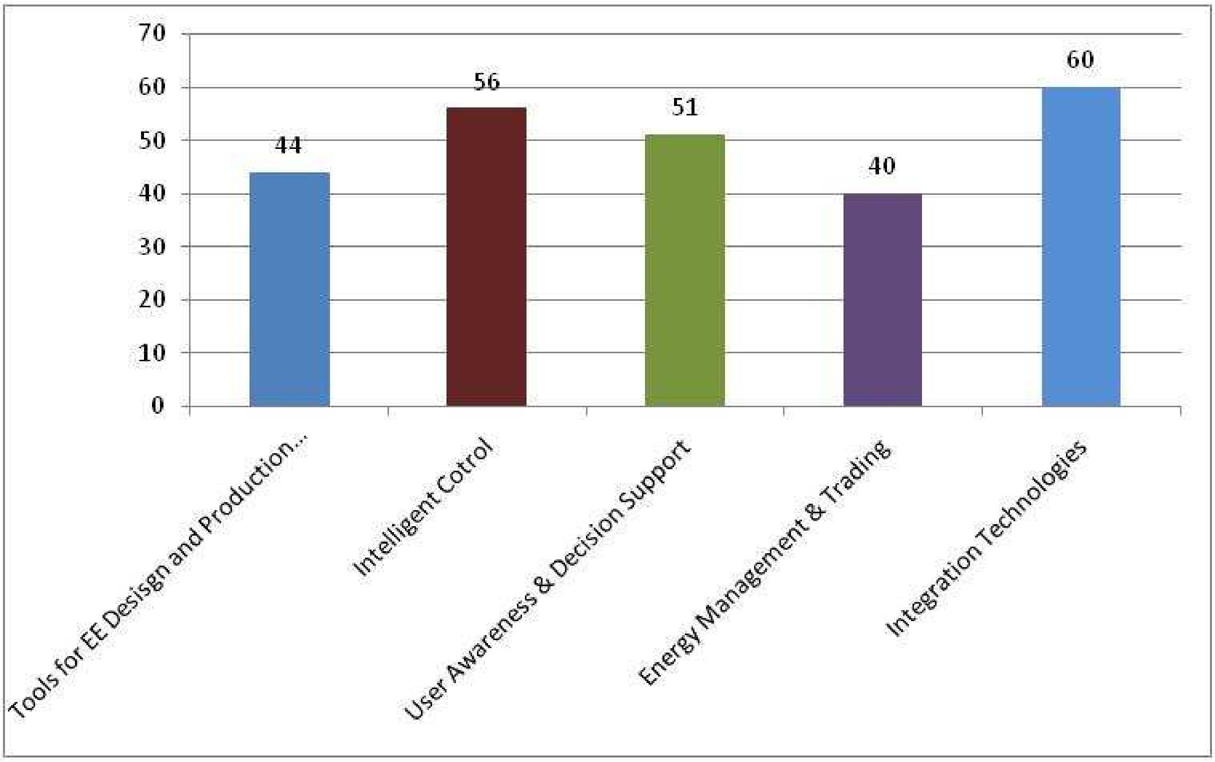


Figure 24: Level of coverage of ICT4E2B Thematic Areas by European Project

This classification indicates that it exists a predominant interest of RTD projetcs towards three ICT4E2B thematic areas, **Intelligent Control, User Awareness & Decision Support** and **Integration technologies** with a slight predominance of the latter. Respectively, 71% , 65% and 77% of the total number of projects considered are related to these three areas.

Then the remaining two areas follow, **Tools for EE Design and Production** and **Energy Management and Trading** by showing similar results; respectively, 56% and 51% of the total number of papers are related to these areas.

It is interesting to note that the **'Energy management and trading'** category is the last one in the ranking. We can observe that normally Energy Management innovation is carried out by energy suppliers, utilities and service providers such as ESCOs that seem to be not fully aware of the potential of ICT solutions.

In addition, after performing a deeper investigation on the European R&D projects, it was possible to assess how the thematic areas and related sub categories and research topics, are involved in the research activity on ICT4E2B domain.

The first result retrieved performing the qualitative analysis is related to the lacking of standardisation in the energy, construction, and ICT sectors. This open issue is a cross need for all the five thematic areas; in fact, it is possible to verify how the aim of several projects is to participate and contribute in standardization efforts, developing common guidelines and regulations for the monitoring and control of energy consumption and power demand, developing energy management system integrated with design tool, smart metering system , or sharing common performance metric and policy marker useful to better support the actions performed by the final user of an efficient building.

A schematic representation of the results retrieved by the qualitative analysis is provided in the following tables. Nevertheless, for each thematic areas it is possible to highlight the following:

- **Tools for EE design and production management:** the need of the integration between simulation and modelling tools with a BMS is tackled by some projects in order to reduce the existent gap.
- **Intelligent Control:** considering the four subcategories that belong to this thematic area, it is clear how the research commitment on “QoS” is lesser than for the other subcategories. It is possible to observe that the current state-of-the-art on ICT tools and solutions used to perform QoS do not need further innovation.
- **User awareness and decision support:** the results demonstrate interest and some focus on this area that cover a very wide domain on ICT4E2B, although some actions on behavioural change need to be implemented.
- **Energy management and trading:** with reference to the considerations provided by the quantitative analysis also the qualitative analysis confirms that **‘Energy management and trading’** category is not currently covered as widely as other thematic areas.
- **Integration Technologies:** the attention is focused on a small set of new advanced technologies that were identified as useful to integrate the other technologies developed for the other four areas.

Table 5: Results on Tools for EE Design and Production Management Area

Thematic Area	Research Topic Addressed by RTD Projects
Tools for EE design and production management	*Design* - Development of intelligent 3D design tool that allow the exploitation of mock up of 3D; - ICT sub system integration into CAD/FM design tools; - Implementation of a simulator and modelling tool, including dynamic models for energy producing, storing and using units that provide decision aid when designing or retrofitting energy infrastructures at the building domain; - Use intelligent touch table used to show to end-user the results of design process and to avoid an easy interaction between end users. With this system it is possible to increase user awareness on what are the effective benefit of the design process. *Modelling* - Development of models to enable energy efficient topology management in distributed systems, with emphasis on dynamic reconfiguration capabilities of resource management devices as key non-functional capability to cope with the legacy challenge by the use of heterogeneous communication networks able to integrate power line techniques, wireless and wired sensor and actuator network technologies; - Development of specialized ontology for multi-system integration of BIM. *Production Management* - Numerical models of energy conversion as well as storage technologies, and numerical model to balance decentralised energy (electrical and thermal) generation with storage. *Performance Estimation* - Development of new business and cost models thatconsider the entire life-cycle of a building and which incorporate the benefits of reduced operating costs and green house-gas emission; - Approach entails development of tools for measuring and analysing building energy profiles based on user comfort needs for efficient solutions to use and manage the energy usage within the building throughout its life cycle; - Simulation software tools allowing emulation of District Energy Networks through the integration of simulated as well as real data sets; - Development of a simulation model calibration methodology for uncertainty mitigation using measured data is also in development; - Algorithms for automatically generating control strategies (BEMS) to optimize performance as measured through relevant performance indices. Depending on the cost function selected, the control algorithms are automatically generated for the particular problem.

Table 6: Results on Intelligent Control Area

Thematic Area	Research Topic Addressed by RTD Projects
Intelligent Control	*Automation and Control* - Develop an integrated electronic system to monitor different building, technical building services, electronic devices and operations in order to optimize and integrate all maintenance functions; - Development of intelligent sensor-based data monitoring; - Development and novel use of nano-materials it aims to increase energy performance in heating, ventilation, air conditioning (HVAC) and lighting systems, and to improve indoor air quality using catalytic purification; - Use of smart sensors and Radio Frequency Based Technology (RFBT) - Developing novel high performance devices with electronic operation of an auto-regulated natural ventilation system and electronic insulating night blind powered by solar power. *Monitoring* - Development of new innovative domestic smart metering technology; - Development of local platform showing the resource and device integrator part, enabling the interoperability of sensors, actuators and meters; - System implementation will require the development of a HW platform that will use a combination of wired and wireless sensing technology to facilitate easy and cost-effective retrofit of devices and infrastructure into existing premises to monitor and control energy usage; - Design and implementation of an energy resources virtualisation environment and appropriate semantics to be used for building energy management applications. *Quality of Service* - Research on diagnosis on data such as detection of malfunctioning equipment, non-optimal performance of buildings - Secure communication inside the built environment *Wireless Sensor Networks* - Development of wireless sensor nodes including multi-source energy harvesters, small factor fuel cells, and energy efficient RF front end with radio triggering capability; - Sensor networks able to collect real-time information detecting environmental and maintenance-oriented parameters of performance from lighting and HVAC services.

Table 7: Results on User Awareness and Decision Support Area

Thematic Area	Research Topic Addressed by RTD Projects
User awareness and decision support	*Performance Management* - Performance analysis and optimization should be implemented by the use of the information collected during the monitoring, to implement corrective/optimization measures and improve the energy efficiency; - Forecasting of energy demand, by taking into account not only the current building operation conditions but also its expected evolution, which depends on the weather forecast and the scheduled home usage profile; - Development of a multi-dimensional visualization system of parameters of building operations and data sharing from technical systems; - Definition of performance metric and policy marker; - Use of product Integrated Virtual Energy Laboratory (IVEL) as quantifying tool for measuring energy performance, consumption and costs throughout building's life cycle; - Development of Decision Support System (DSS) that exploits comprehensive and transferable indicators easily understood by urban planners. *Behavioural Change by Real-time pricing* - Create a paperless on-line solution for construction workers to easily display up-to-date drawings and other construction related materials on site; - Development of To show evidence and demonstrate the cost recovery based on the achieved energy savings and energy efficiency improvement; - Development of intelligent and usable e-learning system that allow to change residents' behaviour as a result of ICT in order to increase its added value. *Visualisation of Energy Use* - Multimodal user interface - Dissemination of energy consumption information in an attractive way by using accessible interface

Table 8: Results on Energy Management and Trading Area

Thematic Area	Research Topic Addressed by RTD Projects
Energy management and trading	*Building and District Management* - Design and implementation of energy management system, for self configuring automated building systems, targeting the usability requirements of three user-groups: o power distribution network operators o residential users o communication network operators; - Exploitation of in-Home energy management strategies and forecast algorithm - Microgrid energy management - Intelligent local management enables participation to Energy Markets *Smart Grids* - The real time controller, data collection module, low cost hardware including, primarily, wireless sensors and data loggers/ transmitters, which will be deployed at the building over a period of time and facilitate the collection of data, which will form the one foundation on which the sourcing decisions may be taken; - Neighbourhood management will also include management of heat and electricity network for efficient integration of renewable energy sources to the distributed systems; - Smart Grids for demand response capabilities of renewable electricity generation and supply chain: - Specify applicable services and develop the interconnection methods, the machine-to-machine (M2M) interfaces and the primitive-based communication techniques to allow communication-level ubiquitous networking and applicability of offering advanced energy-management and control services, bundled with other "smart-home" and "smart-building" services

Table 9: Results on Integration Technologies Area

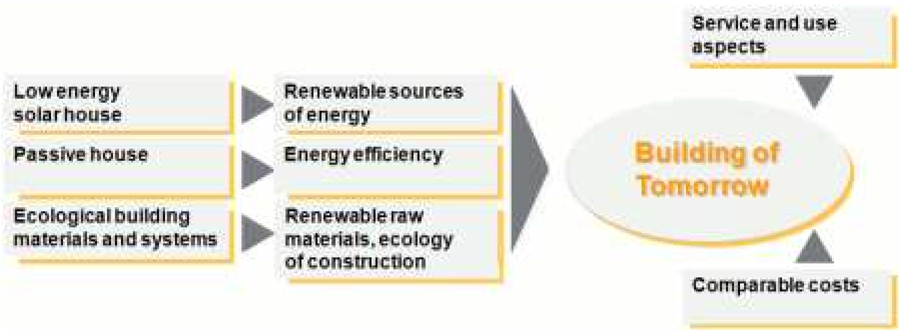
Thematic Area	Research Topic Addressed by RTD Projects
Integration technologies	*Process Integration* - Definition and initial instantiation of architectures and communication platforms to enable the flexible and evolvable interoperation of systems, including sensors, actuators, information systems, control systems and commercial systems across multiple domains and multiple vendors and service providers. *System Integration* - To develop the SOA based platform and to implement and integrate the prototypes of the services for MSI, KM and TEL - IPv6 Wireless technologies for smart metering , integration to enterprise systems, and control network - Design and develop "Agent" platform. This will be an HGi based, sophisticated, yet low-cost monitoring/remote-control platform, integrating both an intelligent electricity metering device, a remote-managed appliances/white-goods controller and a communication module - Lightweight web services (REST) - The coordination is based on a service-oriented model for the middleware, then initiating a cooperation task becomes a task of service composition - Research on artificial intelligence and decision-making methods and, where necessary, develop new techniques specifically to solve energy saving prediction and recommendations

5 European and International RTD Framework on ICT for Energy Efficiency in Buildings

5.1 Identification of EU27 Country Member National Research Framework

5.1.1 Austria National Research Framework

Programme, topic	**FIT-IT (Research, Innovation, Technology - Information Technology)**
Duration	The programme has been running since 2002
Budget M€	more than 10 million Euros in 2005
Website(s)	http://www.fit-it.at/english/index.html
Summary	FIT-IT (Research, Innovation, Technology - Information Technology) – an initiative of the Austrian Ministry for Transport, Innovation, and Technology (BMVIT) - supports co-operative research that addresses challenging innovation and technology development in the area of information and communication technologies. The focus is on visionary and interdisciplinary projects. They aim at significant technological innovation and at a time-to-market frame for new application areas of three to eight years. The result of such a project typically is a proof-of concept for a technical solution, e.g. a prototype. FIT-IT does not support mere product development. Branches of the main programme are the following: - FIT-It Embedded System: The programme will cover aspects of embedded systems that are not only pervasive in everyday household appliances and electronic tools, but they currently also mark an important and rapidly growing field of IT research. - FIT-It Semantic System: The programme will cover aspects of semantic technologies but includes agent technologies, natural language and adaptive systems as important technologies for intelligent web services and systems. - FIT-It System on Chip - FIT-It Trust in IT System - FIT-It Visual Computing
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	FIT-It Visual Computing
	2. Intelligent control
	FIT-It Embedded System FIT-It System on Chip
	3. User awareness and decision support
	FIT-It Trust in IT System
	4. Energy management and trading
	n/a
	5. Integration technologies
	FIT-It Semantic System

Programme, topic	**Technologies for Sustainable Development ("*NachhaltigWirtschaften")* -** Building of Tomorrow sub-programme, second programme phase
Duration	Start date: 2000, second programme phase 2008-2011
Budget M€	35
Website(s)	http://www.bmvit.gv.at/en/innovation/sustainable.html http://www.nachhaltigwirtschaften.at/english/index.html#h1
Summary	This five-year research and technology programme has been developed by the Austrian Federal Ministry of Transport, Innovation and Technology (BMVIT). It initiates and supports trendsetting research and development projects and the implementation of exemplary pilot projects. Sub-programmes related to the ICT for EE in buildings: - **"Building of Tomorrow"** refers to residential and office buildings that feature the following improvements as compared to the present practice in Austria: o Improved energy efficiency over the whole life cycle o Pronounced use of renewable sources of energy, in particular solar energy, o Increased use of renewable raw materials and efficient use thereof, o Increased consideration of service and use aspects for the benefit of users of residential and office buildings, o Costs comparable to those of conventional building designs. Research and development work has provided a firm basis for innovative, sustainable concepts both for new buildings and for renovating existing ones.  The current phase 2 of the program – **Building of Tomorrow Plus** – is developed by following prioritized aims: - Creating the technological basis for the building of tomorrow, especially the plus-energy house. - The program is also focused on office and factory buildings and on modernizing existing buildings. - Adapting innovative technologies and products for large-scale industrial manufacture. - Initiating demonstration projects (buildings, settlements, networks etc.) to put new technologies and approaches on the map. - Supporting the interlinking of the key Austrian providers of know-how internationally, boosting the transfer of know-how across borders, accumulating human resources and integrating existing knowledge into suitable training schemes. With the planning and implementation of innovative residential and office buildings,

	"Building of Tomorrow" has pointed the way for eco-efficient construction and the sustainable use of resources in Austria: - A great deal of scientific competence in this field has been accumulated in Austria. - Austria now has the highest density of passive buildings worldwide. - Austrian firms have taken the lead in the technology of sustainable construction worldwide. - Support has been provided for the process of adapting the Austrian system of subsidizing the construction of accommodation to take account of the latest developments in construction.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	This thematic area is covered by the programme
	2. Intelligent control
	This thematic area is covered by the programme
	3. User awareness and decision support
	This thematic area is covered by the programme
	4. Energy management and trading
	This thematic area is covered by the programme
	5. Integration technologies
	This thematic area is covered by the programme

Programme, topic	**NEUE ENERGIEN 2020**
Duration	2008 – up to date
Budget M€	n/a
Website(s)	http://www.ffg.at/neue-energien-2020
Summary	NEW ENERGY 2020 is the research and technology program of the Climate and Energy Fund. **Program objectives:** respect, given the rapidly increasing global energy demand, climate issues and the increasing risks of a secure energy supply, our energy system from the necessary and drastic changes. For this reason, the climate and energy fund in 2008, a research and technology program called "New Energy 2020" project. This program builds on the results of the strategy process E2050 (**www.e2050.at**) and on the experience of the tender ENERGY OF THE FUTURE of the year 2007. The program focuses on three **basic orientations** : - Efficient energy use - Renewable energies - Intelligent Energy Systems Ambitious ideas and concepts with long-term perspective through to **basic research** and **technological research and development work** and realized with the help of

	pilot and demonstration plants are out in the direction of market proximity. In addition to these primarily technology-related issues, the program also has the task to respond to social issues and to develop knowledge for long-term planning processes.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	This thematic area is covered by the programme
	2. Intelligent control
	This thematic area is covered by the programme
	3. User awareness and decision support
	This thematic area is covered by the programme
	4. Energy management and trading
	This thematic area is covered by the programme
	5. Integration technologies
	This thematic area is covered by the programme

5.1.2 Belgium National Research Framework

Programme, topic	**Science for a Sustainable Development" (2005-2009) - SSD**
Duration	2005-2009 (continuation in 2010)
Budget M€	65,4
Website(s)	http://www.belspo.be/belspo/ssd/index_en.stm
Summary	On 4 March 2005, the Council of Ministers approved the research programme **"Science for a Sustainable Development" (2005-2009) - SSD.** This research programme is the continuation of the first and second Scientific Support Plan for a Sustainable Development Policy (SPSD I (1996-2001) and SPSD II (2000-2005)). Compared to SPSD I and II, the Programme integrates new themes, namely "Health and Environment" and "Standardisation". On 9 July 2010, the Council of Ministers approved the continuation of the programme for 2010. The programme SSD is composed of 8 priority research areas: Energy, Transport and mobility, Agrofood, Health and environment, Climate (including Antarctica), Biodiversity (including Antarctica and the North Sea), Atmosphere and terrestrial and marine ecosystems (including Antarctica and the North Sea) and Transversal Research.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	This thematic area is covered by the programme
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	n/a
	5. Integration technologies
	This thematic area is covered by the programme

5.1.3 Denmark National Research Framework

Programme, topic	**EUDP (Energy Technology Development and Demonstration Programme)**
Duration	2008 - ongoing
Budget M€	100 M€ in 2011
Website(s)	www.ens.dk/DA-DK/NYTEKNOLOGI/OM-EUDP
Summary	The main objective of the EUDP is to ensure the development and demonstration of new energy technologies, which can reduce dependency on fossil energy, and which can contribute to minimising the CO2 burden and the environmental impact of energy consumption. In 2011 there is 4M€ budgeted for research in energy efficient buildings, however that includes non ICT related research such as e.g. building materials.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	This thematic area is covered by the programme
	2. Intelligent control
	This thematic area is covered by the programme
	3. User awareness and decision support
	This thematic area is covered by the programme
	4. Energy management and trading
	This thematic area is covered by the programme
	5. Integration technologies
	This thematic area is covered by the programme

5.1.4 Estonia National Research Framework

Programme, topic	**National Strategic Reference Framework**
Duration	2007 – 2013
Budget M€	341
Website(s)	http://www.struktuurifondid.ee/index.php
Summary	This operational programme covers activities that support the development of Estonian enterprises and growth in their productivity as well as starting and developing export to foreign countries. In priority axis - development of information society, the goal is to provide an easy and secure Internet access all over Estonia and make more and more public services accessible online. By 2013, the transactions and proceedings in public institutions shall be paperless. We would like to make procedures in public institutions as well as local governments easier, clearer and transparent for the citizens. In research and development the resources of the European Social Fund (ESF) have been used for supporting a knowledge-based society, a new generation of scientists and engineers and for improving the quality of higher education. In Estonia R&D activities are funded from the state budget, budgets of rural municipalities or cities, targeted donations, income earned from the economic activities of R&D institutions, and from other sources.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section. All of the projects, ideas that are innovative can be co-funded, including projects related to EE design and production management.
	2. Intelligent control
	No direct relations to this section. All of the projects, ideas that are innovative can be co-funded, including projects related to intelligent control.
	3. User awareness and decision support
	No direct relations to this section. All of the projects, ideas that are innovative can be co-funded, including projects related to user awareness and decision support.
	4. Energy management and trading
	No direct relations to this section. All of the projects, ideas that are innovative can be co-funded, including projects related to energy management and training.
	5. Integration technologies
	No direct relations to this section. All of the projects, ideas that are innovative can be co-funded, including projects related to integration technologies.
	Unclassified recommendations
	The Estonian Science Foundation allocates (intermediates) the individual grants on competitive bases, to support - the purpose is primarily to support high-level initiative research, new ideas and studies. Funding comes entirely from the state budget.

Programme, topic	**ICT Programme**
Duration	2007 – 2013
Budget M€	315
Website(s)	http://archimedes.ee/teadus/index.php?leht=327&lng=1&vah=1

Summary	Information and communication technology R & D program (IKTP) is part of the Estonian R&D and innovation (RD & I), "Knowledge-based Estonia 2007-2013" implementation plan. Aims of the programme: - Promotethe Estonian ICT in higher education towardsnew, internationally competitive levels. - Increase R&D capabilities in the ICT field. - Strengthen education and research institutions, and cooperation among enterprises in the ICT sector. - Enhance applied research in the field of ICT research and development activities. Increase participation in international research institutions and business and IT Technology works.	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**	
	No direct relations to this section. All of the projects, ideas that are innovative can be co-funded, including projects related to EE design and production management.	
	2. Intelligent control	
	No direct relations to this section. All of the projects, ideas that are innovative can be co-funded, including projects related to intelligent control.	
	3. User awareness and decision support	
	No direct relations to this section. All of the projects, ideas that are innovative can be co-funded, including projects related to user awareness and decision support.	
	4. Energy management and trading	
	No direct relations to this section. All of the projects, ideas that are innovative can be co-funded, including projects related to energy management and training.	
	5. Integration technologies	
	No direct relations to this section. All of the projects, ideas that are innovative can be co-funded, including projects related to integration technologies.	

5.1.5 Finland National Research Framework

Programme, topic	**PRE – Built Environment Re-engineering**
Duration	2010 - 2013
Budget M€	31
Web site(s)	http://www.rym.fi/en/programs/builtenvironmentprocessreengineeringpre/
Summary	"Programme aims to create totally new procedures and business models for the real estate, construction and infra sectors. They will be more user-centred and supported by product model-based data management over the entire life cycle of the real estate, infrastructures and communities in question. The adoption of new business processes allows a significant increase in productivity and quality.The possibilities of exploiting building information modelling will be studied from many standpoints: the supply chains of industrialised building, real-estate life cycle management and urban planning. The requirements of knowledge work for space management are also a subject." Main ICT related areas include: - Interoperability - Building Information Modelling - Interaction
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Design (1.1), Production management (1.2), Modelling (1.3) Performance estimation (1.4)
	2. Intelligent control
	n/a
	3. User awareness and decision support
	Performance management (3.1), Behavioural change (3.3)
	4. Energy management and trading
	Building energy management (4.1)
	5. Integration technologies
	Process integration (5.1), System integration (5.2), Knowledge sharing (5.3), Interoperability and standards (5.4)

Programme, topic	**Built Environment**
Duration	2009 - 2014
Budget M€	75
Web site(s)	http://www.tekes.fi/programmes/Rak_ymparisto/
Summary	"The basis of the Built Environment programme is on the users´ needs of the built environment and the demands set by them for the practices in real estate and construction sector. The programme increases the functionality of the built environment by developing the practices of real estate and construction field. The programme focuses especially on renovation and refurbishment, construction for well-being concepts and infrastructure construction."
Reference to ICT4E2B	1. **Tools for EE design and production management**
	Performance estimation (1.4)

Classification	2. Intelligent control
	n/a
	3. User awareness and decision support
	Performance management (3.1)
	4. Energy management and trading
	n/a
	5. Integration technologies
	Process integration (5.1)

Programme, topic	**Sustainable community -** Generates renewable business activities in designing, constructing and maintaining sustainable and energy efficient areas and buildings.				
Duration	2007 - 2012				
Budget M€	100	Funding M€	50 Tekes	Person months	N/A
Web site(s)	http://www.tekes.fi/programmes/Yhdyskunta; http://www.acora.net/ajankohtaista.htm				
Summary	"The real estate and construction cluster is of economic significance and its environmental impact is also a serious consideration, as it accounts for as much as 40% of energy use on a global level. The buildings and the built environment are key factors affecting climate change. Urban planning has a major effect on energy and resource consumption and environmental burden. One core theme of the Sustainable community programme is a significant improvement in the energy efficiency of buildings and communities and the promotion of adopting renewable energy sources. Companies and research institutions involved in the programme will create innovative business operations for the planning, construction, maintenance and repair of sustainable and energy efficient buildings and communities. The target group of the Sustainable community programme includes the building and real estate cluster, the energy and environment cluster and the service sector. These clusters are in a key position to offer and implement new solutions and services." The main ICT related areas include: - Use of RFID in construction - Development and Implementation of IFC compatible BIM etc.				
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**				
	Production management (1.2), Performance estimation (1.4)				
	2. Intelligent control				
	Automation & control (2.1), Monitoring (2.2), Quality of service (2.3), WSN (2.4)				
	3. User awareness and decision support				
	Performance management (3.1)				
	4. Energy management and trading				
	Building energy management (4.1), District energy management (4.2), Smart grids and the built environment (4.3)				
	5. Integration technologies				
	Process integration (5.1)				

Programme, topic	**The Ubicom – Embedded ICT (Tekes)** Programme focuses on developing and piloting embedded IT solutions.
Duration	2007 - 2014

Budget M€	294	
Web site(s)	http://www.tekes.fi/programmes/Ubicom; http://www.te-keskus.fi	
Summary	"The programme strengthens the research in ubiquitous computing, increases the resources available for the industry's commercial competitive offerings, enhances the international cooperation environment and spurs on cooperation between different branches of industry by creating new industry networks and industry standards. To strengthen the expert research base in ubicom-technologies to facilitate the expansion of networks internationally, via joint collaboration projects. To pilot and demonstrate new ubicom-solutions and consolidate platforms for Commercialisation of new ubiquitous systems, products and services. The goal is to create new markets and also to improve the productivity and conditions in existing industries."	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**	
	n/a	
	2. Intelligent control	
	ICTs for Automation and control (2.1), monitoring (2.2), Wireless sensors networks (2.4)	
	3. User awareness and decision support	
	Performance management (3.1)	
	4. Energy management and trading	
	n/a	
	5. Integration technologies	
	System integration (5.2)	

Programme, topic	**DIEM - Devices and Interoperability Ecosystems -** Connecting physical and digital environments
Duration	2008 - 2011
Budget M€	35
Web site(s)	http://www.diem.fi/
Summary	"The DIEM programme aims to create the concept and to implement a generic and scalable smart space interoperability solution and platform, which can be adapted to various domains and applications. The programme consists of five content producing work packages and dissemination and has a dual approach with:- - Vertical work packages focusing on first selected application areas and - Horizontal work packages focusing on the key elements of creating the ecosystem for device interoperability. - Experts predict that by the year 2015 there will be one thousand electronic devices for every person on our planet. These devices contain different types of information and are able to share this information by networking with other devices. The value of information increases when it is shared and sharing also makes it possible to create new innovative applications. Through these applications, a vision of a smart environment is brought into being. These smart environments will, in turn, transform our lives." The Main ICT related areas include: - Interoperability - Mobile mixed reality

	- Building automation - Smart spaces - Interaction and user interface
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Performance estimation (1.4)
	2. Intelligent control
	Automation & control (2.1), Monitoring (2.2), WSN (2.4)
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	Building energy management (4.1)
	5. Integration technologies
	System integration (5.2)

5.1.6 France National Research Framework

<table>
<tr><td>Programme, topic</td><td>PREBAT 2 (Programme de Recherché surl'Energiedans le Bâtiment)</td></tr>
<tr><td>Duration</td><td>2010 – 2014</td></tr>
<tr><td>Budget M€</td><td>n/a</td></tr>
<tr><td>Website(s)</td><td>www.developpement-durable.gouv.fr</td></tr>
<tr><td>Summary</td><td>PREBAT was a multiyear programme launched in 2005 in response to the 2004 Climate Plan which set out to cut greenhouse gas emissions in the building sector by 74% by 2050. Financed by ADEME (Environment and Energy Conservation Agency), ANAH (National Housing Association), ANR (National Research Agency), ANRU (National Agency for Urban Renovation) and MEEDDM (PUCA), it aims to achieve significant, sustainable and finalised research, experimentation and dissemination of new solutions to improve energy efficiency in new and existing buildings. It focuses mainly on mitigating the effects of climate change, but also addresses adaptation projects in certain cases.
Two successive programmes have been implemented, PREBAT 1 from 2005- 2009 and PREBAT 2 from 2010-2014. They take the following strategic approaches:

- Sustainable modernisation of existing buildings. The research and development objective is to find technical solutions to the widespread renovation of buildings achieving an energy efficiency rating as close to possible to new buildings in a way which is technically, economically and socially acceptable by 2015-2020
- To foresee the buildings of tomorrow. The research objective is to enable widespread construction of highly energy-efficient buildings of all types by 2015-2020
- The emergence of positive energy buildings. The research objective is to be able to build and renovate a major number of buildings which can supply more energy than they consume. A significant proportion of renovated buildings will benefit from the methods and techniques which will be developed

To this end, four themed committees – the technology committee, existing buildings committee, new buildings committee and a socio-economic committee – are developing an operational action programme incorporating innovative technical solutions, simulation tools and the construction of demonstration buildings. Of these committees, the socio-economic committee is following the approach of a future vision of town planning and the role of stakeholders, offering in particular an analysis of the impact of morphology and the urban dynamic on the assessment of greenhouse gas emissions caused by buildings.</td></tr>
<tr><td rowspan="8">Reference to ICT4E2B Classification</td><td>1. Tools for EE design and production management</td></tr>
<tr><td>This thematic area is covered by the programme</td></tr>
<tr><td>2. Intelligent control</td></tr>
<tr><td>This thematic area is covered by the programme</td></tr>
<tr><td>3. User awareness and decision support</td></tr>
<tr><td>This thematic area is covered by the programme</td></tr>
<tr><td>4. Energy management and trading</td></tr>
<tr><td>n/a</td></tr>
</table>

	5. Integration technologies
	n/a

Programme, topic	**ADEME in action**
Duration	2007 - 2010
Budget M€	30 to 35
Website(s)	http://www2.ademe.fr/servlet/KBaseShow?sort=-1&cid=96&m=3&catid=17778
Summary	Under the PREBAT framework in 2007 – 2010 ADEME will focus on support for demonstration operations highlighting low-energy and positive-energy buildings. Its support may be directed both to demonstration projects proposed by small and medium-sized companies in the buildings sector, and to major construction groups, particularly those that belong to the “Fondation Bâtiment-Energie”. **Long-term stakes** The aim for 2030 is to achieve widespread implantation of high energy-performance buildings and to make the technology available for constructing “positive energy” buildings with low added costs. Another goal is to have construction trades appropriate rehabilitation technologies that can reduce energy consumption in existing buildings by two-thirds. **Objectives for 2010** ADEME breaks down its long-term objectives for 2007 – 2010 into three short-term goals: - develop design tools, materials and equipment that reduce unit energy consumption in buildings (multicriteria design, life-cycle analysis tools, new types of insulation, innovative ventilation systems); - ensure compatibility between product and process development to reduce unit consumption, and environmental and health-quality aspects of buildings (indoor air quality, use of space, lighting and acoustics); - improve our understanding of construction market operations and trends, decision processes and the role of market players. The proposed targets for the first round of new demonstration buildings (2006 – 2009) are consumption of 50 kWh/m²/year for regulated uses (heating and cooling, sanitary hot water, ventilation, lighting) or CO_2 emissions eight times lower than in a reference building. For existing buildings targets will be set at 90/kWh/ m²/year or a fourfold reduction in CO_2 emissions for regulated uses.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	This thematic area is covered by the programme
	2. Intelligent control
	This thematic area is covered by the programme
	3. User awareness and decision support
	This thematic area is covered by the programme
	4. Energy management and trading
	n/a
	5. Integration technologies

	n/a

5.1.7 Germany National Research Framework

Programme, topic	**E-Energy (SmartGrid) Information and Communication Technologies (ICT) for Electric Mobility**
Duration	2008 - 2012
Budget M€	120 for SmartGrids 100 for electric mobility
Website(s)	http://www.e-energy.de/en/ http://www.ikt-em.de/en/
Summary	The primary goal of E-Energy is to create E-Energy model regions that demonstrate how the immense potential for optimization presented by information and communication technologies (ICT) can best be harnessed to enhance the efficiency and environmental compatibility of the power supply and to ensure supply security. It is also hoped that the regional E-Energy model projects will pinpoint ways to create new jobs and markets. To this end, integrative ICT system concepts that optimize the entire electricity supply system - from generation and transport all the way to distribution and consumption - are being developed and put through their paces in practically oriented tests. Information and Communication Technologies (ICT) for Electric Mobility is a support programme operated by the Federal Ministry of Economics and Technology in interdepartmental cooperation with the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. Within the framework of a nation-wide technology competition, seven projects were selected that will develop prototypes and economically viable solutions for the use of ICT in electric mobility systems. These projects focus on such key areas as systems integration (smart charging and vehicle-to-grid systems), vehicle navigation and driving assistance, fees and bill payment systems, vehicle fleets, and mobility services. Total investment amounting to roughly 100 million euro will be allocated to these projects, which will develop prototypes and economically viable solutions to be assessed for the very first time in comprehensive field tests. Thus the "ICT for Electric Mobility" programme forms a key pillar of the German government's National Development Plan for Electric Mobility.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	n/a
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	n/a
	5. Integration technologies
	n/a
	Unclassified recommendations

	- The "ICT for Energy Markets of the Future[11]" and the "German Roadmap for SmartGrids[12]" documents have detailed considerations. - The six pilot regions in the E-Energy technology programme are developing via the respective projects[13] solutions for the ICT-based energy system of the future. - The seven model projects[14] within the technology initiative "ICT for Electric Mobility" are testing crucial new ICT-based technologies and services for integrating electric vehicles into existing energy and transportation systems.

[11] http://www.bdi.eu/BDI_english/download_content/ForschungTechnikUndInnovation/BDI_initiative_IoE_us-IdE-Broschure.pdf
[12] http://www.e-energy.de/documents/DKE_Roadmap_SmartGrid_230410_Engllish.pdf
[13] http://www.e-energy.de/documents/BMWI_Brosch_E_EnergyV4_e_26_6.pdf
[14] http://www.ikt-em.de/documents/BMWi_E-Flyer_Lepo_IKTe_3_5.pdf

5.1.8 Greece National Research Framework

Programme, topic	**Operational Programme Competitiveness**
Duration	2011- 2013
Budget M€	68
Website(s)	http://www.gsrt.gr/default.asp?V_ITEM_ID=32 http://www.gsrt.gr/default.asp?V_LANG_ID=2
Summary	Applied research programme targeting a number of thematic areas; projects may be from 1.5- 3 ME and must involve at a minimum 4 partners; 2 academic and 2c business (minimum).
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	not referenced explicitly
	2. Intelligent control
	highly emphasises area; there is an explicit area relates to low energy wireless systems also for building applications
	3. User awareness and decision support
	indirectly addressed
	4. Energy management and trading
	not referenced explicitly
	5. Integration technologies
	indirectly referenced; important element
Other information	Further to this, core national program, there are regional initiatives, which however has less research and more dissemination elements and orientation. Important activities are carried out by the Technical Chamber of Commerce for the development of tools for the Building directive/ required certificate. In the market integration and monitoring of renewable technology in buildings in an area of important activity; the same applies for service for building certification. Wireless technology is only recently entering the scene.

5.1.9 Hungary National Research Framework

Programme, topic	**Energy related program for both EE in building and green environment**
Duration	2011 – on going
Budget M€	2.6
Website(s)	Former proposal of the energy related program: - http://www.nfu.hu/megjelentek_a_keopenergetikai_palyazati_kiiras - http://palyazatok.org/hirek-az-epuletenergetikai-palyazatokrol-az-oko-programrol-a-zold-beruhazasi-rendszer-alprogramjairol/#more-15822 The new programme covers different R&D thematic among which energy efficiency in building - http://www.korics.hu/aktualis-hirek/hamarosan-ujra-megnyilik-az-epuletenergetikai-korszerusites-palyazat-onkormanyzatoknak
Summary	Started in 2009 was stopped in 2010 by the new government that stops all the previous R&D programme. 20th May 2011the government communicates that the energy related programme will be activated in the next future.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	n/a
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	n/a
	5. Integration technologies
	n/a

Programme, topic	**EEOP-Environment and Energy Operational Programme**
Duration	2007-2013
Budget M€	4.9
Website(s)	http://www.energycentre.hu/

Summary	The Environment and Energy Operational Programme (EEOP) of the New Hungary Development Plan has a total budget of EUR 4916 M to support Hungarian energy projects falling into two priorities in the period of 2007-2013. Within the scope of the priority axis “Increasing the Use of Renewable Energy Sources” 5,15% of the total budget can be allocated while the priority axis “Efficient Energy Use” to promote energy conservation has 1,58% of the total budget. Within the framework of “Increase of the use of renewable energy sources” priority axis developments are supported by the European Regional Development Fund in order to achieve the “Convergence” objective. The following NUTS II regions are eligible for support: West Pannonia, Central Transdanubia, South Transdanubia, North Hungary, North Great Plain, and South Great Plain. Projects implemented in the framework of "Efficient energy use" priority axis are supported by the Cohesion Fund. For this support all the regions of the country are eligible.	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**	
	This thematic area is covered by the programme	
	2. Intelligent control	
	This thematic area is covered by the programme	
	3. User awareness and decision support	
	This thematic area is covered by the programme	
	4. Energy management and trading	
	This thematic area is covered by the programme	
	5. Integration technologies	
	This thematic area is covered by the programme	

5.1.10 Ireland National Research Framework

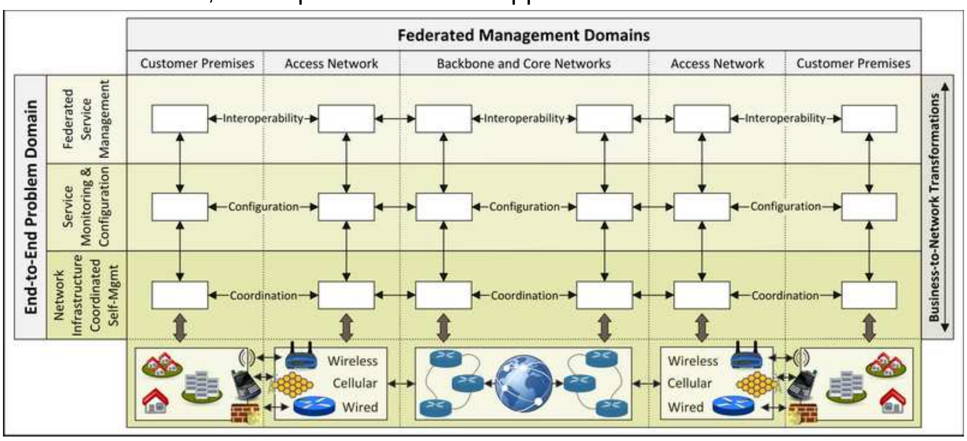
Programme, topic	**SFI Strategic Research Clusters Programme(SRCs)**
Duration	Launched in July 2006
Budget M€	n/a
Website(s)	http://www.sfi.ie/investments-achievements/investments/sfi-strategic-research-clusters/
Summary	The Strategic Research Clusters Programme was launched in July 2006 by Science Foundation Ireland (SFI) which was established to manage Ireland's technology foresight investment programme in biotechnology and Information and Communications Technologies (ICT). SFI Strategic Research Clusters Programme(SRCs) helps link scientists and engineers in partnerships across academia and industry to address crucial research questions, foster the development of new and existing Irish-based technology companies, and grow partnerships with industry that could make an important contribution to Ireland and its economy. The SRC programme has been designed to facilitate the clustering of outstanding researchers to carry out joint research activities in areas of strategic importance to Ireland, while also giving the time and resources to attract and cultivate strong industry partnerships that can inform and enhance their research programmes. Currently funded SFI SRCs related to ICT for EE in buildings: - **ITOBO - Information and Communication Technology for Sustainable and Optimised Building Operation.** ITOBO's research centres around the holistic development of network enabled building management systems. The specific goal is to develop an anticipating (smart) building that operates on an energy efficient and user-friendly basis while reducing its maintenance costs. The research makes a contribution to ICT in the areas of ubiquitous sensing infrastructure; disruptive networking paradigms; decision support systems, and dynamic re configurable service architectures. **Key research highlights:** - Development of Building and Maintenance Models including data warehouse platform and maintenance scheduling tool - Development of constraint based preference and energy optimisation algorithms for lighting control and thermal comfort - Development of indoor solar energy harvesting demonstrator than can continuously operate a wireless sensor mote - Development of first prototype WSAN (wireless sensor and actuator network) design and deployment tool - Jointly organised workshop: "Design and Operation of Smart, Energy Efficient Buildings establishing European Networks for Innovation" with FraunhoferinHaus Research Center, in Duisburg, Germany Expertise: Hardware design, Wireless systems integration and low power network protocol development, N dimensional information modelling, Facilities management, User preferences and intelligent control components Links: http://zuse.ucc.ie/itobo/

http://www.sfi.ie/investments-achievements/researchers/1494/?searched=itobo&advsearch=oneword&highlight=ajaxSearch_highlight+ajaxSearch_highlight1

- **FORME - Functional Oxides and Related Material for Electronics (Strategic Research Cluster).** The FORME project aims to examine cutting edge issues of direct relevance to Irish ICT companies in both the medium term and the longer term - issues which relate to the development of faster, smaller, more power efficient logic processors for computing and associated memory and data storage issues. The potential impact on quality of life that may result from advances in these areas are staggering, ranging from improved mobile communications and enhanced security, to enhanced crime detection, reduced energy consumption (via the creation of **smart homes** for example), greatly improved health diagnostics through biometric sensing.

  Link: http://www.tyndall.ie/forme/

- **Federated, Autonomic Management of End-to-end Communication Services (FAME SRC).** The SFI-funded Federated, Autonomic Management of End-to-end communication services (FAME) Strategic Research Cluster (SRC) will develop autonomic management solutions incorporating new semantic analysis techniques, that can be applied to build federated network and service management systems that understand changes in the environment and coordinate their actions to reconfigure network resources and services to effectively deliver services on an end-to-end basis. FAME brings together academics and industry specialists in the management of communications networks and services. This project is pushing the barriers of what is technically possible in terms of allowing forms of self-management, allowing some parts of a network, and some services that run on these networks, to “work out for themselves” what is needed to operate efficiently. These three research strands are designed to foster innovations in the areas identified above, and are: *Federated Communications Service Management* (“Federation”), *Service Monitoring and Configuration* (“Autonomic”) and *Network Infrastructure Coordinated Self-Management* (“Management” and “End-to-End”). These strands were identified from discussions between the researchers and industry practitioners in the consortium, and represent the best opportunities for innovation.



Links:
http://www.fame.ie/
http://www.tssg.org/archives/portfolio/fame

Reference to | **1. Tools for EE design and production management**

ICT4E2B Classification	This thematic area is covered by the programme	
	2. Intelligent control	
	This thematic area is covered by the programme	
	3. User awareness and decision support	
	This thematic area is covered by the programme	
	4. Energy management and trading	
	This thematic area is covered by the programme	
	5. Integration technologies	
	This thematic area is covered by the programme	

Programme, topic	**National Development Plan (NDP)**
Duration	2007 – 2013
Budget M€	over 25 billion
Website(s)	http://www.finance.gov.ie/ViewDoc.asp?fn=/home.asp&m=0
Summary	The National Development Plan 2007-2013 sets out the economic and social investment priorities needed to realise the vision of a better quality of life for all. This better quality of life will be achieved by supporting the continued development of a dynamic and internationalised economy and society with a high commitment to international competitiveness, social justice and environmental sustainability. As part of the NDP 2007 – 2013 funds are being directed at research on energy efficiency, renewable energy, end-use technology applications and demonstration and related energy research capacity building. The investment programme will also be used to leverage further funding from related EU programmes. It is intended to build on the progress made under the NDP 2000-2006 by investing some **€** 276 million under the Sustainable Energy Sub-Programme over the period 2007-2013. In 2005, the Government, with the Northern Ireland authorities, launched ‘‘2020 Vision’’, an all-island consultation on sustainability in energy supplies, with a particular focus on renewable electricity and are committed to working together to maximise the contribution of renewable and sustainable energy to the future energy needs of the island. In addition to renewable electricity, the renewable heat and transport sectors, and in particular the bioenergy sector are now emerging as areas in which there will be increased policy focus over the lifetime of the new Plan. A target of 15% contribution by renewable energy to electricity generation by 2010 has been set. A 2020 target for the share of electricity produced from renewable energy sources and targets for renewable heat and transport sectors, including bio-energy, will be finalised in the context of the Energy Policy White Paper and in the light of EU developments. Investment in the sustainable energy sector during the 2007-2013 period will encompass the following: • Renewable energy measures will focus on achieving Government targets for renewable energy production and meeting policy goals with regard to competitiveness, environment, security of supply, R&D and the development of a sustainable All-Island energy market. The primary focus will be on the large-scale deployment of wind, the emerging potential and deployment of biomass and biofuels, preparatory action on ocean energy and deployment of other technologies such as solar and geothermal technologies. Deployment will be delivered through a range of supports including taxation, direct grant aid and other funding or support mechanisms;

<table>
<tr><td></td><td>• Energy efficiency measures aimed at establishing and maintaining an effective market structure, informing and empowering consumers to make strong energy efficiency choices. The overall objective of the proposed programme will be the achievement of an annual saving of at least 1% of energy use across the economy over the lifetime of the Plan. Increased energy efficiency will mitigate energy demand growth, reduce import dependence, contribute to carbon reductions and mitigate growth in the energy bill, for the economy and for the individual; and
• Integration and innovation measures will focus on integrating sustainable energy practices and structures into public policies and the development of regional and national infrastructures. There will be two sets of activities: the integration of national sustainable energy policy measures at a regional and city level, and the smaller-scale piloting and evaluation of sustainable energy technology options, including those in the renewable energy, energy efficiency and urban transport areas.</td></tr>
<tr><td rowspan="10">Reference to ICT4E2B Classification</td><td>1. Tools for EE design and production management</td></tr>
<tr><td>This thematic area is covered by the programme</td></tr>
<tr><td>2. Intelligent control</td></tr>
<tr><td>This thematic area is covered by the programme</td></tr>
<tr><td>3. User awareness and decision support</td></tr>
<tr><td>This thematic area is covered by the programme</td></tr>
<tr><td>4. Energy management and trading</td></tr>
<tr><td>This thematic area is covered by the programme</td></tr>
<tr><td>5. Integration technologies</td></tr>
<tr><td>This thematic area is covered by the programme</td></tr>
</table>

5.1.11 Italy National Research Framework

Programme, topic	**Technological Districts**
Duration	Start date: 2004
Budget M€	more than 600
Website(s)	http://www.distretti-tecnologici.it/home.htm
Summary	One of the priorities of the National Research Plan (2005-2007), approved in March 2005, was the promotion of the capacities of SMEs to innovate processes and products and form clusters at local regional areas. In order to enhance the competitiveness of the regions, technology districts in key sectors are being jointly promoted by the government together with the regions, as territorial entities thatare systemically grouped and characterised by technology-intensive products and services. Two technology districts have been founded related to the ICT key strategic area in the sector of energy efficiency and eco-sustainability environment: - “HABITECH” Energia e Ambiente del Trentino – RegioneTrentino Alto Adige - Ediliziasostenibile, fontirinnovabili e gestione del Territorio – Distrettotecnologicodell’Umbria
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	This thematic area is covered by the programme
	3. User awareness and decision support
	This thematic area is covered by the programme
	4. Energy management and trading
	n/a
	5. Integration technologies
	This thematic area is covered by the programme

Programme, topic	**PNR - ProgrammaNazionaledellaRicerca 2011-2013**
Duration	2011-2013
Budget M€	
Website(s)	http://www.istruzione.it/web/ricerca/pnr http://www.miur.it/Documenti/ricerca/pnr_2011_2013/PNR_2011-2013_23_MAR_2011_web.pdf
Summary	In April 2011, the Italian government launched a new research plan (Piano NazionaledellaRicerca, PNR) with the aim to bring the overall investments in RTD from currently 0.56% of GPD – which is among the lowest in the EU - to 1.53% by 2013. The budget will come partly from the national research fund (FondoAgevolazione e Ricerca, FAR) and partly from the research centres’ own resources. An additional funding of € 900 million may be added to support industrial districts. The mechanism for selecting projects will be based on calls and will include

	systems for ceasing the brain drain and attract researchers from abroad. It envisages two action lines – a central and a regional one. The Ministry will manage directly the medium-long term strategic actions in basic research and enabling technologies. The regions will be in charge of driving the local industrial systems towards the adoption of innovation. Specific actions are envisaged for high-tech sectors. The rationale behind this plan is to focus on strategic areas and overcome fragmentation of scattered investments, looking for integration of competences and consistency among the policies of the various stakeholders. This will turn into support to the national technological platforms that will coordinate their activities with the correspondent European platforms, support to the high-tech districts, building poles of excellence (similar to the districts but focused on technological developments), investments in technological infrastructure, the "innovation backbone".
Reference to ICT4E2B Classification	**6. Tools for EE design and production management**
	This thematic area is covered by the programme
	7. Intelligent control
	This thematic area is covered by the programme
	8. User awareness and decision support
	n/a
	9. Energy management and trading
	n/a
	10.Integration technologies
	n/a

Programme, topic	**POI- Programma Operativo Interregionale Energie Rinnovabili e Risparmio Energetico**
Duration	2007-2013
Budget M€	about 1600
Website(s)	http://www.poienergia.it/
Summary	The POI- Programma Operativo Interregionale Energie Rinnovabili e Risparmio Energetico 2007-2013 is the result of intensive consultation between the Ministry of Economic Development (MISE), the Ministry of Environment (MATTM), the Italian Regions "Obiettivo Convergenza" and a large economic partnership and social. It is funded by EU and national funds. The main objective is to Increase the proportion of energy consumed from renewable sources and improving energy efficiency, promoting opportunities for local development, integrating the system of incentives provided by the ordinary policy, emphasizing the links between renewable energy production, efficiency and social fabric, and economic development of territories.
Reference to ICT4E2B Classification	**6. Tools for EE design and production management**
	This thematic area is covered by the programme
	7. Intelligent control
	This thematic area is covered by the programme
	8. User awareness and decision support
	This thematic area is covered by the programme
	9. Energy management and trading
	This thematic area is covered by the programme

	10.Integration technologies
	This thematic area is covered by the programme

5.1.12 Netherlands National Research Framework

Programme, topic	**Smart Energy Systems**
Duration	2010 – 2016
Budget M€	6
Website(s)	www.nwo.nl/nwohome.nsf/pages/NWOP_7YDLQK_Eng
Summary	Based on proven strength in relevant Dutch research areas the following lines of research in the programme have been selected: Smart ICT methods for energy saving, storage and generation in buildings. The research challenge is to minimize energy consumption in offices and homes e.g. using sensor networks for energy monitoring and control. For this line of research new intelligent real-time (on-line) scheduling, planning and control software plus related hardware control options need to be developed.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	This thematic area is covered by the programme
	2. Intelligent control
	This thematic area is covered by the programme
	3. User awareness and decision support
	This thematic area is covered by the programme
	4. Energy management and trading
	This thematic area is covered by the programme
	5. Integration technologies
	This thematic area is covered by the programme

5.1.13 Malta National Research Framework

Programme, topic	**Integrated Utilities Business Systems**	
Duration	Sept 2008 - Sept 2013	
Budget M€	n/a	
Website(s)	n/a	
Summary	Replacement of 250,000 meters with smart meters and implementation of remote management. SCADA for voltage levels 132kV, and 33kV. Reengineering of the utilities processes.	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**	
	n/a	
	2. Intelligent control	
	This thematic area is covered by the programme	
	3. User awareness and decision support	
	n/a	
	4. Energy management and trading	
	n/a	
	5. Integration technologies	
	This thematic area is covered by the programme	

5.1.14 Poland National Research Framework

Programme, topic	**Innovative Economy**
Duration	2007 – 2013
Budget M€	9700
Website(s)	http://www.poig.gov.pl/english/Strony/Introduction.aspx
Summary	In Poland main programme aiming at the whole economy including infrastructure, environment, education and research is the Innovative Economy. This programme is directed mostly to all entrepreneurs who want to implement innovative projects connected with research and development, modern technologies, investments of high importance for the economy or implementation and use of information and communication technologies. Funds within the Programme were divided into so-called priority axes or priorities which will allow to achieve the overall objective and specific objectives of the Programme. Under the Programme, nine priorities were defined, including 8 content-related ones and the Technical assistance priority. Directly connected with the R&D sector are 4 priorities and in these priorities ICT sector as well as generally defined “energy saving” issues are represented. Idea of this Programme is to put science into practice, therefore strong emphasis is put on tangible results
Reference to ICT4E2B Classification	**6. Tools for EE design and production management**
	No direct relations to this section. All of the projects, ideas that are innovative can be co-funded by the Programme, including projects related to EE design and production management.
	7. Intelligent control
	No direct relations to this section. All of the projects, ideas that are innovative can be co-funded by the Programme, including projects related to intelligent control.
	8. User awareness and decision support
	No direct relations to this section. All of the projects, ideas that are innovative can be co-funded by the Programme, including projects related to user awareness and decision support.
	9. Energy management and trading
	No direct relations to this section. All of the projects, ideas that are innovative can be co-funded by the Programme, including projects related to energy management and training.
	10.Integration technologies
	No direct relations to this section. All of the projects, ideas that are innovative can be co-funded by the Programme, including projects related to integration technologies.
	Unclassified recommendations
	One of the priority axes is related to projects aimed at maintaining and developing of the modern IT infrastructure for science through co-financing investments in networks and equipment of nationwide importance, taking into account their crucial importance for the environment.

5.1.15 Portugal National Research Framework

Programme, topic	**National Strategic Reference Framework**	
Duration	2007-2013	
Budget M€	12	
Website(s)	http://www.qren.pt	
Summary	The growing tensions in the global energy system, revealed particularly by the continuous growth in demand for oil, brought on by the industrialization, urbanization and motorisation of the emerging economies, is associated with the political instability that characterises the regions with the greatest concentration of oil reserves, the consequent volatility of the price of hydrocarbons and the very noticeable rise in the price of petroleum. The consequences of these dynamics in countries such as Portugal which are heavily dependent on energy imports are of determinant economic and financial importance, necessarily exacerbated by uncertainty as to future developments – though in the safe knowledge that they will have significant implications for public policies that aim to diversify energy production (namely encouraging investment in renewable sources and increased use of coal allied to new combustion technologies and CO2 sequestration) as well as for those that are aimed at improving energy efficiency (whose main fields of intervention include the construction and equipment of buildings, the acquisition of new vehicles and the alteration of individual and collective behaviour, especially those associated with traffic movements and transportation).	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**	
	n/a	
	2. Intelligent control	
	n/a	
	3. User awareness and decision support	
	n/a	
	4. Energy management and trading	
	highly emphasises area	
	5. Integration technologies	
	indirectly addressed	

5.1.16 Romania National Research Framework

Programme, topic	**Programamul Operational Sectorial CrestereaCompetitivitatiiEconomice - POS CCE**
Duration	2007-2013
Budget M€	2,55
Website(s)	http://www.fonduri-structurale.ro/Detaliu.aspx?t=competitivitate&AspxAutoDetectCookieSupport=1
Summary	Sectoral Operational Programme Increase of Economic Competitiveness (SOP) - General objective of SOP Increase of Economic Competitiveness is the Romanian companies increase productivity to reduce the gap to the average productivity of the Union. The measures taken will generate a 2015 average productivity growth of approx. 5.5% annually and will allow Romania to reach a level of about 55% of the EU. - Strengthening and sustainable development of the productive sector; - Creating an environment conducive to sustainable development of enterprises; - Increase research capacity development (R & D), stimulating cooperation between research institutions and development and innovation (RDI) and enterprises and increasing access of the CDI; - Harnessing the potential of information and communication technology and its application in public sector (administration) and private (enterprises, citizens); - Increase energy efficiency and sustainable development of energy system, promoting renewable energy.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	n/a
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	highly emphasises area
	5. Integration technologies
	indirectly addressed

5.1.17 Spain National Research Framework

Programme, topic	**Plan Avanza 2**
Duration	Start date: 2011
Budget M€	270
Website(s)	http://www.planavanza.es/
Summary	Taking asits starting point theAvanzaPlanapproved in2005 andthe European framework inwhichsuch initiativesfall, we have identified 34specific challengesto be addressed bySpain in the fieldof ICT.In thiscontext, the2011-2015StrategyPlanAvanza 2will focusits efforts onachieving thefollowing 10objectives thathelp overcomethe challenges identified: - Promoting ICT in innovative processes - Extending ICT in health and social welfare - Enhance the application of ICT to education and training system - Improve the capacity and the extension of telecommunications networks - Spread the culture of security among citizens and businesses - Increase the use of advanced digital services for citizens - Expand the use of ICT business solutions in the enterprise - Developing technological capabilities in the ICT sector - Strengthen the digital content sector to ensure better protection of intellectual property in the current technological context and within the Spanish and European legal framework. - Develop Green ICT To achievethe 10goals set, have identifiedover 100specific actions thatmust be articulatedandmonitoring indicatorsthat will measuretheir achievement. Additionally, we have identified a set ofpolicy reformsare necessaryboth to eliminateexisting barriers to theexpansion and useof ICTtoensure the rights ofcitizens in theInformation Society.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	highly emphasises area
	3. User awareness and decision support
	indirectly addressed
	4. Energy management and trading
	highly emphasises area
	5. Integration technologies
	indirectly addressed

5.1.18 Slovakia National Research Framework

Programme, topic	**Cost benefit analysis for the implementation of smart metering with pilot project Ministry of economy of the Slovak republic (SK)**	
Duration	Jan 2011-Dec 2011	
Budget M€	n/a	
Website(s)	http://www.economy.gov.sk/home/126312s	
Summary	Primary project goals are to find relevant facts and proofs for which segments of customers the smart metering could be economical.	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**	n/a
	2. Intelligent control	This thematic area is covered by the programme
	3. User awareness and decision support	n/a
	4. Energy management and trading	n/a
	5. Integration technologies	This thematic area is covered by the programme

Programme, topic	**ENERGOZ Institute of Technology, Slovak Academy of Sciences, Bratislava, (SK)**	
Duration	May 2010-May 2013	
Budget M€	n/a	
Website(s)	www.energoz.sav.sk	
Summary	Applied research in the field of efficient production, use and storage of energy from renewable sources. Maximizing the socio - economic effect of the research in the field of renewable energy.	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**	This thematic area is covered by the programme
	2. Intelligent control	This thematic area is covered by the programme
	3. User awareness and decision support	This thematic area is covered by the programme
	4. Energy management and trading	This thematic area is covered by the programme
	5. Integration technologies	This thematic area is covered by the programme

5.1.19 Sweden National Research Framework

Programme, topic	**Energy IT and Design**
Duration	2009-04-01– 2012-12-31
Budget M€	6.5
Website(s)	http://www.energimyndigheten.se/en/
Summary	The Swedish Energy Agency supports research and development about the supply, conversion, distribution and use of energy. Assistance is also provided to development of new technologies. The Agency is involved in broader international energy research cooperation, which among other things, is about the increased use of renewable energy sources and development of new technologies and systems for energy supply. The program *Energy, IT and Design* provide funding for projects concerning human behaviour and energy efficiency. The main emphasis of the programme is to influence the everyday habits, values and behaviour of users as far as improving the efficiency of energy use is concerned, with some concentration on improving the efficiency of electricity use through application of both IT and design. This is an applied programme, intended to result in a number of prototypes and demonstration activities: - Attractive design solutions are intended to make individuals aware of their daily use of energy. - Informative IT solutions provide detailed and usable information on energy and electricity consumption. - Simple but at the same time advanced IT solutions enable operation and control of residential energy use. - Relevant and motivating decision making material that assists the move towards more resource efficient and energy efficient everyday habits.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	This thematic area is covered by the programme
	2. Intelligent control
	This thematic area is covered by the programme
	3. User awareness and decision support
	This thematic area is covered by the programme
	4. Energy management and trading
	n/a
	5. Integration technologies
	n/a

5.1.20 United Kingdom National Research Framework

Programme, topic	**ICT for manufacturing and construction**
Duration	2011
Budget M€	£7m
Website(s)	http://www.innovateuk.org/content/competition/ict-for-manufacturing-and-construction.ashx
Summary	The Technology Strategy Board will invest up to £7m to fund collaborative R&D projects that will mobilise the talents and inspiration of information and communication technology (ICT) companies to develop new approaches for key challenges in manufacturing and construction. These challenges lie around: - deriving and reusing knowledge - interoperability across supply chains - engaging users in design and operation processes - accelerating product and process innovation. This competition focuses on the software components of ICT and the alignment of ICT systems with people and processes. The project innovation must be in the software and process change elements to be in scope.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	This thematic area is covered by the programme
	2. Intelligent control
	This thematic area is covered by the programme
	3. User awareness and decision support
	This thematic area is covered by the programme
	4. Energy management and trading
	n/a
	5. Integration technologies
	This thematic area is covered by the programme

Programme, topic	**Electronics, photonics and electrical systems**
Duration	n/a
Budget M€	n/a
Website(s)	http://www.innovateuk.org/ourstrategy/our-focus-areas/electronicsphotonicsandelectricalsystems.ashx
Summary	The technology areas of Electronics, Photonics and Electrical Systems (EPES) underpin activity in all industrial sectors and throughout the consumer market. Whether through power supply, sensors, invisibly embedded systems, lasers or displays, the UK benefits from a strong science base and a long tradition of inventiveness and innovation in the uses of electricity and light, underpinning the hugely disruptive technologies of electronics, photonics and electrical systems. The global electronic products market has been estimated at $2.0 trillion, and the

	market for photonics products exceeds $600 billion; both markets continue to expand strongly. Of these figures, $260 billion is accounted for by the semiconductors themselves, with 900 million transistors being produced every year for every man, woman, and child on earth. The development of ideas from universities and research and development organisations into industrially relevant technologies, and then onwards to become products in the marketplace, provides one route to realising the economic benefits that is one of the goals of the Technology Strategy Board. To balance this, adoption of existing EPES technologies in new applications in the healthcare, transport, energy, retail and environmental sectors yield benefits that can be felt by both the technology providers in the device industries and by the technology adopters in the end-use markets. The EPES sector should always be looking for technology with an identifiable route to market and those areas where technology push and market pull are both evident, are of particular interest and provide persuasive arguments for intervention. A number of established global corporations are represented in the modern UK device industries, and are supported by a large, vibrant and diverse community of technology-intensive SMEs. The Technology Strategy Board will work to further a business framework that allows these players to work together to the best advantage for the UK economy as a whole and will particularly target the EPES sector with existing and new vehicles that are most accessible to SME involvement. Planning of the knowledge and material supply chain to maximise value, and networking to establish the contacts to realise it, are crucial to success of innovative businesses within a global market. Partnership and collaboration with other branches of government and with major stakeholder groups in industry, is essential in a sector lacking natural focal points. The Technology Strategy Board's EPES team works with the Research Councils to ensure alignment of Science and Technology development strategies, with the Department of Business, Innovation and Skills (BIS) on the business and regulatory environment, with the Regional Development Agencies and the Devolved Administrations to coordinate national and regional policy and investment, with UKTI to encourage inward investment and to attract and protect value in the UK, and with other government departments to investigate technology synergies and sector collisions.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	This thematic area is covered by the programme
	2. Intelligent control
	This thematic area is covered by the programme
	3. User awareness and decision support
	This thematic area is covered by the programme
	4. Energy management and trading
	This thematic area is covered by the programme
	5. Integration technologies
	This thematic area is covered by the programme

Programme, topic	**DECC's Innovation funding and support**
Duration	Started in 2011
Budget M£	35 million
Website(s)	http://www.decc.gov.uk/en/content/cms/funding/funding_ops/innovation/innovation.aspx
Summary	Strategic innovation is needed, in order to meet the challenging future climate change goal of an 80% reduction in greenhouse gas emissions by 2050. DECC has a proactive Energy Innovation policy which aims to: • reduce the cost of existing low-carbon technologies • develop new technologies to give the UK a portfolio of energy sources and make best use of our natural resources; and • make the UK a better place to create new low carbon technologies and develop associated businesses Technology innovation reduces the cost of commercial deployment, making it more cost effective for business to invest in our energy infrastructure and ensure security of supply. Investment in innovation can grow UK companies, and encourages others to locate their supply chains in the UK. Research Councils, the Technology Strategy Board, the Carbon Trust and the Energy Technologies Institute are also involved in supporting technology research, development and demonstration. DECC's support for energy innovation tends to work in three ways: • Technology 'push' is direct funding for demonstration and pre-commercial deployment - recently this has been through the Environmental Transformation Fund and the Low Carbon Investment Funding • Market 'pull' is indirect funding, through mechanisms such as the Renewables Obligation, Feed-In tariffs and Emissions trading • Barrier removal aims to address the areas which slow development down, such as planning and grid issues In 2011, up to £35 million was set aside for innovations to drive down the costs of saving energy and reducing carbon emissions in homes and businesses. It will support the development and demonstration of innovative technologies and systems that can reduce carbon emissions from buildings. This funding will help drive down the costs of saving and generating energy in domestic and non-domestic buildings. Commitment of the earmarked funding remains subject to further value-for-money assessments. These programmes will be further developed over the coming months, in consultation with industry and developers, and more details will be announced before the end of this financial year.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	This thematic area is covered by the programme
	2. Intelligent control
	This thematic area is covered by the programme
	3. User awareness and decision support
	This thematic area is covered by the programme

	4. Energy management and trading
	This thematic area is covered by the programme
	5. Integration technologies
	This thematic area is covered by the programme

Programme, topic	**RCUK Energy Programme**
Duration	Started in 2011
Budget M£	530 million
Website(s)	http://www.decc.gov.uk/en/content/cms/funding/funding_ops/innovation/innovation.aspx
Summary	The Energy Programme's mission is to position the UK to meet its energy and environmental targets and policy goals through high quality research and postgraduate training. Objectives •to support a full spectrum of energy research to help the UK meet the objectives and targets set out in the 2007 Energy White Paper •to work in partnership to contribute to the research and postgraduate training needs of energy-related businesses and other key stakeholders •to increase the international visibility and level of international collaboration within the UK energy research portfolio •to expand UK research capacity in energy-related areas.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	This thematic area is covered by the programme
	2. Intelligent control
	This thematic area is covered by the programme
	3. User awareness and decision support
	This thematic area is covered by the programme
	4. Energy management and trading
	This thematic area is covered by the programme
	5. Integration technologies
	This thematic area is covered by the programme

5.2 Identification of Research Framework for the European countries not belonging to EU-27

5.2.1 R&D related to ICT for Energy Efficiency in Buildings in Croatia

Programme, topic	**Research Projects**
Duration	Ongoing
Budget M€	In 2011 budget was 1.865 Million Euros (maximum 180 000 Euros per project).
Website(s)	http://www.hrzz.hr/index.php?option=com_content&view=article&id=124
Summary	The basic aim of the programme is to create new knowledge and enhance the existing notions (by supporting research, development and technological activities). They are the main support instrument to international cooperation but also serve to promote and develop strategic priorities of the Republic of Croatia. Researches covered by priority themes have a direct practical value while the basic research will enhance the knowledge about certain areas without the necessity of having a practical value. The aims are: • To enhance the existing knowledge. • To support the work of internationally competitive research groups within the priority areas. • To develop scientific fields that allow technological advances and are applicable in Entrepreneurship, Economy and other sectors (Agriculture, Health, etc.). • To foster training of young researchers. • To support research The project cannot be longer than 36 months.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.
	Unclassified recommendations
	Priority thematic areas: • Ecosystems, Adriatic Sea, Coastline and Land • New Energies, Renewable Energy Sources • Materials and New Production Technologies • Information and Communication Technology • Food and Water • Health

	• Learning, Education • Sustainable Development of the Society, National and Regional Security • Croatian Identity

Programme, topic	**Collaborative Research Projects**
Duration	Ongoing
Budget M€	In 2011 budget was 2 Million Euros (maximum 180 000 Euros per project).
Website(s)	http://www.hrzz.hr/index.php?option=com_content&view=article&id=125
Summary	Collaborative Research Programmes is a research programme carried out by universities, faculties and public institutes that involves a number of content-related research projects – minimum of three research groups of which at least 2 are coming from different legal entities. Collaborative Research Programme has to be approved by the Senate of the University, Academic Council of the Faculty or the Scientific Council of the Public Institute or other scientific institutions registered in the Republic of Croatia, and comply with the priorities of the applicant's home institution. The ultimate goal of the programme is to encourage development and strengthen the cooperation of research groups to be able to create internationally competitive programmes and provide conditions for development of Centres of Excellence. Programme goals: • To encourage cooperation on research programmes covered by priority areas • To develop scientific fields that allow technological advances and are applicable in Entrepreneurship, Economy and other sectors (Agriculture, Health, etc.) • To support research that meets the strategic priorities of the Croatian Science Foundation and the Republic of Croatia • To create internationally competitive and recognized research field at the universities or between the universities and public institutes • To promote and strengthen the scientific institutions • To encourage interdisciplinary research and collaboration • To promote networking • To ensure conditions for the development of Centres of Excellence • To foster training of young researchers The project cannot be longer than 36 months.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.

5.2.2 R&D related to ICT for Energy Efficiency in Buildings in Russia

Programme, topic	**Start 2012**
Duration	3 years
Budget M€	n/a
Website(s)	www.fasie.ru
Summary	Purpose of the program: government support for small innovative companies seeking to develop and master the production of new goods, products, technologies or services using the results of their scientific and technological research at the initial stage of development and have great potential for commercialization. Financial support is provided for research and development activities. R & D can be supported for up to three years. Contests on the "START-2012" are held on the five thematic areas including “Information Technology” (130 projects) and “new devices and hardware systems” (160 projects). Sub-clusters on these thematic areas include: **Information Technology:** N1.1.Cloud software, and tools for developing cloud applications, monitoring and administration. N1.2. Applications for the Tablet and mobile devices, including the use of geo-location, as well as tools for developing such applications. N1.3. Intelligent Decision Support System. N1.4. Intelligent building management systems (smart house). N1.8. System optimization of production costs (lean production). N1.9. software for fast design and innovative layout prototyping. N1.10. New interfaces interact with computers. H1.13. New methods for image and video processing. H1.15. Augmented Reality. N1.19. Information systems to support crowd sourcing. **New tools and hardware systems** H4.3. intelligent sensors. N4.7. new devices communicate with computers. N4.9. devices to control power systems (power management), including stand-alone power systems for use in the field of alternative energy. N4.10. Electronic equipment and software for "smart grids" in the power industry (technology and systems SMART GRID). N4.11. Multifunction devices (controllers) for collecting, processing and transmission of data, including for use in the "smart home". N4.12. Devices for the organization and operation of wireless sensor networks (MESH network). N4.13. Electronic devices and software systems for the "Internet of things» (Internet of things).
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Production Management (1.2)
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	Augmented Reality
	4. Energy management and trading
	Intelligent Decision Support System; Electronic equipment and software for "smart grids" in the power industry (technology and systems SMART GRID); devices to

	control power systems (power management), including stand-alone power systems for use in the field of alternative energy; Multifunction devices (controllers) for collecting, processing and transmission of data, including for use in the "smart home".
	5. Integration technologies
	No direct relations to this section.

5.2.3 R&D related to ICT for Energy Efficiency in Buildings in Serbia

Programme, topic	**Energy efficiency in district heating**
Duration	1 year – 2005
Budget M€	214
Website(s)	http://www.seea.gov.rs
Summary	Project objective is to demonstrate possibilities of the Modernization of district heating systems on the Demand side. Basically, the activities include installation of heat meters, automatic and centralized monitoring and control of substations, installation of variable flow pumps in substations, installation of thermostatic valves and heat allocators on radiator in flats. This project is also important in the light of the new Energy Law, i.e. payment of bills for heating based on the heat consumption measured and the benefits to the heat consumers. Expected results: - Improvement of Energy Efficiency in the selected Buildings - Division of the costs based on the measured consumption - Promotion of the Consumption based billing - Raising Public Awareness of the need for introduction of the Consumption based billing
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	- Intelligent Automation and Control (2.1) - Monitoring (2.2)
	3. User awareness and decision support
	- Visualization of energy usage (3.2) for user awareness and decision support tools - Behavioural change (3.3)
	4. Energy management and trading
	n/a
	5. Integration technologies
	n/a

Programme, topic	**Energy efficiency in municipal services**
Duration	2005-2006
Budget M€	190
Website(s)	http://www.seea.gov.rs
Summary	- Demonstration of saving energy possibilities in water supply systems and street lighting - Energy savings up to 40% compared to the current consumption savings in energy costs of municipal government - Promotion of up-to-date technologies through examples of best practice - Raising awareness about energy efficiency
Reference to	**1. Tools for EE design and production management**

ICT4E2B Classification	n/a
	2. Intelligent control
	- Intelligent Automation and Control (2.1) - Monitoring (2.2)
	3. User awareness and decision support
	- Visualization of energy usage (3.2) for user awareness and decision support tools - Behavioural change (3.3)
	4. Energy management and trading
	n/a
	5. Integration technologies
	n/a

Programme, topic	**Energy efficiency in public buildings**
Duration	2004-2005
Budget M€	880
Website(s)	http://www.seea.gov.rs
Summary	Demonstration of energy efficiency in municipal public buildings; Energy efficiency measures relate to: - Building envelope (thermal insulation of walls, roofs, ground floors; replacement/upgrading of windows; other measures) - Building heating and sanitary warm water preparation systems (replacement/upgrading of boilers and fuel burners,switch from 'dirty' fuels to natural gas or district heating, replacement/upgrading of buildings heat substations, indoor temperature control, installation of thermostatic valves, heat cost allocators, heat meters; other measures) - Upgrading of building interior lighting (replacement of bulbs and luminaries and/or reconstruction of lighting system providing adequate illumination quality)
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	- Intelligent Automation and Control (2.1)
	3. User awareness and decision support
	- Visualization of energy usage (3.2) for user awareness and decision support tools - Behavioural change (3.3)
	4. Energy management and trading
	n/a
	5. Integration technologies
	n/a

Programme, topic	**Serbian Energy Efficiency Project**
Duration	2005-2010
Budget M€	US$ 25 millions
Website(s)	http://www.seea.gov.rs
Summary	- Rehabilitation of the energy system in the Clinical Centre of Serbia in order to improve energy efficiency and reduce environmental pollution switching from 'dirty' fuels to natural gas (Component A); - Energy efficiency improvements in the retrofitted social public buildings (schools, hospitals, orphanages and elder people houses) by implementation of energy saving measures on building envelope, heating system and interior lighting; - Increase in end-user satisfaction with the improved indoor comfort; - Awareness raising of the end users about energy efficiency, the need for rational use of energy, the related cost and saving that can be achieved

Reference to ICT4E2B Classification	**1. Tools for EE design and production management**	
	n/a	
	2. Intelligent control	
	- Intelligent Automation and Control (2.1)	
	3. User awareness and decision support	
	- Visualization of energy usage (3.2) for user awareness and decision support tools - Behavioural change (3.3)	
	4. Energy management and trading	
	n/a	
	5. Integration technologies	
	n/a	

5.2.4 R&D related to ICT for Energy Efficiency in Buildings in Turkey

Programme, topic	**The Support Programme For Scientific And Technological Research Projects**
Duration	Ongoing
Budget M€	Yearly limit around 55 000 Euros per project.
Website(s)	http://www.tubitak.gov.tr/home.do?cid=11533&lang=en
Summary	The purpose of this programme is to support research in Turkey for generating new information, interpreting scientific findings, or solving technological problems on a scientific basis. Funding goes to principal investigators, researchers and advisers, what means generally a university personnel. Equipment and machines can be funded as well. The project cannot be longer than 36 months.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.

5.2.5 R&D related to ICT for Energy Efficiency in Buildings in Switzerland

Programme, topic	**SwissEnergy**
Duration	2001 - Ongoing

<table>
<tr><td>Budget M€</td><td>n/a</td></tr>
<tr><td>Website(s)</td><td>http://www.energieschweiz.ch</td></tr>
<tr><td>Summary</td><td>In view of the current status of Switzerland's energy and climate policies, and on the basis of findings obtained during its first five years, the SwissEnergy programme is to be optimised and adapted for its second five-year period (i.e. from 2006 to 2010). The aim here is make the programme more impact-oriented and efficient, and this is to be effected by focusing its activities on five main priority areas:

• Modernisation of buildings
• Renewable energy
• Energy-efficient appliances and motors
• Efficient use of energy and waste heat throughout the economy
• Energy-efficient and low-emission mobility

This strategy is to be implemented on the basis of the following main criteria:

• Strengthening existing partnerships betwen the federal government, the cantons, the economy and trade associations
• Defining clear objectives for each individual partner and agency
• Developing broad-based communication and joint communication platforms for each of the five priority areas
• Optimal co-ordination of SwissEnergy measures with other energy and climate policy instruments (CO2 fee, "climate cent", legal measures)
• Definition of clear principles for the distribution of funds, focusing on specific targets and projects within the five priority area</td></tr>
<tr><td rowspan="10">Reference to ICT4E2B Classification</td><td>6. Tools for EE design and production management</td></tr>
<tr><td>n/a</td></tr>
<tr><td>7. Intelligent control</td></tr>
<tr><td>- Intelligent Automation and Control (2.1)
- Monitoring (2.2)
- Quality of Service (2.3)</td></tr>
<tr><td>8. User awareness and decision support</td></tr>
<tr><td>- Performance management (3.1) for performance analysis and evaluation
- Visualization of energy usage (3.2) for user awareness and decision support tools
- Behavioural change (3.3)</td></tr>
<tr><td>9. Energy management and trading</td></tr>
<tr><td>- Smart Grids (4.2)</td></tr>
<tr><td>10.Integration technologies</td></tr>
<tr><td>- System Integration (5.2)</td></tr>
</table>

5.2.6 R&D related to ICT for Energy Efficiency in Buildings in Turkey

Programme, topic	**The Support Programme For Scientific And Technological Research Projects**
Duration	Ongoing
Budget M€	Yearly limit around 55 000 Euros per project.
Website(s)	http://www.tubitak.gov.tr/home.do?cid=11533&lang=en
Summary	The purpose of this programme is to support research in Turkey for generating new information, interpreting scientific findings, or solving technological problems on a scientific basis. Funding goes to principal investigators, researchers and advisers, what means generally a university personnel. Equipment and machines can be funded as well. The project cannot be longer than 36 months.
Reference to ICT4E2B Classification	**6. Tools for EE design and production management**
	No direct relations to this section.
	7. Intelligent control
	No direct relations to this section.
	8. User awareness and decision support
	No direct relations to this section.
	9. Energy management and trading
	No direct relations to this section.
	10.Integration technologies
	No direct relations to this section.

Programme, topic	**Short Term R&D Funding Programme**
Duration	Ongoing
Budget M€	Yearly limit around 10 000 Euros per project.
Website(s)	http://www.tubitak.gov.tr/home.do?cid=11085&lang=en
Summary	The purpose of this programme is to support short-term R&D projects with small budgets and immediate start requirements. Proposals are accepted from members of universities, research hospitals, and research institutes. Similar to previous scheme, funding goes to principal investigators, researchers and advisers, what means generally a university personnel. Equipment and machines can be funded as well. The project cannot be longer than 12 months.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading

	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.

Programme, topic	**The Support Programme For The Initiative To Build Scientific And Technological Cooperation Networks And Platforms**
Duration	Ongoing
Budget M€	Yearly limit around 100 000 Euros per project.
Website(s)	http://www.tubitak.gov.tr/home.do?cid=11533&lang=en
Summary	The purpose of The Support Programme for the Initiative to Build Scientific and Technological Cooperation Networks and Platforms is to support the establishment of cooperation networks and platforms between national and international corporations, units and groups about the areas such as basic sciences, engineering, health and social sciences, especially in order to align and develop our country with science and technology foresights. The networks/platforms supported by this programme are expected to: ➢ Define roadmaps/strategies at national/international level in the related fields in order to have scientific and technological advances ➢ Increase the international reputation and collaborations of Turkey in the related field, ➢ Facilitate share of knowledge at national/international level in the related field in order to have the effective usage of supports and information ➢ Lead new national/international projects and develop infrastructure in the related field by the support of these projects ➢ Increase qualified human resource in the related field ➢ Provide conditions for the conversion of information/knowledge to technology in the related field ➢ Increase competitive power of Turkey in international market in the related field as a result of initiated collaborations. The project cannot be longer than 36 months. Turkish Research Agency supports 50% of the total budget. 50% of the budget is supported by the organizations in the network/platform.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.

5.3 Identification of International Research Framework

5.3.1 R&D related to ICT for Energy Efficiency in Buildings in Argentina

Programme, topic	**Projects of Scientific Research and Technology (PICT)**
Duration	2008 - Ongoing
Budget M€	N/A
Website(s)	http://www.mincyt.gov.ar/financiamiento/financiamiento_detalle.php?id=30
Summary	The National Agency for Promotion of Science and Technology, through the Fund for Scientific and Technological Research (FONCYT) provides funding for scientific research projects and technological research institutions, public or private non-profit organization based in the country. The presentation of projects can be done in the following categories: I. OPEN TOPICS: Research projects in science and technology open to all areas of knowledge. II. REGIONAL ISSUES IMPACT: Projects of scientific and technological research aimed at solving regional problems. III. INTERNATIONAL COOPERATION: Research projects involving scientific and technological research group with another Argentine abroad for funding in different areas: equipment, mobility, publications, etc. IV. START-UP: Draft scientific and technological research aimed at developing new technological capabilities in the market for goods and services with the goal of creating technology-based companies.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.

Programme, topic	**ICT Scholarships**
Duration	Ongoing
Budget M€	The amount of scholarship funded by the Agency is around 430 Euros per month.
Website(s)	http://www.mincyt.gov.ar/financiamiento/financiamiento_detalle.php?id=62
Summary	The National Agency for Promotion of Science and Technology, through FONCyT provides funding to promote product innovation by strengthening and consolidation of human capital applied to the industry of Information Technology and

	Communications (ICT). Beneficiaries are students who attend in person the following ICT Degree Programs at National Universities or university institutes of public administration: Degree in Computer Science. Bachelor of Computer Science. Degree in Systems / Information Systems. Degree in Systems Analysis Computer Systems Engineer / Information Systems. Computer Engineering Also included are other ICT university courses, such as those that are closely related to embedded software and telecommunications: Electronic Engineer. Telecommunications Engineer.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.

Programme, topic	**Federal Projects of Productive Innovation (PFIP)**
Duration	2004 - Ongoing
Budget M€	N/A
Website(s)	http://www.mincyt.gov.ar/financiamiento/financiamiento_detalle.php?id=6
Summary	This funding line has the general objective to solve, from the generation and transfer of knowledge, social and productive individual, wide municipal, provincial or regional level, identified as priorities by the Provincial Authorities in Science and Technology accredited to the Federal Council Science and Technology (COFECYT). This line of funding, aims also contribute to the incorporation of technology in society and in business, and its innovative culture. Beneficiaries are public bodies, centralized or not, public enterprises, universities, NGOs, and in general, all legal persons constituted as such at the time of presentation of the project, and based in the country. The resources administered through this line are non-refundable contributions. In any case these may exceed 70% (seventy percent) of total project cost.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support

	No direct relations to this section.
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.

Programme, topic	**National Innovation Competition - INNOVATE**
Duration	2005 - Ongoing
Budget M€	N/A (First price is around 5000 USD)
Website(s)	http://www.innovar.gob.ar/
Summary	The aim of the contest is to encourage the transfer of knowledge and technology through projects and products that promote innovation, improved quality of life of society as well as enable their commercialization and integration into input markets nationally and internationally.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.

5.3.2 R&D related to ICT for Energy Efficiency in Buildings in Australia

Programme, topic	**Research block grants**
Duration	2011 - Ongoing
Budget M€	1060
Website(s)	http://www.innovation.gov.au/RESEARCH/RESEARCHBLOCKGRANTS/Pages/default.aspx
Summary	The Department of Innovation, Industry, Science and Research of Australian government provides block grants for research and research training, through a number of performance-based schemes. Research block grants (RBG) are allocated according to performance based formula and are independent of funding for specific research projects, programs, or fellowships. Higher Education Providers have considerable autonomy in deciding what research projects, personnel, equipment and infrastructure this funding should support.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.
	Unclassified recommendations
	Research in Australia is led by Higher Education Providers (mostly universities) which are funded for their own projects. Most of the funding is assigned to projects related to training of scientists, their exchanges with other countries and increase their competency. There are three levels of thematic research priority. At the broadest and least directive level there are national research priorities. Second, from time to time the Commonwealth Government seeks proposals for research (i.e. Centres of Excellence) in specific areas. The National ICT Centre of Excellence (NICTA) and the National Stem Cell Research Centre, were established on this basis. Third, within the Rural Industry R&D Corporations (RIRDCs) and the National Health and Medical Research Council(NHMRC) there are varying degrees of priority setting or invitations for proposals in association with specific objectives.

Programme, topic	**Research block grants**
Duration	2010 - Ongoing
Budget M€	1328 M€ for the year 2012
Website(s)	http://www.innovation.gov.au/RESEARCH/RESEARCHBLOCKGRANTS/Pages/default.aspx
Summary	The Department of Innovation, Industry, Science and Research of Australian government provides block grants for research and research training, through a number of performance-based schemes. Research block grants (RBG) are allocated according to performance based formula and are independent of funding for specific research projects, programs, or fellowships. Higher Education Providers have considerable autonomy in deciding what research projects, personnel, equipment and infrastructure this funding should support.

<table>
<tr><td rowspan="12">Reference to ICT4E2B Classification</td><td>1. Tools for EE design and production management</td></tr>
<tr><td>No direct relations to this section.</td></tr>
<tr><td>2. Intelligent control</td></tr>
<tr><td>No direct relations to this section.</td></tr>
<tr><td>3. User awareness and decision support</td></tr>
<tr><td>No direct relations to this section.</td></tr>
<tr><td>4. Energy management and trading</td></tr>
<tr><td>No direct relations to this section.</td></tr>
<tr><td>5. Integration technologies</td></tr>
<tr><td>No direct relations to this section.</td></tr>
<tr><td>Unclassified recommendations</td></tr>
<tr><td>Research in Australia is led by Higher Education Providers (mostly universities) which are funded for their own projects. Most of the funding is assigned to projects related to training of scientists, their exchanges with other countries and increase their competency.
There are three levels of thematic research priority. At the broadest and least directive level there are national research priorities. Second, from time to time the Commonwealth Government seeks proposals for research (i.e. Centres of Excellence) in specific areas. The National ICT Centre of Excellence (NICTA) and the National Stem Cell Research Centre, were established on this basis. Third, within the Rural Industry R&D Corporations (RIRDCs) and the National Health and Medical Research Council(NHMRC) there are varying degrees of priority setting or invitations for proposals in association with specific objectives.</td></tr>
</table>

5.3.3 R&D related to ICT for Energy Efficiency in Buildings in Brazil

Programme, topic	**Habitare - Program for Housing Technology**
Duration	1995-2007
Budget M€	20
Website(s)	http://www.habitare.org.br
Summary	The overall objective of the Program for Housing Technology - Habitare is to contribute to the advancement of knowledge in the technology field of the built environment, supporting scientific research, technology and innovation in order to meet the needs of modernization of the housing sector and contribute to the meeting the housing needs of the country.In The following the specific objectives of the programme: - Stimulate cooperation between universities, other institutions Education and Research, Research, Technical and Scientific Associations, Agencies or public or private companies and non-profit organizations, and the relationships between these organizations and society, strengthening the generation and transfer of knowledge in order to produce significant impacts to the social development and the integration of the productive area of the built environment; - Contribute to a better understanding of the specific forms through which to structure the various segments of the market (formal and informal) housing; - Contributing to the increase of innovative dynamics, in terms of economic, social and environmental, and development or improvement of products and processes with significant added value, with potential economic and social relevance for the development of alternative lower cost, better quality and greater productivity in production processes and recovery of Social Housing; - Contribute to improving the quality of projects and architectural typologies of housing of social interest, considering aspects of comfort, affordability, durability and specific local / regional; - Contribute to the advancement of knowledge aimed at improving or proposing innovative housing programs and policies; - Encourage the development of processes, methods and techniques aimed at recovering slums (as slums), to better their living conditions and reducing risk; - Encourage the development of processes, methods and techniques aimed at re-qualification of urban areas and buildings damaged or idle and housing rehabilitation and consolidation of underutilized central areas. In 13 years the Housing Technology Program (Habitare) allocated nearly $ 20 million for research in technology of the built environment. The funds invested by the Financier of Studies and Projects (FINEP) and CaixaEconomica boost the production of knowledge, collaborate with the introduction of innovations and improvements in the construction industry. The financial contribution has the support of CaixaEconomica Federal, CNPq and several companies, the studies developed by partner universities around the country to improve the quality of social housing.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	This thematic area is covered by the programme
	2. Intelligent control
	No direct relations to this section.

	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.

5.3.4 R&D related to ICT for Energy Efficiency in Buildings in Canada

Programme, topic	**CABA research program** **Smart Grid Impact on Intelligent Buildings 2011**
Duration	n/a
Budget M€	n/a
Website(s)	www.canada.gc.ca
Summary	The Continental Automated Buildings Association (CABA) is an industry association dedicated to the advancement of intelligent homes and intelligent buildings technologies. CABA is committed to research and development within the intelligent buildings and connected home sector. In 2010, CABA's collaborative research scope evolved and expanded into the CABA Research Program which facilitates and provides opportunities to participate in collaborative research projects and pilot programs. Research projects: Smart grid impact on intelligent buildings and the progression of intelligent buildings towards net zero energy. Impact of smart grids on connected homes.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent and Control
	Automation and control (2.1)
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	Smart grids (4.2)
	5. Integration technologies
	No direct relations to this section.

Programme, topic	**SNEBRN** Smart Net-Zero Energy Buildings Research Network
Duration	2011-2016
Budget M€	6,25
Website(s)	http://www.solarbuildings.ca
Summary	SNEBRN aims to perform the research that will facilitate widespread of optimized NZEB energy design and operation concepts suited to Canadian climatic conditions and construction practices. It aims to influence long-term national policy on the design of net-zero energy buildings and communities in association with our partners. The objective is to develop optimal pathways for achieving zero average annual energy consumption at both the building and neighbourhood levels. This will be achieved through combinations of dynamic building methods that integrate a number of technologies: building-integrated solar systems, high performance windows with active control of solar gains, short-term and seasonal thermal energy storage, heat pumps, combined heat and power technologies, and smart controls. The aim is for simultaneous reduction of energy demands and shifting of peak loads through

	techniques such as predictive control at the building and neighbourhood scales. Themes: • Integrated Renewable Energy Systems and heating/cooling systems for Buildings. • Dynamic Building Envelope Systems and Passive Solar Concepts • Mid-to Long-Term Thermal Storage for Buildings and Communities • Smart Building Operating Strategies • Technology transfer, design tools and input to national policy • Smart Building Operating Strategies: This Theme will develop ways to integrate the control of all building subsystems so as to optimize the net renewable energy fed into the grid and the electricity demand profiles. Techniques such as predictive control based on weather forecasting and online prediction of building response will be employed. Integrated design and control will be emphasized. • Technology transfer, design tools and input to national policy: This Theme includes many facets: the coordination and implementation of demonstration projects, technology transfer, development of design tools and guidelines (especially for engineers and architects), input to codes and standards, and national policy.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Design (1.1)
	2. Intelligent and Control
	Automation & control (2.1)
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	Building and district management (4.1) and Smart Grids (4.2)
	5. Integration technologies
	Interoperability and standards (5.3) and Knowledge sharing (5.4)

5.3.5 R&D related to ICT for Energy Efficiency in Buildings in China

Programme, topic	**Clean Energy Research Centres (CERCs)**	
Duration	2011– 2016	
Budget M€	55	
Website(s)	http://eetd.lbl.gov/newsletter/nl34/eetd-nl34-2-cerc.html	
Summary	The third in a series of joint US-China Clean Energy Research Centres (CERCs) will be led by Lawrence Berkeley National Laboratory and focus on energy efficient buildings. The consortium, which includes Oak Ridge National Lab, Massachusetts Institute of Technology, the University of California-Davis, The Dow Chemical Company, Honeywell and General Electric, will receive $12.5 million from the US Government, matched by at least $12.5 million from the partners, and $25 million from Chinese counterparts over five years. The new CERC will look at a range of measures including monitoring and control systems, glazing materials, insulation, cool roofs and lighting. It will also build a test centre in China to evaluate new technologies and systems.	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**	
	This thematic area is covered by the programme	
	2. Intelligent control	
	This thematic area is covered by the programme	
	3. User awareness and decision support	
	This thematic area is covered by the programme	
	4. Energy management and trading	
	No direct relations to this section.	
	5. Integration technologies	
	No direct relations to this section.	

5.3.6 R&D related to ICT for Energy Efficiency in Buildings in India

Programme, topic	**India Smart Grid Task Force**
Duration	
Budget M€	
Website(s)	http://www.isgtf.in/
Summary	As reported by the United States Trade and Development Agency[15]: "India's energy demand is predicted to more than double by 2030, requiring significant investment in generation, transmission and distribution capacity, and potentially increasing the frequency of power outages even in urban areas. Indian utilities face unprecedented challenges from a growing demand for high-quality, reliable electricity, increasingly stringent regulation, environmental concerns, and rising customer expectations, which require utilities to transform traditional electricity generation, transmission and delivery systems. Smart grid technologies are seen to provide a solution to this set of challenges, providing the ability to improve the quality and reliability of service, reduce technical and commercial power losses, integrate consumer use with peak and off-peak demand periods, and take advantage of distributed generation potential." India has set up a Smart Grid Task Force (www.isgtf.in) as an inter-ministerial group and will serve as government focal point for activities related to Smart Grids. Some intial working groups have been set up: WG1 – Trials/Pilot on new technologies. WG2 – Loss reduction and theft, data gathering and analysis. WG3 – Power to rural areas and reliability & quality of power to urban areas. WG4 – Dist Generation & renewable. WG5 – Physical cyber security, Standards and Spectrum. Efforts exist also in industry e.g. TPDDL (Delhi, India) is a joint venture between Tata Power and the Delhi government, created innovative initiatives that significantly reduced energy loss and pioneered substation automation in India.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	Smart Grids (4.2)
	5. Integration technologies
	No direct relations to this section.
	Unclassified recommendations
	The applicability of existing approaches on this area will be considered by the Indian SmartGrid Task Force. At this stage no new R&D results stemming from these

[15] India - CESC Smart Grid Project Feasibility Study, United States Trade and Development Agency, https://www.fbo.gov/index?s=opportunity&mode=form&id=0d78e71c698b42530301c85c597e4286

	actions are envisioned.

5.3.7 R&D related to ICT for Energy Efficiency in Buildings in Israel

Programme, topic	**National Energy Efficiency Program** **Reducing Electricity Consumption 2010-2020**
Duration	10 years
Budget M€	30,6M€
Web site(s)	http://energy.gov.il/English/PublicationsLibraryE/energyplan_inside_eng.pdf
Summary	Electricity consumption by acclimatization systems (cooling and heating) comprises about 40% of local authorities' energy consumption, and about 50-60% of the energy consumed in buildings. The energy consumed by acclimatization systems may be reduced by at least 30% by performing thermal treatment on buildings' envelopes. 10% of the overall energy consumed by acclimatization systems can be saved by mere treatment of buildings' roofs, which is relatively cheap. The efficiency programs in local authorities will include incentives for roof retro-fit operations: The cost of roof retro-fit is relatively lower than treating the rest of the structure's envelope, and it reduces electricity demands on top floors only. Due to the fact that many local authority institutions are located in relatively low buildings (2-3 storey high) – schools and kindergartens in particular - retro-fit operations are expected to reduce acclimatization consumption by some 5% (compared to a very minor influence on demands in other branches in which buildings are mostly high). However, the cost of envelope retro-fit is very high, and according to present consumption data – it will pay itself back after many years. Moreover, the payback period will probably be even longer in light of the expected decrease in electrical appliances' consumption. It is therefore recommended to focus on roof retro-fit. Based on this standard, various financial benefits - including tax benefits - should be offered to contractors who build in accordance with energy ratings, in order to promote high energy-rating construction.
Recommendations how to consider this project for WP2 scenarios, priorities and roadmap (with references to taxonomy classes)	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	Addressed
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.

5.3.8 R&D related to ICT for Energy Efficiency in Buildings in Malaysia

Programme, topic	**Smart Grid National Program**
Duration	n/a
Budget M€	n/a
Website(s)	http://www.tnb.com.my/
Summary	The efforts towards building a national framework are still work in progress. According to a 2012 report[16]: The total Malaysia Smart Grid technology market is projected to grow from \$35.2 million in 2011 to \$109.0 million by 2016. Among the five major Smart Grid technology areas, the communication and wireless infrastructure segment is projected to grow the fastest from 2011 to 2016, growing at an annual rate of 28.5%. The smart meters segment is projected to be the largest, reaching \$29.8 million by 2016. The national goal of the Malaysia's Smart Grid program is to reduce carbon emissions to 40% of the 2005 level, and increase the renewable energy levels to 2,080 MW 4,000 MW by 2020 and 2030, respectively. In addition, the Smart Grid will help Malaysia's utilities reduce grid operational costs and improve energy efficiency. An energy efficiency programme is proposed[17] with the following initiatives: • Government leadership by example in energy efficiency • Stimulating the sales of energy- efficient equipment and appliances • Promoting the co-generation of electricity • Promoting building insulation • Stimulating the sales of energy-efficient cars in the market There are no new R&D recommendations stemming from the efforts done in Malaysia; the country started now with a demonstration project[18] and wants to build in the future a national roadmap addressing energy efficiency.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.

16 http://zpryme.com/news-room/109m-malaysian-smart-grid-market-by-2016-zpryme-reports.html
17 http://www.greenprospectsasia.com/content/malaysia-rolls-out-energy-efficiency-roadmap
18 http://www.ewh.ieee.org/soc/pes/malaysia/images/KeyNote%20PECON2010/Mohd%20Yusof%20Rakob%20-%20Planning%20for%20TNB%20Smart%20Grid.pdf

5.3.9 R&D related to ICT for Energy Efficiency in Buildings in Mexico

Programme, topic	National Program for Sustainable Energy
Duration	3 years
Budget M€	n/a
Web site(s)	http://www.sener.gob.mx
Summary	1. New buildings and renovation and modernization of old buildings with the objective of to reduce the energy consumption optimizing heat losses in new and existing buildings. Initiatives: - Promote the efficient use of materials in commercial buildings and residential. - Incorporate standards insulation for building licenses residential. - Expand coverage green mortgages - Implement best practice for energy conservation government buildings. - Implement efficient equipment campaign. - Implement program information to users. - Implement inefficient equipment replacement program focusing on marginalized groups. - Implement inefficient equipment replacement program via producer. - Continue updating existing standards. - Apply guidelines in Public Administration.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Included
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	Included
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.

5.3.10 R&D related to ICT for Energy Efficiency in Buildings in Peru

Programme, topic	**Currently there are no specific programmes related with ICT / Energy Efficiency in Buildin**
Duration	n/a
Budget M€	n/a
Web site(s)	Ministry of Energy and Mining. http://www.minem.gob.pe and Ministry of Housing http://www.vivienda.gob.pe/
Summary	Currently there are no specific programmes in the Ministry of Energy and Mining related with ICT One of the working lines of the Energy Efficiency Office (http://www.minem.gob.pe/sector.php construction companies to adapt buildings to the climate or natural conditions (natural lighting, v new materials (thermal, insulating materials..). Peru has 28 of the 32 existing types of climate and architectural design (Bioclimatic design) sh use of materials that better respond to climate requirements. A “Climate-Map” has been elabora “climate-zones”, with specific requirements and conditions (architectural, materials..) for each of http://www.vivienda.gob.pe/dnc/archivos/difusion/eventos/2011/trujillo/Zonas%20Clim%C3%A1t The legal framework for Energy Efficiency is: • Ley N°27345 (08/09/2000) / Ley de Promoción del Uso Eficiente de La Energía. • Ley Nº 28832 (23/07/2006) / Ley para asegurar el desarrollo eficiente de la energía eléc • D.S. Nº 053-2007-EM (23/10/2007) / Reglamento de la Ley de Promoción del Uso Eficie • Decreto Legislativo Nº 1041 (26/06/2008) / Modifica diversas normas de marco normati • D.S. N°026-2010- EM (28/05/2010) / Modificación del Reglamento de Organización y Fu Energía y Minas y creación del la Dirección General de Eficiencia Energética • DS. Nº 064-2010-EM (24/11/2010) / Aprueban la Política Energética Nacional del Perú On the other hand the FONAM (Fondo Nacional del Ambiente) has a project related with the PR AND ENERGY EFFICIENCY (PE-M1038). It aims to promote the use of renewable energy and e of technologies reducing carbon emissions. The program is oriented to SME. http://www.fonamperu.org/general/energia/promocion.php
Recommendations how to consider this project for WP2 scenarios, priorities and roadmap (with references to taxonomy classes)	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.

Programme, topic	**Currently there are no specific programmes related with ICT / Energy Efficiency in Buildings**

Duration	3 years
Budget M€	n/a
Web site(s)	Ministry of Energy and Mining. http://www.minem.gob.pe and Ministry of Housing http://www.vivienda.gob.pe/
Summary	Currently there are no specific programmes in the Ministry of Energy and Mining related with ICT / Energy Efficiency in Buildings. One of the working lines of the Energy Efficiency Office (http://www.minem.gob.pe/sector.php?idSector=12) is to orientate the construction companies to adapt buildings to the climate or natural conditions (natural lighting, ventilation, etc.), and by the use of new materials (thermal, insulating materials..). Peru has 28 of the 32 existing types of climate and architectural design (Bioclimatic design) should consider the conditions and use of materials that better respond to climate requirements. A "Climate-Map" has been elaborated which divides the country in 9 "climate-zones", with specific requirements and conditions (architectural, materials..) for each of them. http://www.vivienda.gob.pe/dnc/archivos/difusion/eventos/2011/trujillo/Zonas%20Clim%C3%A1ticas%20del%20Per%C3%BA.pdf
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Included
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	Included
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.

5.3.11 R&D related to ICT for Energy Efficiency in Buildings in Saudi Arabia

Programme, topic	Smart Grid in Saudi Arabia - Technologies, Drivers, Challenges and Supporting Policies
Duration	
Budget M€	
Website(s)	http://saudi-sg.com http://www.mowe.gov.sa/English
Summary	As reported[19]: According to the Saudi Arabia Solar Industry Association (SASIA), domestic oil consumption is expected to surpass the volume of oil exported by the country by 2025. For this reason, the government is looking for alternate sources of power generation. Major emphasis has been placed on power generation using solar technology and a target has been established to up solar power generation capacity to 10% by 2020. Advance grid technologies were deployed across the power grid in Saudi Arabia before 2011. Despite being deployed to improve the efficiency of the grid, they were not labeled as smart grid technologies. In 2011, Saudi Arabia undertook the deployment of High Voltage Direct Current (HVDC) cables, smart meters, Gas-Insulated Switchgear (GIS) substations and electric vehicle infrastructure. The need to need the rising demand for electricity, improve energy efficiency and integrate renewable energy sources into the power grid is expected to encourage Saudi Arabia to adopt further smart grid technologies in the future. Although a dedicated programme on energy efficiency touching buildings and smart grid does not seem to explicitly be in place, several issues are considered.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.
	Unclassified recommendations
	No R&D lessons learned but efforts are ongoing on demonstration projects.

[19] http://www.researchandmarkets.com/research/fp65dz/smart_grid_in_saud

5.3.12 R&D related to ICT for Energy Efficiency in Buildings in South Korea

Programme, topic	**Green Korea – Minister Of Environment (MOE)**
Duration	2006 - 2015
Budget M€	n/a
Website(s)	http://eng.me.go.kr/file.do?method=fileDownloader&attachSeq=1582
Summary	The MOE is pushing forward a comprehensive ten year plan for environmental health to protect the public health, conducting basic surveys on areas and social classes vulnerable to environmental pollutants, examining heavy metal levels in human blood and building a continuous monitoring system of the damage from the hazardous substances in children's products. In addition, the MOE aims to minimize the impact of environmental pollution on the public health by strengthening the management of hazardous substances in the living environment, and indoor air quality. The MOE also intends to enact a special law on the control of Persistent Organic Pollutants (POPs) such as dioxin to protect the public health from their harmful effects with a plan to phase out PCBs by 2015.The MOE will lay the groundwork for enhancing national efforts for reducing greenhouse gas emissions to lead sustainable development at a global level and drive a full-fledged environmental cooperation project to improve the environment of South Korea. Meanwhile, for the efficient management of protected area, the Korean government plans to hold the "Korea Protected Area Forum" with the participation of governmental organizations (Ministry of Environment, Ministry of Maritime Affairs & Fisheries and Korea Forest Service) as well as NGOs (Korean commission of IUCN and UNESCO) to streamline and advance the management of protected areas.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	This thematic area is covered by the programme
	2. Intelligent control
	This thematic area is covered by the programme
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	This thematic area is covered by the programme

5.3.13 R&D related to ICT for Energy Efficiency in Buildings in Japan

Programme, topic	Japan Smart Community Alliance (JSCA)	
Duration	n/a	
Budget M€	849[20]	
Website(s)	www.asiaeec-col.eccj.or.jp,www.jase-w.eccj.or.jp/eng/ , www.nedo.go.jp/english/, https://www.smart-japan.org/english/tabid/103/Default.aspx	
Summary	The Federation of Electric Power Companies of Japan is developing a smart grid that incorporates solar power generation by 2020 with government investment of over $100 million. Japan has a very modern electricity network and up to now relied on nuclear power; however after the Fukushima nuclear crisis a new policy is drafted and focus on alternative energy resources and smartgrid technologies is expected. Japan is focusing on the last mile for a SmartGrid and on (i) storage batteries, (ii) energy management systems (iii) Photovoltaic and concentrated solar power, (iv) electric vehicles, (v) new energy services.	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**	
	No direct relations to this section.	
	2. Intelligent control	
	No direct relations to this section.	
	3. User awareness and decision support	
	No direct relations to this section.	
	4. Energy management and trading	
	This thematic area is covered by the programme	
	5. Integration technologies	
	No direct relations to this section.	
	Unclassified recommendations	
	- Japanese companies heavily invest in all SmartGrid technologies have inter-country collaborations (e.g. US-Japan) and target worldwide markets e.g. China, US etc. - Japan will consider the use of smart grid technologies as it forms a new energy policy following the nuclear crisis in Fukushima prefecture - In recent years Japan has invested significantly in its transmission infrastructure, which is operating with very high reliability levels, and is now focusing on its distribution networks.	

[20] http://www.powermag.com/business/Smart-Grid-On-the-Money_2578_p4.html

5.3.14 R&D related to ICT for Energy Efficiency in United Arab Emirates

Programme, topic	IRENA Innovation and Technology Centre
Duration	n/a
Budget M€	n/a
Website(s)	http://www.irena.org
Summary	The IRENA Innovation and Technology Centre (IITC) aims to provide the governments the means for an accelerated technological change and the use of innovation to transition to renewable energy based systems. This will be achieved through analysis of renewable energy technology policies; dissemination of information and increased awareness; technologies and equipment overview and assessment of success-failure factors; improved relevant knowledge and technology cooperation, and joint RD&D and provision of information on the development and deployment of national and international technical standards in relation to renewable energy. The IITC programme consists of two main activity areas: • Assist governments on request in energy planning for more efficient and effective renewable energy technology and innovation strategies • Facilitate a better understanding of cost and cost reductions through technology development and market deployment to accelerate renewables uptake
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	No direct relations to this section.
	5. Integration technologies
	No direct relations to this section.

5.3.15 R&D related to ICT for Energy Efficiency in Buildings in USA

Programme, topic	**SmartGrids and Energy Infrastructure**
Duration	2008 - Ongoing
Budget M€	$100 Mio (Energy Independence and Security Act of 2007) $21.5 Billion for Energy Infrastructure (American Recovery and Reinvestment Act of 2009) $27.2 Billion for Energy efficiency and renewable energy research and investment (American Recovery and Reinvestment Act of 2009) $4 billion in American Reinvestment and Recovery Act funds to support smart grid projects
Website(s)	www.energy.gov,www.ferc.gov, www.nsf.gov
Summary	SmartGrids is a huge domain in USA not constrained in the R&D but modernizing also the whole country's electricity network, mobility, energy efficiency etc. Support for the smart grid in the United States became federal policy with passage of the Energy Independence and Security Act of 2007. Smart grids received further support with the passage of the American Recovery and Reinvestment Act of 2009, which set aside several billions for the creation of a smart grid.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	No direct relations to this section.
	3. User awareness and decision support
	No direct relations to this section.
	4. Energy management and trading
	This thematic area is covered by the programme
	5. Integration technologies
	No direct relations to this section.

Programme, topic	**Smart Grid Impact on Intelligent Buildings 2011 (CABA)**
Duration	2011- Ongoing
Budget M€	n/a
Web site(s)	http://www.caba.org/ ; http://docs.caba.org/documents/research-program/PROSPECTUS-SMART-GRID-IMPACT-ON-INTELLIGENT-BUILDINGS.pdf ; http://docs.caba.org/documents/SmartGridImpactonIntelligenBuildings.pdf
Summary	"The purpose of this study is to identify, define and size the principle business opportunities presented by the growth of smart grids, in relation to "intelligent buildings". This will serve to add to market education and understanding, and address market knowledge gaps. As well, open and interoperable communication between energy suppliers and commercial energy users is an eventuality - which should be further explored in relation to smart grid development and intelligent buildings. Overall, the research will provide a market size forecast and roadmap for smart grid and intelligent buildings, contributing to business process transformation deemed

necessary to capitalize on investments in smart technology. This study is particularly timely, in light of the recent US Recovery Act Smart Grid stimulus programs that funneled $3.4 billion in investment and demonstration grants, in addition to loan guarantees, to develop and implement an intelligent, energy efficient and secure electric grid.

The main ICT related areas include:-

- Demand Side: To identify and quantify the benefits and implications for the principle stakeholder groups (i.e. building developers, owners, users, managers)
- Supply Side: Identify the implications and quantify business opportunities for all those who are (or are potentially) trying to expand their footprint in the building technical facility markets and supply chain (e.g. Utilities; Automatic Metering Infrastructure (AMI) providers; Utility Systems Developers and Integrators; providers of Demand Response and Energy Management System/Software as a Service (EMS); Communications infrastructure; Meters; Building Automation
- Systems (BAS); and Grid Optimization
- The research will include, but not necessarily be limited to, the opportunities for smart metering, building energy management, integration and convergence, as well as services
- To support and validate research findings in real-world case study
- demonstrations of participant projects encompassing intelligent buildings and smart grids
- Will also include an assessment within the commercial building space of net zero energy buildings (NZEB) and their relationship to smart grids.
- Assessment of stages of NZEB implementation (i.e. low energy or near-net zero buildings and % of net zero energy achieved)
- Identification of the building energy codes and incentives driving NZEB.
- Definition of net zero energy in terms of types of building that is more suitable (i.e. factors of design, scale, infrastructure, location, etc.) Identification of the new technologies and applications needed, and identification of the optimal business opportunities for the industry
- Identification of communications protocols that will be the enablers for smart grids and NZEB
- Identification and showcase of best practice within the current handful of NZEB pilot projects in North America."

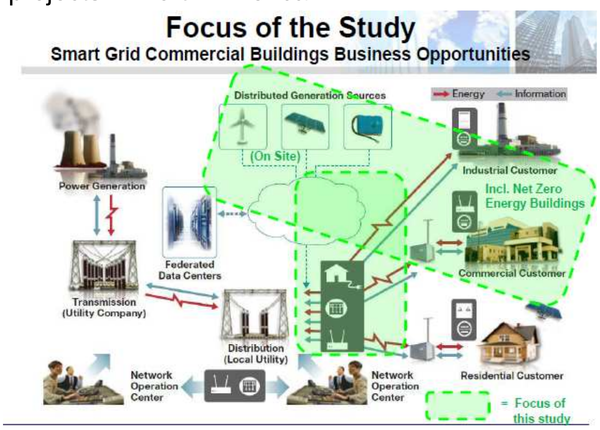


Fig 01: Smart Grids

Reference to ICT4E2B	**1. Tools for EE design and production management**
	Performance Estimation (1.4)

Classification	**2. Intelligent control**
	ICTs for Automation and control (2.1), Quality of service (2.3),
	3. User awareness and decision support
	Performance management (3.1),
	4. Energy management and trading
	Building as a prosumer (4.1), Smart grids (4.2)
	5. Integration technologies
	Process integration (5.1), System integration (5.2), Interoperability & standards (5.3)

Programme, topic	**Building Technologies Program (United States, EERE)**
Duration	2011 - 2015
Budget M€	n/a
Web site(s)	http://www.eere.energy.gov/; http://apps1.eere.energy.gov/buildings/publications/pdfs/corporate/myp11.pdf
Summary	"The mission of the programme is to develop and promote efficient and affordable, environmentally friendly, technologies, systems, and practices for our nation's residential and commercial buildings that will foster economic prosperity, lower greenhouse gas emissions, and increase national energy security while providing the energy-related services and performance expected from our buildings.Goal is to create a self-sustaining market for building energy efficiency retrofits. Achieve 1 million home energy retrofits by 2013; 5 million retrofits by 2015. Achieve 3 billion square feet of commercial space retrofitted by 2015.The goal is to deploy building technologies and practices that can reduce U.S. energy use. Reduce the energy demand growth of U.S. buildings, by focusing on: - R&D in advance innovative technologies for appliances, equipment, and products; Integrated buildings approaches - Codes & Standards in leverage market priming and advanced technologies; Broaden coverage and update frequently to capture saving opportunities Market priming by pulling new products, practices and services into market faster at scale; Technical support to ENERGY STAR/ new higher tier."
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	No direct relations to this section.
	2. Intelligent control
	ICTs for Automation and control (2.1), monitoring (2.2), Quality of service (2.3), Wireless sensors networks (2.4)
	3. User awareness and decision support
	Performance management (3.1), Behavioural change by real-time pricing (3.3)
	4. Energy management and trading
	Building as a prosumer (4.1), Smart grids (4.2) for Demand response capabilities,
	5. Integration technologies
	Interoperability & standards (5.3) for business models

Programme, topic	**Advanced Building Energy Technologies Program (NIST)**
Duration	2009-10-01 - Ongoing

Budget M€	n/a
Web site(s)	http://www.nist.gov/; http://www.nist.gov/el/highperformance_buildings/abet_program.cfm
Summary	"The program's topical focus is on three technology thrusts: Space Conditioning, Renewable and Distributed Energy Technologies, and Cleaning and Control Technologies for Indoor Air Quality. This last focus area is important and so included because the impact of net-zero energy technologies on the indoor environment must be assessed to ensure that indoor air quality is not compromised but preferably enhanced. The technical ideas pursued within these thrusts can be placed in the following four categories: 2. **Cost-neutral energy savings:** Apply advances in material science—nanolubricants—to improve the energy efficiency of chillers used to cool commercial buildings. Apply particle image velocimetry measurements, computational fluid dynamic modeling, and evolutionary computation methods for optimization of space-conditioning heat exchangers. Since the concept of the net-zero energy building includes cost effectiveness on a life-time basis. advanced cost-neutral solutions are of particular interest. 3. **Testing and rating methodologies:** Reduce the measurement uncertainty associated with rating of photovoltaic modules; Develop testing and rating procedures for micro-cogeneration systems; Develop test methods for high efficiency particle filtration devices. 4. **Indoor air quality:** Enhance NIST's multizone modelling tools for indoor environmental analysis to incorporate more complete particle transport; apply multizone building analysis to relate air cleaner performance as measured in the laboratory to contaminant exposure reduction in actual occupied environments. 5. **Exploratory research:** Identify measurement science barriers that impede market implementation of alternative, emerging cooling technologies."
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Performance Estimation (1.4)
	2. Intelligent control
	ICTs for Automation and control (2.1), Monitoring (2.2), Quality of service (2.3),
	3. User awareness and decision support
	Performance management (3.1),
	4. Energy management and trading
	Building as a prosumer (4.1), Smart grids (4.2)
	5. Integration technologies
	Process integration (5.1), System integration (5.2), Interoperability & standards (5.3)

Programme, topic	**Embedded Intelligence in Buildings Program (United States, NIST)**
Duration	n/a
Budget M€	n/a
Web site(s)	http://www.nist.gov/; http://www.nist.gov/el/highperformance_buildings/eib_program.cfm
Summary	"A cybernetic building system integrates intelligent building automation and control systems for energy management, fire detection, security, and vertical transport. It also integrates the building systems with outside service providers and utilities. This research program aims to address building systems measurement needs in a holistic, integrated manner that considers complex system interactions and their impact on energy consumption, comfort, safety, and maintenance.The main ICT

	related areas include: - Expansion, certification, and demonstration of BACnetis the cornerstone upon which all other aspects of cybernetic building systems are built because it provides the basis for communication and information exchange. This research will remove a number of identified barriers to expanding BACnet beyond HVAC. - Virtual Cybernetic Testbed (VCBT). The VCBT consists of a variety of simulation models combined with commercial and prototype BACnet controllers that create a hybrid software/ hardware environment suitable for testing various integrated control system components for cybernetic buildings in ways that cannot be accomplished by testing in actual buildings. The current research focus is on expanding the capabilities of the VCBT to include additional building systems and a wider range of building types and emergency scenarios. - Fault detection metrics and tools for HVAC equipment, automated commissioning tools, autonomous, intelligent agents for optimizing system performance, integration of building systems with a future Smart Grid, and providing building system information to emergency responders.”
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Performance Estimation (1.4)
	2. Intelligent control
	ICTs for Automation and control (2.1), Monitoring (2.2), Quality of service (2.3), Wireless sensors networks (2.4)
	3. User awareness and decision support
	Performance management (3.1), Visualization of energy use (3.2), Behavioural change by real-time pricing (3.3)
	4. Energy management and trading
	Building as a prosumer (4.1), Smart grids (4.2)
	5. Integration technologies
	Process integration (5.1), System integration (5.2), Interoperability & standards (5.3)

Programme, topic	**Improved Building Energy Performance Program**
Duration	2009-10-01 - Ongoing
Budget M€	n/a
Web site(s)	http://www.nist.gov/; http://www.nist.gov/el/highperformance_buildings/ibep_program.cfm
Participants	NIST, Engineering laboratory
Summary	“The goal of the Improved Building Energy Performance program is to improve the as-constructed performance of high-performance buildings by developing and implementing the measurement science to assess the energy consumption, CO2 emissions, indoor air quality, and cost effectiveness of buildings. The program addresses building energy, greenhouse gas emissions, and indoor air quality measurement science in a holistic, integrated manner that considers system interactions involving weather, the building envelope, control systems, and space conditioning equipment.ICT related areas include: Research efforts are focused on the development of cost-effective building energy monitoring systems, improvements in the efficiency of space conditioning equipment through self-diagnostics and enhanced design tools, providing accurate metrics to capture the performance of thermal insulation, improved measures of

	CO2 emissions from facilities, and development of tools to enhance indoor air quality (IAQ) through measurement science advancements to address volatile organic compounds (VOC) emissions and advanced ventilation schemes. Metrics to assess the sustainability of buildings and to quantify the carbon footprint of buildings are an integral part of the program.”
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Design (1.1), Production Management (1.2), Performance estimation (1.4)
	2. Intelligent control
	Quality of Service (2.3)
	3. User awareness and decision support
	Performance management (3.1),
	4. Energy management and trading
	Building as prosumer (4.1),
	5. Integration technologies
	Process integration (5.1), System integration (5.2), Interoperability and standards (5.3)

5.4 RTD Framework Comparative Analysis

5.4.1 European National Level

Buildings in Europe are responsible for 40% of energy consumption and 36% of EU CO_2 emissions. Energy performance of buildings is the key to achieve the EU Climate & Energy objectives, namely the reduction of a 20% of the Greenhouse gases emissions by 2020 and a 20% energy savings by 2020. Substantial steps have been taken towards this objective. Nonetheless, recent Commission estimates suggest that the EU is on course to achieve only half of the 20% objective[21]. On 22 June 2011, a new set of measures for increased Energy Efficiency is proposed by the European Commission to fill the gap and put back the EU on track.

The need of modernisation of the existing building stock and the construction of new buildings to ensuring energy savings and CO2 reductions is also depending on strengthening the research investments in Information and Communication Technologies (ICTs) specifically the building sector. **The enhanced ICT systems will support the needs for developing innovative business models and services that can provide continuous and precise information to decision makers, industries and policy making.**

The *"ICT for a Low Carbon Economy, Smart Buildings"*[22] report on July 2009 pointed out different examples where ICT can contribute to improve the energy performance of buildings:

- New ICT based Neighbourhood Management Systems will allow peer-to-peer sharing of energy produced through renewable schemes

- New ICT based meters will allow households not only to buy but also to sell energy

- ICT will allow information on energy consumption of every energy-consuming appliance in a home or a building to be provided in real-time, in a user friendly way, thereby empowering citizens to take decisions that lead to energy savings.

Members States are fully aware of the role ICT will play in the near future when analysing, designing, monitoring and operating buildings. Increasingly investments in research on ICT for the Energy Efficiency in this field have already been put in place at National level. However, it is not always clear to them how ICT will help, what the quantifiable impacts are and which the most appropriate solutions are.

National R&D frameworks focuses on the ICT for the Energy Efficiency in Buildings have been analysed in all the 27 European countries. Many Member States do not have any National R&D framework in this specific sector, and in some countries those have not been possible to identify (see Table 11). Therefore, during the comparative analysis, 20 European countries out of 27 have been assessed and are listed in**Error! Reference source not**

[21]Energy Efficiency Plan COM(2011) 109 final

[22]ICT for a Low Carbon Economy, Smart Buildings (July 2009) - Findings by the High-Level Advisory Group and the REEB Consortium On the Building and Construction sector – European Commission DG INFSO

found. Table 10. Figure 25 shows Europe's map of the National R&D frameworks assessed in this report.

Table 10: Analysed Members States

Members States			
Austria	Belgium	Denmark	Estonia
Finland	France	Germany	Greece
Hungary	Ireland	Italy	Malta
Netherlands	Poland	Portugal	Romania
Slovakia	Spain	Sweden	United Kingdom

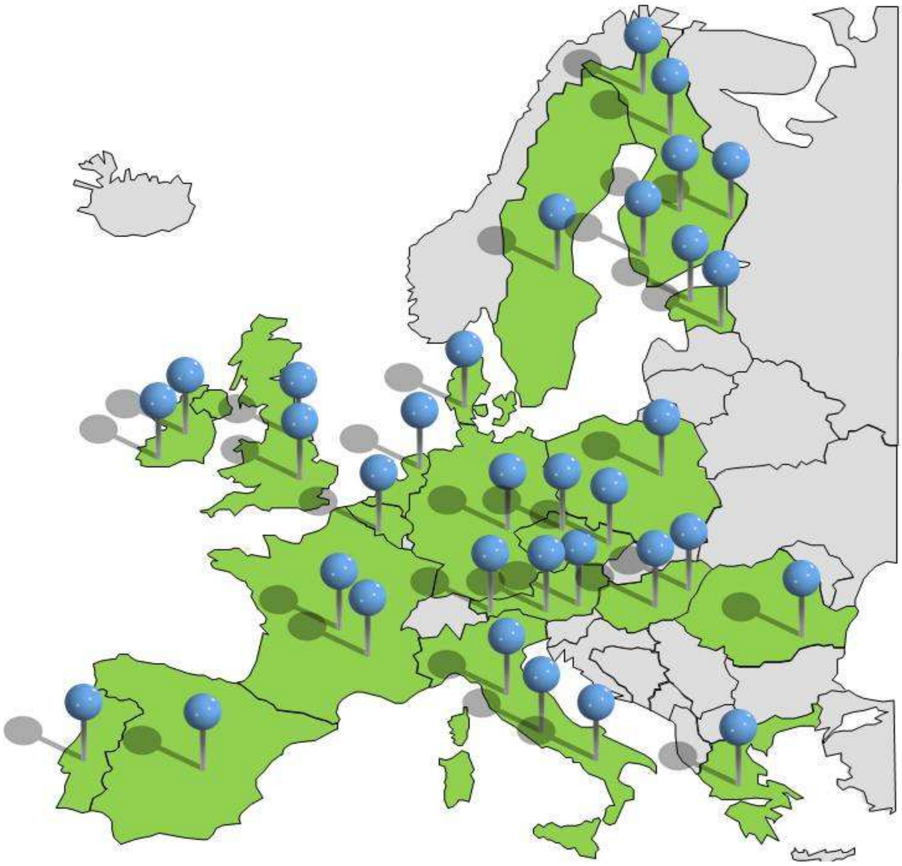


Figure 25: EU 27 Map on National R&D Framework on Energy Efficiency in Building

For the European countries listed below, specific National R&D frameworks have not been possible to identify.

Table 11: No National R&D Framework found

Members States			
Cyprus	Czech Republic	Bulgaria	Latvia
Lithuania	Luxembourg	Slovenia	

In Cyprus investments are done on alternative energy resources. Cyprus participates in EU research projects that deal with energy efficiency, smart grids etc., however a specific government-financed R&D framework for the investigation of smart grids as such has not been possible to identify.

The Czech Republic system of public R&D funding is characterised by a nearly equal balance between institutional and competitive funding. The largest shares of institutional funding are distributed between the Academy of Sciences and Ministry of Education, Youth and Sports, which in turn, provide this type of funding to individual recipients, predominantly to universities and public research institutes. The main provider of competitive funding is the Czech Science Foundation which provides smaller grants for basic research and also the Ministry of Industry and Trade which funds predominantly experimental R&D projects with a potential commercial application (for both the academic and business sectors).

The majority of the assessed countries have not more than one research program(11 countries) programs focusing on the ICT for the energy efficiency in buildings. Then there are 4 countries with two programs and finally also 4 countries with more than two programs,

Nevertheless, due to the different structure of the research system, some countries have developed more than one R&D programme focusing on ICT for the Energy Efficiency in Buildings at Regional and local level, which however have not been assessed in this analysis. For instance the governance of the Belgian research system reflects the federal structure of the country. The federal government funds research programmes of national interest while the regions fund their specific policies through agencies of their own[23]. In Greece further to the core national programme, there are regional initiatives, which however have less research and more dissemination elements and orientation. Important activities are carried out by the Technical Chamber of Commerce for the development of tools for the Building directive/ required certificate.

For Bulgaria, Latvia, Lithuania, Luxembourg and Slovenia it was not possible to identify any R&D programme focusing on ICT for the Energy Efficiency in Buildings at Regional and local level.

5.4.2 Overview of European RTD Framework on ICT for Energy Efficiency in Buildings

The aim of this paragraph is to outline the methodology adopted to carry out the National level R&D Framework Analysis based on the contribution in the selected countries given by each project partners:

- The **Qualitative** National R&D Framework analysis aims to identify and evaluate the non-covered areas in each of the category.
- The **Quantitative** analysis aims at identifying the importance of EU National R&D Frameworks by the following parameters:
    - National level R&D Framework Starting Year
    - Distribution of National Research Programmes among the thematic areas

Concerning the **'National level R&D Framework Starting Year'** three different years have been considered as a reference to a better understanding of the willingness from the

[23] See Annex to visualize Belgian Regional Programmes on ICT for the Energy Efficiency in Buildings.

European Member States to invest in Research Programmes in the ICT for energy efficiency in buildings sector.

- **Before Kyoto** (before 2005)
- **After Kyoto Protocol** (from 2005 to 2008)
- **After 20/20/20 EU Strategy** (after 2008)

The Kyoto Protocol, an international agreement linked to the United Nations Framework Convention on Climate Change, was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. Following the Kyoto Protocol, in which the European Union has long been a driving force[24], the EU adopted an integrated energy and climate change policy in December 2008, including ambitious targets for 2020, hoping to set Europe on the right track *towards a sustainable future with a low-carbon and an energy-efficient economy* by:

- cutting greenhouse gases by 20% (30% if international agreement is reached)
- reducing energy consumption by 20% through increased energy efficiency
- meeting 20% of our energy needs from renewable sources

The starting year will show how many Member States started their R&D activities in the ICT sector before any binding commitment for reducing greenhouse gas (GHG) emissions, how many R&D programmes were introduced from 2005 to 2008, therefore after the starting of the Kyoto Protocol, and in particular the commitment to reduce greenhouse gas emission to an average of five per cent against 1990 levels over the five-year period 2008-2012. It will also show how many countries developed R&D activities in the ICT field in line with the integrated energy and climate change policy of the European Union.

Thematic areas in the **'Distribution of National Research Programmes among the Thematic areas'** section refers to the thematic areas described in section **Error! Reference source not found.**.

The analysis will allow identifying which of the mentioned thematic areas are the most widely covered by the Research Activities on ICT for Energy Efficiency in Buildings at National level. The analysis will further illustrate how different Member States are investing in R&D research activities and in which areas they are focusing most.

Based on the data collected from the various Member States, the thematic areas could be also gathered as follow:

- **Covered area[25]**
- **Highly emphasises area**
- **Indirectly addressed/referenced area**

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[24]The EU has played a key role in developing the two international treaties addressing climate change, the 1992 United Nations Framework Convention on Climate Change and its Kyoto Protocol, agreed in 1997.

[25]*'This thematic area is covered by the program* related to the National R&D Framework tables provided.

- **Not referred explicitly**

5.4.2.1 National level R&D Framework Starting Year

Many European countries (45,5%) started to focus on the ICT for Energy Efficiency in Buildings, thus developing National R&D Programmes in this area, after the *'Kyoto Protocol'* agreement that entered into force in 2005. Again The same percentage of EU countries (45.5%) started after the *'Climate and energy package'* agreed by the European Parliament and Council in December 2008. The minority of countries (8,5%) have developed R&D Programmes at National level already before these European and international agreements.

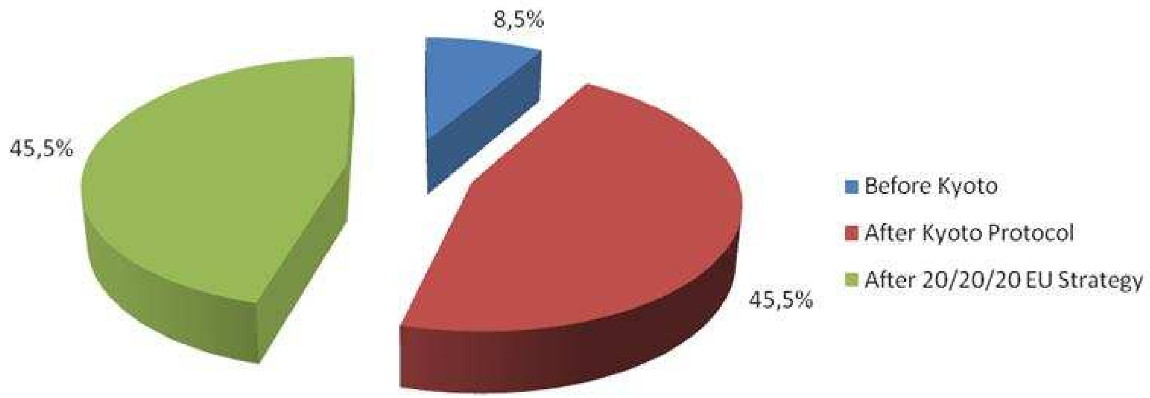

Figure 26: EU27 National R&D Framework Start Year Period

Member States in Europe are becoming more and more concerned on the climate change and the security of energy issues. The pie above shows how in the last years Member States are putting much emphasis on R&D investments in the ICT for Energy Efficiency in Buildings. Member States thus recognise the ICT as a key for empowering people with both smart e-metering and new smart devices by putting ICT at the core of the energy efficiency effort and fostering R&D into novel ICT-based solutions, following the leading example of the European Commission's research priorities in this sector.

In some countries there have also been developed national level R&D Programmes for the period 2007-2013 in line with the objectives of the Cohesion policy for the same period. In particular countries under the Convergence Objective and the European Competitiveness and Employment Objective. By way of example, Estonia R&D activities are funded from the state budget, budgets of rural municipalities or cities, targeted donations, income earned from the economic activities of R&D institutions, and from other sources. The resources of the European Social Fund (ESF) have been used for supporting a knowledge-based society, a new generation of scientists and engineers and for improving the quality of higher education.

5.4.2.2 Distribution of National level Research Programmes among thematic areas

Thematic areas covered by the National level R&D programmes within the domain on ICT enabled energy efficient buildings can be ranked as follow:

1. ***Intelligent Control***
2. ***Integration technologies***
3. ***User awareness and decision support***
4. ***Tools for EE design and production management***
5. ***Energy management and trading***

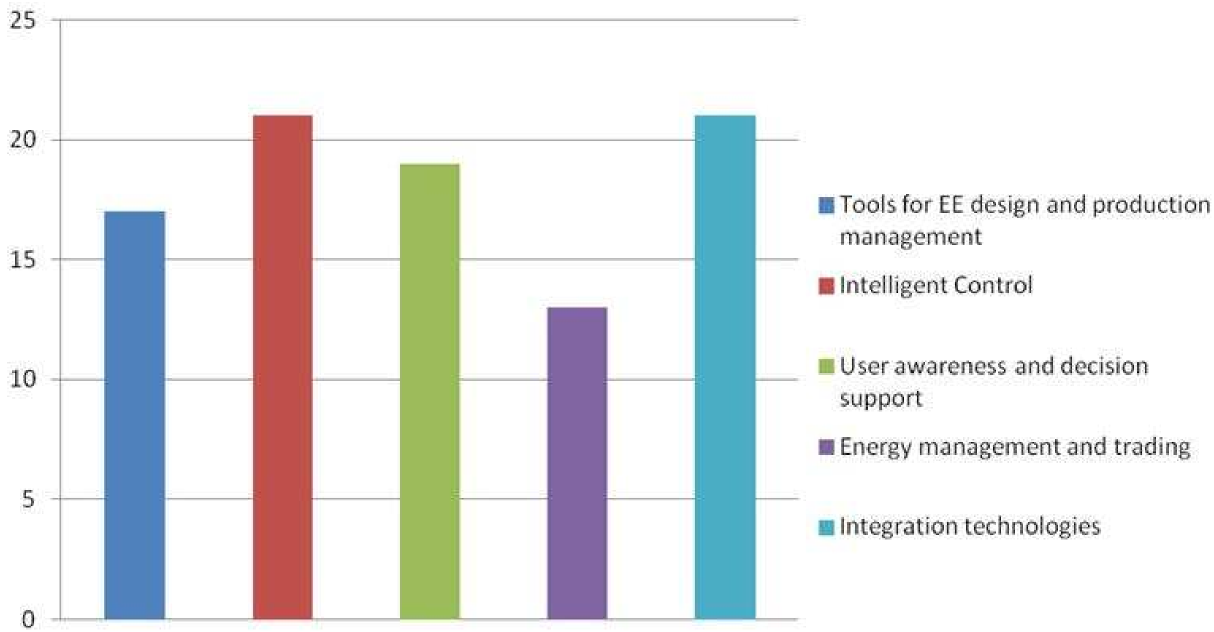

Figure 27: Ranking of Thematic Area Covered at European Level

The most two covered areas are *'Intelligent Control'* and *'Integration technologies' (*21 National level R&D Programmes for each theme). Then *'User awareness and decision support'* follows with 19 National level R&D Programmes. Finally we have the *'Tools for EE design and production management'* (17 National level R&D Programmes) and *'Energy management and trading'* (13 National level R&D Programmes).

This classification work allows to clearly underlining the actuality of the REEB classification with respect to the on-going RTD activities at national level, considering that large of the programmes cover most of the terms of the REEB classification. Yet, from Figure 27 it is important to highlight that one of the two predominant areas is **"Intelligent Control",** this is consistent also with REEB project finding.

Additionally it is important to emphasize how Member States give considerable importance to the **'User awareness and decision support'** area that normally is not fully covered by Research Frameworks as it is not seen as a priority one.

With respect to the **‘Energy management and trading’** area, we can see that this is the least covered. In general Energy Management innovation is carried out by energy suppliers, utilities and service providers such as ESCOs. Energy trading research and innovation for financial energy trading rather than physical tradings is carried out by traders, energy marketers and companies offering trading services such as electronic energy trading platforms (e.g. Endex).

Regarding the **distribution of National level R&D Programmes** on the ICT sector for the energy efficiency in buildings (see Figure 28), Austria, Denmark, Finland, Ireland,Slovakia, The Netherlands and UK have developed National programmes that cover all the five thematic areas. National level R&D Programmes in Italy and Spain cover four thematic areas, while in France, Greece and Sweden National level R&D Programmes cover three thematic areas. Belgium, Malta, Portugal and Romania seem to give more emphasis on two thematic areas especially on the ‘Integration technologies’ one.

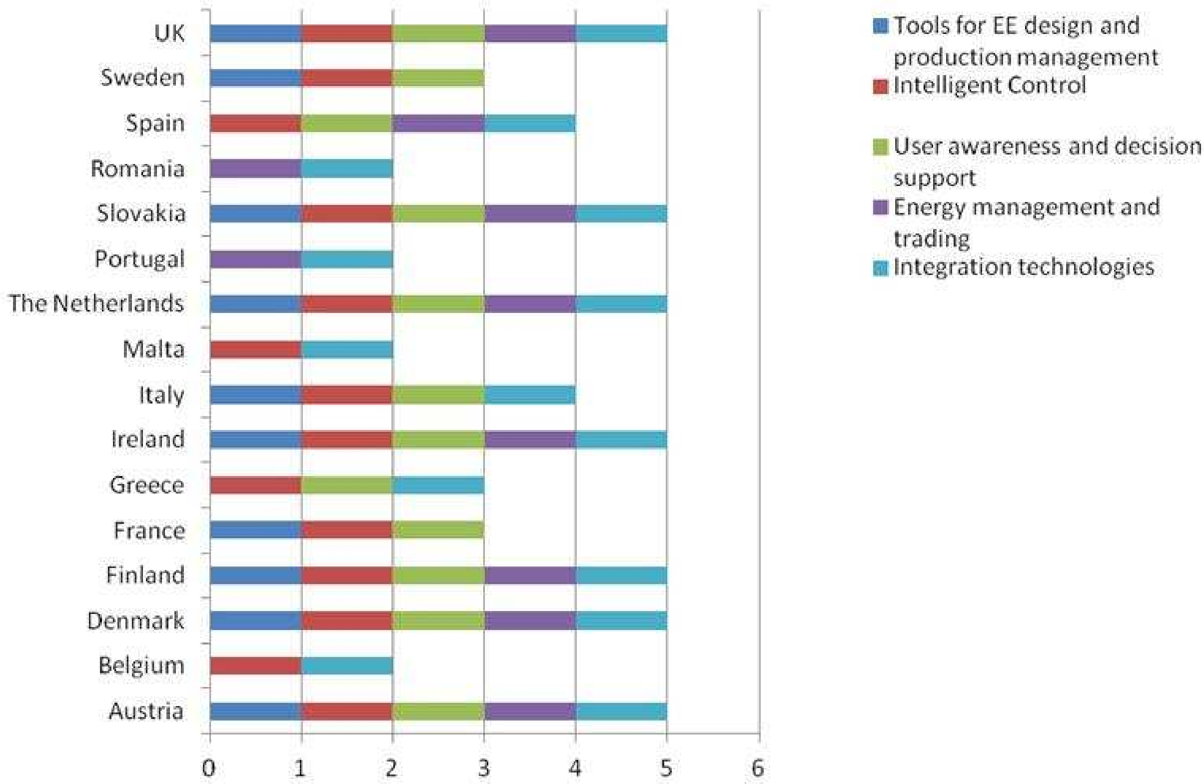

Figure 28: Distribution of National Research Programmes among the Thematic Areas

Finland is giving a great emphasis on the ICT sector for the Energy Efficiency in Buildings R&D Programmes at National level, having five different National Programmes which coverall the thematic areas. ‘PRE – Built Environment Re-engineering Programme’, ‘Built Environment’, and ‘Sustainable Community’ focus on the creation of new procedures and business models for the real estate and construction sector with user needs being at the basis. The ‘Ubicom – Embedded ICT’ Programme goal is to creating new markets and improving the productivity and conditions in existing industries, while the ‘DIEM – Devices and Interoperability Ecosystems’ Programme aims to create the concept and to implement a generic and scalable smart space interoperability solution and platform.

Austria similarly gives a special importance on the ICT sector for the Energy Efficiency in Buildings R&D Programmes at National level, having three different National Programmes covering all the thematic areas. ‘FIT-IT’ (Research, Innovation, Technology - Information Technology) supports co-operative research that addresses challenging innovation and technology development in the area of information and communication technologies, while the five-year research and technology programme ‘Building of Tomorrow’ initiates and supports trendsetting research and development projects and the implementation of exemplary pilot projects. ‘NEUE ENERGIEN 2020’ (New Energy 2020) is the research and technology programme of the Climate and Energy Fund which responds to social issues and the knowledge development for long-term planning processes.
Italy has a particular focus on the ‘Intelligent control’ area that is covered by the two running National programmes. Two technology districts cover the ICT key strategic area in the sector of energy efficiency and eco-sustainability environment, whereas the Italian National Research Programme will turn into support to the national technological platforms that will coordinate their activities with the correspondent European ones giving support to the high-tech districts, building poles of excellence.

The “Energy Technology Development and Demonstration Program” in Denmark focuses on Smart ICT methods for energy saving, storage and generation in buildings.

The ‘Science for a Sustainable Development’ programme in Belgium, and the ‘Operational Programme Competitiveness’ in Greece have different priorities including ICT. Furthermore Belgium and Greece have R&D programme focusing on ICT for the Energy Efficiency in Buildings also at Regional and local level.

Denmark and France programmes mainly relate to the reduction of CO_2 emission objectives. The main objective of the ‘Energy Technology Development and Demonstration Programme’ in Denmark is to ensure the development and demonstration of new energy technologies, which can reduce dependency on fossil energy and contribute to minimising the CO_2 burden; PREBAT in France, a multiyear programme launched in 2005, aims to achieve significant, sustainable and finalised research, experimentation and dissemination of new solutions to improve energy efficiency in new and existing buildings focusing mainly on mitigating the effects of climate change.

Different programmes have been developed in order to foster the national economy as the ‘SFI Strategic Research Clusters Programme’ in Ireland, the ‘National Strategic Reference Framework’ in Portugal, and the ‘Programul Operational Sectorial Cresterea Competitivitatii Economice’ in Romania. Realising economic benefits, with particular emphasis on the SME involvement, is also an objective of the ‘ICT for manufacturing and construction’ and the ‘Electronics, photonics and electrical systems’ programmes in the UK.

Spain and Sweden’s programme seem to pay particular attention to the user behaviour. Plan ‘Avanza 2’ in Spain aims to eliminate existing barriers to the expansion and use of ICT to ensure the rights of citizens in the Information Society; the program Energy, IT and Design in Sweden provide funding for projects concerning human behaviour and energy efficiency. The main emphasis of the programme is to influence the everyday habits, values and behaviour of users as far as improving the efficiency of energy use is concerned, with some concentration on improving the efficiency of electricity use through application of both IT and design.

Looking at National R&D Programmes and based on the data collected from the various Member States, the following thematic areas could be gathered as follow:

Table 12: Thematic Area Coverage

	Covered area	**Highly emphasises area**	**Indirectly addressed/referenced area**	**Not referred explicitly**
Tools for EE design and production management	Austria Denmark Finland France Ireland Italy Netherlands Slovakia Sweden UK			Greece
Intelligent control	Austria Belgium Denmark Finland France Ireland Italy Malta Netherlands Slovakia Sweden UK	Greece Spain		
User awareness and decision support	Austria Denmark Finland France Italy Ireland Netherlands Slovakia Sweden UK		Greece Spain	
Energy management and trading	Austria Denmark Finland Ireland Netherlands Slovakia UK	Portugal Romania Spain		
Integration technologies	Austria Belgium Denmark Finland Ireland Italy Malta Netherlands Slovakia UK		Greece Portugal Romania Spain	

Covered area are as follow: '*Tools for EE design and production management*' in 10 countries (Austria, Denmark, Finland, France, Ireland, Italy, Netherlands, Slovakia, Sweden, UK); '*Intelligent control'* in 12 countries (Austria, Belgium, Denmark, Finland, France, Ireland, Italy, Malta, Netherlands, Slovakia, Sweden, UK); '*User awareness and decision support'* in 10 countries (Austria, Denmark, Finland, France, Italy, Ireland, Netherlands, Slovakia, Sweden, UK); '*Energy management and trading'* in 7 countries (Austria, Denmark, Finland, Ireland, Netherlands, Slovakia, UK); '*Integration technologies'* in 10 countries (Austria, Belgium, Denmark, Finland, Ireland, Italy, Malta, Netherlands, Slovakia, UK).

Highly emphasises area are *'Intelligent Control'* in Greece and Spain, *'Energy management and trading'* in Portugal, Romania and Spain.

Indirectly addressed/referenced area are *'User awareness and decision support'* in Greece and Spain, *'Integration technologies'* in Greece, Portugal, Romania and Spain.

In Greece *'Tools for EE design and production management'* and *'Integration Technologies'* are **not referred explicitly**. There is an explicit area relates to low energy wireless systems also for building applications. In the market integration and monitoring of renewable technology in buildings is an area of important activity. The same applies for service for building certification, while Wireless technology is only recently entering the scene.

Estonia, Germany, Hungary and Poland have developed National level R&D Programmes on ICT for the Energy Efficiency in Buildings; however the classification into the specific thematic areas where the National Programmes focus on has not been possible.

The Estonian Science Foundation allocates (intermediates) the individual grants on competitive bases, to support - the purpose is primarily to support high-level initiative research, new ideas and studies. Funding comes entirely from the state budget. No direct relations to the thematic areas section. All of the projects, ideas that are innovative can be co-funded, including projects related to EE design and production management, intelligent control, user awareness and decision support, energy management and trading, integration technologies.

In Germany the primary goal of National level R&D Programme E-Energy is to create E-Energy model regions that demonstrate how the immense potential for optimization presented by information and communication technologies (ICT) can best be harnessed to enhance the efficiency and environmental compatibility of the power supply and to ensure supply security. It is also hoped that the regional E-Energy model projects will pinpoint ways to create new jobs and markets. To this end, integrative ICT system concepts that optimize the entire electricity supply system - from generation and transport all the way to distribution and consumption - are being developed and put through their paces in practically oriented tests.

The new programme in Hungary covers different R&D thematic among which energy efficiency in buildings.

In Poland the main programme aiming at the innovating the whole economy including infrastructure, environment, education and research is the Innovative Economy. Funds within the Programme were divided into so-called priority axes or priorities that will allow achieving the overall objective and specific objectives of the Programme. Under the Programme, nine priorities were defined, including 8 content-related ones and the Technical assistance priority. Directly connected with the R&D sector are 4 priorities and in these priorities ICT sector as well as generally defined "energy saving" issues are represented. The idea of this

Programme is to put science into practice, therefore strong emphasis is put on tangible results. No direct relations to the thematic areas section. All of the projects, ideas that are innovative can be co-funded, including projects related to EE design and production management, intelligent control, user awareness and decision support, energy management and trading, integration technologies. One of the priority axes is related to projects aimed at maintaining and developing of the modern IT infrastructure for science through co-financing investments in networks and equipment of nationwide importance, taking into account their crucial importance for the environment.

5.4.3 Overview of the RTD Framework on ICT for Energy Efficiency in Buildings for the European Countries not belonging to EU 27

ICT for Energy Efficiency in Buildings is increasing also within the European countries not belonging to EU 27. The following European countries not belonging to EU 27 have been analysed:

Table 13: European Countries not Belonging to EU 27 Analysed

States			
Croatia	Russia	Serbia	Switzerland
Turkey			

The methodology adopted to carry out the International R&D Framework Analysis is similar to the one used to analyze the EU27 countries, except for the fact that the program starting year was not considered:

- The **Qualitative International R&D Framework** Analysis aims to identify and evaluate the weak/non-covered areas in each of the category.
- The **Quantitative** Analysis aims at identifying the importance of International R&D Frameworks by the following parameters:
    - Distribution of Research Programmes among the thematic areas

With regards to the **'Distribution of National Research Programmes among the thematic areas'** the thematic areas used are the same mentioned in Section 5.4.2.

5.4.3.1 Distribution of Research Programmes among the thematic areas at the Level of EU Countries not belonging to EU 27

At the level of European countries not belonging to EU 27 the thematic areas covered by the National R&D programmes can be ranked as follow:

1. ***Tools for EE design and production management***
2. ***Intelligent Control***
3. ***User awareness and decision support and Integration technologies***
4. ***Integration Technologies***
5. ***Energy management and trading***

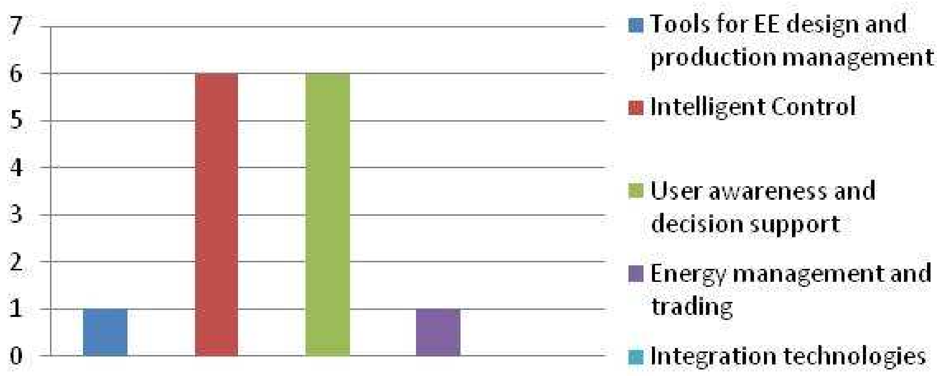

Figure 29: Ranking of Thematic Area Covered at the Level of European Countries not belonging to EU 27

'Intelligent Control' (6 programmes) and *''User Awareness and Decision Support"* (6 programmes) are the most covered area in the European countries not belonging to EU 27, followed by the *'Tools for EE Design and production management'* and '*Energy management and trading*" (1 programme). We did not find any programme covering the "Integration Technologies" thematic area.

Regarding the **distribution of R&D Programmes on the ICT sector for the Energy Efficiency in Buildings** for the European countries not belonging to EU 27, it was possible to identify specific thematic areas only for three countries, Russia (4 areas), Serbia and Switzerland (2 areas).

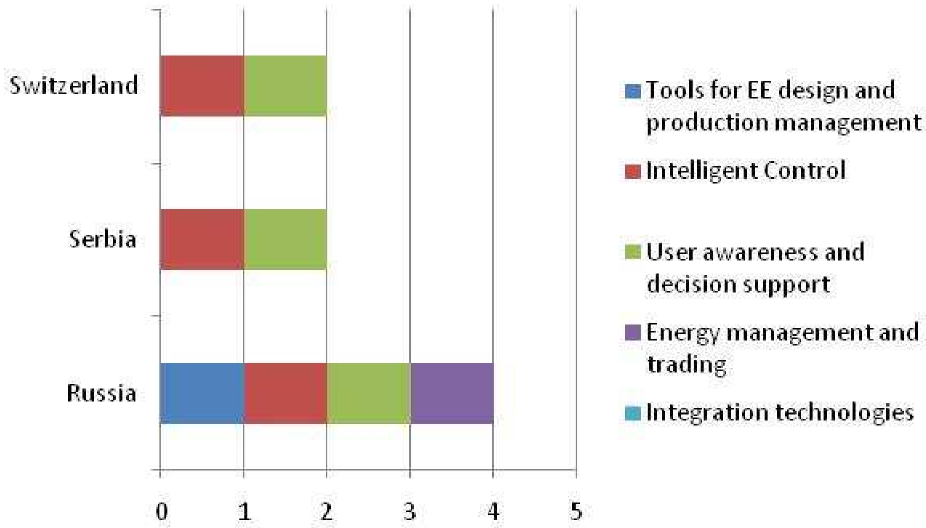

Figure 30: Distribution of International Research Programmes among the Thematic Areas

5.4.4 International Level

ICT for Energy Efficiency in Buildings is growing faster at the international level too. Seven countries, one for each continent (excluding Asia for which three countries have been considered), and based on the economic and technology progress development of the country, have been assessed. The aim is to drawing up the scenario analysis of programmes focusing on this field in non European countries. The following non European countries have been analysed:

Table 14: International Countries Analysed

States			
Australia	Brazil	Canada	China
India	Israel	Malaysia	Mexico
Peru	South Korea	USA	

5.4.5 Overview of International RTD Framework on ICT for Energy Efficiency in Buildings

The methodology adopted to carry out the International R&D Framework Analysis has some differences between the one used to analyse EU27 as showed in the following:

- The **Qualitative International R&D Framework** Analysis aims to identify and evaluate the weak/non-covered areas in each of the category.
- The **Quantitative** Analysis aims at identifying the importance of International R&D Frameworks by the following parameters:
    - o Distribution of Research Programmes among the thematic areas at International level

With regards to the **'Distribution of National Research Programmes among the thematic areas'** the thematic areas used are the same mentioned in section 5.4.2.

5.4.5.1 Distribution of Research Programmes among the thematic areas at International level

At International level thematic areas covered by the National R&D programmes can be ranked as follow:

1. ***Tools for EE design and production management***
2. ***Intelligent Control***
3. ***User awareness and decision support and Integration technologies***
4. ***Integration Technologies***
5. ***Energy management and trading***

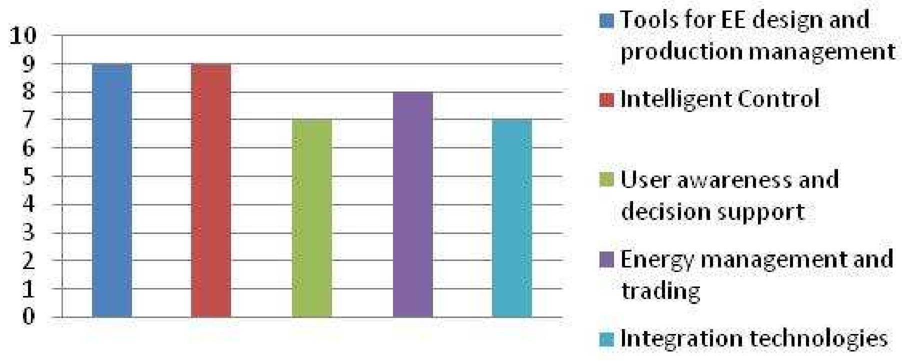

Figure 31: Ranking of Thematic Area Covered at International Level

'Tools for EE design and production management' (9 programmes) and *'Intelligent Control'* (9 programmes each) are the most covered area at International level, followed by the *'Energy Management and Trading'* (8 programmes). Finally the *'Integration technologies'* and the *'User awareness and decision support'* areas are the less covered ones (7 programmes each).

Regarding the **distribution of R&D Programmes on the ICT sector for the Energy Efficiency in Buildings** at international level (see Figure 32), USA has developed National R&D Programmes which cover all the five thematic areas. Canada R&D programmes that covers four areas. China and South Korea have National R&D Programmes which cover three thematic areas, while Brazil, Israel, India, Mexico and Japan National R&D Programmes cover only one thematic area.

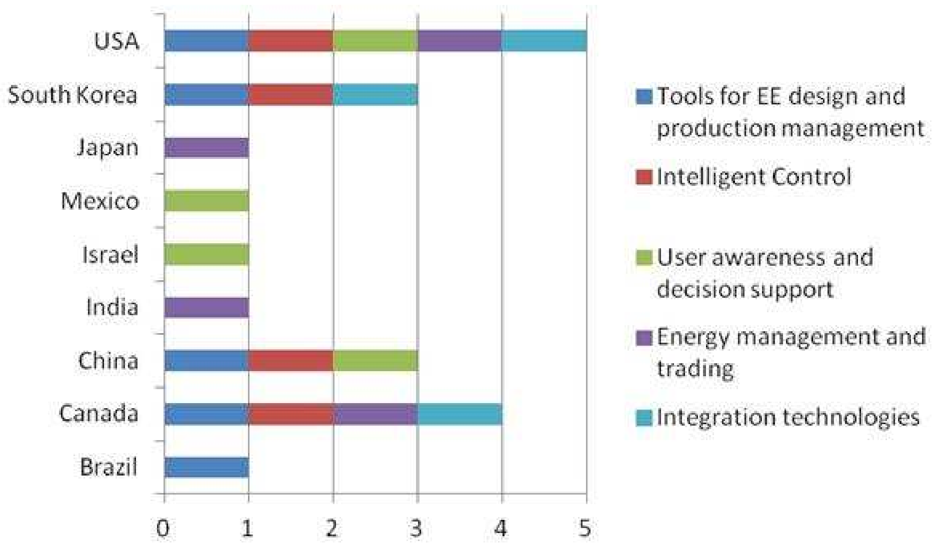

Figure 32: Distribution of International Research Programmes among the Thematic Areas

'Tools for EE and production management' area is covered by National R&D Programme in four countries (Brazil, China, South Korea and USA), while *'Intelligent control'* is covered in three countries (China, South Korea and USA). *'User awareness and decision support'* and *'Integration technologies'* are covered by two countries each respectively China and South Korea, and USA which covers both.

Smart Grids is a huge domain in USA not constrained in the R&D but modernizing also the whole country's electricity network. Support for the smart grid in the United States became federal policy with passage of the Energy Independence and Security Act of 2007. Smart grids received further support with the passage of the American Recovery and Reinvestment Act of 2009, which set aside several billions for the creation of a smart grid. '***Smart Grid and Energy Infrastructure'*** and Smart Grid Impact on Intelligent Buildings 2011 (CABA) are huge programmes touching on all aspects of R&D and deployment of Smart Grids and relevant domains including electric mobility, energy efficiency etc. The 'Building Technologies Program', 'Advanced Building Technologies Program (NIST)', and 'Improved Building Energy Performance Program' pay attention on fostering economic prosperity, lowering greenhouse gas emissions, and indoor air quality with the goal of creating a self-sustaining market for building energy efficiency retrofits. The 'Embedded Intelligence in Buildings Program' aims to address building systems measurement needs in a holistic and integrated manner.

The overall objective of the Program for Housing Technology (Habitare) in Brazil is to contribute to the advancement of knowledge in the technology field of the built environment, supporting scientific research, technology and innovation in order to meet the needs of modernization of the housing sector and contribute to the housing needs of the country.

The new joint US-China Clean Energy Research Centres (CERCs) will look at a range of measures including monitoring and control systems, glazing materials, insulation, cool roofs and lighting. It will also build a test centre in China to evaluate new technologies and systems.

The Minister of Environment in South Korea will lay the groundwork for enhancing national efforts for reducing greenhouse gas emissions to lead sustainable development at a global level and drive a full-fledged environmental cooperation project to improve the environment of South Korea.

Japanese companies heavily invest in all Smart Grid technologies have inter-country collaborations (e.g. US-Japan) and target worldwide markets e.g. China, US etc. Japan will consider the use of smart grid technologies as it forms a new energy policy following the nuclear crisis in Fukushima prefecture. In recent years the country has invested significantly in its transmission infrastructure, which is operating with very high reliability levels, and is now focusing on its distribution networks.

Australia, Japan and USA have developed National R&D Programmes on ICT for the energy efficiency in buildings; however the classification into the specific thematic areas where the National Programmes focus on has not been possible.

Research in Australia is led by Higher Education Providers (mostly universities) which are funded for their own projects. Most of the funding is assigned to projects related to training of scientists, their exchanges with other countries and increase their competency. There are three levels of thematic research priority. At the broadest and least directive level there are national research priorities. Second, from time to time the Commonwealth Government seeks proposals for research (e.g. Centres of Excellence) in specific areas.

The National ICT Centre of Excellence (NICTA) and the National Stem Cell Research Centre, were established on this basis. Third, within the Rural Industry R&D Corporations (RIRDCs) and the National Health and Medical Research Council(NHMRC) there are varying degrees of priority setting or invitations for proposals in association with specific objectives.

6 Conclusions

The report provides an update to March 2012 of the State-of-the-Art on ICT for Energy Efficient Buildings both at Scientific and Industrial Level and an update of the European RTD Projects and Research Frameworks focusing on ICT for Energy Efficiency in Buildings. The projects have been analysed at National level in the EU-27 countries, in the European countries not belonging to EU-27 and in some non-European countries.

According to the work already performed in D1.2 *"Initial analysis of the state of the art"*, the first stage of our work has been focused on:

- the identification of significant scientific/technical papers/publications that clearly tackle the involvement of ICT for increasing Energy Efficiency in buildings;
- the update of Industrial State-of-the-Art, following as reference the five thematic areas defined in D1.1 *"Classified Research Areas".*

The second part of this document collects the relevant information retrieved about the available results from recently closed and ongoing projects within FP7 programmes (ENERGY, ENV, ICT, NPM, SME) and CIP programmes (ICT-PSP and IEE) related to the impact of ICT for Energy Efficiency in Buildings.

From the of the 78 identified projects, 62 projects belong to FP7 framework, and 16 to the CIP framework.

The analysis clearly shows how at both quantitative and qualitative level exists an homogeneous distribution of research activities that involve the five thematic areas, defined before in REEB [10] and then used in ICT4E2B Forum classification, without a predominant involved area.

For what concerns the analysis of RTD programmes, by respect to D.1.3, in this document we extended the analysis to European countries not belonging to EU-27 (Croatia, Russia, Serbia, Switzerland, Turkey) and we included in the analysis some additional non-European countries (Argentina, Canada, India, Israel, Malaysia, Mexico, Peru, Saudi Arabia, Arab Emirates). At the same time we updated the information on all countries already included in D1.3.

Many of the RTD programmes cover most of the terms of the ICT4E2B Forum classification. In particular it is important to highlight that the area *"Intelligent Control"* predominates at EU and non-EU27 level; this is consistent with REEB finding.
With the same level of coverage of this area, we identify the "*Integration Technologies"* area at National level and the *"Tools for EE Design and production management"* at International level.

"User awareness and decision support" is the second covered area both at EU27 National and non-EU27 level and the least covered area at International level.

Finally the thematic area *"Energy management and trading area"* is the least covered at National level and the second most covered one at International level. It is possible to highlight how *'Energy management and trading'* category is the least covered; it is possible to assume that in general Energy Management innovation is carried out by energy suppliers, utilities and service providers such as ESCOs, apparently without stressing the potential support that could be provided by ICT solutions.

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8 Appendix A – FP7 Energy Research Projects

ECOGRID EU

Project acronym, title, type	**ECOGRID EU - Large scale Smart Grids demonstration of real time market-based integration of DER and DR**				
Programme, topic	Large-scale demonstration of smart electricity distribution networks with distributed generation and active customer participation (ENERGY.2010.7.1-1)				
Duration	From 2011-03-01 to 2015-02-28 (48 months)				
Budget M€	20,7	**Funding M€**	10,3	**Person months**	n/a
Website(s)	www.ecogrid.eu				
Participants	- SINTEF ENERGI AS - OSTKRAFT HOLDING A/S - SIEMENS AS - DANMARKS TEKNISKE UNIVERSITET - FUNDACION TECNALIA RESEARCH & INNOVATION - EANDIS CVBA - LANDIS+GYR A/S - ÖSTERREICHISCHES FORSCHUNGS- UND PRÜFZENTRUM ARSENAL GES.M.B.H. - ENERGINET.DK - ENCT GMBH - IBM DANMARK APS - ELIA SYSTEM OPERATOR - TALLINNA TEHNIKAULIKOOL - EDP DISTRIBUICAO ENERGIA SA - STICHTING ENERGIEONDERZOEK CENTRUM NEDERLAND				
Summary	The key objective of the EcoGrid EU project is to demonstrate efficient operation of a distribution power system with high penetration of many and variable renewable energy resources. The demonstration will take place on the Danish island Bornholm with more than 50 % of electricity consumption from renewable energy production. A real-time market concept will be developed to give small end-users of electricity and distributed renewable energy sources new options (and potential economic benefits) for offering TSOs additional balancing and ancillary services. Strong industrial participation and innovative experiences from related European and US Smart Grids RD&D project will				

	contribute to the development and implementation of robust ICT platforms and information architectures. This is the key to allow all distributed energy resources to participate actively in the real-time power market. Of a total of 28 000 customers on Bornholm, at least 2600 residential consumers will participate with flexible demand response to real-time price signals. The participants will be equipped with residential demand response devices/appliances using gateways and smart controllers. Installation of the smart solutions will allow real-time prices to be presented to consumers and allow users to pre-program their automatic demand-response preferences, e.g. through different types of electricity price contracts. Automation and customer choice is one of the key elements in the EcoGrid EU concept. To make the EcoGrid EU solutions more widely applicable, the market concept will be designed for existing power exchange(s) and power regulation market(s). Because of the test site location on Bornholm, the real-time market concept will first be operational in the Nordic power market system. EcoGrid EU replication activities will ensure that the concept (or part of the solutions) can be adjusted and prepared for implementation in other power systems and regulatory conditions across Europe.
Main ICT related results	Development of a robust platform to optimize a power system with high penetration of many renewable energy sources focused on automation and customer choice: - intelligent management, - integration of renewable energy - balancing community supply and demand - smart solutions to present real-time prices to consumers and allow users to program demand-response preferences
Information sources used for this analysis	Project website and Cordis website
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	Automation and Control (2.1) of building installations, Monitoring (2.2) of energy usage
	3. User awareness and decision support
	Visualization of energy use (3.2)
	4. Energy management and trading
	Building and District Energy Management (4.1) and Smart Grids (4.2)
	5. Integration technologies

	System Integration (5.3)

ECO-LIFE

Project acronym, title, type	**ECO-LIIFE -Sustainable zero carbon ECO-town developments improving quality of life across EU**				
Programme, topic	Concerto communities: the way to future (ENERGY.2008.8.4.1)				
Duration	2010-01-01 to 2015-12-31 (72 Months)				
Budget M€	21,67	**Funding M€**	12,25	**Person months**	n/a
Website(s)	http://www.ecolife-project.eu/				
Participants	- COWI A/S (Co-Ordinator), Denmark - VEKS I/S, Denmark - UAB Busto Ideja, Lithuania - Rockwool A/S, Denmark - University of Gent, Belgium - HoejeTaastrupFjernvarmea.m.b.a, Denmark - The Danish Technological Institute (DTI), Denmark - Birstonas Municipality, Lithuania - Housing and Urban Development Agency, Lithuania - 11City Design, Denmark - GoedkopeWoning, Belgium - Lithuania Builders Association, Lithuania - HøjeTaastrup Municipality, Denmark - DetGrønne Hus (The Green House), Denmark - Kortrijk Municipality, Belgium - Ecopower, Belgium - UAB BirstonoSiluma, Lithuania - Vilnius Gediminos Technical University, Lithuania - UAB COWI Baltic, Lithuania				

	- AVSC Group, Lithuania - APTUS ElektronikAb, Denmark - BURO II + VAS, Belgium - Palanga Municipality, Lithuania - evr-Architecten, Belgium
Summary	The objective of ECO-Life project is to establish a replicable planning & implementation approach and to demonstrate innovative and integrated energy concepts in supply and demand side in municipalities in LT, BE and DK to reach the goal of zero CO2. The local ECO-life projects are integrated in large climate action initiatives in the municipalities. The large number of demonstration activities is based on both the demand side (demonstration of ECO-buildings and rational use of energy) and the production side (demonstration of various renewable energy technologies). All demonstration projects are defined in a "Whole Community Approach" which means that all project initiatives are considered as integrated components. The aim is to ensure optimal interaction and balance of the energy demand and energy supply at all times. The project will use 100 % RES. Concerning RUE, LT is representing huge refurbishment potential in East Europe, BE focuses on social housing and DK represents the next level of energy efficiency. A Whole Town Design Approach is used in all three communities with focus on achieving goals at affordable costs and on developing new financing tools. The approach includes end-user involvement and dissemination. The DK Concerto experiences from Concerto III will be transferred to first Concerto projects in BE and LT. Furthermore the activities will be coordinated between the three communities to exploit and learn from each other across borders and traditions.
Main ICT related results	Key innovations of project includes: - Whole town design approach, including end-user involvement and dissemination; - smart metering & CEMS; - New ESCO scheme
Information sourced from	Project website and Cordis
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Design (1.1) for District design/Urban planning
	2. Intelligent control
	- Automation and Control (2.1) for system concepts, intelligent HVAC etc. - Monitoring (2.2) for smart metering
	3. User awareness and decision support
	Performance management (3.1) for recording performance information to support design for sustainable buildings and for audits

	and labelling
	4. Energy management and trading
	Smart Grids (4.2) for ICT and smart gird solutions
	5. Integration technologies
	Automation and control (3.2) for "ICT for micro-generation & storage systems" to integrate renewable energy.
	Unclassified recommendations
	- TABS (Thermo Active Building Systems) - Integrated use of a segmented underground seasonal energy storage - Bio-Fuel based mini-CHP units - PV-cells

PIME'S

Project acronym, title, type	**CONCERTO communities towards optimal thermal and electrical efficiency of buildings and districts, based on MICROGRIDS (PIME'S)**				
Programme, topic	CONCERTO communities: the way to the future (ENERGY.2008.8.4.1)				
Duration	2008-09-01 … 2011-08-31 (36 months)				
Budget M€	18,1	**Funding M€**	10,83	**Person months**	n/a
Website(s)	www.pimes.eu				
Participants	- ROGALAND FYLKESKOMMUNE (NORWAY) - METEOR MERNOKI TANACSADO ES SZOLGALTATO BETETI TARSASAG (HUNGARY) - SANDNES KOMMUNE (NORWAY) - INTERNATIONAL RESEARCH INSTITUTE OFSTAVANGER AS (NORWAY) - VAROSI SZOLGALTATO ZARTKORUEN MUKODO RESZVENYTARSASAG (HUNGARY) - DALE EIENDOMSUTVIKLING AS (NORWAY) - SZENTENDRE VAROS ONKORMANYZAT POLGARMESTERI HAVATAL (HUNGARY) - AYUNTAMIENTO DE VITORIA-GASTEIZ (SPAIN) - VIVIENDA Y SUELO DE EUSKADI, S.A. (SPAIN)				

	- ENTE VASCO DE LA ENERGIA (SPAIN) - STEINBEIS INNOVATION GGMBH (GERMANY) - EPITESUGYI MINOSEGELLENORZO INNOVACIOS KOEHASZNU TARSASAG (HUNGARY) - ACCIONA INFRAESTRUCTURAS S.A. (SPAIN) - FUNDACION LABEIN (SPAIN)
Summary	The overall objective of PIME'S consortium is characterized by the ambition of conceiving a global sustainable framework for the quality of life for the citizens of three communities, and so providing a good and verified model to be extended to future communities. The three communities are Salburua in Vitoria (Spain), Dale in Sandnes (Norway) and Szentendre in Szentendre (Hungary). The proposed approach focuses on economically improving energy efficiency and integrating and harnessing renewable energy sources, combined with adequate storage systems and intelligent management, in a continuous quest for economic profitability based on optimum power exchange with the grid.
Main ICT related results	Development of a long term platform focused on the issue of efficient use of the energy resources through: - intelligent management, - integration of renewable energy - adequate storage systems - balancing community supply and demand
Information sources used for this analysis	Project website
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Balancing community supply and demand
	2. Intelligent control
	Intelligent Energy management
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	- intelligent management, - integration of renewable energy, - adequate storage systems,

	- balancing community supply and demand.
	5. Integration technologies
	n/a

SCHOOOL OF THE FUTURE

Project acronym, title, type	**School of the Future – Towards Zero Emission with High Performance Indoor Environment**				
Programme, topic	Demonstration of Energy Efficiency through Retrofitting of Buildings (EeB-ENERGY.2010.8.1-2)				
Duration	60 months (01/02/2011 – 31/01/2016)				
Budget M€	4.97	**Funding M€**	3.47	**Person months**	136.5
Website(s)	www.school-of-the-future.eu				
Participants	- FRAUNHOFER INSTITUTE FOR BUILDING PHYSICS (FRAUNHOFER IBP, FRAUNHOFER-GESELLSCHAFT ZUR FÖRDERUNG DER ANGEWANDTEN FORSCHUNG), COORDINATOR (D) - LANDESHAUPTSTADT STUTTGART (D) - ENEA (AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE) (I) - COMUNE DI CESENA (I) - ALDES SPA (I) - CENERGIA ENERGY CONSULTANTS APS (DK) - AALBORG UNIVERSITET – SBI (DK) - BALLERUP KOMMUNE (DK) - SAINT-GOBAIN ISOVER A/S (DK) - SCHNEIDER ELECTRIC BUILDING DENMARK AS (DK) - SINTEF BYGGFORSK (N) - DRAMMEN EIENDOM KF (N) - GLASS OG FASADEFORENINGEN (N)				
Summary	'School of the Future' is a collaborative project within the 7th Framework Program of the European Union in the energy sector. It started in February 2011 and will run for 5 years. The aim of the «School of the Future» project is to design, demonstrate, evaluate and communicate shining examples of how to reach the future high performance building level. School buildings and				

	their primary users – pupils, the next generations – are in the focus of the project. Both, the energy and indoor environment performance of 4 demo buildings in 4 European countries and climates will be greatly improved due to holistic retrofit of the building envelope, the service systems, the integration of renewables and building management systems. The results and the accompanying research and dissemination efforts to support other actors dealing with building retrofits will lead to a multiplied impact on other schools and on the residential sector, since the pupils will act as communicators to their families. The user behaviour and the awareness of energy efficiency and indoor environment will be improved due to tailored training sessions. Zero emission buildings are a main goal in various country roadmaps for 2020. The demonstration buildings within the project may not completely reach this level as the aim of the call is cost efficiency and multiplication potential. The retrofit concepts will, however, result in buildings with far lower energy consumption than in regular retrofits with high indoor environment quality – thus leading the way towards zero emission. They can be considered as schools of the future. Results from national examples of zero emission schools will complete the information used for developing the deliverables such as guidelines, information tools, publications and a community at the EU BUILD UP portal. The project is based on close connection between demonstration, research and industry represented by the "design advice and evaluation group". The proposal idea was introduced at the E2B association brokerage event with high interest which results in a consortium including well-known partners from the building industry.

Main ICT related results	The School of the Future project will deliver the following project results during the working phase from February 2011 to January 2015:
	• A summary report of the available international knowledge concerning energy efficient school buildings and high indoor comfort
	• A database of the available international knowledge concerning energy efficient school buildings and high indoor comfort
	• A report on the result of the technology screening: Which retrofit technologies should be best applied at which type of school buildings in which climate
	• 4 retrofit guidelines for school buildings on the following topics:
	    o Indoor environmental quality in schools
	    o Retrofit of building construction elements
	    o Retrofit of building service systems
	    o Solution sets for zero emission/energy surplus schools
	• An information tool presenting the 4 demonstration buildings, a benchmarking system and a database with measured data from various school buildings
	• 4 retrofitted energy efficient school buildings with high indoor environment quality
	• A report of the design phase of the 4 school building retrofits
	• A building diary on the website

	• A report of the design, realisation, commissioning and monitoring of the 4 school building retrofits • A simple energy performance calculation tool for the use in school lectures • 3 sets of training material for pupils, teachers and care-takers • Various dissemination activities including publications such as conference papers, journal articles and an information and discussion platform on the portal BUILD UP (already available)	
Information sources used for this analysis	Public deliverables and publications will be available on the project website. Interested parties in further information or dates for the deliverables are urged to communicate with the coordinator. (Hans Erhorn, hans.erhorn@ibp.fraunhofer.de).	
Reference to ICT4E2B Classifi-cation	**1. Tools for EE design and Production management**	
	n/a	
	2. Intelligent Control	
	n/a	
	3. User awareness and Decision support	
	3.1.3 Performance metrics	
	4. Energy management and Trading	
	n/a	
	5. Integration Technologies	
	n/a	

9 Appendix B – FP7 Environment Research Projects

BRIDGE

Project acronym, title, type	**BRIDGE - sustainable uRbanplannIng Decision support accounting for urban mEtabolis**				
Programme, topic	Urban metabolism and resource optimisation in the urban fabric (ENV.2007.2.1.5.1)				
Duration	2008-12-01 to 2011-11-30 (36 Months)				
Budget M€	4,1	**Funding M€**	3,1	**Person months**	n/a
Website(s)	http://www.bridge-fp7.eu/				
Participants	- Foundation For Research and Technology Hellas (Co-ordinator), Greece - Wageningen University and Research - Alterra, The Netherlands - University of Helsinki, Finland - University of Basel, Switzerland - National and Kapodistrian University Of Athens, Greece - InstytutEkologiiTerenowUprzemyslowionych, Poland - Centro Euro-Mediterraneo Per I CambiamentiClimaticiS.c.a.r.l, Italy - ConsiglioNazionaleDelleRicerche, Italy - Technical University of Madrid, Spain - King's College London, United Kingdom - University Of Southampton, United Kingdom - Trinity College Dublin, Ireland - Meteo-France Centre National De RecherchesMeteorologiques, France - University of Aveiro, Portugal				
Summary	The BRIDGE project aims at bridging the gap between bio-physical sciences and urban planners by introducing innovative planning strategies for urban planning. The main objectives of the BRIDGE project is to provide the means to: define and quantitatively estimate energy, water, carbon and pollutants fluxes at local scale; quantitatively estimate the environmental impacts of the above components; translate the above environmental impacts to socioeconomic benefits; Support the development of sustainable planning strategies; Involve local and regional stakeholders in the project from the beginning; Support the implementation of EU policy on urban environment; Illustrate the economic advantages of accounting for environmental				

	issues on a routine basis in urban planning decisions. BRIDGE is a joint effort of 14 European Organizations aiming at incorporating sustainability aspects in urban planning processes, accounting for some well recognised relations between urban metabolism and urban structure.
Main ICT related results	- The approach entails the identification of sustainability objectives and indicators, which will be subsequently used for the assessment of planning alternatives in the Decision Support System (DSS). - Decision Support System (DSS) reflects the multidimensional nature of the urban metabolism, as operationalizedin comprehensive and transferable indicators easily understood by urban planners (end-users) and it has the potential to propose modifications on the metabolism of urban systems towards sustainability; The urban planning is based on spatial processes imposing the use of GIS in the DSS development for analysis, simulation, decision modelling and evolution; integration of multiple of online and offline models (physical flow modelling).
Information sources used for this analysis	Project website andCordis
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Design tools (1.1) and (1.3) for Urban/District modelling, design, planning simulation and urban analysis.
	2. Intelligent control
	Quality of Service (2.3) for emissions (including power) at level of neighbourhood and district energy systems.
	3. User awareness and decision support
	Performance analysis and evaluation (3.1) and Visualization of energy usage (3.2) by use of impact assessment and Multi Criteria Evaluation (MCE) modules (e.g. BRIDGE DSS framework of multiple modules to assess environmental and socio-economic components of urban metabolism).
	4. Energy management and trading
	n/a
	5. Integration technologies
	Knowledge sharing (5.4) for socio economic impact analysis to ensure ICT's viability at urban level.
	Unclassified recommendations
	- Urban level monitoring and controlling techniques by use of simulation software's can be introduced for realising sustainable neighbourhoods.

	- Protocol for Knowledge supply and knowledge needs for end users (BRIDGE- D2.2) - Role of ICT in balancing sustainability indicators at urban level such as Air quality, Carbon and pollutants, thermal discomfort, Indoor air quality, energy etc.

BUILDSMART

Project acronym, title, type	**BUILDSMART energy efficient solutions ready for the market**				
Programme, topic	Demonstration of very low energy new buildings (EeB.ENERGY.2011.8.1-1)				
Duration	2011-12-01 to 2015-08-31 (33 months)				
Budget M€	8,6	**Funding M€**	5,0	**Person months**	n/a
Website(s)	www.buildsmart.eu				
Participants	- MALMO STAD - SKANSKA SVERIGE AB - PEAB SVERIGE AB - FCC CONSTRUCCION SA - IKANO BOSTAD AB - FUNDACION TECNALIA RESEARCH & INNOVATION - WSP SVERIGE AB - BR ROTH FASTIGHETER AB - NCC AB - IVL SVENSKA MILJOEINSTITUTET AB - CITY OF DUBLIN ENERGY MANAGEMENT AGENCY LIMITED - EUSKO JAURLARITZA-GOBIERNO VASCO. - DUBLIN CITY COUNCIL				
Summary	The Objective of the Builtsmart-project is to demonstrate and mainstream innovative and cost effective techniques and methods for constructing very low energy buildings in various climates. Residential and non-residential new buildings in Sweden, Ireland and Spain will participate in the project. The total gross floor space of the buildings will be 81 300 m^2.				

	New forms of incentives will be developed and implemented to increase the involvement of the inhabitants where the inhabitants can actually benefit from lower energy costs and a better environment. The systematic monitoring and performance evaluation in all the included buildings makes it possible to compare the effect of different energy saving techniques on different locations. Demonstrated buildings are good large scale example and will act as important showcases for future building norms in the various countries and with considerable replication potential in the measures undertaken and the techniques used. The included large scale demonstration buildings are characterized by the following innovative techniques: - Energy efficient building envelopes with high air tightness and low energy losses. - Energy efficient installations creating a minimized energy use. - Techniques for minimizing the cooling need such as efficient windows and shading equipment. - Close connections to surrounding infrastructures as energy systems optimizing energy use and reducing peak loads for both heating and cooling. - Waste management system created for maximum recycling and energy recovery. Including how to treat the biological waste fraction. All actions implemented will be analysed out of a system perspective, where the whole energy system is included, thus calculation the primary energy need for different technology choices as well as it/s life cycle costs. Building Information Modelling (BIM) as an innovative ICT tool in will be used for generating and managing data during life cycles of participating buildings.
Main ICT related results	- Energy performance calculation of the building through ICT tools - Innovative BIM ICT platform to manage data during the building lifecycle - Development of ICT tools and techniques for intelligent control and monitoring of the energy consumption of the building
Information sources used for this analysis	Project website and Cordis website
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Design tools (1.1) , Building and District information modelling (1.3) , Performance estimation (1.4)
	2. Intelligent control
	Automation and Control (2.1) of building installations, Monitoring (2.2) of energy usage
	3. User awareness and decision support
	n/a
	4. Energy management and trading

	Smart Grids (4.2) to connect the building to surrounding infrastructures as energy systems
	5. Integration technologies
	n/a

CETIEB

Project acronym, title, type	**CETIEB - Cost-Effective Tools for Better Indoor Environment in Retrofitted Energy Efficient Buildings**				
Programme, topic	Technologies for ensuring, monitoring and/or controlling a high quality indoor (EeB.ENV.2011.3.1.5-1)				
Duration	2011-10-01 to 2014-09-30 (36 months)				
Budget M€	3.46	**Funding M€**	2.5	**Person months**	
Website(s)	n/a				
Participants	- R.E.D. SRL, ITALY - DELAP & WALLER ECOCO LIMITED, IRELAND - CONSORZIO PER LO SVILUPPO E IL TRASFERIMENTO DI TECNOLOGIE E PER LA REALIZZAZIONE DI SERVIZI NEL SETTOREDEL RECUPERO EDILIZIO, ITALY - INFRATEC GMBH INFRAROTSENSORIK UND MESSTECHNIK, GERMANY - FCC CONSTRUCCION SA, SPAIN - SOLINTEL M&P SL, SPAIN - COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, FRANCE - STAM SRL, ITALY - SCHWENK PUTZTECHNIK GMBH & CO. KG, GERMANY - S&B INDUSTRIAL MINERALS MINING OUARRYING INDUSTRIAL COMMERCIAL TOURIST SHIPPING TECHNICAL COMPANY SA, GREECE - TTI-TECHNOLOGIE-TRANSFER-INITIATIVE GMBH, GERMANY - UNIVERSITA POLITECNICA DELLE MARCHE, ITALY - FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V, GERMANY				
Summary	The refurbishing to an energy efficient standard leads to tight buildings (whole envelope: windows, walls, etc.) and affects the indoor climate. In case of refurbishing the inhabitants or users are not adapted to this new situation. Therefore the air exchange				

	rates could be lower than required if no mechanical ventilation is installed or the system performance is not optimised. Then, in trying to increase the energy performance of buildings, the indoor environment quality is often degraded due to the lack of exchange with the outdoor environment. People in Europe spend more than 90 % of their time indoors (living, working, and transportation). In more than 40 % of the enclosed spaces, people suffer from health- and comfortable related complains and illness. Already in 1984 the WHO reported an increased frequency in buildings with indoor climate problems. The complexity of the problem and the fact of building related symptom clusters were later described as Sick Building Syndrome. The main objective of the project is to develop innovative solutions for better monitoring the indoor environment quality and to investigate active and passive systems for improving it. The focus lies on cost-effective solutions to ensure a wide application of the developed systems.
Main ICT related results	ICT results are expected in these main objectives: - Development of monitoring systems (wireless and/or partly wired) to detect insufficient comfort and health parameter. It is foreseen to develop a modular version for allowing normal end users making a quick check of the indoor air quality. - Development of control systems for indoor environments which could be based on passive elements like cost effective photo catalytic materials or PCMs and active systems which control the air flow rates based on the monitoring data. Modelling of indoor environments for the assessment and validation of monitoring data and to optimise with respect to energy efficiency the control parameters and systems.
Information sources used for this analysis	European Commission info on new projects
Reference to ICT4E2B Classification	**1. Tools for EE design and Production management**
	Smart house energy management
	2. Intelligent Control
	- Intelligent Energy control - Intelligent Monitoring - Development of Wireless Sensor networks
	3. User awareness and Decision support
	n/a
	4. Energy management and Trading
	n/a
	5. Integration Technologies

	Retrofiting buildings (cost-effective integration)

INTASENSE

Project acronym, title, type	**INTASENSE Integrated air quality sensor for energy efficient environment control**				
Programme, topic	Technologies for ensuring, monitoring and/or controlling a high quality indoor environment, particularly in relation to energy efficient buildings (EeB.ENV.2011.3.1.5-1)				
Duration	2011-10-01 to 2014-09-30 (36 months)				
Budget M€	3,4	**Funding M€**	2,5	**Person months**	n/a
Website(s)	www.intasense.eu				
Participants	- C-TECH INNOVATION LIMITED - ADVANTIC SISTEMAS Y SERVICIOS - LANCASTER UNIVERSITY - GOOCH & HOUSEGO (TORQUAY) LIMITED - CSEM CENTRE SUISSE D'ELECTRONIQUE ET DE MICROTECHNIQUE SA - RECHERCHE ET DEVELOPPEMENT - CENTRO DE ESTUDIOS E INVESTIGACIONES TECNICAS - TECHNISCHE UNIVERSITAET ILMENAU - U.C. TECHNOLOGIES BV				
Summary	Space heating accounts for more than 50% of the energy consumption of public & residential buildings, and reduction of this energy demand is a key strategy in the move to low energy/low carbon buildings. The careful management of air flow within a building forms part of this strategy through the control of inlet fresh air and exhaust air, maximising air re-circulation, and minimising the amount of fresh air which is often drawn in through a heat exchanger. However, there is a high risk that the air quality is reduced. Continued exposure to environments with poor air quality is a major public health concern in developed and developing countries. It is estimated that the pollutants responsible for poor air quality cause nearly 2.5 million premature deaths per year world-wide. Significantly, around 1.5 million of these deaths are due to polluted indoor air, and it is suggested that poor indoor air quality may pose a significant health risk to more than half of the world's population. Perhaps surprisingly, remedial action to improve air quality is often easy to implement. Relatively simple measures such as increased air flow through ventilation systems, or a greater proportion of fresh air to re-circulating air are sufficient to improve air quality. Low-energy air purification and detoxification technologies are available which will reduce the concentration of specific pollutants. Similarly, filtration systems (e.g. electrostatic filters) can be switched in to reduce the level of the particulate matter in the air (the principle pollutant responsible for poor health). The INTASENSE concept is to integrate a number of micro- and nano-sensing technologies onto a common				

	detection platform with shared air-handling and pre-conditioning infrastructure to produce a low-cost miniaturised system that can comprehensively measure air quality, and identify the nature and form of pollutants. INTASENSE is a 3-year project which brings together 8 organisations from 5 countries.	
Main ICT related results	- Development of a common detection platform by integrating a number of micro/nano sensing technologies to produce a low-cost miniaturised system that can measure air quality and identify pollutants	
Information sources used for this analysis	Project website and Cordis website	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**	
	n/a	
	2. Intelligent control	
	Monitoring of air quality and Automation and Control (2.1) of HVAC systems to support the efficient use of heating	
	3. User awareness and decision support	
	n/a	
	4. Energy management and trading	
	n/a	
	5. Integration technologies	
	System integration (5.2)	

10 Appendix C – FP7 ICT Research Projects

AIM

Project acronym, title, type	**AIM - A novel architecture for modelling, virtualising and managing the energy consumption of household appliances**				
Programme, topic	ICT for environmental management and energy efficiency (ICT-2007.6.3)				
Duration	2008-06-01 to 2010-05-31 (24 months)				
Budget M€	4,39	**Funding M€**	2,61	**Person months**	n/a
Website(s)	www.ict-aim.eu				
Participants	- EURESCOM-EUROPEAN INSTITUTE FOR RESEARCH AND STRATEGIC STUDIES IN TELECOMMUNICATIONS GMBH, (GERMANY) - DOEBELT WOLFGANG (GERMANY) - KELETRON EIDIKES ILEKTRONIKES EFARMOGES ETAIREIA PERIORISMENIS EFTHYNIS (GREECE) - INDESIT COMPANY S.P.A. (ITALY) - BLUECHIP TECHNOLOGIES AE (GREECE) - INFINEON TECHNOLOGIES AG (GERMANY) - POWER PLUS COMMUNICATIONS AG(GERMANY) - CEFRIEL - SOCIETA CONSORTILE A RESPONSABILITA LIMITATA (ITALY) - FRANCE TELECOM SA(FRANCE) - PHILIPS ELECTRONICS NEDERLAND B.V. (NETHERLANDS) - POLITECNICO DI MILANO (ITALY)				
Summary	AIM's main objective is to foster a harmonised technology for profiling and managing the energy consumption of appliances at home. AIM introduces energy monitoring and management mechanisms in the home network and will provide a proper service creation environment to serve virtualisation of energy consumption, with the final aim of offering users a number of standalone and operator services. Behind this goal, the main idea is to forge a generalised method for managing the power consumption of devices that are either powered on or in stand-by state. Especially for the second category of devices, the project will define intelligent mechanisms for stand-by state detection, using all-device-fit control interfaces.				
Main ICT related	- Design and implementation of logic for managing the energy consumption of home appliance intelligently, beyond the				

results	simple ON/OFF model - Design and implementation of a generic method for measuring energy consumption of appliances at home - Interfacing to the home network the energy consumption values of three household appliance types - Design and implementation of an energy resources virtualisation environment and appropriate semantics to be used for building energy management applications - Design and implementation of a methodology addressing energy management of active as well as stand-by appliances - Design and implementation of energy management applications targeting the usability requirements of three (3) user-groups: power distribution network operators, residential users and communication network operators - Enhancement of the ESTIA gateway architecture from a simple communication equipment to an energy-aware management system, with the addition of logic for autonomous energy consumption monitoring and control - installation of the AIM appliances and platform in real households, of the efficiency of the AIM architecture to reduce energy waste in households
Information sources used for this analysis	Project website and project deliverables
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Energy resource virtualisation and semantics for building energy management tools
	2. Intelligent control
	Intelligent devices for energy management
	3. User awareness and decision support
	- Online energy monitoring - Online energy management - Online user rules
	4. Energy management and trading
	- intelligent residential energy management - a Gateway for energy management
	5. Integration technologies
	- Residential device integration

	- Embedded devices technologies

BEAMS

Project acronym, title, type	**BEAMS – Buildings Energy Advanced Management System**				
Programme, topic	ICT for energy-efficient buildings and spaces of public use (ICT-2011.6.4)				
Duration	2011-10-01 to 2014-03-31 (42 months)				
Budget M€	2,7	**Funding M€**	1,8	**Person months**	n/a
Website(s)	http://www.ict-beams.eu				
Participants	- ETRA INVESTIGACION Y DESARROLLO SA - FUNDACIO PRIVADA BARCELONA DIGITAL CENTRE TECNOLOGIC - SODEXO FACILITIES MANAGEMENT SA - UNIVERSITA DEL SALENTO - THALES ITALIA SPA - INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS - FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V				
Summary	BEAMS strategic goal is the development of an advanced, integrated management system which enables energy efficiency in buildings and special infrastructures from a holistic perspective (i.e. considering the indoors areas, the public spaces around the facility and the interaction of the overall compound with the grid and urban network outside it). The project will include an open interoperability gateway allowing the management of diverse, heterogeneous sources and loads, some of them typically present nowadays in spaces of public use (e.g. public lighting, ventilation, air conditioning), some others emergent and to be widespread over the next years (e.g. renewable sources, electric vehicles). These general goals translate into a set of spedific objectives: 1. Specification of requirements, use-cases and architectures. 2. Definition of common ontology, information modells and interfaces to facilitate deployment and adoption by end-user, operators, ESCOs, etc. 3. Inclusion of greening energy positive tools. 4. Development of a flexible open gateway to interact with ICT solutions from different vendors.				

	5. Design and Implementation of a FAcility Management Environment including: a. Smart Control Algorithm with learning capabilities. b. Decision Support and Simulation tool. c. Energy Efficiency Balanced Score Card. 6. Demonstration of the project results in two different pilot sites: a. The Stadium of the Football Club Barcelona in Spain. b. The campus of the University of Salento in Italy. 7. Evaluation and Assessment by means of a thorough methodology of the amount of energy and CO2 emissions saved through the deployment of BEAMS technology. The focus of BEAMS will not be so much to develop breakthrough technologies from scratch but to integrate different technologies so that their combined use leads to increased energy savings and CO2 reduction. This will allow having a rapid impact on the market, in the spirit of the European Economic Recovery Plan 2010-2013.
Main ICT related results	Developement of an advanced (smart, with learning capabilities), integrated (i.e. including or interoperating with the main ICT based legacy subsystems) management system which enables energy efficiency in buildings and special infrastructures from a holistic perspective
Information sources used for this analysis	Project website and Cordis
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	- Automation and control (2.1) - Monitoring (2.2) - Quality of Service (2.3) - WSNs(2.4)
	3. User awareness and decision support
	- Performance management (3.1) - Visualization of energy usage (3.2) - Behavioural change by real time pricing (3.3)
	4. Energy management and trading

	- Smart Grids (4.2)
	5. Integration technologies
	- System integration (5.2) - Interoperable standards (5.3)

BEAWARE

Project acronym, title, type	**BE AWARE - Boosting Energy Awareness with Adaptive Real-time Environments**				
Programme, topic	ICT for environmental management and energy efficiency (ICT-2007.6.3)				
Duration	2008-05-01 to 2011-04-30 (36 months)				
Budget M€	3,96	**Funding M€**	2,71	**Person months**	n/a
Website(s)	http://www.energyawareness.eu/beaware/				
Participants	- Helsinki University of Technology, HUT (Co-ordinator), Finland - Vattenfall Research and Development AB, Sweden - BaseNCorporationOy, Finland - The Interactive Institute, Energy Design Studio, Sweden - ENEL.si, Italy - Engineering –IngegneriaInformatica Spa, Italy - University of Pandova, Department of General Psychology (UNIPD), Italy - Intelligence for Environment & Security - IES Solutions Srl, Italy				
Summary	The research program in BeAware investigates the energy conservation behaviour from the users' perspective, to inform the prototype development as well as to advance the scientific knowledge of the psychological aspects of electricity consumption. At present, energy information flows are slow, aggregated, and hidden, being operated by a market lacking incentives and proper service models. The opaqueness discourages users to learn and apply conservation strategies in their everyday lives. However, novel ICT's offer opportunities for removing this bottleneck. In particular, ubiquitous interfaces combined with low-cost sensors support real-time information from energy networks and consumption, empowering users to learn and share conservation strategies. BeAware studies how ubiquitous information can turn users into active players by developing: (1) An open and capillary				

	infrastructure sensing wirelessly energy consumption at appliance level; (2) Ambient and mobile interaction to integrate energy use profiles into userseveryday life; (3) Value added service platforms and models where consumers can act on ubiquitous energy information while energy producers and other stakeholders gain new business opportunities.
Main ICT related results	The technology developed in the project will be set up in two different pilot sites.. In each site, studies will be carried in a home environment. The research approach is highly multidisciplinary and combines a variety of approaches in the area of user studies, user centred design and evaluation. Disciplines include cognitive science, social psychology, anthropology, and design. The user research approach will be a combination of qualitative and quantitative field studies and trials.
Information sources used for this analysis	Project website and Cordis
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	- Design (1.1) for performance management tools - Performance estimation (1.4) for simulation
	2. Intelligent control
	- Monitoring (2.2) for Instrumentation and smart metering - WSN (2.4) for hardware and network design
	3. User awareness and decision support
	- Performance management (3.1) for performance analysis and evaluation - Visualization of energy usage (3.2) for energy awareness tools and real time energy consumption.
	4. Energy management and trading
	n/a
	5. Integration technologies
	System integration (5.2) for development methods and tools

BEYWATCH

Project acronym, title, type	**BeyWatch - Building energy watcher**				
Programme, topic	ICT for environmental management and energy efficiency (ICT-2007.6.3)				
Duration	30 month				
Budget M€	5,01	**Funding M€**	2,87	**Person months**	n/a
Website(s)	http://www.beywatch.eu/				
Participants	- TelefonicaInvestigacion y Desarrollo SA - FAGOR ELECTRODOMESTICOS S. COOP. - ADVANTICA LIMITED - UNIVERSITA DEGLI STUDI DI PALERMO - ELECTRICITE DE FRANCE S.A. - GORENJE GOSPODINJSKI APARATI D.D. - SIGMA CONSULTANTS - SYNELIXIS LYSEIS PLIROFORIKIS AUTOMATISMOU & TILEPIKOINONION MONOPROSOPI EPE				
Summary	BeyWatch is a 30-month research project supported by the European Commission (DG Information Society and Media) aiming at ICT tools for environmental management and energy efficiency. BeyWatch will develop an energy-aware and user-centric solution, able to provide intelligent energy monitoring/control and power demand balancing at home/building &neighbourhood level. To reach its objectives, BeyWatch has undertaken the following: - Design ultra-low energy-consumption white-goods - Implement methods, techniques and services to reduce the power consumption in smart/green homes/blocks/neighbours by intelligent control of electrical devices - Generate hot water and electricity from renewable energy sources at building level, - Elaborate business plans and business support system (BSS) applications that will help the users and providers to reach beneficiary contracts - Motivate user's awareness, towards less CO2 emissions on the whole energy value chain (production, transportation,				

	distribution, supply) and cleaner environment.
Main ICT related results	- Design and prototype three ultra-low power consumption white-products - Specify applicable services and develop the interconnection methods, the machine-to-machine (M2M) interfaces and the primitive-based communication techniques to allow communication-level ubiquitous networking and applicability of offering advanced energy-management and control services, bundled with other "smart-home" and "smart-building" services - Design and develop the BeyWatch "Agent" platform. This will be an HGi based, sophisticated, yet low-cost monitoring/remote-control platform, integrating both an intelligent electricity metering device, a remote-managed appliances/white-goods controller and a communication module - Design and implement an intelligent user-oriented software “Agent” - Design and implement the BeyWatch "Supervisor" system. This will be an open and distributed system/platform for the management and control of energy consumption and power demand at a local/square or urban geographical level. - Optimize, prototype and integrate an innovative combined photovoltaic/solar (CPS) system - Study, analyse, evaluate and validate the results, as well as the conduction of case studies and business models for the wider adoption of the platform and the proposed services - Participate and contribute in standardization efforts, special guidelines and regulations for the monitoring and control of energy consumption and power demand, aiming at the suppression of peaks and smooth out of consumption.
Information sources used for this analysis	Project website and Cordis
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	n/a
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	D4.1 Monitoring & Control System Specification D3.4 Combined Photovoltaic/Solar prototype
	5. Integration technologies

	- D3.2 M2M Communication Interface - D4.3 Middleware adaptation & user preferences profiling mechanism

CAMPUS21

Project acronym, title, type	**CAMPUS21 – Control & Automation Management of Buildings & Public Spaces in 21st Century**				
Programme, topic	ICT for energy-efficient buildings and spaces of public use (EEB-ICT-2011.6.4)				
Duration	2011-09-01 to 2014-08-31 (36 months)				
Budget M€	3,9	**Funding M€**	2,4	**Person months**	n/a
Website(s)	None				
Participants	- UNIVERSITY COLLEGE CORK, NATIONAL UNIVERSITY OF IRELAND, CORK - KONINKLIJKE BAM GROEP NV - ELECTRICITY SUPPLY BOARD - FUNDACION CARTIF - UNITED TECHNOLOGIES RESEARCH CENTRE IRELAND, LIMITED - HSG ZANDER INTERNATIONAL GMBH - AYUNTAMIENTO DE VALLADOLID - NEC EUROPE LTD - TEMPERATURE LIMITED				
Summary	CAMPUS 21 focuses on the energy-efficient operation of public buildings and spaces. It brings together the expertise of national research centres from Germany (Telecommunications), Ireland (IT in AEC, Artificial Intelligence), Austria (Building Physics), and Spain (Information Technology); the management experience of Public Authorities and bundles this with the process expertise from multiple industry sectors, such as Construction & Facilities Management, Building Services Systems Manufacturers and Energy Providers. CAMPUS 21 develops, deploys, and tests a Hardware-Software-Platform for the integration of existing ICT-subsystems supporting energy, building, and security systems management. The key technological innovations of CAMPUS 21 are (i) integration concepts for energy management systems (WP3) including the related middleware components (WP4), (ii) methodologies for intelligent, optimised control of building services systems (WP5), and finally (iii) algorithms and tools to support load-balancing between renewable micro-generation, storage systems, and energy consuming devices in buildings and public				

	spaces (WP6). This is complemented by the development of key business elements, including: (iv) new business models for integrated energy management and the underpinning novel procurements schemes (WP1) and (v) the development of Performance Metrics and a holistic Evaluation Concept for Systems Integration (WP2). CAMPUS 21 uses existing demonstrators and living laboratories as a nucleus for up-scaling and expanding the project scope from single building to campus scale. Three sites are used for research and validation of energy and cost savings, a university campus, a multi-purpose sports arena and an indoor sports complex. Due to its cross-sector membership, CAMPUS 21 goes across the whole innovation chain. It contributes with ground-breaking innovation to the establishment of world-class infrastructures and the economic recovery plan of the European Union.
Main ICT related results	- Development of a platform for the integration of existing ICT-subsystems supporting energy, building, and security systems management. The key technological innovations of CAMPUS 21 are (i) - Integration concepts for energy management systems including the related middleware components (ii) - Methodologies for intelligent, optimised control of building services systems - Algorithms and tools to support load-balancing between renewable micro-generation, storage systems, and energy consuming devices in buildings and public spaces.
Information sources used for this analysis	Cordis website
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	- Automation and control (2.1) - Monitoring (2.2), - Quality of Service (2.3) - WSNs(2.4)
	3. User awareness and decision support
	- Performance management (3.1) - Visualization of energy usage (3.2)

	4. Energy management and trading
	- Smart Grids (4.2)
	5. Integration technologies
	- System integration (5.2) - Interoperable standards (5.3)

CASCADE

Project acronym, title, type	**CASCADE – ICT for Energy Efficient Airport**				
Programme, topic	ICT for energy-efficient buildings and spaces of public use (EeB-ICT-2011.6.4)				
Duration	01/10/2011 to 30/09/2014 (36 months)				
Budget M€	3,8	**Funding M€**	2,6	**Person months**	n/a
Website(s)	n/a				
Participants	- FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V, Germany - PSE AG, Germany - D'APPOLONIA SPA, Italy - NATIONAL UNIVERSITY OF IRELAND, GALWAY, Ireland - ENERIT LIMITED, Ireland - SENSUN MI ITALIA S.r.L., Italy - SOCIETA' PER AZION ESERCIZI AEROPORTUALI SEA SPA, Italy - INSTITUT MIHAJLO PUPIN, Serbia - AEROPORTI DI ROMA SPA, Italy				
Summary	CASCADE will develop facility-specific measurement-based energy action plan for airport energy managers underpinned by systematic Fault Detection Diagnosis (FDD) Methods. CASCADE will develop a framework and methodology to underpin the execution of customised ICT solutions building upon existing ICT infrastructure. A measurement framework and minimal data set will be established that control and benchmark equipment performance, optimise user behaviour, and match client specifications. FDD enables beyond the state of the art energy management because FDD can be used to detect problems in system design, equipment efficiency, and operational settings. CASCADE will enable transformation of FDD into actionable information by developing an energy action plan that links Actions-Actors-ISO Standards				

	through a web-based management portal. CASCADE will provide the European Commission with the opportunity to engage the European airport community on the topic of energy efficiency. Airports are politically visible and public hubs that connect Europe. ACI-Europe has committed its support to the proposal providing a direct exploitation channel to 400 of the 500 EU-27 airports. Furthermore, CASCADE embodies what E2B and the PPP is trying to do. It is industry shaped, politically visible, provides near term impact, creates jobs, and meaningfully addresses 20-20-20 targets. Airport managers are under considerable pressure to economise in energy management and need tools to provide adequate support. From CASCADE, they demand solutions that can integrate with existing ICT solutions installed at their facilities. From them, CASCADE can obtain access to their terminals, HVAC systems, renewable energy systems, co-generation plants, parking areas, maintenance hangers, security systems, etc. HVAC systems and CO2 reduction will receive special emphasis. CASCADE will target a 3 year return on investment and a 20% reduction of energy consumption and CO2 emissions.
Main ICT related results	n/a
Information sources used for this analysis	Document of Work
Reference to ICT4E2B Classification	**1. Tools for EE design and Production management**
	Smart house energy management
	2. Intelligent Control
	n/a
	3. User awareness and Decision support
	Data mining
	4. Energy management and Trading
	Optimisation of energy management system
	5. Integration Technologies
	Integrate FDD, standards (EN 16001/ ISO 50001) and energy management software Process integration

DEHEMS

Project acronym, title, type	**DEHEMS - Digital Environment Home Energy Management System**				
Programme, topic	ICT for environmental management and energy efficiency (ICT-2007.6.3)				
Duration	2008-06-01 to 2010-11-30 (30 Months)				
Budget M€	3,73	**Funding M€**	2,9	**Person months**	n/a
Website(s)	http://www.dehems.eu/				
Participants	- Manchester City Council (Co-ordinator), United Kingdom - Energy agency of Plovdiv Association, Bulgaria - Corinex Communication As, Slovakia - Ivanovo Municipality, Bulgaria - Hildebrand Technology Ltd., United Kingdom - Clicks and Links Ltd., United Kingdom - The Centre SA, Belgium - Technical University of Cluj-Napoca, Romania - Bristol City Council, United Kingdom - Birmingham City Council, United Kingdom - University Of Rousse, Bulgaria - Coventry University, United Kingdom - Institute e-Austria Timisoara, Romania - The University of Salford, United Kingdom				
Summary	DEHEMS aims to extend the current state of the art in intelligent meters, moving beyond energy "input" models that monitor the levels of energy being used to an "energy performance model" that also looks at the way in which the energy is used. It would bring together sensor data in areas such as household heat loss and appliance performance as well as energy usage monitoring to give real time information on emissions and the energy performance of appliances and services. It will enable changes to be made to those appliances/services remotely from the mobile phone or PC and provide specific energy efficiency recommendations, for the household. The impact would be to personalize action on climate change, and so help enable new policies such as Personal Carbon Allowances as well as supporting the move towards increased localized generation and distribution of energy. DEHEMS is a joint effort of 14 European organizations aiming at incorporating and regulating use of developed domestic smart metering technology. The project partnership includes mix of European local authorities, private sector and universities. The key stakeholder group includes consumers, energy retailers, electricity network operators and the metering industry.				
Main ICT related	- DEHEMS is approached to extend current state of the art in intelligent meters by developing and testing a home energy management system for the home market using Living Labs/innovation platform in 5 cities across Europe. It approaches				

results	Citizens and user group to validate the usability and acceptability by acting as key contributors. - The project aims to improve the current monitoring approach to levels of energy being used by households, with an overall aim of reducing CO2 emissions across Europe to develop an online energy dashboard projecting real-time energy usage in household as compared to the neighbourhood. - In addition, a key topic related to the project is to stimulate the "behavioural change" in Energy management. - DEHEMS monitors energy consumption of households in a municipality and store energy consumption data in a central database. Service oriented architecture device architecture (SODA) was applied by SOA standards with addition of Devices Profile for Web Servers (DPWS) for monitoring energy consumption. The knowledge base system accommodates knowledge expressed in rules, facts, and functions. In addition, it communicates with other components in the system in order to form an integrated semantic system platform
Information sources used for this analysis	Project website and Cordis
Reference to ICT4E2B Classification	**1. Tools for EE design and Production management**
	Design tools (1.1) for urban design/ district planning and performance management tools.
	2. Intelligent Control
	- Automation control (2.1) and - Monitoring (2.2) for smart metering to record and reporting energy consumption.
	3. User awareness and Decision support
	- Performance management (3.1) and - Visualization of energy use (3.2) for energy awareness tools for real time metering.
	4. Energy management and Trading
	- Building energy management system (4.1) and - Smart grids (4.2) for remote control systems and advanced metering infrastructure to support consumer awareness.
	5. Integration Technologies
	System integration (5.2) for connections (interoperable connections and protocol) and for integrated service platforms.

E4U

<table>
<tr><td>Project acronym, title, type</td><td colspan="6">E^4 U – Electronics enabling efficient energy usage</td></tr>
<tr><td>Programme, topic</td><td colspan="6">ICT for environmental management and energy efficiency (ICT-2007.6.3)</td></tr>
<tr><td>Duration</td><td colspan="6">2008.06.01 2009.11.30 (18 Months)</td></tr>
<tr><td>Budget M€</td><td>0,61</td><td>Funding M€</td><td>0,45</td><td>Person months</td><td colspan="2">60.6</td></tr>
<tr><td>Website(s)</td><td colspan="6">http://www.e4efficiency.eu/</td></tr>
<tr><td>Participants</td><td colspan="6">- EUTEMA TECHNOLOGY MANAGEMENT GMBH, Austria
- ECPE EUROPEAN CENTER FOR POWER ELECTRONICS E.V., Germany
- UNIVERSIDAD POLITECNICA DE MADRID, Spain
- UNIVERSITY COLLEGE CORK, NATIONAL UNIVERSITY OF IRELAND, CORK, Ireland</td></tr>
<tr><td>Summary</td><td colspan="6">E4U aims at fostering world-leadership in ICT enabled energy efficiency in the EU through accelerating research and development for energy-efficient ICT systems.
It will achieve this through the creation of a strategic research roadmap for power electronics in alignment with the national, EU, and international policy framework.
E4U will create impact through targeted interaction with the research community, leading European industry, and RTD policy makers at the national and European level. E4U will also advertise the benefits of power electronics and ICT for energy efficiency to the broad public.</td></tr>
<tr><td>Main ICT related results</td><td colspan="6">No ICT results are provided directly by this project that developed a strategic research roadmap for power electronics in alignment with the national, EU, and international policy framework.</td></tr>
<tr><td>Information sources used for this analysis</td><td colspan="6">Project website, Cordisand direct information from the project technical coordinator (EUTEMA)</td></tr>
<tr><td rowspan="7">Reference to ICT4E2B Classification</td><td colspan="6">1. Tools for EE design and production management</td></tr>
<tr><td colspan="6">n/a</td></tr>
<tr><td colspan="6">2. Intelligent control</td></tr>
<tr><td colspan="6">This thematic area is covered by the project roadmap</td></tr>
<tr><td colspan="6">3. User awareness and decision support</td></tr>
<tr><td colspan="6">n/a</td></tr>
<tr><td colspan="6">4. Energy management and trading</td></tr>
</table>

	This thematic area is covered by the project roadmap
	5. Integration technologies
	n/a

ENERGY WARDEN

Project acronym, title, type	**ENERGY WARDEN - Design and Real Time Energy Sourcing Decisions in Buildings**				
Programme, topic	ICT for Energy Efficiency (ICT-2007.6.3)				
Duration	2010.01.01 2013.12.31 (36 Months)				
Budget M€	4	**Funding M€**	2,7	**Person months**	406
Website(s)	http://www.energywarden.net/				
Participants	- CNE TECHNOLOGY, Cyprus - ACCIONA INFRAESTRUCTURAS S.A., Spain - APPLIED INDUSTRIAL TECHNOLOGIES, Greece - ASM CENTRUM BADAN I ANALIZ RYNKU SP. Z O O, Poland - BUILDING RESEARCH ESTABLISHMENT, UK - D'APPOLONIA, Italy - DAEDALUS INFORMATICS, Greece - FUNDACION FATRONIK, Spain - INSTITUT MIHAJLO PUPIN, Serbia				
Summary	The energy supply and sourcing decisions for new and existing building infrastructures is far from optimal. Many reasons contribute to this fact. Energy systems become obsolete, as energy technology advances and energy infrastructure diversifies. Just as an example, buildings, built twenty or thirty years ago, "knew" nothing of renewable sources, with several EU countries having small penetration of fuels common today such as natural gas. In addition, concepts as insulation, effective lighting, etc. were far less developed, if known at all. Energy supply and sourcing decisions are becoming exponentially more complex. Renewable energy is gaining momentum, while storage technologies are advancing rapidly beyond batteries and will soon include options such as phase changing materials, hydrogen-fuel cells, compressed air, super-capacitors, etc. Energy providers are increasing in number and in operational features, and may differ also as regards the source of their energy, i.e., some provide energy from thermal stations whereas others from				

	renewable sources. The incentives they provide may also largely differ. In addition, more and more buildings will be offered the possibility to store and use energy locally or to feed it in the network, normally under the rules set by the network provider, which again are bound to become complex as the energy provider has his own optimizations to perform. Performing these, literally delicate, shifts between storing, using and network feeding is of a clearly dynamic and real time nature. In the context of ENERGY WARDEN, "energy sourcing" includes a design decision as to what energy infrastructure should be deployed. This decision is due either at design or retrofit stage. More importantly, however, “energy sourcing” implies a real time, a “dynamic decision” controlling the balance between energy supply, storage, use and feed-to-the-network. The measurement and enhancement of the CO2 building footprint will also be supported both by the design as well as, far more predominantly, by this real time controller.
Main ICT related results	The three products of the project will be: - EW-SIMULATOR: A simulator and modelling tool, including dynamic models for energy producing, storing and using units that provide decision aid when designing or retrofitting energy infrastructures at the building domain. What is important to highlight even at this broad level of detail is that the simulator will be run in three timeframes; that of 4 days, month and year. This first timeframe will be driven by meteorological forecast data, which have a large level of confidence for this time-frame. Thus, at this simulation timeframe extremely accurate estimations will be possible. - EW-CONTROLLER: The real time controller will manage all in-situ energy modules and will define how network inflowing and locally produced energy is allocated between uses, stores, and possibilities to be fed back to the energy network. It will include a data collection module, low cost hardware including, primarily, wireless sensors and data loggers/ transmitters, which will be deployed at the building over a period of time and facilitate the collection of data, which will form the one foundation on which the sourcing decisions may be taken. Typical field parameters that may influence both design as well as real time energy sourcing decisions are sun intensity, wind speed, quality of the insulation (only design decision), energy use patterns, etc. It is emphasized that emerging wireless networks will be a key aspect of this data collection, as such systems are particularly important in the case of energy retrofit action, where wired sensors may be impossible or costly to install. Wireless data collection presents some significant advantages. In new buildings wireless sensors can be even buried in the building elements, with obvious aesthetic results. In retrofit cases, wiring can be extremely expensive. Wireless data collection is now becoming cost effective, whereas new possibilities for energy harvesting will increase, in the midterm, the economic benefit. Wireless technology (details on protocols to follow in later sections) is therefore a key technological aspect of ENERGY WARDEN. - EW-POLICY: A higher level functionality will support policy & conformance and emission trading, allowing to control the building performance, old and new, against existing policies or standards, including the EU directive on building energy as well as providing the capability to be used in emission trading calculations. Energy module performance against applying standards will also be feasible.
Information sources used for this analysis	Energy Warden deliverables: - D1.4 - Simulator Technical Specifications - D1.5 - Simulator Tool development

	- D2.3 - Controller Prototype development - D2.5 - Simulator / Controller Integration, Prototype development - D3.2 - Policy Interface Module, Prototype development
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	This thematic area is covered by the project
	2. Intelligent control
	This thematic area is covered by the project
	3. User awareness and decision support
	This thematic area is covered by the project
	4. Energy management and trading
	n/a
	5. Integration technologies
	n/a

EnerSIP

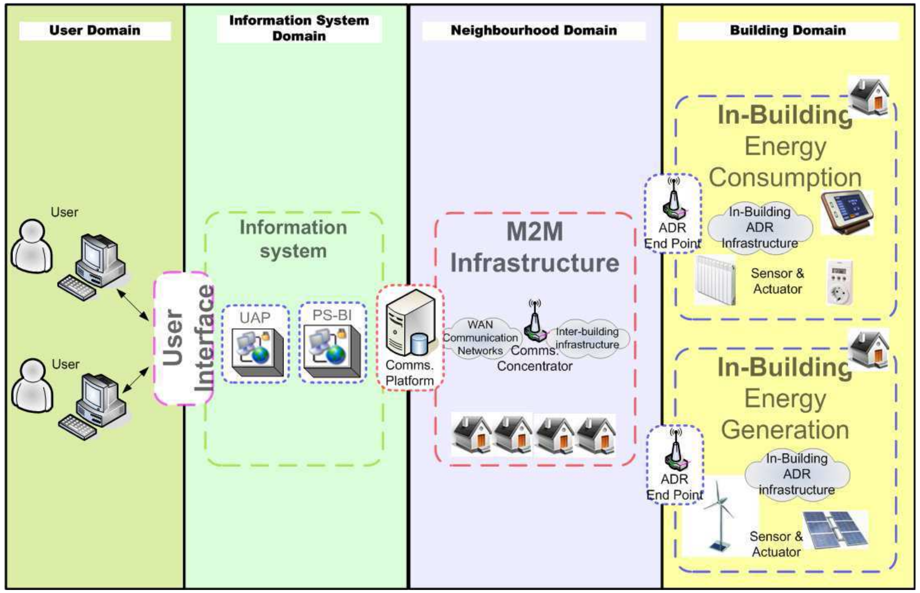
Project acronym, title, type	**EnerSIP- Energy Saving Information Platform for generation and consumption networks**				
Programme, topic	ICT for Energy Efficiency (ICT-2007.6.3)				
Duration	30 months				
Budget M€	6.3	**Funding M€**	3.99	**Person months**	n/a
Website(s)	http://www.enersip-project.eu				
Participants	- ESI-Tecnalia - AMPLIA - Motorola - ISA - Honeywell				

	- IEC - Automation and Control Applications, S. A. - University of Coimbra - VITO, the Flemish institute for technological research, - Israel Electric Corporation - Carlos III University of Madrid
Summary	To create an adaptive, intelligent and open service-oriented platform that allows end users to optimise, in near real-time, and to save energy by remotely monitoring, controlling and coordinating power generation and consumption in neighbourhoods with residential and commercial buildings. The main of ENERsip project is to create an adaptive, customizable and service-oriented energy monitoring and control system by active and proactively coordinating energy, communications, control, computing and construction for near real-time generation and consumption matching in residential, commercial buildings and neighbourhoods.
Main ICT related results	Building level: - Meter enhancements to discriminate power consumption in the different electrical appliances. - Methods, models and tools for local electricity generation simulation. - In-building communications infrastructure that implements short range wireless/wired networks like 6LoWPAN, Z-Wave, ZigBee, PLC, among others, to interconnect building sensors with the M2M infrastructure. - Sensors for in-house power consumption monitoring discriminating consumption in different rooms and electrical appliances. - General actuators that act on each appliance's power supply in the case of "dumb" devices (lamps, electrical heaters) or on its infrared port, in the case of "smarter" devices (TV, Hi-Fi, HVAC, Domotics). - ADR Endpoints will act as the routing of the external network into the building, both the in-house and the generation facilities. Neighbourhood level: - WAN communication infrastructure that combines Mobile Operator Networks (GPRS/UMTS) with ad-hoc public or non-public Networks (WiFi/WiMax Mesh Networks), whenever access to simple broadband is not available (ADSL or Cable). - Communications infrastructure that implements short/medium range wireless/wired networks like 6LoWPAN, Z-Wave, WiFi-Mesh or ZigBee to interconnect residential meters with WAN Networks. - Interfaces and APIs to integrate with M2M infrastructure, third party sensors & actuators for monitoring elements of the power distribution infrastructure, and also applications. - Communication Concentrators as intelligent elements of the infrastructure that will integrate the communication of several

	ADR Endpoints existing in the neighbourhood, being able to execute tasks delegated by the Information system to allow a reduction in the use of long range communications, and a distribution of the decision taking in the distribution of the energy. - Communications middleware Platform that implements basic functions such as reliable and robust data transport, device management (inventory, status monitoring, updating, presence, etc.), time synchronization, among others, making the communications network (WAN, LastMile, in-building) transparent to AMR/AMI applications. Information Systems platform and User Application level: - Application of the service-oriented approach to design the ENERsip platform enabling the provision of value added and customised services. The services will support an optimal configuration of in-house network of appliances, which will be adapted to users' needs, and contextual data such as calendar or weather conditions. - Security issues as confidentiality and privacy, providing embedding security.
Information sources used for this analysis	Project website and public deliverables of the project
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	n/a
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	n/a
	5. Integration technologies
	The ENERsip System Architecture is structured in four main domains: - Building Domain, where the entire infrastructure associated to smart building is located comprising consumption and/or generation. - Information System Domain, responsible for collecting all the data related with generation and consumption, processing

and allowing efficient use of available resources anytime.

- Neighbourhood Domain, based on M2M technologies to ensure data transmission between the Building and Information System domains.
- User Domain, which allows system-users (end-users, energy consumers, utilities, local energy-producers, etc.) to interact with the platform.



EnPROVE

Project acronym, title, type	**EnPROVE - Energy consumption prediction with building usagemeasurements for software-based decision support**				
Programme, topic	ICT for Energy Efficiency (ICT-2007.6.3)				
Duration	February 2010 – February 2013 (36 months)				
Budget M€	3,61	**Funding M€**	2,49	**Person months**	278.5

Website(s)	http://enprove.eu
Participants	- UNINOVA - University College Dublin - Philips Technologie GmbH - Centre Scientifique et Technique du Bâtiment - FundaciónLabein - G.E.M. Team Solutions - Mostostal Warszawa SA - GroupeArchimen
Summary	The objective of EnPROVE is to develop a software model for predicting the energy consumption of a specific building, with different scenarios implementing energy-efficient technologies and control solutions based on actual measured performance and usage data of the building itself. The key hypothesis of EnPROVE is that it is possible, from adequate gathering and assessing data on how a structure performs and is being used from an energy viewpoint, to build highly accurate and specific energy consumption models relevant for prediction of alternative scenarios. The EnPROVE software tools will assess the energy-efficiency impact of alternative technologies for which available investment resources can be directed and, thus, support the decision maker finding the optimized set of energy-efficient solutions to be implemented. These results will be tailored to the actual building itself, through automated measurements of the building usage and energy efficiency. Technological solutions will include energy-reducing, -generating, and –storing options, and with user-defined criteria on resources and restrictions, will identify through new prediction algorithms when the return on investment will be realized. By solving these problems, EnPROVE will be able to develop tools, interoperable with existing CAD or Facility Management tools, to model the energy consumption from monitored data, predict the performance of alternative scenarios and support the decision maker in finding the optimal point for the investment. Compared to current available energy auditing services and prediction tools, it is foreseen that EnPROVE will increase the cost-effectiveness of renovation investments by 15 to 30%
Main ICT related results	- Innovative, validated and marketable ICT-based solutions including sensor-based data monitoring, building data modelling, control strategies and optimisation technologies. - Integrating BEMS design tools into CAD software and strengthening position of European software developers. - Multi-criteria analysis to support the optimal choice of control systems
Information sources used for this	- Annex I – Description of Work of EnPROVE project - Personal communication with participant from Mostostal Warszawa

analysis	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	CAD tools will allow comparing and choosing the most energy efficient alternative while design process.
	2. Intelligent control
	Software tools for modelling the energy consumption from monitored data on infrastructure usage
	3. User awareness and decision support
	- Software tools for Supporting the decision making process, providing recommendation and installation plans, in compliance with existing CAD tools. - Prototype of decision support engine. - Research on artificial intelligence and decision-making methods and, where necessary, develop new techniques specifically to solve energy saving prediction and recommendations.
	4. Energy management and trading
	- Prototypes of energy consumption prediction engines. - EnPROVE tool can evaluate possible cost reduction scenarios through the installation of alternative energy-efficient control systems technologies.
	5. Integration technologies
	- Project will facilitate cheaper and a more energy efficient installation of control systems by providing energy prediction and decision making support for several parts of the structure. - EnPROVE will provide a sales tool for installation companies to predict customers' return on investment (ROI) for the market of existing buildings

FIEMSER

Project acronym, title, type	**FIEMSER – Friendly Intelligent Energy Management System for Existing Residential Buildings**				
Programme, topic	ICT for Energy Efficiency (ICT-2007.6.3)				
Duration	2010.02.01 2013.01.31 (36 Months)				
Budget M€	3,92	**Funding M€**	2,49	**Person months**	284.5

Website(s)	http://www.fiemser.eu/
Participants	- FUNDACION LABEIN CONSTRUCTION UNIT, Spain - TENESOL SA, France - ACCIONA INFRAESTRUCTURAS S.A., Spain - UNIVERSITY COLLEGE DUBLIN, NATIONAL UNIVERSITY OF IRELAND, DUBLIN, Ireland - FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V, Germany - PHILIPS CONSUMER LIFESTYLE B.V., Netherlands - THALES COMMUNICATIONS SA, France - CENTRE SCIENTIFIQUE ET TECHNIQUE DU BATIMENT, France
Summary	FIEMSER (Friendly Intelligent Energy Management System for Residential Building) addresses the need of achieving energy positive buildings through solutions based on a rational consumption of energy, local generation and an increase in the consciousness of the building owners towards their energy consumption habits. FIEMSER aims to achieve those goals in a short time span by aiming to the application of those automation measures to buildings in general (existing and new) and not only to new buildings, whose degree of automation can be quite advanced and its application less demanding. Then within the project a special relevance is given to existing buildings by investigating in solutions, like wireless connectivity based on IPv6, that reduce the expenses needed for the adaptation of the building to benefit from the use of energy efficiency measures. This approach takes into account that the life span of a building is around 50 years and that afterwards a minimum amount of money is usually devoted to its refurbishment.
Main ICT related results	As result of FIEMSER project, several potential products are expected, which could be exploited as an integrated energy management system for residential buildings, the FIEMSER platform, or each component as an independent product: - IPv6 Wireless control network: There is a huge potential to this type of communication networks, because in the near future, homes will be more intelligent and will require flexible and non-intrusive communication platforms that will have to be fully compatible with Internet. FIEMSER will also develop solutions for interoperability with existing control protocols like KNX, ModBus, or ZigBee. - Holistic home energy manager: Latest EU initiatives are evolving towards energy positive buildings in order to reduce C02 emissions and energy costs; building related legislation and building users are becoming more aware about this need. Consequently, a new generation of control systems will be required to coordinate the main energy demand systems in the building (HVAC and lighting) with the local generation (RES and CHPs (Combined Heat and Power). It includes the forecasting of energy demand, by taking into account not only the current building operation conditions but also its expected evolution, which depends on the weather forecast and the scheduled home usage profile. - Multimodal user interface: Increasingly, all services are becoming more supported by ICTs. The FIEMSER multimodal

	user interface will open these services to the typical ICT user (used to manage computers), to the mobile users (familiarized with PDAs, smartphones etc.) and also to the ICT "excluded users", as elderly people or technologically unskilled users, which are much more comfortable with the TV.
Information sources used for this analysis	Project website,Cordis, and direct information from the project technical coordinator (CSTB). FIEMSER deliverables: - D1 : Energy generation, consumption and storage in buildings (public) - D3: Technical Specifications (confidential) - D4 : System Architecture (public) - D5 : FIEMSER data model (public) - D7: User Interface Architectural Design (confidential).
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	Innovative Building Energy Management System (BEMS) for existing and new residential buildings that minimizes the energy demand from external resources, through the reduction of the energy consumption in the building and the correct management of local generation (heat and electricity) and energy storage equipment to satisfy the energy demand of the building, and even provide the capability to export energy to the utilities when needed.
	3. User awareness and decision support
	Interaction with the building user, in order to increase the consciousness of the consumer about his energy consumption.Providing hints to make punctual changes in his behaviour without major disruptions of his comfort conditions.
	4. Energy management and trading
	n/a
	5. Integration technologies
	OSGI-based architecture that has been designed in such a way that different control protocols (KNX, Zigbee, ModBus…) can be integrated through the development of the corresponding gateway.

GENESIs

Project acronym,	**GENESI – Green sEnsorNEtworks for Structural monItoring**

title, type					
Programme, topic	Engineering of Networked Monitoring and Control Systems (ICT-2009.3.5)				
Duration	2010.04.01 2013.03.31 (36 Months)				
Budget M€	3	**Funding M€**	2	**Person months**	n/a
Website(s)	http://genesi.di.uniroma1.it/				
Participants	- UNIVERSITA DEGLI STUDI DI ROMA LA SAPIENZA DIPARTIMENTO DI INFORMATICA, Italy - ST MICROELECTRONICS SRL, Italy - SOLEXPERTS AG, Switzerland - CONSORZIO TREESSE, Italy - ALMA MATER STUDIORUM-UNIVERSITA DI BOLOGNA, Italy - UNIVERSITEIT TWENTE, Netherlands - UNIVERSITY COLLEGE CORK, NATIONAL UNIVERSITY OF IRELAND, Ireland				
Summary	The GENESI project has the ambitious goal of bringing Wireless Sensor Node (WSN) technology to the level where it can provide the core of the next generation of systems for structural health monitoring that are long lasting, pervasive and totally distributed and autonomous. This goal requires embracing engineering and scientific challenges never successfully tackled before. Sensor nodes will be redesigned to overcome their current limitations, especially concerning energy storage and provisioning (we need devices with virtually infinite lifetime) and resilience to faults and interferences (for reliability and robustness). New software and protocols will be defined to fully take advantage of the new hardware, providing new paradigms for cross-layer interaction at all layers of the protocol stack and satisfying the requirements of a new concept of Quality of Service (QoS) that is application-driven, truly reflecting the end user perspective and expectations.				
Main ICT related results	- A new generation of GENESI wireless sensor nodes including multi-source energy harvesters, small factor fuel cells, and energy efficient RF front end with radio triggering capability. - Protocols and algorithms exploiting the new HW features, performing HW/SW joint optimizations to maximize user perceived satisfaction and to meet application driven QoS requirements.				
Information sources used for this analysis	Project website, Cordis, and direct information from the project technical coordinator (UNIVERSITA DEGLI STUDI DI ROMA LA SAPIENZA)				
Reference to ICT4E2B	**1. Tools for EE design and production management**				
	Development of new algorithm that aims to increase HW/SW performances of the system.				

Classification	**2. Intelligent control**
	- Development of a new generation of self-governing wireless sensor nodes. - Structural monitoring and control of intelligent infrastructure. - Use of renewable to provide power to the sensing system and the transmission network during the operation
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	New integrated system for fuel sell
	5. Integration technologies
	n/a

GreenerBuildings

Project acronym, title, type	**GreenerBuildings - An ubiquitous embedded systems framework for energy-aware buildings using activity and context knowledge**				
Programme, topic	Engineering of Networked Monitoring and Control Systems (ICT-2009.3.5)				
Duration	2010-09-01 to 2013-08-31 (36 months)				
Budget M€	2,56	**Funding M€**	1,85	**Person months**	281
Website(s)	http://www.greenerbuildings.eu				
Participants	- TU/Eindhoven, The Netherlands - University of Groningen, The Netherlands - La Sapienza University of Rome, Italy - CINI, Italy - Fluid Solutions Alternative, Italy - Advantic, Spain - Philips, The Netherlands - ITRI, Taiwan				

Summary	GreenerBuildings is an Information and Communication Technologies (ICT) project funded under the European Seventh Framework Programme (FP7) on Engineering of Networked Monitoring and Control Systems and Wireless Sensor Networks and Cooperating Objects. GreenerBuildings develops an integrated solution for energy-aware adaptation of public buildings. It investigates self-powered sensors and actuators, occupant activity and behaviour inference, and an embedded software for coordinating thousands of smart objects with the goals of energy saving and user support. GreenerBuildings embraces the following key principles in order to achieve its goals: living-lab experimentation and validation, an agile interdisciplinary consortium, and a user centric approach. In particular, the validation will consider test cases with at least 1000 networked devices deployed in living-lab buildings.
Main ICT related results	- Aggregating information to infer the context of the building and the activity performed by the users of the building and to coordinate then the various building elements based on the inferred activity and context information. - Exploitation of a serviceoriented model for the middleware, then initiating a cooperation task becomes a task of service composition.
Information sources used for this analysis	Project website, Cordis, and direct information from the project technical coordinator (Dr. Oliver Amft)
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	- 2.1 Automation & control - 2.4 Wireless sensor networks
	3. User awareness and decision support
	3.3 Behavioural change
	4. Energy management and trading
	n/a
	5. Integration technologies
	5.2 System integration

HOBNET

Project acronym, title, type	**HOBNET- HOlistic Platform Design for Smart Buildings of the Future InterNET**				
Programme, topic	Future Internet experimental facility and experimentally driven research (ICT-2009.1.6)				
Duration	36 month				
Budget M€	2,93	**Funding M€**	2,1	**Personmonths**	n/a
Website(s)	http://www.hobnet-project.eu				
Participants	- SENSINODE OY FINLAND - MANDAT INTERNATIONAL ALIAS FONDATION POUR LA COOPERATION INTERNATIONALE - UNIVERSITY COLLEGE DUBLIN, NATIONAL UNIVERSITY OF IRELAND - ERICSSON D.O.O FOR TELECOMMUNICATIONS - UNIVERSITE DE GENEVE - SWITZERLAND THE UNIVERSITY OF EDINBURGH				
Summary	The main objective of HOBNET is to ease and maximize the use of FIRE platforms by multidisciplinary developers of Future Internet applications focused on automation and energy efficiency for smart/green buildings. The project's research addresses algorithmic, networking and application development aspects of Future Internet systems of tiny embedded devices: a) an all IPv6/6LoWPAN infrastructure of buildings and how IPv6 can integrate heterogeneous technology (sensors, actuators, mobile devices etc.) b) 6lowApp and its standardization towards a new embedded application protocol for building automation c) novel algorithmic models and scalable solutions for energy efficiency and radiation-awareness, data dissemination, localization and mobility d) rapid development and integration of building management applications e) support for the deployment and monitoring of resulting applications on FIRE test beds. Key research innovations will be experimentally validated at an integrated platform of a large scale smart building proof of concept application, in two buildings of a UN related foundation in Geneva and two existing FIRE test-beds. The buildings will act as source of research challenges for smart services like energy optimization, control access, safety, audio/video provision and automatic control. Developed algorithms and technology solutions will be tested via deploying large numbers of diverse smart devices at the buildings and FIRE test-beds. These tests will also provide real data traces towards accurate models. A repository of implemented algorithms and a multipurpose building automation demonstration for connecting with external activities will be provided.				
Main ICT related results	- The design and evaluation of scalable all IPv6/6LoWPAN network architectures to support Future Internet services and applications, particularly for the smart/green building management domain. The creation of a simulation framework for networks of heterogeneous IP networks. The developments of an energy aware protocol stack enhancing existing				

	standards for wireless sensor networks. - To come up with a coherent set of novel models and implemented, tested and validated best algorithmic solutions and high level technical recommendations particularly for smart building scenarios, for problems including self-organizing network design and on-line topology management, energy and radiation awareness, routing around obstacles, localization/tracking and mobility management. - To develop a service oriented architecture easing the mutual integration of several control and monitoring systems, such as those developed by the HOBNET partners. To provide an interface layer between the building management system and FIRE experimentation platforms to be used for the rapid development and the evaluation of building management applications. The overall goal is to ease and maximize the utility of FIRE for the research and development of real building management systems (BMS). - To implement, integrate and evaluate a platform prototype including proposed research solutions and key innovations coming out of WP2, WP3 and WP4 on a FIRE experimental research facility deployed in UNIGE and RACTI. The findings of this FIRE evaluation will provide feedback to the relevant WPs towards improving the proposed research solutions in the next research/validation iteration. To also evaluate the results from FIRE facilities in an end-user environment deployed in the MANDAT building in Geneva. A broader research goal is to test the potential of IPv6 to deploy and integrate heterogeneous sensors, including non IP based sensors together with 6LoWPAN sensors, actuators and mobile devices. - To contribute to 6lowApp and its standardization towards a new embedded application protocol for building automation. To also develop a multipurpose building automation demonstration integrated into the project website and easily useable as part of demonstration activities and for connecting with external activities through an API. A broader research goal is to contribute to the vision of the Future Internet and building automation.	
Information sources used for this analysis	Project website	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**	
	n/a	
	2. Intelligent control	
	D4.1 Control Algorithms for Building Management	
	3. User awareness and decision support	
	n/a	
	4. Energy management and trading	
	n/a	

	5. Integration technologies
	- D5.2 Integrated platform - D4.2 Definition of a standard Ontology for Integration Support

ICT21EE

Project acronym, title, type	**ICT21EE – European ICT network for energy efficiency**				
Programme, topic	ICT for Energy Efficiency (ICT-2007.6.3)				
Duration	2008.10.01 2011.11.30 (30 Months)				
Budget M€	0,42	**Funding M€**	0,41	**Person months**	n/a
Website(s)	http://www.ict21ee.eu/				
Participants	- ASSOCIATION COMMUNICATION ET INFORMATION POUR LE DEVELOPPEMENT DURABLE, France - ASSOCIATION DES ACTEURS REGIONAUX DE L'ECONOMIE ET DE L'ENVIRONNEMENT, France - VILLES INTERNET ASSOCIATION, France - ENTE PER LE NUOVE TECHNOLOGIE, L'ENERGIA E L'AMBIENTE (ENEA), Italy - ENERGTSKA AGENCIJA ZA PODRAVJE (ENERGY AGENCY OF PODRAVJE), Slovenia - FILIALA INSTITUTUL DE CERCETARI SI MODERNIZARI ENERGETICE (ENERGY RESEARCH AND MODERNIZATION INSTITUTE), Romania - MOTION HELLAS, Greece - HELECTOR S.A., Greece - POUR LA SOLIDARITE POUR LA SOLIDARITE ASBL, Belgium - INSTITUT NATIONAL DE ENGENHARIA, TECHNOLOGIA E INOVAÇAO, Portugal - GLOBAL E-SUSTAINABILITY INITIATIVE, France - THE CENTRE SA, Belgium - AGENCE MONDIALE DE SOLIDARITE NUMERIQUE ASSOCIATION, France - AGENCE MONDIALE DE SOLIDARITE NUMERIQUE ASSOCIATION, Belgium - EUROPE ENVIRONNEMENT, France - EUROPEAN PARTNER FOR ENVIRONMENT, Belgium				

	- MANCHESTER CITY COUNCIL, United Kingdom
Summary	The overall objective of the ICT21-EE thematic network is to promote and achieve a reasoned use of Information and Communication Technologies (ICT) to enable enhanced energy efficiency in the multiple functions which constitute the complexity of urban areas – at home, in the workplace and in transport. By addressing urban issues related to energy savings, this project shall contribute to achieve the objective of the European Council to reduce by 20% the global EU energy consumption by 2020 as estimated by the Council in March 2007 on an Energy policy for Europe. The specific objectives of the thematic network are: - To contribute to the European Commission initiatives on “ICT for sustainable growth” by establishing working groups on three specific topics (ICT for energy efficiency in buildings, ICT for energy efficiency in transport and impact of ICT on user behaviours) thus following the priorities of the European Council of the 8/9 March 2007 and the EU/G8 energy efficiency conference of April 2007. - To participate to the definition of good practices and to contribute to the definition of a framework of norms and processes to be reproduced and disseminated at the European level - To gather initiatives – defined as good practices - involving ICT in a perspective of better use of energy implemented on different European territories and by public and private stakeholders and to promote them through a European online repository to be developed. Stakeholders from public and private sectors will participate to the network. As they come from ten European countries and gather more than 1000 towns/cities, 21 corporations, 43 regional and local organisations which implement, co-ordinate and facilitate energy and environment policies, from all over Europe, the objective to define strategies and to promote good practices and policy debate at the European level for the wider possible audience should be adequately met.
Main ICT related results	- An interactive social network that will be based on the EOINET platform from the EEA. - A good practice platform where case studies will be described and analysed in the most comprehensive way to favour replication - On-line, open and interoperable, multilingual – all contributions will be made available in English but partners will be invited to translate some parts of them -, user-friendly, coherent with the W3C specifications regarding accessibility, the resource centre will be seen as a WIKI tool.
Information sources used for this analysis	Project website and Cordis
Reference to	**1. Tools for EE design and production management**

ICT4E2B Classification	n/a
	2. Intelligent control
	n/a
	3. User awareness and decision support
	This thematic area is covered by the project
	4. Energy management and trading
	n/a
	5. Integration technologies
	This thematic area is covered by the project

INTUBE

Project acronym, title, type	**INTUBE - Intelligent Use of Buildings' Energy Information**				
Programme, topic	ICT for Energy Efficiency (ICT-2007.6.3)				
Duration	2008-05-01 to 2011-04-30 (36 Months)				
Budget M€	3.79	**Funding M€**	2.7	**Person months**	n/a
Website(s)	http://www.intube.eu/				
Participants	- VTT Technical Research Centre of Finland (Co-ordinator), Finland - Ariston Thermo Group, Italy - Pöyry Building SevicesOy, Finland - Nederland's Organisation for Applied Scientific Research (TNO), Netherlands - Ramon Llull University, Spain - University of Teesside, United Kingdom - University College Cork, National University of Ireland, Ireland - University of Stuttgart, Germany - Centre Scientific et Technique de Batiment (CSTB), France				

	- SINTEF Group, Norway - UniversitaPolitechnicaDelle Marche, Italy - Vabi Software, Netherlands
Summary	The objective is to use the existing building stock more efficiently with the help of the new tools and business models developed in IntUBE. The solutions will also be applicable to new buildings. IntUBE intends to increase life-cycle energy efficiency of buildings without compromising the comfort or performance of buildings by integrating the latest developments in ICT-field into Intelligent Building and Neighbourhood Management Systems (IBMS and NMS) and by presenting new ICT-enabled business models for energy-information related service provision. The results of IntUBE will benefit the owners, users, energy service providers, maintenance service providers, etc in form of well-performing buildings that uses natural resources (especially energy) optimally, resulting in less environmental effects and reduced life-cycle costs of energy. The IntUBE consortium consists of 11 partners from universities, research centres and companies from Southern to Northern Europe. The partners have established dissemination channels, and the SMEs of the consortium will be able to extensively exploit the results in their business.
Main ICT related results	- Development of tools for measuring and analysing building energy profiles based on user comfort needs for efficient solutions to use and manage the energy usage within the building throughout its life cycle. - Increased life-cycle energy efficiency of the buildings without compromising the comfort or performance of the buildings by integrating the latest developments in ICT-field into Intelligent Building and Neighbourhood Management Systems (IBMS and NMS) and by presenting new ICT-enabled business models for energy-information related service provision. - IBMS and NMS can be attached with varying form of intelligent metering, wireless sensors, Radio Frequency Identification (RFID), Near Field Communication (NFC), Automated Meter Reading (AMR) to n-Dimensional visualization and advanced user interfaces. An open platform developed in IntUBE will enable to integrate these technologies including mobile phones as user interface etc. Integrated simulation and real-time data capturing sensors for energy profiling of building and neighbourhood with local planning tool for early design phase. - Neighbourhood management will also include management of heat and electricity network for efficient integration of renewable energy sources to the distributed systems.
Information sources used for this analysis	Project website and Cordis
Reference to ICT4E2B Classification	**1. Tools for EE design and production management** - Design (1.1) for District/Urban planning and performance management tools - Performance estimation (1.4) for simulation, LCM costing and assessment

	2. Intelligent control
	- Automation and control (2.1) for system concepts, ICT for micro generation & storage systems for management of renewable sources. - Monitoring (2.2) for instrumentation and smart metering.
	3. User awareness and decision support
	- Performance management (3.1) for specifications, metrics, analysis and evaluation - Visualization of energy usage (3.2) for real time metering
	4. Energy management and trading
	- Building a prosumer (4.1) for BMS and EMS - Smart grids for energy network design and integration etc.
	5. Integration technologies
	- System Integration (5.2) for integration and service platforms for real time operation - Interoperable standards (5.3) for simulation and interoperability
	Unclassified recommendations
	- IntUBE D5.1 for business models and ICT tools in NMS, focused on district heating networks and "heat trading" concept - IntUBE D5.2 for dynamic energy monitoring and smart metering technologies.

IREEN

Project acronym, title, type	**IREEN: The ICT Roadmap for Energy-Efficient Neighbourhoods (CA)**				
Programme, topic	ICT for energy-efficient buildings and spaces of public use (EEB-ICT-2011.6.4)				
Duration	2011-09-01 to 2013-08-31 (24 months)				
Budget M€	1.46	**Funding M€**	1.00	**Person months**	94.5
Website(s)	http://www.ireenproject.eu/				
Participants	- MANCHESTER CITY COUNCIL (CO-ORDINATOR), UNITED KINGDOM				

	- CENTRE SCIENTIFIQUE ET TECHNIQUE DU BÂTIMENT (CSTB), FRANCE - VTT TECHNICAL RESEARCH CENTRE OF FINLAND - ATOS ORIGIN, SPAIN - ACCIONA INFRASTRUCTURES, SPAIN - AMSTERDAM, NETHERLANDS - D'APPOLONIA S.P.A., ITALY - AUSTRIAN INSTITUTE OF TECHNOLOGY (AIT), AUSTRIA
Summary	IREEN will deliver a comprehensive strategy (including the identification of drivers and gaps, future policies and operational support for their implementation, and the identification of new appropriate multi-disciplinary stakeholders value chain and partnerships) for European-scale innovation and take-up in the field of ICT for Energy Efficiency and performance in large areas including neighbourhoods and extended urban/rural communities. The implementation of this strategy will be further detailed by an innovation roadmap (linking and prioritizing all actions over the innovation life-cycle: RTD, experimentation and validation, transfer to market and deployment, and standardisation). Active engagement of a broad set of stakeholders from different disciplines (e.g. ICT, energy, construction, local authorities, building owners, facility managers, etc.) will facilitate validation of the outcomes of IREEN and act as catalysts for their implementation. The IREEN coordination action will be implemented through: • engaging European and other International experts and stakeholders in real and virtual hearings and collaborative workshops on the continuous elaboration and assessment of the innovation strategy and roadmap over the IREEN duration and beyond; these experts/stakeholders are expected to offer a full coverage of the entire value-chain, including: - the energy sector, including RES, energy providers and distributors, ESCOs etc., as well as new entrants to an open and diversifying market; - the ICT industry – appliance/equipment, infrastructure, software and advanced systems, - the Construction sector, including "urbanisers", built environment and process engineering specialists, - stakeholders from the demand side including local and regional authorities and NGOs; • supporting the Advisory group - ICT Infrastructure for energy-efficient buildings and neighbourhoods for carbon-neutral cities; • supporting the Smart Cities European Innovation Partnership; • the production and dissemination of results describing state-of-the-art (ICT-based) supply-side solutions and best practices, demand-side visions and scenarios, and step-by-step implementation recommendations that are both user-driven and business-oriented; • the assessment and validation of IREEN results (innovation strategy and roadmap) by relevant stakeholder communities, for prioritisation of research, experimentations and pilot projects, take-up and deployment in the market, and standardisation activities;

	The IREEN work programme will be developed within the overall context of the industrial and socio-economic trends and challenges Europe is facing in the current period. All relevant stakeholders brought together under the IREEN umbrella will contribute to extend the notion of energy-positive performance from homes and buildings to large areas including neighbourhoods and extended urban/rural communities in a holistic dimension.
Main ICT related results	• State of the art analysis on ICT-based innovation projects, large-scale pilots and supply-side ICT standards, methodologies & tools. • Use cases and scenarios, prioritized by stakeholders. • Roadmap for European-scale innovation and take-up (the main result).
Information sources	Document of Work and project web site.
Reference to ICT4E2B Classification	**1. Tools for EE design and Production management**
	n/a
	2. Intelligent control
	n/a
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	n/a
	5. Integration technologies
	n/a
	Other Information
	IREEN addresses all areas above with focus on neighbourhoods / districts. Only preliminary results of IREEN will be available within the timeframe of ICT 4 E2B FORUM project which ends in October 2012: • Feb 2012: State of the art analysis. • Apr 2012: Use cases and scenarios • Aug 2012: Priorities.

	• Aug 2012: Roadmap These can be used for the Updated research roadmap D2.4 (due in Aug 2012), especially in district / neighbourhood related topics.

ISES

Project acronym, title, type	**ISES - Intelligent Services for Energy-Efficient Design and Life Cycle Simulation (STREP)**				
Programme, topic	ICT systems for Energy Efficiency (ICT-2011.6.2)				
Duration	2011-12-01 to 2014-11-30 (36 months)				
Budget M€	4.41	**Funding M€**	2.96	**Person months**	n/a
Website(s)	http://cordis.europa.eu/fetch?CALLER=PROJ_EN&ACTION=D&DOC=26&CAT=PROJ&QUERY=01339a22f13f:9a75:26e7caf9&RCN=101478 http://tu-dresden.de/die_tu_dresden/fakultaeten/fakultaet_bauingenieurwesen/cib/forschung/ises/index_html/document_view?set_language=en				
Participants	- TECHNISCHE UNIVERSITAET DRESDEN, GERMANY - NYSKOPUNARMIDSTOD ISLANDS, ICELAND - SOFISTIK HELLAS AE, GREECE - TRIMO INZENIRING IN PROIZVODNJA MONTAZNIH OBJEKTOV, D.D., SLOVENIA - LEONHARDT ANDRA UND PARTNER BERATEN DE INGENIEURE VBI GMBH, GERMANY - INSINOORITOIMISTO OLOF GRANLUND OY, FINLAND - NATIONAL OBSERVATORY OF ATHENS, GREECE - UNIVERZA V LJUBLJANI, SLOVENIA				
Summary	The objective of ISES is to develop ICT building blocks to integrate, complement and empower existing tools for design and operation management (FM) to a Virtual Energy Lab. This will allow evaluating, simulating and optimizing the energy efficiency of products for built facilities and facility components in variations of real life scenarios before their realization, acknowledging the stochastic life-cycle nature. The focus of the prototype application domain is on buildings, factories and warehouses because in buildings about 40% of the				

	global energy is used and 30% of CO2 emissions and solid waste is created. There is a huge market for more energy-efficient design of new buildings and for refurbishing of the huge building stock through energy-efficient component products. The goal of the project is to increase, by an order of magnitude, the quality of energy-efficiency in design through the development of an In-Silico Energy Simulator Laboratory, based on an interoperable ontology-supported platform. The focus of RTD is on multi-model design and testing, stochastic lifecycle analysis/simulation in combination with new supporting ontology and interoperability tools and services, and respective re-engineering of existing tools, making them more intelligent and smartly interoperable. Further goals are the combination of energy profile models with product development STEP models and building and facility BIM models. The Virtual Energy Lab will be configured as an ontology-controlled SOA system with distributed services, distributed modelling and analysis/simulation tools and distributed data sources. This will allow concentrating the RTD work on ICT gaps, whereas existing, market-proof services, tools and data sources can be incorporated nearly development-free.
Main ICT related results	Virtual Energy Lab, an ontology-controlled SOA system with distributed services: modelling tools, analysis & simulation tools and data sources.
Information sources	CORDIS
Reference to ICT4E2B Classification	**1. Tools for EE design and Production management**
	The Virtual Energy Lab (= ICT platform + tools) integrates several existing tools for design (1.1), modelling (1.3) and analysis/simulation (1.4) into a service. This could be included in a design scenario and/or roadmap as a medium term step.
	2. Intelligent Control
	NA
	3. User awareness and Decision support
	The Virtual Energy Lab also includes tools for facility management (2.1, 2.2).
	4. Energy management and Trading
	NA
	5. Integration Technologies
	Integration (5.2) of design tools is based on e.g. STEP and BIM models (5.3). Integration of design and energy simulation tools could contribute to enhanced standards.

KNOHOLEM

<table>
<tr><td>Project acronym, title, type</td><td colspan="5">KNOHOLEM - Knowledge-based energy management for public buildings through holistic information modelling and 3D visualization.</td></tr>
<tr><td>Programme, topic</td><td colspan="5">ICT for energy-efficient buildings and spaces of public use (EEB-ICT-2011.6.4)</td></tr>
<tr><td>Duration</td><td colspan="5">2011-09-01 to 2014-08-31 (36 months)</td></tr>
<tr><td>Budget M€</td><td>4,47</td><td>Funding M€</td><td>3,2</td><td>Person months</td><td>n/a</td></tr>
<tr><td>Website(s)</td><td colspan="5">Not available yet</td></tr>
<tr><td>Participants</td><td colspan="5">- BUILDING RESEARCH ESTABLISHMENT LTD, UNITED KINGDOM
- CENTRO DI PROGETTAZIONE, DESIGN & TECNOLOGIE DEI MATERIALI
- KARLSRUHER INSTITUT FUER TECHNOLOGIE
- STICHTING HOGER BEROEPSONDERWIJN HAAGLANDEN EN RIJNSTREEK
- WONINGSTICHTING DE ZALIGHEIDEN
- FUNDACIO PRIVADA BARCELONA DIGITAL CENTRE TECNOLOGIC
- ISOTROL SA
- TERA SRL
- MATRIX SPA
- STEINBEIS INNOVATION GGMBH
- THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN
- CARDIFF UNIVERSITY
- STICHTING SMART HOMES</td></tr>
<tr><td>Summary</td><td colspan="5">The objective of the project is to elaborate an intelligent energy management solution for energy efficient buildings and spaces of public use. The solution will considerably reduce energy consumption, both by systematically avoiding energy wasting in buildings and by knowledge-based holistic optimization of energy consumption. It will be applicable and configurable for a broadband of building types from any EU region.

The intelligent energy management solution will be based on existing knowledge representation technologies like functional modelling and ontology, which will be used in the context of smart buildings in combination with Building Automation Systems. It will be enhanced by energy consumption behaviour simulation with realistic visualization assistance. Approaches previously developed by the project partners will be integrated into a holistic intelligent energy management solution.</td></tr>
</table>

	The focus of the project will not be on development, but on detailed analysis and validation. KnoholEM includes five demonstration objects in Spain and the Netherlands that will be used by the consortium of industry and research partners to develop, enhance and extensively test the solution. An overall knowledge base will be created through a detailed analysis of the structure of the demonstration object buildings and their energy consuming/producing devices, through the intelligent interlinking of building usage with its energy demand, as well as by various energy consumption behaviour simulations.
Main ICT related results	• intelligent energy management solution • reduced energy consumption in buildings • optimisation of energy usage • visualization assistance • validation of technologies
Information sources used for this analysis	Short summary on the EC website.
Reference to ICT4E2B Classification	**1. Tools for EE design and Production management**
	Information not available yet
	2. Intelligent Control
	Information not available yet
	3. User awareness and Decision support
	Information not available yet
	4. Energy management and Trading
	Information not available yet
	5. Integration Technologies
	Information not available yet

NICE

Project acronym, title, type	**NiCE – Networking intelligent Cities for Energy Efficiency**				
Programme, topic	ICT systems for Energy Efficiency (ICT-2011.6.2)				
Duration	2011-09-01 to 2014-02-28 (30 months)				
Budget M€	1.15	**Funding M€**	0.998	**Person months**	117.75
Website(s)	www.greendigitalcharter.eu				
Participants	o EUROCITIES (COORDINATOR, BE) o CLICKS AND LINKS LTD (UK) o MANCHESTER CITY COUNCIL (UK) o LEIBNIZ INSTITUTE OF ECOLOGICAL AND REGIONAL DEVELOPMENT (DE)				
Summary	NiCE will promote and advance implementation of the commitments of the Green Digital Charter (GDC). Promoted by EUROCITIES, the network of major European cities, and signed by currently 23 cities, the GDC commits signatories to exploit ICT as enabling technology for reducing CO2 emissions, to demonstrate leadership in adopting innovative technical solutions for delivering on climate change commitments; and to build partnership between the public and private sectors to use ICT as an enabler to significantly reduce energy consumption and CO2 emissions. It is structured into three building blocks: 1. Develop GDC Framework and Tools The project will develop a common framework, tools, and information resources for classifying, measuring, reporting and supporting city actions in the context of the Green Digital Charter and the Covenant of Mayors. 2. City Support and Action These framework and tools will be transferred to cities and their implementation partners through a series of targeted exchange and learning activities with experts and other signatory cities with a view to triggering implementation. A strategy for continued exploitation and support activities beyond the project's lifetime will be put in place. 3. Outreach and Engagement Networking and visibility events will be held to increase the number of signatories and showcase cooperation opportunities with key policy and practices communities, including a special focus on engaging with Chinese cities currently developing similar				

	initiatives.
Main ICT related results	o **Action Framework** The Green Digital Charter action framework will help GDC signatory cities to move from the objectives and declarations of intent contained in the charter towards concrete measures and actions by establishing a transferable framework for action and reporting in the field of ICT and Energy Efficiency. o **ICT Footprint reporting tools** This tool will represent a flexible technique which is complementary to existing methods that cities already use. It will draw on existing international standards (such as the GHG protocol , the Carbon Disclosure Project , as well as standards from international bodies such as ISO14064) to enable cities to measure, compare and report on ICT's direct carbon footprint at a city level. o **GDC implementation progress reporting tool** Based on the GDC action framework, these reporting tools will review existing methods for progress assessment and derive qualitative and, as far as possible, quantitative indicators for processes, outcomes and impacts, covering the commitments of the Charter to use ICT as enablers to reach energy efficiency. o **GDC-CoM reporting tool** This tool will allow integration of a specific strand on ICT-related actions into the Covenant of Mayor's (CoM) action planning and reporting process, enabling cities to highlight the ICT dimension of their efforts to reach the CoM commitments without creating an extra burden through separate processes.
Information sources used for this analysis	Document of Work
Reference to ICT4E2B Classification	**1. Tools for EE design and Production management**
	n/a
	2. Intelligent Control
	n/a
	3. User awareness and Decision support
	3.1.1 Understanding ICT impacts 3.1.4 Performance analysis and evaluation
	4. Energy management and Trading
	n/a
	5. Integration Technologies

	n/a

NOBEL

Project acronym, title, type	**NOBEL - Neighbourhood Oriented Brokerage ELectricity and monitoring system**				
Programme, topic	ICT for energy efficiency (ICT-2009.6.3)				
Duration	2010-02-01 … 2012-07-31 (30 months)				
Budget M€	2.92	**Funding M€**	1.89	**Personmonths**	n/a
Website(s)	http://www.ict-nobel.eu				
Participants	- ETRA I+D (SPAIN) - SUMINISTROS ESPECIALES ALGINETENSES COOP. V. (SPAIN) - SAP (GERMANY) - CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS (GREECE) - UNIVERSITAET DUISBURG-ESSEN (GERMANY) - SICS, SWEDISH INSTITUTE OF COMPUTER SCIENCE (SWEDEN)				
Summary	Distributed generation of energy coming from various vendors, even private homes, is a big challenge for tomorrows power management systems that, unlike today, will not dispatch energy centrally or under central control. On the contrary, the production, distribution and management of energy will be treated and optimized in a distributed manner using local data. Even today, parts of the power system are highly nonlinear with fast changing dynamics. It is hard to predict disturbances and undertake countermeasures on time. In existing approaches electricity is distributed to the final users according to its expected estimated demand. Such non-dynamic approaches, are difficult to evolve and cannot accommodate rapid changes in the system. By having a cross-layer and open information flow among the different actors involved we can make better and more timely predictions, and inject new dynamics in the system that will lead to better energy management and achieve better energy savings. The NOBEL project is building an energy brokerage system with which individual energy prosumers can communicate their energy needs directly to both large-scale and small-scale energy producers, thereby making energy use more efficient.				
Main ICT related results	- Development of Energy Efficiency concepts for neighbourhoods - Evaluation of local electricity markets for neighbourhoods				

	-	Exploitation of IPv6 technologies for smart metering and integration to enterprise systems
Information sources used for this analysis	Project website, public deliverablesand project partners.	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**	
	-	Neighbourhood energy management
	-	End-user involvement via mobile devices
	2. Intelligent control	
	-	Public Infrastructure Management (e.g. the Public lighting system)
	-	IPv6 enabled device management (via web services).
	3. User awareness and decision support	
	-	Enterprise services for monitoring
	-	User awareness via mobile services
	-	User-driven energy trading
	4. Energy management and trading	
	-	Trading of energy at neighbourhood
	-	Market concepts for microgrids
	-	Microgrid energy management
	5. Integration technologies	
	-	IP enabled devices
	-	Event driven infrastructure (publish/subscribe)
	-	Lightweight web services (REST)

PEBBLE

Project acronym, title, type	**PEBBLE – Positive-Energy Buildings through Better controLdEcisions**
Programme, topic	ICT for energy efficiency (ICT-2009.6.3)

Duration	36 months				
Budget M€	3,34	**Funding M€**	2,39	**Personmonths**	323
Website(s)	http://www.pebble-fp7.eu				
Participants	- Technical University of Crete (Coordinator, GR); - Fraunhofer-GesellschaftzurFörderung der AngewandtenForschunge.V.(DE); - Rheinisch-WestfälischeTechnischeHochschule Aachen (DE); - TechnischeUniversität Graz (AT); - Association pour la Recherche et le Développement des Methodes et ProcessusIndustriels - ARMINES (FR); - CSEM Centre Suisse d'Electronique et de Microtechnique SA - Recherche et Développement (CH); - SAIA-Burgess Controls AG (CH)				
Summary	In the design and operation of positive-energy buildings a pragmatic target is maximization of the actual net energy produced (NEP) by intelligently shaping demand to perform generation-consumption matching. To achieve this, informed decisions in (almost) real-time are required to operate building subsystems and to account for unpredictable user-behaviour, occupancy scheduling and occupants' activity and changing weather conditions. These decisions have direct consequences to occupant thermal comfort, energy efficiency and, ultimately, to the NEP. The complex interplay between the many parameters precludes empiricism or rule-based decisions and necessitates the development of generic decision tools. As maximization of the NEP for Positive-Energy Buildings is attained thru Better ControLdEcisions (PEBBLE), a control and optimization ICT methodology that combines model-based predictive control and cognitive-based adaptive optimization is proposed. There are three essential ingredients to the PEBBLE system: first, thermal simulation models, that are accurate representations of the building and its subsystems; second, sensors, actuators, and user interfaces to facilitate communication between the physical and simulation layers; and third, generic control and optimization tools that use the sensor inputs and the thermal models to take intelligent decisions. Building occupants have a dual sensor-actuator role in the PEBBLE framework: through user-interfaces humans act as sensors communicating their thermal comfort preferences to the PEBBLE system, and in return the PEBBLE system returns information with the goal of enhancing energy-awareness of the users Achieving the objectives of the PEBBLE Project requires advances beyond the state of the art in a number of areas: including use of thermal simulation modelling tools, control and optimization algorithms, performance evaluation procedures, and advances in sensing and actuation modalities.				
Main ICT related results	- Algorithms for automatically generating control strategies (BEMS) to optimize performance as measured through relevant performance indices. Depending on the cost function selected, the control algorithms are automatically generated for the particular problem. Approximately Optimal Model-Predictive methodologies along with Stochastic Optimizers are used for the control-design problem.				

	- Development of a hierarchy of thermal simulation models to be used for control design (efficient, able to capture relevant dynamics) and evaluation purposes (accurate, incorporate sensor measurements). The ability to include sensor measurements (e.g. as obtained through occupancy or contact sensors) to further improve predictions has been investigated. A simulation model calibration methodology for uncertainty mitigation using measured data is also in development. - Integration of wireless technologies, and development of a common interoperability framework for integrating simulations, control, actual sensor measurements and physical building implementation. This integrated approach allows for transparent communication and two-way interaction between the physical (building) and simulation (algorithms) layers. - Implementation (by the end of the 2011) and demonstration (in 2012) of the proposed system in three office buildings: in RWTH Aachen (DE), Fraunhofer,Kassel (DE), and Chania, Crete (GR).
Information sources used for this analysis	Project website and directly communications with Dr.Dimitrios V. Rovas, Technical University of Crete.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	- 2.1 Automation & control - Monitoring - 2.4 Wireless sensor networks
	3. User awareness and decision support
	3.3 Behavioural change
	4. Energy management and trading
	n/a
	5. Integration technologies
	5.2 System integration

POBICOS

Project acronym, title, type	**POBICOS - Platform for opportunistic behaviour in incompletely specified, heterogeneous object communities**				
Programme, topic	Network embedded and control systems (ICT-2007.3.7)				
Duration	2008-05-01 to 2011-04-30 (36 Months)				
Budget M€	3.19	**Funding M€**	2.3	**Person months**	n/a
Website(s)	http://www.ict-pobicos.eu/				
Participants	- VTT Technical Research Centre of Finland (Co-ordinator), Finland - Centre for Research& Technology-Thessaly, Greece - Centre for Renewable Energy Sources, Greece - Accenture Technology Labs, France - SAE- Automation, s.r.o, Slovakia - Warsaw University of Technology, Poland				
Summary	The POBICOS project targets communities of regular objects with embedded sense-compute-actuate nodes, found in homes and buildings. Such objects are inherently heterogeneous in terms of sensing, actuating and computing resources/capabilities. Moreover, the actual mix of objects available in different settings is practically n/a at the development time. The platform will include (a) appropriate middleware-based programming model and mechanisms, (b) an implementation of the middleware on embedded motes, and(c) application testing, deployment and monitoring tools. The major S&T objectives are: (a) ontology-driven, multi-resolution representations of sensor/actuator resources, (b) abstractions for physical node transparency, and (c) mechanisms for application deployment and monitoring, ensuring security and privacy. The domain of home automation and energy-efficient buildings will provide the context for application scenarios and system requirements. Core technology development is done by two research institutes and a university, all with extensive research and prototyping experience in the area of wireless embedded systems. Domain expertise for energy-efficient buildings is provided by a research institute that specialises exclusively in that area. Application development is led by an SME active in the area of embedded systems. Finally, dissemination and exploitation efforts are led by technology consulting company. The system prototype and applications will be deployed and tested in a special building featuring several sensing and actuating capabilities.				
Main ICT related results	- Design and developa programming model and supporting mechanisms for opportunistic pervasive computing. - Design and develop an ontology-driven approach for modelling and flexibly accessing resources for a given application domain - The implementation of a corresponding middleware on top of embedded wireless sensor/actuator nodes; The provision of suitable resource abstraction and domain-based customisation tools as well as application development, simulation and deployment tools The experimental validation of the middleware and tools for a selected application domain in the area of home				

	automation.
Information sources used for this analysis	Project website and Cordis
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Modelling (1.3) ontology for interoperability between heterogeneous systems and system engineering.
	2. Intelligent control
	Automation and Control (2.1) for system concepts, intelligent HVAC, smart lighting, predictive control and WSNs.
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	Building as a prosumer (4.1) for building energy management systems
	5. Integration technologies
	Interoperability & standards (5.3) protocols for real time operation data.

REEB

Project acronym, title, type	**REEB - The European Strategic Research Roadmap to ICT enabled Energy-Efficiency in Building and Construction**				
Programme, topic	ICT for environmental management and energy efficiency (ICT-2007.6.3)				
Duration	2008-05-01 to 2010-10-31 (30 Months)				
Budget M€	2,01	**Funding M€**	1,25	**Person months**	n/a
Website(s)	http://www.ict-reeb.eu/				
Participants	- Centre Scientifique et Technique du Batiment (CSTB) (Co-ordinator),France - VTT Technical Research Centre of Finland, Finland - FundacionTecnalia Research & Innovation, Spain - AccionaInfraestructuras (ACCIONA), Spain				

	- Technical University of Dresden, Germany - Arup Group Ltd. (ARUP), United Kingdom - Commissariat a l` EnergieAtomique (CEA), France - University College Cork (UCC), Ireland
Summary	The aim of the REEB project is to facilitate co-creation of a Strategic Research Agenda (SRA) and a supporting Implementation Activity Plan (IAP) for sustainable and energy-efficient smart building constructions by and through the establishment of and federation of dialogue between interactive and complimentary communities of practice from energy, environment, and building construction domains. REEB will establish a community operating method that will allow these communities to act as breeding and nurturing grounds for innovation in bringing together the relevant organisations and stakeholders for the purpose of starting up "innovation cycles in ICT-based environment management and energy efficiency" in smart building constructions. The main outcomes will be:- (i) A SRA and detailed IAP for R and D and innovation in ICT supporting energy-efficient smart facilities, (ii) A comprehensive coordination of information exchange and dissemination between energy-related ICT projects in various EU, national, and global programs/initiatives, in terms of on-going research, developed solutions, standardisation efforts, etc. This will include organising events and communication channels for identifying, defining, promoting and stimulating the innovative use of ICT in the Sustainability and Energy Efficiency area to reach the widest audience and bring together all stakeholders from the enlarged EU and relevant global communities. The REEB consortium involves 8 partners with complementary expertise drawn from 6 European countries (France, Finland, Spain, Ireland, UK and Germany). Moreover, the core partners, in their effort to build up the REEB community and develop the vision, roadmap and implementation plan, are supported by this Special Interest Group (SIG) whose members (both RTD and industry) will participate in community discussions and decisions, and provide active feedback to studies and analyses.
Main ICT related results	No ICT results are provided directly by this project that developed a strategic research roadmap on which is based ICT4E2B Forum
Information sources used for this analysis	Project website and Cordis
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	- Design (1.1) - Production management (1.2) - Modelling (1.3) - Performance Estimation (1.4)

	2. Intelligent control
	- Automation and control (2.1) - Monitoring (2.2), - Quality of Service (2.3) - WSNs(2.4)
	3. User awareness and decision support
	- Performance management (3.1) - Visualization of energy usage (3.2) - Behavioural change by real time pricing (3.3)
	4. Energy management and trading
	- Building a prosumer (4.1) - Smart Grids (4.2)
	5. Integration technologies
	- Collaboration support (5.1) - System integration; interoperable standards (5.3) - Knowledge sharing (5.4) - Virtualization of built environment (5.5)

REViSITE

Project acronym, title, type	**REViSITE -Roadmap Enabling Vision and Strategy for ICT-enables Energy Efficiency.**				
Programme, topic	ICT for energy efficiency (ICT-2009.6.3)				
Duration	2010-02-01 to 2012-01-31 (24 Months)				
Budget M€	1.82	**Funding M€**	1.25	**Person months**	n/a
Website(s)	http://www.revisite.eu/				
Participants	- Loughborough University (Co-ordinator), United Kingdom - VTT Technical Research Centre of Finland, Finland				

	- InnovaSpA, Italy - Fraunhofer- Institute for Production Systems and Design Technology IPK, Germany - Intel Performance Learning Solutions Limited, Ireland - Centre Scientifique et Technique du Batiment (CSTB), France - KEMA Consulting, The Netherlands
Summary	REViSITE will contribute to the formation of a European multidisciplinary 'ICT for energy-efficiency' research community by bringing together the ICT community and 4 important and complementary application sectors: grids, building/construction, manufacturing and lighting. The objectives of REViSITE are to: - Establish communication between sectoral ICT4EE communities in the 4 key industrial domains; - Develop causal model on the impacts of ICT on energy efficiency and apply this methodology for identifying high-impact RTD priorities; - Develop a cross-sectoral RTD roadmap by identifying and harmonising common topics; - Promote interoperability and standards; - Awareness raising. The consortium consists of 7 partners from 7 countries with wide geographic coverage of EU. Through dissemination and awareness-raising activities, REViSITE aims at creating the following impacts: Multidiciplinary European ICT4EE community; Rational selection of priorities for RTD on ICT4EE; European ICT4EE research agenda; Convergence of ICT standards across sectors; ICT4EE as a cross-discipline path in education and training.
Main ICT related results	No ICT results are provided directly by this project that developed a strategic research roadmapuseful toidentify complementarities between the four target sectors: grids, buildings, lighting and manufacturing in the area of ICT for energy efficiency (ICT4EE), harmonising common RTD priorities for ICT4EE in the four sectors, and establishing a cross-sectoral "community" with links to different industry sectors and related ETPs
Information sources used for this analysis	Project website and Cordis
Reference to ICT4E2B Classification	**1. Tools for EE design and Production management**
	- Design (1.1) for District design/ urban planning concepts - Production management (1.2) for logistics - Modelling (1.3)
	2. Intelligent Control
	- Automation and Control (2.1) for smart lighting, system concepts for LED technology with intelligent light management system and predictive control

	- Monitoring (2.2)
	3. User awareness and Decision support
	Performance management (3.1) for audits, labelling and performance specification
	4. Energy management and Trading
	- Smart Grids (4.2) for real-time self-assessment, load balancing techniques, energy network design and integration (data exchange), secure, ubiquitous and low-latency communications - Smart Grids (4.2) for demand response capabilities of renewable electricity generation and supply chain.
	5. Integration Technologies
	- System integration (5.2) - Knowledge sharing (5.4)

S4EEB

Project acronym, title, type	**S4EEB – Sounds for Energy-Efficient Buildings**				
Programme, topic	ICT for energy-efficient buildings and spaces of public use (EEB-ICT-2011.6.4)				
Duration	2011-10-01 to 2014-09-30 (36 months)				
Budget M€	3.96	**Funding M€**	2.67	**Person months**	n/a
Website(s)	http://www.s4eeb.org/				
Participants	- SOLINTEL M&P SL, SPAIN - CORIO, NETHERLAND - ÖSTERREICHISCHES FORSCHUNGS- UND PRÜFZENTRUM ARSENAL GES.M.B.H., AUSTRIA - SOCIETA PER AZIONI ESERCIZI AEROPORTUALI SEA SPA, ITALY - D'APPOLONIA, ITALY - FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V, GERMANY - IMMS INSTITUT FUER MIKROELEKTRONIK- UND MECHATRONIK-SYSTEME GGMBH, GERMANY				
Summary	S4EeB will develop and deliver a prototype to optimize the existent Building Management Systems (BMS) by means of acquiring, identifying, monitoring, and adding the parameter of occupancy level in buildings and surroundings to enhance operations and				

	eliminate unnecessary consumptions of energy for Heating, Ventilation, Air Conditioning, Lighting (HVACL), and other existent production and consumption systems, maintaining users comfort. This will be achieved through the integration of a low-cost novel network of audio sensors with other building sensing and controls and the improvement of the strategies and algorithms of automation and conditioning deployed, calibrated and validated in two shopping malls and one international airport in real operational situation in order to demonstrate that energy savings and benefits justify the investment, providing new market solutions and supporting reduction of climate change.	
Main ICT related results	n/a	
Information sources used for this analysis	Project website, document of work	
Reference to ICT4E2B Classifi-cation	**Tools for EE design and Production management**	
	n/a	
	2. Intelligent Control	
	Smart Metering Intelligent HVAC system	
	3. User awareness and Decision support	
	Quantify the EeB performance and analyze the effects of main influential factors and monitor the main factors of the performance for remote analysis and demonstration	
	4. Energy management and Trading	
	Optimize the energy management system models,	
	5. Integration Technologies	
	Design of a SoA-based interoperable platform	

Project acronym, title, type	**SEEDS – Self Learning Energy Efficient Buildings and open Spaces**				
Programme, topic	ICT for energy-efficient buildings and spaces of public use (EEB-ICT-2011.6.4)				
Duration	2011-09-01 to 2014-08-31				
Budget M€	4,1	**Funding M€**	2,9	**Person months**	n/a
Website(s)	None				
Participants	- CENTRO DE ESTUDIOS MATERIALES Y CONTROL DE OBRAS S.A. - SOFTWARE FOR CRITICAL SYSTEMS SL - NSC GMBH - UNIVERSITETET I STAVANGER - FASA AG HOCH TIEF UND INGENIEURBAU - THE UNIVERSITY OF SALFORD - FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V - FUNDACION CIDAUT - FERROVIAL AGROMAN SA				
Summary	This project develops a novel Self Learning Energy Efficient builDings and open Spaces (SEEDS) Facility Management system. The system will allow buildings to maintain user comfort whilse minimising energy consumption and CO2 emissions. SEEDS will develop an open architecture suitable both for retrofitting existing buildings and open spaces and for new building design. SEEDS will be based on research and scientific advances in wireless sensor technology, machine learning, and Bayesian networks, as well as standard statistical methods to enable the relationships between key variables to be continuously learned, facilitate prediction and enable control. SEEDS results will be validated in two pilots at opposite sites of Europe: i) part of a university campus (Stavanger, Norway) including several buildings and open spaces and ii) an office building plus parking area (Madrid, Spain). The Consortium includes organisations from the building, electronic and ICT and energy sector. The dissemination and active contribution to forums such as ICT4EB will assure the impact of the proposal.				

	The economical and environmental benefits of the project are: 1) Reduction of energy consumption and costs and CO_2 emissions; 2) Reduction of first adjustment and maintenance costs; 3) Maintenance of natural resources and reduction of generated waste.
Main ICT related results	- Development of an ICT system to allow buildings to maintain user comfort while minimising energy consumption - Development of an open architecture suitable both for retrofitting existing buildings and open spaces and for new building design based - Utilisation of latest advances in wireless sensor technology, machine learning, and Bayesian networks
Information sources used for this analysis	Cordis website
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	- Design (1.1) - Modelling (1.3) - Performance estimation (1.4)
	2. Intelligent control
	- Automation and control (2.1) - Monitoring (2.2) - Quality of Service (2.3) - WSNs(2.4)
	3. User awareness and decision support
	- Performance management (3.1) - Visualization of energy usage (3.2)
	4. Energy management and trading
	n/a
	5. Integration technologies
	- System integration (5.2) - Interoperable standards (5.3)

SmartCoDe

Project acronym, title, type	**SMARTCODE -Smart Control of Demand for Consumption and Supply to enable balanced, energy-positive buildings and neighbourhoods**				
Programme, topic	ICT for energy efficiency (ICT-2009.6.3)				
Duration	2010-01-01 … 2012-12-31 (36 months)				
Budget M€	3.32	**Funding M€**	2.3	**Person months**	n/a
Website(s)	https://www.fp7-smartcode.eu				
Participants	- EDACENTRUM GMBH (GERMANY) - TRIDONICATCO GMBH & CO KG (AUSTRIA) - UNIVERZITET U NOVOM SADU FAKULTET TEHNICKIH NAUKA (SERBIA) - ENNOVATIS GMBH (GERMANY) - QUIET REVOLUTION LTD (UNITED KINGDOM) - INFINEON TECHNOLOGIES AUSTRIA AG (AUSTRIA) - TECHNISCHE UNIVERSITAET WIEN (AUSTRIA) - ARDACO, A.S. (SLOVAKIA)				
Summary	Future buildings and neighbourhoods are expected to combine a manifold of Energy using Products ("EuP") ranging from electrical lighting to HVAC with locally available renewable energies (e.g. solar, wind) and with locally available storages (e.g. car batteries). An intelligent management of energy in such a local grid would enable customers to participate in the energy market and even contribute to the stability of the power grid. The problem is that such an energy management requires fine-grained infrastructure and expensive hardware. Today, this limits applicability of energy management to large consumers in the industrial and commercial sector. The objective of SmartCoDe is to enable the application of demand side management and smart metering in private and small commercial buildings and neighbourhoods by: - Developing new methods for automated energy management that specifically consider the requirements of Energy using Products in homes / offices and local renewable energy providers such as information security and dependability. - Developing an inexpensive (<3€) hardware/software implementation that can be integrated into arbitrary Energy using Products, providing them with the ability to communicate and to remotely control its use of power. - Demonstration of technical and economic feasibility and benefit of intelligent energy management in buildings and neighbourhoods with an initial focus on electric lighting. If successful, the project will allow all manufacturers of EuP to add energy management functionality (and maybe additional				

	features such as remote control, etc.) for very little additional cost, and thereby address a new and huge market in homes and offices. The local energy management will enable local entities to participate in the energy market as an intelligent, managed "sub-grid" that can – if necessary – even contribute to a demand side management and thereby reducing the required "spinning reserve".
Main ICT related results	Development of low cost hardware & software (<3€) useful to automate energy management for homes / offices
Information sources used for this analysis	Project website
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	- Combination of available infrastructure i.e. production, storage and consumption - A wind energy forecasting methodology
	2. Intelligent control
	- Intelligent Energy management - Cheap (<3€) HW to support intelligent energy monitoring and control
	3. User awareness and decision support
	User awareness via monitoring
	4. Energy management and trading
	- Intelligent local management enables participation to Energy Markets - A toolkit for modelling and analysing smart energy grids at various levels of abstraction
	5. Integration technologies
	Low cost HW/SW (open source specification and high-level architectural models of an integrated circuit)

SMARTHOUSE/SMARTGRID

Project acronym, title, type	**SmartHouse/SmartGrid**
Programme, topic	ICT for energy efficiency (ICT-2009.6.3)

Duration	2008-09-01 … 2011-08-31 (36 months)				
Budget M€	3.81	**Funding M€**	2.56	**Person months**	
Website(s)	http://www.smarthouse-smartgrid.eu				
Participants	- SAP (GERMANY) - PUBLIC POWER CORPORATION S.A. (GREECE) - INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS (GREECE) - STICHTING ENERGIEONDERZOEK CENTRUM NEDERLAND (NETHERLANDS) - FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG (GERMANY) - MVV ENERGIE AG (GERMANY)				
Summary	The SmartHouse/SmartGrid project sets out to validate and test how ICT-enabled collaborative technical-commercial aggregations of Smart Houses provide an essential step to achieve the needed radically higher levels of energy efficiency in Europe. Improving energy efficiency, increasing the penetration of renewable energies, and diversifying and decentralising Europe's energy mix - these are the three goals that the SmartHouse/SmartGrid project is heading towards. ICT will play a key role in the transformation of the electricity sector, enabling it to cope with more decentralized and renewable generation efficiently. The energy distribution of today only knows one direction from few centralised power plants to millions of users, while the energy distribution of the future will be closer to a community based model, with energy and information flowing from thousands of decentralised power systems to millions of users. The SmartHouse/SmartGrid concepts builds on available open industry standards from both ICT and energy worlds, and communication and computing capabilities that are already in widespread use in mainstream home and working environments On this basis, the project will define a roadmap to mass application. Only by considering the aggregated network level of smart houses managed by intelligent networked ICT for scale and flexibility, one is able to achieve the quantum leap in energy efficiency and sustainability that the EU's "20% by 2020" objectives call for.				
Main ICT related results	Development of a real-world trials of 3 different energy management concepts				
Information sources used for this analysis	Project website,Cordis and project partner				
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**				
	- SmartHouse Energy management				
	2. Intelligent control				

	- Intelligent Energy management via Energy Gateways - Integration with enterprise services
	3. User awareness and decision support
	- Enterprise services for monitoring - User awareness via monitoring
	4. Energy management and trading
	- Microgrid energy management - Price signals for device scheduling
	5. Integration technologies
	- IP enabled technologies - Middleware for device integration - Web services for enterprise integration

V-CITY

Project acronym, title, type	**V-CITY – The virtual city**				
Programme, topic	Digital libraries and technology-enhanced learning (ICT-2007.4.3)				
Duration	2008.12.01 2011.11.30 (36 Months)				
Budget M€	3,77	**Funding M€**	2,70	**Person months**	n/a
Website(s)	http://vcity.diginext.fr/				
Participants	- DIGINEXT SARL VIRTUAL REALITY DEPARTMENT, France - PROCEDURAL AG, Switzerland - BLOM COMPAGNIA GENERALE RIPRESEAEREE SPA, Italy - CONSIGLIO NAZIONALE DELLE RICERCHE, Italy - IMMERSION SAS, France				

	- CENTRO DI RICERCA, SVILUPPO E STUDI SUPERIORI IN SARDEGNA, Italy - KATHOLIEKE UNIVERSITEIT LEUVEN, Belgium
Summary	3D geo-informatics has entered the digital age, hesitantly in some areas, and rampantly in others. Google Earth and Microsoft Virtual Earth are household names. Although limited to landscapes and few buildings envelopes, their massive digital geographic libraries are today the playground of millions of people and the generator of new forms of content and applications with tremendous impact perspectives. However, these pale in comparison to those that will be made possible as soon as urban digital libraries will be fully available and exploitable. The focus of the project on urban environments is not only made possible by the latest technological advances of the consortium, but also highly justified. Urban environments represent one of the most important and valuable cultural heritage as acknowledged by the UNESCO. Therefore, the V-City project aims to research, develop and validate an innovative system integrating the latest advances in Computer Vision, 3D Modelling and Virtual Reality for the rapid and cost-effective reconstruction, visualisation and exploitation of complete, large-scale and interactive urban environments. This system will enable historians, architects or archaeologists to reconstruct from existing data, study, understand, preserve or document urban environments using an innovative interactive 3D user interface.
Main ICT related results	The V-City consortium provides the world-class and complementary competencies required to tackle the following scientific and technological challenges: - Processing of a new generation of geo-referenced images: multi-angle oblique pictures captured from the ground, with airborne systems operated by the consortium, or satellites. Filtering, perspective correction, tone homogenisation, and correlation of these images with other multi-source and multi-format geo-referenced data (LIDAR point clouds, cadastral data, DEMs…), extraction of building shapes and facade textures. - Automatic extraction of the topological and semantic information about the constructions (floors, doors, windows, style, shape of roof...). - Reconstructing complete cities using procedural rules derived from the extracted topological and semantic information. - Implementing techniques for optimising, storing and visualising online large-scale geographic, architectural and environmental datasets in real-time, from global scale to building interiors. These techniques will also support non-Euclidian information, such as textual information, topological and semantic tags, or exogenous data enriching the environment. - Implementing new multi-user interaction metaphors to intuitively browse, manipulate and interact with the displayed 3D urban datasets. This encompasses the research and development of a new kind of device, the interactive 3D map table, featuring a multi-touch multi-user table used to display and interact with the 3D reconstructed city.

<table>
<tr><td>Information sources used for this analysis</td><td>Project website, Cordis and direct information from the project technical coordinator (DIGINEXT)</td></tr>
<tr><td rowspan="10">Reference to ICT4E2B Classification</td><td>1. Tools for EE design and production management</td></tr>
<tr><td>- Development of intelligent 3D design tool.
- Exploitation of mock up of 3D
- Performance estimation: exists the possibility to tune the system for decrease the energy consumption in the city throw the use of dedicated parameterisation module
- Building modelling: use of desktop pc with high photographical capabilities</td></tr>
<tr><td>2. Intelligent control</td></tr>
<tr><td>n/a</td></tr>
<tr><td>3. User awareness and decision support</td></tr>
<tr><td>- HW for final user: intelligent touch table used to show to end user the results of design process and to avoid an easy interaction between end users. With this system it is possible to increase user awareness on which are the effective benefit of the design process.
- Dissemination of results in an attractive way</td></tr>
<tr><td>4. Energy management and trading</td></tr>
<tr><td>n/a</td></tr>
<tr><td>5. Integration technologies</td></tr>
<tr><td>n/a</td></tr>
</table>

11 Appendix D – FP7 NMP Research Projects

CLEAR UP

Project acronym, title, type	**CLEAR UP - Clean buildings along with resource efficiency enhancement using appropriate materials and technology**				
Programme, topic	Resource efficient and clean buildings (NMP-2007-4.0-5)				
Duration	48M				
Budget M€	12	**Funding M€**	8,3	**Person months**	1002
Website(s)	http://www.clear-up.eu				
Participants	- EberhardKarlsUniversitaetTuebingen (coordinator) - ACCIONA INMOBILIARIA, S.R.L. - Siemens Schweiz AG - C.T.G. SPA (Italcementi) - AppliedSensor GmbH - Porextherm-Daemmstoffe GmbH - DanmarksTekniskeUniversitet - Uppsala Universitet - Foundation for Research and Technology – Hellas - Saint Gobain Weber GmbH - European Commission, DG Joint Research Centre, Institute for Health and Consumer Protection - Steinbeis GmbH & Co KG fuerTechnologietransfer - Centre Scientifique et Technique du Batiment - Bouygues Construction - Centre Scientifique et Technique de la Construction (BBRI) - Siemens AG - BUDAPESTI MUSZAKI ES GAZDASAGTUDOMANYI EGYETEM - CESKE VYSOKE UCENI TECHNIKE V PRAZE - Saint-Gobain Weber Terranovaa.s.				

Summary	Clear-up presents a holistic approach to the reducing operational energy use in buildings. By development and novel use of nano-materials it aims to increase energy performance in heating, ventilation, air conditioning (HVAC) and lighting systems, and to improve indoor air quality using catalytic purification. Clear-up's solutions are designed for retro-fitting existing buildings and of course for new constructions. It will achieve this by addressing four key components which control the indoor environment: - Windows. Clear-up will advance the practical use of shutters and electrochromic window foils which reduce the building cooling load and along with light-guide technology, reduce the need for artificial lighting. - Walls. Clear-up will use photo catalytic materials for air purification and nano-porous vacuum insulation in combination with phase change materials to passively control temperature. - Air Conditioning. Clear-up will advance technologies for demand controlled ventilation and improved air quality. - Sensors and control provide an underpinning technology for Clear-up's approach. New sensors will be developed, and their use optimised for the operation of smart windows; demand controlled ventilation and catalytic purification. Clear-up will develop, install, measure and evaluate technological solutions in the laboratory, in a large-scale testing facility and in real world applications. Its approach will be demonstrated at the UN Climate Summit in Copenhagen, 2009. The safety of new materials will be considered; it will propose inputs to standards and environmental product declarations for its technologies. Clear-up will also investigate environmental and economic lifecycles for components and systems. The practical issues of exploitation will be addressed in cooperation with industry bodies ECTP, ECCREDI and ENBRI providing access to large firms and SMEs.
Main ICT related results	*See below*
Information sources used for this analysis	Document of Work and public deliverables
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Multiphysics model for energy, lightning and indoor air pollution
	2. Intelligent control
	Demand Control ventilation

	3. User awareness and decision support
	Environmental product declaration, Life cycle assessment studies, Life cycle costing studies
	4. Energy management and trading
	Demand Control ventilation
	5. Integration technologies
	Environmental and cost assessment integration in performance assessment

COST-EFFECTIVE

Project acronym, title, type	**COST-EFFECTIVE – Resourceand CostEffective integration of renewable in existing high-rise buildings**				
Programme, topic	Resource efficient and clean buildings (NMP-2007-4.0-5)				
Duration	2008.10.01 2012.09.30 (48 Months)				
Budget M€	10,7	**Funding M€**	7,5	**Person months**	837.5
Website(s)	http://www.cost-effective-renewables.eu/				
Participants	- Fraunhofer-GesellschaftzurFörderung der angewandtenForschunge.V. (Fraunhofer ISE), De - PSE AG, DE - ACCIONA ENERGIA SOLAR, S.L., ES - AccionaInfraestructuras, ES - Electricité de France – SA, FR - AccionaInstalaciones, ES - PermasteelisaS.p.a, IT - BundesverbandSolarwirtschafte.V. (German Solar Industry Association), DE - NIBE AB, SE - InterpaneEntwicklungs-und BeratungsgesellschaftmbH& Co KG, DE - Sto AG, DE - IPB GmbH IngenieurgesellschaftfürEnergie- &Gebäudetechnik, CH - ASM - Centrum BadańiAnalizRynku Sp. z o.o.,PL				

	- D'AppoloniaS.p.A., IT - Emmer Pfenninger Partner AG, CH - Kurt Schüle& Thorsten SiemsGbRKollektorfabrik, DE - Centre Scientifique et Technique du Bâtiment, FR - ECN Energy research Centre of the Netherlands, NL - National and Kapodistrian University of Athens, GR - LabeinTecnalia, ES - TNO Netherlands Organisation for Applied Scientific Research, NL - Universität Stuttgart (LBP), DE - Slovenian National Building and Civil Engineering Institute, SI - Alustanatuurlijkeventilatietechniek BV, NL - Hidria IMP Klimad.o.o.,SI - KOW Architectuur B.V., NL - Signet Solar GmbH, DE
Summary	The use of renewable energy in the building sector is today dominated by the application of solar domestic hot water and PV systems in single-family houses. In order to significantly increase the use of renewable energy in the building sector, concepts have to be developed for large buildings. In these buildings high fractions of the energy demand can only be met with renewable energy sources, when the façade is used for energy conversion in addition to the roof. This is especially true for buildings with a small roof area compared to the floor area (“high-rise buildings”) and for existing buildings which generally have a higher energy demand than new buildings. Therefore the main focus of the project is to convert facades of existing “high-rise buildings” into multifunctional, energy gaining components. This goal will be achieved through the - development of new multi-functional façade components which combine standard features and the use of renewable energy resources and the - development of new business and cost models which consider the whole life cycle of a building and which incorporate the benefits from reduced running costs and greenhouse-gas emissions. The new components will in particular profit from the application of nano-structured coatings and films which will enhance their performance and durability due to antireflective, anti-soiling and seasonal shading functionality. In order to achieve a successful development and implementation of these new technologies and concepts European key actors from construction industry and energy research have agreed to collaborate within this project. The project results will be an important support for the European technology platforms ECTP, ESTTP and PV-platform in which the project partners have a leading role.
Main ICT related results	- Development of new business and cost models which consider the entire life-cycle of a building and which incorporate the benefits of reduced operating costs and green house-gas emission - Development of a decision support tool that helps the planners to find the best integrated building concept
Information sources used for	Cost Effective deliverables: - D4.1.3 – A report on the assessment of the environmental impacts of the different integrated concepts for the different

this analysis	building categories of high-rise buildings. The report will consider the whole life cycle of the buildings and will analyse the manufacturing of the "cost effective" solutions, the building construction, maintenance, the end of the life and especially the use of the building. - D4.1.6 - A report including guidelines on how to implement the new concepts and components in building management systems (BMS). For each of the concepts an implementation strategy will be developed. - D4.1.8 - A DST tool including Case studies with examples and pictures of virtual and real buildings, Support for planners on how to integrate the new concepts in building management systems, Best practice catalogues, Examples of business models, test results for components, Support for design and commissioning of building management systems. - D4.1.9 - A support-tool for decision making during component development based on a statistical analysis of correlations between different requirements of possible clients.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	- D4.1.3
	2. Intelligent control
	- D4.1.6
	3. User awareness and decision support
	- D4.1.8 - D4.1.9
	4. Energy management and trading
	n/a
	5. Integration technologies
	n/a

EASEE

Project acronym, title, type	**EASEE - Envelope Approach to improve Sustainability and Energy efficiency in Existing multi-storey multi-owner residential buildings**
Programme, topic	Energy saving technologies for buildings envelope retrofitting (EeB.NMP.2011-3)
Duration	01-03-2012 to 29-02-2016 (48 months)

Budget M€	7,8	**Funding M€**	5,05	**Person months**	n/a
Website(s)	n/a				
Participants	-				
Summary	EASEE aims at developing a tool-kit for energy efficient envelope retrofitting of existing multi-storey and multi-owner buildings which combines novel design and assessment strategies, modular prefabricated elements, advanced insulating materials and new scaffolding-free installation approaches, to reduce energy demand, minimising the impact on occupants while preserving the facade original appearance. Particularly, the project will target residential buildings with cavity walls built before 70s. These buildings require facade retrofitting for technical reasons or improvements in the insulation and energy efficiency to reduce the energy demand, while the conservation of the building appearance is necessary. EASEE will focus on the 3 main components of the envelope that influence the energy performance of multi-storey building, namely the outer facade, the cavity walls and the interior envelope, by developing innovative and easy to implement solutions. A new range of specific solutions will be developed within the project, that will be combined according to the characteristics of the building to be retrofitted as well as to other non technical parameters as for example cost and location of the building, also within the district. The proposed approach will allow for an overall retrofitting cost over the whole life cycle and for a total cost of ownership up to 120 Euro/m2 allowing a return on investment below 7 years. EASEE will reduce overall retrofitting duration and optimise the worksite in general with direct benefits for the workers and the occupants, while creating new business opportunities worth 4 BEuro in energy efficient retrofitting of existing buildings by the 5th year after project completion, mobilising new cooperation schemes between Les and local SMEs through licensing mechanisms. This is fully in line with the expected impact in the call and with the overall goal of the EeB PPP under the recovery plan.					
Main ICT related results	n/a				
Information sources used for this analysis	European Commission info on new projects				
Reference to ICT4E2B Classification	**1. Tools for EE design and Production management**				
	n/a				
	2. Intelligent Control				
	n/a				
	3. User awareness and Decision support				
	n/a				

	4. Energy management and Trading
	n/a
	5. Integration Technologies
	BIM standardisation

E-Hub

Project acronym, title, type	**E-Hub - Energy-Hub for residential and commercial districts and transport**				
Programme, topic	New technologies for energy efficiency at district level (EeB.NMP.2010-2)				
Duration	01/12/2010 to 01/12/2014 (48 Months)				
Budget M€	11,6	**Funding M€**	7,99	**Person months**	676
Website(s)	http://www.e-hub.org/				
Participants	- Energy Research Centre of the Netherlands, NL - TNO, NL - D'Appolonia, IT - Acciona, ES - VITO, BE - Fraunhofer, DE - VTT, FI - DIMSET-TPG/Univ. Of Genua, IT - Solintel, ES - EDF, FR - ISPE, BE - Mostostal, PL - Ertzberg, BE - Electrawind, BE - CESTEC, IT - ICAX, UK				

	- HSW, DE
Summary	The aim of the E-Hub project is to develop a concept able to implement/utilise the large share of renewable energies, similar to an energy station, in which energy and information streams are interconnected/converted into each other and/or stored. The E-Hub would exchange energy via the energy grids between the different actors, depending on their role (once consumer and once supplier). These would exchange information with the E-Hub, depending on their energy needs and energy production rates, in order for the available energy to be distributed efficiently. The E-Hub concept would hold for all types of energy flows: primarily heating/cooling and electricity, and may connect not only households, but also (electrical) cars and commercial/industrial buildings. The project adopts an integrated and multidisciplinary approach asking for a careful balance of complementary expertise and roles that are collectively reflected in the Consortium constitution. The consortium is composed by 17 partners, each having specific and high value expertise in all needed scientific and technological branches which are required to meet the objectives of the project. Within this framework, the Consortium constitution reflects a balanced mix of research and academic competences as well as industrial participation. Excellence Research Organisations and Academic Institutions such as ECN, TNO, VITO, Fraunhofer, VTT, DIMSET-TPG cooperate with leading industrial partners such as Acciona, Solintel, EDF, ICAX, Mostostal, HSW and D'Appolonia, towards the realisation of the E-Hub concept and its concretisation at demonstration level through Ertzberg. This exemplary partnership guarantees on the one side that the most of technological advancement is taken into account, and on the other side that this technological excellence is translated into industrial viability. Financial and banking competences, represented by ISPE, complement activities aimed at enabling the emerging Business Models. Finally, governmental representation is achieved through the commitment of partners such as CESTEC, representing the Lombardy Region in Italy, as well as the Municipality of Amsterdam (as subcontractor), both of them providing the governmental counterpart competences as far as energy planning as well as urban planning are concerned.
Main ICT related results	- Definition of numerical models of energy conversion as well as storage technologies, and numerical model to balance decentralised energy (electrical and thermal) generation with storage. o Simulation software tools allowing emulation of District Energy Networks through the integration of simulated as well as real data sets. This extended simulation tool will take into account new technologies and thermal storage. - Control for active demand response in districts, allowing integrated electrical as well as thermal energy management as well as grid connection of different types of energy storage (including thermal energy storage). - Business Logic Integration: development of optimal control strategies and ICT applications for E-Hub systems from perspectives of different stakeholders having influence on business/costs/profits. - ICT-enabled energy services to improve the district energy hub services and business at different level of stakeholders from decision makers to end-users. - Implementation of an integrated and smart system to match supply and demand for multi commodities. This means that information (for the inhabitants and the operator) and active intelligence shall function as a virtual power plant. - Installation of a smart in depth monitoring system and data analysis that will provide short term energy information for

	producer and end user and allows active management of multi commodity network.
Information sources used for this analysis	- D3.3: Numerical model to balance decentralised energy (electrical and thermal) generation with storage; - D4.1: Interoperability requirements for energy management in district energy grids; - D4.2: Control concept for active demand response in districts; - D4.3: Extended simulation tool for districts taking into account new technologies and thermal storage; - D6.3: Model(s) for energy hub ICT solutions for different stakeholders and cost-benefit analysis model for decision of investment in ICT solutions.
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Numerical models of energy conversion as well as storage technologies, and numerical model to balance decentralised energy (electrical and thermal) generation with storage. - Simulation software tools allowing emulation of District Energy Networks through the integration of simulated as well as real data sets. This extended simulation tool will take into account new technologies and thermal storage.
	2. Intelligent control
	Control for active demand response in districts, allowing integrated electrical as well as thermal energy management as well as grid connection of different types of energy storage (including thermal energy storage).
	3. User awareness and decision support
	Installation of a smart in depth monitoring system and data analysis that will provide short term energy information for producer and end user and allows active management of multi commodity network.
	4. Energy management and trading
	- Business Logic Integration: development of optimal control strategies and ICT applications for E-Hub systems from perspectives of different stakeholders having influence on business/costs/profits. - ICT-enabled energy services to improve the district energy hub services and business at different level of stakeholders from decision makers to end-users.
	5. Integration technologies
	Implementation of an integrated and smart system to match supply and demand for multi commodities. This means that information (for the inhabitants and the operator) and active intelligence shall function as a virtual power plant.

FC-DISTRICT

Project acronym, title, type	**FC-District - New μ-CHP network technologies for energy efficient and sustainable districts.**				
Programme, topic	New technologies for energy efficiency at district level (EeB.NMP.2010-2)				
Duration	48 Month				
Budget M€	11,8	**Funding M€**	8	**Person months**	1010,4
Website(s)	http://fc-district.eu/				
Participants	- MOSTOSTAL WARSZAWA S.A. - NATIONAL TECHNICAL UNIVERSITY OF ATHENS - ACCIONA INFRAESTRUCTURAS S.A. - TU BERGAKADEMIE FREIBERG - INSTITUTE OF POWER ENGINEERING - FAGOR ELECTRODOMESTICOS S.COOP.LTDA. - ENERGY RESEARCH CENTRE OF NETHERLANDS - EBZ ENTWICKLUNGS- UND VERTRIEBSGESELLSCHAFT BRENNSTOFFZELLE GMBH - CHALMERS UNIVERSITY OF TECHNOLOGY - POWERPIPE SYSTEMS AB - IKERLAN S. COOP. - INSTITUTO SUPERIOR TECNICO - INSTITUTE OSKAR VON MILLER SC OVM ICCPET S.A. - RINICOM - SOLINTEL M&P SL - KNAUF GIPS GK - D' APPOLONIA SPA - SVERIGES TEKNISKA FORSKNINGSINSTITUT AB - ECOFAST ITALIA SRL - INTESASANPAOLO EURODESK S.P.R.L.				

	- KNAUF GYPSOPIIA ABEE - VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK
Summary	The overall objective of the FC-DISTRICT project is to optimize and implement an innovative energy production and distribution concept for sustainable and energy efficient refurbished or new "energy autonomous" districts, exploiting decentralized co-generation coupled with optimized building and district heat storage and distribution network. The concept is based on dynamic heat exchange between the buildings (fitted with Solid Oxide Fuel Cells) for energy production collaborating with improved thermal storage and insulation building systems, the distribution system (optimized piping and district heating with or without a heat buffer) and the consumer (new business and service models), aiming to achieve energy balance at district level. A technology in scope of the project is a high temperature solid oxide fuel cell (SOFC) with versatile fuel processor for gas reforming and optimized peripheries making possible successful integration with district networks. FC-DISTRICT integrates a proven innovative SOFC technology with heat management at building and district level (building thermal storage coupled with intelligent distribution networks) to serve the consumer needs for economy-ecology-sustainability. It introduces a new paradigm in energy efficiency by developing materials, technologies, methodologies and systems specifically intended for integration at district level. Advanced insulation materials will be developed and implemented for the improvement of building and pipe thermal response. The energy reduction will originate from improved efficiency and cost effective high temperature (SOFC), to act as μ-CHP systems providing demand-flexible electricity and heat to the building and district, coupled with optimised energy and power distribution networks that will optimally control heat storage at building and district level.
Main ICT related results	Main ICT related results concern communication and control of the networks. The conventional approach to sensory networks assumes a homogeneous network infrastructure whereas most real-life scenarios are based upon the use of hybrid networks. This creates a number of issues related to the reliability of the received data, localization and remote calibration of the sensors and provision of the same quality of service to wireless and wired sensor nodes. A prototype hybrid network will be developed and implemented within FC-DISTRICT. Data communication requirements will be identified and ranked communication strategy necessary to achieve the desired performance will be deployed.
Information sources used for this analysis	Mostostal Warszawa is a coordinator of this project.
Reference to	**1. Tools for EE design and Production management**

ICT4E2B Classification	Virtual reality will be used to illustrate how energy efficiency can be integrated within wider sustainability objectives, achieving material benefits and providing a rich breeding ground for innovation and adaptation. The virtual reality tool will help to reduce the barriers to the widespread deployment of μ-CHP technologies. The tool also provides a database for procurement and other summary information for management.
	2. Intelligent Control
	FC-District aims to develop and implement a novel hybrid mesh sensor network, which will utilize the existing communication infrastructure (both wired and wireless) and allow the provision of additional nodes to accommodate possible dynamic changes in SOFC μ-CHP unit locations.
	3. User awareness and Decision support
	No direct relations to this section.
	4. Energy management and Trading
	The control of the micro-generators that will be developed in the project will be based on protocols developed in another project – Flame SOFC. This control will have the full capability of the FlameSOFC system as the control of the power injected to the micro-grid. Moreover, novel control algorithms which will provide the required voltage support to the micro-grid while supporting a large number of micro-generators in the grid.
	5. Integration Technologies
	Due to many technologies in the project integration is an important parameter. ICT solutions will provide necessary communication between devices and control room.

GE2O

Project acronym, title, type	**GE2O - Geo-clustering to deploy the potential of Energy efficient Buildings across EU**				
Programme, topic	Geo-clusters approach to support European energy-efficiency goals (EeB.NMP.2011-4)				
Duration	2012-01-01 to 2013-12-31 (24 months)				
Budget M€	1.5	**Funding M€**	0,99	**Person months**	n/a
Website(s)	http://www.geocluster.eu				
Participants	- CENTRE SCIENTIFIQUE ET TECHNIQUE DU BATIMENT, FRANCE				

	- ZAVOD ZA GRADBENISTVO SLOVENIJE, SLOVENIJA - ARCELORMITTAL BELVAL & DIFFERDANGE SA, LUXEMBOURG (GRAND-DUCHÉ) - NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK – TNO, NEDERLAND - ACCIONA INFRAESTRUCTURAS S.A., SPAIN - ENERGY EFFICIENT BUILDINGS AISBL, BELGIUM - ASM CENTRUM BADAN I ANALIZ RYNKU SP. Z O O, POLAND - TECHNICKY A ZKUSEBNI USTAV STAVEBNI PRAHA S. P., CECK REPUBLIC - CENTRE SCIENTIFIQUE ET TECHNIQUE DE LA CONSTRUCTION, BELGIUM - POLITECNICO DI MILANO, ITALY - INSTITUTE FOR SUSTAINABILITY, UNITED KINGDOM - D'APPOLONIA SPA, ITALY
Summary	Energy efficiency in buildings will play a major role in responding to climate change and energy issues, if we are able to trigger large scale actions involving EU, all Member States and their regional and local authorities. The concept of Geo-clusters is highly relevant, being virtual trans-national areas where strong similarities are found (i.e. climate, culture and behaviour, construction typologies, economy, energy price and policies and gross domestic product, to name a few). In this framework, it is clear that the geo-cluster map will not be based on fixed geographic regions, but is to be considered as a multi-dimensional and dynamic tool. Our goal is to locate similarities across enlarged EU by combining single or multiple parameters and indicators organised in homogeneous layers and sub-layers. As a pure example, we may consider a Technological layer (i.e. building typologies, technologies,..), a Context layer (i.e. climatic conditions,...), a Socio-economic layer (i.e. macroeconomic indicators, behavioural aspects,), a Political-strategic layer (i.e. standards and regulations, energy policies,..). There are however a number of barriers that are due to scattered knowledge, specific needs, failure modes and bottlenecks, as well as the weakness and threats experienced by running clusters dealing with energy efficiency in the built environment across EU, requiring a EU coordination action centred on a two-fold approach: 1. Structuring and correlating the existing knowledge and information available at broader public level on EU, National and local basis. Once descriptors have been identified, a correlation methodology will then be developed to associate the different data layers and create multi-dimensional maps. 2. Validation through two pilot clusters, performing an in-depth analysis and validation of the overall approach and methodology focusing on the two pilot clusters Mediterranean arc and Western Central and Northern West EU.
Main ICT related results	n/a

Information sources	Document of Work.
Reference to ICT4E2B Classification	**1. Tools for EE design and Production management**
	Development of a mapping tool which implements energy efficient methodology
	2. Intelligent control
	Automation and Control
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	n/a
	5. Integration technologies
	Development of a repository to store the knowledge and information

H2SUSBUILD

Project acronym, title, type	**H2SusBuild - Development of a clean and energy self-sustained building in the vision of integrating H_2 economy with renewable energy sources (Collaborative Project - Large-scale integrating project)**				
Programme, topic	Resource Efficient and Clean Buildings (NMP-2007-4.0-5)				
Duration	01-10-2008 to 30-09-2012 (48 months)				
Budget M€	9,9	**Funding M€**	6,7	**Personmonths**	828.5
Website(s)	www.h2susbuild.ntua.gr				
Participants	- D'AppoloniaS.p.A., IT - National Technical University of Athens, GR - S.C.A.M.E. SistemiS.r.l., IT				

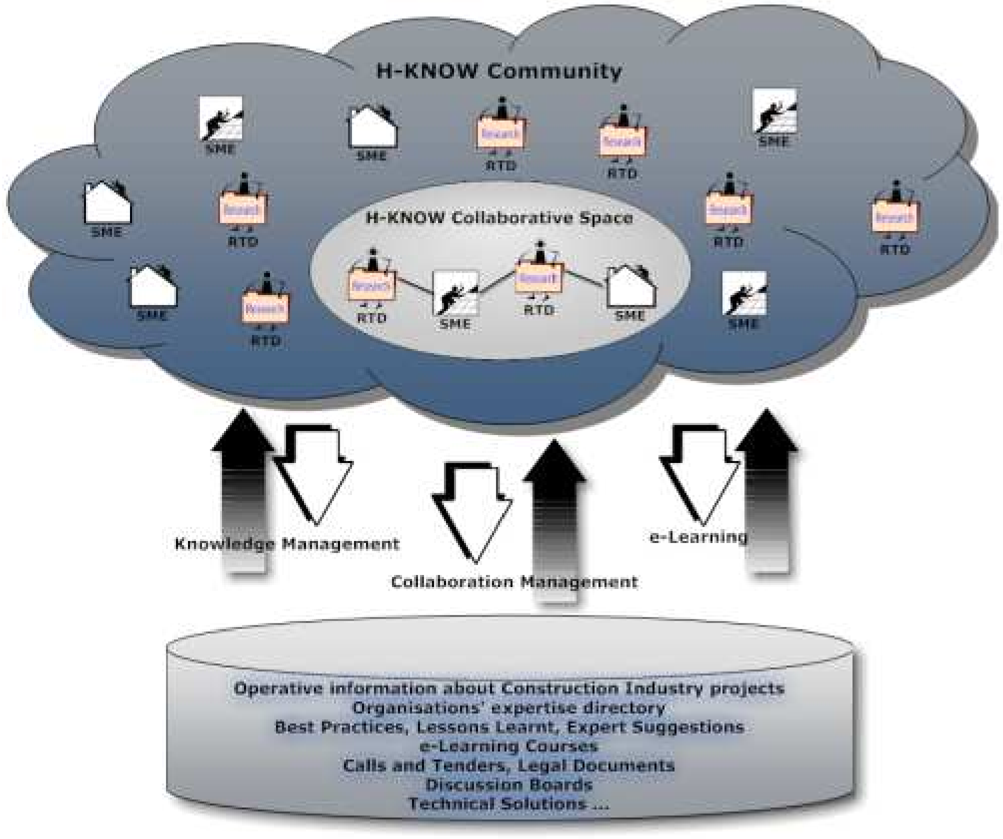
	- IKERLAN SociedadCooperativa, ES - IDROGEN2 S.r.l., IT - SCHNEIDER ELECTRIC S.A., GR - InstitutfürVerbundwerkstoffe GmbH, DE - Comat Composite Materials GmbH, DE - AccionaInfraestructuras S.A., ES - ICI CaldaieS.p.A., IT - Catator AB, SE - The University Court of the University of St. Andrews, UK - Centre for Renewable Energy Sources (CRES), GR - SKANSKA Nya Hem AB, SE - Van Berkel&Bos U.N. Studio B.V., NL - DECSOFT SpólkaAkcyjna, PL - CAVE S.r.l., IT - Det Norske Veritas AS, NO
Summary	The concept behind the H_2SusBuild project is to develop a self-sustainable and zero-CO_2-emission hybrid energy system, in which the storage of hydrogen will provide for the energy supply in case of energy shortage from RES, thus compensating their intermittent nature. With this respect, RES technologies such as photovoltaic solar panels as well as wind power generators will be coupled with water electrolysis for the production of hydrogen. The produced hydrogen will be stored in form of pressurized gas and consumed on-demand in order to produce thermal and electrical energy in case of shortage of Renewable Energy. More specifically, RES technologies will be used to harvest primary energy to be directly applied to cover the building's contingent loads. In case of excess Renewable Energy availability, the excess energy will be converted to hydrogen to be used as energy storage medium. In case of Renewable Energy shortage, the stored hydrogen will be applied as green fuel in order to cover the building's electrical and thermal energy demand, through Combined Heat and Power generation by means of Fuel Cells as well as by direct combustion for additional heat production when needed. This hybrid energy system will be installed in a real building environment in order to demonstrate that application of such a system in buildings such as of commercial or residential type is possible (not only from the perspective of technical feasibility but also from the point of view of Safety). Accordingly, the concept will be demonstrated through two subsequent installation steps; the first step will foresee a reduced scale prototype installation focusing on satisfying the electrical energy demand of a target indicative 150 m^2 surface area dedicated to office use; the second step will foresee a full-scale installation focussing on satisfying both the electrical as well as the thermal energy demand of a target indicative surface area of about 600 m^2. Within this framework, since the system would have limited efficiency if current State-of-the-Art technologies would be utilised, a

	further parallel objective concerns the improvement of single technologies' performance in order to contribute to the improvement of the whole system's efficiency. Furthermore, with an outlook to future potential applicability, each component will be specifically designed for building environments (domestic or commercial), thus targeting the highest level of Safety. Ease of installation and maintenance, and ease of operation thanks to a higher level of automation will also be a target. Last but not least, reduction of investment costs on single key components will be pursued. Finally, the synergistic operation of the various system components will be tackled together with the development of optimised operational strategies.
Main ICT related results	Effective Energy Management and Control System building on optimised operational strategies
Information sources used for this analysis	- D7.2 Detailed design of the Energy Management and Control System for the small-scale prototype RES-H_2 system - D7.3 Detailed design of the Energy Management and Control System for the full-scale prototype RES-H_2 system
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	This thematic area is covered by the project
	2. Intelligent control
	This thematic area is covered by the project
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	n/a
	5. Integration technologies
	n/a

H-KNOW

Project acronym, title, type	**H-KNOW - Advanced infrastructure for knowledge based services for buildings restoring**
Programme, topic	Innovative added-value construction product-services (NMP-2007-4.0-6)
Duration	24 months

Budget M€	2,64	**Funding M€**	1,87	**Person months**	n/a
Website(s)	http://www.h-know.eu/				
Participants	- Fundación Santa María La Real - TECNALIA - InstitutfuerAngewandteSystemtechnik Bremen GmbH - INESC Porto - Faculdade de EngenhariaUniversidade do Porto - Istituto di Scienzedell'Atmosfera e del Clima - Confédération des Artisans et Petites Entreprises du Bâtiment - H. D. Tietjen GmbH & Co. - Ventimola GmbH & Co. Dämmtechnik KG - Teusa S.A. - Construção e Reabilitação de EdifíciosLda. - TEICOS Costruzionis.r.l. - SARL Andre Cottenceau - Vortal, ComércioElectrónicoConsultadoria e Multimédia, S.A. - SociedadeTécnica de Tratamento de Aços e Betões, Lda.				
Summary	Increasing number of complex works in old building restoration and maintenance activities in Construction Industry Sector urgently requests an advanced, systematic and promptly access to the relevant knowledge. A highly promising approach to enable such an access, and to foster advancing of construction industry “Small and Medium Enterprises” towards the Knowledge organisations, comprises the implementation of innovative forms of collaborative knowledge through the creation of novel business networks of “Small and Medium Enterprises” and “Research and Technical Development organisations”. Novel solutions are needed to assure higher efficiency in the knowledge-based approach spreading, resulting in the creation of new full services with a high added value for clients. In this regard, H-KNOW project plans to develop a *software solution* supported by a *methodology* suitable for “Small and Medium Enterprises”, which will include innovative/competitive knowledge and training providing services surrounded by collaboration services.				

	
Main ICT related results	H-KNOW will offer innovative results in the form of: - H-KNOW Methodology for the introduction of a radically new approach in provision of relevant knowledge to the Construction Industry "Small and Medium Enterprises", dealing with Restoration and Maintenance of Old Buildings, including Cultural Heritage objects. The methodology will guide the establishment of H-KNOW Collaborative Spaces comprised of "Small and Medium Enterprises" and "Research and Technical Development organisations", who belong to the H-KNOW Community. The transformation from this general cooperative community into the precisely defined and joint-

	goal oriented H-KNOW Collaborative Spaces (see next figure) will be specifically elaborated. - H-KNOW Software System is an Internet based web tool aimed at the "Small and Medium Enterprises" and "Research and Technical Development organisations", which are dealing with Old Building Restoration activities. This platform will allow the creation of cooperative and collaborative business networks in order to facilitate the sharing of Construction Industry Knowledge among the network partners. The platform will also include systems for managing information, interaction and innovative training services through the employment of e-Learning facilities.
Information sources used for this analysis	Project website
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	n/a
	3. User awareness and decision support
	H-KNOW will offer a strategy (supported by the methodology and tools) to SMEs in this sector to attack problematic areas which have not yet been solved. The highly sophisticated and flexible solution to revolutionise efficiency in buildings repair/maintenance will not only enable these SMEs to perform on a par with other industry, but will also give them an extreme flexibility, which SMEs in many other sectors currently do not enjoy, hence providing CI SMEs with an approach going beyond the capabilities of the current approach taken by SMEs in many sectors.
	4. Energy management and trading
	n/a
	5. Integration technologies
	- To specify in detail methodology, ontology framework and services for the H-KNOW solution. - To develop the SOA based platform and to implement and integrate the prototypes of the H-KNOW services for MSI, KM and TEL.

HEAT4U

Project acronym, title, type	**HEAT4U - Gas Absorption Heat Pump solution for existing residential buildings**

Programme, topic	New efficient solutions for energy generation, storage and use related to space heating and domestic hot water in existing buildings (EeB.NMP.2011-2)				
Duration	2011-11-01 to 2014-10-31 (36 months)				
Budget M€	9.6	**Funding M€**	6.25	**Person months**	n/a
Website(s)	http://www.heat4u.eu				
Participants	- ROBUR SPA, ITALY - POLITECNICO DI MILANO, ITALY - GRDF SA, FRANCE - BOSCH THERMOTECHNIK GMBH, GERMANY - GDF SUEZ, FRANCE - ZAVOD ZA GRADBENISTVO SLOVENIJE, SLOVENIA - E. ON RUHRGAS AG, GERMANY - CF CONSULTING FINANZIAMENTI UNIONE EUROPEA SRL, ITALY - AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE,L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE, ITALY - PRIMORJE DD DRUZBA ZA GRADBENISTVO,INZENIRING IN DRUGE POSLOVNE STORITVE, SLOVENIA - FLOWAIR GLOGOWSKI I BRZEZINSKI SPOLKA JAWNA, POLAND - BRITISH GAS TRADING LIMITED, UNITED KINGDOM - FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V, GERMANY - D'APPOLONIA SPA, ITALY - PININFARINA SPA, ITALY				
Summary	Residential buildings represent 60% of the building stock and the area where most of the potential to drastically reduce energy use and CO2 emissions lies. New directives push for deep retrofitting efforts, in order to achieve energy efficiency and RES adoption targets for 2020 and beyond. These require acting both on envelope and on energy use systems, mainly heating and DHW equipment that representing 51% of energy use in this sector. Frequently the upgrade of the envelope insulation is subject to constraints (i.e. historical centres, availability of space, need to relocate the tenants, costs and time issues) and acting on the heating plant is the only viable option. Currently solutions are not always suitable or cost effective in existing buildings (radiators, DHW, solar radiation in winter). Therefore to accelerate the improvement in energy efficiency and in the use of renewable energy in the residential building, a specifically designed solution needs to be made available. HEAT4U is an Industry led project whose main objective is to develop a Gas Absorption Heat Pump (GAHP) solution with efficiency on primary energy of 165% (EN12309) to allow a cost-effective use of renewable energy in existing residential building for heating and DHW services. The project is conceived to overcome a number of technological and non-technological barriers which currently prevent GAHP application in single family houses or small multi-storey buildings.				

Main ICT related results	HEAT4U main objectives are: i) Development of Appliance with specifications suitable for the residential market (10-25 kW); ii) Integration of the technology in existing heating and DHW architectures or into pre-fabricated building components, designed for deep retrofitting iii) Development of a decision support system, enabling the optimal design in different building operating conditions; iv) Dissemination activity to promote the awareness of the benefits of the GAHP technology. The results will be demonstrated in 5 real cases.
Information sources used for this analysis	Project website and CORDIS
Reference to ICT4E2B Classifi-cation	**1. Tools for EE design and Production management**
	n/a
	2. Intelligent Control
	Intelligent control of GAHP
	3. User awareness and Decision support
	Development of a decision support system
	4. Energy management and Trading
	n/a
	5. Integration Technologies
	Integration of the technology in existing heating and DHW architectures

MEEFS RETROFITTING

Project acronym, title, type	**MEEFS RETROFITTING: Multifunctional Energy Efficient Façade System for Building Retrofitting**

Programme, topic	Energy saving technologies for buildings envelope retrofitting (EeB.NMP.2011-3)				
Duration	2012-01-01 to 2015-12-31 (48 months)				
Budget M€	9.94 million euro	**Funding M€**	7.32 million euro	**Person months**	n/a
Website(s)	n/a				
Participants	- ACCIONA INFRAESTRUCTURAS S.A. - SKA POLSKA SP Z O. O. - ANTWORKS SRL - CQFD COMPOSITES SARL - TPF SPOLKA Z OGRANICZONA ODPOWIEDZIALNOSCIA - ADVANCED SIMULATION TECHNOLOGIES - VIPIEMME SOLAR SRL - G.K. RIZAKOS ANONIMI BIOTECHNIKI EMPORIKI TECHNIKI - CONSEJERIA DE FOMENTO - JUNTA DE EXTREMADURA - TBC GÉNÉRATEURS D'INNOVATION - FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER - GREENOVATE! EUROPE - FUNDACION TECNALIA RESEARCH & INNOVATION - TEKNOLOGIAN TUTKIMUSKESKUS VTT - NATIONAL TECHNICAL UNIVERSITY OF ATHENS - TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY				
Summary	The building envelope (roof, façade and basements) is the key element to address in order to achieve the energy efficiency in the retrofitting of buildings, where the façade represent the largest part of the heat transmission surface and includes a number of critical components (like windows, balconies, ventilation units,etc) and thermal bridge phenomena. The present project aims to develop an energy efficient integrated system composed by an innovative concept, built on composite materials, and advanced multifunctional panels with technological modules integrated in the façade for building envelope retrofitting. The following solutions will be developed: - Innovative façade concept for retrofitting based on new industrialized constructive system integrating advanced multifunctional				

	panels, technological modules and installations; allowing personalized configurations for each façade typology, orientation and local climate conditions, always using standardized panels and technological modules. It will be cost effective in service life, with low maintenance, easy assembly and disassembly. - Energy Efficient panels and modules integrated in the façade will include a particular technology for reducing energy demand of the building or for supplying energy by means of RES; two new energy efficient modules will be developed: Advanced Passive Solar Protector and Energy Absorption auto mobile unit, Advanced Passive Solar Collector and Ventilation Module. - A set of flexible, lightweight and cost-effective structural panels, easy to be industrialized and assembled, made of composite materials (FRP - Fibre Reinforced Polymer). The solution will be demonstrated in a real building in Spain, in a region with a continental climate, where extreme conditions in summer up to (>35℃) and in winter (<0℃), covering the different seasons. The building will be monitored before and after the retrofitting with the new Retrofitting system to evaluate the performance solutions
Main ICT related results	n/a
Information sources used for this analysis	http://cordis.europa.eu/fetch?CALLER=PROJ_EN&ACTION=D&DOC=46&CAT=PROJ&QUERY=01286305dab4:f1a7:2ff46f9c&RCN=102074
Reference to ICT4E2B Classification	**1. Tools for EE design and Production management**
	n/a
	2. Intelligent Control
	A set of flexible, lightweight and cost-effective structural panels, easy to be industrialized and assembled, made of composite materials (FRP - Fibre Reinforced Polymer)
	3. User awareness and Decision support
	n/a
	4. Energy management and Trading
	Innovative façade concept for retrofitting based on new industrialized constructive system integrating advanced multifunctional panels, technological modules and installations
	5. Integration Technologies

	Energy Efficient panels and modules integrated in the façade will include a particular technology for reducing energy demand of the building or for supplying energy

MESSIB

Project acronym, title, type	**MESSIB - Multi-source Energy Storage System Integrated in Buildings (Collaborative, Large-scale integrating project)**				
Programme, topic	Resource Efficient and Clean Buildings (NMP-2007-4.0-5)				
Duration	2009-03-1 ... 2013 -2-28 (48 months)				
Budget M€	8.6	**Funding M€**	6	**Person months**	729
Website(s)	www.messib.eu				
Participants	- ACCIONA, Spain - AIDICO, Spain - BASF, Germany - CCS, Slovenia - CNR-ISAC, Italy - CSTB, France - ECN, Netherlands - FRAUNHOFER, Germany - GESTA, Italy - KNAUFKG, Germany - MOSTOSTAL, Poland - NTUA.HMCS, Greece - ROBOTINA, Slovenia - SRIBS, China - TECNALIA-LABEIN, Spain - UPONOR, Finland				

	- USTUTT, Germany - VTT, Finland - WANSDRONK, Netherlands - ZIGOR, Spain - D'APPOLONIA, Italy - TEKNIKER, Spain - KNAUFABEE, Greece
Summary	**Objective:** The overall objective of MESSIB is the development, evaluation and demonstration of an affordable multi-source energy storage system (MESS) integrated in building, based on new materials, technologies and control systems, for significant reduction of its energy consumption and active management of the building energy demand. This new concept will reduce and manage smartly the electrical energy required from the grid favouring the wider use of renewable energy sources . It will reduce raw material use for thermal performance and improve the indoor environment, the quality and security of energy supply at building and district level, including Cultural Heritage buildings. Furthermore, a significant reduction of the energy unit cost for end-users will be achieved. MESS is composed by two thermal and two electrical storage systems, integrated with the building installations and a control system to manage the building energy demand. The MESSIB basic principles are: - Rational use of thermal energy for primary energy savings and for increasing the indoor comfort. - Improvement of electrical energy storage in combination with RES to shift the demand with the production and to optimise the use of low cost off peak power from the grid. - Integration of the technologies in the building. Each of the technologies developed in the project will be integrated with conventional installations optimizing their functionality. - An active control system will manage the profile of use of each storage system and their interactions. This will contribute to the intelligent management of building energy demand and to ensure its security, quality and reliability.
Main ICT related results	- Development of an adapted simulation tools for each system as well as dedicated computational tools for the calculation of the transient heating/cooling energy demand at building level to properly integrate the technologies developed in the design phase of the building. - Development of a control/actuation system for each energy storage technology (thermal and electrical). - Integration of the four energy storage systems (storage technologies + its controls) with conventional installations of HVAC and electrical grid. - Development of an active control/actuation system to smartly manage energy demand of the building.
Information sources used for	- D2.4: Optimized simulation tools for both thermal technologies - D5.1: Monitoring system and demonstration scenarios defined

this analysis	- D5.2: Control strategy defined - D5.3: Central process unit - D5.4: Graphic for user interface - D5.5: Smart energy management system - D7.3: Smart management system for districts
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	- D2.4 - D5.2
	2. Intelligent control
	- D5.1 - D5.3
	3. User awareness and decision support
	D5.4
	4. Energy management and trading
	- D5.5 - D7.3
	5. Integration technologies
	n/a

12 Appendix E – FP7 SMEs Research Projects

CLIMAWIN

Project acronym, title, type	**CLIMAWIN - An intelligent window for optimal ventilation and minimum thermal loss**				
Programme, topic	Research for SMEs (SME-1)				
Duration	2010-10-01 to 2012-09-30 (24 months)				
Budget M€	1.57	**Funding M€**	1.18	**Person months**	n/a
Website(s)	http://www.climawin.aau.dk/				
Participants	- Aalborg Universitet (Co-ordinator), Denmark - Fraunhofer, Germany - Solearth Ecological Architecture, Ireland - HORN Vinduer, Denmark - University of Minho, Portugal - RAUH SR FensterbauGmbh, Germany - Designit A/S, Denmark				
Summary	The CLIMAWIN consortium, a group of European SME manufacturers and suppliers of windows and ventilation systems, aims to address a major market opportunity regarding energy efficient fenestration systems for renovation of residential and commercial buildings. The CLIMAWIN project is primarily aimed at the renovation sector, especially in old buildings thatdo not have energy efficient ventilation systems. The envisaged solution is expected to promote a paradigm shift for building renovation in the construction industry from expensive and energy intensive heating/cooling systems to cost, health, and energy efficient intelligent windows. The climawinwindows optimize indoor air quality while at the same time maximizing thermal efficiency in buildings. It is expected to be a vital component for European Initiatives towards encouraging the use of passive houses since windows are the largest source of heat losses in a building while at the same time, have a high potential for utilizing thermal insulation for indoor heating and lighting. A total of 7 partners from Germany, Portugal, Ireland and Denmark are participating in the project.				
Main ICT related results	Development of a novel high performance window with electronic operation of an auto-regulated natural ventilation system and electronic insulating night blind powered by solar power. Through in-situ smart sensors and Radio Frequency Based Technology (RFBT), the system will optimize, in real time, indoor climate on the basis of parameters such as indoor/outdoor temperature, CO2 and humidity etc., thereby providing both better indoor climate and reducing thermal loss.				
Information sources	Project website and Cordis				

used for this analysis	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Design (1.1) for configuration management
	2. Intelligent control
	- Automation and Control (2.1) for system concepts and predictive control - Monitoring (2.2) for instrumentation of building elements
	3. User awareness and decision support
	Performance management (3.1) for performance metrics of building component
	4. Energy management and trading
	n/a
	5. Integration technologies
	n/a
	Unclassified recommendations
	In-situ smart sensors and Radio Frequency Based Technology (RFBT) is used as technology in CLIMAWIN to optimize real-time IAQ.

MOBI3CON

Project acronym, title, type	**Mobi3Con - Developing Mobile 3D data collection, processing and dissemination solution for construction SMEs.**				
Programme, topic	Research for SME associations (SME-2)				
Duration	January 2009 – January 2012 (36 moths)				
Budget M€	2.23 M€	**Funding M€**	1.76 M€	**Person months**	200
Website(s)	http://mobi3con.eii.ee/				
Participants	- European Construction Industry Federation - Belgian Building Research Institute				

	- EestiInnovatsiooniInstituut - TeknologiskInstitutt - Sofware-BüroLotharBubel - TRV Kliima - Jarosh& Haas - Beltronic - HisbimBilgiveİletişimTeknolojileri
Summary	Mobi3Con solution combines 3D navigation with 3D drawings and BIM data in easy accessible way with powerful rugged hand held device manufactured especially on site conditions. The Mobi3Con system is the most accurate positioning system on the market with state-of-the-art UWB positioning system. However the real power of the system is its modularity. The system can use any positioning system with minimal changes, allowing a use of any other positioning systems to be used as well. From the beginning user can choose from Bar-code reading based positioning, RFID positioning, and when needed the best possible accuracy, the specific Mobi3Con UWB positioning can give up to one centimetre accuracy. The Mobi3Con system allows user to work with object data, providing a real BIM experience to the user. All the objects in the BIM database can be forwarded to the site over the internet, and the user can view data of any object there is in the system. Any object can have unlimited amount of properties. For example window or door, can have manufacturer info, width, height, thickness, noise reduction factor, style, colour or virtually any other properties. The Mobi3Con server software allows the project managers to plan man-power usage in effective way. They can assign tasks for any users, provide extra information for users about rooms, objects or site and the most important, they can receive up-the date status of the work on any work site in the system.

Main ICT related results	- Ultra Wide Band based indoor positioning system. This is directly ICT result as a new device.
	- Navigation system itself (software) and supporting software:
	    o Hand Held Software for collecting data on site
	    o Communication services
	    o Data exchange between the hand held device and server software (admin module)

Information sources used for this analysis	Project website and personal communication with ViliSiko – coordinator of Mobi3Con project
Reference to ICT4E2B Classification	**1. Tools for EE design and production management** There are currently no tools for energy efficient design, but there is no limitation why those couldn't be implemented in the future. Production management however is a part of the project by means of following the current situation (real time) of the building and

	task management for the workers and eventually ERP connection to control also the other tasks of the production.
	2. Intelligent control
	Administrative module will allow to control all the information gathered by the devices. User can manage the site works with the help of the handheld device.
	3. User awareness and decision support
	Positioning itself is a tool for awareness (it could be used for example to mark danger zones, forbidden areas etc.). Task management is of course also a control tool to guide workers to carry out their tasks. Currently there are no decision support tools (result analysis tools), but since the system allows users to follow in real time and in history the construction process, this gives excellent backbone for any decision support software (or algorithms).
	4. Energy management and trading
	No tools for energy management and trading implemented so far.
	5. Integration technologies
	Integration of several technologies. These include: - RFID reading, - Bar code reading, - Photographing (not implemented yet), - WiFi-positioning, - GPS positioning.

PICODICON

Project acronym, title, type	**PICODICON -Development of a mobile Pico-projector based data Displaying solution for Construction SMEs enabling the paperless construction site**				
Programme, topic	Co-operative Research (all areas of science and technology) (SME-1)				
Duration	2009-08-01 to 2011-07-31 (24 months)				
Budget M€	1.49	**Funding M€**	1.12	**Person months**	n/a
Website(s)	http://www.picodicon.com/				
Participants	- EpiCrystalsOy (Co-Ordinator), Finland				

	- ElgertaElectronicsOÜ, Estonia - BellustElektroonika OÜ, Estonia - Asociacion industrial de óptica, color e imagen, Spain - EestiInnovatsiooniInstituut OÜ, Estonia - HiperscanGmbh, Germany - BeltronicGmbh, Germany - Fraunhofer Institute PhotonischeMikrosysteme, Germany
Summary	This project will provide a rugged and robust pico-projector and PDA based solution for the construction industry to enable a paperless construction site, which would allow easy drawing and other construction related documents to be displayed at construction site. Support the growth of ICT and construction industry SMEs. The paperless construction site is currently very far from reality and there is no reliable and easy-to use affordable solution to replace printed drawings and other construction related documents on construction sites The general goal of the PICODICON project is to create a paperless on-line solution for construction workers to easily display up-to-date drawings and other construction related materials on site. It will enable the display of drawings and other construction related documents on-line on construction site without need for large and expensive ruggedized PC's and extending current PDA's limited display area. It will be an easy to use, reliable and affordable solution for construction SMEs, who can project image on any flat surface on construction sites. The consortium of PICODICON represents 8 participants from 6 EU countries.
Main ICT related results	Development of apico-projector which is based on EpiCrystalsDeCIBEL® lasers, two 1D MEMS micro mirrors, state-of-the-art optics and power efficient driving and image processing electronics.
Information sources used for this analysis	Project website and Cordis
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	n/a
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	n/a
	5. Integration technologies

	Process integration (5.1) for collaboration support in realisation stage tools for electronic document management, product data management, workflow management etc.

PRESTO

Project acronym, title, type	**PRESTO - Identification of Priority RESearchTOpics for SMEs associations in the construction sector with a focus on new technologies in the Energy, ICT and New Materials domains.**				
Programme, topic	ICT for environmental management and energy efficiency (ICT-2007.6.3)				
Duration	2008-02-01 to 2010-01-31 (24 months)				
Budget M€	0,56	**Funding M€**	0,56	**Person months**	n/a
Website(s)	www.presto-project.eu				
Participants	- Steinbeis-Europa-Zentrum (Germany) - ACCIONA (Spain) - FundaciónLabein (Spain) - Cracow University of Technology (Poland) - Targeting Innovation Ltd. (Scotland) - UnioncamerePiemonte (Italy)				
Summary	The PRESTO project is aimed at facilitating the identification of priority research topics for SMEs associations by establishing a close and sustainable dialogue with ETPs(European Technology Platforms). Moreover, PRESTO will bring SMEs associations and ETPs closer together by enacting a series of activities oriented towards the creation of links between them. PRESTO is concentrated on the Construction Sector with a specific focus on new technologies of three construction-ancillary domains -Energy, Information and Communication Technologies (ICT), and New Materials- which play not only a significant role in the European economy but, more importantly, which are Small and Medium-sized Enterprises (SMEs) intensive sectors				
Main ICT related results	The ICT results are not visible as of yet.				
Information sources used for this analysis	Project website and project deliverables				
Reference to	**1. Tools for EE design and production management**				

ICT4E2B Classification	n/a
	2. Intelligent control
	n/a
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	n/a
	5. Integration technologies
	n/a

13 Appendix F – FP7 EeB-PPP

EnRiMa

Project acronym, title, type	**EnRiMa - Energy Efficiency and Risk Management in Public Buildings (Collaborative)**				
Programme, topic	ICT for energy-efficient buildings and spaces of public use (ICT-2010.10.2)				
Duration	1 October 2010 to 31 March 2014 (42 months)				
Budget M€	3,5	**Funding M€**	2,6	**Person months**	278
Website(s)	http://www.enrima-project.eu/				
Participants	- Stockholm University - University College London - International Institute for Applied Systems Analysis - Universidad Rey Juan Carlos - Center for Energy and Innovative Technologies - Minerva Consulting and Communication - SINTEF Group - Tecnalia Research and Innovation - HidrocantábricoEnergía				
Summary	The overall objective of EnRiMa is to develop a decision-support system (DSS) for operators of energy-efficient buildings and spaces of public use. By providing integrated management of conflicting goals such as cost minimisation, meeting energy, efficiency, and emission-reduction requirements as well as risk management, the DSS will enable operators to improve building energy efficiency in the most cost-effective manner based on their tolerances for comfort and risk. The DSS will be seamlessly integrated with the existing ICT for controlling each site's energy sub-systems, thereby facilitating the operators' real-time on-site generation dispatch, off-site energy purchases from diverse sources, and open positions in energy markets. The DSS will also enable long-term planning aimed at increasing energy efficiency, specifically analysis of retrofits and/or expansion of on-site energy sub-systems, in order to meet forthcoming EU targets for reducing CO_2 emissions. A laboratory facility in Bizkaia, Spain will serve to test the operation of the DSS, while a community centre in northern Spain and a college campus in Austria will be the venues for the validation exercise. These site tests will enable cost-benefit analyses along with policy lessons for potential users of the DSS via workshops so that they may be able to reduce energy consumption and CO2 emissions by up to 10% in certain				

	cases and improve sub-system integration in line with EU targets. In conjunction with preliminary market analyses and an exploitation plan, the DSS will be ready to make a wide impact at the project's termination by leading to the opening of a market for ICT-based solutions for buildings.
Main ICT related results	- Improved forecasting of electricity and fuel prices as well as energy loads - Development of DSS Engine for integrated management of energy-efficient sites - Customised and user-friendly interface for the DSS Engine linked to a user's existing ICT architectures
Information sources used for this analysis	Project website and personal communications with EnRiMa project coordinator AfzalSiddiqui
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	- 2.1 Automation & control
	3. User awareness and decision support
	- 3.1 Performance management - 3.2 Visualisation of energy use - 3.3 Behavioural change
	4. Energy management and trading
	- 4.2 Smart grids
	5. Integration technologies
	- Process integration - 5.2 System integration

HESMOS

Project acronym, title, type	**HESMOS - ICT Platform for Holistic Energy Efficiency Simulation and Lifecycle Management of Public Use Facilities**
Programme, topic	ICT for energy-efficient buildings and spaces of public use (ICT-2010.10.2)

Duration	2010-09-01 to 2013-08-31 (36 Months)				
Budget M€	4.64	**Funding M€**	2.7	**Person months**	11,7
Website(s)	http://hesmos.eu/index.php				
Participants	- Technical University of Dresden (Co-ordinator), Germany - ObermeyerPlanen + Beraten GmbH, Germany - The Granlund Group, Finland - Royal BAM Group NV, The Netherlands - NEMETSCHEK Slovensko, S.R.O., Slovakia - AEC3 LTD, United Kingdom				
Summary	HESMOS will achieve an industry-driven holistic approach for sustainable optimisation of energy performance and emissions (CO2) reduction through integrated design and simulation, while balancing investment, maintenance and reinvestment costs. The objective is to close the gaps between existing intelligent building/facilities data so that complex lifecycle simulation can easily be done in all design, refurbishment and retrofitting phases where the largest energy saving potentials exist by the following:- (1) Extending existing BIM, energy simulation and cost calculation tools, so that they can seamlessly exchange the required data; (2) Integrating advanced energy simulation tools into the design and FM process, so that BIM-CAD and FM tools can be used as building energy simulator and gap identifier; (3) Developing new applications that can visualize building performance in easy to understand way and can quickly display impacts of changed building/space parameters; (4) Developing new Cockpit functionality in BIM-CAD on EPBD basis to provide fast feedback of the impact of design parameters on lifecycle energy performance; (5) Extending BIM-CAD to model and manage buildings and surrounding areas, and (6) Extending BIM-CAD by web services to act as Integrated Virtual Energy Laboratory (IVEL) enabling the study of design and retrofitting alternatives concerning energy performance and total costs. The consortium includes 6 stakeholders from varied branches of Construction, buildings, transport and environment planners, Facility management consulting group, civil engineering, PPP consultancies, Software Developers and strategic solution planners.				
Main ICT related results	- HESMOS focuses on tool derivation for EE design and production management, with integration technologies. - The approach is to develop specialized ontology for multi-system integration of BIM, ICT sub system integration into CAD/FM, Intelligent access methods Sensor networks, Building Material Management, Climate and product database.				
Information sources used for this analysis	Project website and Cordis				
Reference to	**6. Tools for EE design and Production management**				

ICT4E2B Classification	- Design (1.1) for performance and cost management tools - Performance estimation (1.4) for advance simulation supporting LCM costs (buildings investment costs, design, construction, operating costs, energy costs).
	7. Intelligent Control
	Monitoring (2.2) for Smart Metering WSN's (2.4) for network design.
	8. User awareness and Decision support
	n/a
	9. Energy management and Trading
	Building Energy management systems (4.1) for self configuring automated building systems.
	10.Integration Technologies
	System Integration (5.2) for system oriented architecture, Integration and service platforms.
	Unclassified recommendations
	- Generalised model subset definition (GMSD) for multi model view definition (BIM, IFC proprietary sets, Link model, Engineering Query Language) - Key performance indicators - Facility management in LCM stages.

SEEMPUBS

Project acronym, title, type	**SEEMPubS – Smart Energy Efficient Middleware for Public Spaces**				
Programme, topic	ICT for energy-efficient buildings and spaces of public use (ICT-2010.10.2)				
Duration	2010.09.01 2013.08.31 (36 Months)				
Budget M€	4,1	**Funding M€**	2,9	**Person months**	565.5
Website(s)	http://seempubs.polito.it/				
Participants	- POLITECNICODI TORINODAUIN-DIPARTIMENTO DI AUTOMATICA E INFORMATICA, Italy - FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V, Germany				

	- ISTITUTO SUPERIORE MARIO BOELLA SULLE TECNOLOGIE DELL'INFORMAZIONE E DELLE TELECOMUNICAZIONI, Italy - CNET SVENSKA AB, Sweden - SINOVIA SA, France - UNIVERSITE CLAUDE BERNARD LYON 1, France - CENTRO RICERCHE FIAT SCPA, Italy - KATHOLIEKE UNIVERSITEIT LEUVEN, Belgium - ST MICROELECTRONICS SRL, Italy
Summary	SEEMPubS specifically addresses reduction in energy usage and CO2 footprint in existing Public buildings and Spaces without significant construction works, by an intelligent ICT-based service monitoring and managing the energy consumption. Special attention will be paid to historical buildings to avoid damage by extensive retrofitting. SEEMPubS will provide control of appliances to effortlessly optimise energy efficiency usage without compromising comfort or convenience and offering decision makers strategies and tools needed to plan energy saving measures. SEEMPubS will make use of the service-oriented middleware for embedded systems being developed in the Hydra project and use its huge potential to create services and applications across heterogeneous devices to develop an energy-aware platform. The SEEMPubS platform will provide necessary functionality and tools to add energy efficiency features to monitor dynamic sensor data in real time, taking advantage of natural resources (like daylight and solar energy) and controlling the operation of both passive and active environmental systems to ensure the best possible comfort conditions with the most efficient use of energy. SEEMPubS will use its real-time energy-awareness services for all users of the Public Space and combine awareness services with a community portal.
Main ICT related results	- Development of an integrated electronic system to monitor different building models, technical building services, electronic devices and operations in order to optimize and integrate all maintenance functions. - Implement an interoperable web-based software solution for real-time energy performance monitoring and control of lighting, heating, ventilation and air conditioning (HVAC) services through wireless sensor networks in existing buildings and open public spaces. This will be done through an integrated approach based on an energy-aware middleware platform (i.e., the HYDRA platform, developed within and FP6 project by some of the SEEMPubS partners). In this way, the project will be able to deploy the new solution in buildings and public spaces by reusing already existing structures, like proprietary sensor networks or management systems and by integrating them into one intelligent energy management system, supported by a Graphical User Interface (GUI). - Raise people's awareness for energy efficiency in public spaces by the construction of a user community portal to enable communication and information exchange among users. - Provide multi-dimensional visualization of parameters of building operations and data sharing from technical systems.

	Real-time information will be collected by sensor networks detecting environmental and maintenance-oriented parameters of performance from lighting and HVAC services. The primary purpose of such a performance monitoring system is to provide facility managers and operators with the means to easily assess the current and historical performance of the building as a whole, and its significant energy consuming systems and components. The performance monitoring system includes not only the needed sensors, wiring and data acquisition device, but also the means to calculate, display and archive resultant parameters. System implementation will require the development of a HW platform that will use a combination of wired and wireless sensing technology to facilitate easy and cost-effective retrofit of devices and infrastructure into existing premises to monitor and control energy usage. - Development of the main software must be modular and should include: an automatic management of the real estate that comprises all information inside the database; the planning and the automatic management of interventions; the automatic report intended for people that work on billing and accounts.
Information sources used for this analysis	Project website and directly by Project Coordinator (POLITECNICO DI TORINO)
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	- Develop an integrated electronic system to monitor different building models, technical building services, electronic devices and operations in order to optimize and integrate all maintenance functions. - Provide multi-dimensional visualization of parameters of building operations and data sharing from technical systems.
	2. Intelligent control
	- Implement an interoperable web-based software solution for real-time energy performance monitoring and control of lighting, heating, ventilation and air conditioning (HVAC) services through wireless sensor networks in existing buildings and open public spaces. - System implementation will require the development of a HW platform that will use a combination of wired and wireless sensing technology to facilitate easy and cost-effective retrofit of devices and infrastructure into existing premises to monitor and control energy usage
	3. User awareness and decision support
	Raise people's awareness for energy efficiency in public spaces by the construction of a user community portal to enable communication and information exchange among users.
	4. Energy management and trading
	n/a
	5. Integration technologies

	WP4 (web service): Implement an interoperable web-based software solution for real-time energy performance monitoring and control.

SPORTE2

Project acronym, title, type	**SportE2 – Intelligent Management System to integrate and control energy generation, consumption and exchange for European Sport and Recreation Buildings**				
Programme, topic	ICT for energy-efficient buildings and spaces of public use (ICT-2010.10.2)				
Duration	2010.09.01 2013.08.31 (36 Months)				
Budget M€	4,71	**Funding M€**	2,97	**Person months**	n/a
Website(s)	http://www.sporte2.eu/				
Participants	- D'APPOLONIA SPA, Italy - SCHNEIDER ELECTRIC SA, Greece - ISA - Intelligent Sensing Anywhere S.A., Portugal - STARING di Arch. Guglielmetti Maurizio, Arch. Riva Diego e Ing. Marzorati - Pier Luigi Associazione, Italy - SELF ENERGY – SERVICOS DE ENERGIA S.A., Portugal - ASSOCIAZIONE SPORTIVA FIDIA S.R.L., Italy - FUNDACION LABEIN, Spain - Empresatecnica de gestiondeportiva, S.L. EMTESPORT, Spain				
Summary	The European Sport and Recreation Building Stock accounts for approximately 1,5 Million buildings or 8% of the overall building stock. These facilities are unique by their physical nature, their energy consumption profiles, the usage patterns of people inside, ownership, and comfort requirements. SPORTE2 will excite the sport facility community about energy efficiency and develop ICT related energy consultancy services, hardware, and software to reduce energy consumption and emissions production by 30% in these facilities with a 5 year return on investment. To do this, the project will develop an integrated, modular, and scalable ICT system to manage energy consumption, generation, and exchange locally and within the larger context of the smart grid/neighbourhood. The project will then implement the SportE^2 modules in three full-scale pilots representative of sport facilities at large (see our Pilots Page) and able to implement the smart grid concept through the availability of RET and cogeneration devices.				
Main ICT related	The core of the system and approach are four scalable modules that can be purchased and employed separately or integrated				

results	depending on client needs. These modules are SportE2 How (smart metering to determine where energy is being consumed), SportE2 When (integrated control systems that enable the actuation of energy sourcing and consumption), SportE2 Why (intelligent and optimal decision making given smart metering data and control capabilities), and SportE2 Where (a multi-facility management portal).
Information sources used for this analysis	Main SportE2 deliverables related to the ICT solution: - D1.2 System Architecture - D2.1 Smart Meteringin the Context ofSport Facilities - D3.1 Control Systemin the Context ofSport Facilities - D4.1 Energy Optimization Systemin the Context ofSport Facilities - D5.3 IntegratedPrototypeofthe SPORTE2System - D5.5 IntegratedSPORTE2System product complete - D8.1 Dissemination and Awareness Plan
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	- D1.2
	2. Intelligent control
	- D2.1 - D3.1 - D4.1
	3. User awareness and decision support
	- D8.1
	4. Energy management and trading
	n/a
	5. Integration technologies
	- D5.3 - D5.5

TIBUCON

Project acronym, title, type	**"TIBUCON" - Self Powered Wireless Sensor Network for HVAC System Energy Improvement - Towards Integral Building Connectivity.**				
Programme, topic	ICT for energy-efficient buildings and spaces of public use (ICT-2010.10.2)				
Duration	September 2010 – September 2013 (36 months)				
Budget M€	2.46 M€	**Funding M€**	1.59 M€	**Person months**	279,30
Website(s)	http://www.tibucon.eu				
Participants	- Mostostal Warszawa S.A. - Tekniker-IK4 - Giroa-Dalkia - University of Southampton - KatholiekeHogeschoolKempen - E&L Architects				
Summary	In the current European Energy Scenario, the building sector is responsible for covering 35-40% of the total energy consumption, and the space heating is the largest component of that energy use in virtually all member states, accounting for 67% at the level of EU-15 till 2005 This project proposal focuses on the space heating and cooling aspects. The current project proposes a solution beyond the existing wireless based HVAC control systems, derived from the use of Self Powered Multi Magnitude Wireless Sensor Network (SP-MM-WSN) for building thermal condition monitoring. The SP-MM-WSN completely avoids the use of cables and removable batteries, thanks to the combination of extremely energy efficient wireless communication technology, ultra low power electronics, and the power-harvesting concept. The wiring and battery removal is a real breakthrough, considering that: - Wiring can represent up to 80% of the total cost for a control point in HVAC system, - There could be hundreds of sensors in a newly deployed wireless based HVAC control system for a mid-range commercial building, what generates hundreds of wasted batteries. The aim of the TIBUCON project is to develop SP-MM-WSN technology that will be used in building thermal condition monitoring for either new or existing HVAC installations. SP-MM-WSN along with an actuating scheme will allow optimized real time control, or at least automatic monitoring and user energy awareness for the retrofit cases. The project will result in: - a more cost effective and less invasive tool for HVAC retrofitting and,				

	- more efficient HVAC structure in terms of energy consumption and thermal comfort for new installations Both alternatives will have an important impact on the energy consumption and CO2 emission of the HVAC systems, and due to the wire and battery reduction the use of limited resources (cooper, PVC, heavy metals, etc) and waste generation (batteries disposal) will be abated.
Main ICT related results	Development of self-powered wireless technology for HVAC systems in order to minimize required wiring in buildings.
Information sources used for this analysis	- Annex I – Description of Work of TIBUCON project. - Personal communication with coordinator from Mostostal Warszawa. - Deliverable 2.1 – Wireless Communication Protocol Description - Deliverable 3.1 – Energy harvesting strategies performance
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	- Wireless and battery free (self-powered) sensors for HVAC controlling that can be used in BMSs.
	2. Intelligent control
	- Improved wireless communication protocol - New type sensors at control points
	3. User awareness and decision support
	- User awareness through the display of real thermal conditions in contrast with recommended ones.
	4. Energy management and trading
	- Cheaper Installations due to cabling reduction
	5. Integration technologies
	- Integration of greater number of sensors for HVAC control, better performance and thermal comfort for users. - Wireless Network opened for the inclusion of new devices

14 Appendix G – FP7 ARTEMIS Research Projects

eDIANA

Project acronym, title, type	**E-Diana (Embedded Systems for Energy Efficient Buildings)**				
Programme, topic	ARTEMIS Call 2008 Sub-programme addressed: SP7. Embedded Technology for Sustainable Urban Life				
Duration	36 months				
Budget M€	17.3 M€ €	**Funding M€**	National authorities contribution: 4.6M€ ARTEMIS-JU contribution: 2.6 M€	**Person months**	2052 PM
Website(s)	http://www.artemis-ediana.eu				
Participants	- ACCIONA INFRAESTRUCTURAS - ATOS ORIGIN - BASEN - ELSAG DATAMAT - EUROPEAN SOFTWARE - INSTITUTE ESI - FIDELIX - GAIA - INFORMATION & IMAGE MANAGEMENT SYSTEMS - INFINEON TECHNOLOGIES - TECNALIA-LABEIN - MONDRAGON CORPORACION - PHILIPS ELECTRONICS NETHERLANDS - APPTECH				

	- PHILIPS CONSUMER LIFESTYLE - PHILIPS RESEARCH PRES - ST MICROELECTRONICS - TASK24 - UNIVERSITY OFBOLOGNA - UNIVERSITY OF ROME LA SAPIENZA - VTT - ZIV MEDIDA
Summary	eDIANA (Embedded Systems for Energy Efficient Buildings) addresses the need of achieving energy efficiency in buildings through innovative solutions based on embedded systems. The main goal of eDIANA, in line with SP7, is to enable sustainable urban life through rationalisation in the use of resources while increasing comfort in urban environments by means of embedded intelligence and integration technologies. The eDIANA approach is to achieve greater efficiency in use of resources, prioritising energy as scarce resource, more flexibility in the provision of resources and better situation awareness for the citizen and for service and infrastructure owners. This will be achieved through the deployment and inter-operation of embedded systems throughout the eDIANA environment of buildings and intra-building units. eDIANA's main outcome of application is in fact the improved energy efficiency in residential and non-residential buildings, first priority for SP7.
Main ICT related results	- Definition and initial instantiation of architectures and communication platforms to enable the flexible and evolvable interoperation of systems, including sensors, actuators, information systems, control systems and commercial systems across multiple domains and multiple vendors and service providers. eDIANA architecture will provide support to the seamless integration, control and monitoring of heterogeneous devices/sensors/actuators through a novel middleware infrastructure based on event-centric communication models and peer-to-peer interactions. - Definition of a standard HW and SW modelling framework and of development tools based on common industry driven meta-models, for high-level analysis and validation of resource usage, emphasizing composability and reuse. Requirements engineering tasks will be performed in order to produce software tools for gathering, classifying and modelling requirements implementing a Building Model Infrastructure, creating a Domain Specific Language that will form the basis for subsequent initiatives in the context of ARTEMIS SP7. Moreover, a model based simulation framework will be developed in order to produce and assess robust elements for the eDIANA Platform for product development, support and after-market engineers. - Development of models to enable energy efficient topology management in distributed systems, with emphasis on dynamic reconfiguration capabilities of resource management devices as key non-functional capability to cope with the legacy challenge by the use of heterogeneous communication networks able to integrate power line techniques, wireless and wired sensor and actuator network technologies.
Information sources	Project website

used for this analysis	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	D2.1-A Model Driven Engineering methodology for architecture realisation.
	2. Intelligent control
	n/a
	3. User awareness and decision support
	D4.3-A Control Strategies Analysis
	4. Energy management and trading
	D3 2-B In-Home energy management strategies development
	5. Integration technologies
	- D2.1-B eDIANA Reference Architecture - D2.3-B Communication protocol specification

ENCOURAGE

Project acronym, title, type	**ENCOURAGE Embedded intelligent controls for buildings with renewable generation and storage**				
Programme, topic	**ARTEMIS JOINT UNDERTAKING** **Sub-Programme: ASP7 Embedded technology for sustainable urban life**				
Duration	36 month				
Budget M€	6.3	**Funding M€**	2.8	**Person months**	792 PM's
Website(s)	http://www.encourage-project.eu/				
Participants	- AALBORG UNIVERSITY - ENERGI NORD				

	- SELUXIT - ADVANTIC SISTEMAS Y SERVICIOS - GNERA ENERGIA Y TECNOLOGIA - ATOS SPAIN - ESVALL - ISA-INTELLIGENT SENSING ANYWHERE - ENEL INGEGNERIA E INNOVAZIONE - EZMONITORING
Summary	The ENCOURAGE project aims to develop embedded intelligence and integration technologies that will directly optimize energy use in buildings and enable active participation in the future smart grid environment. The desired energy savings will be achieved in three complementary ways. Firstly, by developing supervisory control strategies that will be able to coordinate larger subsystems (HVAC, lighting, renewable energy generation, thermal storage, etc) and orchestrate operation of the numerous devices in such systems. The energy use will be optimized as a trade-off between occupants comfort, energy costs and environmental impact while considering people habits, weather conditions, characteristics of appliances, local generation and storage capacities and market conditions. Secondly, through an intelligent gateway with embedded logic supporting inter-building energy exchange. This brokerage agent will communicate directly with other buildings and local producers to negotiate possible use of the electricity produced locally in their premises. And thirdly, by developing novel virtual sub-metering technologies and event-based middleware applications that will support advanced monitoring and diagnostics concepts. Systematic performance monitoring will ensure the achieved savings are sustained over long period of time without being degraded by deteriorated performance of both mechanical equipment and the monitoring and control system itself.
Main ICT related results	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
Information sources used for this	Documentation of the project

analysis		
Reference to ICT4E2B Classification	**1. Tools for EE design and Production management**	
	n/a	
	2. Intelligent Control	
	Non-intrusive monitoring and control	
	3. User awareness and Decision support	
	n/a	
	4. Energy management and Trading	
	Energy efficiency at system level and not individual appliance / sub-system Control and forecast algorithms Energy brokerage mechanisms	
	5. Integration Technologies	
	Open architectures	

15 Appendix H – CIP ICT-PSP Research Projects

3e-Houses

Project acronym, title, type	**3e-HOUSES - Saving Energy & the Environment across Europe**				
Programme, topic	ICT for energy efficiency, environment and smart mobility : ICT for energy efficiency in social housing **(**ICT-PSP.2009.4.1)				
Duration	From 01/02/2010 to 31/01/2013				
Budget M€	4	**Funding M€**	2	**Person months**	n/a
Website(s)	http://www.3ehouses.eu				
Participants	- Gas Natural Fenosa - Indra - Promusa - Ennovatis GMBH (Ennovatis) - Bulgarian Housing Association - Bristol City Council - Knowle West Media Centre - IP-Performance LTD				
Summary	The goal of this project is to build the customers into the energy system through ICT's, allowing them to develop or enhance their relationship not only with the utility, but also with the environment, as saving energy is saving CO2 emissions.. This would be achieved by piloting in several social housing buildings the interaction between smart devices and the users to create, in a first approach, awareness around their energy consumption and therefore a change in their energy-use patterns. This energy ICT-based management service pilot pretends to be a first real and direct relationship between promoters and social housing consumers. Furthermore, for utilities, it could be the seed that would evolve towards new business models based on dynamic pricing and flexible tariffs that could partially avoid the use of the energy in the most expensive periods, resulting in flatter power demand loads and indirectly in a reduction of energy consumption. This would have to be offered (real case scenario) under a wider portfolio of services for the customer. i.e. Security services (i.e. on/off of the lighting systems when on holidays), programming capacity of their HVAC systems, scheduling of different loads (washing machines, dish-washers, pool pumps, etc.), Maintenance support from manufactures, and a endless list of opportunities. Thus, this kind of projects is a means of showing and				

	demonstrating, not only the advantages that a consumer can be provided with at home, but also the potential that the promoter can benefit from this profile changing. Not to mention the environmental benefits all in all by reducing peak demand and energy consumption that incur unavoidably in a CO2 reduction. This would leverage the Regulatory Authorities to take action in order to promote these services for the climate change benefit.	
Main ICT related results	The Project allows to tenants develop or enhance their relationship with the utility, the environment, as the concept, saving energy is saving CO2 emissions. This would be achieved by piloting in several social housing buildings the interaction between smart devices and the users to create, in a first approach, awareness around their energy consumption and therefore a change in their energy-use patterns.The described new services will allow the integration of renewable energy and other sources of distributed energies. As well it is expected to achieve a reduction around 20% in energy consumption in social buildings, by means of the real time monitoring, and management and control systems.	
Information sources used for this analysis	Project website and Cordis	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**	
	n/a	
	2. Intelligent control	
	n/a	
	3. User awareness and decision support	
	This thematic area is covered by the project	
	4. Energy management and trading	
	n/a	
	5. Integration technologies	
	n/a	
	Unclassified recommendations	
	The introduction of new technology does generally result in some behavioural changes in the users. Changes in residents' behaviour as a result of ICT innovations must be guided and supplied by a proper informational and educational campaign in order to increase its added value. For interventions at a higher level policy makers can consider a full suite of instruments (legislative, financial, communications) in order to achieve the best result from the technology measures applied.	

BEST Energy

<table>
<tr><td>Project acronym, title, type</td><td colspan="5">BEST Energy - Built Environment Sustainability and Technology in Energy</td></tr>
<tr><td>Programme, topic</td><td colspan="5">ICT for energy efficiency in public building and spaces, including lighting (ICT-PSP.2008.2.1)</td></tr>
<tr><td>Duration</td><td colspan="5">From February 2009 until February 2012</td></tr>
<tr><td>Budget M€</td><td>4,52</td><td>Funding M€</td><td>2,26</td><td>Person months</td><td>n/a</td></tr>
<tr><td>Website(s)</td><td colspan="5">http://www.bestenergyproject.eu</td></tr>
<tr><td>Participants</td><td colspan="5">- Fomento de San Sebastian
- ENESA A.S.
- VIBORG KOMMUNE
- COWI A/S
- UNIVERSITAET DES SAARLANDES
- TECHNISCHE UNIVERSITAET BRAUNSCHWEIG
- RUMPE INFORMATIONS TECHNOLOGIE GMBH
- RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN
- ENERGYDESIGN BRAUNSCHWEIG - INGENIEURGESELLSCHAFT FUR ENERGIEEFFIZIENTE GEBAUDE MBH KONZEPTE - PLANUNG- BETRIEB
- CAMARA MUNICIPAL DE ALMADA
- AGENCIA MUNICIPAL DE ENERGIA DE ALMADA ASSOCIACAO
- GREEN POWER MONITOR SISTEMAS DE MONITORIZACION, S.L.
- GIROA SOCIEDAD UNIPERSONAL</td></tr>
<tr><td>Summary</td><td colspan="5">The main objective of this project is to improve the energy efficiency in public buildings and street public lighting, by the ICT-based centralized monitoring and management of the energy consumption and production, and to provide decision makers with the necessary tools to be able to plan energy saving measures. To achieve this objective BEST Energy project will implement and validate four pilots, two related to energy efficiency in public buildings (one in a Sports centre in Spain and one in a University building in Germany), and another two regarding energy efficiency in public street lighting. All the pilots will implement innovative advanced control mechanisms allowing to substantially improve the energy efficiency in the respective buildings and spaces, each of them particularized to the specific characteristics of the different buildings and spaces. The initially quantified objective is to achieve a 12% reduction on the energy consumption of the buildings, and at least a 30% reduction of the energy consumption of the public lighting systems. This objective will be reviewed after the initial stage of the project, when more detailed information about the energy use and the different possibilities of reducing the energy consumption will be available. An additional set of</td></tr>
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	objectives will be defined at this stage of the project, regarding energy consumption peaks reduction, and renewable energy use (in the public buildings). Based on these experiences there will be a later replication of the pilot in other buildings, located in Spain, Denmark and the Czech Republic. The aim is to experiment during the BEST Energy project a first replication of the pilot experiences, that will serve other Municipalities to take advantage of the results of the first phase of the project as best practices, achieving the corresponding energy savings.
Main ICT related results	The BEST Energy project concept is based on the integration of building and lighting technology and state of the art ICT technology into innovative control and monitoring systems.The continuous (real time) monitoring of the energy consumption and generation is the way to allow centralized control systems to optimise energy performance. At the same time, heightened energy consumption awareness is expected to stimulate behavioural changes on the users of the energy.
Information sources used for this analysis	Project website and Cordis
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	Monitoring: To centralize the energy consumption and production monitoring, control and management Optimization: To use the information collected during the monitoring, to implement corrective/optimization measures and improve the energy efficiency. Validation: To show evidence and demonstrate the cost recovery based on the achieved energy savings and energy efficiency improvement.
	3. User awareness and decision support
	Experience sharing: To make an overall assessment of the project results by putting together the results obtained from each of the pilots, in order to extract conclusions, best practices and enhancements on the implemented pilots. Replication: To replicate the validated pilot experiences in other European countries in order to prove the transferability of the results. Dissemination and promotion: To raise public administrations' awareness and facilitate the replication of the validated solutions with the guidelines and best practices.

	4. Energy management and trading
	n/a
	5. Integration technologies
	n/a

E3SoHo

Project acronym, title, type	**E3SoHo - ICT Services for Energy Efficiency in European Social Housing**				
Programme, topic	ICT for energy efficiency, environment and smart mobility : ICT for energy efficiency in social housing **(**ICT-PSP.2009.4.1)				
Duration	From 2010-02-01 to 2013-01-31 (36 Months)				
Budget M€	3,9	**Funding M€**	1,9	**Person months**	386
Website(s)	http://www.e3soho.eu				
Participants	- AccionaInfraestructuras S.A., ES ◄ **Coordinator** - City of Warsaw, PL - Cecodhas, BE - Centre Scientifique et Technique du Bâtiment, FR - D'Appolonia, IT - ISA – Intelligent Sensing Anywhere, PT - Institute of Control and Industrial Electronics, PL - Mostostal, PL - Nobatek, FR - Telenor, NO - Sociedad Municipal Zaragoza Vivienda, ES				
Summary	The overall objective of E3SoHo project is to implement and demonstrate in 3 Social Housing pilots an integrated and replicable ICT-based solution which aims to bring about a significant reduction of 25% of energy consumption in European social housing by: - Providingtenants with feedback on consumption and offering personalised advice for improving their energy efficiency;				

<table>
<tr><td></td><td>
- reducing the energy consumption by informing and supporting the user to decide for the most appropriate behaviour in terms of energy efficiency, cost, comfort and environmental impact;
- monitoring and transmitting consumption data to Energy Services Companies which could enable real time energy audits in order to perform more accurate refurbishment activities as well as maintenance operations.
</td></tr>
<tr><td>Main ICT related results</td><td>
- Development of ICT integral solution to be applied within the dwellings chosen as case study. The solution identify will represent an Energy Conservation Measure (ECM) and measurements campaign are realised before and after the implementation of the solution in order to be able to provide the energy saving achieved.
- ICT refinement solution in order to be able to provide adequate feedback to tenants and end users
- Development of a global methodology used in order to design implement and monitor the results that could be achieved through the ICT solution applied
</td></tr>
<tr><td>Information sources used for this analysis</td><td>
Main E3SoHo deliverables related to the ICT solution:
- D2.3 Report on the Best technical and cost-effective ICTs solutions identified available among the consortium or on the market at EU level
- D3.1 Report on Specific ICT solutions that have to be applied within the different case studies.
- D3.2 Report on the ICT integrated system
- D4.4 Report on ICT solution refinement needed in order to satisfy the needs of the stakeholders involved
- D5.1 ICT System’s performance the report contain the results achieved in terms of Energy savings due to the implementation of the ICT based solution.
</td></tr>
<tr><td rowspan="9">Reference to ICT4E2B Classification</td><td>1. Tools for EE design and production management</td></tr>
<tr><td>- D2.3
- D 5.1</td></tr>
<tr><td>2. Intelligent control</td></tr>
<tr><td>n/a</td></tr>
<tr><td>3. User awareness and decision support</td></tr>
<tr><td>n/a</td></tr>
<tr><td>4. Energy management and trading</td></tr>
<tr><td>- D4.4</td></tr>
<tr><td>5. Integration technologies</td></tr>
</table>

	- D3.1 - D3.2

EDISON

Project acronym, title, type	**EDISON: energy distribution infrastructure for SSL operative networks**				
Programme, topic	ICT for Energy Efficiency in Public Buildings (CIP-ICT-PSP.2011.1.2)				
Duration	2012-01-01 to 2014-06-30 (18 months)				
Budget M€	2.4	**Funding M€**	1.2	**Person months**	n/a
Website(s)	None				
Participants	- FONDAZIONE UGO BORDONI - VRIJE UNIVERSITEIT BRUSSEL - BK TELEMATICS LTD - TSITALIA - Fondazione IDIS-Città della Scienza - Enel Sole S.R.L. - Comune di Roccamontepiano - Comune di Lettomanoppello - COMUNE DI MANOPPELLO - ANCITEL SPA - SIELTE S.A. - TRAFFIC OBSERVATION VIA MANAGEMENT LTD - Southern Health and Social Care Trust - SEMPLE & MCKILLOP LTD				
Summary	The EDISON Pilot Actions aim to demonstrate, under real operational conditions, that a smart lighting system improves energy efficiency, reduces CO2 emissions and encourages the use of small-scale renewable energy sources in European public buildings (e. g. schools, museums, administrative offices, hospitals, etc.). The Pilot Actions are based on the use of Solid State Lamps (SSLs) combined with a particular method of providing power to them, in order to realize a Smart Energy Platform (SEP),				

	mainly aimed at delivering an efficient lighting system. The SEP accommodates advanced ICT components and systems (e.g. smart metering, power electronics, mechanical/electrical sensors and actuators, etc.), that are designed to directly contribute to reducing energy losses and consumption. It integrates fine-grain sensor and control technology with a low voltage DC-powered network of highly efficient LED fixtures. This combination is able to provide more than 60% reduction in ongoing electricity costs, and is also able to reduce building maintenance costs. The capabilities of the proposed system will allow facilities managers to optimize their energy conservation strategies such as: dimming, daylight harvesting, demand response, peak reduction and activity sensing, by controlling non-critical lighting in a premises without disturbing its occupants. Measurement and analysis tools and metering indicators of energy performance, acting to demonstrate clear energy savings, have a relevant role in the Pilots. The goal of the experimental actions is to validate the effectiveness of the proposed ICT (SEP) solution for smart lighting, to serve as showcases to these technologies, and to facilitate their wider uptake and replication.
Main ICT related results	- Development of a Smart Energy Platform (SEP) aimed at delivering an efficient lighting system - Utilization of ICT components and systems (e.g. smart metering, power electronics, mechanical/electrical sensors and actuators, etc.), that are designed to directly contribute to reducing energy losses and consumption
Information sources used for this analysis	EU website
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	- Intelligent Automation and Control (2.1) - Monitoring (2.2)
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	n/a
	5. **Integration technologies**
	- System integration (5.2)

eSESH

Project acronym, title, type	**eSESH: Saving Energy in Social Housing with ICT**				
Programme, topic	ICT for energy efficiency, environment and smart mobility : ICT for energy efficiency in social housing **(**ICT-PSP.2009.4.1)				
Duration	From 2010-03-01 to 2013-02-28 (36 months)				
Budget M€	5,97	**Funding M€**	2,99	**Person months**	n/a
Website(s)	www.esesh.eu				
Participants	- MPIRICA GESELLSCHAFT FUER KOMMUNIKATIONS- UND TECHNOLOGIEFORSCHUNG MBH, (GERMANY) - UBITRONIX SYSTEM SOLUTIONS GMBH (AUSTRIA) - LINZ STROM GmbH fur Energieerzeugung, -handel, -dienstleistungen und Telekommunikation (AUSTRIA) - GWG-GemeinnützigeWohnungsgenossenschaft der Stadt Linz GmbH (AUSTRIA) - CV ZONNIGE KEMPEN(BELGIUM) - VOLTALIS SA (FRANCE) - VIZELIA(FRANCE) - UNION NATIONALE DES FEDERATIONS D'ORGANISMES D'HABITATIONS A LOYER MODERE(FRANCE) - REAL PROJECT PARTNER SARL(FRANCE) - MOULINS HABITAT(FRANCE) - LE TOIT ANGEVIN SOCIETE ANONYME D'HABITATIONS A LOYER MODERE (FRANCE) - HABITAT ET TERRITOIRES CONSEIL FRANCE - EFFINEO SA (FRANCE) - CELIUM SAS (FRANCE) - VOLKSWOHNUNG GMBH(GERMANY) - Spar- und Bauverein Solingen eG(GERMANY) - STADTWERKE KARLSRUHE GMBH(GERMANY) - NASSAUISCHE HEIMSTATTE WOHNUNGS- UND ENTWICKLUNGSGESELLSCHAFT MBH ORGAN DER STAATLICHEN WOHNUNGSPOLITIK (GERMANY) - ISTA DEUTSCHLAND GMBH (GERMANY) - INSTITUT WOHNEN UND UMWELT GMBH(GERMANY) - INGENIEUR-UND PLANUNGSGEMEINSCHAFTENVI GMBH (GERMANY)				

	- VILLAGGIO DELL'AMICIZIA SOCIETA COOPERATIVA(ITALY) - PIACENZA 74 SOC. COOP. ED. A R.L.(ITALY) - GREENERGY S.R.L.(ITALY) - FINABITA SPA (ITALY) - COOP CASA SC(ITALY) - DOMDATA SPÓŁKA Z OGRANICZONĄ ODPOWIEDZIALNOŚCIĄ(POLAND) - GENERALITAT DE CATALUNYA(SPAIN) - GASSO AUDITORES, SLP(SPAIN) - CIDE SociedadCooperativa(SPAIN) - CENTRE INTERNACIONAL DE METODES NUMERICS EN ENGINYERIA(SPAIN) - COMUNIDAD AUTONOMA DE EXTREMADURA(SPAIN)
Summary	As part of the ICT PSP program of the European Commission Competitiveness and Innovation Programme the eSESH project aims to design, develop and pilot new solutions to enable sustained reductions in energy consumption across European social housing. This is to be accomplished by providing usable ICT-based services for Energy Management (EMS) and Energy Awareness (EAS) directly to tenants, by providing effective ICT monitoring and control of local generation of power and heat and by providing social housing providers, regional and national government with the data they need to optimize their energy-related policy and investment decisions at national, regional and organizational level. The project will help Europe meet emission targets by achieving a significant reduction of energy consumption in European social housing.
Main ICT related results	Develop and pilot new solutions to enable sustained reductions in energy consumption across European social housing
Information sources used for this analysis	Project website and project deliverables
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	n/a
	3. User awareness and decision support
	Energy Awareness Services (EAS) for social housing
	4. Energy management and trading

	Energy Management Service e.g. Optimisation of heating system
	5. Integration technologies
	Web technologies

GREEN@HOSPITAL

Project acronym, title, type	**GREEN@HOSPITAL: web-based energy management system for the optimization of the energy consumption in hospitals**				
Programme, topic	ICT for Energy Efficiency in Public Buildings (CIP-ICT-PSP.2011.1.2)				
Duration	2012-03-01 to 2015-02-28 (36 months)				
Budget M€	2.9	**Funding M€**	1.4	**Person months**	n/a
Website(s)	None				
Participants	- AEA s.r.l. - TECHNICAL UNIVERSITY OF CRETE - GENERAL HOSPITAL CHANIA SAINT GEORGE - Schneider Electric SPA - Azienda Ospedaliero Univesitaria Ospedali Riuniti Umberto I- G.M. Lancisi- G. Salesi - Servicio Andaluz de Salud - FUNDACIO SANITARIA DE MOLLET - FUNDACIO INSTITUT DE RECERCA DE L'ENERGIA DE CATALUNYA - AGEFRED SERVICIO, S.A. - IF Technology B.V. - DEERNS RAADGEVENDE INGENIEURS BV				
Summary	Hospitals are known to be large energy consumers and in most European countries the high proportion of ageing building stocks makes hospitals amongst the least energy efficient public buildings. Nowadays there is a growing urgency to achieve real energy savings from existing building stocks and to build more sustainable new hospitals. The GREEN@Hospital project aims at integrating the latest ICT solutions in order to obtain a significant energy saving in existing hospital buildings, through a better management of energy resources and losses reduction. This will be carried out by the realization of Web-based Energy Management and Control Systems – Web-EMCS – which integrates monitors and controls multiple buildings systems at the component level. Moreover models to assess the energy savings will be developed and algorithms for consumption optimisation				

	implemented. The proposed solution will be also supported by a Maintenance Energy Service, specifically developed and integrated in the Web-EMCS to maintain optimal energy efficiency after initial efforts. Four different hospitals have been selected across Europe to take part in the pilot in order to demonstrate the validity of the proposed solution under real operating conditions. Each hospital will make available specific areas selected considering the presence of: 1) renewable energy sources, 2) already available building management systems that can be easily integrated in the Web-EMCS, 3) refurbishing plans aiming at energy efficiency improvement. Moreover, they will contribute by providing different functional areas so that the consumption needs of a typical hospital structure will be globally included in the technical solution. An intense dissemination activity will be planned to spread the project outcomes across Europe. The study will be the basis for possible replications of the solutions taking into account savings and return of investments.
Main ICT related results	- Development of a Web-based Energy Management and Control Systems – Web-EMCS – which integrates monitors and controls multiple buildings systems at the component level. - Development of models to assess the energy savings - Implementation of algorithms for consumption optimization. - Supported by a Maintenance Energy Service, specifically developed and integrated in the Web-EMCS to maintain optimal energy efficiency after initial efforts
Information sources used for this analysis	EU website
Reference to ICT4E2B Classification	**6. Tools for EE design and production management**
	n/a
	7. Intelligent control
	- Intelligent Automation and Control (2.1) - Monitoring (2.2) - Quality of Service (2.3)
	8. User awareness and decision support
	- Performance management (3.1) for performance analysis and evaluation - Visualization of energy usage (3.2) for user awareness and decision support tools - Behavioural change (3.3)
	9. Energy management and trading
	n/a

	10.**Integration technologies**
	- System integration (5.2)

HosPilot

Project acronym, title, type	**HosPilot: Intelligent Energy Efficiency Control in Hospitals**				
Programme, topic	ICT for energy efficiency in public building and spaces, including lighting (ICT-PSP.2008.2.1)				
Duration	From 2009-03-01 to 2012-02-29 (36 months)				
Budget M€	4,34	**Funding M€**	2,17	**Person months**	n/a
Website(s)	http://www.hospilot.eu/				
Participants	- Philips Lighting B.V.(Co-ordinator), The Netherlands - VTT Technical Research Centre of Finland, Finland - The Granlund Group, Finland - Hospital District of South Osthrobotnia, Finland - Centre Scientifique et Technique du Batiment (CSTB), France - Enoleo S.A.R.L., Monaco - ServicioRiojano de Salud (SERIS), Spain - Philips Iberica S.A.U., Spain - FundacionLabein, Spain - Acciona Infrastructures S.A., Spain - UniversitairMedisch Centrum Groingen (UMCG), The Netherlands				
Summary	The concern of European society for the well being of its residents and the sustainability of the environment has led to the consciousness that energy savings need to be at the top of the political agenda. Until recently, the focus of energy reduction has been on schools and offices. Hospitals, however, also use large amounts of energy. Therefore, the project addresses specifically the hospital domain. The main goal of HosPilot is to prove that the proposed energy reduction service leads to reduced energy consumption and				

	improved level of comfort for the end users. This goal will be achieved by identifying requirements of hospitals with respect to the building, its surroundings and its usage; designing a generic methodology addressing the needs, yielding the most energy efficient solution. The methodology will be interlinked with expert knowledge of the various technologies into aholistic energy saving service. The HosPilot project will support the decision makers with an ICT based service that will drastically reduce the energy consumption of newly built hospitals and existing hospitals being refurbished, increasing well-being and comfort. The consortium comprises of 14 partners where stakeholder group includes hospital building owners, managers andend-users, SME's in Construction/energy sector, ICT companies, European authorities and policy makers.
Main ICT related results	- HosPilot is a demonstration project intending to propose energy reduction by adding intelligence and incorporating ICT. Addressing only Hospital technology areas in Lighting and HVAC targeting as Healthcare, Construction, ICT and Energy sectors. - The project would take consideration of Climate of the environment (seasons, temperature, wind, etc.); Influence of daylight; Building envelope (used materials, insulation, etc.); Operating conditions per room 24/7 usage, presence of people, required working condition (light, air, etc.); Provide the hospital with an ICT based blue-print to reduce the energy consumption, Computer simulations will be performed to generate this blue-print; Implement a system according to the blue-print; Tuning of energy consumption by monitoring.
Information sources used for this analysis	Project website, Cordis and deliverable 6.3
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	- Automation and Control (2.1) for predictive control - Quality of Service for (2.2) system concepts, intelligent HVAC and smart lighting
	3. User awareness and decision support
	Performance management (3.1) for ICT impacts, performance specification, performance metrics, analysis and evaluation.
	4. Energy management and trading
	Building as a prosumer (4.1) for Indoor air quality in BMS
	5. Integration technologies
	Process integration (5.1) for collaboration support in usage stage.

	Unclassified recommendations
	HosPilot also includes: Socio-economic and market positioning study, dissemination and awareness through Second Life Island, new services and business models.

LITES

Project acronym, title, type	**LITES : Led-based Intelligent street lighting for Energy Saving**				
Programme, topic	ICT for energy efficiency in public building and spaces, including lighting (ICT-PSP.2008.2.1)				
Duration	From 2009-12-01 to 2012-05-31 (30 Months)				
Budget M€	2.56	**Funding M€**	1.28	**Person months**	N/a
Website(s)	http://www.lites-project.eu/				
Participants	- S.A.R.L. VEADES (Co-ordinator), France - Municipality of Bordeaux, France - UniversitePualSabatier,Toulouse, UPS-LAPLACE, France - Polotecnico di Torino, Italy - Municipality of Piaseczno, Poland - Universidade de Aveiro, Portugal - Riga Technical University, RTU DESC Latvia - Metercom, France				
Summary	The objective of LITES project is to develop and produce a smart, LED based street lighting device that is compatible with EU electrical standards, to prove that solid-state lighting using LED technology can drastically reduce energy consumption. The device can be used on secondary streets, commercial access routes, alleyways, pedestrian walks, cycle tracks, university paths and other thoroughfares. The core element of the solution is the dimming of the lamp depending on the environment; a set of embedded sensors measure ambient light, temperature, current, and detect motion. Output data of sensors is then processed by the embedded intelligence allowing optimum regulation of light levels. The objectives will be achieved by manufacturing a lantern specially designed to receive the LED array and the embedded intelligence. The piloted, full members of the consortium as well, will procure their sets of lanterns to a subcontractor of the consortium in charge of the industrialisation of LITES. The consortium constitutes of 8 partners covering the entire value-chain of the project and the standardisation as well. The				

	projects significant energy saving potential is up to 70 %, environmental and economical benefits and the increased level of traffic safety for the public.
Main ICT related results	- Possibility of light intensity real-time control in different geographic locations; environments and climate circumstances; in consequence check level of energy consumption reduction which means reduction of CO_2 emission; - Ability of remote (Internet) installation management and collection of basic technical data;.
Information sources used for this analysis	Project website and Cordis
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Design (1.1) for District design/Urban planning and configuration management
	2. Intelligent control
	- Automation and Control (2.1) for smart lighting - Monitoring (2.2) for sensor technology - WSN (2.4) for operating systems
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	Smart grids (4.2) for energy network design and integration and load balancing techniques.
	5. Integration technologies
	System Integration (5.2) for integration & service platforms

SAVE ENERGY

Project acronym, title, type	**SAVE ENERGY: Save Energy**				
Programme, topic	ICT for energy efficiency in public building and spaces, including lighting (ICT-PSP.2008.2.1)				
Duration	From 2009-03-01 to 2011-08-31 (36 months)				
Budget M€	4.46	**Funding M€**	2.23	**Person months**	n/a

Website(s)	http://www.ict4saveenergy.eu/
Participants	- Alfamicro (Co-ordinator), Portugal - Nokia Oyj, Finland - Metropolia, Finland - City of Helsinki, Finland - Helsinki School of Economics, Finland - Green Net Finland Ry, Finland - SPI, Portugal - RTS - Real Time Solutions Lda, Portugal - Lisboa E-Nova, Portugal - ISA - Intelligent Sensing Anywhere S.A., Portugal - LTU-CTD, Sweden - Lulea Municipality, Sweden - CeTIM - Centre for Technology And Innovation Management, Netherlands - Leiden Municipality, The Netherlands - The University Of Salford, United Kingdom - Manchester City Council, United Kingdom
Summary	The SAVE ENERGY will use a serious game providing an engaging believable virtual environment for citizens, consumers and policy makers to gain awareness, understanding and experience with regard to the issues associated with behavioural change and energy efficiency, in both the immediate and longer terms. Pilots will involve public buildings from 5 European Cities (Helsinki, Manchester, Lisbon, Lulea and Leiden) that will demonstrate the extent to which tangible emissions reduction is achievable. The 5 pilots implementation will follow Living Lab methodology by use electronic sensors to measure energy usage, plug adapters between wall sockets and the devices that plugs into them will use the mains electricity as both a power source and means of communication, measure the energy used by devices, and communicate this to a local “gateway” system with a web interface. The information of a network of sensors will be gathered by a central server allowing for the data analysis and identification of consumption patterns and real time view, providing an action plan to adjust the energy usage pattern and hence, the carbon footprint. A given public space will become better informed of their energy profile and be given advice on adapting behaviour. The project brought together 16 partners - including public authorities, public agencies, universities, research institutes, SMEs and corporations.
Main ICT related results	- Targets to develop a local platform showing the resource and device integrator part, enabling the interoperability of sensors, actuators and meters. This layer will integrate into the central platform middleware which allows the integration

	of bus systems, mobile and computer platforms. The user interface layer includes web interfaces for computers and mobile devices, the gaming and simulation engines and a business logic service. - The main focus of the SAVE ENERGY project is to foster behaviour transformation regarding energy efficiency. The project stakeholders will become aware of the consequences of living in a world of ever more expensive energy and the potential impact (economic, environment and political) of current trends. - The SAVE ENERGY Roadmap will provide the technical, social, economic and political guidelines emerging from the project as a tool to sustain the SAVE ENERGY vision. The project policy engagement at regional, national and European levels will be facilitated by an Advisory Board to validate the energy efficiency policy recommendations derived from SAVE ENERGY Pilots results.
Information sources used for this analysis	Project website and Cordis
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	Design (1.1) for performance management tools
	2. Intelligent control
	Monitoring (2.2) for instrumentation
	3. User awareness and decision support
	- Performance management (3.1) for performance analysis and evaluation - Visualization of energy usage (3.2) for user awareness tools
	4. Energy management and trading
	n/a
	5. Integration technologies
	System integration (5.2) for middleware, integration and service platform.

SMARTBUILD

Project acronym,	**SMARTBUILD: Implementing smart ICT concepts for energy efficiency in public buildings**

<table>
<tr><td>title, type</td><td colspan="5"></td></tr>
<tr><td>Programme, topic</td><td colspan="5">ICT for Energy Efficiency in Public Buildings (CIP-ICT-PSP.2011.1.2)</td></tr>
<tr><td>Duration</td><td colspan="5">2012-02-01 to 2015-01-31 (36 months)</td></tr>
<tr><td>Budget M€</td><td>2.6</td><td>Funding M€</td><td>1.3</td><td>Person months</td><td>n/a</td></tr>
<tr><td>Website(s)</td><td colspan="5">www.smartbuild.eu</td></tr>
<tr><td>Participants</td><td colspan="5">- WIRTSCHAFT UND INFRASTRUKTUR GMBH & CO PLANUNGS KG
- TECHNISCHE UNIVERSITAET WIEN
- KENTRO ANANEOSIMON PIGON KE EXIKONOMISIS ENERGEIAS (CENTRE FOR RENEWABLE ENERGY SOURCES AND SAVING)
- Generplus SPA
- F.A.R. SYSTEMS SPA
- ACCADEMIA EUROPEA PER LA RICERCA APPLICATA ED IL PERFEZIONAMENTO PROFESSIONALE BOLZANO (ACCADEMIA EUROPEA BOLZANO)
- Solski center Velenje</td></tr>
<tr><td>Summary</td><td colspan="5">A smart ICT concept will be implemented in existing public buildings in Germany, Italy, Slovenia and Greece in order to reach energy savings in annual and peak consumption up to 35% and to provide social-economic benefits to building users, to building managers, to public authorities and to distributor network operators. The ICT concept proposed with this action will be based on the off-the-shelf “Far Echo” ICT system, developed by the partner FAR Systems for the targeted countries Italy, Slovenia and Greece. The “Far Echo” ICT system has already been installed and successfully tested for more than one year in Italy. The “Far Echo” ICT system will be implemented in each pilot building according to the building characteristics and National standards. In order to do this, a preliminary analysis of every individual pilot case has been already made during the proposal preparation phase in order to have a realistic view of the proposed solutions. A further and more accurate energetic analysis will be carried out at the beginning of the project and a strategy will be developed to achieve the foreseen reduction in the energy consumption. The analysis is based on a classification for each pilot of the main loads and energy supply systems, considering their efficiency, timely profile, and the capacity of the current control (if available) to be improved by the installation of the proposed concept based on the “Far Echo” ICT system. The analysis will refer to energy as well as to the behavior of the people. The analysis will be carried out by the ICT provider FAR Systems with the support of the local energy and ICT experts from the target countries of the proposed action: WIP for Germany, EURAC for Italy, SCV for Slovenia and CRES for Greece.</td></tr>
<tr><td>Main ICT related results</td><td colspan="5">Installation “Far Echo” ICT system on pilot buildings to reach energy savings and to provide social-economic benefits to building users, to building managers, to public authorities and to distributor network operators</td></tr>
<tr><td>Information sources</td><td colspan="5">Project website and Cordis</td></tr>
</table>

used for this analysis	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	- Intelligent Automation and Control (2.1) - Monitoring (2.2) - Quality of Service (2.3)
	3. User awareness and decision support
	- Performance management (3.1) for performance analysis and evaluation - Visualization of energy usage (3.2) for user awareness and decision support tools - Behavioural change (3.3)
	4. Energy management and trading
	- Smart grids (4.2)
	5. Integration technologies
	- System integration (5.2)

SMARTSPACES

Project acronym, title, type	**SMARTSPACES: Saving Energy in Europe's Public Buildings Using ICT**				
Programme, topic	ICT for Energy Efficiency in Public Buildings (CIP-ICT-PSP.2011.1.2)				
Duration	2012-01-01 to 2014-12-31 (24 months)				
Budget M€	7.0	**Funding M€**	3.4	**Person months**	n/a
Website(s)	www.smartspaces.eu				
Participants	- EMPIRICA GESELLSCHAFT FUER KOMMUNIKATIONS- UND TECHNOLOGIEFORSCHUNG MBH				

	- VILLE DE MOULINS - REAL PROJECT PARTNER SARL - MOULINS HABITAT - LYONNAISE DES EAUX FRANCE SA - EDF Optimal Solutions - STADT HAGEN - INGENIEUR-UND PLANUNGSGEMEINSCHAFTENVI GMBH - IBM ITALIA SPA* - COMUNE DI MILANO - BT Italia SpA - University of Belgrade - Faculty of Mechanical Engineering - PREDUZECE ZA INFORMACIONE TEHNOLOGIJE I ELEKTRONSKO TRGOVANJE BELIT DOO - BEOGRADSKE ELEKTRANE - GASSO AUDITORES, SLP - FUNDACIO LLEIDA 21*AGENCIA DE L'ENERGIA DE LLEIDA AEL - CONSORCIO AGENCIA LOCAL DE LA ENERGIA Y EL CAMBIO CLIMATICO DE MURCIA - CENTRE INTERNACIONAL DE METODES NUMERICS EN ENGINYERIA - EXPLOITATIEMAATSCHAPPIJ VILLA FLORA BV - CISCO SYSTEMS INTERNATIONAL B. V. - Istanbul Sport Events Inc. - SYSTEMSLINK 2000 LTD - LEICESTER CITY COUNCIL - DE MONTFORT UNIVERSITY - BRISTOL CITY COUNCIL - BIRMINGHAM CITY COUNCIL
Summary	To substantially reduce peak and overall demand for energy and water across EU public buildings, the project will develop a service comprising innovative ICT-based energy decision support, awareness and management service components. Decision support is provided directly to city energy managers and other professionals responsible for building performance, and to building users, both staff and visitors to the building, including school pupils and university students and the general public, enabling all to optimise their energy-related behaviour based on up-to-date meter feedback on energy consumption. Management components of the service include effective ICT control of local renewable power and the full heat delivery chain for district / building systems.

	The SMARTSPACES service will enable public authorities in Europe significantly to improve their management of energy in the buildings they occupy. In operational terms, the consortium will carry out intensive work on optimising services for all user groups and maximising impact on resource use behaviour. Within the first year, requirements will be investigated with users, use cases agreed and service prototypes subject to rigorous user testing. Test results help finalise service components in a second design iteration lasting some 8 months, cumulating in implementation of operational services at all 11 pilot sites with more than 550 buildings in 8 countries (UK, FR, DE, IT, ES, NL, TR, RS) with almost 20,000 professionals and staff users and reaching an estimated more than 6,000,000 visitors annually. Pilots at all sites will operate for at least one year; lead sites will be identified to being in operation early and provide example solutions to others. The consortium, led by public authorities includes global ICT and service providers and distribution network operators working with local consultants and specialist advisors to carry out all steps in the project service implementation process.
Main ICT related results	Developement a service comprising innovative ICT-based energy decision support, awareness and management service components
Information sources used for this analysis	Project website and Cordis
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	- Intelligent Automation and Control (2.1) - Monitoring (2.2) - Quality of Service (2.3)
	3. User awareness and decision support
	- Performance management (3.1) for performance analysis and evaluation - Visualization of energy usage (3.2) for user awareness and decision support tools - Behavioural change (3.3)
	4. Energy management and trading
	n/a
	5. Integration technologies
	System integration (5.2)

VERYSCHOOL

Project acronym, title, type	**VERYSchool – Valuable EnerRgY for smart School**				
Programme, topic	ICT for Energy Efficiency in Public Buildings (ICT-PSP.2011.1.2)				
Duration	2011-12-01 to 2014-11-30(36 months)				
Budget M€	2.8	**Funding M€**	1.43	**Person months**	n/a
Website(s)	n/a				
Participants	- AGENZIA PER L'ENERGIA E LO SVILUPPOSOSTENIBILE ASSOCIAZIONE, ITALY - SCE S.R.L., ITALY - MAGYAR TUDOMANYOS AKADEMIA SZAMITASTECHNIKAI ES AUTOMATIZALASI KUTATO INTEZET, HUNGARY - ENERGY AGENCY OF PLOVDIV ASSOCIATION, BULGARIA - ENERIT LIMITED, IRELAND - D'APPOLONIA SPA, ITALY - COMUNE DI GENOVA, ITALY - SELF ENERGY - SERVICOS DE ENERGIA SA, PORTUGAL - IS GREEN II, LDA, PORTUGAL - INTEGRATED ENVIRONMENTAL SOLUTIONS LIMITED, UNITED KINGDOM - UNIVERSITY OF BELGRADE - FACULTY OF MECHANICAL ENGINEERING, SERBIA - INTESASANPAOLO EURODESK S.P.R.L, BELGIUM - ANKARA MILLI EGITIM MUDURLUGU, TURKEY				
Summary	VERYSchool will develop customised energy savings strategies and ICT solutions for EU schools. It will do this through the integration of Smart LED Lighting, Smart Meters, Building Energy Management Systems, Energy Simulation Software, and Energy Action Management Software. Each of these technologies are brought to the project from consortium partners with companies dedicated specifically to each hardware or software. The integration of these technologies will be conducted under the guidelines and practices of ISO50001 (energy programs) and IPMVP (measurement & verification) and will be called the VERYSchool Energy Action Navigator.				

	The Navigator will link all actors of the school value chain under a common platform dedicated to energy efficiency and provide “how to” information, enabling tools, and cutting edge intelligent energy savings strategies through the execution of optimisation scenarios dedicated specifically to the needs of schools. VERYSchool will demonstrate its methodology, approach, and integrated solution at 4 Pilot locations. The pilot buildings are selected, they represent different school typologies and geographic locations and are directly managed by Consortium Partners. VERYSchool is industry led and market driven. Consortium members include Municipalty, Educational Directorate, Regional Energy Agencies, Bank Consultant, ESCO, ICT hardware and software Providers, Technology Integrators, and ICT Consultants. Collectively, the consortium has oversight of over 8000 schools. VERYSchool is relevant because schools are highly replicable and are a segment of the building stock to which energy efficient retrofit funding will flow first as Europe determines how to meet 2020 and 2050 targets. VERYSchool will be on the leading edge of this trend providing the roadmap and platform for the efficient uptake and use of future investments.
Main ICT related results	n/a
Information sources used for this analysis	Documentation of Work
Reference to ICT4E2B Classification	**1. Tools for EE design and Production management**
	Energy Simulation Software, and Energy Action Management Software.
	2. Intelligent Control
	Smart LED Lighting, Smart Meters
	3. User awareness and Decision support
	n/a
	4. Energy management and Trading
	Building Energy Management Systems
	5. Integration Technologies
	Integration of Smart LED Lighting, Smart Meters, Building Energy Management Systems, Energy Simulation Software, and Energy Action Management Software.

16 Appendix I – CIP IEE Research Projects

EPI-CREM

<table>
<tr><td>Project acronym, title, type</td><td colspan="5">EPI-CREM – Energy Performance Integration in Corporate Public Real Estate Management</td></tr>
<tr><td>Programme, topic</td><td colspan="5">Buildings (IEE 2007)</td></tr>
<tr><td>Duration</td><td colspan="5">From 2007-12-01 to 2010-05-31</td></tr>
<tr><td>Budget M€</td><td>1,3</td><td>Funding M€</td><td>0,65</td><td>Person months</td><td>n/a</td></tr>
<tr><td>Website(s)</td><td colspan="5">http://www.epi-crem.org</td></tr>
<tr><td>Participants</td><td colspan="5">- energie:bewusst Kärnten, Austria
- ÖsterreichischeEnergieagentur (AEA), Austria
- Centre scientifique et technique du bâtiment (CSTB), France
- EBM-consult BV, Netherlands</td></tr>
<tr><td>Summary</td><td colspan="5">Until now, most public building organizations don’t pay much attention to energy efficiency in relation to decisions on Real Estate. One of the reasons is a lack of tools to facilitate integrated decision-making, in which energy efficiency is taken into account amongst other aspects. EPI-CREM aims to improve energy efficiency and rational use of energy across public building stock in Europe by embedding energy issues in decision making processes within Corporate Real Estate Management (CREM) at the strategic level, and translating those decisions into tactical and operational levels of building management. This way the decision making process surrounding energy saving measures is embedded in the CREM-process, and is made structural and more cost effective. To reach these goals EPI-CREM provides a strategy and a set of tools enabling building owners and users to make the energy aspect an integral aspect of Corporate Real Estate Management.</td></tr>
<tr><td>Main ICT related results</td><td colspan="5">- The EPI-CREM embedding approach, where energy efficiency and rational use of energy issues are embedded into public property management processes (like the tenancy agreement, long term maintenance and renovation plans and specific building related energy saving and efficiency plans);
- The EPI-CREM toolkit, which contains:
o Integrated Data acquisition and Quality Protocol;
o Database Integrated Information System;
o Scenario Analysis Module;</td></tr>
<tr><td>Information sources used for this</td><td colspan="5">Project website and http://www.eaci-projects.eu/iee</td></tr>
</table>

analysis	
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	This thematic area is covered by the project
	2. Intelligent control
	n/a
	3. User awareness and decision support
	n/a
	4. Energy management and trading
	n/a
	5. Integration technologies
	This thematic area is covered by the project

LCC-DATA

Project acronym, title, type	**LCC-DATA–Life Cycle Cost in the Planning Process. Constructing Energy Efficient Buildings taking running costs into account**				
Programme, topic	Buildings **(**IEE 2006)				
Duration	From 2006-12-01 to 2009-05-31				
Budget M€	0,65	**Funding M€**	0,325	**Person months**	n/a
Website(s)	http://www.sintef.no/Byggforsk/Forskning-og-utvikling/LCC-DATA-Life-Cycle-Costs				
Participants	- ÖsterreichischeEnergieagentur (AEA), Austria - CITYPLAN spol. s.r.o., Czech Republic - Berliner Energieagentur GmbH (BE), Germany - Centre for Renewable Energy Sources (CRES), Greece - Building and Civil Engineering Institute ZRMK (BCEI ZRMK), Slovenia				
Summary	The LCC-DATA project aimed at easing and extending the use of Life Cycle Costs Analysis (LCCA) in the construction industry and hence improve the decision-making process towards more sustainable buildings. In more practical terms, the project aimed				

	at developing a web-based database for benchmarking buildings' in-use costs (operation, maintenance, management, energy, etc) in order to ease LCC calculations. Using benchmarking for performing LCCA can indeed be very valuable as usual LCC analysis are often too time-demanding or too complex for the market actors (e.g. architects, engineers, large property owners). In addition, the project aimed at ensuring simplified data exchange between the different ICT-tools used in planning and decision.				
Main ICT related results	- Development of a European database for input to LCC calculations and assessments. - Establishment of a new LCC cost classification framework.				
Information sources used for this analysis	Project website and http://www.eaci-projects.eu/iee				
Reference to ICT4E2B Classification	**6. Tools for EE design and production management**				
	This thematic area is covered by the project				
	7. Intelligent control				
	n/a				
	8. User awareness and decision support				
	n/a				
	9. Energy management and trading				
	n/a				
	10.Integration technologies				
	This thematic area is covered by the project				

SMART-A

Project acronym, title, type	**SMART-A - Smart Domestic Appliances in Sustainable Energy System**				
Programme, topic	Electricity production **(**IEE 2006)				
Duration	From 2007-01-01 to 2009-06-30				
Budget M€	1,3	**Funding M€**	0,75	**Person months**	n/a
Website(s)	http://www.smart-a.org				

Participants	- Inter-University Research Centre for Technology, Work and Culture (IFZ), Austria - COGEN Europe VZW, Belgium - EnBWEnergie Baden-Württemberg AG (EnBW), Germany - Enervision GmbH, Germany - Miele& Cie. KG, Germany - Rheinische Friedrich-Wilhelms-Universität Bonn, Germany - Imperial College of Science, Technology and Medicine, United Kingdom - The University of Manchester, United Kingdom
Summary	Coordinating the demand of domestic energy appliances with local sustainable energy generation and the requirements of regional load requirements in electricity networks is a complex yet necessary objective. Sustainable energy systems require smart energy loads to coordinate their operation with current levels of supply. The project aims to determine if, and under what conditions, consumers would be ready to use 'smart appliances' to spread out the demand placed at peak hours on electricity grids. One possibility would be to offer lower tariffs to those who are prepared to be flexible. Demand-side management (DSM) programmes consist of planning, implementing, and monitoring the activities of electric utilities which are designed to encourage consumers to modify their level and pattern of electricity usage. The project analyses consumer acceptance in EU countries in which case studies are running and extends the analysis to cover other countries as well.
Main ICT related results	- A thorough analysis of technological implications, user preferences, and the economic and ecological costs and benefits of improved coordination of domestic appliances with energy supply, will be conducted - A clear understanding of how appliances should be designed to enable them for smart operation in the larger energy system
Information sources used for this analysis	Project website and http://www.eaci-projects.eu/iee
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	n/a
	3. User awareness and decision support
	This thematic area is covered by the project
	4. Energy management and trading

	This thematic area is covered by the project
	5. Integration technologies
	n/a

SMART-E BUILDINGS

Project acronym, title, type	**SMART-E BUILDINGS - Smart-e buildings - yes we canEnable the building sector to contribute to reaching the 3 x 20 objectives**				
Programme, topic	Buildings **(**IEE 2009)				
Duration	From 2010-05-01 to 2013-04-30				
Budget M€	1,8	**Funding M€**	1,35	**Person months**	n/a
Website(s)	n/a				
Participants	- EUROPEAN TECHNICAL CONTRACTORS COMMITTEE FOR THE CONSTRUCTION INDUSTRY, Belgium - European Renewable Energy Council (EREC), Belgium - European federation of agencies and regions for energy and environment (FEDARENE), Belgium - The European Alliance of Companies for Energy in Buildings (EUROACE), Belgium - Agence de l'Environnement et de la Maîtrise de l'Energie (ADEME), France - Energie-Cités (EC), France - Climate Alliance / Klima-Bündnis / Alianza del Clima e.V., Germany - Eclareon Ltd., Germany - KETCHUM PLEON B.V, Netherlands				
Summary	Smart-e buildings is a European-wide industry-led mobilisation campaign that uses Web 2.0 techniques to attract building owners and provide guidance through their decision making processes in renovation or new buildings. Inspired by the successful Obama's election campaign, the Smart-e Buildings campaign aims at mobilising 2 million Europeans through a robust interactive web portal which will be launched in May 2011. To build and maintain the e-campaign, the portal will be linked to Smart-e Buildings' social network profiles. Not only will it serve as a source of information – thus complementing the existing website of the EU Build Up initiative – but it will also represent a platform where building owners, professionals and citizens can exchange experiences, ideas, and information, proactively supporting the Smart-e Buildings cause. This bottom-up approach will be deployed in 10 languages and 13 EU-countries initially using 5 test markets (4 European Cities and the Region of Upper Austria) to quickly optimise the campaign strategy. As a top-down path, a network of national and European Parliamentarians will be set-				

	up and strengthened through the organisation of events.
Main ICT related results	Engage 2 Mio Europeans (amongst building owners, building professionals and citizens) in a practice-oriented interactive dialogue on how to implement energy efficiency measures and renewable energy technologies in buildings
Information sources used for this analysis	http://www.eaci-projects.eu/iee
Reference to ICT4E2B Classification	**1. Tools for EE design and production management**
	n/a
	2. Intelligent control
	n/a
	3. User awareness and decision support
	This thematic area is covered by the project
	4. Energy management and trading
	n/a
	5. Integration technologies
	This thematic area is covered by the project