SAVE ENERGY

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SAVE ENERGY Vision

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Executive Summary

Energy is an essential part of the European Union (EU), and is a necessary mean to maintain the life standard of EU today. Today the EU imports more than 50 % of its energy, often from regions that are politically unstable, amounting to a negative trade balance of some €240 billion every year. In 2006, the EU pledged to cut its annual consumption of primary energy by 20% by 2020, in sectors such as construction, manufacturing, energy conversion and transport. Once implemented, this would save €60 billion on the European energy bill and bring annual savings of between €200 and €1 000 for individual households.

A substantial part of energy consumption is buildings, which account for 40% of energy consumption and 36% of EU CO_2 emissions. The European Commission has made it one of its priorities to reduce this amount through a series of initiatives and legislation, as well as through R&D investments. This commitment has resulted in a series of pilots being developed as well as acting as a catalyst for private investment by companies, in particular in the energy production and with smart monitoring industries.

This document describes the Vision of the SAVE ENERGY project. The vision of the SAVE ENERGY project is defined as “creating awareness of Energy efficiency through the use of virtual and real-life scenarios”. The vision is an ongoing process that will be adjusted throughout the project as more knowledge and innovative information is gathered. The vision document will likewise be subjected to improvements and inputs as the pilots are being developed. The Vision document will evolve as the project work is carried out. The vision document will be shaped by findings from activities such as; the output from the research, feedback from the involved users from each pilot, findings and updates when the pilot testing period start, feedback from the advisory board. In addition, the Vision document describes the overall body of the SAVE ENERGY project and what the project elements are.

The project elements are the scenarios Real Time Information and the Serious Game and a description of the chosen pilots. The scenarios are being developed and implemented and improved as the pilot continues. Currently, the project scenarios are in the final development phase and the next steps will be the implementation of the scenarios. The project pilots have

been chosen and a description of them and the selected performance indicators will be outlined. The seed users' scenarios are based on the perception of that the user should be in the centre of the activities. The texts are therefore written from the project user's perspective to be the most accurate and explore the project's aspect from the involved users.

The pilots testing period will run from May 2010 to May 2011. The pilot results analysis will be elaborated as soon as the first results from the pilots are clear. It will throughout the testing year be elaborated and updated as long as results and data are found from the pilots. The pilot results analysis will as an overview cover three main areas; the energy consumption monitoring, behaviour transformation and performance indicators. Also conclusive knowledge and information will be included in the pilot results analysis.

The dissemination strategy have several objectives, at the highest level the SAVE ENERGY project aim to show the impact of the project at European Union level. The SAVE ENERGY project wants to reach policy makers and policy recommendation bodies and be a contribution to future policy making within the area of energy efficiency. In addition the SAVE ENERGY consortium uses a range of different strategies, and both traditional ones such as brochures, but also more modern ones such as Facebook, Wikipedia and Goggle. As mentioned at the dissemination strategy it is the aim of the SAVE ENERGY project to reach and influence policy makers and be a foundation for future policy recommendations. The impact – policy recommendation will aim to reach European authorities along with national and regional authorities. In order to do so, the Advisory Board of the SAVE ENERGY project will outline policy recommendations and possible impacts of such actions. In addition each of the partners network will play a vital role to connect and increase a possible impact.

The SAVE ENERGY service is a tool and mechanism to educate and transform the behaviour of the user. In order to do so, real time information is provided to the user, along with guided decision making.

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Introduction

Energy monitoring is an issue that has been lurking in the background for many years. Initiatives such as the Intelligent Energy – Europe (IEE) and in particular, the SAVE Programme, have been in place since the start of the last decade, looking at different ways, including IT and education-based, to encourage energy reduction and behavioural changes of users in public buildings, transport, households and industry. During these years, it has been difficult to effectively encourage energy reduction due to lack of access to key items and processes, such as the internet, as well as the high costs of implementing any technologically-based solution. At a time when energy prices were low, it was simply not an economically-viable option.
However, this all changed with the sudden oil, electricity and gas price increases in the last few years. This, combined with the reducing costs of implementing technology-based solutions, has served as catalyst for many of today's energy monitoring solutions.

European Energy Market

Energy is an essential part of the European Union (EU), and is a necessary mean to maintain the life standard of EU today. Having such importance as energy has, also makes the EU very vulnerable to change regarding the energy market both internally with the member states and externally against the global market.

The European energy market is subjected to several major challenges that need to solved, if EU wants to have a sustainable energy market that is competitive against the rest of the world. EU is increasingly becoming more and more dependent of energy import, which creates an unbalance in the economy and in the balance of payments (export/import). If the energy prises keep increasing due to lack of supply and other influential factors such as political instability, the inequality within the population will increase, as the percentage of income spend on energy will rise and create limitations and lower the disposable amount. The risk of the difference between the rich and poor is also an inevitable effect that will create a non-competitive society. Means to prevent this from becoming a reality have already been taken, EU has invested significantly in new technologies regarding renewable energies and has a goal outlined that by 2020, 20% of the total energy consumption from EU shall be renewable energies.

It is of high importance to EU and the member states to secure the supply of energy resources through external dimension and enlargement. It is found necessary to corporate with developed and developing countries if the goal of secure the energy resources should at all be realistic. The countries can take shape as producers, transit countries or consumers against EU, it is important that EU is united regarding energy issues on international level and create long lasting networks and relationships with countries outside of Europe as well.

To enhance the competitive advantage and be as strong as possible in the world energy market EU has created what they refer to as external dimensions and enlargement through an Energy Community Treaty provides for the creation of an integrated energy market (electricity and gas). It involves numerous countries and developing countries may be accepted as observers. The role of Energy Community is among others:

- to create a stable legal and market framework capable of attracting investment in order to ensure a stable and continuous energy supply;
- to create a single regulatory space for trade in network energy;
- to enhance security of supply in this space and develop cross-border relations;
- to improve energy efficiency and the environmental situation related to network energy and develop renewable energy sources;
- to develop network energy market competition.

The Energy community was initiated in 2006 and will run 10 years, by the end of the period an assessment of continuation of the community will be done.

It is an objective for EU to create an internal market that is both competitive, but also provide the European consumers with a choice between different companies supplying gas and electricity. Another important goal for the European internal market is to make it accessible for all suppliers including small ones and those investing in renewable forms of energy. If such an internal market should be a success it is vital that there exists a reliable and coherent energy network and that investments in infrastructure to secure a reliable supply of energy are undertaken[1].

In order to fully understand the development of the European energy market, it is necessary to consider aspects categorised under Political, Economic, Social and Technological factors, detailed below.

Political Factors

Energy has always due to the high importance and need of it been subjected to strategic speculation and thus policies and legislation has been a necessary tool within the energy market.

After the millennium the discussion of shortage of supply of energy resources increased significantly and it became a reality that the resources of energy will not last forever. New policies and goals were needed if EU should continue to keep the competitive advantage and

[1] http://europa.eu/legislation_summaries/energy/index_en.htm (Last accessed 16/4-10)

secure the energy supply to the population. In 2007 EU proposed a new energy policy functioning as a *"first step towards becoming a low-energy economy, whilst making the energy we do consume more secure, competitive and sustainable (...)"*[2].

It has proven to be the most effective to have a common policy shared by all member states to meet the challenges of today's energy. The European Commission (EC) has defined very clearly the goals and strategies for energy in the future. EU policies focuses on creating a competitive internal energy market, as described earlier. *"(...) that is why EU policy focuses on creating a competitive internal energy market offering quality service at low prices, on developing renewable energy sources, on reducing dependence on imported fuels, and on doing more with a lower consumption of energy"*[3].

With regard to policies EC is the main executive body; it has the right to propose legislation and ensures that EU policies are properly implemented. So, the EU has a high level of influence regarding policy –making. The EU uses among other sources project results to propose recommendations for new legislations and policies.

Economic Factors

Since 2006, a raft of new companies have been joining more established ones in the energy monitoring sector, all working on the assumption that most users have only a vague idea of how much energy they are using for different purposes and what sort of difference they could make by changing day-to-day behaviour or investing in efficiency measures. With this in mind, solutions have been provided based on two simple aims:

- Firstly, to demonstrate in a simple (often graphics-based) way, the energy consumption on a 'real time' basis. These displays are usually customised to the individual user, ensuring they provide information in the most effective way possible.

- Secondly, they aim to make each process in such a way that it becomes a 'learning tool' which allows users to teach themselves through experimentation, providing a sort of indirect feedback through lower utility bills.

Presently, there are a series of major competitors investing heavily in the European markets. These include:

- **Microsoft**: Launched their Hohm system, a free Web application designed to help customers monitor and ultimately conserve energy use.
- **Google**: Launched their PowerMeter, a free software tool that allows users to view their home's energy consumption from the personalized iGoogle homepage.
- **General Electric**: Currently building energy management tools including the smart meters, management software, and energy dashboards.

[2] http://europa.eu/legislation_summaries/energy/european_energy_policy/index_en.htm (Last accessed 16/04-10)
[3] http://ec.europa.eu/energy/index_en.htm (Last accessed 16/04-10)

- **IBM:** Launched a corporate-led energy efficiency certificate program to provide clients documentation and third party verification of the energy saving results of their projects.
- **Cisco:** A variety of solutions and products to become more energy efficient. In addition Cisco and Landis+Gyr have announced in 2009 that they will work together on a holistic approach to smart grid communications infrastructure that is expected to help utility companies and their customers better manage energy.
- **Logica:** Launched their product SmartWorld that is a new business model to help companies. It has several features but overall it helps the consumer to control their energy use and companies to plan better logistically through remote reading of energy consumption.
- And **smaller start-up companies**, such as Onzo, EnergyHub, GEO (Green Energy Options) and Greenbox, who compete on aesthetic designs and innovative features.

Many of these, in order to survive, are reaching agreements with major utility players in various countries. In the UK, for example, AlertMe has recently signed an agreement with British Gas, the UK's biggest gas supplier, to trial Smart Home Energy products in UK homes, including online heating control and smart metering. Additionally, they have also entered a partnership with Google, becoming the first self-install consumer device company to partner with Google PowerMeter and the only one with a product available in the UK.
These companies are reaching out to larger, more established businesses too, encouraging them to undertake energy monitoring projects with the aim of reducing energy consumption by changing the behaviour of employees and those users who utilize their public spaces.

The European energy market is not completely functioning on a natural competitive basis. In many member states incumbent operators are still influencing prices. Both companies and consumers are losing by the way the market is currently. A final report from EC from 2007 indicates possible collusion between incumbent operators to share markets. Another concern is the market concentration and careful scrutiny of future mergers is vital to avoid the situation to get worse. To address this problem and the lack of competition in general in the energy market the Commission will act to improve the regulatory framework for energy liberalisation[4].

Social Factors

As the recently held climate meeting in Copenhagen describe, climate change is also a major challenge for EU and for the rest of the world. The effect of climate change is not yet visible and can propose a threat of dimensions that is not clear at present time.
The solution for the all above mentioned threats and issues that the European energy market faces can be addressed through the simple action of energy efficiency. If we learn how to save energy and use the energy we have more efficient the future of the European energy market will be more secured that the prospects are now.

[4] http://europa.eu/rapid/pressReleasesAction.do?reference=IP/07/26&guiLanguage=de (Last accessed 16/04-10)

Nevertheless the transformation of behaviour is an aspect that implies motivation, which is not always simple. There EU Commission considers that there are 3 main kinds of motivation that are effective:

- Be aware of the impact of our behaviour on energy consumption
- Competition for the most energy efficient behaviour
- Imitation of role models

Technological Factors

The technology aspect of energy is vital if EU wants to achieve the objectives for both 2020 and 2050 regarding challenges as climate change, security of energy supply and the competitiveness of EU to be accomplished. However, energy technology meets many obstacles such as underinvestment or significant delays in the marketing of new products and this can hinder new developments and applications. An external issue that the energy technology sector also faces is the increased competition from some industrialised countries and emergent economies.

As a mean to fight the above mentioned challenges and achieve the European objectives the EC have presented the Strategic Energy Technology plan (SET plan). The SET plan above all proposes a new governance method for energy technologies which is based on joint strategic planning. Another important effect of the plan is an increase in resources, both financial and human. It is essential and necessary that investments in research and innovation increase, and that are possible through the Research Framework Programme of the "Intelligent Energy – Europe" programme and through the European Investment Bank as well as in the member states[5].

The investment in research and development (R&D) with regard to energy technology needs to increase for EU to stay innovative and competitive. The European R&D investments are mainly dedicated to CCS, smart grids, bio-fuels, wind energy and photovoltaic are in-between €270 million and 380€ million each.

[5] http://europa.eu/legislation_summaries/energy/european_energy_policy/l27079_en.htm (Last accessed 16/04-10)

	Corporate R&D investment 2007 (€ million)	**Public EU** (FP6 respectively EURATOM; avg per year) in € million	**Public R&D spending of EU Member States** in 2007 (€ million)	***(Out of which demonstration in MS national budgets)***	**Total**
Non-nuclear SET-P priority technologies					
Hydrogen and fuel cells	375	70	171	*(24)*	616
Wind	292	11	81	*(24)*	383
PV	221	27	136	*(15)*	384
CCS	240	17	39	*(0)*	296
Biofuels	269	13	65	*(19)*	347
Smart Grids	212	14	47	*(5)*	273
CSP	48	5	33	*(1)*	86
SUM (non-nuclear LC techs)	*1656*	*157*	*571*	*(88)*	*2385*
Distribution by investor	*69%*	*7%*	*24%*		*100%*
Nuclear SET-P priority technologies					
Nuclear Fission reactor (mainly reactor related research, thus without safety, waste, environment)	205	4	248	*(0)*	458
Nuclear Fusion	0	204	278		482
Total SET-Plan priority energy technologies	**1862**	**366**	**1097**	*(88)*	**3325**
Other relevant energy technology groups (including some of the above)					
Fossil Fuels	n.a.	n.a	240	*(5)*	
All Renewable Energies	n.a.	94	557	*(142)*	
Bioenergy	n.a.	31	245	*(94)*	
Total Nuclear Fission	550	115	587	*(1)*	1252

Figure 1– Energy R&D investments for 2007 in EU[6]

Even higher R&D investments were found for hydrogen and fuel cells research. Although on the contrary R&D investment in concentrating solar power are quite significantly below investments in other SET plan priority technologies, this may be caused by the fact that this technology is of interest to a limited number of EU countries and companies.

The diversity that is the trademark of EU also exists within energy technology as several countries have tried to identify the key enabling technologies (KET) and each country define different KETs, which can be challenge if not correct strategies to assist them all are developed.

That EU is challenged within the area of energy technology is clearly shown in numbers as well. EU has a R&D intensity of only 25% in high-tech manufacturing compared to 30% in the USA. In addition the high-tech share within the total manufacturing industry is in Japan 33% larger and in USA almost 50% larger than in EU. This composes a threat to the EU that is already falling

[6] R&D Investment in the priority technologies of the European Strategic energy technology plan", Communication paper from EC published 07/10-2009

behind within this area and it will be difficult and require a steady amount of resources to reach the level of the competing countries.

Fostering KET in EU it is necessary to improve the research and innovation performance in EU, if the goal to become a world leading location for entrepreneurship and innovation, to achieve these following policy areas need to be addressed:

1. Increased focus on innovation for key enabling technologies;
2. Increased focus on technology transfer and EU-wide supply chains;
3. Increased focus on joint strategic programming and demonstration projects;
4. State and policies;
5. Combining the development of KETs and climate change policy;
6. Lead markets and public procurement;
7. International comparison of high-tech policies and enhanced international cooperation;
8. Trade policy;
9. European Investment Bank (EIB) financing instrument and venture capital financing;
10. Skills, higher education and training.

If the above mentioned policy areas will be addressed (some are already in the process) the competitive performance and EU as a whole will benefit dramatically from this, but it will require strategic planning, channelled resources and specific policy-making[7].

The market of energy technologies is highly competitive and technologies are typically created within a business environment and with a high level of contribution from SMEs. Corporation and networking is essential tools to build-up long lasting partnerships between organisations, companies and research funds.

As a conclusion to the development of European Energy Market, it is possible to categorise its strides under the following:

- Political Factors: The need for integrated European solution to a Global problem means that coordinated efforts need to be made in order to create a long-term strategy to deal with energy security. This strategy should involve all stakeholders as well as 'grassroots' organisations.

[7] "Preparing for our future: Developing a common strategy for key enabling technologies in the EU" Communication paper from EC published 30/09-2009

- Economic Factors: EU Directives have spurred significant developments in the Energy Markets, although the policies have broadly favoured larger traditional companies with lower innovation potential, preventing SMEs to tender this type of solutions.;
- Social Factors: Although there is consensus that something needs to be done, it is often difficult to modify individual's behaviours toward changing energy consumption in day-to-day activities.
- Technical Factors: Lower levels of R&D compared to other regions in the world in addition to difficulties in the integration of existing technologies due to the lack of interoperability and adequate standards;

Nevertheless it is then expected that the Social eco-conscience together with pioneering behavioural change methodologies, such as user driven Serious Games and Living Lab Environments, will mobilise individuals in such a way that legislators will facilitate and incentivise further energy monitoring and generation solutions. These measures have the potential to decrease the EU's dependency on energy imports and contribute towards the liberalization of the European energy supply markets.

Energy Efficiency

Energy efficiency has been defined in many different ways, the most common of which is "using less energy to provide the same level of energy service […] and without reducing the end-use benefits".[8] Today the EU imports more than 50 % of its energy, often from regions that are politically unstable. This amounts to a negative trade balance of some €240 billion every year.[9] Therefore, unsurprisingly, the European Union (EU) has considered the reduction of energy consumption and encouragement of more efficient energy usage by eliminating of energy wastage among its main goals.

In 2006, the EU pledged to cut its annual consumption of primary energy by 20% by 2020, in sectors such as construction, manufacturing, energy conversion and transport. This pledge was included a green paper published the previous year and titled 'Doing more with less'(COM(2005) 265).[10] The objectives of this paper was to introduce cost effective actions which would encourage the adoption of energy-efficient technologies and change consumer behaviour, in order to bring the EU back to its 1990 energy-consumption level.

[8] U.S. Department of Health and Human Services, Glossary of Selected Terms Used in Utility Deregulation - http://liheap.ncat.org/iutil2.htm

[9] European Commission's Energy and Transport DG Report, 'Education on Energy - Teaching tomorrow's energy consumers', 2006 - http://www.managenergy.net/download/education2005/05-0001-EN.pdf

[10] European Union Green Paper on energy efficiency, 'Doing more with less', COM(2005) 265

It is estimated that actions identified in the Green Paper could save Europe as a whole some €60 billion on its energy bill and bring annual savings of between €200 and €1 000 for individual households.[11] It is the belief of the commission that these reductions will also prove decisive for competitiveness, security of supply and for meeting the commitments on climate change made under the Kyoto Protocol.

To achieve its goals, the EU has been working hard to mobilise public opinion, decision-makers and market operators and to set minimum energy efficiency standards and rules on labelling for products, services and infrastructure. This has been done via the seven main programmes below which have been set up by the EU:[12]

- **Build Up** – An online portal for building professionals, local authorities and building occupants willing to share their experience on how to cut energy consumption in buildings. More information in section 2.1.
- **Covenant of Mayors** - A commitment by signatory towns and cities to go beyond the objectives of EU energy policy in terms of reduction in CO2 emissions through enhanced energy efficiency and cleaner energy production and use.
- **Sustainable Energy Europe Campaign** - Launched in 2005 and extended until 2011, it aims to spread best practices and to build alliances among sustainable energy stakeholders serving as a platform for new ideas and actions.
- **CONCERTO** - Supports local communities, as clearly defined geographical areas or zones, in developing and demonstrating concrete strategies and actions that are both sustainable and highly energy efficient.
- **ManagEnergy** - Supports the work of actors working on energy efficiency and renewable energies at the local and regional level, providing training, workshops and online events targeting energy professionals and managers of energy agencies.
- **Intelligent Energy – Europe (IEE)** - Helps deliver on the ambitious targets that the EU has set for itself to sustain the competitiveness of its economy while fighting climate change. More information in section 2.1.
- **Eco-innovation** - Through the funding scheme, the EU wants to support innovative products, services and technologies that can make a better use of natural resources and reduce Europe's ecological footprint.

Across most of Europe, several projects have been undertaken to encourage energy monitoring and energy efficiency.

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[11] European Commission's Energy and Transport DG Report, 'Education on Energy - Teaching tomorrow's energy consumers', 2006 - http://www.managenergy.net/download/education2005/05-0001-EN.pdf

[12] European Commission, Energy, Energy efficiency & renewable energy actions - http://ec.europa.eu/energy/actions_energy_en.htm

In France – Poweo Energy Company offers a POWEO box to its clients in order to help them cut their energy costs. The box is an interactive terminal for real-time monitoring and control of electricity consumption with the help of simple advice and information. The consumer receives an annual assessment of consumption, including personalized advice.

In Portugal - E-Monitor, the name of the winning project of "Ideias Luminosas 07", consisted of an integrated software system which controls and measures different energy uses in a building, including electricity, gas and water. The system alerts the users of the building when detecting abnormalities in energy consumption.

A substantial part of energy consumption is buildings, which account for 40% of energy consumption and 36% of EU CO_2 emissions. Existing buildings consume, on average, about 25 l/m2, with some buildings using up to 60 l/m2. Although newer buildings consume less, between 3 to 5 l/m2 of heating oil or equivalent a year[13], if the EU is to reach its energy reduction target of 20% by 2020, it must encourage more efficient use of energy in both older and newer buildings.

The founding piece of legislation in the EU guiding energy reduction efforts in Buildings is the Directive on Energy Performance of Buildings (2002/91/EC). This directive requires Member States to apply minimum requirements for the energy performance of new and existing buildings, ensuring the certification of their energy performance and requiring regular inspections of boilers and air conditioning systems. In 2008, the directive was changed to increase the energy saving reduction targets by a further 5 to 6% of total EU energy consumption and to clarify and streamline some of the Directive's provisions.

As a practical step to implement the Directive, funding initiatives for programmes such as the Intelligent Energy - Europe SAVE Programme (SAVE) have been created. These are aimed at encouraging energy savings by improving energy efficiency and rational use of energy resources, in particular in buildings and industry. More specifically, some of the aims of the programme included:[14]

- To improve the energy performance of new and existing buildings and promote integration of renewable energy sources;
- To foster the adoption of intelligent energy use patterns in buildings;
- To facilitate implementation and monitoring of Directive 2002/91/EC on the energy performance of buildings;

[13] The BUILD UP initiative, EU MEMO/09/278, 2009 - http://www.buildup.eu/sites/default/files/press/MEMO-09-278_EN%5B1%5D.pdf

[14] European Commission – Energy, Intelligent Energy - Europe Programme: IEE2-SAVE-1 Energy-efficient buildings - http://www.managenergy.net/buildings.html#progs

The SAVE programme has been behind most of the smart metering solutions which have been emerging. By 2020, 80% of Europeans will have intelligent electric meters, both for the provision of accurate billing but also to act as a behavior changing tool for customers, encouraging them to change their energy usage patterns. ICT solutions will play a big part in the development of smart meters, giving greater importance to the positive outcome of the Save Energy Project.

Additionally, other schemes have been introduced by the EU, which aimed to give interested citizens information on how to reduce energy use of buildings and inform and update the market about the legislative framework surrounding energy efficiency. This is currently done through the Build Up Initiative, which can be accessed through the portal www.buildup.eu and is aimed at home owners and tenants, building professionals, public authorities and umbrella organisations.

Apart from existing legislation which can play a key role in reducing the energy use in buildings, other behaviour-changing measures should be implemented to achieve this goal.

Simultaneously, in order to provide a solution to energy efficiency, as well as reaching the EU's energy and environmental goals, there has been an increase in the supply of energy services to clients in the European Market. Companies undertaking these activities, commonly under the 'green agenda' has been designated as Energy Service Companies (ESCOs), offering "energy services which may include implementing energy-efficiency projects (and also renewable energy projects), in many case on a turn-key basis."[15] These are often provided both in the building construction and/or refurbishment phase and can include a variety of activities, such as:[16]

- Energy analysis and audits;
- Energy management;
- Project design and implementation;
- Monitoring and evaluation of savings:
- Energy and/or equipment supply; and
- Provision of service (space heating, lighting, etc.)

Additionally, these companies are seen as different to traditional energy consultants / equipment suppliers, as they can also finance or arrange financing for the operation and their remuneration is directly related to the energy savings achieved, as seen in the diagram below:

[15] EC Joint Research Centre, Energy Service Companies in Europe - http://re.jrc.ec.europa.eu/energyefficiency/ESCO/index.htm

[16] EC Joint Research Centre, Energy Service Companies in Europe Report, 2005 - http://re.jrc.ec.europa.eu/energyefficiency/pdf/ESCO%20report%20final%20revised%20v2.pdf

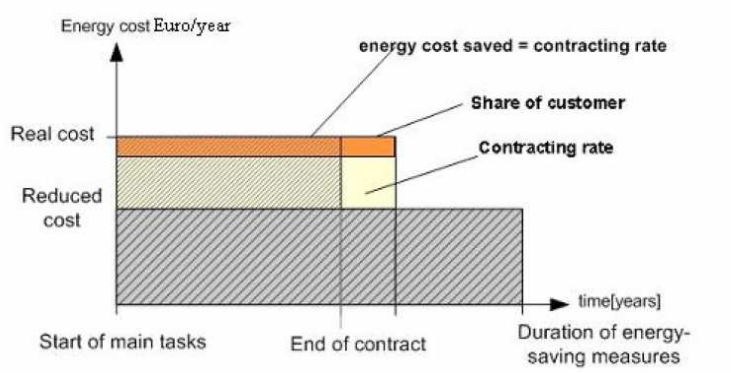


Figure 2 - ESCOs Remuneration Rate[17]

The majority of ESCO projects in Europe have been undertaken in the public sector. This is primarily because the public sector is perceived as being 'safer' clients, unlikely to go out of business. In some cases (for example Germany, Austria and in Spain) national and local authorities and energy agencies have also taken the lead and retrofitted public sector buildings. The most common projects have been in co-generation, public lighting, heating, ventilation, and air conditioning (HVAC), as well as energy management systems.

ESCOs aren't alone in providing for the energy efficiency market. Energy Service Provider Companies (ESPCs) operate mostly with the end-users, supplying and installing energy-efficient equipment, energy and or building refurbishment, maintenance and operation. However, ESPCs provide their services for a fixed fee or as added value to the supply of equipment, not linked to the results of their recommendations.

Save Energy: A new approach to Energy Efficiency Services

It is with this backdrop that the SAVE ENERGY Service comes to light. It is hoped that through the use of ICT and the Serious Games, users who work and visit the pilot buildings understand the impact their actions have on the overall energy use patterns, and feel empowered to change their behaviours to reduce their environmental footprint.

Save Energy services will be used to educate and transform the user energy behaviour sustaining these behavioural changes by his / her empowerment with real time interactive information and guided decision making.

[17] EC Joint Research Centre, Energy Service Companies in Europe Report, 2005 - http://re.jrc.ec.europa.eu/energyefficiency/pdf/ESCO%20report%20final%20revised%20v2.pdf

This service will consist on a single central platform for end-user services, installed at the user premises that will provide a serious game customized to the user environment, real time information and an Energy Management system on energy consumption.

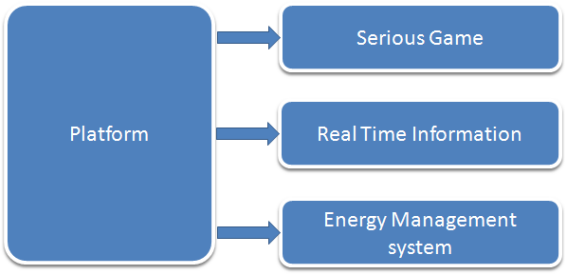


Figure 3 - Platform for end-user services

The innovations of this service focus on:

- Use of **different approaches** to increase the energy efficiency:
  - Change the end-users behaviour – Serious Game based on an existing engine which is an innovative and powerful tool to achieve user behaviour transformation and advanced real time services empowering the decision making of the informed user
  - ICT solutions – implementation of a Energy Management System

- The **high level architecture** of the service that puts together several concepts and products that complement each other.

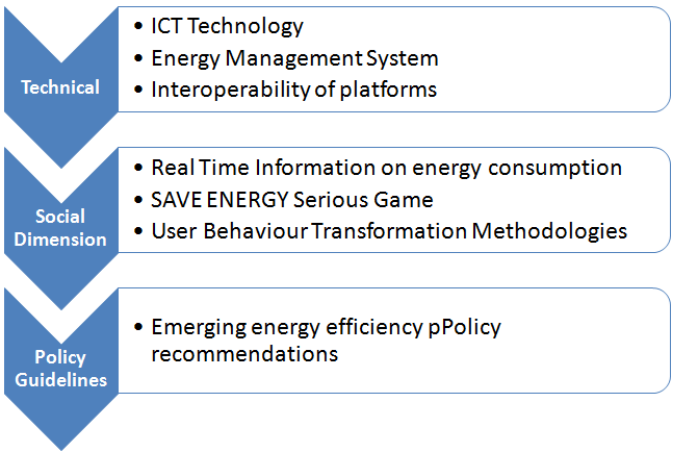


Figure 4 – Concepts and products of the Save Energy Service

- The SAVE ENERGY ICT application and services will result from the **integration of existing technologies.** The SAVE ENERGY platform will be the result of integration of

existing ICT components and technologies addressing the issues of an interoperable architecture:
  - The energy censoring, smart metering and management components are available commercially and the project will focus on its integration and customisation for each specific application;
  - The real time information delivered directed to the consumer will use existing ICT applications providing the information captured in real time;
  - The serious game will be built around an existing game engine and creating a virtual environment for energy efficiency;

- A **single central platform** for end-user services that puts together the Energy Efficiency services and the Portal

- **Use local equipment suppliers**, that provides:
  - A faster implementation of the service;
  - A better support and maintenance services and lower costs; and
  - No local regulatory barriers for equipment homologation.

- The **customized solutions** provided for the client:
  - Each user is free to select a custom local technical solution which will allow:
    - To address all specific users implementation requirements
    - To involve the users in the co-creation of the local solutions
  - The serious game will be customized to the user environment

- A new business that includes SMEs as a new focal point for the development of the Energy market.

To develop such service it was created the Save Energy Project.

Project vision

SAVE ENERGY project will focus on bringing together from the beginning all the stakeholders including technology suppliers, service providers, public authorities and user communities who together will define the functionality of the new energy efficiency services.

Thus the SAVE ENERGY project will:

- Have SMEs as partners in the consortium to develop SMEs business models for the ICT energy efficiency market and facilitates the removal of the technical barriers such as the interoperability.

- Involve the public authorities work and will present guidelines and recommendations for other users to benefit from funds available at national and regional levels.
- Be actively engaged in identifying and establishing pro-active links with national and regional sources of funding aiming to accelerate the replication of the results achieved in the Project
- Use the open innovation user driven methodology of Living Labs, thus bringing together all key actors of the new energy efficiency services.
- Employ the Social Networking using Web 2.0 services for fast dissemination and the supportive role of focused policy making in the energy efficiency sector

The approach chosen for the project is to demonstrate that through smart energy management system and through behavioural changes of users, energy savings are possible. The energy reduction will come from energy consumption transformation behaviour and smart ICT energy management.
The premises for this energy consumption are 5 public buildings geographically situated throughout the European Union. These 5 pilots were chosen to be premium establishments to conduct the SAVE ENERGY project. It is believed by the consortium that the energy reduction objectives can be achieved in public buildings through the use of services enabled by ICT and in particular by supporting the user transformation behaviour.
Thus the Consortium partner's and respective roles were carefully though to create a team that could sustain all the technical, social and political objectives.

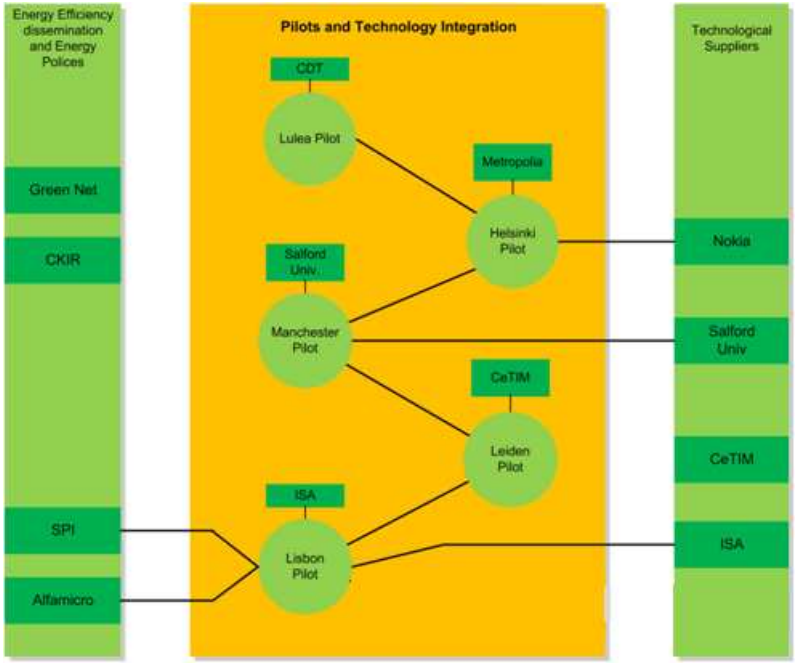


Figure 5 – Consortium Overview

Source: Alfamicro; Save Energy Technical Annex I - "Description of Work"

1. Strategy and Goals

The project is based on an experimental service with the following pilots chosen: Pilots located at public buildings that are supplying services to the public in; Helsinki (School), Leiden (Town Hall), Lisbon (Town Hall Offices), Lulea (House of Culture), Manchester (Town Hall).
Please see figure 1 below as it portrays the overall structure of the SAVE ENERGY project.

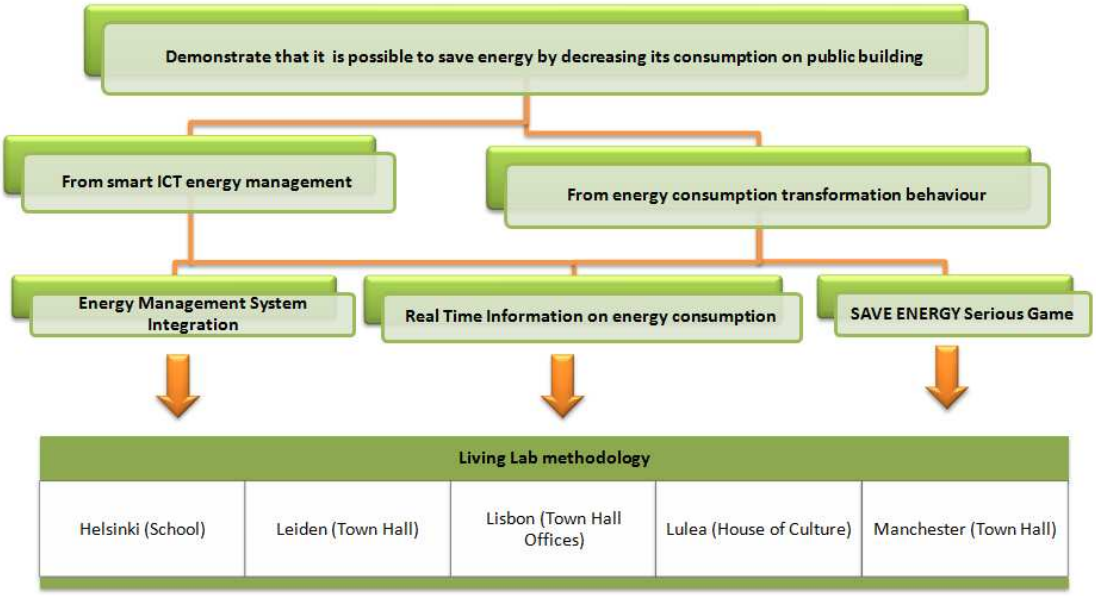


Figure 6 – Save Energy Vision

Stakeholders for each pilot will be chosen to implement the ICT management system and supervise the possible energy reduction through users' transformation behaviour. Possibility of Real Time Information on the energy consumption will provide a clear and actual picture of the current energy consumption, and in addition comparability within a time period will be possible. A serious game will be created to the stakeholders and users of the pilots to create awareness of the reduction of energy and portray how quick and easy reduction in energy can be done.

The pilots will use Living Labs methodology which involves the user from the very beginning of a new idea, creating the motivation to share and discuss their experiences and expectations.
Through the pilots and the activities implemented in them assumed reduction in energy and stakeholder's behaviour transformation will occur. The results will be disseminated and the results are expected at a regional, national and international level, possibility the policy recommendations change.

***Table 1* – Save Energy elements and structure**

Project Objective		
Demonstrate that it is possible to save energy by decreasing its consumption on public building		
Technical objectives		**Social objectives**
Decrease of energy consumption through ICT Energy Management		Decrease of energy consumption through the consumer behaviour transformation
Methods		
ICT Energy Management Method A	**Real time Information Method B**	**Serious Game Method C**
The Energy Management system is installed and configured; according to the consumer acceptance will Living Lab behaviour change methodology to identify acceptable thresholds of comfort and self satisfaction led by ecological principles and perceptions.	The Real Time Information is made available to the user of public displays, mobile devices, and desk top PCs. The information will guide the user to adopt energy efficiency behaviour.	The Serious Game is made available to the consumers using public systems, mobile devices and desk top PCs. The different type of users can play among themselves or against the system. The learning process of the Serious Game will drive the behaviour transformation.
Experience Methodology		
Living Lab Methodology		
Result		
Pilot's stakeholders behaviour transformation Pilot's Energy Savings		
Dissemination strategy		
Traditional Tools		Innovative tools
Project Impact		
Building managers and regional authorities		**European and National authorities**
Good practices		Partner's network Advisory Board

The overall project objective is to demonstrate the possibility of energy savings in public buildings by decreasing its energy consumption mainly due to: The installation of ICT energy management and, more importantly, change the behaviour of the people through direct observation of energy consumption and the usage of Serious Games.

How the project will be implemented lead the consortium to the definition of several specific objectives, as follows:

- Energy management system implementation
- Real time information
- Serious games design and development
- Pilots: Critical incidents and stakeholders
- Living lab methodology application
- Energy consumption measurements

- Behaviour transformation analysis
- Dissemination Strategy
- Save Energy impact on policy recommendations

2. Project elements

Save energy will prove that it is possible to save energy by three main methods:

- Using **ICT Energy Management** - it is possible to decrease the energy consumption in a public building by providing the space users the power of controlling energy appliances – technical and social objective (Method A).
- Providing **Real time Information** on energy consumption to the public building users - energy consumption can decrease by providing the users information with regard to the impact of their actions on energy consumption – social objective (Method B).
- Produce and release a **Serious Game** - enabling all the users of public buildings to transform their energy efficiency behaviour – social objective (Method C).

The demonstration will consist of the application of the above referred methods to the chosen **public buildings, measuring the energy consumption before and during the pilot**. The energy consumption profile will contribute to understand the impact on each of the energy savings methods.
Thereby the pilots will demonstrate through time, space and the stakeholders, the effect of **Living Lab methodology**. Simultaneously the pilots will supply the project with vital data for further study.

The scheme of the experience is represented in Figure 2.

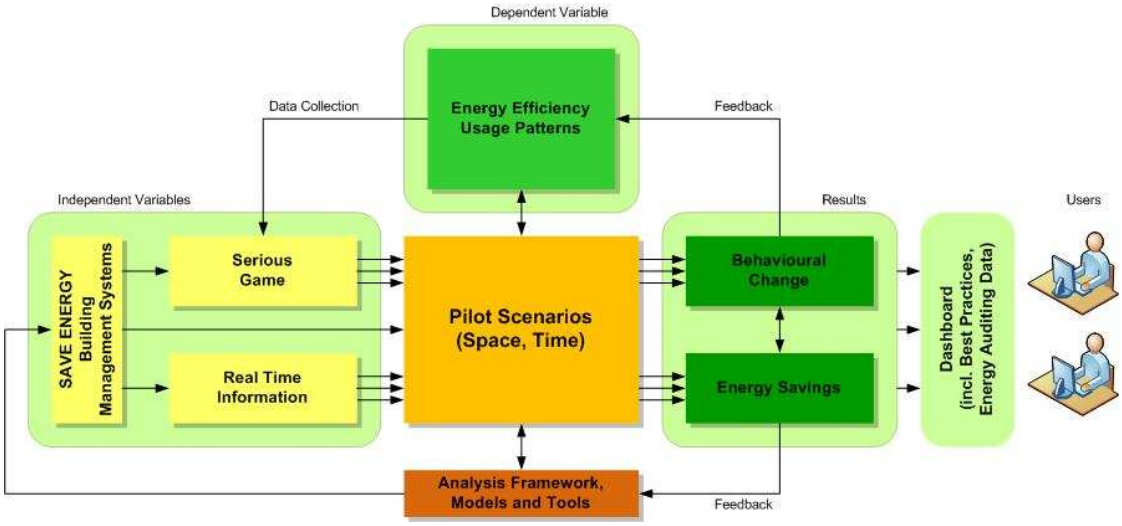


Figure 7 – Experience architecture.
Source: Alfamicro; Save Energy Technical Annex I - "Description of Work"

2.1. Methods and Methodologies

The pilots will be submitted to the above mentioned methods with changeable time possibilities; One chosen space and one chosen time or the same space, but at various time intervals. Figure 8 illustrates the sequential added impact of the 3 methods, along with the time (scenario A, B and C) in a determinate space of the pilots.

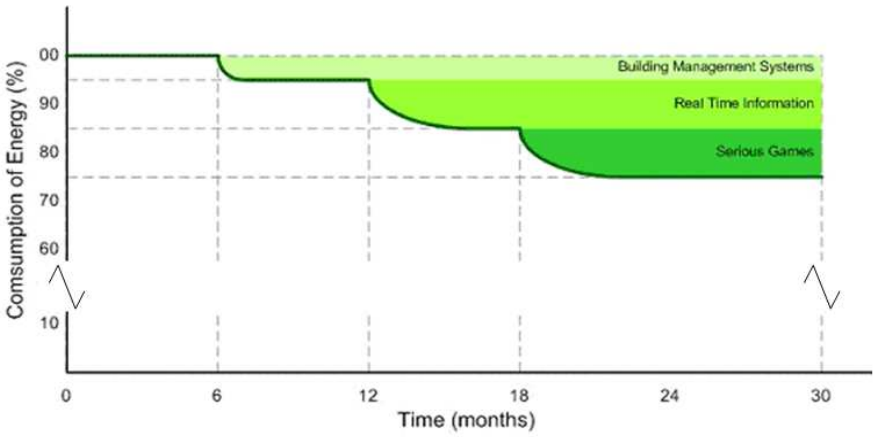


Figure 8- Scenarios implementation.
Source: Alfamicro; Save Energy Technical Annex I - "Description of Work"

As mentioned above the methods were designed to be implemented in the pilots and demonstrate the objective of the project that it is possible to save energy by reducing the consumption.

A technique will be used to evaluate of how individuals use the SAVE ENERGY Serious Game, the Energy Management System and the Knowledge Repository in the Living Labs methodology context. In order to do this, a series of tests were programmed that should result in the identification of clear and expressive indicators to be investigated by the project team.

2.1.1. Behaviour Transformation

To create behaviour transformation the project will empower the users in different ways. As users' motivation is core for behaviour changes we need to identify what motivates the users to save energy and to be involved in the process. Different ICT-based solutions will empower citizens to take decisions that lead to behaviour changes and energy saving. Theses solutions are set-up to address different motivators like:

- Power
- Curiosity and status
- Social contact
- Idealism

Processes

The Pilots implementations follow the Living Lab methodology and users are engaged in the co-creation of the energy saving solutions to share ideas, influence solutions and to measure and show behaviour changes. The process is set up in three main iterations where users are involved in an iterative and interactive way in the creation of the energy-saving methodology and technology and in the implement and test of the final solutions to support uptake.
The user involvement has different purposes in the different iterations:

- Iteration 1
  - Baseline-status on user behaviour and motivators
  - Identification on status in users behaviour regarding energy saving and measurement of actual energy consumption and motivators before introducing the energy-saving solution.
  - Need finding, idea-generation and conceptualization
  - Users are involved to discover what they want and what their priorities and ideas are.

- Iteration 2
  - Early-prototype testing and change analysis
  - Prototype-testing is done among different users in their real-life setting to verify the concept, prioritize further development and to evaluate status on behaviour transformation

- Iteration 3
  - Impact analysis
  - Identification on status in users' behaviour regarding energy-saving and measurement of actual effect on the energy consumption when the energy-saving solutions are implemented in a real-life setting.

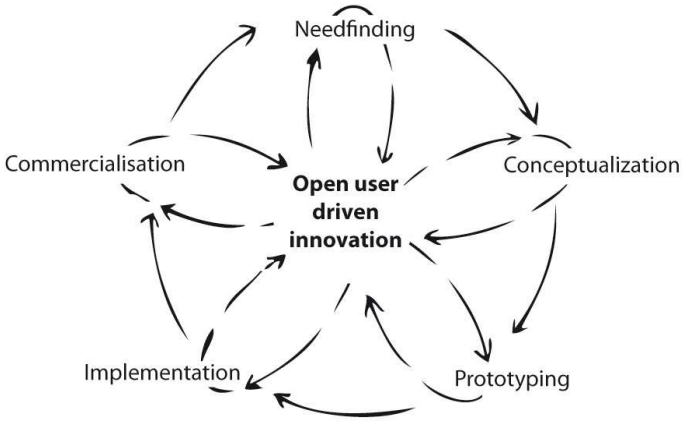


Figure 4 – Overview of Open user driven innovation

2.1.2. ICT Energy Management

The ICT Energy Management has the potential to contribute to energy efficiency through the use of improved control and management systems based on new technologies, smart appliances and communication networks.

The modern ICT tools enables smart metering and more accurate measurement of energy consumption trough the implementation of advanced sensors, metering and control devices applied to electrical appliances in buildings. The gathered information will provide knowledge, in real time, on energy consumption patterns and be presented to users using serious game, web-portal, mobile phone applications, and screen on a wall to the users, etc.

For the present project, ICT Energy Management such as sensors, metering and control devices acting upon electrical appliances will be implemented in all the five pilot buildings, providing useful information and the possibility for users to acknowledge and manage energy consumption which is expected to influence their behaviour towards a more sustainable consumption and consequent energy savings.

2.1.3. Real Time Information on energy consumption

By using ICT Energy Management it is possible to provide real time information on energy consumption that gives users important and sensitive feedback on the effects of their immediate usage of electric equipment and it can represent a significant potential to change behaviour on energy systems usage.

The possibility for the user to see, almost immediately, results on his energy cutting actions will make user awareness a fundamental tool in changing his behaviour.

Without ICT dynamic measurement and real time awareness for reductions the consumer is not fully engaged in the process and the demand for energy efficiency is suppressed.

For the present project, following the ICT implementation in the five pilot buildings, it will be possible to generate and gather real time information on energy consumption in each one of them.

2.1.4. Serious Games

Serious games aims to change human behaviour through education and training. The Serious Games are a simulation environment, based on social interaction and scenarios experimentation, designed to highlight, although virtually, potential realistic outcomes.

For this project, they will reflect the energy consumption of a varied range of uses of public building as well as the actions that could be performed by the users in order to change energy consumption patterns. Additionally, they will be designed to provide a fun and engaging game experience, while shaping the player's behaviour towards energy saving issues.

With this in mind, the following three goals have been specifically developed and demonstrate the general approach these games will take:

- To educate people in the ways in which energy can be saved, via simple actions that anyone can conduct;
- To increase interest in the pilot scheme buildings;
- To be an inherently enjoyable game for a sufficiently diverse audience.

The game has a target audience, which is constituted by (in priority order):

- Pilot building users: citizen, public servant, policy maker;
- Non-users directly linked to pilot, e.g. school parents, families;
- General public in pilot building local area.

The overall concept of the game will consist on a two levels of play:

- A Meta-game - The idea is to create a story that will serve as an umbrella for several mini-games. These meta-game will be designed to make the initial stages of the game attractive to the end user and to enable reach and accessibility. Characteristics:
    - On-going for the whole (academic) year 2010-2011
    - World and Buildings that contain the minigames
    - Gives context, story, place and meaning
    - Demonstrates the results of the player involvement and pilot efficiency progress: buildings get improved or decrepit

- 5 Minigames – Integrated on the meta-game, the content of the mini-games will be customized to SAVE ENERGY project pilots during the experiment what will create interest for as much as possible different target audiences that are expected to interact with it. Characteristics:
    - Brief single-player, one-session, 1...5 minutes / game play
    - Always related to energy use
        - Can be educational or simply serve to engage players
        - For engagement-only games, the education comes from further info

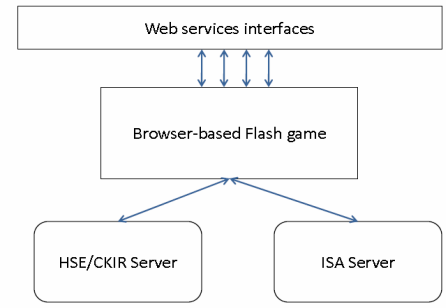


Figure 5 - SE Game Schematic. Source: CKIR-HSE, "Green my Place"

Green My Place

Meta - Game

Europe is in danger! Big Oil Group (BOG) produces huge amounts of energy using coal and oil. Ships transport oil and coal from west. Coal mines cause environmental problems in Europe and oil pipes from east have leaks and shortages. There is a lot of smoke and grey ash.
You want it better! By saving energy within the whole EU area, you can save money and invest it into greener energy, like water, solar and wind power. This will make BOG redundant so its polluting ships and power plants can be closed.

You and your friends in Luleå, Manchester, Helsinki, Lisboa and Leiden have a common goal: Greener Europe. Fight for it and make the Europe a more beautiful place. But remember: if you are the most effective one, you and your country will be remembered as leaders in fight to go green.

How it integrates to real life?

- Real world energy saving has an effect in the game
- The game is seen on a daily basis, to remind the people about the project and to show the scores
- Special events, screen savers and other real world actions remind the people about the game and energy saving overall
- Mini-games engage the people, motivate them to find out about energy efficiency, and some games give ideas for energy saving
- Customizing the games for each building makes a mental connection between the real world and the game ideas

Structured Incentives: Scoring

- Personal level
    - Each player has her own game-play and score records for each game
    - These scores can be compared and ranked to make top-lists and compare with other players

- Building level
  - Basic unit is kWh
  - Basic level is estimated consumption (use history and trends)
  - Scores from different games can be compared to similar scores from other buildings
  - Combined scores from games gain achievements which have an effect on building consumption
  - The total score is calculated from estimates, compared to real consumption, which is modified with the achievements

- Europe level
  - Buildings can be compared together
  - There is a common enemy, against which all of the buildings are fighting together
  - The better the buildings do, the greener Europe gets

2.1.5. Living Lab Methodology

The Living Lab methodology consists in the evaluation of a product in a real-life environment and over a determined period of time. By using Living Labs, researchers can obtain a deeper understanding about how people interact with products, finding constraints or new features, leading to the development of a better product, more adequate to user needs and expectations, increasing bigger success in user acceptation.

The Laving Lab methodology is a relatively new term and which has a variety of definitions. One of the definition and also how the LL methodology is going to be applied in the SAVE ENERGY project is that a Living Lab is a user driven open innovation environment, where the users (of the pilots) can participate and have an active part in the process of research, development and innovation. The Living Lab will be created at the scene of each pilot, where the users have their everyday activities and are comfortable and familiar with the scene. In one sense the whole pilot building will be the Living Lab, and as well as the performance indicators and the serious game, the Living Lab might be subjected to changes and improvement when the testing period is ongoing. The creation of the Living Lab will at first require few resources as it is more based on the users and their ideas and inputs then equipment and technical aspects. The Living Lab will provide Real Time Information to users and create a database of knowledge, where the users can provide ideas and solutions. The Living Labs will most likely differ depending of the pilot and the users, but the methodology will be the same, to create active actors of the users instead of passive receivers of a public building. The Living Lab will be the location where ideas, innovation and solutions meet together with the users of the pilot and the SAVE ENERGY team.

The idea of the SAVE ENERGY Living Lab methodology is to create a user – friendly environment where the users are comfortable and have an open mind to create innovative ideas. The objective of the Living Lab is to include the users in the project and pilot and from that explore possible ideas and inputs that they might have. All the pilots are public buildings with a variety of different users, and it is important to include them as much as possible in the project. The idea of choose public buildings as pilots were also to create as much awareness as possible about Energy efficiency and how we all can contribute to the reduction of energy consumption and here the Living Lab is playing a vital role in the creation of awareness. The importance of the Living Lab is that everybody can contribute to the Lab and in that sense to the SAVE ENERGY project. It is driven by the users of the pilot along with guided decision making. The Living Lab experimentation and co-creation with real users in real life i.e. pilots.
The Living Lab has yet another aspect to the project; it can contribute to the creation of awareness of the SAVE ENERGY project and of energy efficiency to the users.

The energy management system and knowledge repository helps users to understand the critical incidents connected to energy consumption in a public building. This should occur on a Living Lab environment.

1. The energy management system and knowledge repository allows users to verify the impact of actions related to energy consumption;
2. The energy management system and knowledge repository allows the users to understand how they can contribute to cut back energy consumption in a public building;
3. The user's knowledge on energy savings increases while (s)he is playing this simulation game.

With the help of pilot users, testing the energy impact in their daily tasks and electric equipment usage, this methodology will bring the opportunity of achieving real impact assessment of ICT Energy Management tools in the pilot Buildings.

2.1.6.SAVE ENERGY architecture

Save Energy architecture is illustrated in the next Figure.

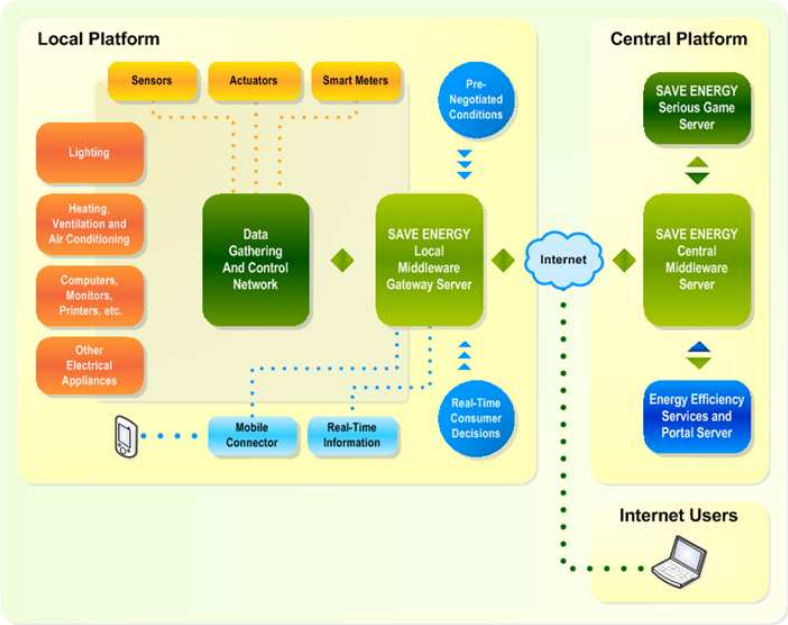


Figure 9 - General architecture of the SAVE ENERGY technical platform

Source: Alfamicro; SAVE ENERGY Technical Architecture Overview *Project Meeting – Manchester 3-5th March 2010*

Each pilot is implementing a different local technical platform from different suppliers, as shown in the next Table.

Figure 10 - Local technical platform

	Lisbon	Helsinki	Luleå	Manchester	Leiden
Key people	Employees	Role model (kitchen people)	Employees and visitors	Employees	Employees
Data server ownership	ISA server	Metropolia server	Kyab server	Samelco/Schneider server	Leiden university
Metering equipment supplier	ISA	Kyab, Dunkkis, Meshworks	Kyab	Samelco/Schneider	PlugWise
Platform interoperability	All local platforms will be integrated with ISA iCenter platform uploading data				
Data flow	All pilots have a services orientated local architecture				
End - user services (serious game)	All end user services and serious game will consume data from the central platform (iCenter)				

All platforms will integrate with a central platform supplied by ISA (iCenter) to which they will frequently upload aggregated data collected from each pilot installation.
Thus the ISA's iCenter platform will be the connector of all the elements, as the unifying middleware that will integrate with Pilots local middleware and provide interoperability with End-user Services and Serious Game

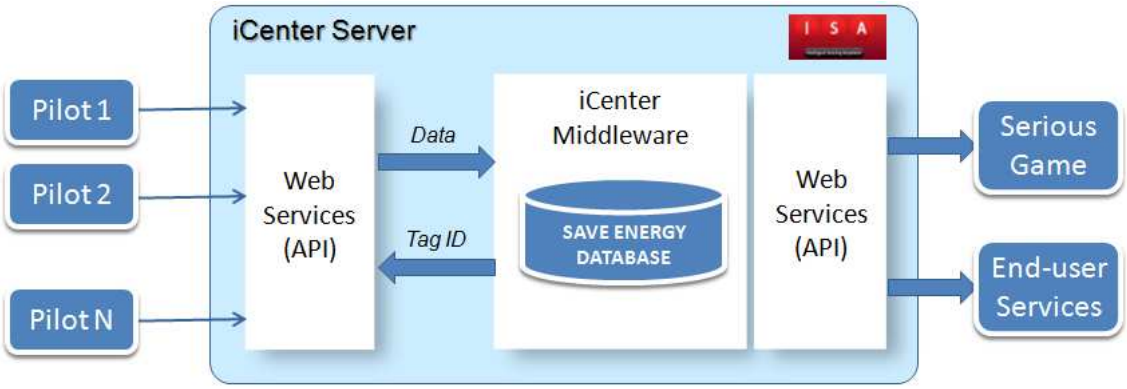


***Figure 11* - Central platform: iCenter**

Source: Alfamicro; SAVE ENERGY Technical Architecture Overview *Project Meeting – Manchester 3-5th March 2010*

The end-user services including the Serious Game will consume data stored in the Central platform and originated by all five pilots, as:

1. **Central Platform - Serious Game**
    - Serious Game infrastructure
    - Web portal
    - Meta Game
    - Mini-games
    - Social Interaction
    - Integration with Social networks
2. **Central platform - Energy Efficiency Services**
    - Energy Efficiency services
    - User behaviour analysis services
    - Reporting services

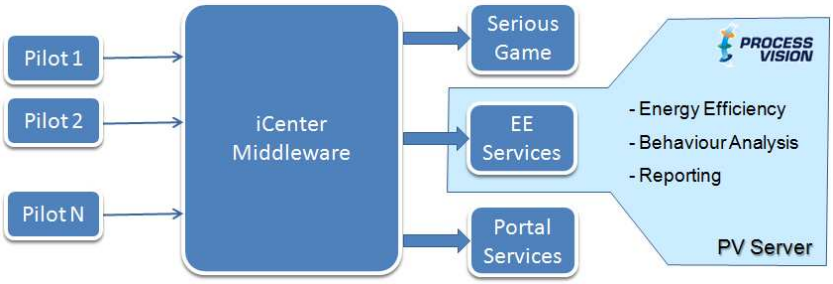


***Figure 12* - Central platform and Energy Efficiency Services**

Source: Alfamicro; SAVE ENERGY Technical Architecture Overview *Project Meeting – Manchester 3-5th March 2010*

As a result of this architecture a Single central platform for end-user services will be create, with common Energy Efficiency services and Portal, and providing interoperability of platforms from five local technical solutions witch fulfils each Pilot specific requirements and improves the overall project knowledge on Smart Metering technology by contacting with different suppliers and technologies.

2.2. Pilots

The identification of the five pilots is considered as one of the most important and vital decisions. The project will solely base its conclusions on the data and results obtained from the pilots, and therefore the identification of the most eligible and suitable pilots are required.

In order to ensure the suitability of the data, the pilots must offer the adequate space, time and dependent variables that can be applied in different public building scenarios. The scenarios are defined as a specific space, where both the stakeholders and critical incidents are clearly identified. In addition the systems can be implemented and the energy consumption can be measured without great difficulties.

To collect eligible data a vast number of scenarios must be studied, which imply the argumentation of several pilots implementations to obtain the most precise and trustworthy data.

With regard to energy saving, the project addresses the aspect of the various climate challenges that the world face today. Consequently pilots from different climates and environments are needed in order to reach eligible and useful results, for all European countries.

Combining the precedent requests 5 pilots were selected:

- Helsinki Pilot - Public Schools: The key objective at the Helsinki pilot is to improve the energy efficiency at schools with the support of ICT technologies.
- Leiden Pilot – Town Hall: The key objective at Leiden Pilot is to improve the energy efficiency at a public house hosting a variety of public functions for the local communities.
- Lisbon Pilot - Town Hall Offices: The Lisbon Pilot is owned by the municipality and provides public services to the Lisbon residents
- Lulea Pilot - Culture House: Lulea Pilot intends to achieve energy efficiency performance through ICT applied to the Energy Management System and empowering the users of the building to take appropriate actions
- Manchester Project - City Town Hall: ICT is consider the best approach to achieve the required energy efficiency performance, considering the major restrictions on what can be applied at structure level.

2.2.1. Helsinki Pilot

The Helsinki pilot is using two schools, The Malmi primary/comprehensive school and The Pihkapuisto Lower level School.

- The Malmi primary school/comprehensive school was build in 1965. It currently boasts of a student population of 220 and a staff contingent of 25. The users of the school are already involved in energy saving measures and are motivated to save energy but lack access to modern ICT tools.
- The Pihkapuisto Lower level School: a relatively new school (1989), with a student population of 300 and a staff contingent of 50. Its artificial ventilation system creates challenges to energy management, like in many other Helsinki buildings.

The Helsinki Pilot seeks to change the user behaviour and experience a reduction in the energy consumption for the pupils, administrative people, parents and other involved stakeholders.

As a means to save energy, the Helsinki Pilot will employ Web 2.0, social media and the serious game is all used as tools for the education of how to save energy. The ICT management will provide Real Time information to the stakeholders and support the energy reduction. The system database will receive measured data once per minute from BMS systems based on SQL queries, restore it and use it for calculations and user displays.

Three classrooms per school will be installed with control lightning systems, one room to use as a reference and to compare with. The 2 other rooms will consists of one half automatic and one fully automatic. The HVAC of the Gym will use renewed EC motors and BMS – sw systems to control the energy. The Helsinki government ordered Greensnapper energy savings system

for all schools; this was delivered in October, 2009. The electricity consumption (total and some sub centre) will be measured by extra measurement devices to be connected with the BMS. This feature is completely new in Finland and has now been ordered and implemented at schools. A wireless sensing device has been ordered and delivered in December, 2009. It is wireless Dunkkis – platform with 3 Asus routers.

At the central hall at Pinkapuisto have been designed and ordered the re – grouping of 20 lamps at the hall to be installed during December, 2009. Manual power analysers and several measurement devices will be used as extra data acquisition systems for low electricity consumption, like lighting.

It is believed at the Helsinki Pilot that children's behaviour are related to habits and the entire attitude of the family, it is therefore relevant to create awareness of how to save energy, as this might affect the pupil's families also.

The system architecture of Helsinki Pilot is based on the local permanent Building Management Systems, BMS, developed Dunkkis platform, manual Fluke power analyser and some wireless, portable, temporary sensor systems (KYAB,ISA, Meshworks), connected with the virtual server at Metropolia.

The Living Lab Methodology is applied to the Helsinki Pilot as a learning society where energy savings are in focus.

Below is presented the critical incidents along with the performance indicators for the Helsinki Pilot, as the pilot is two different schools a variety in the critical incidents and performance indicators might occur.

2.2.2.Leiden Pilot

The Leiden pilot will take place in Leiden Town Hall, a public building that provides public services to the citizens, and in addition hosts offices and meeting rooms. The City Hall was built in the 1600 and partly rebuilt in 1932. An energy audit was performed in 2007, which resulted in numerous technical solutions for energy efficiency that has been gradually adopted over time.

The Leiden pilot will consists of 4 participating and 4 reference rooms. The rooms will not be of equal room size, as for the layout inside and outside will be different as well. In addition a various number of people will participate in the pilot. The installation and configuration of the rooms will be from November, 2009 – to January 2010. Afterwards the system testing and base line use will run from January 2010 to April 2010. The pilot will run officially from May 2010 to May 2011.

The Leiden pilot will demonstrate how energy efficiency can be achieved through the use of ICT monitoring systems, which will be installed in the pilot to measure the electricity, heating and temperature inside and outside. The ICT monitoring equipment will measure and send the measured data back to an overall database which will store the data. The electricity consumption will be measured from electrical equipment such as computers. The lighting of the rooms will be controlled by users and measured, and through these activities awareness of the importance of energy efficiency will be created for the users of the pilot. The heating consists of radiators, controlled both manually on/off and by manually set point control (thermostatic valves) by the users. These radiators will also be equipped with ICT energy systems that measure the heating consumption of the rooms, allowing for a temperature reading of both inside and outside to be produced. The reason for this measurement is to determine whether energy consumption is falling, when outside temperature rise along with the decrease of lightning hours needed when the days becomes longer. The use of such equipment will most likely increase the awareness of energy consumption and energy efficiency within the users of the pilot.

All of the above mentioned energy reduction initiatives are believed to have an even greater impact through the possible behaviour change of the pilot's users.
In addition, a serious game is currently under development, which will make it possible for the user to interact and create solutions to energy consumption. The Living Lab methodology will be applied to the pilot throughout the testing period in order to gain innovative and valuable research and solutions for the future, and to educate as many of the pilot's user of how to save energy.

Below is the performance indicators outlined, along with the critical incidents. As already mentioned adjustment of the performance indicators throughout the pilot is most likely to happen in order to optimize the pilot as much as possible.

2.2.3. Lisbon Pilot

The Lisbon Pilot will take place in the Lisbon Municipality main office building. The building started to function in 1998, serving both as administrative office and public attending services. The building, with approximately 1800 employees and approximately 200 daily visits, provides municipal administrative services (urban management, project development, financial services, and public relations). At the Lisbon Pilot two vital issues are addressed: dynamic analysis of the building energy performance, carried out within the context of the building Energy and Indoor Air Quality Certification process. The other issue is to address the building users and actively promote their engagement in the building energy use, influencing their energy consumption patterns through awareness raising actions and best practices promotion regarding energy use in service buildings.

The Lisbon Pilot consists of two separate areas (blocks) one that serves the Pilot itself and actively communicates with the users and another area that serves as a constant baseline assessment in order to perceive behaviour changes derivate from the actions undertaken

within the SAVE ENERGY project. During February and March 2010 the ICT management system equipment will be installed and tested. The pilot will start officially from May 2010 and run to May 2011. The Lisbon pilot will also make use of the ICT management system in order to measure and store energy consumption data. In the Lisbon Pilot the measurements will consider the block's overall electricity consumption, a separate desegregation regarding the electricity consumption in each electrical circuit, plugs, lights, etc and 9 measurement points in the office space .Measures will not only focus on energy consumption and two very interesting factors regarding energy efficiency and energy consumption will also be monitored, namely the humidity of the room and the CO2 contents in the air indoors. The temperature inside and outside of the facilities of the pilot will also be measured. These measurements are assessed in order to understand and estimate how much energy consumption is related to the outdoor temperature.

It is through the ICT management and the public display of the measurement results that education and awareness of how to save energy within a public building will be increased. The expected outcome is that through ICT management, additional activities and scenarios as the Serious Game and the Living Lab methodology, the Lisbon Pilot will be able to experience higher awareness and educational standards regarding energy efficiency and a significant reduction in the Pilot's area electricity consumption.

The Living Lab methodology will be applied as a user innovative environment within the Lisbon Pilot. The dynamic display of the energy consumption, along with the serious game scenarios and the awareness raising sessions that will take place periodically during the Pilot, are the active keys of the Living Lab methodology, through which it is expected to promote users behaviour change in energy consumption The serious game is a complementary interface that intents to foster users interaction within known settings and perform energy efficiency activities. The Living Lab will be an environment for open education and innovation where users' area called to contribute with solutions and ideas for the constant Lisbon Pilot development.

Description of the performance indicators and critical incidents is presented in the following sections. The performance indicators are in constant development in order to adapt to the Pilot's reality and ensure the most efficient indicators for the Lisbon Pilot.

2.2.4.Lulea Pilot

The Luleå Pilot is the City Culture House. The City Culture House was finished in 2006 and in January 2007 the grand opening took place. The building holds a Library, Concert Hall, Restaurant, Café, Art Gallery, Tourist Agency, Conference and Office area. The selected rooms for the pilot are the restaurant, offices and entrance doors. The building has a completely new state-of-the-art energy management system controlling every room in the building. It is planned to use ISA sensors in the pilot, it is believed that these sensors will increase the accuracy of the collected data.

The total energy consumption is measured for the whole house. There will be four “rooms” selected for testing. These are the restaurant, 2 separate sections of office rooms and finally the entrance doors. For the restaurant electricity, temperature and hot and coldwater consumption (energy) is measured. For the offices electricity is measured. For the entrance doors the user behaviour will be measured directly by counting the number of persons using the “open door button” or not.

For the entrance doors we will measure the change of user behaviour by in step 1 do nothing, step 2 introduce a text saying “please help us save energy” or similar and finally introduce a delay so the user must push the “open door button”) 3 seconds before the doors open.

The creation of awareness and change of behaviour of the users of the pilot will be driven from the Serious Game and the establishment of the Living Lab methodology. The Living Lab will be created at the Pilot premises and thus be an active environment, where the users of the pilot will contribute to innovative solutions and change their energy consumption behaviour.
The pilot testing period will be from March 2010 and run to April 2011.

2.2.5. Manchester Project

The Manchester Pilot will take place in the town hall building, built in 1887. All the electricity construction is post construction and since the building is quite old, it also challenges the energy efficiency and carbon emissions, as no such thing was thought of at the construction time of the Manchester pilot.

The Manchester pilot will consists of a chosen room in the pilot, where electricity consumption from lightning, computers and other electric equipment are located. As the testing period goes on, data will be added on a regular basis, which provides the opportunity to compare and develop solutions and ideas for improvement of the pilot. The temperature of inside and outside facilities of the Manchester pilot will be measured on a regular basis.

The Manchester pilot is a relative old building, where modern ICT management systems can be rather difficult to install and in addition, the design of the pilot can also create difficulties. However, it is the objective of the Manchester pilot to be a case study for other old buildings and to prove at energy efficiency is still possible, even in old buildings. Another aspect is the change of user behaviour, which is circled around the creation of awareness of energy efficiency and how to handle this, and is related to the serious game and Living Lab methodology.

A serious game will be available for the users of the pilot to interact in already known settings that will help them to promote awareness and gain greater knowledge of energy efficiency and how to save energy.

The Living Lab methodology will be unfolded in the environment of the pilot and create an open lab for the stakeholders and users of the pilot, where interaction and creativity is the priority. The users can help the SAVE ENERGY to understand the pilot in deep and in addition learn more about energy efficacy and how to reduce energy consumption.

The pilot period will run from May 2010 to May 2011, where the performance indicators will be adjusted and improved as the progress of the pilot is made. The current performance indicators along with the critical incidents are described below.

2.2.6. General Pilots - Generalisation

The SAVE ENERGY pilots will take place at 5 different locations in the European Union and at 5 different public buildings. The difference in the pilots varies great regarding appearance, equipment available, size, possible performance indicators, and other variables. The difference in the pilots are considered as a strength, since each of the pilot will be a best practice for other public buildings that wish to create energy efficient buildings and create behaviour change through processes such as the creation of the serious game and the Living Lab methodology that will involve the users of the pilot into an innovative and creative environment. Each of the pilots has an individual approach to the three selected scenarios, ICT management system, Serious Game and Living Lab methodology. For instance, one pilot might have slightly more focus on one aspect than another, or have a better possibility to address one issue compared to another. This can also be due to the age of the building, new buildings tend to already have responded to a certain extent to energy efficiency, i.e. having installed some kind of ICT management system or having outlined a Energy Efficiency Policy for that building or various others initiatives. All the pilots have that in common that they want to promote energy efficiency and to change the behaviour of the users.

3. Project Scenarios

Based on the work description of project scenarios (Task 1.3), this chapter's main focus are the SAVE ENERGY project users. For this reason the basis for the textual descriptions has been on how the users act in each of the different types of scenarios, i.e. the texts have been written from the user perspective.

Data for the project scenarios has been collected from the pilot users (from the Living Lab methodology perspective), i.e. they have been asked how they would like to receive the real time energy information, in which situations they would play the serious game etc.

In the Helsinki pilot schools the data has been collected by interviewing the different stakeholders of the schools: pupils, teachers and principals. In the other pilots the ideas and comments have been collected only from the pilot coordinators, due to the lack of resources. The interview questions can be found as an appendix of this deliverable.

The different scenarios will be viewed from the different stakeholder perspectives due to the different working conditions and levels of knowledge. Some differentiation has also been needed between the pilots.

The project scenarios are illustrated in the following picture, which covers the main areas of the project that concern the pilot users. The users are defined in the SAVE ENERGY project technical annex as being citizens (mainly pupils and office workers), public servants (janitors, teachers) and policy makers (city officials). The area rounded by the red square is of special interest in this chapter, as it focuses especially on the pilot users. The users' actions and decisions concerning the pilot buildings' energy consumption have been covered in the SAVE ENERGY project deliverables D3.1 and D3.2; thereby this document is mainly focusing on the interaction between the user and the Real Time Information as well as the Serious Game.

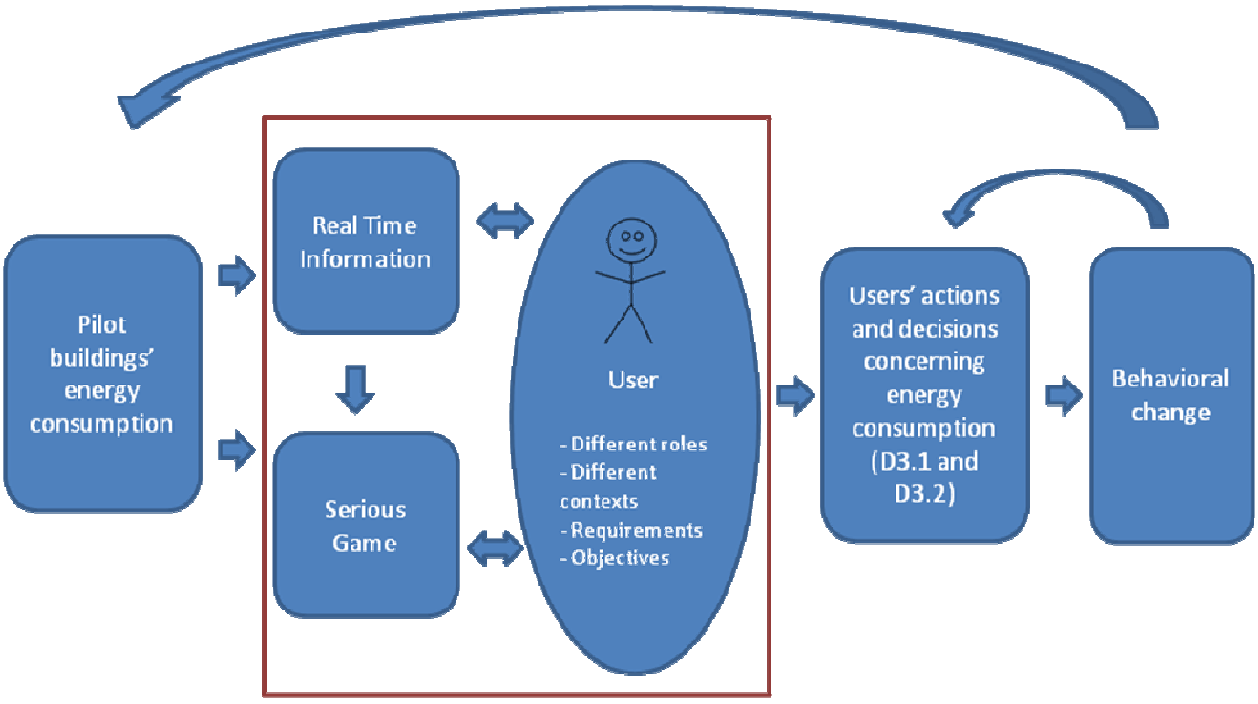


Figure 8 - Users' interaction with Real Time Information and Serious Game

The main objective of these SAVE ENERGY project elements – Real Time Information and Serious Game – is the behavioral transformation of the users. They are provided information about their own energy consumption as well as the best practices concerning energy-related behavior.

The behavioral transformation topic has been covered in the SAVE ENERGY Concept deliverable (D1.2) concerning the theme in general as well as in the Serious Game Design deliverable (D3.6) focusing on the behavioral changes with regard to the game playing. The general idea is that as a result of positive actions and decisions in the pilots the behavioral

change of the stakeholders influences the energy efficient decisions to become routines. This would also enable the energy reductions to become permanent. The results from other projects similar to SAVE ENERGY confirm the effectiveness of information and feedback based approaches in the behavioral change, which has been taken into account in the planning of the displays of Real Time Information and the Serious Game.

3.1 Real time information (RTI)

In the pilot buildings energy consumption is measured from different sources. The results of these measurements as well as the comparisons to the previous results should be delivered to the pilot users in order to show them the impact of their behavior on the total energy consumption of the building. The energy information would not necessarily be real time; there has not been seen need for such frequent measurements. However, it will be something from every minute to every hour. The real time information about pilot buildings' energy consumption has to be translated to an understandable format before delivering it to the pilot users. Each pilot will be responsible for its own method of displaying the energy information.

The fourth chapter of this document discusses about the measurements that will take place in the five SAVE ENERGY pilot buildings. The situation in the different pilots varies still at this point of the project.

3.1.1 Objectives

The desired objectives of the interaction of users and the real time information include getting direct information of the impact of energy efficient behavior and increase the knowledge about energy efficiency. Continuous information flow of energy efficiency issues helps to achieve one of the main objectives of the SAVE ENERGY project, i.e. permanent change in behavior, perhaps at first in the form of awareness of the issues, later transferred to the behavior. Furthermore, the "role models", being engaged users in leading positions showing good example in energy saving in schools as well as in offices can have an impact on the behavior of the other pilot users.

In Helsinki pilot schools the youngest pupils absorb easily new information and may bring it also to their homes. That would be a very desirable chain of actions, as it would have a wider impact also for the household energy consumption. The open format of the serious game is also designed to facilitate this spread of interest and engagement.

3.1.2 Communication means for delivering RTI

The users are mainly involved with this real time information as receivers; a majority of them is not involved in formatting the data.

There are different communication means for delivering this real time energy information from the pilot buildings to the users.

In Helsinki pilot the existing media and possible ways of delivering this information as well as engaging the users into the serious game include:

- Lectures (especially biology, geography and physics)
- Poster on the wall describing the weekly changes in the energy consumption (e.g. in the form of a diagram). This poster should be on some special place, otherwise the information will be lost, e.g. SAVE ENERGY bulletin board. Part of the game site is designed to show pilot status: this design could be for example adapted and printed.
- For teachers in an intranet that could contain continuously updated information about the building's energy consumption.
- Environmental news via central radio or in assemblies every two or three weeks; some major changes could be formulated into news.
- If major changes occur, those could be announced in some school event
- On the school web pages (also external stakeholders could view the information). Also a link to the serious game should be added there.
- Some tasks for the pupils to actively search for that information. This kind of a search topic could be derived for example from students' favorite game.
- In Pihkapuisto: Fronter (intranet), of which the downside is that it's not used in every class. It would be good for storing information (link to the information in the Internet or some kind of a news feed)
- In Ala-Malmi: InfoTV – several TVs on school corridors. Those attract mostly pupils, not teachers
- For teachers information/reminders via email (possibly in principal's weekly notice)
- For kitchen staff information mainly via possible InfoTVs (not existing yet)

Majority of these communication means mentioned above would require some modification of the energy information. Pupils (probably in the Green Students' Union or the environmental agents) together with some teachers could translate the information. For this definitely some special skills and possibly help from energy experts would be required, in order to be able to correctly display the energy information in an interesting and distinct way.

The information would be delivered at a certain phase of a day in schools, it could be weekly on a certain day, e.g. every Monday afternoon. Also some special energy weeks were suggested, when the school would put extra interest in saving energy by different means – an intensive period could engage the attention and interest better than continuous information flow.

In other SAVE ENERGY pilots the availability of different media is not as good as in schools; the most probable means for delivering energy information for the office workers will be emails (e.g. electronic newsletter), via Internet and through a display screen set up separately from the computer systems. **In Luleå** a plan is also to deliver this information daily during the coffee breaks at 9:30 am and 2:30 pm. **In Manchester** due to the firewall restrictions that limit the access to the internet, applications won't be able to run on the computer machines and the internet usage (most websites filtered including popular social media sites) is restricted. A solution for this could be that MDDA would provide special machines for SAVE ENERGY project's access, those could be then utilized at break times.

In Lisbon the information is expected to be available at the block's hall display screen and online at a dedicated webpage, where users are invited to explore the different display formats and the different possibilities the measurements results can be presented. There is also going to be installed in each user private computer an applet, an information software that intents to be users' constant reminder of the SAVE ENERGY objectives. The applets will not only present data on the actual energy consumption, but will also provide information regarding the actions that can be developed, present topic highlights regarding the efficient use of office equipments and also present information the user can explore at home. The pilot is also expected to run with monthly seminars to the users, not only organized as awareness raising actions, but also as a communication and interaction space, where users can give their feedback and provide innovative solutions to run the pilot. Additionally, users will also be called to perform some actions at their own home, as the group will be given display plugs to pass around and test at home in order to get some information about the domestic consumptions. Hopefully, this change of scenario into a scenario where energy consumption has a direct impact on the energy bill will be an additional motivation for users to change their behavior at the office and at home.

In Leiden the situation is somewhat different. They are using a test group (users that get all the information about energy efficiency) and a reference group (users that do not get information at all). The Leiden pilot is using this kind of reference group in order to be able to draw conclusions about the attained results. Thus, the amount of information that can be supplied publicly or to non-test-participants is limited.

About the roles of the different stakeholders in the buildings, **in Manchester** the Green Champions are office representatives who have an interest in eco activities and who volunteer to act as the liaison point for the Manchester City Council scheme. The pilot will work directly with them; they would thus act as office representatives. **In Leiden** the building facility management facilitates the measurements and installation. **In Lisbon** the team that manages the building energy consumption is involved in the measurements. They are responsible for the general lights, for the options made in terms of equipments, for the functioning of the air conditioning equipments and they are involved in the SAVE ENERGY project.

The janitors in the pilot buildings already have this information and cannot be targeted with the same messages as the other stakeholders due to the different requirements of the information.

In the Leiden pilot two city politicians will participate in the project and their rooms have been provided with sensors recently. There are also two directors as participants in order to involve the policy makers in this part of the project. In the pilots where the policy makers do not work in the pilot buildings it is still open how they should be targeted both with the real time information as well as the serious game.

3.1.3 The ideas and requirements for the real time information

In this subchapter the ideas from the pilots' users and coordinators will be introduced, in order to clarify, what is their vision about the possible communicational means of RTI. The following subchapter introduces then the energy expert's vision about the best practices concerning RTI. In the appendix the drafts of Helsinki pilot's displays are being illustrated.

In Helsinki the pilot users (teachers, principal and pupils) had the following ideas about the format of the information. The data should be interestingly, but still clearly and positively illustrated, so that it attracts attention as well as clearly shows the impact of energy saving actions. Perhaps a competition and some kind of a prize would motivate even more (the prize should be well thought, so that it would be in line with the energy efficiency theme). The savings translated in monetary terms might work, only problem is that it might give a wrong kind of idea for the youngest pupils of why energy should be saved. Furthermore, the users would also be willing to achieve concrete information about best practices of how one should behave.

In Luleå the ideas included that the energy information could be illustrated i.e. in the traffic light format. In Leiden the suggestion was that information should be illustrated in figures, pictures, text and comparisons.

In Lisbon users revealed a strong interest in having an applet device and to have the information to be presented in a more familiar language. Comparison with domestic use via pictures and simple graphs are seen as good illustrations of the energy consumption.

Figure 9 - Example for the measurements presentation online in the Lisbon Pilot

In Manchester the ideas included text information with illustrations e.g. smiley face if doing well or a 'dial' like screen:

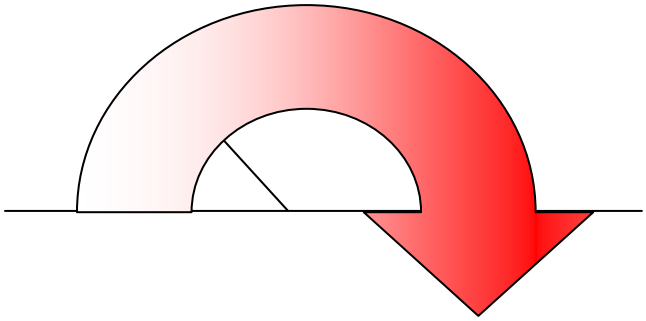


Figure 10 – Example of an illustration of RTI in the Manchester Pilot

The individual user's names or information that identifies their work station should not be included.

Overall in the pilots visual illustrations were seen as most useful way of expressing the energy consumption. Furthermore, some comparisons to the previous consumption would be needed in order to clearly show the impact of users' behavior. However, in Leiden due to the different testing purposes the comparisons will be done between the testing group and the reference group.

3.1.4 Best practices concerning real time information

Energy supply and consumption are socio-technical in nature: technology and behavior interact and co-evolve with each other over time. In many cases technical and physical improvements in buildings are not enough to guarantee reduced energy consumption; consumption can easily differ by several factors depending on the behavior of the building users in identical buildings, even those designed to be low-energy dwellings. Any attempts to change the patterns of consumption therefore need to include the interfaces between supplier, technology and consumer and the ways in which these can be improved. This is where consumption feedback issues enter the debate.

Giving consumers regular data on consumption will help them take steps to be more energy-efficient and will be an effective way to cut their personal energy use and greenhouse gas emissions. Most people do not have a clear idea of how much energy they are using for different purposes and what sort of difference they could make by changing day-to-day behavior or investing in efficiency measures, or what are the actual actions they can do, that have an impact on their personal consumption.

According to the wide literature view done by University of Oxford's Environmental Change Institute (Darby, 2006) about the effectiveness of feedback on energy consumption, the effectiveness in decreasing energy consumption is about 5-15 %. The role of the meter or display is to provide a clearly-understood point. If there is no separate, free-standing display then the meter must also be clearly visible, within the building. There is some indication that high energy users may respond more than low users to direct feedback.

Indirect feedback (feedback that has been processed in some way before reaching the energy user, normally via billing) is usually more suitable than direct feedback for demonstrating any effect on consumption of changes in space heating, household composition and the impact of investments in efficiency measures or high-consuming appliances. Savings have ranged from 0-10%, but they vary according to context and the quality of information given. Historic feedback (comparing with previous recorded periods of consumption) appears to be more effective than comparative or normative (comparing with other households/public buildings, or with a target figure).

An easily accessible display may give the consumer adequate information on different end uses, by showing the surge in consumption when the lights are switched on, or the relative significance of a radio or computer. Information on how energy use is disaggregated among end-uses in an average similar public building can also be given to the user. Because of energy itself, as well as the units used when talking about energy consumption (like kWh, kW) are in many cases something that some for example non-technically oriented people may find confusing, the displays could provide the information in a format that is more easily understood by everyone.

People may also need additional help in changing their habits – this is where the well-thought-out energy advice can be of use. The displays could for example include some kind of "tip-of-the-day" or similar to give the users the knowledge and tools to change their habits. Where feedback is used in conjunction with incentives to save energy, behavior may change but the changes are likely to fade away when the incentive is taken away. As a rule of thumb, a new type of behavior formed over a three-month period or longer seems likely to persist – but continued feedback is needed to help maintain the change and, in time, encourage other changes.

Important factors influencing the effectiveness of feedback are:

- General context, e.g. social, educational and historical factors, energy infrastructure
- Scale and timing of usage. Indirect feedback is most likely to give a compelling picture of what is happening to the heating load, while instantaneous direct feedback illustrates the impact of smaller end-uses
- Timing. Billing or other periodic feedback (e.g. via a PC) will show up longer term effects best, e.g. investment in insulation, use of new appliances, replacement of heating systems and appliances etc. Direct displays will show up the significance of moment-to-moment behavior best.

- Synergies between feedback and other forms of information.

Monitors would be most useful if they showed instantaneous usage, expenditure and historic feedback as a minimum, with the potential for displaying information on micro generation, tariffs and carbon emissions. Feedback is of value in itself as a learning tool and must be seen in context. The outcomes from feedback will vary according to circumstances, but they can also sometimes be improved by using feedback in conjunction with advice and information.

Buildings' energy consumption is still largely invisible to millions of users and this is a prime cause of much wastage. Feedback on consumption is necessary for energy savings. It is not always sufficient – sometimes people need help in interpreting their feedback and in deciding what courses of action to take – but without feedback it is impossible to learn effectively.

When planning the displays in the SAVE ENERGY project, a good starting point is to keep in mind the generally used energy efficiency indicators that are also widely used in the project. These are:

- Consumption monitoring:
    - Heat consumption per building area kWh /m^2, per volume kWh/m^3
    - Electricity consumption per building area kWh/m^3, per volume kWh/m^3
    - Water consumption per building area m^3/m^2, per volume m^3/m^3
    - Primary energy consumption kWh/m^2
- CO_2 –monitoring:
    - CO_2 consumption kg/m^2
    - Carbon footprint kg CO_2
- Other potential indicators, that also include the level of usage:
    - Energy and water consumption in a kitchen
        - i.e kWh/portion, l/portion
    - Electricity consumption of a certain space (like the gym hall)
        - i.e kWh/m^3, kWh/person
    - Heat consumption of a certain space (like the gym hall)
        - i.e kWh/m^3, kWh/person
    - Water consumption
        - i.e l/person

It depends personally on the user involved, if the given feedback in some (or several) of the units listed above is efficient or not. In many cases these can be very effective, especially if complemented with figures and historical consumption data. However, if the user is not technically minded, figures and numbers can be difficult to understand and relate to in real terms. As the goal of the SAVE ENERGY project is to affect the behavior of many kinds of users, it may be more effective to convert the information into various different forms, including figures for the technically minded and other indicators for those who are not. Different kinds of information can mean something very simple, like thumbs up/down based information and smiley faces or converting the kWh to something more easily understood, such as kilometers driven with an average car or tea kettles heated or computer using hours etc. The kind of indicators used should be chosen to reflect the interests of the target group of users.

The Helsinki pilot's preliminary ideas about the possible use of displays concerning RTI are presented as an appendix.

3.2 Serious Game

In the SAVE ENERGY project a Serious Game is being developed. Its purpose is to raise thoughts about energy issues and teach energy efficiency. The game is not going to be a simulation of the pilot building, but information about the energy consumption in each pilot building will be added to it. The game has a meta-game level that has links to the real time information about the buildings' energy consumption as well as to different social media. In addition to the meta-game there will be continuously evolving mini-games that will attract the users to visit the game.

3.2.1 The desired objectives

The desired objectives of the interaction of users and the SAVE ENERGY Serious Game include i.e. that the Serious Game should be an engaging environment that stimulates the users to save energy. The users should be getting direct information of the impact of energy efficient behavior also via the Serious Game, which would inform the end user (possibly through feedback at the end of the game) that saving energy is possible. This way the users can see how much they can make a difference with their behavior. Furthermore, continuous information flow of energy efficiency issues helps to achieve permanent change in behavior. The serious game would thus work both as another dissemination platform for energy-use info, and as a driver for pilot users to go and see their energy use data, since the interaction flow always ends in this general and pilot-specific energy efficiency info.

Interaction between several countries/cities (in the beginning between the pilot cities) can be achieved with the help of the game. In this the cooperative aspects of the game interaction

between pilots must be somehow enhanced, rather than only the competition level that is also embedded in the game. This has been already thought in the design of the game, as the pilot users, even though registered as members of a single pilot, can pick any pilot building in the game to view it. While in the other pilot, if they play games, the points contribute to that pilot building rather than their own. E.g. while in the Luleå pilot pages, if the user clicks 'Play for Luleå', game points go to Luleå, no matter which pilot he/she is personally registered to.

In the Helsinki pilot schools the game could be a good addition for the pedagogical tools, it could inspire especially boys or those that don't otherwise pay attention during the lessons

3.2.2 Interaction between the users and the game

With regard to the SAVE ENERGY Serious Game all the users have somewhat similar role, they are primarily just playing the game and interacting via the meta-game.

In Helsinki the pupils have probably most possibilities for playing the game in certain classes (physics, computer classes, biology). Some teachers can also play it during the classes, but most of them might not have time for that or it is not related to their subject. In Pihkapuisto School at least until now playing has been prohibited during the breaks. For pupils playing the game could also be an extra task, if they had finished early their other tasks. The purpose is to get the users attracted to the game so that they would also play it during their free-time, and in this way disseminate it among non-school users, e.g. parents. Teachers could also see the game activity of students, to know who to target with more motivation. In the InfoTV screens also a serious game status could be shown in order to increase the motivation to play the game.

In Manchester and in Leiden there are limitations placed on the users' computers and restrictions placed on the internet connection, which means that the majority of users won't be able to play the game via the internet. Due to these limitations on the council's computer systems, applications won't be able to run on the computer machines and the internet usage (most websites filtered including popular social media sites) is restricted. The game would have to be played during the users own time (lunch period etc.) during work because of city council policy. That would be facilitated with laptops via a wireless network in some lunchtime sessions.

In Leiden pilot the purpose is to get feedback on the energy consumption of the test rooms (compared to the reference rooms) on a real time basis in an attractive form e.g. webpage ('dash board') and some 'game' that stimulates the room occupants to save energy, e.g. a competition based on relative performance. At this point there are no plans for a 'serious game' implementation in Leiden that is aimed at changing the behavior of employees by providing general information on energy consumption / ways to save energy etc. The possibilities for the users of playing the game depends entirely on the employee. The basis is 'empowerment'.

In Luleå pilot the game would be played during the coffee breaks at 9:30 am and 2.30 pm. Perhaps also the library computers could be utilized for playing the serious game.

In Lisbon the game is expected to be online, available to everyone**.** Users' interaction with the serious game depends mostly on the employee. The monthly awareness actions will also focus on the game existence, new games, scores, most positive aspects from the user's point of view, etc. Additionally, the applet installed in the individual computers will also present reminding messages for the users to play the games.

In all the pilots, special game events need to be planned, giving bonus scores for pilots that get involved.

3.2.3 Ideas and requirements for the Serious Game

There are certain requirements for the Serious Game in order to attract the users to play the game. The competitive aspect of the game helps to drive people to take responsibility for their own involvement in the game, as the outcome of their team depends on this. However, the overall focus of the game is collaborative, as the concept of waste is depicted as the common enemy of all. In this way, failure in the competition (one concern especially with younger pupils) is not absolute failure.

Information about the actions and pilot development in the other pilots would be useful, together with the possibilities to learn about similar projects in order to raise awareness of the users. It could be made available through the dedicated webpage and through the applet services.

The game would have to provide energy usage of the pilot and display ways in which energy can be saved. The game requires on-demand energy data from the pilots: i.e. whenever the player logs in, the game website makes a demand to the server for up-to-date info.

The game should emphasize the positive aspects of saving energy, e.g. player would get rewards when making the right choices in the game. The social networking elements will be added as a part of players account page.

Instructions for the games have to be translated in different languages.

In Helsinki pilot in order to get the teachers interested in the game, it definitely would need to have educational content, so that they would give time for the pupils to play it during the classes. Also the possibility for bullying via the social networking elements must be somehow handled, i.e. some kind of supervision would be needed. Furthermore some different levels for pupils with different ages might be necessary. As a solution, probably different difficulty levels will be implemented in the game.

The game can also work as a mean to deliver information about the best practices in order to save energy. One way to achieve this is that the game would work as a central portal, or part

of a portal, through which other information pages/services can also be accessed. The rest of the project web presence should feed into this.

3.3 Conclusions

This chapter has discussed about the project scenarios from the pilot user point of view. As stated in the introduction, the users face the SAVE ENERGY project mainly when getting information about the real time information of the building's energy consumption and when playing the SAVE ENERGY Serious Game. The desired objectives of these actions are related to the behavioral change of the pilot users: they are provided information about their own energy consumption as well as the best practices concerning energy-related behavior and as a result the behavioral change of the stakeholders influences the energy efficient decisions to become routines. This would also enable the energy reductions to become permanent.

The information about the users was collected by interviews in the Helsinki pilot. From the Helsinki pilot schools, Pihkapuisto and Ala-Malmi, pupils of different age as well as teachers and the principal were interviewed. In the other pilots the information was gathered only from the pilot coordinators due to lack of resources.

There are different possibilities for delivering the energy consumption information for the users. In the Helsinki schools the possibilities for usage of different type of media is the vastest, in the other pilots internet will be the main media. Comparisons to historical data were seen as a suitable way for delivering the information, illustrated by different types of diagrams. However, in Leiden, where the research frame is somewhat different, the energy consumption of the test rooms will be compared with the reference rooms' energy consumption. Most likely the ways of delivering the information will vary between the pilots as well as also inside pilots depending on the target user.

The serious game will be more unified between the pilots; however the possibilities to play the game differ as in some pilots there are limitations in the internet access. This can be taken care for example with extra laptops that would be provided for the employees' use during lunch hours. Probably the most efficient way for achieving the projects' objectives would be to integrate these two elements of the project as effectively as possible – the serious game and the information about buildings' energy usage.

Already when planning these user-related actions in the pilots it would be necessary to consider also the dissemination of the results gained during the project, i.e. how the project's lessons learned will be extended outside the pilot buildings as well as how they will be continued in the pilots after the project is finished. This will be discussed in the sixth chapter of this Vision deliverable: Impact – Policy Recommendations.

4. Pilots Results Analysis

The Save Energy project focuses on two dimensions in the pursuit of reducing energy consumption: Implementing ICT management systems and changing the behaviour of those who use the pilot buildings. In order to reach these objectives, the following two dimensions should be analysed in detail in order to understand how it will be possible to reach the given objectives: energy consumption monitoring and behaviour transformation.

4.1. Energy consumption monitoring

The ultimate aim of the project is to make users aware of their energy (and water) consumption in public buildings based on pre-established periodic electricity, water, fuel oil and gas consumption readings, comparing them to past, current and post-project readings.
This method of analysis should allow the building energy managers to highlight the energy consumption profile of each building and understand how the Save Energy project will positively impact on its energy consumption.

To evaluate the extent of this impact, it is necessary to ensure that the project area represents a significant energy consumption of the building, meaning that this area has to include appliances used throughout the building. It is also important to establish the current level of energy consumption and have, at the very least, a rough idea of the consumption distribution (which parts are the most energy consuming), before being able to proceed with a corrective course of action.

Therefore, the first step of the Save Energy Project was to define the **pilot building energetic consumption critical points**, utilizing a building-wide energy audit.

An **Energy Audit** is defined as a systematic procedure through which the building energy profiled is defined and critically analysed in order to identify the factors that most impact on the overall energy consumption and assess the cost effective saving opportunities that derivate from implementing the identified measures. .

The aim of an energy audit is to encourage the reduction of energy and water consumption in addition to their costs, decreasing CO_2 emissions caused by the use and production of energy. This is reduction can be achieved through the use of economically profitable actions to improve the energy efficiency of the building and ultimately reduce overall energy costs. More specifically, the objectives are:

- To define potential energy-saving areas in each pilot building taking into consideration comfort, sanitary conditions and other influences on indoor climate control
- To motivate and encourage staff and building users to use energy more efficiently
- To produce and achieve an Energy Efficiency Certificate for the pilot buildings

The procedure followed by the pilots to achieve these objectives is summarized below:

1. **Evaluating the present energy consumption** – This initial step comprised of a site survey to inspect its energy efficiency, paying particular attention to its technical systems and other key areas, identifying down vital measurements.

2. **Identifying possible energy saving areas / opportunities** – Taking the data collected in step one, statistical modelling was conducted to identify possible energy saving opportunities. The Model included factors such as the annual heat demand and summertime heat consumption, presenting the current situation as well as predicting the future outlook, once users and staff are encouraged to be more responsible.

Each pilot defined the critical points of their building and conducted their own energy audit. On a side note, it would have been interesting to evaluate the impact of each of these points on the overall energy consumption, although this procedure required several meter-read dates and would have been too expensive for this project to handle.

As a result, the Save Energy partners chose to fulfil the energy consumption monitoring objective using a global perspective, which involved measuring the global energy consumption on the building. With that in mind, they used the following indicators:

- Energy consumption monitoring:
  - Heat consumption per building area kWh / m^2, per volume kWh/ rm^3
  - Electricity consumption per building area kWh/brm^3, per volume kWh/rm^3
  - Water consumption per building area m^3/brm^2, per volume m^3/rm^3
  - Primary energy consumption kWh/m^2
- CO_2 monitoring:
  - CO_2 consumption kg/m^2
  - Carbon footprint kg CO_2

These indicators don't take into account the density or use of the space in question, just the area / volume of the space. This is why some pilot-specific indicators might have been useful to identify how energy consumption and CO_2 levels changed in specific areas during the day. The types of indicators used for this level of investigation are as follows:

- Energy and water consumption in a kitchen
  - i.e kWh/portion, l/portion
- Electricity consumption of a certain space (like the gym hall)
  - i.e kWh/m^3, kWh/person
- Heat consumption of a certain space (like the gym hall)
  - i.e kWh/m^3, kWh/person
- Water consumption
  - i.e l/person

Having this as base and the meter-read dates system, the pilots will be able to measure the following parameters:

Figure 13 - Energy consumption monitoring

Pilots		Helsinki	Lulea	Leiden	Manchester	Lisbon
Electricity	**Unit**	MWh Per year	KW/KWh	kW/KWh	KW/KWh	KW/KWh
	frequency	1 min	1 min Others Possible	10 min / 1 h	1 hour	15 min
	Area measured	Whole school GYM Central Entrance Classroom1/ 2/ 3 Kitchen	Room(Sensors)	Room – windows site Room – door site Room Desk	Room	Overall Room 9 measurement points
	Appliance measured	HVAC, Lighting Kitchen	*Details needed*	Lighting Equipment PC etc	Ambient light levels	Lighting PC Equipment
Heating/Cooling	**Unit**	MWh Per year	KW/KWh	Kwh	KW/KWh	KW/KWh
	frequency	1 min	1 min others	10 min		
	Area measured	Whole school GYM		Room		
	Appliance measured	Heating		Radiator – auto manual		
Water	**Unit**	m3 Per year	m3			
	frequency	1 min				
	Area measured	Whole school GYM				
	Appliance measured					
Humidity	**Unit**					%
	Area measured	1 min	1 min others			15 min
	Appliance measured	GYM	Room Sensors)			Room
CO2 contents in the air	**Unit**					ppm
	frequency	1 min	1 min (others			15 mins
	Area measured	GYM	Room(Sensors)			Room
Air temperature	**Unit**	Celsius	Celsius	C	Celsius	Celsius
	frequency	1 min	1 min others	10 min,1h		15 mins
	Area measured	GYM	Room External	Room Outside	Internal/ External	Room and external

4.2. Behaviour transformation

As described on the deliverable "SAVE ENERGY – Potential energy-saving benefits of behavioural modification", the evaluation criteria for behavioural intervention studies to save energy, are set out in Abrahamse *et al* [2007]:

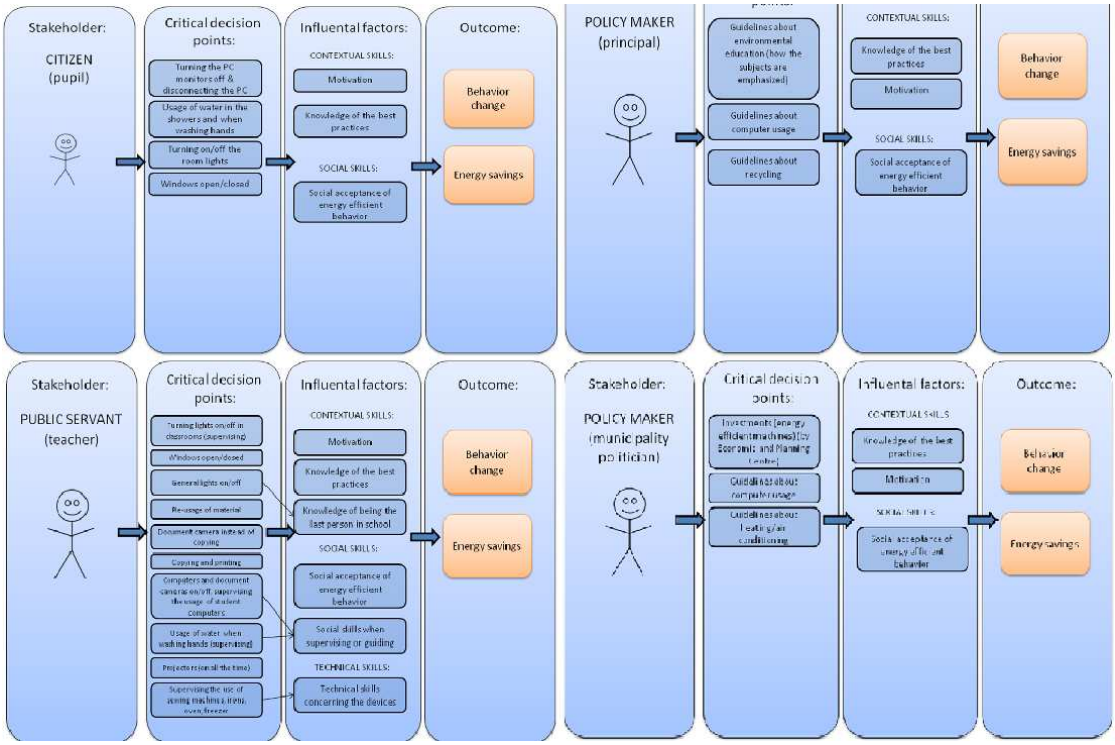
- **Extent of change in direct/indirect energy use** – Evaluated using average historic measures.
- **Extent of change in energy-related behaviour** - Evaluated by comparing to pre-existing behavioural determinants (knowledge, attitudes, social influences).
- **Maintenance of change over time** - Conduct re-evaluation sometime after initial trials.

Using the above suggestions, the Save Energy Consortium has defined the following strategy to evaluate the behaviour transformation caused by the implementation of the project:

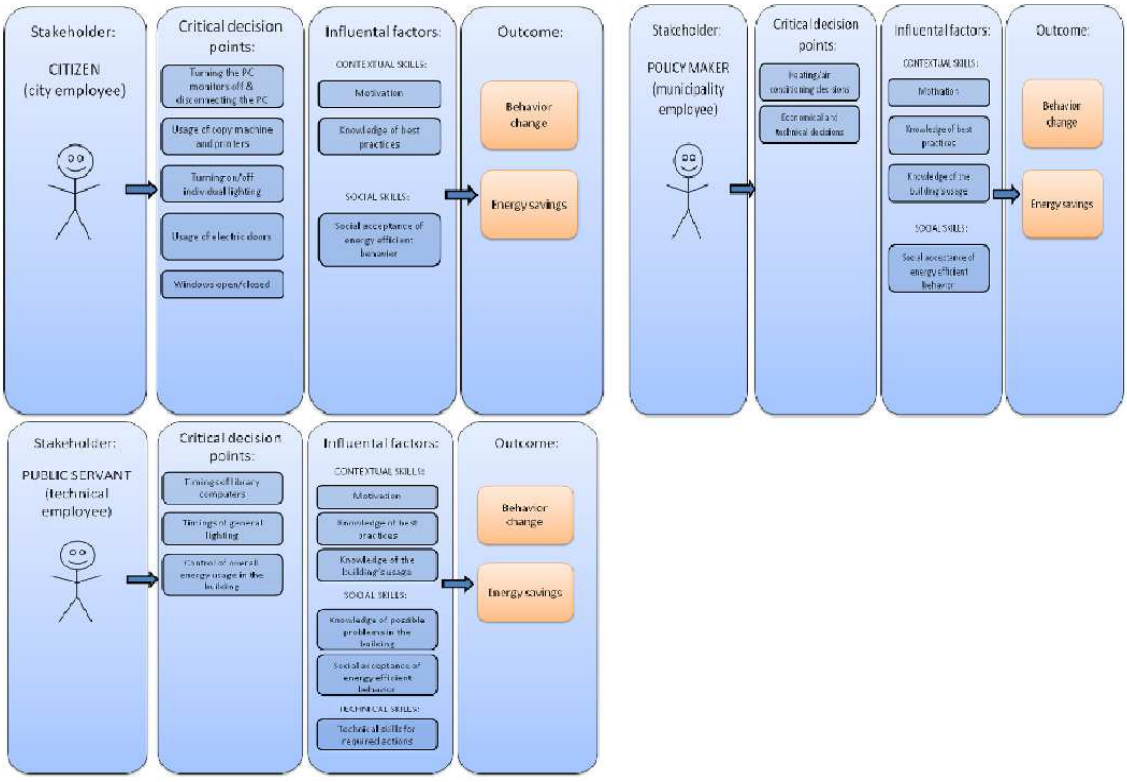
1. **Define the critical points** – Those appliances which consume the most energy consumption (defined before)
2. **Define the Key individuals (decision-making)** - who are the individuals responsible for controlling the critical points. There are 3 levels of decision impact and consequently 3 key individual roles:
    - Full time occupancy (Public Servants)
    - Temporary occupancy (Users for the part of the day or limited period of time)
    - Transient occupancy (Visitors/public)
3. **Define the actions that key individuals can make when faced with the critical points** – critical decision points

These tasks were done by each pilot through interviews and observations and are summarised on D1.2. The main results are illustrated on the following Figure:

Helsinki



Lulea



Lisbon, Manchester and Leiden

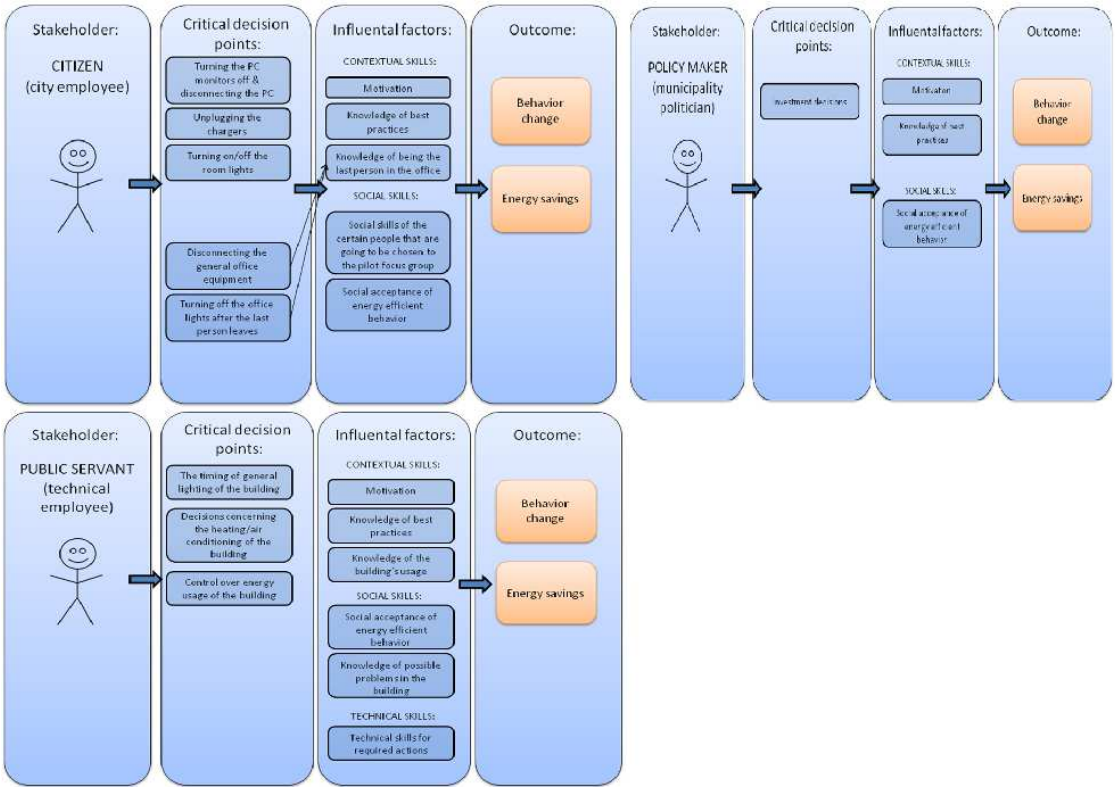


Figure 11 – D1.2 Main Results

4.3. Performance indicators

The identification of critical incidents allows for a set of performance indicators to be developed in order to measure the outcome of the behavioural changes that the key individuals provide and the outcome of the implemented ICT management system.

The overall objective of the performance indicators is to provide a coherent and easily measureable way to present the outcome of critical incidents, i.e. the most effective and efficient method of measuring the impact that the Save Energy project has on energy consumption. The performance indicators will be specified for each pilot.

The performance indicators must reflect the variety of factors that can influence the outcome and results in each of the pilots. There are a range of issues to be accounted for in each pilot. Additionally, the general factors applying to all of the pilots must also be considered.

One such general factor is time. The results of many indicators can be dependent on the period set for measurement. Furthermore, an indicator could be regarded as out of date, or not providing useful information, if a very long time period is used. It is important to develop indicators that are considered as invariant to time, even during longer time periods.

In defining the performance indicators, it is relevant to investigate which energy use activities can be directly impacted by stakeholders. For instance, behavioural habits, levels and types of activities in the selected space, and the recognition of the importance of energy efficiency can be directly impacted by stakeholders. However, some elements in the building infrastructures used in the pilots may not be able to be influenced by the stakeholders.

The indicators must be clear, coherent and measureable in order to provide the most effective way of measuring the outcome of the critical incidents. Tailored performance indicators for each pilot ensure that the outcome of the critical incidents can be observed, and the impact on the energy consumption recorded.

Quality assurance will be validated through constant observation of the indicators. The indicators are designed to be comparable over time, to assess consistency, and, as far as possible, between pilots in order to help investigate the reasons driving significant changes occur in any pilot.

All of the performance indicators should fulfil these requirements:

- Simple and understandable
- Measurable
- Objective
- Containing boundaries
- Verifiable
- Relevant to what each pilot does

As noted above, the Save Energy project has a two dimensional focus; the ICT management system and the pursuit of behavioural change of stakeholders. In order to measure both dimensions, each critical incident requires two performance indicators, one for the actual measurement of the energy consumption and one for the measurement of change in behaviour. In the next section, each pilot with the critical incidents is listed, along with the appropriate performance indicators.

Taking the collected critical incidents into account, a list of performance indicators should be created that corresponds to every incident and every pilot.

The first step, at the beginning of each pilot, is to assume that the indicators will be measured on a weekly basis, and identify which indicators would be most easily measured and effective under this time constraint. The time period of a week is chosen as sufficient enough in order to create measurable results, but short enough time to rapidly tackle any unseen problems with the performance indicators and change them if necessary.

The performance indicators defined by this methodology are considered to be the “ideal” indicators, designed to ensure that the indicators correspond to the specific objectives of each

pilot. In order to develop this process, substantial communication with the pilots' representatives and energy experts is required.

From such communication the performance indicators, as shown in the annex, were defined. The performance indicators developed are the same for the Lisbon, Manchester and Leiden Pilots, given since the similarity in the type of buildings used.

Despite the good purpose some indicators cannot be measured as:

- One's must allow privacy to the pilot's collaborators what could not be guarantee if someone will observe their attitude; and
- Unavailability of time and resources to performance all the measurements indicated.

Therefore new indicators were defined and finally approved by the pilot's coordinators.

Figure 14 - Performance indicators

Lulea	P 1. All: Electricity consumption of the room per week (including before and after the project) P 2. Electricity consumption of the whole building (sensors) per week (including before and after the project) P 3. Restaurant: Hot & cold water consumption (m3) P 4. Restaurant: Temperature P 5. Office rooms (2 section with about 6 rooms in each): Eletricity (kWh) P 6. Entrance doors: Number of persons passing that: 1. Use the push button to open doors 2. Do not use the push button 3. Elderly that use push button 4. Not elderly that use push button 5. No of seconds both doors are open 6. And probably some more that is still not defined! 7. Theoretical calculation of energy loss due to wrong usage of push button for entrance doors.
Lisbon	P 1. Electricity consumption of the room per week (including before and after the project) P 2. Electricity consumption of the 9 measures point per week (including before and after the project) P 3. Humidity measurement: collect humidity data for the room every Monday at 12h. P 4. CO2 measurement in the air: collect CO2 data for the room every Monday at 12h. P 5. Temperature measurement of the room per week (including before and after the project) P 6. External temperature measurement of 3 locations per week (including before and after the project)
Manchester	P 7. Electricity consumption of room P 8. Measurement of ambient light levels in the room P 9. Measurement of temperature at indoor and outside
Helsinki	P 1. Electricity consumption of gym, central entrance, classroom 1/2/3 and kitchen per week (including before and after the project) P 2. Electricity consumption of the whole school per week (including before and after the project) P 3. Number of hours lights are on gym, central entrance, classroom 1/2/3 and kitchen per week P 4. Number of hours lights are on in the whole school per week P 5. Heating consumption of the gym per week (including before and after the project) P 6. Heating consumption of the whole school per week (including before and after the project) per pilot room P 7. Water consumption of the gym per week (including before and after the project) P 8. Water consumption of the whole school per week (including before and after the project) P 9. Humidity measurement: pick up the humidity value on the gym every Monday at 12h P 10. CO2 contents in the air measurement: pick up the CO2 value on the gym every Monday at 12h. P 11. Temperature measurement: pick up the Tº value on the gym every Monday at 12h.
Leiden	P 1. Electricity consumption of the room (window site) per week (including before and after the project) P 2. Electricity consumption of the room (door site) per week (including before and after the project) P 3. Number of hours lights are on in the room per week P 4. Electricity consumption of the room per week (including before and after the project) P 5. Electricity consumption of desk per week (including before and after the project) P 6. Heating consumption of the room 1 per week (including before and after the project) P 7. Heating consumption of the room 2 per week (including before and after the project) P 8. Temperature measurement of the room per week (including before and after the project) P 9. Temperature measurement of outside per week (including before and after the project)

All pilot coordinator will be responsible for pick up the measurements and elaborate the energy consumption and behaviour transformations profile. These results should be presented on the final report.
The performance indicators are a vital tool in mapping the social behaviour of stakeholders, key individuals and users. The indicators will provide valuable information on the actual change of behaviour and will function as a tool for the consortium to evaluate if the aims and objective of the Save Energy project are reached and fulfilled.

5. Dissemination strategy

An important aim of SAVE ENERGY is ensuring that its objectives have a Europe-wide impact. For this to happen, the consortium and wider community groups will develop and will utilize an effective communication and dissemination plan and strategy, with the aim to promote the project on European Network of Energy Efficient Public buildings and spaces, as well as relevant entities in the partner countries.

The vision of the dissemination strategy is as follows: "**The key element to a successful Communication Strategy is to mobilize People. The secret is not to mobilize everyone, but only key people who are linked to larger networks and will, in turn, help mobilize others, spreading the SAVE ENERGY message in the process**.

Keywords: Technology Determinism - Social Nudging – Competition

5.1. Dissemination tools

To support the dissemination strategy, several tools will be developed throughout the project, split under the headings of "traditional" and "innovative" tools.

5.1.1. Traditional tools

To support the awareness and promotion of the SAVE ENERGY project, it is predicted that four types of traditional dissemination tools will be developed: Brochures, newsletters, publications and videos.

Brochure - The SAVE ENERGY brochure aims to support the awareness and promotion of the SAVE ENERGY project, including its vision, concept and objectives. The design of the brochure revolves around the concept of a high quality cover in addition to the inclusion of loose single pages within. This approach allows for the provision of a different brochure depending on the SAVE ENERGY audience and events.

Newsletters – For the SAVE ENERGY project, three newsletters will be produced and published on-line (Save Energy Portal) during the 30 project months, with the first being published on 28th February 2010. The newsletters will highlight the progress of the SAVE ENERGY work plan, providing insight into the research, development, innovation and demonstration activities.
A newsletter distribution list will be collected by each partner in their own country and used to notify users when the FIRST newsletter is published on-line. In this first email, there will be an option for users to subscribe on-line if they want to continue to receive the next issues of the newsletter (ict4energyefficiency.eu mailing list). A printed version will be provided for promotion at organised events.

Publications - Publications of the research results will be available at appropriate venues. A final compilation of all publications is to be released towards the last project gateway at month 30.

Video – The video contents will be done in such a way that they send the right message to the right people. Therefore more than one video is planned:

- For dissemination at **local level, a video showing** the pilots' implementation strategy images will be developed. The contents will be used and the corresponding raw material will be provided to the coordinator to be processed with broadcast quality.
- For dissemination at **international and EU level**, the video much respond and provide answers to the following questions:
    1. What is SAVE ENERGY about and why is it important
    2. What makes this project different to other projects
    3. What will be the "wider" benefits and impacts
    4. Who will it benefit? (directly and indirectly)
    5. Who should be interested? Media, industry, local authorities, local citizens
    6. How does it fit and how it will contribute to the EU Energy Efficiency Policy at local, regional, national and European levels
    7. Living Lab methodology
    8. Pilot creation and implementation
    9. Pilot cases

5.1.2. Innovative tools

The SAVE ENERGY internet presence has been designed to aggregate tools, services and communities in single environments in order to foster collaboration and knowledge sharing among all stakeholders. This information and interaction may occur in both public and private spheres.

The SAVE ENERGY tools will include several applications for messaging and collaboration among the inner core of the stakeholders, with emphasis on the consortium partners. Events will be posted and shared through Google Calendar and the knowledge repository will be

constructed over an open Wiki platform. Additionally, other tools will be used including Skypecasts, email and SMS.

SAVE ENERGY follows a systemic architecture-oriented approach, in other words, its presence is defined by the main components of the system and their respective relationships within a loosely-coupled architecture. Basically, SAVE ENERGY has 5 different areas:

- **The SAVE ENERGY Portal** - static / not time sensitive information will be published on the portal. It will provide a prime online access point to the project, promoting the sharing of information, which in combination with the software, makes the portal a public dissemination tool with content derived from the research output (such as presentations, publications and demonstrations). The portal will also provide updated news on the progress of the SAVE ENERGY project, updated periodically when deemed necessary, and a private access to a collaborative work environment, where members of the consortium can build knowledge concerning the project to maximize the synergies between partners in the implementation of the various work packages. The community building support mechanisms will be accessible via the SAVE ENERGY Portal.

- **Web 2.0 Tools** - SAVE ENERGY Web 2.0 Communication Systems will be an active node in global networks related with energy efficiency in public buildings, using social networking as the main driver in order to make it easier to reach multiple audiences.

- **SAVE ENERGY Community** - real time / entertaining information and social news will be available through the most popular Web 2.0 tools .The SAVE ENERGY communities will provide a social networking platform to build online communities of practice where users can share location, interests and activities or participate in the interests and activities of other users. These communities are closely linked with best of the breed Web 2.0 tools already available in the Internet to share blogging and micro blogging posts, podcasts, documents, videos, bookmarks, presentations and photos. The SAVE ENERGY Portal aggregates information from all the other components through widgets, RSS feeds, links, add-ons and the embedding of applications or multimedia resources. Dynamic and continuously updated information plus user generated content will be shared through blogs and messaging in the community.

- **SAVE ENERGY Services** - The SAVE ENERGY services syndicates data to and from the building management systems, operating as a broker of information for the real time information systems and the serious game.

- **Private SAVE ENERGY services –** restricted information co-created and shared in the SAVE ENERGY Wiki, which also works as a document repository as well. All this architecture is supported by several tools for project management and collaboration.

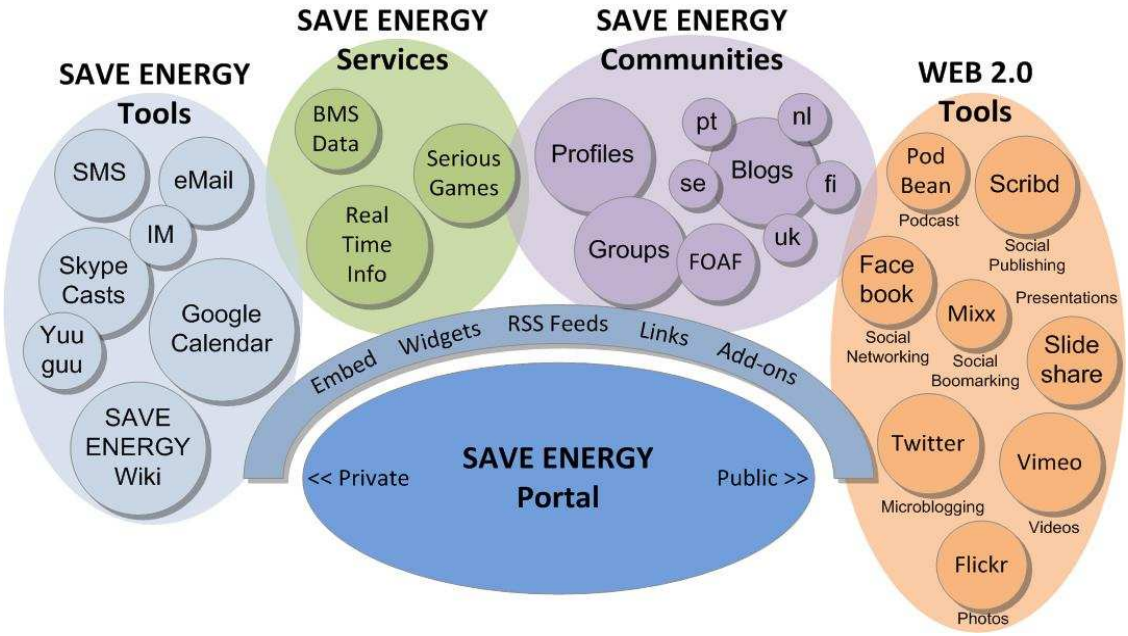


Figure 12 - SAVE ENERGY web architecture

The portal is a seamless combination of a content management and a community building platforms where loosely-coupled add-ins, add-ons, widgets and other increasingly available Web services could be used to enhance SAVE ENERGY Internet presence. Linkages to popular social networking sites are considered critical.

5.2. Dissemination activities

In order to promote the project among their target groups, 3 main activities are being developed: Attendance and organization of conferences, support of workshops and promotion of European Network for energy Efficient Cities.

SAVE ENERGY Conference and participation in international conferences – A conference is a formal event where experts present results, workshops, and other activities, concerning a specific topic.

The Save Energy consortium expects to give exposure to the Save Energy project, its activities and results to the European Commission using two types of approaches:

1. **Attending international conferences focused on SAVE ENERGY themes**:
   For this, the consortium has to target the most relevant and important conferences on the scope of ICT Technical subjects, focusing on the technologies included into the project; behavioural change, Energy efficiency, Living Lab methodologies, etc. Among them is the High Level Event on ICT for Energy Efficiency (Brussels, 19/20th March 2009 and Brussels, 23/24th February 2010) - The Commission has recognized that ICTs and ICT-based innovations may provide

one of the potentially most cost-effective means to achieve the 2020 targets. The Save Energy project fits this strategy: at creating a policy framework that will allow the energy-saving potential of ICTs to be widely recognized and exploited.

2. Organize its own international conference:

The consortium will be responsible for preparing and organising:

- The content – which requires the selection of a date programme committee, key note speakers;
- Logistic issues - a venue and a strategy to attract industry sponsors and ongoing European projects relevant to the themes (this activity will get the support of the Advisory Board);
- The dissemination mechanisms (papers and slide presentation, etc) and setting up the portal to support the presentations, debate and recommendations.

SAVE ENERGY Workshops - A workshop is a brief intensive course, a seminar or a series of meetings emphasizing interaction and exchange of information among a usually small number of participants. The workshops are good way to introduce the project and disseminate its results, especially among Educational and Industry systems.
The goal of the SAVE ENERGY workshops is to network, share knowledge with companies and experts and to promote the wider uptake of the project results by universities and industry. The workshop participants are to be project (and other) partners, experts, academics, company representatives etc.

In the SAVE ENERGY project, each pilot is responsible for arranging two workshops. Each pilot can decide what kind of workshop is needed. The topics of the workshops arranged in each of the partner countries could be the following (for example):

- Technical workshops i.e. focusing on the technologies included into the project; lighting, HVAC, building automation, ICT, real time information, metering solutions etc.
- Educational workshops i.e. focusing on competences required in SAVE ENERGY pilots; behavioural change, motivating users to save energy etc.
- Educational workshops focusing on relevant projects, researches etc.
- And others...

Reporting the workshops include the use of diverse Save Energy Dissemination tools, as follows:

- Workshop slides (presentations, debates, recommendations) will be downloaded to Slide Share SAVE ENERGY group, http://www.slideshare.net/group/save-energy
- Workshop presentation videos will be downloaded to Vimeo SAVE ENERGY group, http://www.vimeo.com/groups/saveenergy

- Workshop photos will be downloaded to Flickr SAVE ENERGY group, http://www.flickr.com/groups/saveenergy/. Each partner is requested to provide photos from each of the workshops arranged.
- Other possible workshop material will be downloaded to suitable social media tool used in SAVE ENERGY

Finally a SAVE ENERGY workshop questionnaire will be sent after the workshop to each of the workshop participants.

European Network for Energy Efficient Cities - The aim of this task is to implement, grow and sustain the European network in Energy efficiency Cities which was publicly announced in Helsinki on the 28th August 2008.

6. Impact - Policy Recommendation

6.1. Policy recommendations

According to the task description of the SAVE ENERGY project Task 8.7 (Policy Recommendations), the policy recommendations should be formulated based on the results obtained in the project. As the project will not terminate until 18 months after the deadline of this deliverable, conclusions of the project's results cannot be drawn yet at this point.

For the moment, however, the plan has been developed, that clarifies the necessary actions that will result in formulating the policy recommendations at the end of the SAVE ENERGY project. Furthermore, some preliminary results and problems have been recognized and analyzed in this chapter.

The policy recommendations will be organized according to the targets of the project. For each target, certain policy recommendations will be formulated in order to reach that goal. The objectives of the project include the following:

- Energy savings in the public buildings
- User behaviour transformation
- User involvement (Living Lab methodology)

The policy recommendations will be thus drawn for each of these objectives based on the achievements of the project. Besides the project results also the achievements of the related European Union projects as well as existing policies concerning the primary targets mentioned above will be studied in order to provide up-to-date information for the stakeholders of the project.

The policy recommendations will be targeted to different stakeholders of the SAVE ENERGY project. Naturally, the main objective is to provide useful recommendations for the use of European Commission. However, also the possibilities to formulate recommendations for national and local level for the use of governments and cities will be examined.

The policy recommendations will include the actual description of the recommendation as well as the objectives of that particular recommendation and the requirements in order to follow that recommendation.

The SAVE ENERGY Advisory Board will validate the policy recommendations that have been derived from SAVE ENERGY results. They will also be invited to provide information and documentation on current relevant policy activities and thus feed into the policy recommendations of SAVE ENERGY project.

The following text discusses about the preliminary findings made in the SAVE ENERGY project during the first project year. It focuses on the energy savings in the pilot buildings, but takes also into account some aspects of the other main focus areas: user behavior transformation, user involvement as well as the Serious Game, which can be considered as a tool to achieve the project goals. In the end of the SAVE ENERGY project the well-defined policy recommendations will be formulated, based on these preliminary results as well as the final results of the whole project.

SAVE ENERGY results from the first project year

During the first year of the SAVE ENERGY project the work done in pilot buildings has been focusing primarily on technical installations, not yet so much on user behaviour that will be targeted during the second project year.

It is already widely known that user behaviour has a big role in public buildings' energy use. This is why the goal is to make the energy efficient user choices possible and practical. Technical installations and measurements are required as a first step towards more energy efficient public buildings.

Increasing the level of energy efficiency of a building is a topic that is currently very popular. There is quite a lot of research done and some commonly known actions that are applicable in most of the buildings and in almost all of the cases lead to decreasing energy consumption. These actions include issues such as:

- controlling the consumption during the "low-seasons", meaning times when the building is not used actively (e.g. during school holidays)
- lighting (lamp type, controlling, timing)
- adjusting the timing of the HVAC system

- adjusting the temperature of the HVAC system
- adjusting the water streams in pipes and lowering the pressure
- checking the electricity tariff
- adjusting the inside temperature
- user behaviour change in using electricity consuming devices (e.g. computers)

In general, when aiming at saving energy in the building, the greatest possibilities are found in saving both electricity and heat. In most of the cases the saving potential can be found in the areas listed above. Here, as well as in so many cases, usually the simpler the action, the better the achievable results.

When planning and implementing a new project aiming at decreasing building energy consumption, the first step is to discover the saving potential, i.e. where and how much energy can be saved. For this reason, it is good to start with an audit of the building and construct the building's energy profile. The aim of an energy audit is to reduce energy and warm water consumption and costs, thereby decreasing the CO_2-emissions caused by the use and production of energy and finding all the economically profitable actions to improve the energy efficiency of the building or reduce the energy costs.

The results of an energy audit support the validation of most cost-efficient energy saving investments. The results can also act as a motivator to users in changing their energy usage behaviour i.e. by comparing the energy audit results with the results of similar kinds of buildings with higher energy efficiency. This can motivate the users to aim at the same level as the other similar buildings. Also, comparing the "zero-level consumption" with the current consumption level can give users direct feedback of their behaviour. The methodology of an energy audit is introduced in more detail in Deliverable 2.3.

When the most potential saving actions and saving potential in general are recognized, the next step is to start implementing them. Usually one public building includes several services that are very often outsourced to different actors, for example restaurant services to a catering company and service and maintenance to a service and maintenance company. All these service providers are usually functioning according to their own processes, it is important that they are included in the process.

This is also the case when building a new building – energy efficiency should be an integral part of the actors' processes right from the planning and building stage, and all the actors should be committed to doing them. Energy efficient technology and solutions should be included in the budget from the very beginning, so that budget matters do not come as a surprise or hinder implementation. Energy efficient equipment is in most cases not even that much more expensive than "traditional" technology, but if the costs are not evaluated and included in the original budget, they can be perceived as an extra cost.

When all the different actors are included into the process and are interested in making their own processes more energy efficient, the next challenge is to keep them motivated towards increased energy efficiency and decreased energy consumption. Among public building users there are usually different kinds of people; those who are very or quite environmentally oriented, as well as those who are not, at least so much. Naturally those who are not that environmentally oriented are usually the more challenging group to motivate. That is why it is important to show the users that they themselves benefit from the actions they take inside the building. At the moment the problem in many public buildings is that the users themselves usually do not get the (economical) benefit from the decreased energy consumption.

For example, in the SAVE ENERGY project, all the economical benefit from the lower electricity and heat bills in the Helsinki pilot buildings (two schools) goes to the City of Helsinki and not directly the pupils or teachers. Providing more direct feedback of the economical benefits would involve changing the fundamentals of billing system, which is quite a big challenge and not achievable overnight.

Probably the most challenging task will be to engage the users to continue their energy efficient behaviour after the project is ended. This has been seen as a challenge in similar projects before, for example in the Intelligent Metering project (http://ieea.erba.hu/ieea/page/Page.jsp?op=project_detail&prid=1618).

All the stakeholder levels have to be engaged to the user behaviour transformation. Especially in Helsinki pilot it is very important to contact also the policy maker level early enough in order to be able to develop practices that can be continuously executed in the pilot schools as well as distributed to other schools as well. There are different departments in the Helsinki city that have to be considered, both concerning the technical issues as well as the educational ones.

In public buildings there are also so-called key persons or key users that have more influence on building's energy consumption than average building visitors, e.g. service personnel and janitors, who are responsible for controlling and adjusting the HVAC system, lighting and other building systems. Educating this kind of personnel is very important when improving building's energy efficiency, as implementing the actions is usually their responsibility. However, it is not that simple to find the skilled, motivated janitors and service personnel who have the adequate know-how to control and adjust the building systems to work as effectively as possible. There can also be changes in the personnel, meaning that continual training in energy efficiency is required to ensure energy efficient building use.

When developing the policy recommendations concerning the serious game, it is very important to contact also the policy makers level early enough, preferably already in the development phase, in order to be able to develop practices that can be continuously executed in the existing pilots as well as to be distributed to other similar pilot buildings as well. Technical requirements for PCs as well as internet and PC accesses in the buildings are examples of issues that need to be considered also at the policy maker level in order to enable the dissemination of the game. Concerning the Helsinki pilot, in the development of the

serious game the involvement of the educational department is necessary, so that the game has the elements that are needed in order to be able to use it in the school context.

As mentioned in the beginning of this chapter, energy efficiency is currently a very popular topic in building sector in general. Energy efficiency needs to be seen as an integral part of the specification of a new building and be applied holistically in all of the stages of the building lifecycle, from site selection and design through to maintenance and demolition. Furthermore, all the stakeholders of the building have to get involved when trying to develop practices that increase energy efficiency trough behavioural change. This way it can be assured that the developed practices will be executable also in the long run. Also the users will be fully committed and motivated to act according to these practices when they themselves have been involved from the beginning of the process.

6.2. Save Energy Roadmap

The SAVE ENERGY project will widen its impact through the development and exploitation of policy recommendations. The policy recommendation description defines how the project's policy and standardization recommendations will be developed and delivered to the target decision-makers.

Figure 13 - Target decision-makers

6.2.1. Building Managers and Regional Authorities

SAVE ENERGY is implementing the five Energy Efficiency pilots using a strong co-creative methodology in order to follow common guidelines. Despite implementing different solutions, being able to extract comparison results and extrapolations for generic technical and business architectures is key for this projects' success. Thus all SAVE ENERGY pilots are involved in analyzing their own pilot and produce best practice elements / criteria that can be shared with the other pilots.

With this in mind, the project will provide a list of good practice solutions on how energy consumption can be reduced in public buildings, setting an example to subsequent building

managers who can then follow the pilot's experience, comparing the results to the final results of their own projects, in particular on:

- Critical points – identification of appliances and end-users equipments that are responsible for significant energy consumption;
- Key individuals – who are the individuals that must be considered essential on a energy saving plan for a public building;
- Technical solutions applied for saving energy on public buildings;
- Activities applied for changing individual behaviour towards energy; and
- Performance indicators on energy consumption and behaviour transformation.

All these items will be presented on Save Energy deliverables, namely in the final **Testing and Evaluation of Each Pilot** and on **D7.7 Best Practices for Energy Efficiency Systems Implementation guidelines**.
The consortium believes that the sooner it involves Local/Regional authorities, the more feasible the final work will be. Therefore, it has started to devise methodologies and business models that may support the take up and acceleration of Energy Efficiency best practices at Local/Regional level, namely with the involvement of SMEs.

These are to be developed with the aim of identifying new business models for deregulated markets integrating the following: energy efficiency, micro-generation, energy aggregation, smart grids, dynamic pricing, etc. The basic scalability and sustainability questions addressed by SAVE ENERGY are:

- The strategy to involve the local utility companies for future scaling up at each pilot.
- Models for the data flow management.
- Ownership of the measurement reading data.
- Services to be created based on the collected data.

Additionally, the project has ambitions to go beyond the Consortium itself, due to its exposure using traditional and new communication tools such has Web 2.0 and Social Networks. As a result, this proactive activity involving and motivating the SMEs, new business opportunities are being devised namely in cross-border and international environments such as Brazil.

6.2.2. European and National Authorities

The impact of the project at a national level should be facilitated by the partner's network of contacts and the Energy Efficiency Advisory Board. These include recommendations provided at a European and national level – for instance, to EU Presidencies and Member State Governments – and to other relevant decision-makers such as CEO's and important local stakeholders.

The final aims are as follows:

- **Release a green paper** with policy recommendations based on the compilation of the results obtained in the project. The Living Labs methodology and the approach to transform the user behaviour and empower him/her are part of it;
- **Networking** with related Energy Efficiency organizations at National and EU levels. (i.e. the Covenant of Mayors);
- **Work with EU Presidencies** to take energy efficiency as a focus on their priorities;
- **Political interventions** by the pilot public owners at the national and European Parliaments;
- **Utilise Living Lab methodologies** to reinforce the e-participation of well informed motivated and empowered citizens;
- **Keep their sustainability** by implementing co-created measures to improve energy efficiency and use creative social networking contents and events to further develop their motivation.

Furthermore, with the development of the project, the consortium will recommend to the EC the creation of a Programme to support a platform for Energy Efficiency related applications. This Programme should aim to provide the development of a technical platform dedicated to the distribution of Energy Efficiency related applications and services to consume data generated from Energy Efficiency projects.

As it stands, the SAVE ENERGY consortium would immediately recommend to the European Commission to regulate energy metering equipment certifications in order to ease the certification process of this equipment from one country to another. This recommendation is based on the challenges our pilots faced when choosing an equipment supplier, due to equipment certification problems when purchasing from suppliers in other EU countries.

6.2.2.1. Advisory Committee

The project's Advisory Committee will be made up of high-ranking and important stakeholders, ensuring that the correct decision-makers are targeted and providing access to networks through which they can be influenced, greatly helping the project aims. The committee shall be constituted by the following people:

- Luís Mira Amaral - Ex. Minister of Industry and Energy
- Oras Tynkkynen - Member of the Parliament of Finland
- Phil Woolas - Member of Parliament of United Kingdom
- Gerard Magnin - Director of Energie – Cities
- Pedro Miguel Santos de Sampaio Nunes - ex. Director of Energy Technologies in the Directorate General for Energy of the European Commission
- Peter Lund - ex-chairman of the Advisory Group on Energy of the EU/E.C

The Advisory Committee will namely have 4 main tasks:

1. **Strategic guidance for the projects development** - The Advisory committee will meet at least once a year. These meetings will provide the opportunity for the experts and the consortium to discuss matters together, including the project progress. Before the each meeting, a report should be provided to the Advisory Board. The report should include 4 main points:
   - Results achieved – small description
   - Data sources used
   - Next steps
   - Questions that WP partners would like to be addressed in the Reports

   The Advisory Committee is invited to provide recommendations to be included in the Save Energy work.
2. **Participation on EU level and other relevant meetings -** Whenever relevant, the Advisory Committee will participate in the EU Commission Meetings.
3. **Feedback on the project key points -** It is expected that the Advisory Committee Experts provide guidance through virtual contact.
4. **Assist the SAVE ENERGY consortium with policy recommendations** - All experts will be invited to provide information and documentation on current relevant policy activities and feed into the policy recommendations from SAVE ENERGY.

The Advisory Board should interact with the project whenever main intermediate results are expected.

Conclusions

The vision document is a document under continuous development and elaboration. The vision document is a description of the SAVE ENERGY project as a whole with detailed information about all the elements and process that takes place along the SAVE ENERGY project. As the SAVE ENERGY project has a long time frame and there are a total of five pilots, it is important always to have a document that very clear describes the whole project and that is under constant development with the changes that occur throughout the project. These developments can be related to all aspects of the projects, change in performance indicators, pilot experience of ICT management, a meeting held by the Advisory Board, possible policy recommendations, data results from the pilots, Living Lab methodology, Observatory, stakeholders and so forth.

References

Darby, S. (2006). *The effectiveness of feedback on energy consumption.* Environmental Change Institute, University of Oxford.

European Union project: Energy Savings from Intelligent Metering and Behavioural Change (Intelligent Metering), http://ieea.erba.hu/ieea/page/Page.jsp?op=project_detail&prid=1618 (webpage accessed on 22th of February 2010)

European Union legislations regarding energy; http://europa.eu/legislation_summaries/energy/index_en.htm

European Union energy policies; http://europa.eu/legislation_summaries/energy/european_energy_policy/index_en.htm

European Commission on energy; http://ec.europa.eu/energy/index_en.htm

Press release from the European Commission about the situation of the European energy market; http://europa.eu/rapid/pressReleasesAction.do?reference=IP/07/26&guiLanguage=de

"Preparing for our future: Developing a common strategy for key enabling technologies in the EU" Communication paper from EC published 30/09-2009

"R&D Investment in the priority technologies of the European Strategic energy technology plan", Communication paper from EC published 07/10-2009

The European Commission's Joint Research Centre site on end-use energy efficiency: http://re.jrc.ec.europa.eu/energyefficiency/index.htm

European Commission, Directorate-General for Energy and Transport, "2020 vision: Saving our energy"

U.S. Department of Health and Human Services, Glossary of Selected Terms Used in Utility Deregulation - http://liheap.ncat.org/iutil2.htm

European Commission's Energy and Transport DG Report, 'Education on Energy - Teaching tomorrow's energy consumers', 2006 - http://www.managenergy.net/download/education2005/05-0001-EN.pdf

European Union Green Paper on energy efficiency, 'Doing more with less', COM(2005) 265

European Commission's Energy and Transport DG Report, 'Education on Energy - Teaching tomorrow's energy consumers', 2006 - http://www.managenergy.net/download/education2005/05-0001-EN.pdf

European Commission, Energy, Energy efficiency & renewable energy actions - http://ec.europa.eu/energy/actions_energy_en.htm

The BUILD UP initiative, EU MEMO/09/278, 2009 - http://www.buildup.eu/sites/default/files/press/MEMO-09-278_EN%5B1%5D.pdf

European Commission – Energy, Intelligent Energy - Europe Programme: IEE2-SAVE-1 Energy-efficient buildings - http://www.managenergy.net/buildings.html#progs

EC Joint Research Centre, Energy Service Companies in Europe - http://re.jrc.ec.europa.eu/energyefficiency/ESCO/index.htm

EC Joint Research Centre, Energy Service Companies in Europe Report, 2005 - http://re.jrc.ec.europa.eu/energyefficiency/pdf/ESCO%20report%20final%20revised%20v2.pdf

EC Joint Research Centre, Energy Service Companies in Europe Report, 2005 - http://re.jrc.ec.europa.eu/energyefficiency/pdf/ESCO%20report%20final%20revised%20v2.pdf

ANNEX

Interview questions

The following questions have been asked from the different pilots and their stakeholders. Only in the Helsinki pilot all the different stakeholders have been covered. In the other pilot, due to the lack of resources, only the pilot coordinators have provided their comments and ideas with regard to the following issues.

Real time information (questions for all stakeholders):

In the pilot buildings energy consumption is measured from different sources. The results of these measurements as well as the comparisons to the previous results should be delivered to the pilot users in order to show them the input of their behavior to the total energy consumption of the building.

- In which situations you would want to get information about the daily/weekly energy consumption? At what time during the day it would be convenient?
- What means of communication already exist in the pilot?
- Which media would be the most suitable for delivering this information? (Examples: paper leaflet/own cell phone/own computer/public screen/electronic newsletter/other)
- In which format the information should be illustrated? (Examples: figures/pictures (examples?)/text/comparisons/other)
- How would you expect your behavior related to energy efficiency to change due to this information, or would you expect there to be any change?

Serious Game (questions for all stakeholders):

In the SAVE ENERGY project a Serious Game is being developed. Its purpose is to raise thoughts about energy issues and teach energy efficiency. The game is not going to be a simulation of the pilot building, but information about the energy consumption in each pilot building can be added to it.

- In which situations you would want/be able to play the game? At what time during the day there would be possibility, time and interest for that?
- What do you expect of the game?
- What kind of information you would want to get via the game?

- Would you be interested in getting real time information (or daily/weekly) on building's energy consumption via the game?
- How would you expect the game to influence your behavior related to energy efficiency, or would you expect it to have any effect?
- Do you enjoy online social networks? Which ones (give examples)?
- Would you be interested in the energy efficiency activities in other places in the world? E.g. if there would be competition based on teams scattered around Europe?
- Do you prefer competitive games or collaborative games?

Other information needed related to Project Scenarios:

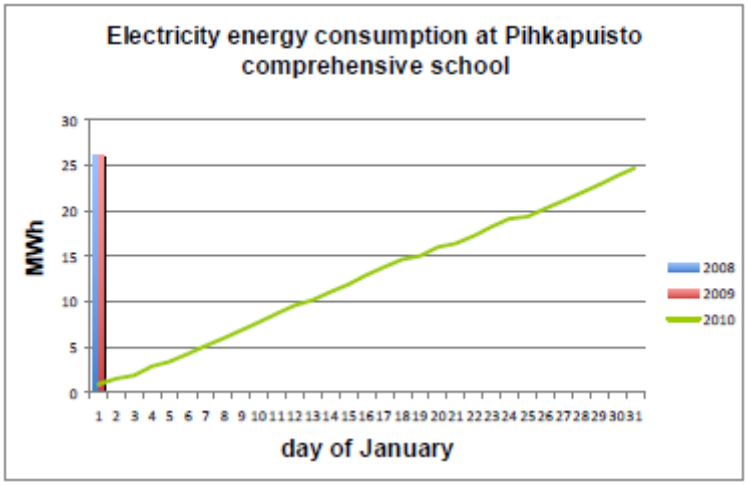
- Are there already some kinds of activities in the pilot building related to energy efficiency?
- What activities the stakeholders would want/could do in the building related to energy efficiency?
- Which stakeholders of the building have something to do with the energy measurements (for real time information)? What is their role in that?

Helsinki pilot displays

The Helsinki pilot has started planning the use of displays during the beginning of 2010. The ideas presented here are preliminary and currently under development during the writing of this deliverable.

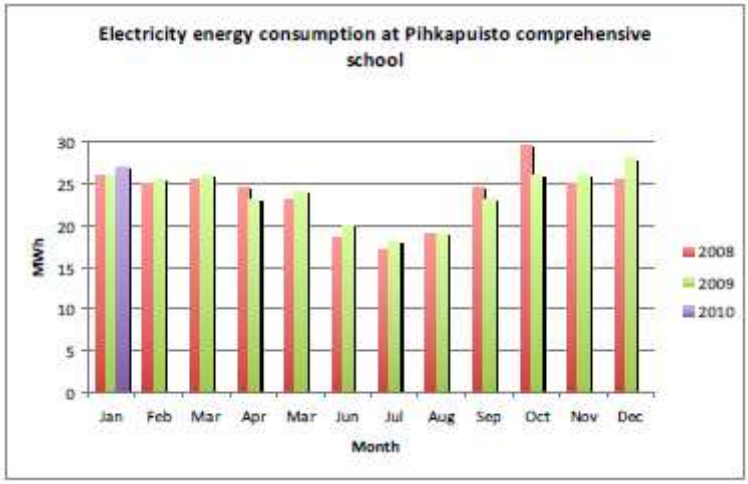
The idea in Helsinki is to have a display where one screen is divided into smaller ones and information is given in different kind of forms. The idea is to have approximately the following:

Screen 1:



This figure shows one month electricity consumption and also gives the historical data from the same month in previous years.

Figure 14 Monthly electricity consumption of the school



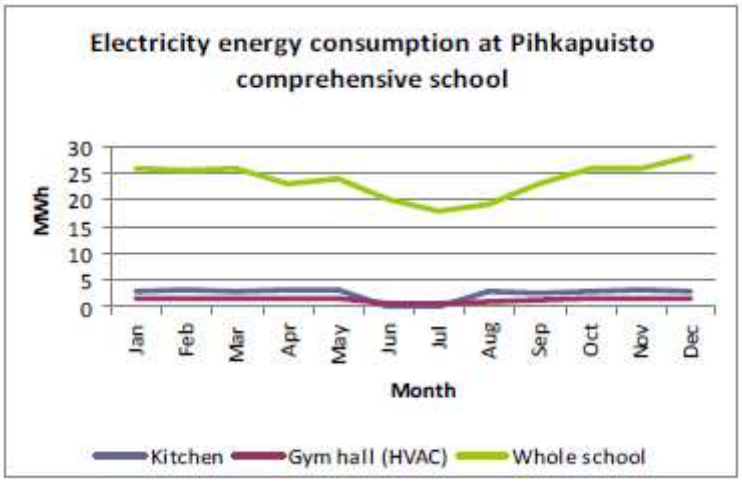
This figure shows the whole year electricity consumption and also the consumption from the previous years.

Figure 15 Yearly electricity consumption of the school

	Electricity energy consumption	CO_2 emissions due to the use of electricity energy
Today/ person	2,6 kWh/pers	520 g*CO_2/pers
Yesterday /person	2,7 kWh/pers	540 g*CO_2/pers
Today	651 kWh	130 kWh
Yesterday	659 kWh	132 kWh

This table shows the daily electricity consumption in kWh and kWh/person and also the carbon footprint generated in producing this amount of electricity. It also compares the consumption with the historical data from the previous day.

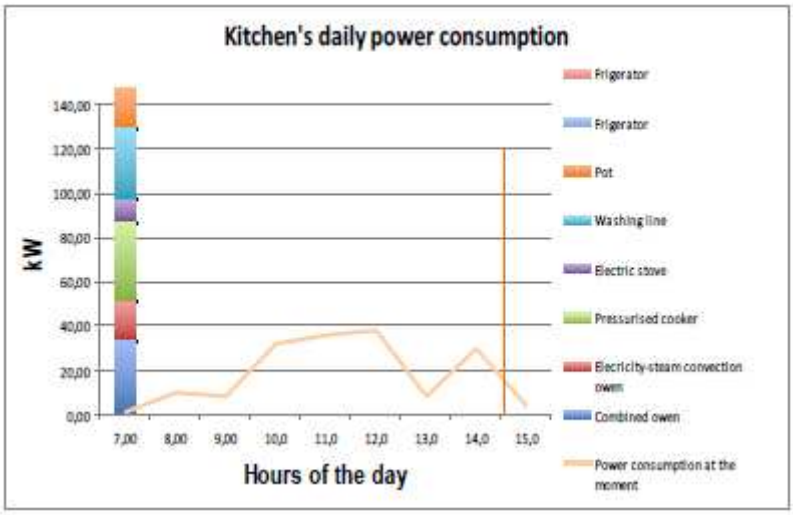
Figure 16 Daily electricity consumption (kWh and kWh/person)



This figure shows where in the school and how much electricity is consumed.

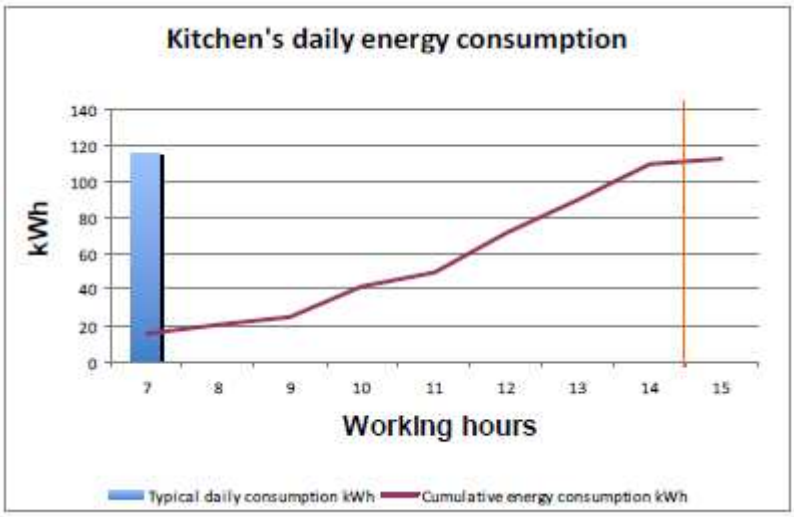
Figure 17 Electricity consumption of different rooms/areas in the school

Screen 2 – specially designed for the kitchens:



This figure shows the power consumption of different kitchen equipment, as well as the total power consumption.

Figure 18 Power consumption of kitchen devices



This figure shows the cumulative consumption during one work day and gives an average of typical daily consumption.

Figure 19 Kitchen's daily electricity consumption

	Electricity energy consumption	CO2 emissions due to the use eletricity energy
Today/portion	367 Wh/portion	1835 mg*CO_2/annos
Yesterday/portion	373 Wh/portion	1865 mg*CO_2/annos
Today	110 kWh	22,0 kg*CO_2
Yesterday	112 kWh	22,4 kg*CO_2

Figure 20 Electricity consumption and carbon footprint of one portion

This table shows the electricity consumption per portion prepared, the total amount of electricity used in the kitchen during one day and a comparison with the previous day's consumption. It also shows the carbon footprint created by the production of this amount of electricity.

Screen 3 – screen for lighting:

	Electricity energy consumption per pupil	CO2 emissions due to the use of electricity energy per pupil
Today	2,6 kWh/pers	520 g*CO_2/pers
Average	3,2 kWh/pers	646 g*CO_2/pers

Mon	Tue	Wed	Thu	Fri	Scores
28	29	30	31	1	350
4	5	6	7	8	250
11	12	13	14	15	150
18	19	20	21	22	100
25	26	27	28	29	350
1	2	3	4	5	300

Switch off the unnecessary lights, always ! – all the lights including the eco lamps and tubes are worth while switching off, always !

Figure 21 Lighting screen

On screen 3, the lighting screen specially designed for the youngest school children is based on simple and easily understandable “smiley face” categorizations. The idea here is that the application measures if there no-one in the room and if the lights are switched on or off. The idea is simple; if there is no-one in the room and lights are on, you’ll get a sad face, if the lights are switched off, you’ll be rewarded with smiley face. There will also be a competition based on the amount of smiley faces during week, and some kind of monthly or yearly competition to keep the children motivated towards switching off the lights. The display also gives some simple energy saving ideas such as a “tip-of-the-day”.

Performance Indicators - Ideal indicators

Table 4 – Ideal Performance Indicators

	Key Individual	Critical points	Energy Consumption Performance Indicator	Behaviour Change Performance Indicator
	Citizens: pupils	Turning on/off the room lights	Electricity consumption per room, per week: Directly by ICT management or by extrapolation (electricity consumption/room area).	Number of days per week that lights remain on after class: 2/3 student from the class will be charged of keeping a diary with this indicator.
		Amount of water used when taking bath/shower, and when washing hands	Water consumption per toilet per week: directly by ICT or by extrapolation (water consumption/nº of showers)	Number of times water has been found running after gym class, or unnecessary usage of it per week: 2/3 students are in charge of keeping a diary with this indicator
			Water consumption per shower section (E.g. measuring showers at female and male toilets or different classes) per week: directly by ICT or by extrapolation (water consumption/nº of showers)	Duration of the showers per sections (E.g. measurement of shower duration at the female and the male toilets or different classes) per week: 2/3 students will be in charge of seeing the duration of the class showers after the gym class
			Heat consumption per toilet per week: directly by ICT management or extrapolation (heat consumption/nº toilets)	
			Heat consumption per shower section (E.g. measurement of the showers at the female and male toilets or different classes) per week:: directly by ICT management or extrapolation (heat consumption/nº toilets)	
		Turning the PCs or PC monitors off, setting PC on a sleep-mode	Electricity consumption per computer room per week: Directly by ICT management or by extrapolation (electricity consumption/room area).	Number of computers that are found running with no necessity per week per room: 2/3 students will be in charge of keeping a diary with this indicator
			Temperature measurement: pick up the Tª value in the room every Monday at 12h.	Number of computers that remains with the monitors on during shorter breaks per day per room: 2/3 students will be in charge of keeping a diary with this indicator
				Number of computers that remains on a sleep mode during the shorter breaks per day per room: 2/3 students will be in charge of keeping a diary with this indicator
		Windows open/closed	Temperature measurement: 1 student from the classroom pick up the Tª value in the room every Monday at 12h	Number of times windows are found opened after classrooms are empty or during class, per room per week: 2/3 students will be in charge of keeping a diary with this indicator
	servant: technical teachers	Turning lights on/off in classrooms	Electricity consumption per room per week Directly by ICT management or by extrapolation (electricity consumption/room area)	Number of times per week the lights remain on after class (a technician will be in charge of measuring this indicator and keep it in a diary)
		Computers and document cameras on/off, supervising the usage of student computers	Electricity consumption per computer room per week Directly by ICT management or by extrapolation (electricity consumption/room area)	Number of times electronic devices that are found running with no necessity per week per room (a technician will be in charge of measuring this indicator and keep it in a diary)
		Windows open/closed	Temperature measurement: 1 student from the classroom pick up the Tª value	Number of times windows are found open after classrooms are empty or during class,

			in the room every Monday at 12h	per room per week: a technician will be in charge of measuring this indicator and keep it in a diary
		Energy sage of sewing	Electricity consumption per room where these items are located, per week Directly by ICT management or by extrapolation (electricity consumption/room area)	Number of times, items are found running or plugged in unnecessarily, per week: (a technician will be in charge of measuring this indicator and keep it in a diary)
		Machines, irons, oven, freezer	Electricity consumption per room where these items are located, per week Directly by ICT management or by extrapolation (electricity consumption/room area)	Number of times, items are found running or plugged inn unnecessarily, per week per week: (a technician will be in charge of measuring this indicator and keep it in a diary)
		Re-usage and purchase of material		Internal control of items, so unnecessary purchases are limited. If purchase is required, items with the lowest energy consumption are selected. Every 6 months
				Number of times items and material goods are thrown out. Every 6 months
				Control of items bought (e.g. could be measured by the financial department).
		Copying and printing	Paper consumption per week	
			Electricity consumption per printing/copying room per week Directly by ICT management or by extrapolation (electricity consumption/nr of devices)	Number of times copying/printing was done but found unnecessary, per week (a technician will be in charge of measuring this indicator and keep it in a diary)
		General lights on/off	Electricity consumption per room per week Directly by ICT management or by extrapolation (electricity consumption/nr of devices)	Number of times per week the lights remain on (a technician will be in charge of measuring this indicator and keep it in a diary)
		Usage of water when washing hands (supervising)	Water consumption per toilet per week	Number of times water has been found running, or unnecessary usage of it per week (a technician will be in charge of measuring this indicator and keep it in a diary)
			Water consumption per shower section (E.g. measurement of the showers at the female or male toilets, or different classes) per week	Duration of the showers per sections (E.g. measurement of the showers duration at the female and male toilets or different classes) per week (a technician will be in charge of measuring this indicator and keep it in a diary)
			Heat consumption per toilet per week	
			Heat consumption per shower section (E.g. measurement of the showers at female and male toilets, or different classes) per week	
		Turn off all the heating devices (e.g. ovens in kitchens)	Electricity consumption per room per week: Directly by ICT management or by extrapolation (electricity consumption/nr of devices)	Number of times heating devises are found on or unnecessary usage per week (a technician will be in charge of measuring this indicator and keep it in a diary)
			Heat consumption per room per week	
		Decisions about timings of lights	Electricity consumption per room with integrated timing devise, measured against spaces without per week	Number of times light is found unnecessary on and timing the light could be preferable, per week (a technician will be in charge of measuring this indicator and keep it in a diary)
		Usage of water e.g. in the schoolyard	Water consumption in schoolyard per week	Number of times water is found running, per week (a technician will be in charge of measuring this indicator and keep it in a

				diary) (a technician will be in charge of measuring this indicator and keep it in a diary)
		Decisions about heating/air conditioning	Temperature measurement: 1 student from the classroom picks up the Tª value in the room every Monday at 12h	Number of times windows are found opened after classrooms are empty or during class, per room per week: a technician will be in charge of measuring this indicator and keep it in a diary (a technician will be in charge of measuring this indicator and keep it in a diary)
		Some investment decisions (from certain given companies)	Electricity consumption before and after the investments	Make investment decision with consideration to reduce energy consumption
			Heating consumption per room per week before and after the investments	Make investment decision with consideration to reduce heat consumption
			Water consumption before and after the investments	Make investment decision with consideration to reduce water consumption
				Number of times investments are made without the consideration to the energy consumption
		General lights on/off	Electricity consumption per room per week	Number of times per week the lights remain on, per week
		Investments (energy efficient machines) (Economic and Planning Centre)	Electricity consumption before and after the investments	Investment decisions based on reduction in energy consumption
			Heating consumption per room per week before and after the investments	Overall view of energy efficient machines out of total energy machines
			Water consumption before and after the investments	
		Guidelines about computer usage	Electricity consumption before and after the guidelines elaboration	Drawing up guidelines of computer usage
				Number of times guidelines are not followed per week
		Guidelines about heating/air conditioning	Electricity consumption before and after the investments	Drawing up guidelines for the usage of heating/air conditioning
			Heating consumption per room per week before and after the investments	Number of times guidelines are not followed per week
	Policy maker: Principal	Guidelines about environmental education (how the subjects are emphasized)	Electricity consumption before and after the investments	Drawing up guidelines for environmental education purpose
			Heating consumption per room per week before and after the investments	Number of times environmental issues are discussed in class per month
			Water consumption before and after the investments	Teachers knowledge of environmental issues
		Guidelines about recycling	Kg or Lt of recycled materials used before and after the guidelines elaboration	Drawing up guidelines for recycling purpose
				Availability of recycling possible at present moment
				Decision of increasing recycling possibilities
		Guidelines about computer usage	Electricity consumption before and after the guidelines elaboration	Drawing up guidelines of computer usage
				Number of times guidelines are not followed per week

The ICT4EE: High Level Event on ICT for Energy Efficiency

Alfamicro has organized the participation of SAVE ENERGY project including an exhibition stand, brochure, posters and aproject video that was created at the five pilots. Alfamicro has also organized the participation of one of the members of the SAVE ENERGY Advisory Board: Prof Luis Mira Amaral, Prior Minister of Industry and Energy. He was an invited speaker at the Event.

Videos online: http://www.vimeo.com/groups/saveenergy/videos