



E3soho

Energy Efficiency in European Social Housing

E3SoHo final workshop : ICT solutions for energy awareness and management in buildings: main conclusions and lessons learnt

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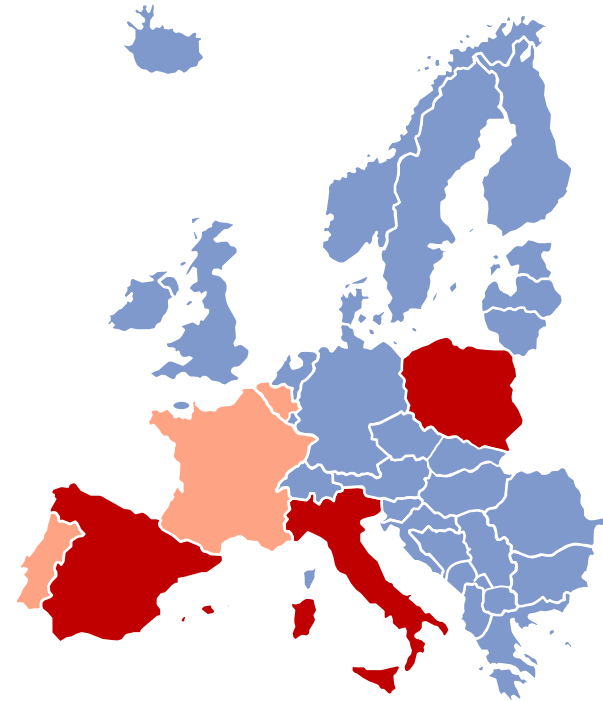
ICT solutions for energy efficiency in residential buildings

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The project & partnership

- Consortium: 11 partners from 6 countries
- Pilots: 3 pilot sites in 3 countries (Spain, Poland, Italy)
- Budget: 3,6 M€ (1,8 M€ EC funding)
- Duration: 44 months
- Starting date: 01/02/2010



The overall objective

To achieve a significant **reduction of energy consumption** by implementing and demonstrating an integrated, interoperable and replicable **ICT-based solution in 3 Social Housing pilots**



Zaragoza,
Spain



Genova,
Italy



Warsaw,
Poland

Partial objectives

Providing information to building owners/managers as support tool for building management/refurbishment

Developing global methodology for design, implementation and validation, and guidelines for replication

Providing building owners/managers feedback on energy production & management



PMVP
INTERNATIONAL PERFORMANCE
MEASUREMENT AND VERIFICATION

E3SoHo Solution



Providing tenants feedback on consumption, offering personalised advice for improving energy efficiency

Assessing energy savings and tenants' acceptance of the solution

Support tenants to decide best behaviour in terms of energy efficiency, cost, comfort and environmental impact



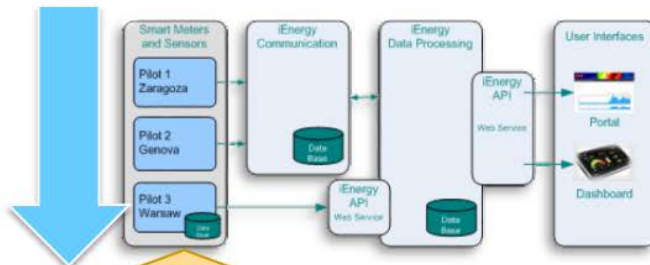
Dissemination, Exploitation, and Generation of business models around the E3SoHo global service and sub-services **(WP7)**

Methodology for design, implementation and evaluation of the services **(WP6)**

Perform building audits to identify energy savings potential & tenants/owners requirements **(WP2)**



Pre-monitoring, Baseline definition. Evaluation of energy savings and users acceptance, solution validation **(WP5)**



Provide tenants/owners with an ICT based blue-print to reduce energy consumption **(WP3)**



Implement the system according to the blue-print, training/awareness activities, maintenance and refinement of the installed system **(WP4)**

Spanish pilot site

- **Location:** Zaragoza
- **Owner:** Zaragoza Vivienda
- **Year of construction:** 2002
- **No of floors:** Ground + 8
- **No of dwellings:** 43 (16 active in the project)
- **No of users:** > 120 (46 active in the project)
- **Heating:** 2 Central gas boilers
- **DHW:** Solar thermal + gas



Polish pilot site

- **Location:** Warsaw
- **Owner:** City of Warsaw
- **Year of construction:** 2007
- **No of floors:** Ground + 4
- **No of dwellings:** 48 (16 active in the project)
- **No of users:** 111 (34 active in the project)
- **Heating:** Central gas boiler
- **DHW:** Central gas boiler



Mostostal
WARZAWA



WARSAW UNIVERSITY OF TECHNOLOGY

nobatek

CSTB
le futur en construction

Italian pilot site

- **Location:** Genova
- **Owner:** Comune di Genova / Private
- **Year of construction:** 1980-1990
- **No of dwellings:** 350 belonging to Comune (30 active in the project: 15 monitoring + 15 control)
- **No of users:** > 500 (> 60 active in the project)
- **Heating:** Central thermal power plant
- **DHW:** Gas



The main result of the E3SoHo project is the development of an integrated ICT system composed of:

- a **communication and data processing platform** (iEnergy)
- a **user interface for the tenants**, allowing them to consult the historic of consumptions, to view the consumptions in real-time, to check comfort conditions and to be alerted of limit conditions (sDisplay)
- a **user interface for building managers**, allowing them to consult and compare aggregate consumptions and other parameters associated with common equipment and areas, and a flexible alarm management engine (BMUI)

E3SoHo ICT solution main result



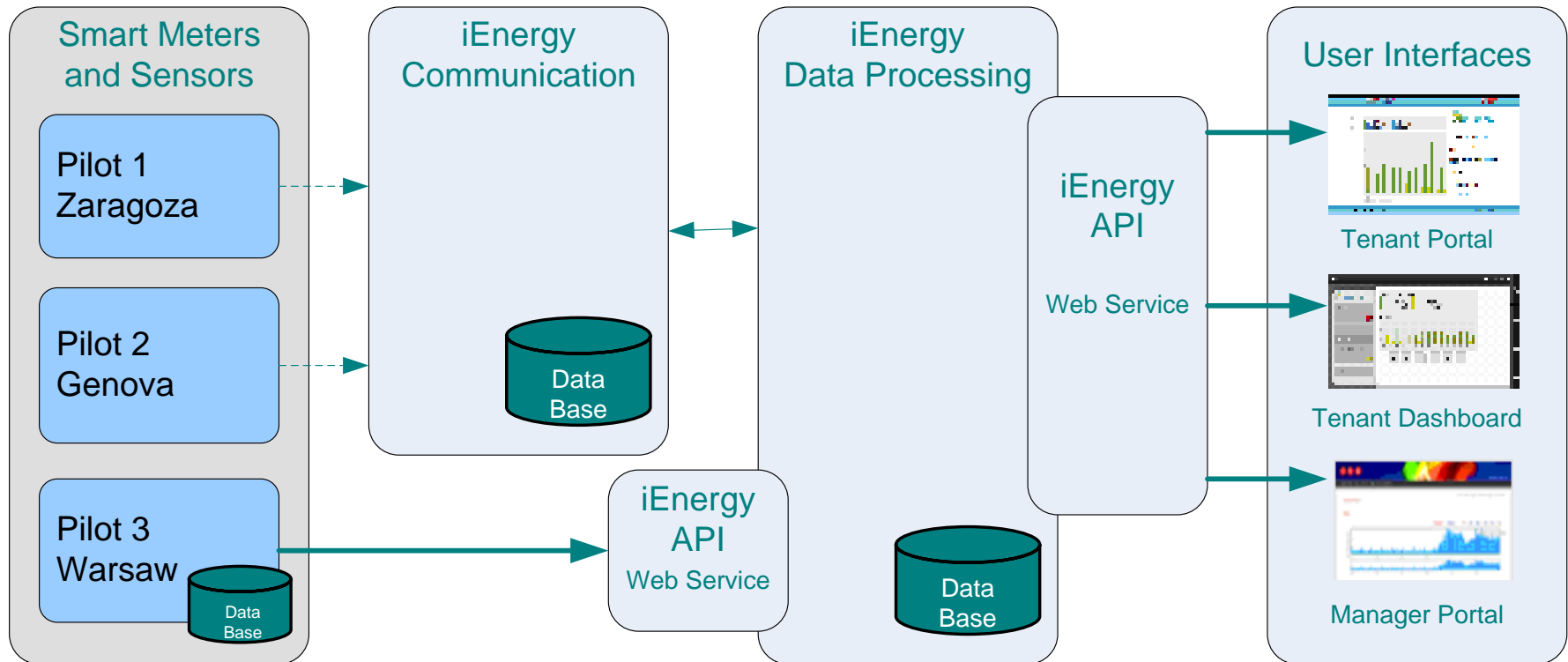
An additional solution only for tenants has been developed composed by :

- **Local data base** for Polish **data collection and storage**
- VAS – **Visualization and Alert System**: ICT Graphical User Interface (**web application**) providing energy consumption visualization, awareness and alerts for the tenants.

At the field level the E3SoHo solution has **the flexibility to communicate** with a **large variety of sensors and meters** from different vendors, **and integrate** with existing (BMS) and BEMS

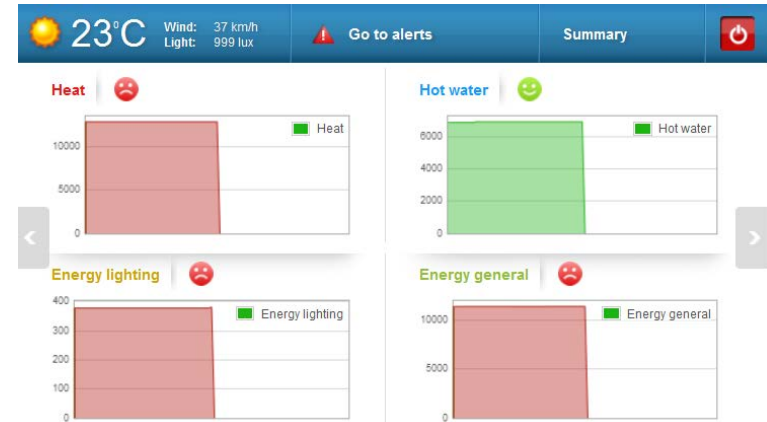
Interoperability of the E3SoHo global solution has allowed the **integration of two** different user interfaces for the tenants (SDisplay and VAS), and others may follow **Both** sDisplay and VAS **can** be **used** in the **3** pilots

E3SoHo ICT solution: Architecture



E3SoHo ICT Solution: Tenant tools

- **Energy consumption** information
 - Electricity (global and partial)
 - Hot/cold water
 - Heating
- **Comfort** data
 - Temperature/Humidity
- **Historical** data
- Monthly **targets**
- **Advices**
- Smart **Alerts**
- User **interfaces**: Android and web applications



Screenshot of **VAS** interface for tenants used in Warsaw (English version)



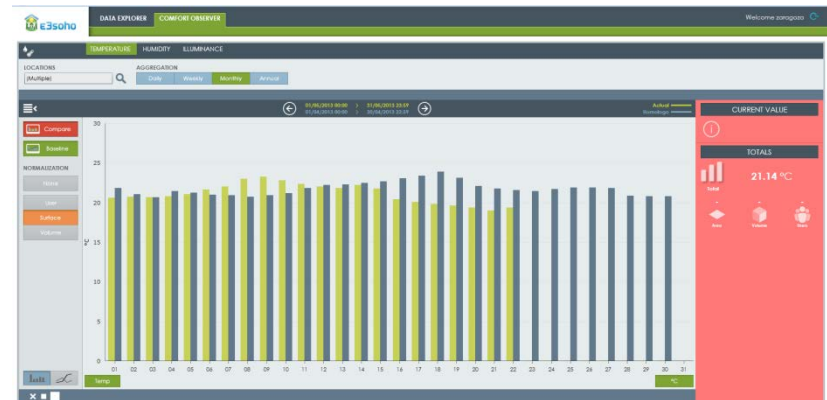
Screenshot of **sDisplay** interface for tenants used in Zaragoza

E3SoHo ICT solution: Tools for building managers

- **Energy consumption** information
 - Monitored dwellings
 - Total building consumptions
- **Energy production**
 - Solar thermal
- **Comfort** data
 - Common areas
 - Meteorological data
- **Historical** data
- **Devices** management



Screenshot of iEnergy web interface



Screenshot of refined user interface for building managers

Achievements and results (I)

- Analysis of **users** and **buildings requirements**
- Energy consumption **baseline definition** combining:
 - Energy invoices
 - Monitored data
 - Definition of control group
- Definition and implementation of **common interoperable ICT solution** for 3 pilot sites
- Definition and implementation of **training and awareness** campaign



ISA NetMeter connected to individual heating counter



Enthalpy meter used for measuring energy generation through solar panels



Collective training session in Zaragoza

Achievements and results (II)

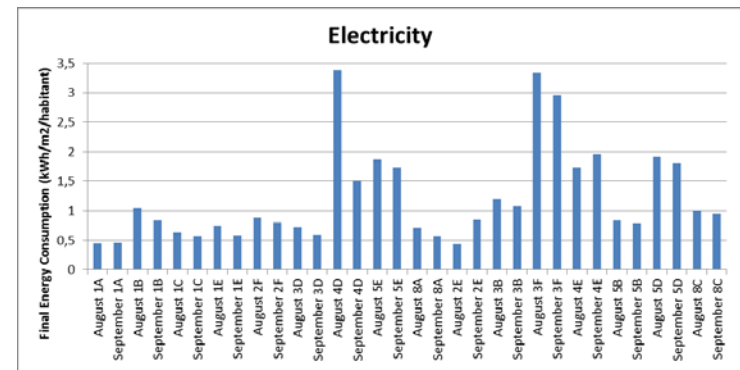
- ICT **solution validation**
 - **Performance** analysis: periodic analysis and reporting of energy savings
 - Users' **acceptance** analysis: tenants, technical staff, training staff, building managers
- ICT **solution refinement**
 - Refinement of the tenants user interface: improvement of **usability**
 - Refinement of user interface for building managers: addition of more powerful **analysis functionalities**
- Development of global **E3SoHo Methodology** for design, methodology and implementation of ICT solution
- **Dissemination**. Definition of **business models** and **exploitation & replication** strategy



ISA iMeters used for measuring electricity consumption



Tablet installed in one dwelling



Analysis of energy consumptions

Energy savings in Zaragoza

	Annual consumption (baseline period)			Annual consumption (monitoring period)	Savings		
	Real	Corrected			Without HDD correction	With HDD correction	
Heating (kWh)	40.075	41.940		37.591	6,20%	10,37%	
DHW (m3)	593	645		613	-3,37%	4,96%	
DHW (kWh)	17.078	18.576		17.654	-3,37%	4,96%	
Electricity (kWh)	34.969			32.224	7,85%		
Total (kWh)	Without corrections	Corrected Heating	Corrected Heating + DHW		Without corrections	With corrected Heating	With Corrected Heating + DHW
	92.122	93.987	95.485	87.470	5,05%	6,93%	8,39%

HDD: Heating Degree Days

Energy savings in Warsaw

	Annual consumption (baseline period)		Annual consumption (monitoring period)	Savings		
	Real	Corrected		Without HDD correction	With HDD correction	
Heating (kWh)	39.345	39.852	35.544	9,66%	10,81%	
DHW (m3)	391	402	417	-6,52%	-3,61%	
DHW (kWh)	24.633	25.326	26.240	-6,52%	-3,61%	
Electricity (kWh)	15.141		14.842	1,97%		
Total (kWh)	Without corrections	Corrected Heating	Corrected Heating + DHW	Without corrections	With corrected Heating	With Corrected Heating + DHW
	79.119	79.626	80.319	76.626	3,15%	3,77%

HDD: Heating Degree Days

Lessons learnt with control group in Genova

- The **control group methodology**, which was the only possible in the pilot due to late incorporation to the project and unavailability of data from energy bills, **has proved problematic**
- **Pairs of dwellings** from the control and monitoring group, which were in theory similar, **have** actually had very **disparate ranges of energy consumption**.
- As a result, **savings** in the pilot site **could not be assessed** properly **by comparing the two groups**.
- **Control group may work with much bigger samples** of dwellings, but in general is preferable to use comparison with baseline defined with energy bills and/or measurements
- **Analysis of small group of dwellings:** 4 dwellings were analyzed with comparison of baseline and monitoring periods. Average savings obtained were **1.8% (only electricity)**

Main exploitable products and services (1)



Energy Efficiency in European Social Housing

Product/service description	Maturity/Time to market	Application sectors/customers	Partners developers for exploitation	Business models associated	Routes for exploitation	Partners' IPR- Owner(s)/ Right of partners of use and exploitation-replication
1. Energy Auditing (building and user requirements) and for establishing energy consumption baseline	Mature. Available capacity	Public and Private Social housing building owners. Tenants of social housing. Private building owners and Facility managers	CSTB, Nobatek, Dap, Acciona, Mostostal	Ownership model: Consulting services:	Direct service through sales network	N.A
2.E3Soho ICT solution design, installation, commissioning and maintenance integrating metering infrastructure(ISA or others), communication storage and processing(iEnergy) and user interfaces for tenants and owners(sDisplay) and BMUI	Stable and tested prototype/6months. Simplified solutions for better affordability	Public and Private Social housing building owners. Private building owners. ICT solutions providers, Energy Consulting, Facility managers, BEMS providers, EE Building construction&refurbishment companies,ESCOs Utilities	ISA, ISEP, Acciona, Mostostal, D'Appolonia, CSTB, Nobatek	Ownership model: direct contract for design, installation, commissioning and maintenance. Technology transfer & licenses to others outside the consortium	Direct service through sales network Other sales networks	ISA-ISEP-Mostostal/ all the partners

Main exploitable products and services (2)

Product/service description	Maturity/Time to market	Application sectors/customers	Partners developers for exploitation	Business models associated	Routes for exploitation	Partners' IPR- Owner(s)/ Right of partners of use and exploitation-replication
4. E3SoHo Polish solution composed by VAS – Visualization and Alert System: for the tenants.and Polish data base specification for Polish data collection and storage	Stable and tested prototype/6 months. Simplified solutions for better affordability	Public and Private Social housing building owners. Private building owners. ICT solutions providers, Energy Consulting, Facility managers, BEMS providers, EE Building construction and refurbishment companies, ESCOs Utilities	ISEP – Mostostal / Acciona- D'Appolonia-ISA- CSTB-Nobatek	Ownership model: direct contract for design, installation, commissioning and maintenance. Technology transfer & licenses to others outside the consortium	ISEP –Mostostal: Through their own sales network/ Licensing. Others :through their own sales networks	ISEP – Mostostal/All partners
9.-Adaptation of SportE2 interface for its use as social housing owners' tool in E3SoHo	Prototype/6 months	Public and Private Social housing building owners. Private building owners. ICT solutions providers, Energy Consulting, Facility managers, BEMS providers, E E Building construction & refurbishment co ESCOs ,Utilities	ISA/Acciona- Mostostal- D'Appolonia- CSTB-Nobatek	Ownership model ISA:Software <u>direct sale</u> to user- <u>licensing</u> . Other partners: <u>direct sale</u> to user	ISA: Through their own sales network/ Through other sales networks .Others: through their own sales networks	ISA/ All partners

Main exploitable products and services (3)



Product/service description	Maturity/Time to market	Application sectors/customers	Partners developers for exploitation	Business models associated	Routes for exploitation	Partners' IPR-Owner(s)/ Right of partners of use and exploitation-replication
10.-Project , supply, installation, commissioning and maintenance of Energy consumption and comfort monitoring infrastructure (metering...) mainly based on ISA metering equipment (deployed in Zaragoza and Genova pilot sites)	Infrastructure available in the market	Public and Private Social housing building owners. Private building owners. ICT solutions providers, Energy Consulting, Facility managers, BEMS providers, E E Building construction&refurbishment companies,ESCOs Utilities	Project ISA /Acciona-Nobatek Supply, installation, commissioning and maintenance: ISA-other providers /all	Design: consulting service. Supply Installation, commissioning and maintenance: direct contract(s) Technology transfer & licenses to others outside the consortium	ISA:Direct sales through their own sales network/ Others: through their own sales networks	Project:ISA-Dapp Supply:ISA Installation, commissioning and maintenance: Free
11 Project , supply, installation, commissioning and maintenance of. Energy generation metering infrastructure (...) mainly based on ISA equipment (deployed in Zaragoza pilot site in solar panels for DHW production)	Infrastructure available in the market	Public and Private Social housing building owners. Private building owners. ICT solutions providers, Energy Consulting, Facility managers, BEMS providers, E E Building construction &refurbishment companies, ESCOs Utilities	Project:ISA/Acciona-Nobatek Supply, installation, commissioning and maintenance: ISA-other providers /all	Design: consulting service. Installation, commissioning and maintenance: direct contract Technology transfer & licenses to others outside the consortium	ISA:Direct sales through their own sales network/ Others: through their own sales networks	Project:All Supply:ISA Installation, commissioning and maintenance: Free

Main exploitable products and services (4)

Product/service description	Maturity/Time to market	Application sectors/customers	Partners developers for exploitation	Business models associated	Routes for exploitation	Partners' IPR- Owner(s)/ Right of partners of use and exploitation -replication
12 Project , supply, installation, commissioning and maintenance of.Energy consumption and comfort monitoring infrastructure based on PLC and wired/wireless sensors/meters from different vendors installed in Poland	Infrastructure available in the market	Public and Private Social housing building owners. Private building owners. ICT solutions providers, Energy Consulting, Facility managers, BEMS providers, E E Building construction & refurbishment companies,ESCOs Utilities	Project:ISEP-Mostostal/all Supply, installation, commissioning and maintenance: ISEP-Mostostal-other providers /all	Design: consulting service. Installation, commissioning and maintenance: direct contract Technology transfer & licenses to others outside the consortium	ISA:Direct sales through their own sales network/ Others: through their own sales networks	Project:All Supply:ISA Installation, commissioning and maintenance: Free
13. Social innovation	Tenants behavior	Tenants	all	Consulting services	All partners: through their own sales networks	All
114 User awareness training	Courses have been prepared	Tenants, building owners	all	Training services	All partners: through their own sales networks	All

Grouping products/services

The 13 Exploitable products and services identified in the project may be offered to the market under **7 different structured** categories of products

- A. Consultancy services** could be provided as standalone services and could be customized based on the reference context. They are not only ICT related.
- B. ICT Solution –infrastructure:** encompass the product and services needed to build the platform for collection and analysis of data. This infrastructure may encompass the collection of data from energy generation if this type of infrastructure is present in the building. The smart meters and sensors integrated in the infrastructure may be supply by ISA or by external suppliers.
- C. ICT Solution -infrastructure + tenants services** – as B + the services customized for tenants. Services include the dedicated user interfaces for tenants (either sDisplay or VAS) and specific training, monitoring and awareness services.

Grouping products/services

D. ICT Solution – infrastructure + tenants services + managers services – as C + the services customized for building owners/managers (including dedicated user interfaces).

E. Project , supply, installation, commissioning and maintenance: development of customized project , supply, installation, commissioning and maintenance services.

F. Full ICT solution (D+E) it encompasses the ICT solution + the services for tenants + managers services + development and maintenance of overall infrastructure.

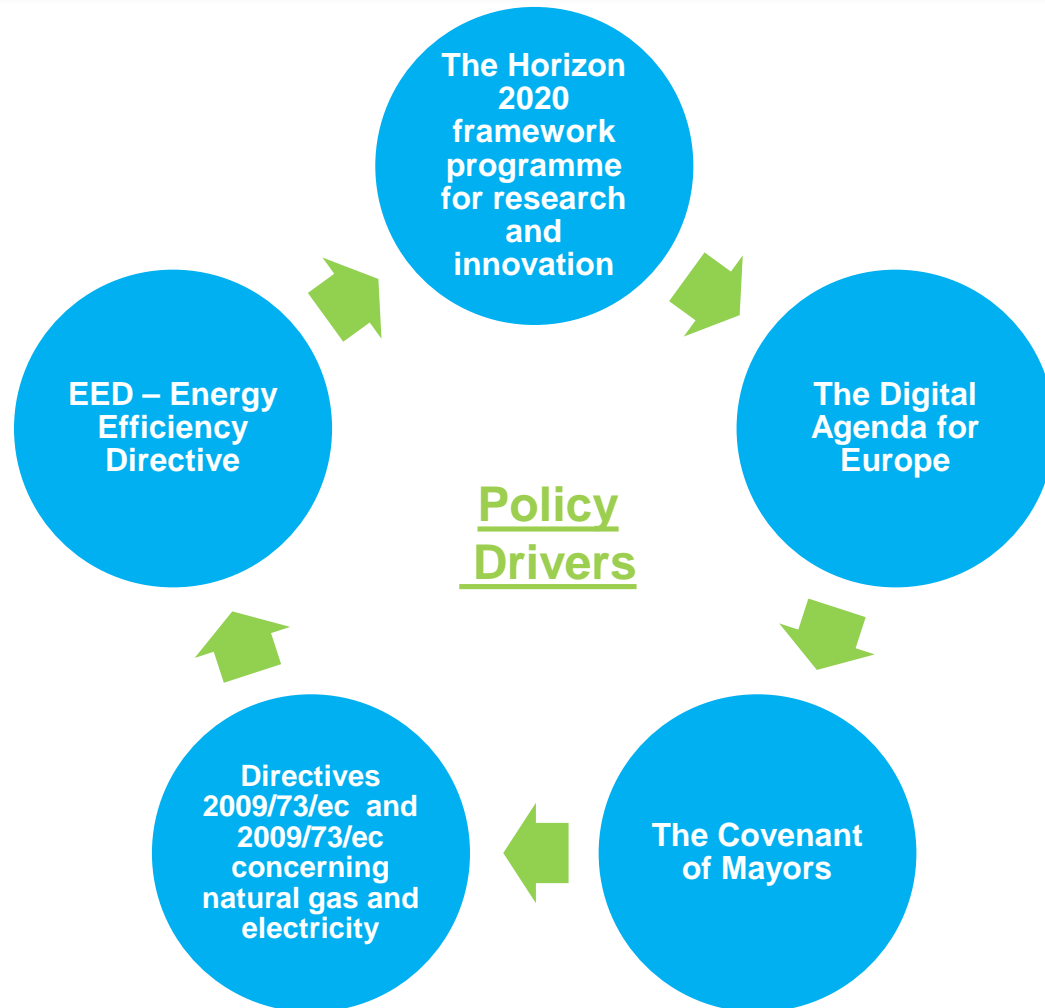
G. Full solution with consultancy (A+F) services encompasses all the products and services identified.

It should be noted that new categories could be defined by combining the products in different ways. For instance, we could have either a full ICT solution providing services for tenants only, or another full ICT solution providing services exclusively for building managers; user interfaces could be marketed as standalone products to be integrated with external BEMS, etc.

Drivers for implementation (1)



Drivers for implementation (2)



ICT solutions for energy efficiency in residential buildings –Javier Mardaras–
ACCIONA Infraestructuras Contract number: 250497

Brussels.18 September 2013

Political barriers

Difficulties on (common) agreement of what sustainable and energy-efficient buildings or near zero energy buildings are and the means to achieve them;

Lack of coherence between the EU and some MSs in financial support to Energy Efficient Buildings due to different views

Economical barriers

Lack or small available financing to carry out new construction or refurbishment, specially in those MSs like Greece, Spain, Italy Portugal..., that are experiencing severe economic crisis

Reluctance from banks and ESCOs to invest if it is not clear a short period of payback

Lack of incentives for architects, builders, developers and owners to invest

Lack of incentives for energy companies to sell less energy and encourage efficiency among customers.

Long building renewal cycles

Social barriers

Credibility due to the few examples from pilots

The different profile of the tenants of social housing including aged people with low ICT skills

In general due to the low income people, who are already applying some own strategy to save energy, there is **low margin to get additional savings** from the installation of ICT solutions

Technical barriers

Incompatibility between different control systems and sensors

Difficulty to achieve reliable real-time energy measurement and management tools of energy consumption

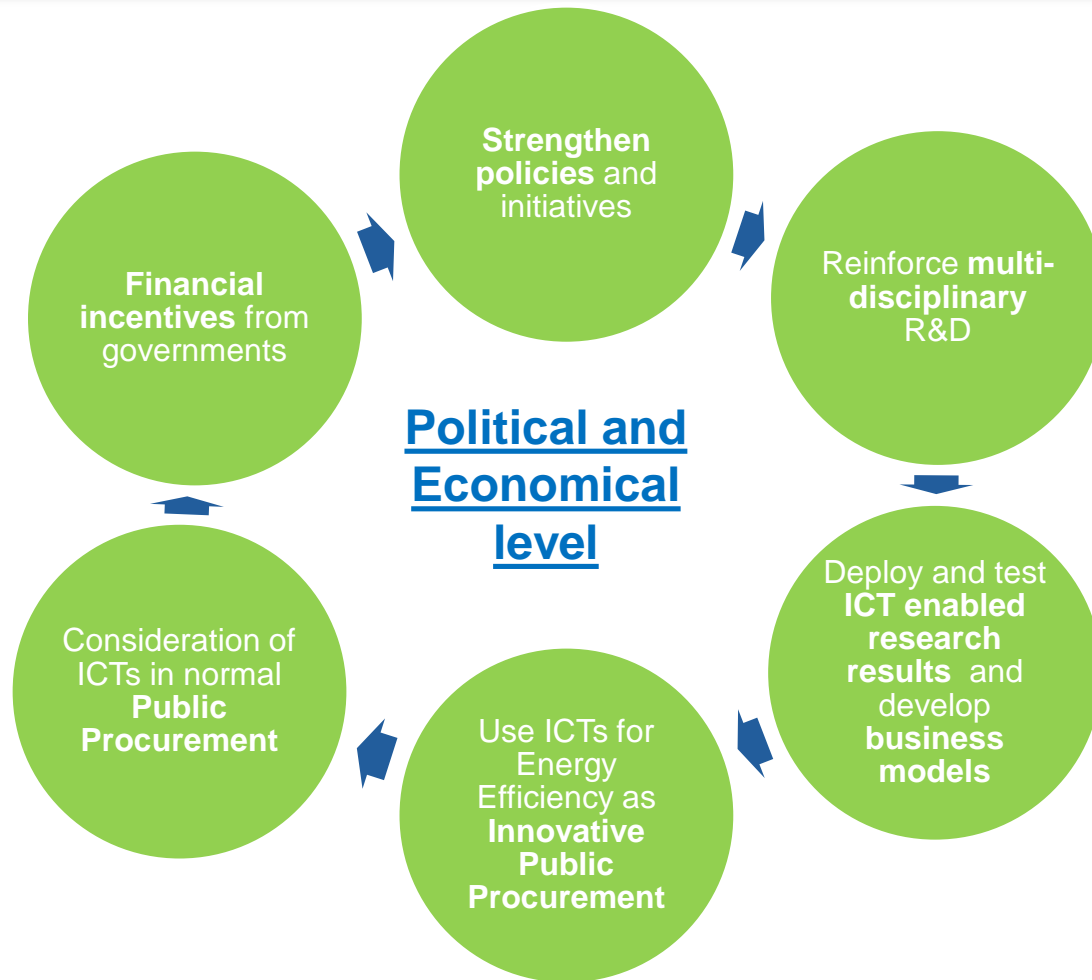
Difficulty to achieve intuitive user energy consumption awareness tools for owners/managers and tenants

Insufficient skilled staff in social housing providers with knowledge in ICTs, Energy and buildings

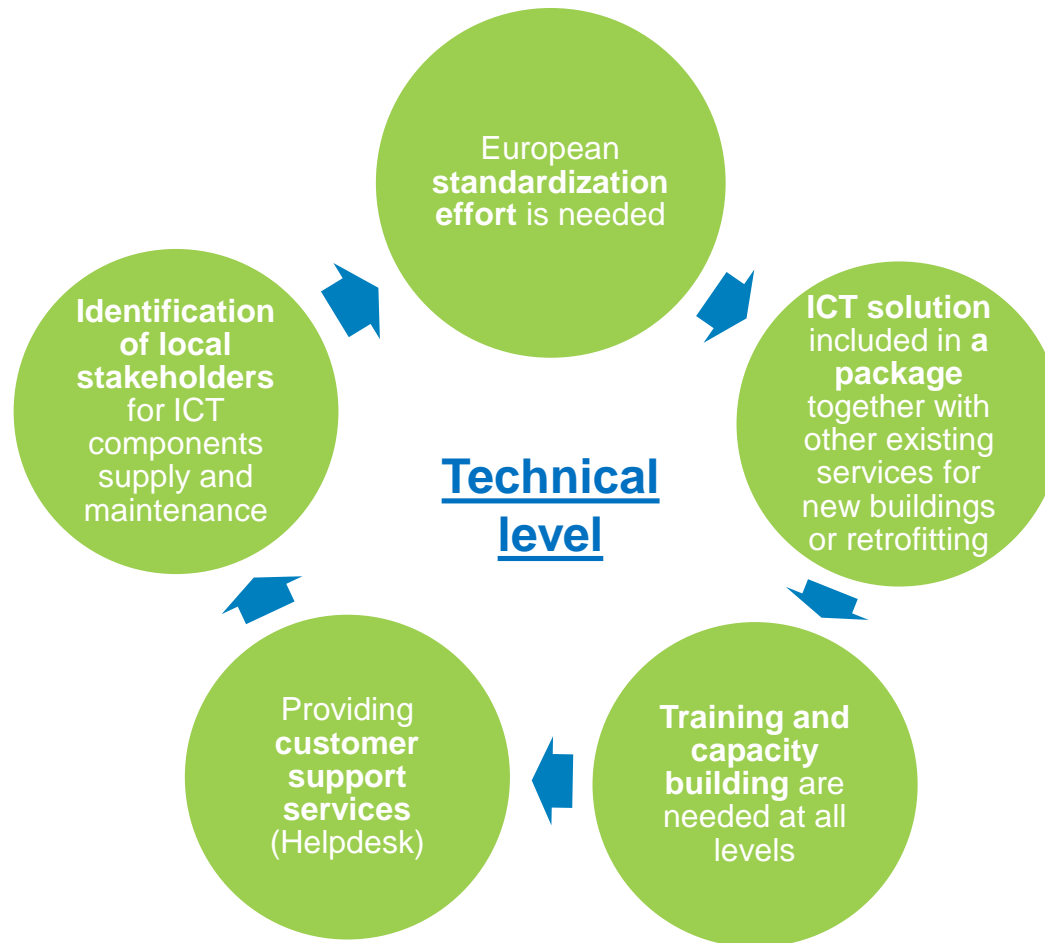
Lack of skilled technicians to handle BMS

Information on energy consumption from utilities is **not clear enough** and it is difficult to get and then establishing the base line

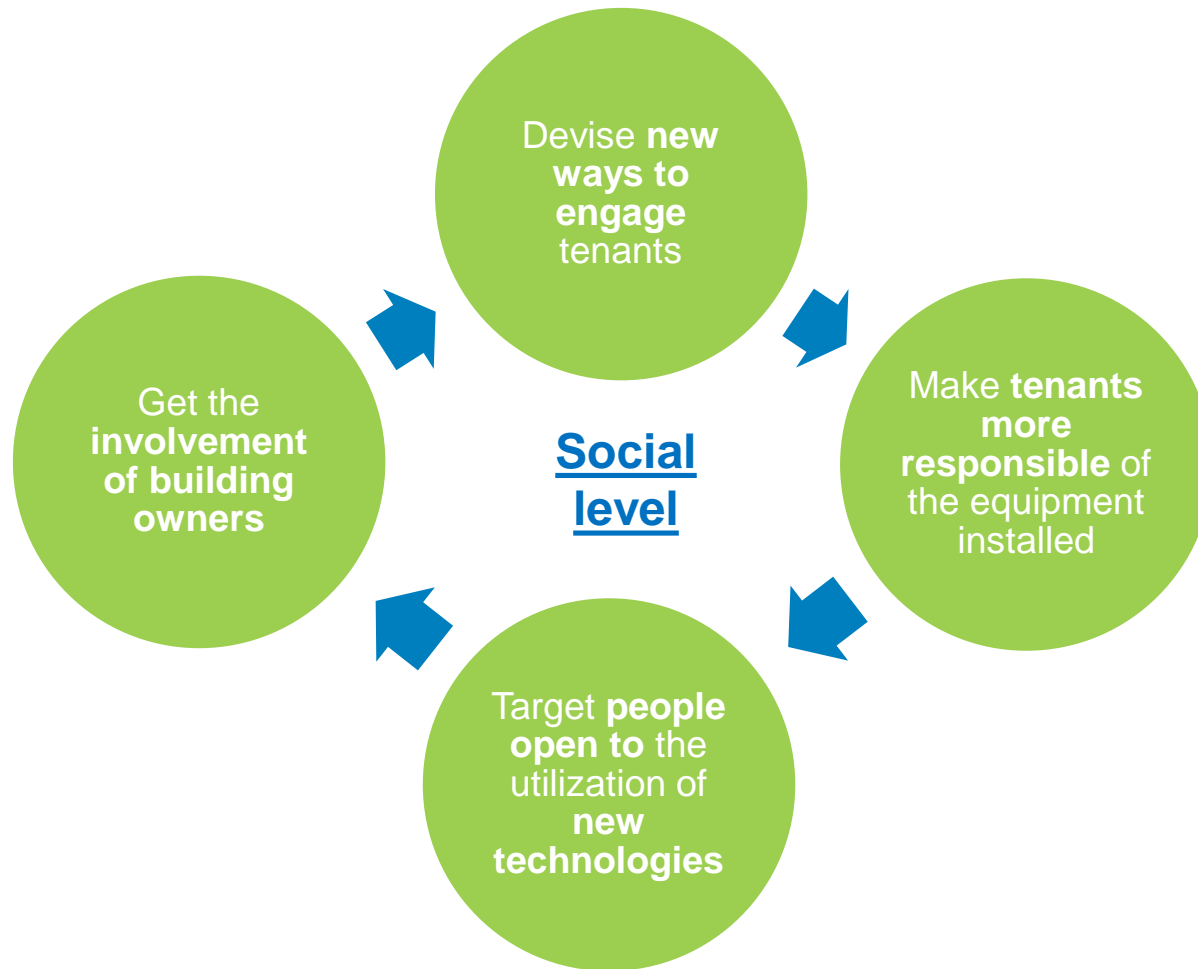
Actions to Accelerate the Deployment of ICTs for Energy Efficient Solutions in Buildings(1)



Actions to Accelerate the Deployment of ICTs for Energy Efficient Solutions in Buildings(2)



Actions to Accelerate the Deployment of ICTs for Energy Efficient Solutions in Buildings(3)



Main conclusions and lessons learnt for exploitation (I)

Market & Competitors

Social Housing Market is **huge**

There are **several providers of BEMS** (building level)

There are **competitors worldwide** offering similar solutions to E3SoHo, the majority **operating in single countries** or regions.

The majority of **European countries lack local providers**

Poor public information available regarding costs, performance, interoperability, differentiation and implemented projects

Different channels for commercialization (online, intermediaries...)

Social Housing **not specifically addressed**

Main conclusions and lessons learnt for exploitation (II)

Technical issues

Definition of **baseline**, **targets** to be achieved and **monitoring** are key to assess impact

Standardization & Interoperability among manufacturers are key enablers for exploitation

Ideally, ICT solutions should be included in the **design phase of new buildings** or refurbishments

Reduction of **technology costs** allow the provision of affordable solutions

In existing buildings commercialization is easier in rented dwellings if the **owner decides to install** the ICT solution

In both cases, for new and existing buildings, and also with individual owners/tenants, the ICT solution can be **sold directly to tenants/private owners**

Main conclusions and lessons learnt for exploitation (III)

Feasibility of investment

A quick **audit** is necessary to assess the possible savings to be achieved

The evolution of the E3SoHo products (**cost reduction**) permits to have **ROIs less than 5 years** in many cases

ROI depends on a wide variety of factors, such as: structure of energy bills (e.g. fixed vs. variable costs), consumption levels, features of the building, users' profiles, etc.

Traditional business models such as direct purchase of the system by the owner (**ownership model**) can be applied, but also **EPC model** for services are envisaged

Main conclusions and lessons learnt for exploitation (IV)

Strategy for commercialization

Intensive **awareness** and **dissemination campaigns** in Europe are necessary for a rapid introduction of the solution

Specific **branding strategies** must be considered

Packaging of the ICT solution **with other retrofitting services**

Search of local stakeholders for support to project deployment

Definition of the most appropriate **routes for exploitation** and targeted **customers and intermediaries**

Define clearly the **involvement of the building owners** in the commercialization process

IPR issues shall be clearly defined together with a clear **definition of products/services** to be exploited, **time to market**, and associated **business models**

Main conclusions and lessons learnt from the project (1)

Preparing the proposal/project

The active participation of social housing providers (owners) as partners is absolutely necessary from the pilot conception, mobilization of tenants, to the impact analysis and further replication

Tenants voluntary involvement is a key necessity for the success of the project

Local partners around the pilots are fundamental to support the social housing providers and tenants

The **selection of the pilots** themselves is **fundamental** before starting a pilot project. An energy efficiency **audit before** starting is convenient

It is very **recommendable**, if possible, to incorporate utilities as partners or have a collaboration agreement with them to develop this kind of projects

A **larger duration** of the project is recommended (about 4 years).

Main conclusions and lessons learnt from the project (2)

Performing the project

Better understanding of tenants behaviours on energy efficiency. **Money savings being the biggest motivation**

Knowledge about stakeholders that should be involved during the lifecycle of the project

Building managers could and should play a **key role** for changing tenant behaviours

Successful implementation and test of an interoperable solution

Identification of **common problems associated to ICT solution** design, deployment and verification: meters calibration, communication, bills availability

Appropriate communication networks is a critical point for a fully operative working solution

Reduction of **peak loads** could reduce the cost of the supply and total emissions

Summer efficient comfort management strategies are needed in warm climates to avoid/reduce use of air conditioning

Significant levels of **residual (stand-by) consumption** detected

Users acceptance of the ICT technologies implemented is **key**

Main conclusions and lessons learnt from the project (3)

Performing the project

Informing tenants about achieved energy savings is a key factor for acceptance. This information can be provided through the user interface and/or written reports

User interface usability is essential. Tablet/smartphone applications are better accepted than web

People were **satisfied** with the solution **installation** process and the solution **functionalities**, even if it had some technical problems

Foreigners and **elderly** have the highest difficulties to use the solution

Training sessions are fundamental and are positively assessed by the users

Providing a **specific tool for building owners** answers a real demand from their side and also **reduce the consumption of tenants**

Important **energy savings potential detected** in the three pilots

Difficulties for ICT system evaluation: savings are on the same range as “natural evolutions” or typical measures, or influence of the awareness itself?

In **Zaragoza** and **Warsaw** pilots a **reasonable level of savings** have been achieved

In **Genoa control group** strategy did not work properly, savings could not be assessed

We have realized about the **real costs of ICT** solution deployed and how to simplify it to make it **economic feasible** for of its **replicability** and **exploitation**

Thank you!

E3SoHo PROJECT information: **www.e3soho.eu**

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