REEB, the European strategic research roadmap to ICT enabled Energy-Efficiency in Buildings and construction

GREEMBED 2010

Juan Pérez – TECNALIA Labein

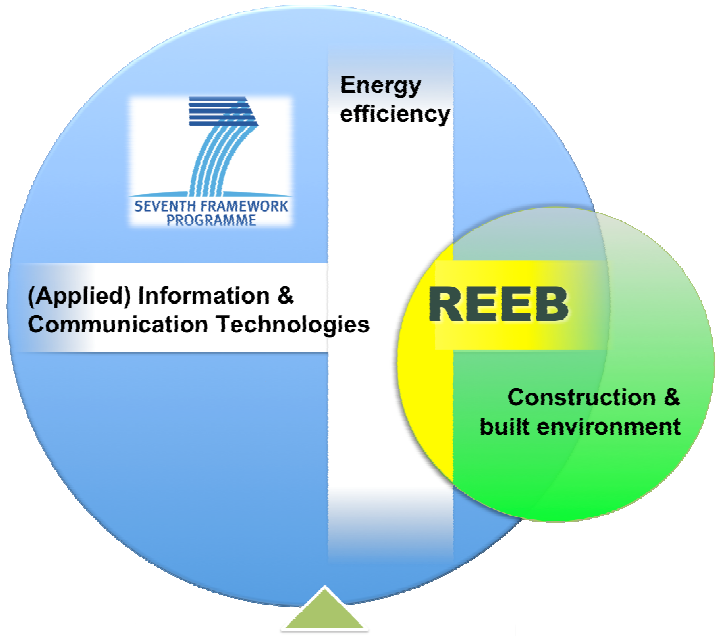
juan@labein.es

Agenda

- Project overview
- Objectives
- Consortium
- Scope, expected impact
- Achievements
- The REEB Vision
- The Roadmap
- Collaboration

Project overview

- Establish a European strategic research roadmap to ICT enabled Energy-Efficiency in Buildings and construction
  - Grant agreement no. 224320
  - Starting Date
    - 1st May 2008
  - Finishing Date
    - 31st October 2010



The REEB synergism

Project overview

- Coordination action
  - Strategic Objective: ICT for Energy Efficiency for the Building sector
  - DG INFSO - Unit H4
- The project aims at providing:
  - a vision & a roadmap,
  - supported by a detailed strategy,
  - for co-ordinating and rationalising current and future RTD in the fields of ICT support to energy-efficiency in the built environment of tomorrow

Objectives (1/2)

- **Objective 1.** Setup the European & National REEB communities
  - *« Bringing together actors from the ICT, Energy and Construction sector »*
  - Provide with a comprehensive set of stakeholders for discussion and feedback to vision & roadmap

- **Objective 2**: Identify current best practices & RTD project results
  - *« Key exemplary projects and initiatives in the field of ICT for EE in construction »*
  - Provide a reference basis for identification of SOTA in the roadmap

Objectives (2/2)

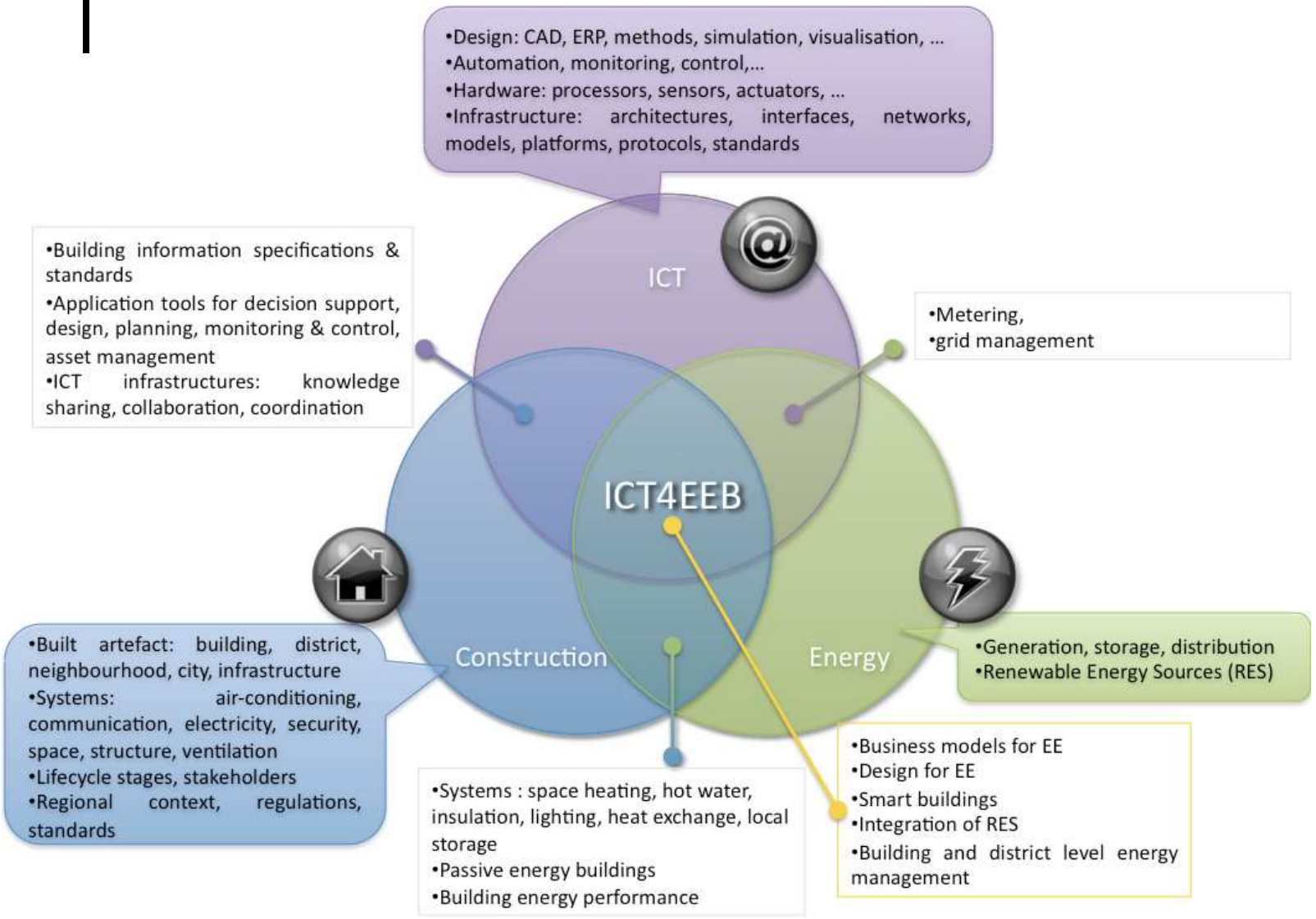
- **Objective 3**: Establish a vision, a roadmap and implementations recommendations
  - *« A shared European vision for ICT supported EE in Construction »*
  - Realisation of a book

- **Objective 4:** achieve dissemination, training & education
  - *« e-learning lecture courses in ICT supporting sustainability in buildings and neighbourhoods »*
  - Provide awareness to future stakeholders in the Construction sector

Consortium

- 8 partners led by CSTB

Scope


•Design: CAD, ERP, methods, simulation, visualisation, …
•Automation, monitoring, control,…
•Hardware: processors, sensors, actuators, …
•Infrastructure: architectures, interfaces, networks, models, platforms, protocols, standards
ICT
•Building information specifications & standards
•Application tools for decision support, design, planning, monitoring & control, asset management
•ICT infrastructures: knowledge sharing, collaboration, coordination
•Metering,
•grid management
ICT4EEB
Construction
Energy
•Built artefact: building, district, neighbourhood, city, infrastructure
•Systems: air-conditioning, communication, electricity, security, space, structure, ventilation
•Lifecycle stages, stakeholders
•Regional context, regulations, standards
•Generation, storage, distribution
•Renewable Energy Sources (RES)
•Systems : space heating, hot water, insulation, lighting, heat exchange, local storage
•Passive energy buildings
•Building energy performance
•Business models for EE
•Design for EE
•Smart buildings
•Integration of RES
•Building and district level energy management

Expected impacts

- REEB to contribute to
  - Pave the way to the EU world-leadership in ICT enabled energy efficiency through intelligent solutions
  - Widen take-up of ICT based energy systems and services and therefore contribute to future energy neutral and energy-positive buildings & neighbourhoods
  - Increase awareness about ICT potential, priorities and impact in terms of energy efficiency in Buildings
  - Provide with a more holistic view on the need for integrated complex engineering ICT systems for EeB.

Achievements (1/2)

- **Objective 1.** Setup the European & National REEB communities
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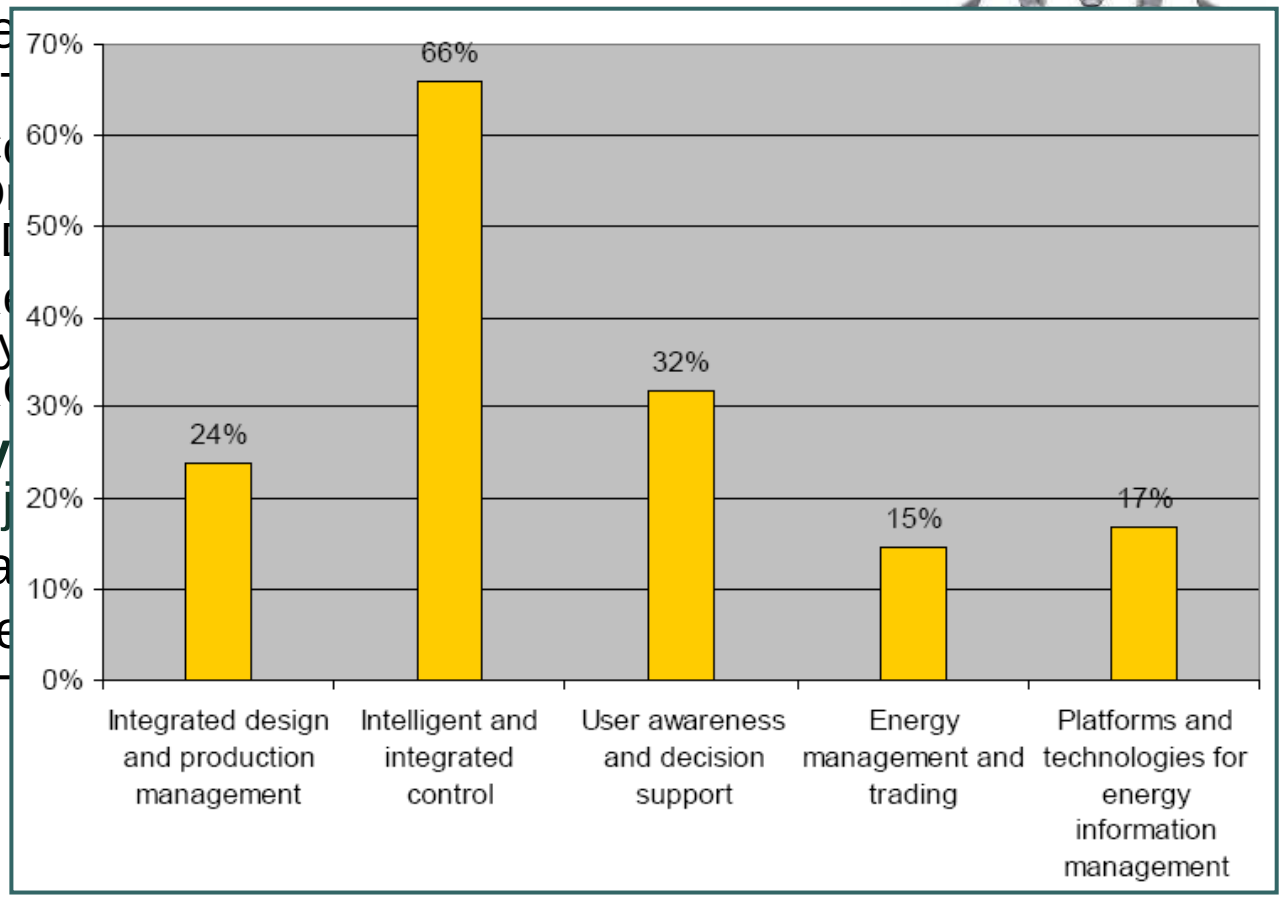
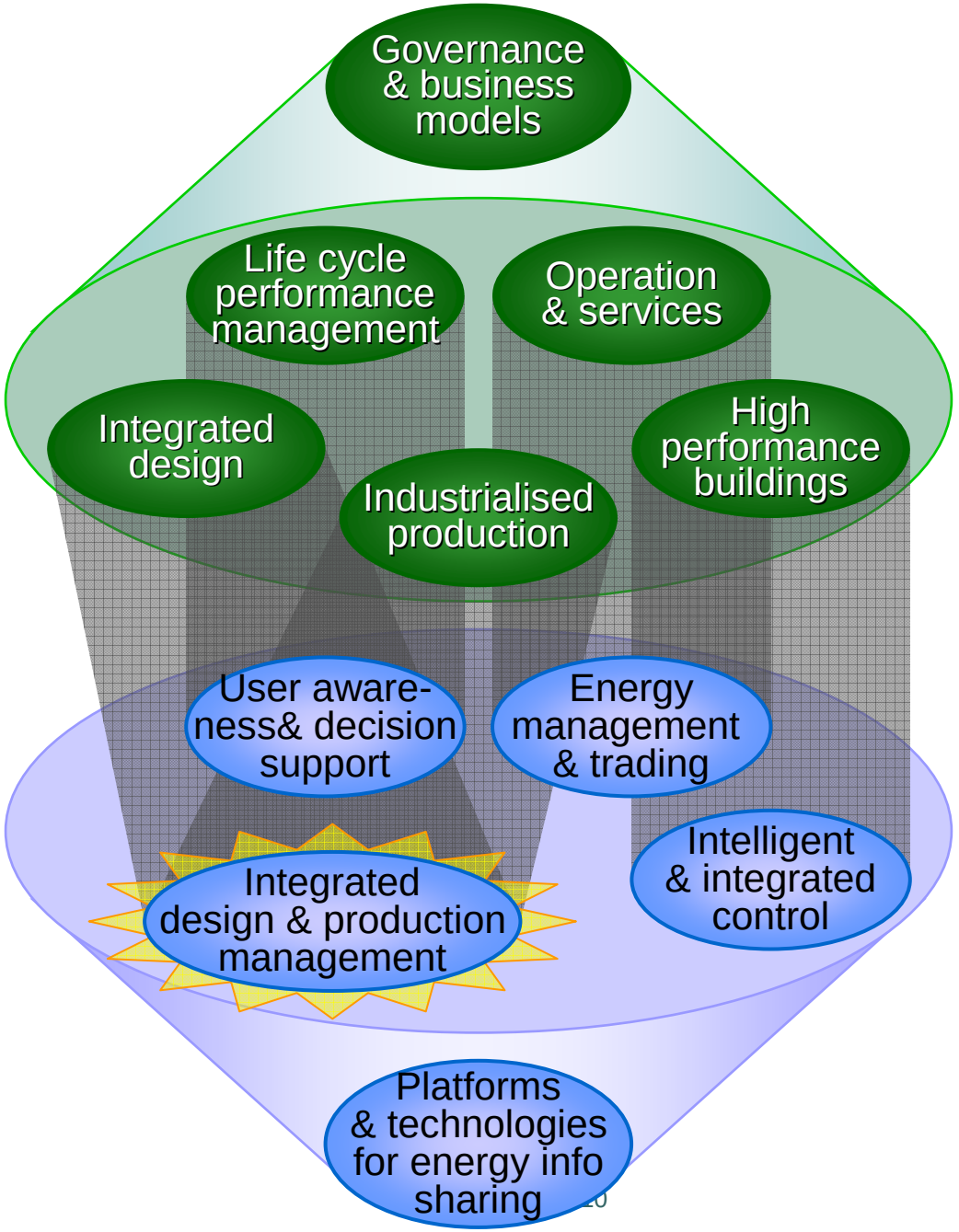


Achievements (2/2)

- **Objective 3**: Establish a vision, a roadmap and implementations recommendations
  - REEB Vision and Technogical Roadmap have been already issued
  - Implementation Actions will be available by the begining of next month
  - REEB Book will be available by the end of October
- **Objective 4:** achieve dissemination, training & education
  - e-learning lecture courses will be available by the end of August

Vision: The Views

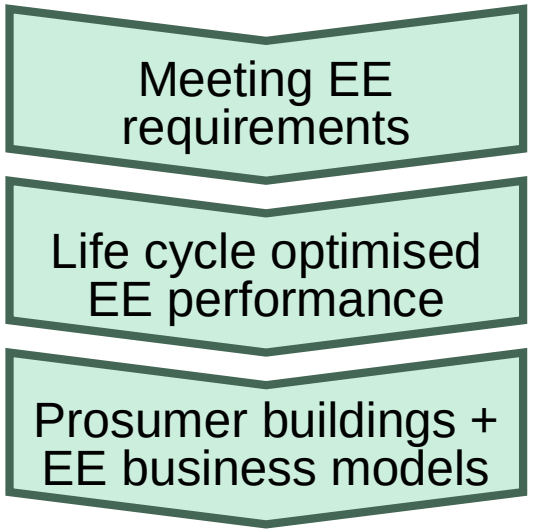


Construction view

ICT view

The Roadmap (1/3)

- **Short term**: Buildings meet the energy efficiency requirements of regulations and users.
- **Medium term**: The energy performance of buildings is optimised considering the whole life cycle.
- **Long term**: New business models are driven by energy efficient “prosumer” buildings at district level.



The Roadmap (2/3)

Intelligent and integrated control:

- Drivers:
  - Dynamic electricity prices,
  - local production of electricity and storage,
  - Increasing energy prices,
  - Regulations and standards for energy efficiency of buildings
- Barriers
  - ROI has still to be proven for users
  - Insufficient Interoperability
  - End-user acceptance
- Impacts
  - Increasing demand for integrated BMS
  - Opportunities thanks to interoperability standard
  - *"EnergyPlus for everybody"*
- Scenarios
  - Smart Box: Dynamic energy price.
  - Smart Office: Integration of security and HVAC systems
  - Smart Shutter: Plug&Play of Energy saving devices

The Roadmap (3/3)

- Research Topics:
  - Automation and control.
    - **Short term**: Developing **holistic control strategies** that integrate all building dimensions and take user activities and building context into account; Address all BMS components for **predictive maintenance**.
    - **Medium term**: **Integrate simulation tools in BMS** to optimize control strategy in real-time.
    - **Long term**: **Self-learning** features in control algorithms that adapt to the user's preferences and the possible change in the building environment.
  - Monitoring.
    - **Short term**: **Decrease costs** of manufacturing sensors. **Multi-energy smart-meters**.
    - **Medium term**: **Integration of multi-meters at neighborhood level**, **More** [illegible] **sensors**.
    - **Long term**: Tightly and securely **integrate Smart Grids and Smart Buildings**. Adoption of **Distributed Intelligence** concepts.
  - Quality of service.
    - **Short term**: **Enabling diagnosis of EE-related building components**
    - **Medium term**: Generalize diagnosis of EE-related building components through the **embedding of sensors in the components**.
    - **Long term**: Develop **BMS that will be fully auto-controlled and auto-monitored**, discovering their own malfunctions.
  - Wireless sensors networks.
    - **Short term**: **Improve sensors reliability**; **Reduce energy consumption**; Identify possible negative **side-effects associated to WSN**.
    - **Medium term**: **Plug&Play**, **Embedded multi-tasking OS**.
    - **Long term**: **Completely autonomous in terms of energy supply network nodes**

Interoperability

How ICT can help

Case study #1

Integrated design & production management

- CAD Software for EeB design, Finland

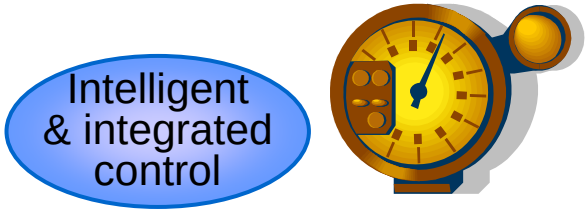
- Objectives
  - Building services systems design and analysis
  - Draw all building systems in the same drawing and run a complete functionality test
  - The tool includes HVAC design, Electrical design, comfort & energy simulation

- Applied ICTs
  - Model (BIM based) CAD system
  - **IFC2x3 standard**
  - Component catalogues including thermodynamic & flow behaviours

- Impact
  - Integrates EE and other aspects as parts of holistic design thus avoiding to overload design with extra activities and additional tools for EE
  - Skilled users can expect huge potential gains in terms of total energy consumption of the designed building(s).

How ICT can help

Case study #2



▶ Smart meters deployment in France

- Objectives
  - For consumers : Consumer awareness of real-time electricity consumption
  - For producers : Better peak load management and energy networks balance
  - For grid managers, utilities, and ESCOs : Better knowledge of real electricity flow, introduce flexible tariffs, holistic service concepts (energy audits, predictive maintenance…)
- Applied ICTs
  - The **smart meter** itself: simple display for some basic information to the customer, a limited storage capacity, a clock, some limited command capabilities
  - **PLC technology** for transmitting data (up to the hub and down to the smart meter)
  - A **hub**, connected to all neighbouring smart meters storing all data
  - **RTC, GSM, GPRS, Wireless or Internet technologies** to send data from the hubs to the central management system
  - The **central management system**, gathering all data and providing them to the different business units of the grid management company (Finance, Grid management, etc.)
- Impact
  - At consumers' level : Reduced electricity consumption (consumer's behaviour change)
  - At producers' level : Reduction of electricity production's costs through peak load management + Help to manage decentralized PV production
  - At grid managers' level : 35 Millions kilometres covered by the utility agents each year should be saved thanks to the remote online maintenance of the smart meters

How ICT can help

Case study #3

- Building energy management systems

- Objectives
  - Systems are modular, easily customisable with configuration tools, adaptive and able to learn from their environment.
  - Combination of predictive control, intelligent HVAC, intelligent lighting.
  - Enable condition- and performance-based maintenance.

- Applied ICTs
  - Embedded sensing.
  - Automation and control including monitoring and sensors (voltage, current, etc.).
  - Automated switches and controls and micro-processing capability.
  - Decision support algorithms.

- Impact
  - Interoperable connections and protocols allow holistic provision, operation, monitoring and maintenance of systems.
  - Various control and service software will run on a common integration platform, a “building operation system”.
  - Various building services (heating, cooling, lighting, air-conditioning, security etc.), which are currently often operated independently, will be managed holistically.

How ICT can help

Case study #4

User aware-ness& decision support

- Power Price Signal Device – changing behaviour by real-time pricing

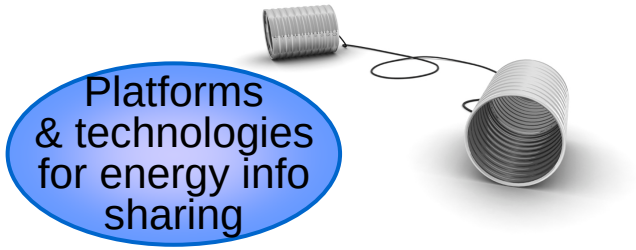
- **Objectives**
  - Empower customer to make “smart” power consumption decisions that lessened energy demand at peak time
  - Stronger competitive differentiation through transparent pricing and usage-based billing for residential users
  - Established technical platform for future process transformation initiatives

- **Applied ICTs**
  - **Energy customer display** showing energy pricing (i.e. using electricity traffic light), and also displays the date, time, temperature and weather trend.
  - **Communication infrastructure** that leverages an existing commercial paging network for price data to be transmitted to the displays
  - Developed an **algorithm** to generate a simple, easy-to-understand tariff through:
    - a custom data feed of wholesale electricity price at periodic intervals & incorporating other important tariffs determinants

- **Impact**
  - Lower cost and more efficient power generation through reductions in peak energy consumption
  - Improved ability to absorb alternative energy sources into the power grid
  - Lower energy costs for the customers

How ICT can help

Case study #5



- Standardized Building Information Data Models (BIM)

- Objectives
  - Providing a common data model that support the information that is managed during the building life cycle in relation with its Energy Efficiency.
  - Enabling the collaboration among different EEB (energy efficiency in buildings) related software tools without “retyping” the same data (building definition, climatic conditions, …) for every tool.

- Applied ICTs
  - **Ontologies** to provide a formal representation of the EEB concepts and the relationships between those concepts.
  - **Information brokers**, to make possible accessing to the building information from remote places and providing the information that is relevant to every type of users (domain, role in building life cycle, …).

- Impact
  - Avoiding the mistakes, incoherencies, costs and delays that are common when the information is duplicated and manually handled.
  - Enabling more detailed analysis about EEB without increasing the cost and duration of the building project.
  - Facilitating the maintenance of installations, in such a way that their efficiency doesn’t

How ICT can help

Case study #6

User aware-ness& decision support

- Holistic Energy & Facilities Management Germany (best practice) / Ireland (research prototypes)

- Objectives
  - For Tenants: (1) Improve the awareness about user actions (what is the implication of my action?) (2) to inform about different tariffs and allow easy decision making,
  - For Energy Providers: to get a detailed understanding about user demands
  - For Operators (FM): Optimize scheduling of required maintenance activities
  - For Owners: Optimize decisions about renovation of systems & components
  - For Maintenance Staff: Better understanding of impacts of malfunctioning devices (what else needs to be repaired?)

- Applied ICTs
  - Web-based user interfaces which allow context sensitive representation of data
  - Data Warehouse Technology: which allows consolidation of data from multiple sources and the multi-dimensional aggregation of performance data
  - Data Mining: which allows the analysis of data stored in Data Warehouses (e.g. to categorise “demand profiles” as basis for flexible tariffs)
  - Multi-criteria Decision Support: which allow the consideration of criteria/requirements from different stakeholders

- Impact
  - at tenants level: optimal energy consumption → allowing response to supply options
  - at operator level: improved customer relationship management / opportunity to offer “holistic” services concept to users (e.g. ESOC)

How ICT can help

Case study #7

Integrated design & production management

- Clean Room Operation (Ireland),
  Pre-Manufactured Intelligent Façades (inHaus2, Germany)

- Objectives:
  - for General Contractor: Improved design of interfaces between systems and components (e.g. “”Intelligent Façade” and under floor heating)
  - for Manufacturer: Optimization of energy consumption during production process (e.g. “load balancing”);
  - for Manufacturer: Optimised layout of manufacturing facilities (to allow “integrated”usage of individual systems and components (e.g. allow heat recovery, to allow integration of “natural resources”),
  - For Energy Provider: Energy consumption planning (workload scheduling according to tariffs);

- Applied ICTs:
  - Building Information Modelling (i.e. the “holistic”, consistent availability of geometrical and technical/descriptive data in a standardised format)
  - Business Process Modelling and Business Process Simulation integrated with Energy Management tools,
  - Production Planning and Integrated Energy Simulation tools (e.g. CFD)
  - Tools and Data Exchange Standards for Energy Information Sharing (preferably web-based tools, service oriented architectures and semantic web)

- Impact:
  - envisaged reduction of energy consumption of up to 20%,
  - optimised delivery (reduction of transport energy) and installation,
  - optimised systems integration into overall control system → leading to optimised building operation → allowing energy savings of up to 15%

Collaboration (1/2)

- Join our REEB community
  - Receive regular progress update, newsletters, and publications
  - Get preliminary information and draft deliverables
  - Receive invitations to workshops and related events
    - REEB Final workshop

- http://ict-reeb.eu/irc.html

Collaboration (2/2)

- Write your own corporate vision
  - We have issued a first version of the REEB Vision and Technological Roadmap, but
  - We are willing sharing them with you and getting your feedback:
    - Do you agree with them?
    - Do you disagree with some of our positions?
    - Would you like adding or emphasizing some topic?
  - Your comments and contributions will be analyzed and included in the REEB Book that will be published in collaboration with the EC by the end of October of this year.
    - Main contributors will be invited to appear in the foreword of this book.

Thank you

- Questions ?
  - Juan Pérez – TECNALIA Labein

    IRC (International REEB Community) Coordinator
    - juan@labein.es

Looking forward to collaborating with you.

The work leading to these results has received funding from the European Community's Seventh Framework Programme under grant agreement n° **224320**