Beywatch

Building Energy Watcher

European Project

More efficient

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Less efficient

Strategic Objective ICT for environmental management and energy efficiency Contract number FP7-ICT-2007-2-223888	6.1
Start Date dd/mm/yyyy	01/12/08
Duration in month	30
Website Further information is available at www.beywatch.eu	

Beywatch White Paper

In a few words

Beywatch is a European project ***supported by the European Commission's DG Information Society and Media*** *aiming at* ***ICT for energy efficient white goods and energy management, targeting:***

- ***Ultra-low power*** *white-goods*
- ***Intelligent control*** *of electrical devices in smart homes & neighbours*
- *Hot water & electricity generation from* ***renewable energy sources***
- ***Business plans*** *for all stakeholders*
- *Enhanced consumers awareness towards* ***less CO2 emissions***

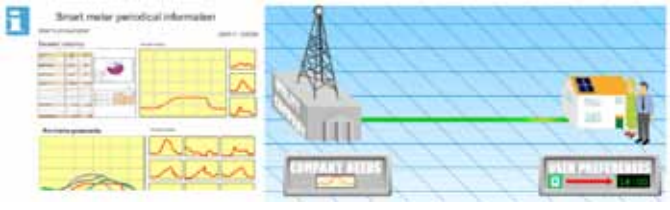
Overall vision

Energy is essential in almost every aspect of our lives and global emissions are having severe impacts on our climate and the global economy. We face two long-term energy challenges:

- *tackling the global climate change by reducing carbon dioxide (CO2) emissions and*
- *ensuring secure, clean and affordable energy, as most countries become increasingly dependent on imported fuel (oil or gas).*

BeyWatch actively supports the ***European Commission's proposals to save 20% of the EU's energy consumption*** *through improved energy efficiency by 2020.*

The starting point of BeyWatch is to save energy by ***making consumers aware of their energy expenses*** *and enabling them to intelligently control the home energy consumption. As a second step, BeyWatch aims to efficiently distribute the home preserved electricity energy at neighbouring level, allowing for electricity load balance and flexible electricity energy consumption contracts. Improving the energy efficiency of homes and neighbourhoods, BeyWatch aims to reduce the carbon dioxide (CO2) emissions and the energy bills. According to the European Environment Agency statistics, the households' energy consumption has increased by 17.4 % between 1990 and 2003 in EU. Households' energy consumption is a large percentage of the overall energy consumption: there is room for improvement and this all what Beywatch is about.*



Strategic issues

Beywatch has identified the following strategic issues, which for the project intends to bring significant innovations.

#1 Energy-aware white goods

#2 Combined PV & solar home system

#3 Energy consumption monitoring

#4 Low-cost home networking

#5 Load / energy management

#6 Emerging business models

#1 Energy-aware white goods

Domestic refrigerated appliances are significant consumers of electricity, accounting for around 15% of domestic energy consumption when excluding heating and hot water. As refrigerators are operating constantly, even small increase at the instant energy efficiency may lead to significant overall energy reduction.

The washing-machine and the dishwasher are not working permanently, but each time they are switched on, they consume big amounts of electrical energy. Power limits in domestic electrical installations installations or the progessive introduction by utilities of «Demand Response» programs, including dynamic pricing of energy, are constraints that justify the installation of systems able to delay the start or pause the washing process. Additionally, it must be taken into account that most of the energy consumed by these devices is employed to heat water to a given temperature; so big energy savings would be achieved if this hot water could be obtained from an external source.

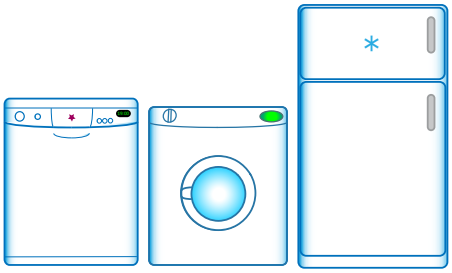
How BeyWatch will answer this issue

In the realm of the BeyWatch project energy aware white goods will be developed, able to provide the home user with energy related information and features, such as the instant consumption.

With respect to the refrigerator, further technological innovations will be introduced in commercial appliances that will reduce their energy consumption at about 20%. In the last years (with respect to cold appliances), there have been small design changes, like the change in refrigerant and the insulation gases, the optimization of the thickness of the insulated walls versus the usable internal space and improved compressor efficiency in order to increase energy efficiency of refrigerators. However, in order to achieve substantially greater energy savings, more radical changes in product design and technology have to be performed. Three important approaches that will be implemented in Gorenje's next generation fridges and freezers are the use of:

- *Vacuum Insulated Panels (VIP),*
- *Variable-Speed-Drive (VSD) or Variable Capacity Compressor (VCC), and*
- *More Efficient electronics.*

With respect to the washing-machine and the dishwasher, new appliance will be designed able to offer optimized energy (electricity and hot water) consumption. Delaying the starting time of the appliances, controlling their consumption profile and choosing the source of the hot water may result in significant energy savings. Moreover, by pausing the appliances' operation in selected, energy aware phases of the washing circles may achieve better energy load balancing, without sacrificing the washing result, the appliances' lifetime or spending extra energy for re-heating water.



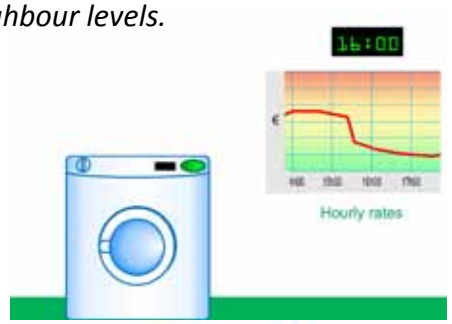
#2 Combined PV & solar home system

Two of the major energy requirements at homes are electricity and hot water. By installing PhotoVoltaic (PV) panels, for electric energy production, and Solar Panels (SP), for hot water production, houses can achieve significant energy consumption reductions. In particular the solar panel is able to cover not only the house hot water requirements, but may also feed some appliances (dishwasher, washing-machine) needs. In this way, reduced environment CO2 emissions and energy savings at house level may be achieved. Moreover, these two local energy generators significantly affect the annual energy requests and turn out in an immediate money savings return for the end-users.

How BeyWatch will answer this issue

BeyWatch will design and implement a CPS (Combined Photovoltaic and Solar) system, which will provide for active energy production, especially during peak hours.

BeyWatch will optimize and integrate a combined photovoltaic/solar (CPS) system, which will provide hot water for white goods (such as dishwasher, washing machine) and for sanitary needs in order to strongly decrease the energy consumption and the CO2 emissions at home by reducing/removing the heating operational cycles and generate electrical energy from Renewable Energy Sources, which can be used at home, and during peak periods even fed to the electricity network in a reverse power generation business model. Information from CPS system will be shared in the BeyWatch network and used for a new set of energy management rules in order to maximize energy savings and environmental savings at home, block and neighbour levels.



The CPS will consist of a PV panel and a SP panel and will produce about 1 kWp of electric power and will accumulate about 200 lt hot water with a temperature ranging between 35 and 65 degree Celsius depending on weather conditions and season.

The Combined photovoltaic/solar system provides an important step beyond state of art by implementing the following features:

- *Integrate the thermal and electric energy generation to increase energy efficiency in its consumptions in household appliances.*
- *Integration with energy-aware white goods for providing sanitary hot water also for those devices*
- *Integration with BeyWatch architecture for implementing energy management rules*

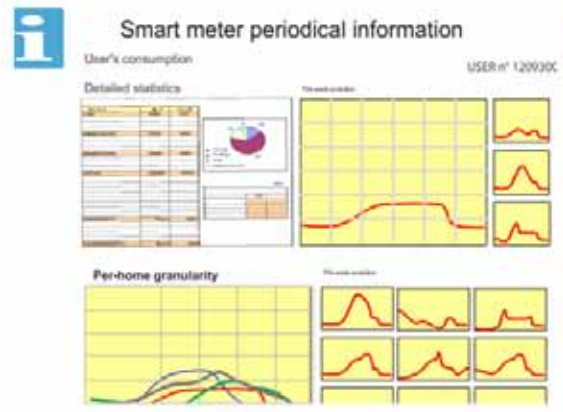
#3 Energy consumption monitoring & control

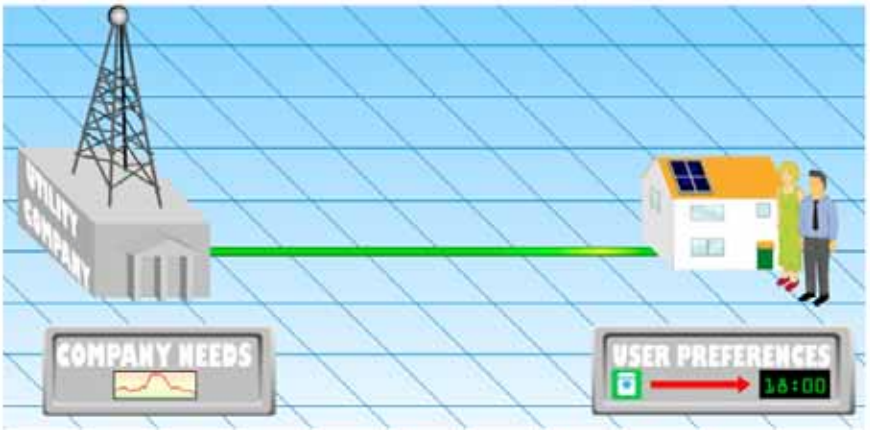
In order to motivate the users and achieve efficient energy balancing, without breaking the customers' loyalty and satisfaction, intelligent metering/remote control platforms may capture and model the user behaviour and habits, generate user profiles, control devices operation and enable energy saving, based on personal preferences. The user will have the option to bypass the automatic generated profile, configure manually the system and select the sequence that the devices will be activated/deactivated or change operational mode. By providing a detailed analysis of the consumption pattern, the user would be able to interactively monitor the consumption of each device, in both operational and standby mode, and thus take decisions on what to do: e.g. tune his contract, use on/off switched gadgets to turn-off appliances whenever they are not used (inefficient standby mode power), control operation in case of intelligent energy-aware devices.

How Beywatch will answer this issue

Based on the efficient home appliances and the CPS system, BeyWatch will step further and build an intelligent energy-aware home-management system (called BeyWatch Agent). Based on the outdoor temperature, the power consumption demand, the power supply network conditions and the users' preferences, all the devices in the home will be set under local interactive monitoring and intelligent control, in order to achieve amortization of loads and peak suppression of small-scale power consumption.

The BeyWatch Agent system will have knowledge of the energy consumption, power limits, tariffs and user preferences at domestic level and will be able to control the local devices (e.g. switch on/off/dim the air-conditioning system, close the widows shades, dim the lights), delay the start/stop/pause of the washing machine or the dishwasher, select if the CPS will give emphasis to the electricity or the hot water production, decide if the BeyWatch washing appliances will be fed with hot water. In particular, the CPS system will communicate with the BeyWatch Agent in order to act according to energy management rules, and even feed the public electricity network on peak hours.





#4 Low-cost home networking

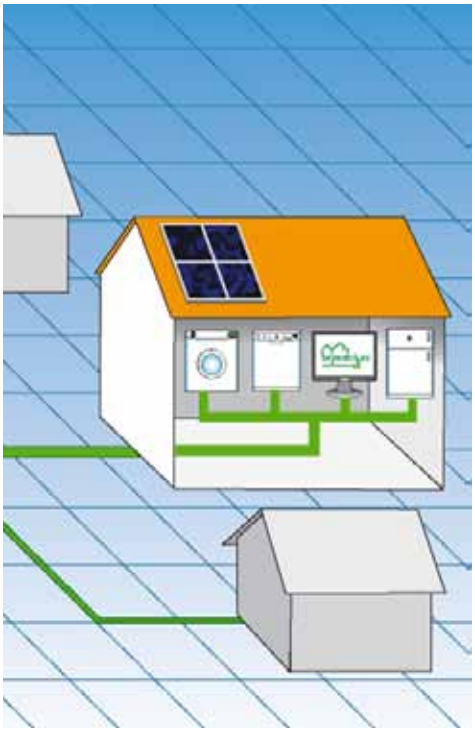
In-home communications will have to deal with all the data exchange associated to energy awareness. It will be a key factor that all the white appliances and devices can be integrated into the home network without increasing too much the costs, which would lower the profit-effects of BeyWatch in home economy. It is also interesting to investigate on how current communication technologies at home level can achieve the data exchange needed by the project and compare them with new alternatives that can lower consumption, manufacturing costs and increase flexibility.

The experience in networking stand-by mode consumption and energy management applications, suggests radio frequency (RF) technologies to be used as communication technology within BeyWatch house network.

Thus, it is a key issue to have in mind the factors that will lead to the M2M (Machine to machine) communications technology choice: cost of system, ease of installation (preferably plug and play), electricity power consumption, standardization and operational flexibility.

How Beywatch will answer this issue

RF state-of-the art alternatives will be studied and the most suitable options will be included in experiments and prototypes, so BeyWatch will not stick to only one specific wireless technology if that is not necessary. M2M communication interfaces will allow interactive monitoring, intelligent control and seamless device capabilities detection and instantiation by the BeyWatch service components (Agent/Supervisor). To this respect the M2M interfaces will allow existing appliances recognition, control and functionality utilization transparently to the user.



Work will be based on existing standards which will be suitably used and adapted to support household appliances, intelligent metering devices, the small scale RES/CPS equipment and the necessary sophisticated capabilities, like status poll, interworking capabilities, instant energy consumption, cumulative/average energy consumption, etc, will be built on top of the RF. The M2M interfaces will be specified to be positioned within the BeyWatch Agent, on top of the OSGi server platform, while a small part of its functionality, namely that for device capabilities polling and energy consumption information, will be ported on the selected household and white goods appliances.

#5 Load / energy management

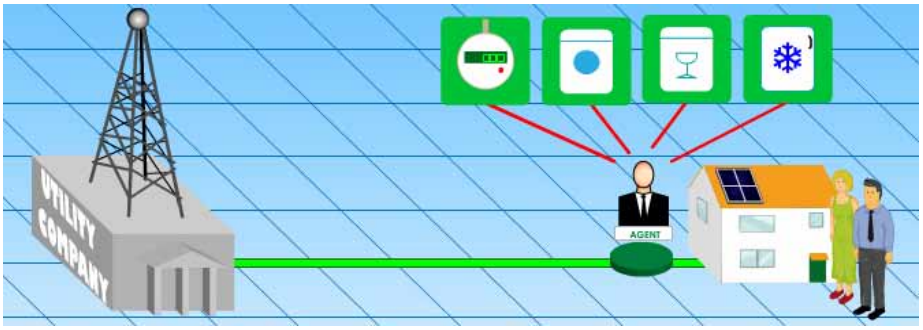
Efficient energy consumption is key to Europe's ambitious goals for sustainable development and air pollution and climate shifting. Especially during the summer period, the complete electricity generation system and distribution network in Southern Europe is working under extremely high loads. Moreover, global climate scenarios show that the average temperature in EU Member States is likely to rise by 0.3-0.7 °C in the next 10 years, and will continue to increase until at least the middle of the century. The probability of extreme temperatures will rise accordingly and there will be corresponding demand from building users for the installation of cooling systems in homes and workplaces, further increasing energy consumption and surcharging the network.

The energy and electricity demand have been constantly growing over the past years, mostly because of the emergence of new electrical applications. This increasing electricity demand puts the generation system and the distribution network under stress and requires increasing investments in the energy producing sector in order for the electricity industry to be able to provide energy when it is needed where it is needed. In order to avoid building new power plants that will be used only during peak demand (which is not environmentally speaking very efficient) and in order to tackle grid congestion issues, the electricity industry is investing on new technologies and carries research activities so as to develop energy efficiency, energy management and load management practices at the customer level.

How Beywatch will answer this issue

By merging local energy production with connected smart households white goods and a smart energy manager, the project aims at reducing both the energy consumption of a house and its CO2 emissions. Electricity and hot water will be produced at the home level by using a Combined Photovoltaic and Solar System that includes both a photovoltaic panel and a solar thermal system (solar panel plus a storage hot water tank).

Information from the Combined Photovoltaic and Solar System, from the smart white goods and appliances, from other home electrical devices and from the electricity distribution grid (tariffs, grid status…) will be shared across the BeyWatch network in order to maximize energy savings and to minimize the environmental impact of the end-users behaviour at the home, block or neighbourhood level.



Technologies for connected and smart low-cost low-power white goods will be developed during the project leading to an integrated low-power motor control for a home fridge and freezer and to an energy aware washing machine that would be able to take advantage of the presence of a Combined Photovoltaic and Solar System on the roof of the home.

#6 Emerging business models

BeyWatch aims to influence and improve the relationship between the utility, the electricity consumer and, in this case, the home electricity producer. In order to achieve this, new ways of automatic interaction and guidance will need to be created.

Business Support Services (BSS) will help all the stakeholders to reach contracts that will benefit them and will serve the user to take easy action on energy savings based on the provided information. This issue will be strategic for household's economy, home electricity generation optimization and for carbon footprint reduction.

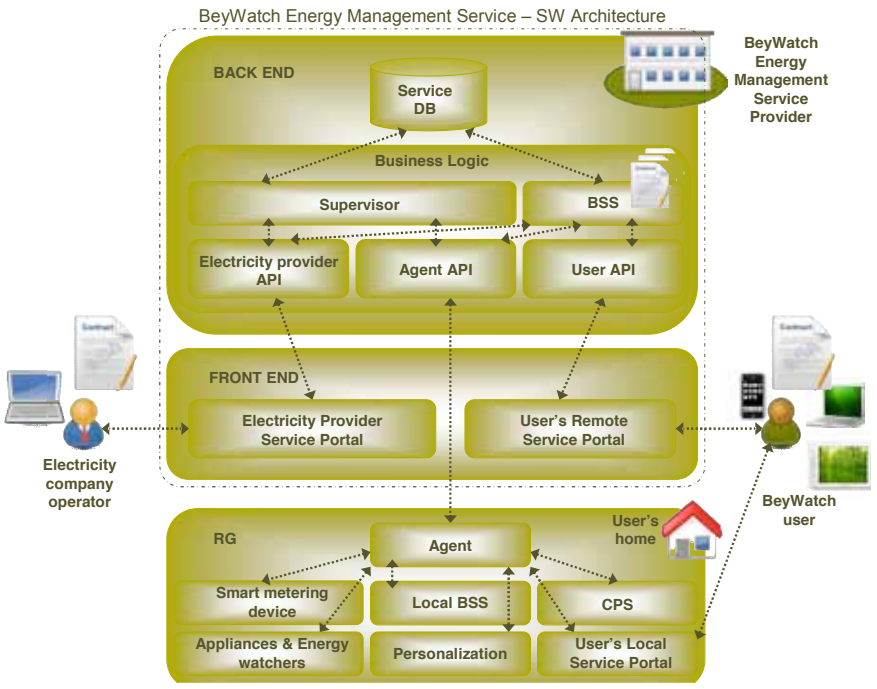
The users will be able to compare their own behaviour with the different alternatives that the utility offers, and the utility will take advantage from the user behaviour information for its own purposes, like peak shaving and load balancing.

How Beywatch will answer this issue

BSS applications will be integrated in the global architecture in a way that all the relevant modules will exchange the required information to achieve the different goals of the BeyWatch Energy Management System, as can be seen in the figure.

As shown, BSS module will interact, at least, with the user -through the Remote Service Portal and User API-, the Agent and the Electricity provider. There will be other modules like prediction tools or Supervisor that will also have influence on the BSS features.

BSS will manage the evolved consumer and energy provider relationship, will be in charge of dynamic provision, contracting and purchasing based on available resources information, will serve as a tool for revenue sharing and billing policies, will offer some statistics and interactive features on the GUI and will evolve with the growing alternatives in new Energy Business Models.



Stay tuned!

www.beywatch.eu

- All project details (including The Beywatch Story!)
- Deliverables and reports
- Industry news

Beywatch group on LinkedIn

- www.linkedin.com/groupInvitation?groupID=1587997
- The right forum to discuss home energy management

Beywatch Workshop on energy efficient white goods and energy management

- Nov. 16 & 17, 2009 – Nice, France
- In the context of the **ICT for sustainable homes** conference
- www.ict-sustainablehomes.org

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