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Electronic Market Place for Energy Building Blocks

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Abstract:

This deliverable identifies relevant business cases and scenarios in the field of the Electronic Market for Energy and provides a high level description in the form of UML scenario diagrams and related use case explanations. It was decided to handle just a sub-group of possible scenarios in this huge topic that by itself could be handled in a unique project. The choices were made based on the novelty of the scenarios proposed with respect to state of the art in the electronic market place being now applied in practice in the different markets in Europe.
This report is the basis for further work on ICT requirements and a functional ICT architecture that will handle appropriately the needs of a booming Electronic market place for Energy.

Keyword list:

eMarket, Energy Trading, Advanced Energy information services, Demand-side Management, Supply-side Management, Smart Grid, Smart Energy, Consumption Information, energy price, control signals.

Disclaimer:

N/A

Executive Summary

The Electricity Grid is being suffering a revolution in the last decade where ICT technologies are being introduced into what it is called now the "SMART GRID" in order to increase controllability, manageability and flexibility of these networks. Moreover the electricity market is being deregulated now at a high pace and thus new tools are needed in the Internet in order to boost electricity and energy based transactions and new services. Therefore a renewed Electronic Energy Market Place is evolving very fast and needs for sure new services provided by the Future Internet that will allow the final customers of energy and its related grid stakeholders to communicate and get services that will allow them better to cope with challenges of reducing energy consumption and less CO2 emissions.

The need for an Electronic Market Place for energy, eMarket4E, arise from the evolution of the electricity market due to de-regulation processes, and the transformation of the old electricity grid into a smart grid. This grid will have to be able to cope with the integration of electricity from renewable sources – green but with a certain degree of unpredictability – variable loads (e.g. EVs) when up to now loads are well known and fixed, and the integration of the end customer as an active element in the electricity grid.

This deliverable specifies at a high level a set of Scenarios within Business Cases that first of all represent and include novel services that normally cannot be found commercially in various European markets. In Finseny WP6, we have decided specifically to not handle scenarios dealing with (Capacity/Energy) and financial contracts support happening already in the energy markets. Functions and services around the long term and daily market bids are already quite mature in the market and are adequately functioning for complex market operations between the different stakeholders of the various European Markets. They already take into account very complex operations and are very well supported by online (meaning Internet) application environments.

In this deliverable we decided to cover the following business cases within the eMarket for Energy landscape (Chapter 4, explain the hierarchy and methodology chosen for the scenarios selection and terminology):

1. Information and final user contracts about energy use
2. Demand Side Management
3. Energy Trading

The first Business case tackles the need of providing to the user the ability to get detailed information about his energy use via different means using the internet in a reliable way connecting his HEM (Home Energy Management system) together with the information available from the energy parties (Grid users or Grid operators). At the same time and energy contract brokering scenario is included that will empower the final customer with tools to configure his electricity contract online. One important accent on the scenarios covered here is about enabling the user of getting information and choosing to use the type of energy (coming from renewables for instance) that he prefers because of cost reasons or simply because of his willingness of being eco-friendly.

In the Demand Side Management Business Case, a scenario is considered that shows how the final user will be able to first get discounts on his electricity bill if he allows the grid users to send signals to his home or premise, in order to flat the Demand curve for example. Then the possibility of reshaping hos contract with the grid user is also considered, allowing him to choose the best offer and the best partner for Demand Side Management.

Finally the third Business case considered in this deliverable is Trading Services. Energy trading is one of the fundamental pieces of the eMarket4E, as it brings together the different actors (grid users, grid operators, providers and customers). Energy trading is implemented in the actual market places where energy-related products are traded and prices are negotiated. This can be done in different scenarios as described in Chapter 5. These flexible prices for energy can be an incentive to consume energy when it is cheap (low overall energy demand or a surplus, e.g., due to availability of regenerative energies), to produce energy or avoid consumption when it is more expensive (high overall demand or low production, e.g., due to poor weather conditions for regenerative energies) or generally reschedule energy presumption according to market transactions. The scenarios here take as an important stakeholder the final customer and Prosumers, that at the moment do not have Internet based eMarket4E services for trading.

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1. Glossary

This document uses the terms included in the general FINSENY Glossary and Terms [0].

2. Introduction

An increase of competition through energy market liberalization has been a European Community objective for the last years. The new deregulated electricity markets are based on a decentralized operating model, where competition is a must to increase quality and to reduce prices for final customers. Therefore the markets now have a greater complexity, many more players have entered the value chain and participants have different objectives, decision making processes and perceptions of risk. Moreover, innovative business models with flexible time-varying tariffs and Renewable Energy Sources (RES) whose output can be either consumed locally or forwarded/sold to the distribution network are expected to be a commodity in the years to come. The Figure below tries to sketch the new energy market trends with respect to the fact that now users (commercial and private) are installing energy generation capabilities in their premises. Therefore they can also offer their energy surplus to the market, transforming their role into Prosumers.

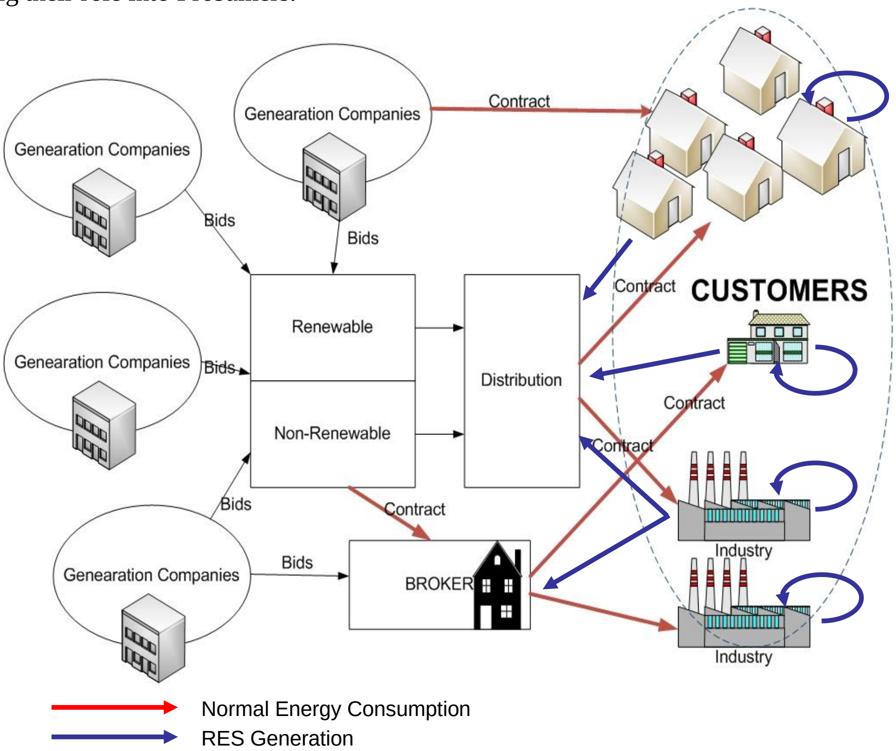

Figure 1: Deregulated electricity market model where users are being also energy distributors

The complexity of the market relationships, transactions, amount of players brings in an important requirement to handle energy efficiency solutions: the use of advanced Future Internet technologies to network all the different players and provide services. Therefore new communication information channels have to be designed in order to be able to control the energy consumption at the customer premises and profit from the new available energy sources that can be used. All these have to be aggregated and presented in a way adapted to the different players participating in the market. This is one of the key contributions of FINSENY: to analyze the actual situation of the market and to define the services and processes that need to be considered for the building of a consistent platform able to handle all the transactions, services and business relationships.

2.1 The Electronic Market Place for Energy (eMarket4E) – Basic Definitions

The need for an Electronic Market Place for Energy (eMarket4E) arises from the evolution of the electricity market due to de-regulation and the transformation of the old electricity grid into a smart grid. This grid will have to be able to cope with the integration of electricity from renewable sources. These renewable sources are environmentally friendly, but include a certain degree of unpredictability. They lead to variable loads while up to now loads are well known and fixed. Further, end consumers which now might also produce energy (e.g., by means of solar panels on the roofs of residential houses or micro-generation plants) need to be integrated as active elements in the electricity grid. Such consumers are frequently referred to as “Prosumers” as they also produce energy.

Prosumers have to be enabled to fulfill their active role in the eMarket4E: They need to be able to react to utility needs (e.g., to react to electricity demand peaks) while they try to keep costs low and to protect the environment. To this end they need to be capable to actively collaborate in the generation of energy fed into the grid, e.g., to start or increase micro-generation at home when it is economically advantageous.

A large variety of actors takes part at the Market Place, each having specific needs. In particular, the actors want to boost their business processes by primarily accomplish fruitful transactions. The will deal with various types of assets that can be found in the smart energy market: financial transactions, physical energy capacity commercialization, information services, etc..

The following picture shows the main actors of a de-regulated electricity market:

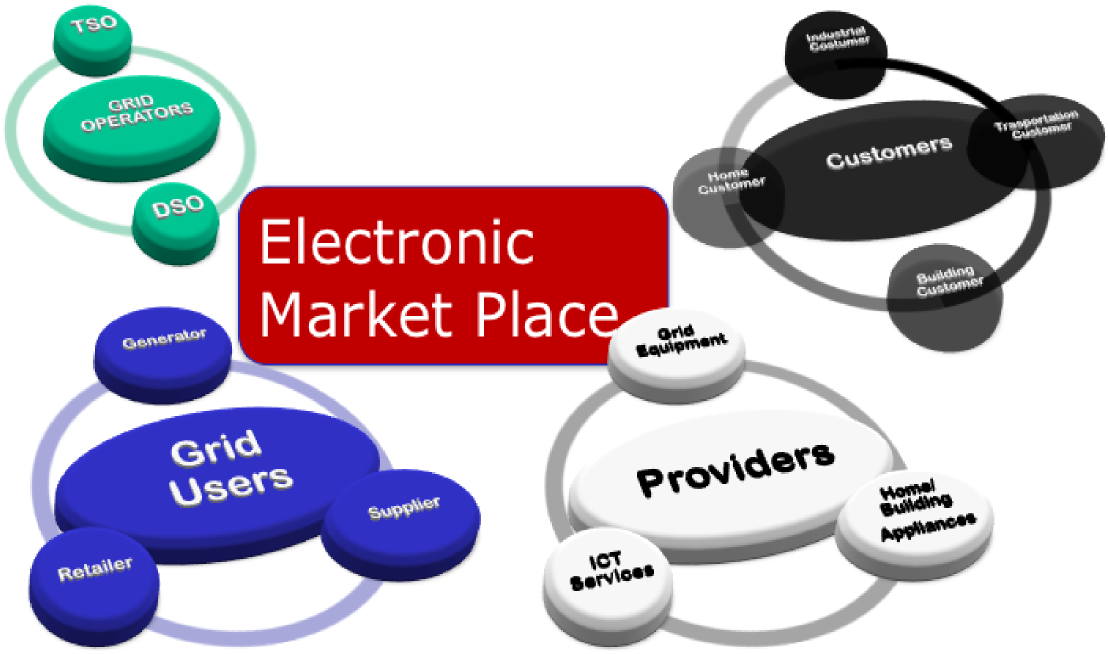

Figure 2: The actors of the Electronic Market Place

In brief, the different roles are summarized as follows[1].

1. Grid Operators: “refers to the undertakings of operating, building, maintaining and planning of the electric power transmission and distribution networks”
2. Grid Users: Are actively generating and/or selling electricity and advanced services to customers. They might have connections to the grid operators.
3. Providers: The actors considered in this group provide technology, products and services to the actors within the Grid operators and Grid Users groups.
4. Customers: consumers of electricity and related services/systems that will allow them to monitor and use more efficiently the electricity in their premises.

The electronic market for energy will in fact pave the way and fulfill the needs of the renewed energy market after deregulation. This electronic market place in FINSENY will have to make use of the renewed capabilities of the Future Internet[2]:

1. **Development of the Smart Grid**, which underpins the need for **sophisticated network management and monitoring tools** to achieve efficiency in the electricity transport network.

[1] EG3 Deliverable: Roles and Responsibilities of Actors involved in the Smart Grids Deployment

[2] FIWARE under the PPP-FI ins designing a whole set of enablers that will pave the way for the Future Internet.

The objective is to **achieve efficiency in the electricity grid and to guarantee quality of service**
Moreover, the **network model is evolving** from a quite predictable topology to a more complex and flexible one:

- It needs to integrate new ‘atomized’ generation sources and in particular renewable energy produced at homes.
- It needs to cope with new loads, such as the electric vehicles, or with the uptake of heat pumps.

2. Due to liberalization of the market, **electricity distribution companies have to ‘open their networks’**, as they need to transport and meter electricity consumption that the end customer will pay to the energy retailer, which can be a company completely separate from the distributor.

3. E**nergy retailers need to compete for the users,** to keep customers fidelity, and try to attract new ones. There are two main ways of achieving this objective:

   - **Competing on price**.
   - **Offering energy-related value added services**.

   Normally energy retailers play with a very small margin to compete on price. For example in newly liberalized markets, prices and rate models are being transformed from fixed, regulated rates to an energy price really depending on the market transactions.
   It is also notable that deregulation might lead to an increase of electricity prices, as electricity might not be subsidized by the governments anymore. Then, the cost of electricity needs to equal production costs, which is higher in most of the cases. The experts agree on a gradual increase of the electricity cost in most of the European countries (in Spain for example experts say that a 30% cost increase is needed), and that in turn will drive end users to actually commit more positively to energy efficiency in their homes by installing new Building Management Systems that will allow them to save energy and costs.

2.2 Challenges in the eMarket4E in FINSENY

There are **clear parallels** between the challenges faced by **utilities** and those faced by **Telco** companies in the last decades:

- Need to **open up heretofore closed networks** to third parties.
- Need to **manage different tariff schemes**.
- Evolution from a fixed, completely predictable network to a **dynamic network** that will have to manage mobile elements.
- **Need to ‘know the customer’ to compete in services** in a more personalized manner and build customer loyalty. Up to now, utilities had ‘meters’, not clients, in the same way that Telco operators used to have ‘telephone numbers’, not customers.
- Traditionally, Telco companies **deal with huge amounts of information** (call registers for instance), and this is something that the utilities need to do from now on – smart metering.

For utilities, new business models are easier to realise if they consider the lessons learned in the Telco industry as they can benefit from the Telco’s expertise in:

- Providing solutions for complex rules for **billing** and even for real time pricing (pre-pay billing systems).
- **User characterization**, by analysing user’s service consumption behaviour.
- **User segmentation** according to consumption and service usage patterns.
- Telco platform provides **communication solutions** for advertising and marketing.
- **Service development**, although this role is also shared with **Third Party Service Providers**.

On the other hand, users can benefit from the transactions to be done on the emarket4E that lead to:

- **Money saving**.

- **Increased comfort**.
- **Security of service provision**.
- Responsible usage of energy – **commitment to the preservation of the environment**.

2.2.1 eMarket4E and the Future Internet

To summarize the context of the energy market briefly in the new Internet era, the table below highlights the situation on the energy (electricity) market, the perspectives of the customers in the actual sustainability and energy efficiency scenarios and the products and services that are demanded by the various stakeholders.

Energy / electricity	• Huge energy market: electricity (16-22% energy mix[0]) global consumer business worth at least $1 trillion yearly[1] • Large players • Universality: coverage/penetration • Regulation : fostering liberalization(commercialization), modernization (**SmartGrids including Smart Meters**) and environment protection (clean energy) with government subsidies • Electricity tariff distortion (flat rate does not reflect fluctuating costs[3]) • Electric cars (mass production started): will increase the share of electricity in energy mix	

Customers	• Would like to decrease consumption both to:
	  • save (low but increasing tariffs)
	  • behave green
	• How?
	  • Optimizing (non-wasting): heating, lighting, white&brown appliances, machinery, transport... -> 13% residential/30% offices savings[4]
	  • Consuming in off-peak periods (electricity[3]) -> 20% savings	

Products and Services: Energy saving, ICT for Smart grids	• Energy saving:
	  • Utilities: Italian market most advanced (Enel full 35M+ deployment of smart meters from 2000 to 2005, -2,1B€)-several differentiated tariffs, displays...
	• ICT players interested to enter the market :
	  • ICT independent players offering energy monitoring solutions (pilots) like Agilewaves (US) OR ONZO (UK)
	  • Telcos: Bell Canada, BT, Comcast, and Verizon planning to offer energy management services
	• M2M communications (smart meters): telcos like AT&T...
	• Smart grid IT solutions: Cisco, HP, Dell, IBM...
		1,4M customers Germany

Table 1: Important insights of the future energy market

In summary, the energy/electricity market is being transformed rapidly due to the challenge to cope with the production (climate changes, fossil fuels shortage, increasing demand, new energy sinks: e-cars, …) and with efficiency in the next decades. Since a transformation is needed there is a huge market potential on improving the grid functionality with ICT technologies. In the case of FINSENY, the latter will be achieved through the use of many new capabilities offered by the Future Internet through the technology foundation (FIWARE project) within the PPP for Future Internet program. At the same time, final users are now starting to be truly concerned about sustainability and the need to be "friendly to the environment". They are open to spend a bit more in order to be more efficient. Thus they are eager to be active participants in the energy market. Finally it is a fact that products and services are needed to achieve all the goals already explained. FINSENY intends to play an important role by defining advanced services around the electronic market place environment.

The eMarket4E will put in place interfaces for the stakeholders using the Future Internet as the main communication channel, functioning under the framework of the Technological Foundation of the PPP (FIWARE).

2.3 Related Work

- "ADDRESS- Active Distribution network with full integration of Demand and distributed energy RESourceS", EU, www.addressfp7.org
  (Load balancing, SRP-based services, CRP-based services)
- "BeyWatch- Building Energy Watcher", EU, www.beywatch.eu, ICT for energy efficient Homes and Neighbourhoods
- The DG Energy Task Force for Smart Grid (SGTF) Expert Group 1 (EG1).

- "E-Energy -ICT-based energy system of the future", GE , http://www.e-energy.de/en/index.php (Virtual Power Plant, Data acquisition and monitoring, demand side management, price induced load shift, smart metering, energy market place, load balancing etc.)

- "SmartHouse/SmartGrid- ICT-enabled collaborative technical-commercial aggregations of Smart Houses", EU, www. smarthouse-smartgrid.eu

- "Energy@Home- communication infrastructure that enables provision of Value Added Services based upon information exchange related to energy usage", IT, www.energy-home.it

- "Mirabel- Micro-Request-Based Aggregation, Forecasting and Scheduling of Energy Demand, Supply and Distribution" http://www.mirabel-project.eu/.

- "BeAware – Boosting Energy Awareness", http://www.energyawareness.eu/beaware/ (Home Energy Monitoring, Customer engagement, smart metering, persuasive end user interface).

3. Insights from the Stakeholders

3.1 Energy Value Chain

The Energy Value Chain includes different stakeholders and its complexity is increasing considering that the deregulation of this market is bringing a lot of new actors to entry in the market.
Since the liberalization waves and subsequent introduction of market forces, the energy sector is subject to new dynamics that demand a recalibration of the traditional vertical oriented vision on the energy value chain.
The tradition Energy Value chain was centered on a centralized energy generation and the entire value chain was structured around power flow. Businesses were defined by the part they played in getting electricity to consumers, for instance generation, transmission, distributors, etc.
The Figure 3 shows the traditional energy industry value chain according IBM institute.

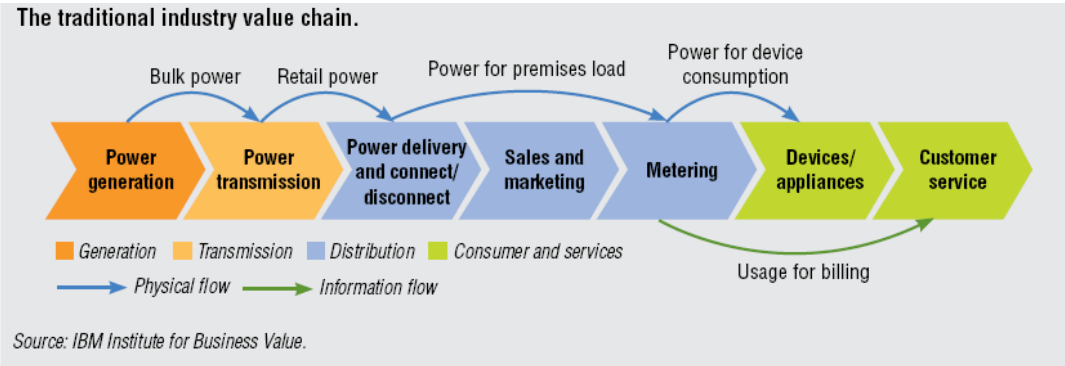

Figure 3: Traditional industry value chain

That value chain is changing due to the energy market deregulation and liberalization as well as to environment sustainability and the increased awareness of the energy customers. In fact the so called "Energy Transition" implies a gradual, but drastic shift towards a sustainable, reliable and affordable energy system in 2050 in order to dramatically reduce the negative environmental impact of energy consumption and to mitigate the risks of increasing dependence on the import of fossil fuels. In order to maintain their competitive edge, energy companies have to anticipate on the structural changes in the energy sector that are required to make this transition happen.
In the same time customer awareness regarding energy prices and environmental issues, legislative measures, technological development and shifting geopolitical relations are examples of factors that drive changes in the configuration and dynamics in the energy value chain.
In short, the energy value chain is not fixed, but subject to external and internal influences. In this perspective, new entities are coming in the Energy Value chain while the roles of the current stakeholders are changing. That situation creates opportunities and threats that have to be addressed, in particular, by

energy companies in terms of strategic reorientations and corresponding policies. This could give rise to changing product and service portfolio, new alliances or acquisitions or divestment of activities.

The diffusion of decentralized generation on one hand and the emerging of innovative technologies more and more reliable for instance related, smart meters and intelligent network enable real-time data exchange, and it will make emerge the need to manage increasingly voluminous and complex new information flows in addition to energy flows. Historically, a utility's primary information exchange with consumers was related to the bill (provided in the best case every month).
But in a context based on a future Internet vision, real-time data on consumer usage will be available, enhancing utilities' ability to forecast and balance loads and offer targeted products and services to customers on a more individualized basis.
Where distributed generation is in the mix, power from multiple sources will have to be metered, reconciled and billed.
Actually, once energy (from different sources) has flown into the grid, it's not possible to meter (i.e verify the exact amount of the single sources) and to bill it (each sources has different cost/price): the source mix of each customer should be defined/profiled before the grid-input. One available tool in order to verify the exact amount of renewable energy is the Renewable Energy Certificates: they enable the customer to profile the desired amount of renewable energy to purchase[3].
All of these reasons are bringing about a greater focus on information flow, which will play a much greater role in energy industry value chain (in the figure below) as well as at a new industrial model so called "Participatory Network" characterized of an high level of grid and network technologies evolution Figure 4 and in particular of consumers control (Figure 5).

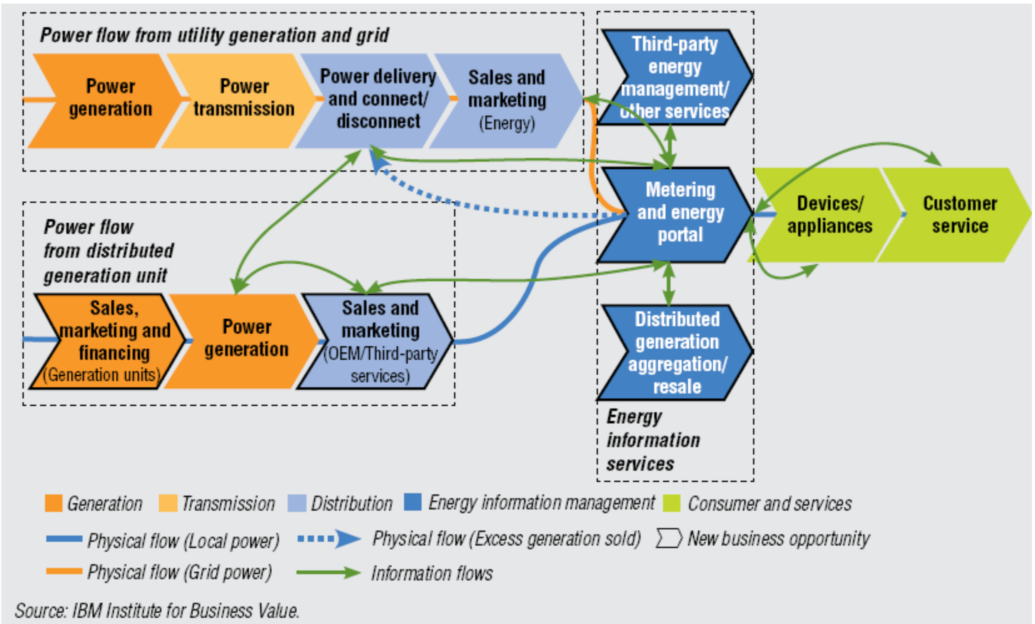

Figure 4: Potential Evolution of Energy industry value chain

[3] (http://www.recs.org/content.php?IDPAGE=20)

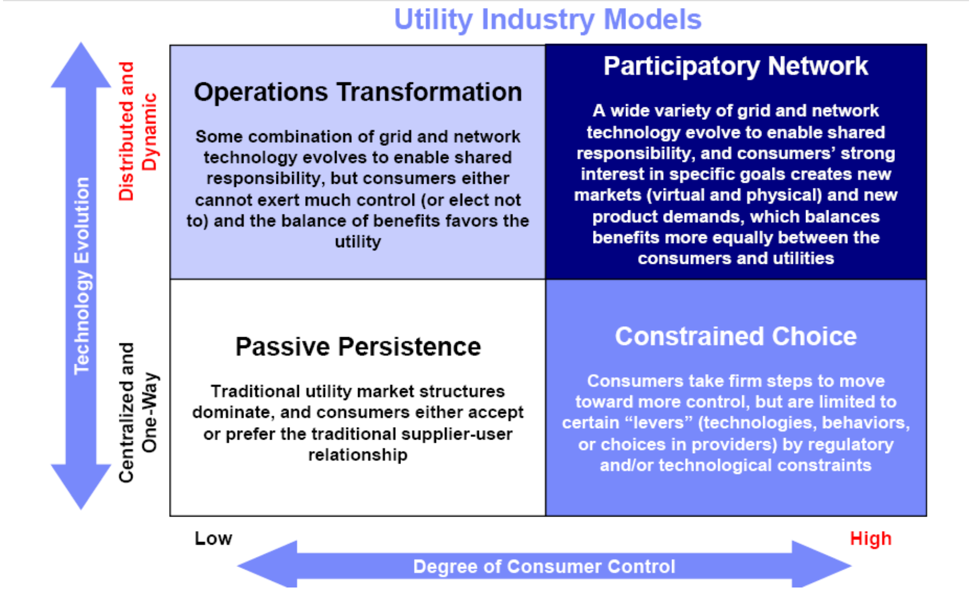

Figure 5: Utility Industrial evolution models

In this perspective, this information-rich environment could give different new opportunities for all the energy stakeholders and new entrants, generating a range of new products, services and business models. According this perspective the main changes could be at the Generation and Distribution level as well as it sees the introduction of a new level that is "energy Information management" which could take in new entrants on the industry.

3.2 Stakeholders and eMarket4E

The eMarket4E vision is based on these considerations and aims at offering solutions for the networking of energy stakeholders, in particular between customer and Energy Utility companies, focusing on the involvement of the former as active actor of the Energy Value Chain, shifting in this way toward a "Participatory Network" Industry Model.
For the scope of this deliverable, here below an overview of the current challenges of the stakeholders and their potential point of view about the eMarket4E is provided.
As we said above, stakeholder point of views and needs are evolving according the change on the Countries laws, new environment constraints and the technology changes and innovation which enable to them to cover roles in the system before not possible. Of course, this brings to break down the old equilibriums among stakeholders.
The main change is about the customer role and its impact on the whole energy industry.
So, our idea about eMarket4E is focused on the energy customer as active player on the market and on the create conditions for the shaping of local energy market.
The following table offers an overview of the energy stakeholder situation and the potential opinion about eMarket4E:

* Stakeholder	Current Situation	eMarket4E opinion
	GRID USERS	
Energy Generator	The generation of energy is currently more and more decentralized. A part of the big energy producers, a lot of new medium/small energy producers is emerging on the market which include the householders too as new energy producers. In different European countries, energy market mechanisms are defined in order to sell the energy generated. Anyway such as mechanisms are not enough and easy to involve in particular not business produces.	The eMarket4E could be a good tool for manage and incentive the energy exchange in particular for the small not commercial entities.
Energy Retailer and	Currently retailers and suppliers are in charge of the retail of energy and other	The eMarket4E could be a good communication and management tool for

Supplier	services to the customers. Usually, they are responsible to manage the relationships with the final customers. They are the main affected actors of the liberalization of the Energy Market and they are facing a market more and more competitive and more exigent customer where the main challenge is the differentiation. More, surveys on customer indicate that consumers now consider a utility's ethical reputation, alignment with community values, and environmental actions on par with traditional "buyer values" like customer service and reliability.	the Energy retailer and supplier. Through it, retailers could introduce their vision, ethics, energy source mixer, policy price etc to the customers in an open competitive market. They will be able to provide innovative customized solution, e.g. real-time consumption information and related price/cost to own customers based on smart metering, sensors and distributed generation. They could be use eMarket4E as a tool to better involve the Customer, offering more control for take decision about energy use.
GRID OPERATORS		
DSO	They currently participate to the Power Exchange Market and usually they work as retailer too or strictly correlated with them. They are assuming an important role in the aggregation of the energy decentralized production. The three key challenges for the DSOs are: ➢ connecting additional generation from renewable; ➢ enabling active demand/customer side participation in the market; ➢ keeping the distribution grid stable and balanced by handling electric power flows in both directions.	The eMarket4E could provide to them tools in particular to enabling active demand side participation. The eMarket4E could offer the tools to put in relationship DSO with energy customers providing the tailored incentive to improve the participation of these latter. Moreover, different researches proofed that the Time of Use (TOU) pricing approach (in particular if near-real time), more a related penalty or reward mechanisms enable to shift the demand and to reduce overall consumption too. So, they could have the opportunity to adopt mechanisms (also near real time) to address the energy demand in the needed way and the potential reduction of overall energy use will enable them to replay to the national and international normative.
TSO	They are in charge of the transmission system in a given area. Moreover, the TSO is responsible for connection of all grid users at the transmission level and connection of the DSOs within the TSO control area. Large scale variable generation from renewable sources will be connected to the transmission and distribution grids in the future. So, the three key challenges for the TSOs are: - to maximize interconnection capacities, - to support the integration of the large wind generation plants - to keep the grid stable and balanced in cooperation with the DSO´s.	Currently the relationship and market exchange among TSOs, DSO and large energy generations are already advanced and mature. TSOs usually do not have contact with the final customer. In this perspective, the eMarket4E won't be able to take particular added value to them a part the possibility to better understand the consumption behavior and consequently to better foresee the demand.
PROVIDERS		
ICT and tech. Providers	These stakeholders are currently involved to offer different types of ICT service to Energy utilities, e.g. billing, forecast based on business intelligence processing, CRM system, specific hardware and communication network. Of course they are always committed to find and offering new solutions. Instead they usual are not	They will be the providers at different levels of the eMarket4E services/product. The will have the opportunity to introduce new innovative services on the competitive market to different target market: DSOs, suppliers and retailers, end customers, prosumers etc. Information-rich environment will give

	providing specific energy services directly to the final customer. Anyway more than the other they are facing a deep change in their business model.	different new opportunities for generating a range of new products, services and business models, (e.g. storage, management and processing data, energy forecast for prosumers, marketplace management etc.).
	CUSTOMERS	
Customer Home/Building	In some regions with competitive markets, consumers are exercising the right to select their energy providers. However, even where competitive markets are in place, most countries still lack adequate mechanisms to encourage movement. More, other barriers are: charges levied for switching, limited number of competitors in a particular geography, lack of consumer interest due often from inadequate information and long notification periods. In addition, it seems that customer awareness is still low. The global industry's transition to a smart grid infrastructure and intelligent network is challenging the existing models of provider customer relationships, creating the opportunity to reevaluate how value is created and preserved.	The main changes and of course opportunities are for these Stakeholders considering that the eMarket4E is thought for their active and participatory involvement. Below some opportunities that they will be able to catch: ➢ Consumer could drive new and more targeted choices in power supply; ➢ Could have information on quality indicators for content (e.g., green energy standards); ➢ Broader choice of Energy providers (so that more active role in provider selection) ➢ Stronger influence about energy; generation : e.g introduction of residential time-of-use programs and green power options enables more active selection and management of generation deployment at individual level; ➢ Interactivity and involvement with generation and service providers increases; ➢ Consumers active in generating power will be able to influence generation planning decisions ➢ Dynamic, value-based pricing of power (e.g.,time-of-use);
Customer Transport/ Industry	They are a specific target of customers that group together industry and transport entities. They are large consumers of electricity and in the last year some Countries ask to them to be responsible about environment and assume "green behaviors" . So to be energy efficient is for them a necessity for both their business (because to be energy efficient means for them save money) and law requirements. So, they may be involved in contract based Demand/Response and there are already some industry commit in this kind of program. Currently the main constrains for them are the expensive cost for implement and install system for the Energy Efficient management.	The opportunities for them are similar to the Home/Building Customer in terms of energy provider choice but more for them could be easier and less expensive to be energy efficiency in accordance with national and European law about environment.

Table 2: Energy market stakeholder positioning

* Note: The same naming conventions are used than in Figure 2

4. Methodology and Business case Clustering

4.1 Choices made, hierarchy and methodology

We have started by analyzing the energy market state of the art in order to decide in which areas FINSENY could bring new service scenarios that will make use of ICT and Internet resources relevant for the PPP.
We have seen that the energy market (in terms of energy Market exchange)is quite mature and thus FINSENY **WP6 will not** be able to **provide very valuable scenarios in the following areas**:

- There is already a good **handling of daily and long term assignments of production in centrals and Renewable Energy Sources** ("big producers"); the latter embeds the following services:
    - Energy Contracts between grid users and grid operators
    - Market transactions on energy for the above
    - This includes: Dispatching of RES resources also.
    - Ahead predictions for the above users
    - Price forecasting at this level on a per day or year basis
    - Energy production and distribution assignments already existing
    - Auctions, offerings and bids in the ongoing daily and long term markets

For the contrary, we have thus decided to consider scenarios that will handle the needs of the following actors principally:

- From the actors picture, in Figure 2, in FINSENY we should focus on the CUSTOMERS that are at the moment almost not supported by the energy market with ICT enabled services.
    - The Customer viewed in the actual market as Prosumers
    - The Microgrid Actors (Customers and users) that will appear in short in the emarket
    - The Grid users (Producers or retailers) always related to the customers needs.
    - The aggregators (are part of the Providers) as a central point in a lot of cases being the providers of the tools of the emarket4E tools, thus the operators of the market.

And at the same time we have decided to focus on the following types of transactions which are crucial in order to enable market operation for smart energy management:

- Energy Efficiency and cost savings for final customers
- Demand side management and ICT information services for customers
- Information and trading Services for the handling of EV's combined with the grid needs.
- Information and trading Services for Microgrids/e-islands customers-users
- Information and trading Services for new producers (Prosumers) and customers matching energy needs

After the above analysis we have then tried to match the above focus orientation with the possibilities and interests of the different partners trying to seek a balance between the novelty and the maturity of the technologies and pre-competitive technologies that all these partners had "on board".
We have come up at the end with three Business case areas that are explained in section 4.2 and shown in the diagram of Figure 7 in order to explain the description hierarchy employed.

The Hierarchy follows a UML scenario/Use case definition methodology approach and is alike the methodologies followed in the other scenario workpackages (2 to 5).

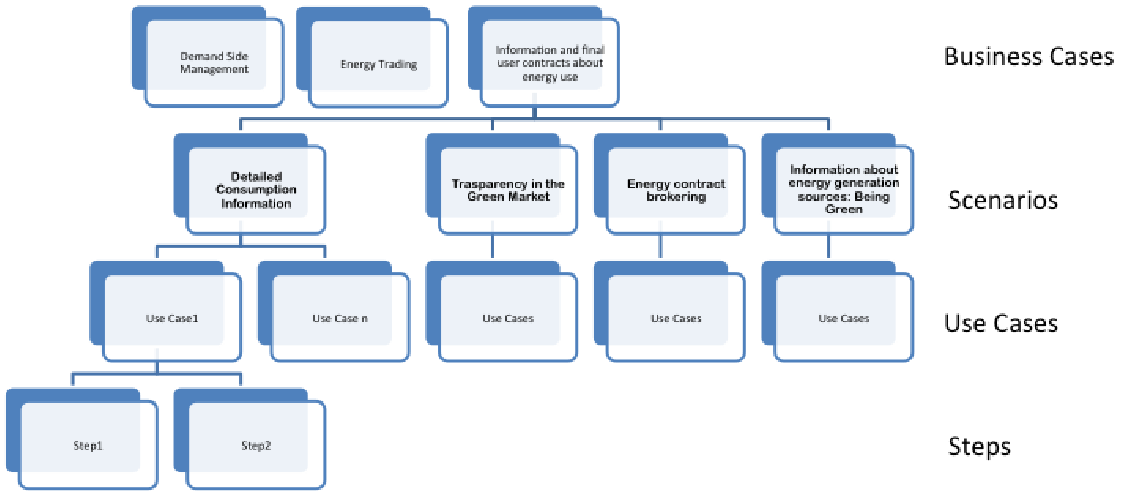

Figure 6: The hierarchy of the emarket4E business cases

The description index (See Chapter 5) or guide for the Business case scenarios we used, follows what has been chosen in the project as a reference document in order to harmonize all the descriptions. The template comes from the Intelligrid initiative (http://intelligrid.epri.com/default.asp), an initiative that is creating the technical foundation for a smart power grid that links electricity with communications and computer control to achieve gains in reliability, capacity, and customer services.

Moreover we have chosen to employ Enterprise Architect[4] as UML tool to design Use Cases diagrams of the different scenarios in chapter 5.

Below in section 4.2, we introduce a general description of the business cases that have been chosen in order to understand what they will be trying to develop via the scenarios defined in Chapter5.

In section 4.3 we introduce a description of all the actors that are included on the scenarios, in order to have a homogeneous and consolidated actors description that will be employed consistently throughout the document.

4.2 eMarket4E Business Cases

4.2.1 Information and final user contracts about energy use

This Business Case will deal with the scenarios and the use cases and steps to be considered in Finseny about the eMarket4E services around the information closely linked to the energy consumption at the user premises and the tariff schemes, giving the opportunity to the users to match their energy profiles and the market opportunities and to access to contracts in a more profitable conditions.

The users will need to have installed at their user premises two kinds of systems:

1. ICT connectivity system (any broadband connectivity packet)
2. Energy monitoring system able to connect the Broadband access system from above.

The user at the same time will have to have an account on the emarket4E system residing at the Internet and normally facilitated by a provider (see 2.1). His energy system will have to be registered at the eMarket4E in such a way that the information could be gathered by the functions of the latter. Access will be provided for multiple device characteristics (Phones, tablets, laptops, etc…).
The grid user (see 2.1) will also be connected to the emarket4E system via an API most probably using web based technologies (Web Services for example), in such a way that tariff information could be handled Moreover most probably also simulation results will have to be provided in order for their customers to receive monthly budget calculations.

[4] http://www.sparxsystems.com/

Finally after the brokering facilities explained above, functions will be accessible to make/modify contracts for the customers.
The following scenarios will be described in more detail in Chapter5.

- Detailed Consumption Information
- Transparency in the green market
- Energy contract brokering
- Information about energy generation sources: Being Green
- Colored Ethical Bid

4.2.2 Demand Side Management

Demand side management scenarios in the emarket4E framework are relevant because of the fact that electronic market tools for energy will always intervene in the process of Demand Side Management. This is the case because contracts will have to be established between the customers and the grid users in order to allow demand side management and the flow of control and pricing signals between the actors.
Therefore the role that the emarket4E plays in demand side management is relevant.
The scenarios covered in this Business Case will deal only with the services that have to be put in place in the market to allow the grid users to act on the energy use of the customers in order, for example, to reduce the energy consumption and therefore implement peak shaving in order to avoid problems in the electricity distribution and provision framework.
Below a diagram borrowed from WP2 that represent clearly the central role of the market in DSM operations.

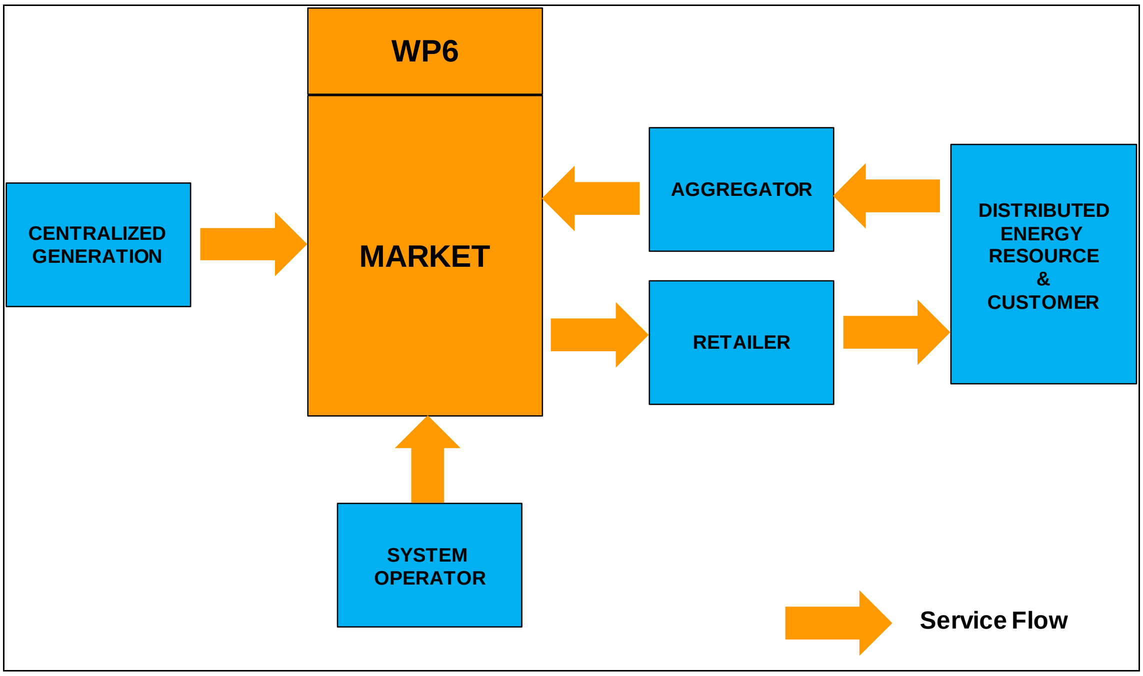

Figure 7: the central role of the emarket4E in DSM services

It is important to mention that the actors considered in Figure 7 are a particular case of the groups represented already in Figure 2.

4.2.3 Energy Trading

Energy trading is the heart of the eMarket4E, as it brings together the different actors (grid users, grid operators, providers and customers, see Figure 2). Energy trading is implemented in the actual market places where energy-related products are traded and prices are negotiated. This can be done in different scenarios as described in Chapter 5. These flexible prices for energy can be an incentive to consume energy when it is cheap (low overall energy demand or a surplus, e.g., due to availability of renewables energies), to produce energy or avoid consumption when it is more expensive (high overall demand or low production, e.g., due to poor weather conditions for renewables energies) or generally reschedule energy presumption according to market transactions.

Different mechanisms may be used to find prices for different energy-related products, incorporating different sets of actors in smaller or larger regions:

- *Mechanisms:* All different kinds of mechanisms for finding prices as known from economics may be used in energy trading, e.g., different kinds of auctions.
- *Products:* Energy trading can be used to trade different products such as long-term energy contracts, short-term energy supply, flexible consumption capacities etc.
- *Actors:* Depending on the scenario, different actors might take part at energy trading. To give some examples, large energy producers can sell their energy, prosumers might offer energy from combined heat and power units, neighbors might buy energy jointly and local demand-side-management brokers might offer to adjust the consumption of its consumers.
- *Regions:* Energy trading might involve smaller or larger regions. Energy trading in local neighborhoods bears the potential that energy does not need to be transferred over long distances (energy loss and high transmission costs) when neighbor consumers trade their demand for energy in a local market. Energy trading incorporating larger regions in turn allows for more global optimizations, e.g., to produce less energy in all parts of a country when wind energy production in certain parts of the country very high.

The exact parameters for energy trading are described in the different scenarios in Chapter 5.

To conclude, energy trading is fundamental for many use cases in the eMarket4E. These use cases range from users who actively control their energy consumption/production based on the current price to users who find different contracts for energy supply to all kinds of automated demand-side-management mechanisms.

4.3 Actor Descriptions

Below a table is appended with the descriptions that will be employed in the next chapter.

Actor Name	Actor Type (Person, device , system,…)	Actor Description
Smart Meter	Device	Grid device or add-on device (provided by the grid operator, grid user or the customer himself) that measures in detail the consumption of customer premises
Customer*	Person	The main actor accessing to the consumption information, residing in a single apartment or single house or building in which energy is consumed.
Grid Operator*	Corporation	It is an actor that generates/ distributes the electricity to the grid users and generates detailed information of the electricity transactions and operations.
DSO (Note: Is a Grid Operator)	Organization	The DSO (Distribution System operator) responsible for the neighborhood.
Microgrid Operator Note: Is a Grid Operator)	System	A system that is able to foresee demand/production for an e-Island at different granularity of time.
Grid User*	Corporation	It is an actor that sells electricity to the customer and other various energy related services

Provider*	Corporation	It is an actor providing various services based on for example the energy monitoring and optimization at the customer premises
Facility Manager	Person	Person responsible for the maintenance and operation of the facility. At the smallest level of granularity, in the Residential market, this is the home owner, landlord, or building superintendent.
Energy Retailer	Corporation	A company that delivers/sells electricity to Facility Manager and/or to a customer.
Financial Manager	Person	Person of the energy retailer company that is responsible for cost accounting and developing financial strategies for an private or industrial or commercial business.
Building Management System (BMS)	Device	A system used to monitor and control the energy consuming devices in apartments, buildings and malls
User Software Agent System (USAS)	System	Autonomous SW entity which observes and stores the final user energy buying habits. Then it acts upon request and directs its activity towards achieving best goals.
Marketplace Operator	Organization	The marketplace for contract brokering needs to be operated as a system. Depending on the underlying business model, this could be a for-profit or a non-profit, or a profit-sharing organization.
Marketplace	System	The marketplace system, which supports the Trading/brokering within the energy market.
Balance Responsible Party	Corporation	The market participant who is responsible for balancing supply and demand. The cost for balancing will be further imposed on the responsible market participants.
Transmission Operator	Corporation	It is the actor that run the transmission grid and provides information of the electricity transactions.
Forecasting Service	System	This is a service which can foresee the demand/production for a defined space in different granularity of time.
Operations Manager	Person	Person that monitors in real time the “available energy production capacity”

Weather Forecast Service	Organization	A company that generates global and local weather forecasts using its proprietary forecast models and techniques.
MDMS	System	Meter data management system functions. This is one major component used for aggregation and disaggregation tasks.
Enterprise service bus	System	The system responsible for the data exchange between different components
NMS (Network Management System)	System	Network management system, used for monitoring, supervisory control and operation of electrical network.
DSM (Demand Side manager)	Corporation	DSM collects meter readings for the network based application and sends control signals to customers (load management).
Electric Vehicle	Device	EVs are the major source for consuming or providing energy
Intelligent devices	Device	Devices that can adapt their consumption according to the signal received by the control box
Prosumer	Person	The typical producer or consumer of energy. He interacts by himself with the marketplace.
Prosumer Community	Person	A group of Prosumers located in the same neighborhood, i.e., a geographically localized community within a larger city.
Commercial Prosumer	Organization	An industrial/commercial/public infrastructure responsible entity, e.g. a chemical factory, public lighting system, shopping mall.

Table 3: Actor descriptions for the scenarios of the emarket4E

: These actors may have various roles as depicted in Figure2, and therefore their actual names in the market could be different (e.g. an Energy Retailer is in fact a Grid User). So the Names marked with a "" can be considered as parent names. This issue can be found in several of the use cases below.

5. Business Case Descriptions

5.1 Information and final user contracts about energy use

5.1.1 Detailed Consumption Information

5.1.1.1 Scenario ID: WP6_IFUCEU_SC1

5.1.1.2 Brief Description

This scenario deals with the use cases to be considered in FINSENY in the field of eMarket4E services that deal with information closely linked to the energy consumption at the user premises and with tariff schemes. Such services give the users the opportunity to get detailed information of the consumption related to the most consuming devices in their homes. At the same time, the user will be able to get information from the utilities on the tariffs and get energy consumption costs in a granular way.

5.1.1.3 Narrative

The user has an Internet interface that allows him to display detailed energy information (consumption and own generation if applicable). This might be tied to specific home islands or even appliances (for those equipped with advanced ICT capabilities). From the interface the user will be able to extract the information in various forms and “shapes” depending on cost and time (e.g. daily consumption, monthly consumption, equivalent CO2 emissions, cost savings possible).
The user will connect via multiple devices, featuring a web browser for example, to the user interface of the BMS (it could reside in an energy Gateway for example or even in an Internet portal/repository) that will present an intuitive interface showing hierarchically all different energy measurements that he is able to access to (it will depend on the complexity of the BMS installed). He will be able to monitor the Home overall consumption, on a per Island basis or even on a per device basis.
The BMS will have also the possibility of reducing the energy consumption at the user premises. The user will set the reduction policies or parameters (e.g. the system has to schedule the appliances functioning preferably during the low tariff periods; day times for energy optimization; vacation period configuration; how the system has to employ the energy generated by solar panels for own energy provision or for external grid use; etc.)

5.1.1.4 Actor (Stakeholder) Roles

Scenario		**Description**
WP6_IFUCEU_SC1		
Actor Name	**Actor Type (Person, device , system,…)**	**Actor Description**
Smart Meter	Device	Grid device or add-on device (provided by the grid operator, grid user or the customer himself) that measures in detail the consumption of customer premises.
Building Management System (BMS)	Device	A system used to monitor and control the energy consuming devices in apartments, buildings and malls
Customer	Person	The main actor accessing to the consumption information, residing in a single apartment or single house or building in which energy is consumed.
Grid Operator	Corporation	It is an actor that generates/ distributes the electricity to the grid users and generates detailed information of the electricity transactions and operations.
Grid User	Corporation	It is the actor that sells electricity to the customer and other various energy related services
Provider	Corporation	It is an actor providing various services based on for example the energy monitoring and optimization at the customer premises

Table 4: WP6_IFUCEU_SC1 Actors Description

5.1.1.4.1 Scenario Actors Overview

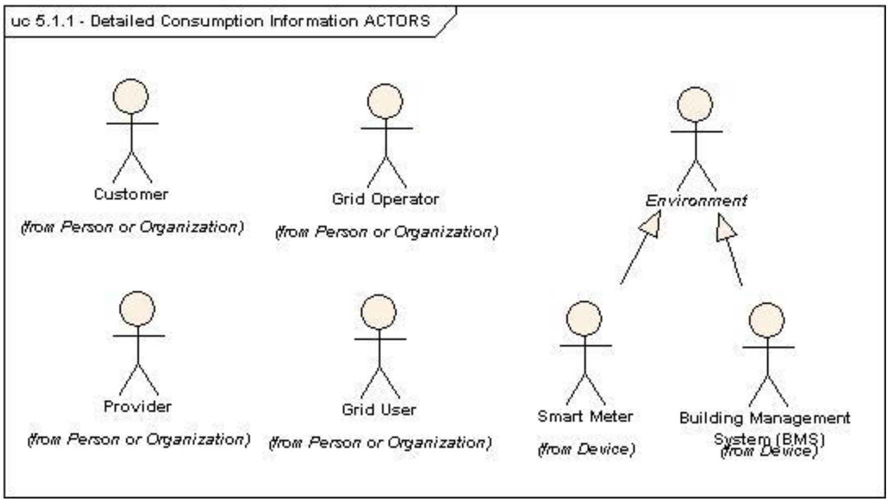

Figure 8: WP6_IFUCEU_SC1 Actors Overview

5.1.1.5 Information Exchanged

Information Object Name	Information Object Description
Overall consumption	The customer is able to get detailed information on the consumption in its dwelling (total power consumption).
Hierarchical information	The customer is able to analyze independently different elements (rooms, floors, types of devices (white appliances, brown appliances, HIFI-Video, …) in order to reveal the critical points in terms of energy consumption in its premises.
Pricing information	The customer is able to get statistical information on the cost of energy in the same hierarchical manner as described above (e.g. Euro per WH per device, per daily/monthly/Yearly periods.
Tariffs simulations per commercial offering	Matching its energy usage, simulations can be performed taking as inputs the different tariffs offered by well identified grid users (e.g. retailers).

Table 5: WP6_IFUCEU_SC1 Information Exchange

5.1.1.6 Services

Service Name	Services provided
Smart metering	Already established service available beforehand.
Energy efficiency ICT service	The possibility to access energy information and control the functioning of the installed system.
Energy monitoring and information access service	Via a user-friendly web interface, the customer is able to monitor its home energy use. The service is likely a supplementary service provided by the Grid User (retailer for example) on a subscription basis, or free-of-charge in order to gain market share and to entail a green footprint.

Table 6: WP6_IFUCEU_SC1 Services Description

5.1.1.7 Contracts/Regulations

Contracts/Regulation	Impact on Functions
Tariff Schemes	Contract brokering and contract settlements
Smart metering	Energy monitoring and information provision

Table 7: WP6_IFUCEU_SC1 Contracts and Regulation

5.1.1.8 Scenario Overview

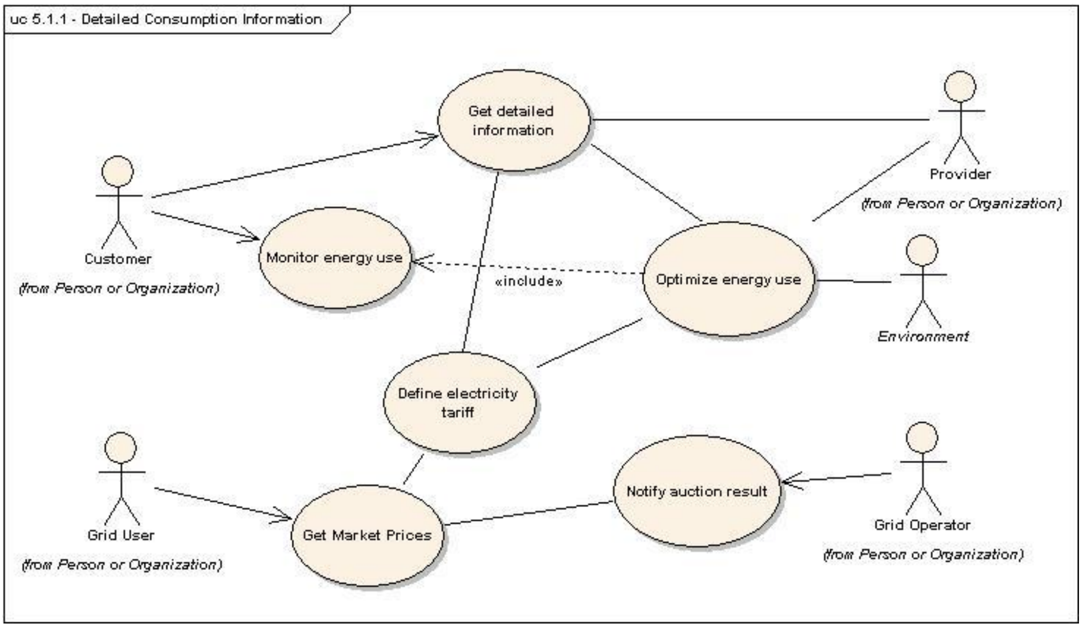

Figure 9: WP6_IFUCEU_SC1 Scenario UML Diagram

5.1.1.9 Use Cases Analysis

5.1.1.9.1 Get Detailed Information - WP6_ IFUCEU _SC1_UC1

This use case details the usage of a service provided by a service provider. This allows the customer to access, e.g., a Smart Meter, to retrieve energy consumption information via the Internet. It is not clear at the moment what kind of company would deliver the service. This will depend on the maturity of the market and of the commercial relationships that could be established between the grid users and the service providers.

As an example, we can think of a service provided by a Telco or IT company that has a contract with an energy retailer. In some cases, the service could be provided by the retailer alone depending on its experience in the field of IT and Internet. The service will be of the same kind of the one established by Google Power Meter [5].

5.1.1.9.2 Notify Auction Results- WP6_IFUCEU_SC1_UC2

This is a service that will be provided by the grid user. This service has an online interface that will provide the results of the daily electricity auctions online. This allows the energy market players to get the information on a day to day or hourly basis.

5.1.1.9.3 Monitor Energy Use- WP6_IFUCEU_SC1_UC3

This is a use case of the BMS that will be running in the customer premises. The system implementation varies from provider to provider but needs to be running in a Home Area Network (HAN) using installed monitoring devices/sensors at home.

In some cases, "intelligent" white appliances are part of the system that are able to communicate with a central service and be programmed according to user profile parameters. The main objective of this use case will be to get the electricity consumption data from the home. Depending of the complexity of the system, the information could be decomposed in time and per appliance to get a more detailed view of the consumption profile. An example would be the service offered by Yellow Strom[6] in Germany.

This use case is more part of WP4 of FINSENY, since it deals with functionalities meant for buildings.

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[5] http://www.google.com/powermeter/about/about.html

[6] http://www.yellostrom.de/

5.1.1.9.4 Optimize Energy Use- WP6_IFUCEU_SC1_UC4

This use case is very similar to the one above, but will go a step further by including functionalities of energy efficiency. The setting and installation will be very similar, but it could include auto-generation capabilities such as the ones offered by solar panels to generate hot water and photovoltaic panels to produce electricity.

The final aim is to optimize the consumption of the building according to policies established mainly by the customer, e.g., on market price and the available local production. Depending on the services contracted by the customer, the system may also consider the possibility of allowing Demand Side Management signals.

5.1.1.9.5 Define Electricity Tariff – WP6_IFUCEU_SC1_UC5

This is a service offered by the grid user that has contracts with the customers. The main objective is that this service publishes tariffs on the Internet that it has calculated using the reference values of the electricity market and company related policies. The objective would be for information purposes alone but they may be used also by the customers who set the policies for optimizing energy use.

5.1.1.9.6 Get Market Prices – WP6_IFUCEU_SC1_UC6

This is a service also run by the grid user that depending on the market results will have to define the price of the electricity in time. This service will have also to run over the Internet allowing all stakeholders to access the information when needed.

5.1.2 Transparency in the Green Market

5.1.2.1 Scenario ID: WP6_IFUCEU_SC2

5.1.2.2 Brief Description

The customer, with a smart phone or a PC accesses the WEB portal of an energy retailer and from there he can plan technically and economically how he would like to contract the energy provisioning service. In this scenario, he would like to measure, in real time, energy costs and monitor the consumption to be able to personalize his contract depending on the costs and program accordingly his BMS to comply to the latter.

5.1.2.3 Narrative

A metering device is included in the BMS (Building Management System) within the customer premises and it will be used to measure the energy consumption (the latter device can be used also by the retailer to meter the consumption for billing purposes); sub-metering equipment could be installed also in order to get a more detailed view of the consumption of devices and/or home areas.

Through a set of BMS systems, the **Energy Retailer** determines the energy consumption and its **Financial Manager** manages the relative economic offers. The energy pricing is composed of customer-specific real-time pricing (RTP) policies and demand-interval data (demand rules, tariffs, previous high demand, etc.).

The cost of energy over a specified time interval is needed by the **Customer** or the **Facility Manager** for validating the energy bill and to determine hierarchically the costs of energy per premise areas/facilities and specific customers.

It is also possible to make use of sub-meters in order to obtain information on the current instantaneous energy usage of specific sub-loads. This information is detected by the BMS from the meters and is made available to the following recipients:

- The Customers so that they can manage their own energy usage patterns.
- The Financial Manager for calculating current energy costs by the metered loads.

The cost of the energy over a period of time is allocated to a particular customer by the Financial Manager. This allocation can be a bill (e.g. tenant billing), a cost accounting entry (e.g. budget allocation), or an informational report (e.g. monthly energy consumption report).

5.1.2.4 Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case.

Actor name	Actor type	Actor description
Facility Manager	Person	Person responsible for the maintenance and operation of the facility. At the smallest level of granularity, in the Residential market, this is the home owner, landlord, or building superintendent.
Customer	Person	The main actor accessing to the consumption information, residing in a single apartment or single house or building in which energy is consumed.
Energy Retailer	Corporation	A company that delivers/sells electricity to Facility Manager and/or to a customer.
Financial Manager	Person	Person of the energy retailer company that is responsible for cost accounting and developing financial strategies for an private or industrial or commercial business.
Building Management System (BMS)	Device	A system used to monitor and control the energy consuming devices in apartments, buildings and malls.

Table 8: WP6_IFUCEU_SC2 Actors Description

5.1.2.4.1 Scenario Actors Overview

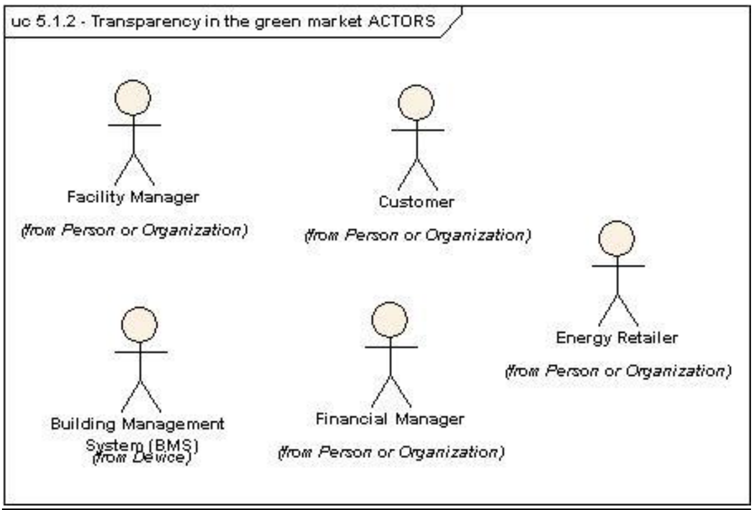

Figure 10: WP6_IFUCEU_SC2 Actors Overview

5.1.2.5 Information Exchanged

The following information are transferred between the actors.

ACTOR	INPUT INFORMATION	OUTPUT INFORMATION

Facility Manager	Pricing Information	From which energy retailer and how much energy will be purchased (contract details, energy thresholds, etc.)
Customer	Pricing Information	From which energy retailer and how much energy will be purchased
Energy Retailer	Real time energy consumption information gathered from the final users.	Quantity and prices of the available energy bid.
Financial Manager	Real time available energy Pricing Information from the competitors.	Its best possible offer (euro/KWh) to the Facility Manager or to the Final User
Building Management System (BMS)	Power consumption in devices at home, building, mall etc.	Profile of power consumption in devices at home, building, mall etc.

Table 9: WP6_IFUCEU_SC2 Information Exchange

5.1.2.6 Services

Here follows a list of activities and services involved in this scenario:

- **Facility Manager**: determines from which energy retailer and how much energy will be purchasing (contract).
- **Customer**: determines from which energy retailer and how much energy will be purchasing (contract).
- **Energy Retailer**: provides and sells the energy in the way that is determined by the contract and will publish all the necessary market information: monitoring in real time the quantity of consumed energy, making suggestions for better energy use policies, publishing news and advertisements via a website for a sustainable energy use and reducing CO2 emissions.
- **Financial Manager**: plans for the best possible offer (euro/KWh) to the Facility Manager/Final Customer. Moreover he develops financial strategies for private, and for industrial or commercial businesses.
- **Building Management System (BMS)**: monitors and controls the energy consumption at customer premises. The BMS stores information about the energy consumption and is capable of generating statistical reports in various forms that could be programmed by the user.

5.1.2.7 Contracts/Regulations

The two simplest and most common contract types are: a fixed tariff contract for physical delivery or contracts for differences where the parties agree a strike price for defined time periods. In the case of a contract for difference, if a resulting wholesale price index (as referenced in the contract) in any time period is higher than the "strike" price, the generator will refund the difference between the "strike" price and the actual price for that period. Similarly a retailer will refund the difference to the generator when the actual price is less than the "strike price". The actual price index is sometimes referred to as the "spot" or "pool" price, depending on the market[7].

Energy retailers, who in aggregate buy from the wholesale market, and generators who in aggregate sell to the wholesale market, are exposed to these price and volume effects and to protect themselves from volatility, they will enter into "hedge contracts" with each other. The structure of these contracts varies by regional market due to different conventions and market structures.

5.1.2.8 Scenario Overview

[7] An observation from a trial performed by one of the Swedish retailers in 2008 was that this kind of contractual arrangement is too complex and hard to understand for the final user. However, with higher future energy prices and increased engagement from the consumers this barrier may go away.

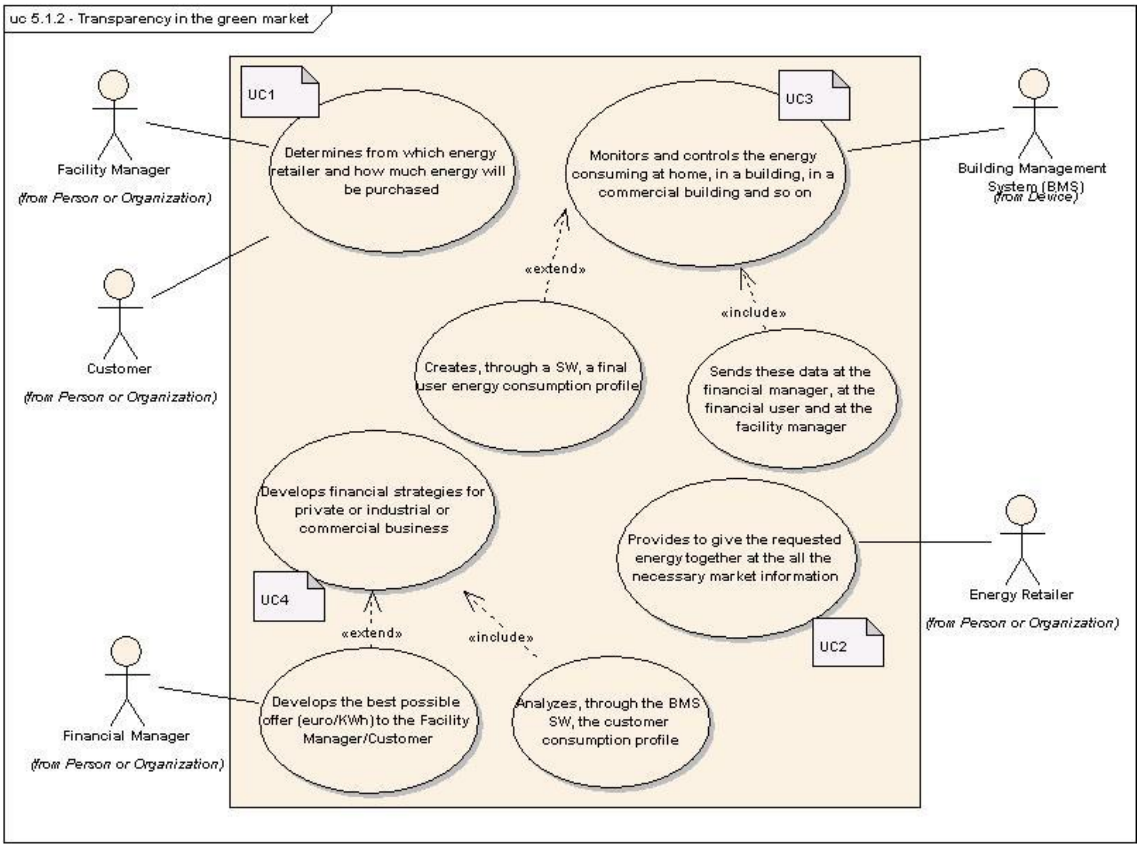

Figure 11: WP6_IFUCEU_SC2 Scenario UML Diagram

5.1.2.9 Use Cases Analysis

5.1.2.9.1 Determines from which Energy Retailer and how much Energy will be Purchased - WP6_ TS _SC2_UC1

The facility manager and the customer, after consulting the offers on the WEB portal, choose from which energy retailer and how much energy will be purchased.

5.1.2.9.2 Provides to Give the Requested Energy Together at all the Necessary Market Information - WP6_ TS _SC2_UC2

The energy retailer provides/sells the requested energy together with all the necessary market information, monitoring in real time the kind and quantity of contracted energy, making suggestions, publishing news and advertisements via a website for a sustainable consumption[8].

5.1.2.9.3 Monitors and Controls the Energy Consuming at Home, in a Building, in a Commercial Building and so on - WP6_ TS _SC2_UC3

This HW/SW system (in the BMS) monitors and controls the energy consumption at home, in a building, in a commercial building, etc,. and at the same time creates an final user profile in order to forecast its energy needs. Then, all these data are sent to the energy retailer, to the customer and to the facility manager.

5.1.2.9.4 Develops the Best Possible Offer (euro/KWh) to the Facility Manager/Final Customer - WP6_ TS _SC2_UC4

The financial manager gets the information coming from the BMS and makes the best possible offer (euro/KWh) to the Facility Manager and/or to the Customer. Moreover he develops financial strategies for private, and for industrial or commercial business.

[8] In some markets the grid operator owns the smart meters and are responsible for metering energy use. This however does not limit future possibilities for retailers to subscribe to this information to sustain this use case.

5.1.3 Colored Ethical Bid

5.1.3.1 Scenario ID: WP6_IFUCEU_SC3

5.1.3.2 Brief Description

In a future smart grids scenario, the final user needs to be aware of the kind of energy that he consumes. In fact, his choices about the consumed kind of energy, contributes to the ecological sustainably in our homes and cities. For that, the final user must know “what kind of energy he is consuming” and “how and where” will be disposed of as waste the elements used to produce this energy. To do so, the Energy Information Provider (EIP) provides information to the final user about the mix of the available energy sources: each kind of energy is represented (on the PC or the smart phone) with a different color (e.g.: red=nuclear, green=renewables, and so on all variations between red and green[9]).

5.1.3.3 Narrative

The **Final User**, through an internet personalized web page connected to the energy retailer database reads the available kind of energy sources, their prices and quantities.

Then the final user selects the type of energy to use and predict the month expenditure through a projection of data from previous months. It could also happen that the customer is willing to spend more to use a cleaner energy.

The **Energy Retailer** buy different kind of energy from different **Energy Producers** and then provides to give the requested energy together at all the necessary market information: monitoring in real time the kind and quantity of hired energy, suggestions, news and advertisement via website for a sustainable consume.

For example, the energy retailer provides information about the mix of energy sources (e.g. 20% hydroelectric, 15% nuclear, 45% wind, 20% thermal) used to generate energy over each period of time (e.g. hourly). This information varies over time (e.g. in the night less solar) and it is synthetically represented to end users via a color (e.g: red= >20% nuclear, green = >50% renewables, and all variations between red and green) and presented on the smart-phone (or notebook).

So the final user knows, in real time, not only “costs” but also “kinds” of available energy. He can use this color to drive his/her decisions about when energy should be consumed more (e.g. when it is more green) or also about which energy retailer is best (something like choice towards ethical banks). This choice can be manually activated or, in alternative, can be automatically performed by a **User Software Agent System (USAS)** that works behind the energy retailer WEB portal[10].

The User Software Agent System performs simulations on the final user expenditure as a function of selected kind of energy source, and it can creates an user profile by “ethical choice” and execute forecast for similar future needs. Obviously the end user can leave the USAS to operate in automatic mode but he also can manually intervene to make their own choices.

5.1.3.4 Actor (Stakeholder) Roles

The following actors (stakeholders) are interacting in this use case.

Actor name	Actor type	Actor description
Customer	Person	The main actor accessing to the consumption information, residing in a single apartment or single house or building in which energy is consumed.

[9] In some markets, the choice of production source is already contractually available. E.g. E.ON private consumers today are supplied with hydroelectric power only.

[10] In order to reduce ping-pong effects on the market, and to reduce churn it is likely retailers will strive to limit the possibility for consumers to make contractual changes too often, e.g. only on monthly basis. This is similar to such limitations already in place in the telecoms market.

User Software Agent System (USAS)	System	Autonomous SW entity which observes and stores the final user energy buying habits. Then it acts upon request and directs its activity towards achieving best goals.
Energy Retailer	Corporation	A company that delivers/sells electricity to Facility Manager and/or to a customer.
Grid Operator	Corporation	It is an actor that generates/ distributes the electricity to the grid users and generates detailed information of the electricity transactions and operations.

Table 10: WP6_IFUCEU_SC3 Actors Description

5.1.3.4.1 Scenario Actors Overview

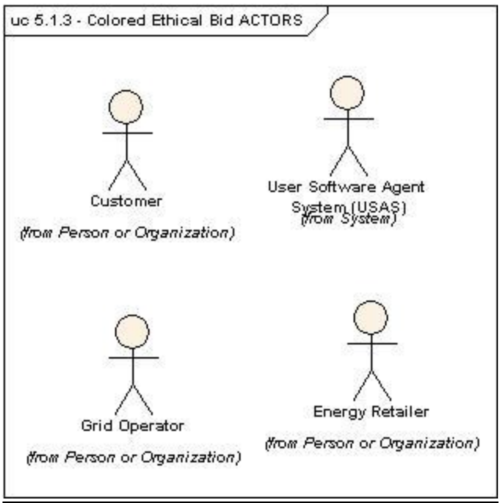

Figure 12: WP6_IFUCEU_SC3 Actors Overview

5.1.3.5 Information exchanged

The following information between actors are exchanged:

ACTOR	INPUT INFORMATION	OUTPUT INFORMATION
Customer	Available kind of energy sources, their prices and quantities.	Kinds and quantities of energy and their relative requested percentage.
User Software Agent System (USAS)	Final user energy buying habits	Best purchase as a function of selected kind of energy source. Automatic purchase order (if allowed by the final user)
Energy Retailer	Kinds and quantities of energy and their relative requested percentage.	Available kind of energy sources, their prices and quantities.
Grid Operator	Quantity of demand energy	Quantity of available energy

Table 11: WP6_IFUCEU_SC3 Information Exchange

5.1.3.6 Services

Here following are listed and described the activities the and services involved in this scenario:
Customer: after having set its own budget, he determines kinds and quantities of energy and their relative requested percentage.

User Software Agent System (USAS): it works behind the energy retailer WEB portal and observes and stores the final user energy buying habits creating his profile. Then it acts upon request and directs its activity towards achieving best offer. The USAS can also be a service provided by a third party to the energy retailer.

Energy Retailer: provides to give the requested energy together at all the necessary market information: monitoring in real time the kind and quantity of hired energy, suggestions, news and advertisement via website for a sustainable consume. If the number of final users increases exponentially, the energy retailer can switch from the manual customer interface at the automatic customer interface using the USAS.

Grid Operator: Generates different kinds of energy and then offers it to the Energy Retailers at the market prices.

5.1.3.7 Contracts/Regulations

The attitude of utilities towards new technologies and applications such as demand response varies widely by geography. In some states, such as Massachusetts, New York and California, utilities can run energy efficiency programmes with returns similar to investment in fixed assets, while in others the economics do not make sense.

For the new energy smart technologies and applications to scale, the utilities must be able to make viable returns on their investments. Utilities operate in a constrained regulatory environment, and “will not go the extra mile” for a new technology unless there is a return to be made so the proactive engagement of utilities is entirely dependent on their specific regulatory environment.

One thought leader made the interesting observation that, given an appropriate regulatory environment, utilities are starting to favour resources that are quick to deploy and nimble, such as demand response. There seems to be no question that utilities are open to exploring new technologies as an alternative to more investment in bulk generation and transmission as long as the economics make sense.

Energy retailers, who in aggregate buy from the wholesale market, and generators who in aggregate sell to the wholesale market, are exposed to these price and volume effects and to protect themselves from volatility, they will enter into "hedge contracts" with each other. The structure of these contracts varies by regional market due to different conventions and market structures.
However, the two simplest and most common forms are simple fixed price forward contracts for physical delivery and contracts for differences where the parties agree a strike price for defined time periods. In the case of a contract for difference, if a resulting wholesale price index (as referenced in the contract) in any time period is higher than the "strike" price, the generator will refund the difference between the "strike" price and the actual price for that period. Similarly a retailer will refund the difference to the generator when the actual price is less than the "strike price".

5.1.3.8 Scenario Overview

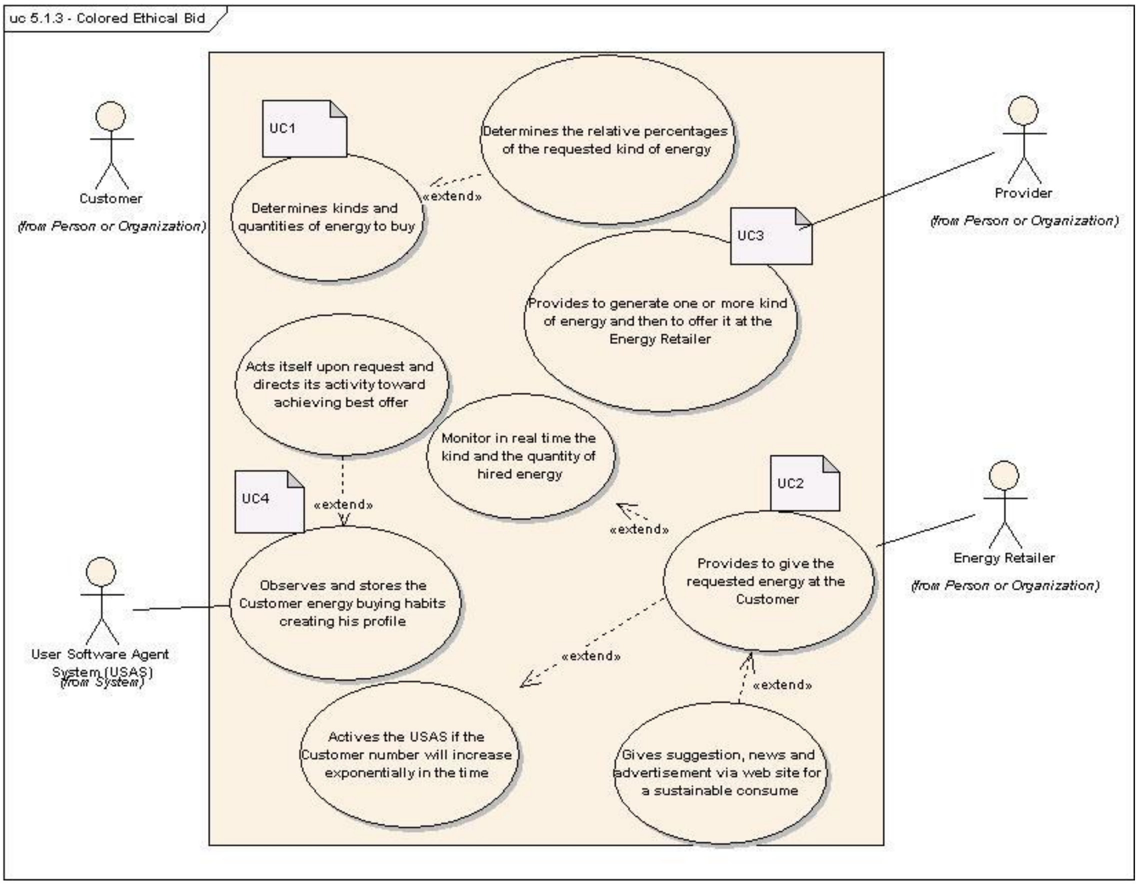

Figure 13: WP6_IFUCEU_SC3 Scenario UML Diagram

5.1.3.9 Use Cases Analysis

5.1.3.9.1 Determines Kinds and Quantities of Energy to Buy - WP6_ TS _SC2_UC1

The Customer, after having set its own budget, on the basis of the energy retailer information, he determines kinds and quantities of energy and their relative requested percentages.

5.1.3.9.2 Provides to Give the Requested Energy at the Customer - WP6_ TS _SC2_UC2

The energy retailer provides to give the requested energy together at all the necessary market information: monitoring in real time the kind and quantity of hired energy, suggestions, news and advertisement via website for a sustainable consume. If the number of customers will increases exponentially, the energy retailer can switch from the manual customer interface at the automatic customer interface using the USAS.

5.1.3.9.3 Provides to Generates One or More Kind of Energy and then to Offer it at the Energy Retailers - WP6_ TS _SC2_UC3

The Grid Operator provides to generates one or more kind of energy and then to offer it at the Energy Retailers.

5.1.3.9.4 Observes and Stores the Customer Energy Buying Habits Creating his Profile - WP6_ TS _SC2_UC4

The user software agent system (USAS) works behind the energy retailer WEB portal and observes and stores the customer energy buying habits creating his profile. Then it acts upon request and directs its activity towards achieving best offer.

5.1.4 Energy Contract Brokering

5.1.4.1 Scenario ID: WP6_IFUCEU_SC4

5.1.4.2 Brief Description

There is a trend towards the increasing decentralization of energy generation, which manifests itself in the growing number of photovoltaic units, small windmills, combined heat and power plants and other technologies. Today, the operation of such units is often subsidized, but in the long term, such units must be operated in a profit-oriented manner. As supply and demand for electricity must be balanced at all times, it is important that there are mechanisms in place that adapt electricity generation to demand and vice versa (this is achieved through demand side management mechanisms, for example). However, the foundation for direct marketing of electrical energy is a contractual relationship between the supplier and the Customer.

5.1.4.3 Narrative

The Energy Retailer is doing business in providing customers with (electrical) energy, generating a profit from selling the energy at a higher price than the he is spending on generating the energy or purchasing it on a wholesale marketplace (e.g. energy exchange). He can be a customer himself, for example an industrial facility that has own generation capacities. In that case, he is interested in selling generated energy, which himself does not consume, to other Customers. It may also be the case that generation units need to be operated efficiently, whereby excess energy is generated and must be passed on to other Costumers.

A Customer is interested in a reliable and affordable source of energy. Usually, a Customer engages in a contract with a single provider, who is covering the complete demand of the Customer. In a more advanced market environment, it could be possible to engage in a number of contracts, where each contract contributes partially to covering the demand.

A contract is usually drawn to cover a certain amount of energy with regard to a certain time frame. For example, a contract might cover 50 kWh per month. This implies that the Energy Retailer is obliged to deliver 50 kWh within a month, and the Customer is obliged to consume the same amount. This means that no real-time balancing of supply and consumption takes place. Rather, balancing occurs only at the end of a month, where the difference is accounted for.

With a growing number of distributed generation units, the potential number of suppliers of energy is also growing. As the number of offerings rises, Customers are getting more interested in that option to cover their demand. This is leading to a complexity of market interactions that is being addressed by the Marketplace.

A Grid Operator is creating contract types, which fit his needs and capabilities, and which are promising to be interesting to Customers. The Energy Retailer is putting one or more contract types on the Marketplace. Whenever a contract is closed with a Customer, the Energy retailer updates his offerings on Marketplace. An Energy Retailer may use the Marketplace for managing his contracts, e.g. getting reminders when contracts are running out.

A Customer is evaluating his energy consumption, taking into account its variability and its fluctuation over time. The Customer is using the Marketplace to search for appropriate contract offerings, which are suitable for covering his demand. He may select one or more contracts and start a negotiation with the offering Energy Retailer. After a negotiation phase, the Customer may refuse a contract or decide to engage in it. The Marketplace can support the Customer in managing his contract(s), for example issue warnings when they run out, or when demand is not fully covered by contracts, or if the contracts are overprovisioned.

The Marketplace acts as a brokering platform with the main goal of supporting Energy Retailers, providers and Customer to create and find appropriate offerings. The Marketplace supports the Energy Retailer and Customer in managing their contracts. The Marketplace supports accounting in that actual consumption and generation data is being collected and reported. The Marketplace can communicate with external stakeholders, e.g. the Grid Operator is interested in getting forecasts of grid load, which result from generation (and consumption) schedules. Also the Balance Responsible Party is interested in data from the Marketplace as it provides information about the responsibility of imbalances between supply and demand. Cost for balancing will be imposed on the players who deviate significantly from their schedules.

5.1.4.4 Actor (Stakeholder) Roles

Actor Name	Actor Type (Person, Device, System,…)	Actor Description
Energy Retailer	Corporation	A company that delivers/sells electricity to Facility Manager and/or to a customer.
Customer	Person	The main actor accessing to the consumption information, residing in a single apartment or single house or building in which energy is consumed.
Marketplace Operator	Corporation	The marketplace for contract brokering needs to be operated as a system. Depending on the underlying business model, this could be a for-profit or a non-profit, or a profit-sharing organization.
Marketplace	System	The marketplace system, which supports the Trading/brokering within the energy market.
Grid Operator	Corporation	It is an actor that generates/ distributes the electricity to the grid users and generates detailed information of the electricity transactions and operations.
Balance Responsible Party	Corporation	The market participant who is responsible for balancing supply and demand. The cost for balancing will be further imposed on the responsible market participants.
Smart Meter	Device	Grid device or add-on device (provided by the grid operator, grid user or the customer himself) that measures in detail the consumption of customer premises

Table 12: WP6_IFUCEU_SC4 Actors description

5.1.4.4.1 Scenario Actors Overview

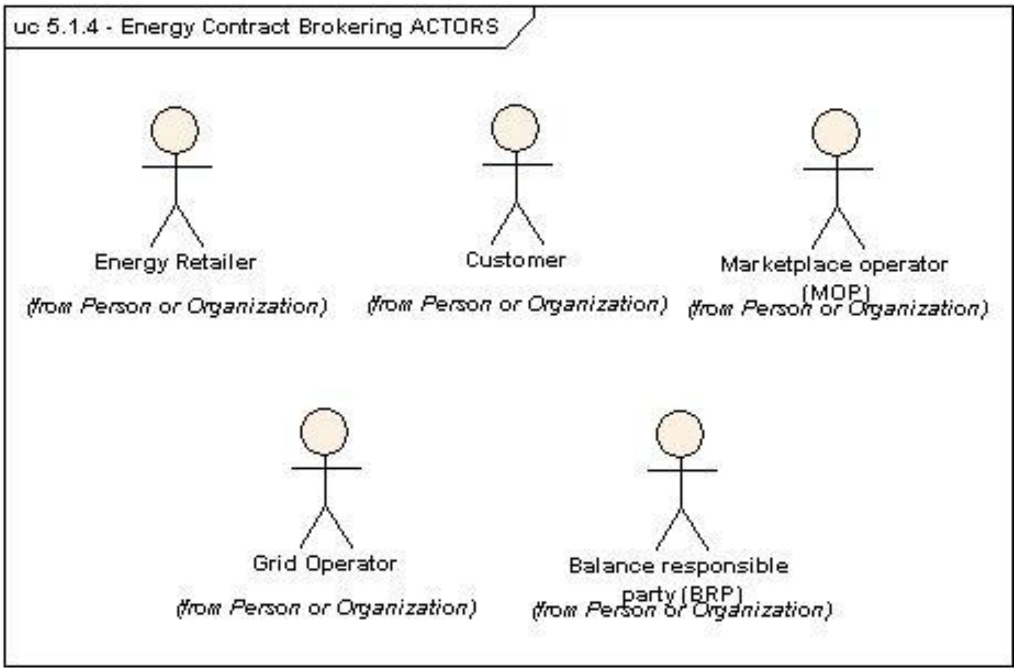

Figure 14: WP6_IFUCEU_SC4 Actors Overview

5.1.4.5 Information Exchanged

Information Object Name	Information Object Description
Reminder	Send from the Marketplace to the Customer, e.g., when contracts are running out.
Contract offering	The Energy Retailers are putting one or more contract offerings onto the Marketplace, both Energy Retailers and Customer send offerings during the negotiation phase.
Acceptance/Rejection message	The Energy Retailer sends this message to the other party at the end of the negotiation phase.
Consumption and generation data	Information on scheduled (and current) consumption and generation of energy. Send by the Energy Retailers and Customers to the Marketplace and from the Marketplace to the Grid Operator.
Balance reports	Reports generated from consumption and generation data with a focus on balanced grid load, send from the Marketplace to the Balance Responsible Party.

Table 13: WP6_IFUCEU_SC4 Information Exchange

5.1.4.6 Services

Service Name	Services provided
Offer Management	The Marketplace provides an interface to create/view/search/delete offerings for energy contracts and to generate reports.
Contract Management	The Marketplace provides an interface to view/search/cancel current energy contracts, to generate reports and to generate automated reminders.
Negotiation	The Marketplace provides an interface for negotiations of energy contracts following a standardized process. This includes the formal closing of contracts.
Aggregated Prosumption Information	The Marketplace provides various interfaces for offering information on (scheduled) consumption, generation and grid load.
Smart Metering	Already established service available beforehand.

Table 14: WP6_IFUCEU_SC4 Services

5.1.4.7 Contracts/Regulations

Contracts/Regulation	Impact on Functions
Market participation	Both Energy Retailers and Customers have contracts with the Marketplace Operator in order to participate at the Marketplace.
Market information	Both Grid Operator and Balance Responsible Party have contracts with the Marketplace Operator in order to receive consumption and generation data.
Energy contract	A contract between the Energy Retailer and the Customer, covers a certain amount of energy with regard to a certain time frame.

Table 15: WP6_IFUCEU_SC4 Contracts and Regulation

5.1.4.8 Scenario Overview

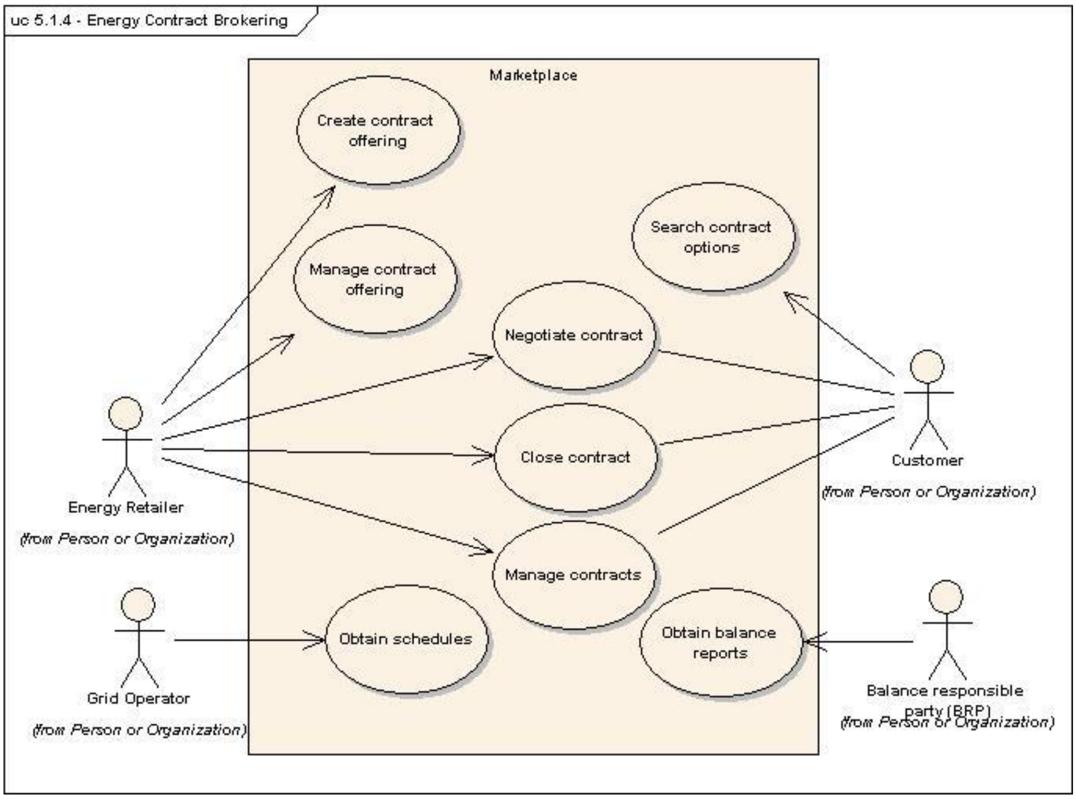

Figure 15: WP6_IFUCEU_SC4 Scenario UML Diagram

5.1.4.9 Use Case Analysis

5.1.4.9.1 Create Contract Offering – WP6_ IFUCEU _SC4_UC1

The Marketplace allows the Energy Retailers to create contract offerings via a standardized interface.

5.1.4.9.2 Manage Contract Offering – WP6_ IFUCEU _SC4_UC2

The Marketplace allows the Energy Retailers to manage contract offerings s, e.g., to view and delete them.

5.1.4.9.3 Negotiate Contract – WP6_ IFUCEU _SC4_UC3

Supported by the Marketplace, Customers can send acceptance notifications to a Energy Retailer or as well new contract offerings with changed details. Energy Retailers can then react with acceptance/rejection message or with adopted contract offerings etc.

5.1.4.9.4 Close Contract – WP6_ IFUCEU _SC4_UC4

The Marketplace supports Energy Retailers and Customers to formally close energy contracts.

5.1.4.9.5 Search Contract Options – WP6_ IFUCEU _SC4_UC5

The Marketplace allows the Customers to search for suitable contract offerings.

5.1.4.9.6 Manage Contracts – WP6_ IFUCEU _SC4_UC6

The Marketplace allows the Energy Retailers and Customers to manage their energy contracts, e.g., the Marketplace generates reminders when contracts are running out and generates reports.

5.1.4.9.7 Obtain Schedules – WP6_ IFUCEU _SC4_UC7

The Grid Operator receives consumption and generation data schedules from the Marketplace.

5.1.4.9.8 Obtain Balance Reports – WP6_ IFUCEU _SC4_UC8

The Balance Responsible Party receives balance reports from the Marketplace.

5.1.5 Information about Energy Generation Sources: Being Green

5.1.5.1 Scenario ID: WP6_IFUCEU_SC5

5.1.5.2 Brief Description

The scenario consists in getting to the customer via the internet information about the energy that is being generated a given time in relation to their own consumption so they can get statistically if the energy they consumed comes from a "green" (renewables) energy source. The service is similar to the one described in 5.1.1.1. But in this case has to take into account of the information provided by the Grid Operators mashing up the latter with the information generated in the latter scenario.

5.1.5.3 Narrative

The customer connects to the Internet and gets on a screen an interface that will allow him to display the consumption information related to the type of energy that was generated. From the screen he will be able to extract the information in various forms and shapes depending on cost and time (e.g. daily consumption, monthly consumption, equivalence in money in CO2).
He will be able to simulate what would be the consumption profile if his energy efficiency system was able to modify the consumption hourly profile to match the green intervals of the Day, Month and Year.

5.1.5.4 Actor (Stakeholder) Roles

Scenario		**Description**
WP6_IFUCEU_SC5		
Actor Name	**Actor Type (Person, device , system,…)**	**Actor Description**
Smart Meter	Device	Grid device or add-on device (provided by the grid operator, grid user or the customer himself) that measures in detail the consumption of customer premises
Building Management System (BMS)	Device	A system used to monitor and control the energy consuming devices in apartments, buildings and malls
Customer	Person	The main actor accessing to the consumption information, residing in a single apartment or single house or building in which energy is consumed.
Transmission Operator	Corporation	It is the actor that run the transmission grid and provides information of the electricity transactions.
Grid Operator	Corporation	It is an actor that generates/ distributes the electricity to the grid users and generates detailed information of the electricity transactions and operations.
Grid User	Corporation	It is an actor that sells electricity to the customer and other various energy related services

Provider	Corporation	It is an actor providing various services based on for example the energy monitoring and optimization at the customer premises

Table 16: WP6_IFUCEU_SC5 Actors Description

5.1.5.4.1 Scenario Actors Overview

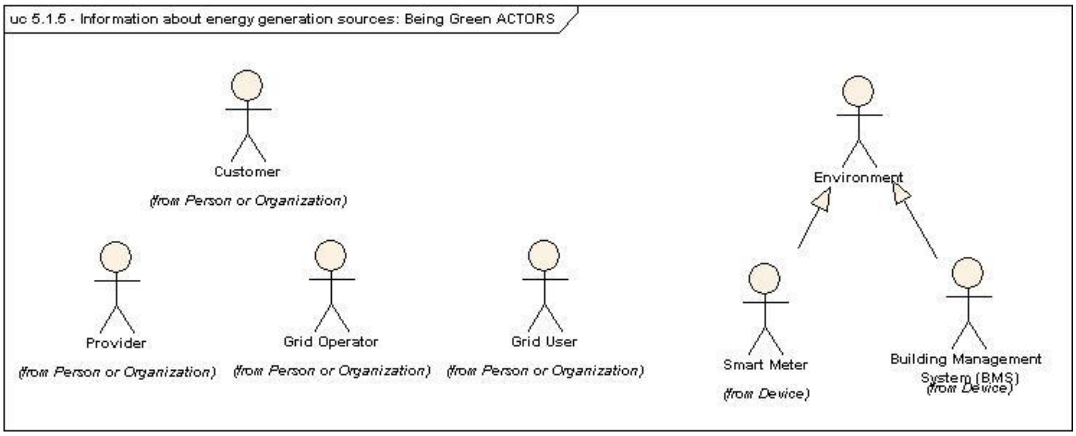

Figure 16: WP6_IFUCEU_SC5 Actors Overview

5.1.5.5 Information Exchanged

Information Object Name	Information Object Description
Overall Consumption	The Customer is able to get detailed information of its dwelling (total power, current)
Information matching between consumption and type of energy produced/consumed	The Customer is able to get the detailed information above mashed with the type of energy he consumed. The information will consist on amount of energy he consumed in correspondence to the type of energy produced at given times.
Hierarchical Information	The Customer is able to analyze independently different elements (areas, set of devices,…) in order to extract what is the critical points in terms of energy consumption in its premises. Again here the information will be presented making reference to the type of energy that was generated to cover for his consumption.
Pricing Information	The Customer is able to get statistically information of the cost of energy in the same hierarchical manner as described above. The energy cost will be also presented taking into account of the type of energy source. Pricing is different depending on the energy source (nuclear, solar, wind, combined cycle, Hydro-electric).
Tariffs simulations per energy type	Matching its energy use, simulations can be performed taking as inputs the different tariffs tied to the type of energy generated.

Table 17: WP6_IFUCEU_SC5 Information Exchange

5.1.5.6 Services

Service Name	Services provided
Smart metering	Already established service available beforehand
Energy efficiency ICT service	The possibility to access energy information and control the functioning of the installed system
Detailed tariffing schemes service	Possibility of getting the information about the cost of energy and tariffs depending on the source of energy used on a timely basis.

Table 18: WP6_IFUCEU_SC5 Services

5.1.5.7 Contracts/Regulations

Contracts/Regulation	Impact on Functions
Tariff Schemes	Contract Brokering and contract settlements
Smart metering	Energy monitoring and information provision

Table 19: WP6_IFUCEU_SC5 Contracts and Regulation

5.1.5.8 Scenario Overview

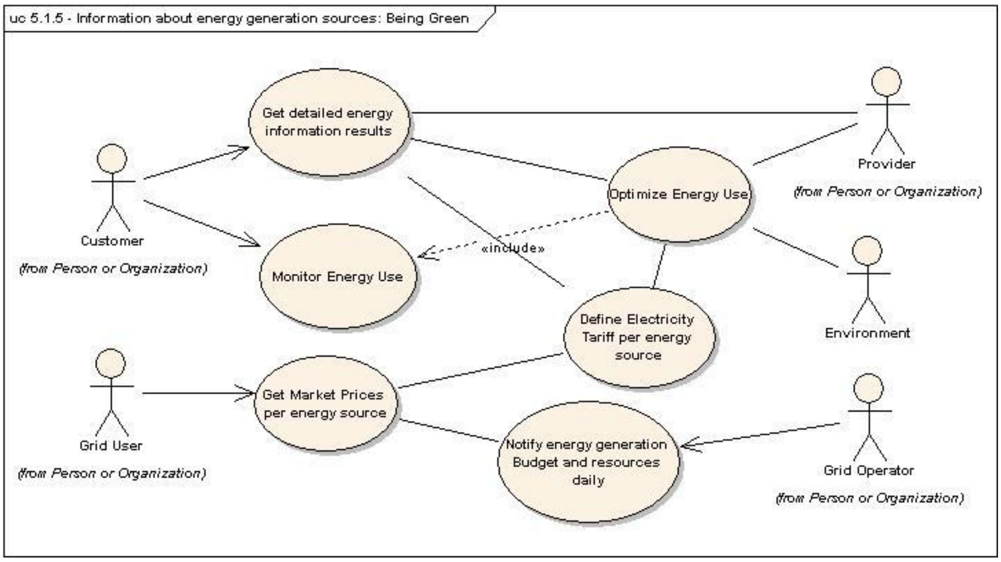

Figure 17: WP6_IFUCEU_SC5 Scenario UML Diagram

5.1.5.9 Use Cases Analysis

5.1.5.9.1 Get Detailed Energy Information Results - WP6_ IFUCEU _SC1_UC1

This use case details the use of a service provided by a service provider that will allow the Customer to access on the Internet connected with any device. It is not clear at the moment what kind of company would deliver the service. This will depend very much on the maturity of the market and of the commercial relationships that could be established between the Grid Users and the Service Providers.
As an example we can be talking of a service provided by a Telco or IT company that has a contract with an energy retailer. In some cases, the service could be provided by the retailer alone depending on its experience in the field of IT and Internet.
The service will be of the same kind of the one established by Google, Power Meter. In this case the information will be organized in a way to distinguish the type of energy used in a timely based and also cost wise. This because the cost of energy varies also depending on the source employed in the generation.

5.1.5.9.2 Notify Energy Generation Budget and Resources Daily- WP6_IFUCEU_SC5_UC2

This is a service that will be provided by a grid operator. This service has an online interface that will provide the results of the daily electricity auctions online based on the type of energy sources. In order for the energy market players to get the information on a daily basis.

5.1.5.9.3 Monitor Energy Use- WP6_IFUCEU_SC5_UC3

Note: Same as in SC1.
This is a use case of the energy monitoring system that will be running over the customer premises. The system implementation varies from provider to provider but needs to be running a Home Area Network (HAN) and monitoring devices/sensors at Home.
In some cases "intelligent" white appliances are part of the system that are able to communicate with a central service and be programmed according to user profile parameters. The main objective of this use

case will be to get the electricity consumption data from the Home. Depending of the complexity of the system the information could be decomposed.

An example would be the service offered by Yellow Strom in Germany.
This use case is more part of WP4 of Finseny, since it deals with functionalities meant for the buildings.

5.1.5.9.4 Optimize Energy Use- WP6_IFUCEU_SC5_UC4

Note: same as in SC1.

This use case is very similar to the one above but will go a step further by including functionalities of energy efficiency. The setting and installation will be very similar but it could include auto-generation capabilities such as the ones offered by solar panels to generate hot water and electricity.
The final aim is to decrease the consumption of the building according to policies established mainly by the customer. Depending on the services contracted by the customer the system may also consider the possibility of allowing Demand Side Management commands.

5.1.5.9.5 Define Electricity Tariff per Energy Source- WP6_IFUCEU_SC5_UC5

This is a service offered by the Grid User that has the contracts with the customers. The main objective would be that this service publishes in the Internet the tariffs that it has calculated using the reference values of the electricity market and company related policies. The information will be organized taking as main reference the energy sources and its related costs. The objective would be for information purposes alone but also they may be used by the customers and their optimization service to take into account the tariffs to make decisions on how and when to use the electricity by programming the connected devices accordingly. Here the user may also act upon its eco friendliness putting as first priority for example the use of eco types of energy coming from renewables.

5.1.5.9.6 Get Market Prices per Energy Source- WP6_IFUCEU_SC5_UC6

This is a service also run by the grid user that depending on the market results will have to define the price of the electricity in time. This service will have also to run over the internet allowing all stakeholders to access the information when needed. Again as above the information will have to be organized on the type of energy produced.

5.2 Demand Side Management (DSM)

Note: Scenario 5.3.3 is also about DSM, but was inserted in 5.3 because it includes many market mechanisms.

5.2.1 Flatten Demand Curve

5.2.1.1 Scenario ID: WP6_DSM_SC1

5.2.1.2 Brief Description.

The Scenario describes how an ICT application may contact the customers via a market and effectively manages DSM signals to reduce the power consumption in customer homes.

5.2.1.3 Narrative

The customer has installed an energy efficiency control system at home that monitors and controls the energy consumption of appliances by changing their programming parameters. This is only possible with an entity (normally software) that can ensure security and effective programming of the appliances to avoid any inconvenience.

The user has access to a DSM application on the Internet where he can see different DSM offerings from the grid users and can choose to contract one of these services. This aims at reducing the monthly bills. By contracting this service, the user allows the grid operator to send DSM signals to his energy efficiency system upon the need to reduce the power consumption in an area, e.g. a region or a city.

The signals are used to initiate actions in the appliances connected to the home energy management system, in order to schedule operations (e.g. e-vehicle charging, starting a washing machine) or lower/increase the temperature of the customers building by some degrees (within a certain range). Such actions contribute to peak shaving in the benefit of grid performance and reduce the need of auxiliary non-environmental friendly peak production.

5.2.1.4 Actor (Stakeholder) Roles

Theme		Description
WP6_DSM_SC1		
Actor Name	**Actor Type (Person, Device , System,…)**	**Actor Description**
Smart Meter	Device	Grid device or add-on device (provided by the grid operator, grid user or the customer himself) that measures in detail the consumption of customer premises
Building Management System (BMS)	Device	A system used to monitor and control the energy consuming devices in apartments, buildings and malls
Customer	Person	The main actor accessing to the consumption information, residing in a single apartment or single house or building in which energy is consumed.
Grid Operator	Corporation	It is an actor that generates/ distributes the electricity to the grid users and generates detailed information of the electricity transactions and operations.
Grid User	Corporation	It is an actor that sells electricity to the customer and other various energy related services
Provider	Corporation	It is an actor providing various services based on for example the energy monitoring and optimization at the customer premises

Table 20: WP6_DSM_SC1 Actors Description

5.2.1.4.1 Scenario Actors Overview

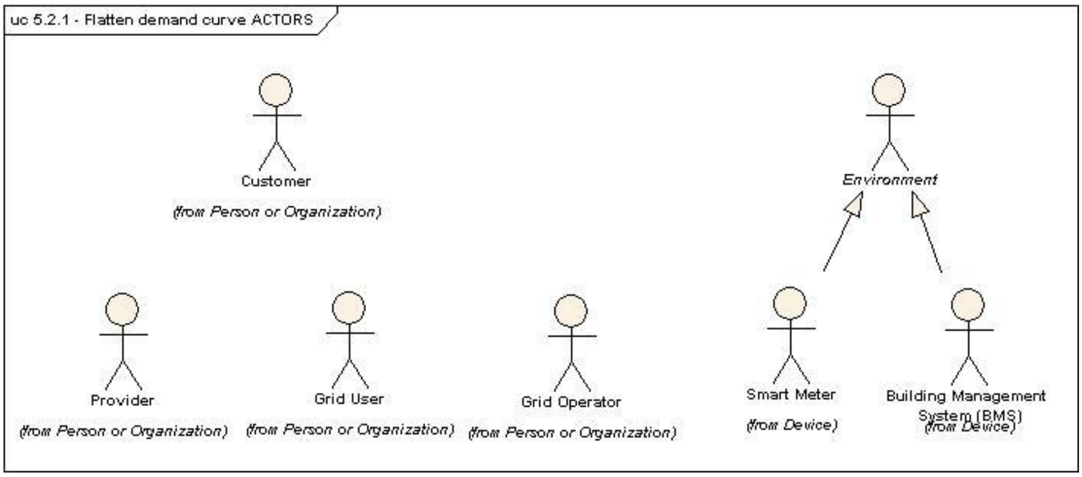

Figure 18: WP6_DSM_SC1 Actors Overview

5.2.1.5 Information Exchanged

Information Object Name	Information Object Description

Overall Consumption	The user and the grid operator is able to get detailed information of the current power consumption.
Information on preferred power consumption	The Home Energy management system will receive information from the grid operator on the preferred power outtake, which will then be able to schedule appliances for optimized power control.
Price tariffs	Price simulations will be obtained via a web interface, matching different appliances control scenarios, in order for the user to optimize the effects of different peak shaving options making profit from a tariff scheme that is provided by the grid user.
Control signals	The grid user will send signals that will start DSM operations at the BSM for specific appliances of the customer. This will be ruled

Table 21: WP6_DSM_SC1 Information Exchange

5.2.1.6 Services

Service Name	Services provided
Demand Side Management	The customer will modify its premise load and consumption profile, in order to satisfy the needs of Grid Users. This service will be ruled by a specific contract. The user will get incentives and compromises to let his system react to signals sent by the Grid User.
Tariff Scheme Energy Efficiency	The Customer will receive detailed tariffing signals/profiles in order to let the BMS react to the latter detailed tariffs (almost real time) in order to shape his demand curve. The BMS will schedule appliance operations in low price periods. In this way the demand is managed by the Grid User.
Grid User Specific Appliance Control	In case the BMS is not capable of executing the above defined service (or not available at all), the Grid User will be able to send specific signals to specific appliances in the Customer premise to decrease the consumption (HVAC, Heater, etc.). The latter will be only possible if extra controllers are installed by the Grid User per appliance in the customer premises, that is to be used for DSM purposes.

Table 22: WP6_DSM_SC1 Services

5.2.1.7 Contracts/Regulations

Contracts/Regulation	Impact on Functions
Tariff Schemes	Contract Brokering and contract settlements
Smart metering	Energy monitoring and information provision
DSM Contract	Will allow users to profit from attractive tariff schemes, allowing at the same time Grid Users to shape the demand
Demand Side Management Regulation	In several countries no regulation still exist on this.

Table 23: WP6_DSM_SC1 Contracts and Regulation

5.2.1.8 Scenario Overview

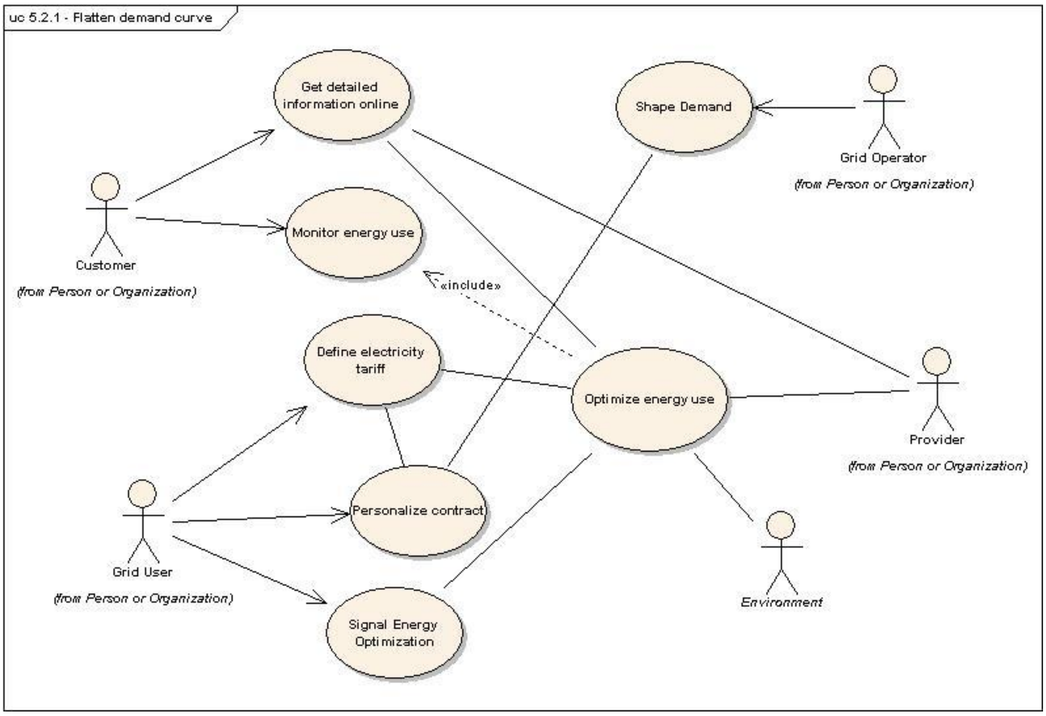

Figure 19: WP6_DSM_SC1 Scenario UML Diagram

5.2.1.9 Use Cases Analysis

5.2.1.9.1 Get Detailed Energy Information Online WP6_DSM_SC1_UC1

This use case is exactly the same as for 5.1.1, except for the fact that detailed tariff schemes will be in this case handled by the BSM and thus the information will be much more detailed: hourly consumption, power limits information, etc.

The description of the use case is again appended below for convenience of the reader:

This use case details the usage of a service provided by a service provider. This allows the customer to access, e.g., a Smart Meter, to retrieve energy consumption information via the Internet. It is not clear at the moment what kind of company would deliver the service. This will depend on the maturity of the market and of the commercial relationships that could be established between the grid users and the service providers.

As an example, we can think of a service provided by a Telco or IT company that has a contract with an energy retailer. In some cases, the service could be provided by the retailer alone depending on its experience in the field of IT and Internet. The service will be of the same kind of the one established by Google Power Meter.

5.2.1.9.2 Shape Demand- WP6_DSM_SC1_UC2

This is a service that is provided by a grid operator. After making simulations and thus predictions of grid usage at certain times of the year, he will signal the need of shaping the demand in order to avoid peaks that will affect the electricity distribution in some areas. The Grid User will send the details of the user contracts that he has personalized in order to be able to shape the demand. The information will be detailed in terms of tariffs and types of control signals he is planning to use in order to reduce the consumption of user premises. The Customer will then subscribe or not to the offered services. It is clear that benefits and incentives will be offered to the customers in order to get sufficient subscribers that will allow the Grid User to really modify the demand curve.

Note: Regulation in this area is also needed in order to effectively shave peaks, otherwise the uptake of DSM will be too slow. It should be noted that in some European markets there is barely any margin to efficiently offer something attractive for the customer. DSM will see the light in the coming years with the increase of the energy prices.

5.2.1.9.3 Monitor Energy Use- WP6_DSM_SC1_UC3

Again this use case is similar to the one in 5.1.1. But now including advanced and detailed tariff schemes. Therefore the user may see the energy use of the home components, how the BMS has affected the demand and how much each appliance has contributed in the load curve.

This is a use case of the BMS that is running in the customer premises. The system implementation varies from provider to provider but needs to be running in a Home Area Network (HAN) using installed monitoring devices/sensors at home.

In some cases, “intelligent” white appliances are part of the system that are able to communicate with a central service and be programmed according to user profile parameters. The main objective of this use case is to obtain the electricity consumption data from the home. Depending of the complexity of the system, the information could be decomposed in time and per appliance to get a more detailed view of the consumption profile. An example is the service offered by Yellow Strom in Germany.

This use case is more part of WP4 of FINSENY, since it deals with functionalities meant for buildings.

5.2.1.9.4 Optimize Energy Use – WP6_DSM_SC1_UC4

The optimization takes onboard the DSM signals and information that gets to the BMS (control signals and/or tariff schemes). The system modifies the appliance scheduling in order to reshape the load curve of the customer premise.

Its main functionality is to optimize the energy use in the building. The setting and installation is very similar but it could include auto-generation capabilities such as the ones offered by solar panels to generate hot water and electricity.

5.2.1.9.5 Define Electricity Tariff – WP6_DSM_SC1_UC5

This is a service offered by the grid user that has the contracts with the customers. The main objective is that this service publishes the tariffs that it has calculated using the reference values of the electricity market and company related policies on the Internet. The information is organized taking as main reference the energy sources and its related costs. The objective is to provide the market stakeholders with information they could use form many services such as billing. The latter information is also used by the customers and their optimization services (such as DSM) to take into account the tariffs and take decisions on how and when to use the electricity, by programming the connected devices accordingly. Here the user may also act upon its eco friendliness putting as first priority for example the use of eco types of energy coming from renewables.

5.2.1.9.6 Personalize Contract – WP6_DSM_SC1_UC6

In order to be able to implement DSM, it is mandatory that the energy contracts between Grid Users and customers are personalized including features such as the permission to the Grid Users to send control signals to the user premises in exchange of tariff reductions or other types of incentives. This depends very much on the capabilities of the BSM installed at the customer premises. DSM is possible still even without a BSM, but the Grid User has to install at home specific devices and couple them to heaters or HVACs in order for them to modify remotely the load profile (parameters modification or even switching on and off).

The personalized contract has to be precise of the benefits that the customer gets and a good reference to the tariffs considered. It is foreseen that DSM will evolve and will be very dynamic. That is why a use case is needed that takes as a reference the versatility of such a service, to be implemented via the Internet. The user will always be in control of his contract. He will get a warning that new features are available about the DSM service (New tariff schemes, energy price variations, etc.). He will always have to accept a new contract or stay in similar conditions with respect to his previous contract.

5.2.1.9.7 Signal Energy Optimization – WP6_DSM_SC1_UC7

This is a service that allows the Grid User to send signals to the customer premises in order to shape the demand and avoid electricity cuts or shortages. The Customer has established a contract with the Grid User, allowing the latter to send signals in order to control certain parameters of some of the appliances available at the customer premises such as the HVAC or Heater (e.g. the customer will allow the Grid User to raise the comfort temperature by some degrees in summer, in such a way that the HVAC will consume less energy; the opposite will happen during winter, decreasing the temperature by some degrees). The latter are some examples of the type of signals that are employed for DSM. In USA, Australia and Canada, DSM services are commercially available following the characteristics described above. In Europe, in some countries there are already some trials that are planned and being implemented.

5.3 Energy Trading

5.3.1 Incentive Based Green Market

5.3.1.1 Scenario ID: WP6_TS_SC1

5.3.1.2 Brief Description

The main scope of this scenario is to spread the participation to the Green Market of the Energy Prosumers providing different kind of incentives.

5.3.1.3 Narrative

Currently in Italy, under the "net metering service" (literally:"*Scambio sul posto*"), producers/consumers may feed into the grid the electricity that they generate on site but do not consume immediately and take in from the grid a part of that (or all) that they need in a different time.
On 1 January 2009, GSE has been appointed as the body in charge of granting the net metering contribution (literally: "*contributo in conto scambio*"). The rules governing the determination of this contribution are laid down in AEEG's Decision ARG/elt 74/08 (posted at http://www.autorita.energia.it), introducing the Integrated text of the procedure and technical-economic terms and conditions for net metering ("TISP").
The application for the contribution may be submitted by parties operating or owning one or more plants:
- using RES and having a capacity of up to 20 kW (if commissioned before 31 Dec. 2007);
- using RES and having a capacity of up to 200 kW (if commissioned after 31 Dec. 2007);
- high-efficiency CHP plants having a capacity of up to 200 kW.

The service provided by GSE entitles the applicant to get a yearly net metering contribution that is expressed in euro. This contribution refunds the producer/consumers for part of the costs incurred for withdrawing electricity from the grid.
In this perspective, this scenario assumes to have available a set of services/information which enable Prosumer to participate to the green market and to take decision according to production/consumption, monitoring and forecasting.

Here below a narrative description:
A Prosumer negotiates a contract in order to operate on the Green Market with a Grid User who can provide incentives
The Prosumer, according to its own Energy production/consumption forecasting at different, may operate on the Green Market by offering surplus energy while, receiving incentives from a Grid User. The Prosumer, whose forecasted energy demand is more than usual, may buy Green Energy receiving incentives, too.

5.3.1.4 Actor (Stakeholder) Roles

Scenario		**Description**
WP6_TS_SC1		
Actor Name	**Actor Type (Person, device , system,…)**	**Actor Description**
Prosumer	Person/entity	The Prosumer is a person or an entity who is able to both consume and produce energy.
Grid User	Corporation	It is an actor that sell electricity to the customer and other various energy related services
Forecasting Service	System	This is a service which can foresee the demand/production for a defined space in different granularity of time.

Table 24: WP6_TS_SC1 Actors Description

5.3.1.4.1 Scenario Actors Overview

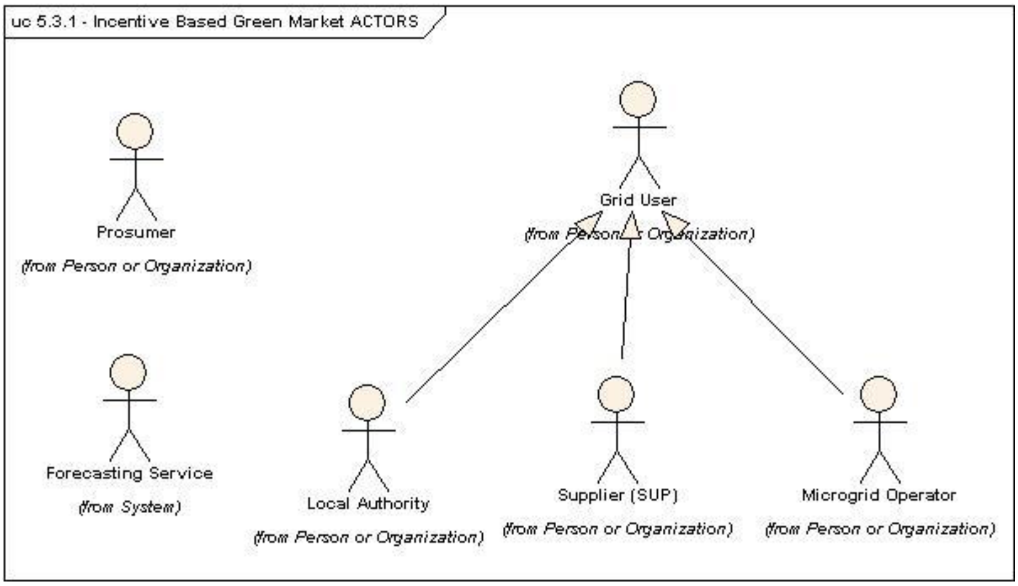

Figure 20: WP6_TS_SC1 Actors Overview

5.3.1.5 Information Exchanged

Information Object Name	Information Object Description
Energy demand/production forecast	It represents the forecast about energy demand/production at different granularity of time. It is provided by the external service "Forecasting Service" and it is used as a suggestion o limit the volume of the energy transaction, both buying and selling.
Incentive	An incentive can assume different formats: it could exists monetary incentives (by a discount on non-RES tariff), it could be other kind of incentives non directly related to the energy domain. The kind of incentive will depend on the customer profiling.
Transaction receipt	It take in the results of the transaction in terms of energy amount exchanged, price defined, time of transaction and delivery time, identification of the parts.
Green Market Contract	It is a legally enforceable agreement between the Prosumer and another entity under the Grid User role. It rules the relationships between those partiers defining rights and duties and Service Level Agreement (SLA) for both.

Table 25: WP6_TS_SC1 Information Exchange

5.3.1.6 Services

Service Name	Services provided
Forecasting Service	Service that foresees the demand/production for a Prosumer in different time frame.
Trading Service	The system that is able to manage transactions for trading energy.

Table 26: WP6_TS_SC1 Services

5.3.1.7 Contracts/Regulations

Contracts/Regulation	Impact on Functions
Energy contract	A contract between the Prosumer and the Grid User has to exist in order to regulate their participation to the marketplace.

Energy National law	The main issue is that the national regulation is different among countries. Moreover the national regulation gives the rules and constrains about what is possible to do in that domain. So, this has a big impact on this scenario. Anyway, different national law considers the active participation of the customer in accordance with the European directives.

Table 27: WP6_TS_SC1 Contracts and Regulation

5.3.1.8 Scenario Overview

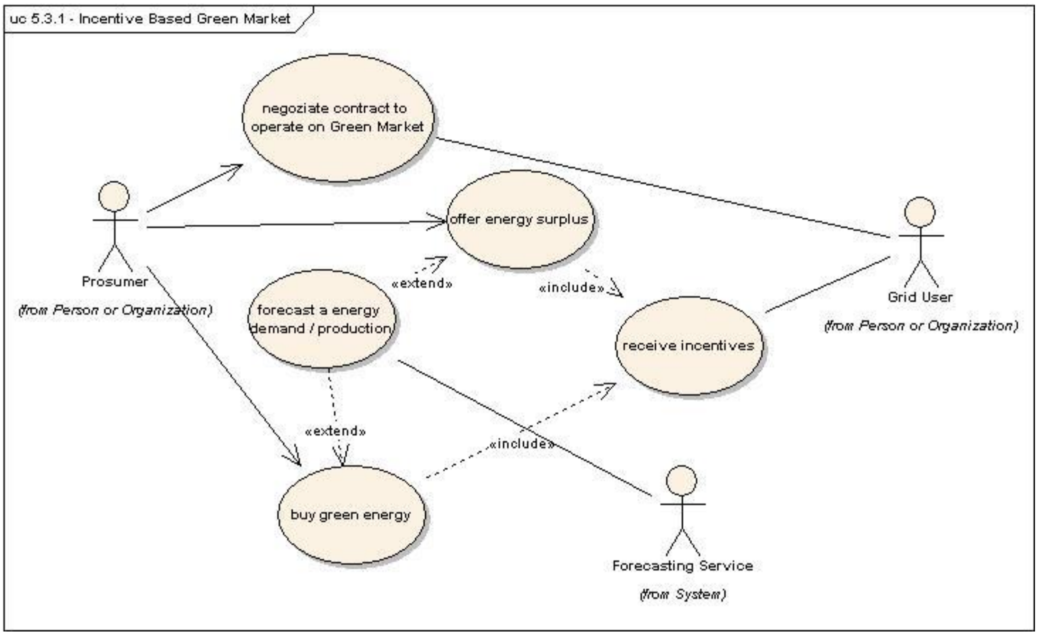

Figure 21: WP6_TS_SC1 Scenario UML Diagram

5.3.1.9 Use Cases Analysis

5.3.1.9.1 Negotiate Contract to Operate on Green Market - WP6_TS_SC1_UC1

This use case considers the necessity to negotiate and subscribe a contract in order to operate on the green energy market. So, each customer who produces removable energy can do that, through the green Market system managed by the Grid User, which (as shown in the Actors Diagram) may be a Local Authority, a Supplier or a Micro Grid operator.
Of course the Prosumer must have an energy production system connected to the overall energy grid and has access to the Green Market System. At the same time the Grid User has to know the Prosumers that are connected to the energy grid.
The main outcomes of this UC is the Green Market contract, which has to be received by both the parts.

5.3.1.9.2 Offer Green Energy Surplus – WP6_TS_SC1_UC2

According this use case the prosumer is able to offer the green energy surplus to the Grid User.
He will be able to offer a specific amount of energy for a defined period and price.
He will be able to offer his energy in different way:

- Prosumer offers all produced surplus for the overall year or for defined period to the Grid User who will be in charge to manage it;
- Prosumer offers from time to time the estimated energy surplus through a logic like the auction in the market operator.

In this perspective the prosumer has an energy surplus and he is aware about the amount of his current and estimated energy production and consumption. More on forecasting of production and consumption are described in UC - *Forecast Energy Demand/Production.* He has to provide a set of information on what he is offering: energy amount offered, kind of energy source, where and for when he are selling, and a what price or at least a minimum price. While the Grid User is able to measure the energy production and consumption of each prosumer in order to manage the energy exchange.

5.3.1.9.3 Buy Green Energy Surplus – WP6_TS_SC1_UC3

This use case takes in accounting that the Prosumer may need to buy energy for his needs. In order to do that a set of choices are available. These energy offer packages include a set of information: description of the energy as product in terms of amount, reliability, stability and security, source mix, producer/seller reputation, final price, price definition mechanisms and other costs included into price. The buyer has more purchasing options, for examples: participation to an auctions, purchasing a last minute offer, and so on.
The buyer is able to purchase energy by different devices (so, he must have a network connection in order to connect to the Green Market Services).

5.3.1.9.4 Forecast Energy Demand/Production – WP6_TS_SC1_UC3

The energy demand/production forecast has been always an important function in the energy domain in order to avoid blackout and to enables the grid to be stable assuring the appropriate provision of the service. Currently different companies provide this services to TSO and energy utilities.
This use case consider to provide this kind of services to the final customer/Prosumers too in order to enable them to take better decision about the purchasing/selling of energy.
This kind of service is based on the processing of different information e.g.: place, whether condition, temperature, humidity, wind, wind direction, in order to define production; instead, concerning consumption, forecasting historical data and consumption behaviors are considered.
Smart metering, sensors and real time communication together with the ICT tools (data analysis, statistical modeling, business intelligent) for processing information could improve this kind of service. For this purpose, a Forecasting Service has been considered as an external actor (System).

5.3.1.9.5 Receive Incentives – WP6_TS_SC1_UC3

This use case takes into account a system based on incentives in order to motivate a Prosumer to participate into Green market. The Incentives are offered by the Grid User (e.g. local authorities, energy suppliers, Microgrid operator or who is in charge to manage a defined geographical area).
These incentives should be tailored according the Prosumer behaviors and his needs. In this perspective the Grid User has to have a set of information about the Prosumer concerning his energy habits and personal issues (e.g. interests, hobbies etc.) and ICT technologies for the customer profiling, in order to launch targeted incentive campaigns.

5.3.2 Trading for the Good of All

5.3.2.1 Scenario ID: WP6_TS_SC2

5.3.2.2 Brief Description

Competition in trading assures energy balancing at city and regional level and guarantees the best price. Through a portal, the suppliers can monitor the energy needs of customers and the offerings of their competitors. While the big suppliers need to better define/foresee city and regional energy demand/production, the little suppliers need guarantees on payments in the short term from the customers (pre-paid contracts).

5.3.2.3 Narrative

In a not so far future scenario on the smart grid, there will be many vendors and consumers of energy, more commonly known as "prosumers". It’s natural that a new energy market will emerge with competition rules in some ways very similar to those of financial markets.

Typically, this myriad of micro-power generation is entrusted, for reasons of time and convenience, to the “Energy retailer competitors”, that must have a deep knowledge of their energy availability at anytime and the characteristics of it, which certainly can vary depending on the times at which they can generate it, the weather conditions and other grid parameters. Through specific profiles, the supplier competitors should also be familiar with the end customers habits in order to make precise forecasts on the future energy demands in terms of time and power

So, each big Energy Retailer will have at least an Operation Manager that will monitor in real time their “available energy production capacity”, and the real cost of such generation. Moreover the Operation

Manager gets from a Weather Forecast Service important information useful to plan its future generation capabilities (e.g. for wind or solar energy generation forecasts).

The latter information coming from the Operation Manager is then sent to Financial Managers that, through a WEB portal, continuously monitor in real time the energy price (euro/KWh) of the other supplier competitors and he will thus be able to compare various external offers with his own in terms of availability, costs, and quality. Then he can offer, real time billing to the Final Customer or to the Facility Manager, and guarantee is such way short term payments.

If the energy retailer is not big enough, he may contract an external Provider that will give all the necessary market information. The interface between the energy provider and the energy consumer is hosted by the Building Management System (BMS), a system that monitors and controls the energy consumed at home, in a building, in a commercial building, etc.

5.3.2.4 Actor (Stakeholder) Roles

Theme		**Description**
WP6_TS_SC2		
Actor Name	**Actor Type (Person, device , system,…)**	**Actor Description**
Operations Manager	Person	Person that monitors in real time the “available energy production capacity”
Facility Manager	Person	Person responsible for the maintenance and operation of the facility. At the smallest level of granularity, in the Residential market, this is the home owner, landlord, or building superintendent.
Customer	Person	The main actor accessing to the consumption information, residing in a single apartment or single house or building in which energy is consumed.
Energy Retailer	Corporation	A company that delivers/sells electricity to Facility Manager and/or to a customer.
Provider	Corporation	It is an actor providing various services based on for example the energy monitoring and optimization at the customer premises
Financial Manager	Person	Person of the energy retailer company that is responsible for cost accounting and developing financial strategies for an private or industrial or commercial business.
Building Management System (BMS)	Device	A system used to monitor and control the energy consuming devices in apartments, buildings and malls
Weather Forecast Service	Corporation	A company that generates global and local weather forecasts using its proprietary forecast models and techniques.

Table 28: WP6_TS_SC2 Actors Description

5.3.2.4.1 Scenario Actors Overview

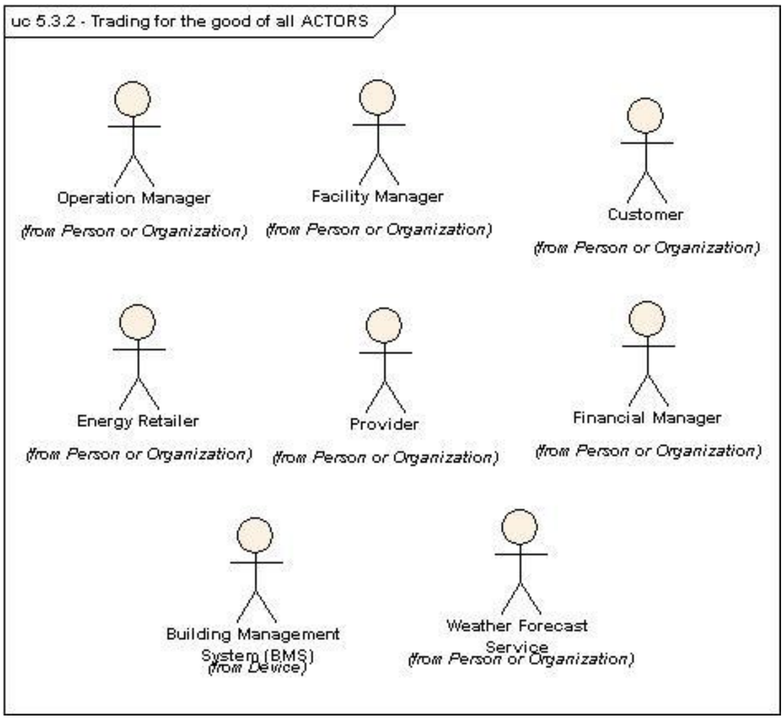

Figure 22: WP6_TS_SC2 Actors Overview

5.3.2.5 Information Exchanged

The following information are transferred between the actors:

ACTOR	INPUT INFORMATION	OUTPUT INFORMATION
Operations Manager	Weather data Present Demand	Onsite generation capabilities
Facility Manager	Pricing Information	By whom and how much energy will be purchased
Customer	Pricing Information	By whom and how much energy will be purchased
Energy Retailer	Real time energy gathered by the prosumer	Quantity and prices of the available energy bid.
Provider	Weather data Real time energy demand Available type and cost of energy by the Energy retailer competitor.	Pricing Information Present Demand Available energy to bid. Forecast for the future energy demand.
Financial manager	Onsite generation capabilities Pricing Information from the competitors.	Its best possible offer (euro/KWh) to the Facility Manager/Final Customer
Building Management System (BMS)	Power consumption in devices at home, building, mall etc	Profile of power consumption in devices at home, building, mall etc.
Weather Forecast Service		Weather data

Table 29: WP6_TS_SC2 Information Exchange

5.3.2.6 Services

Here follows a list of activities and services involved in this scenario.
Operations Manager: monitors in real time the onsite “available energy production capacity”.

Facility Manager: determines by whom and how much energy will be purchased.

Customer: determines by whom and how much energy will be purchased.

Energy Retailer: provides, quantity and prices of the available energy bid. In the future, it is anticipated that pricing policies will become much more dynamic (real time).

Provider (in this case energy information provider): when an energy retailer is small, the Provider gives on his behalf, the pricing Information, the present local demand and the available energy to bid. Moreover he performs forecasts for the future energy demand for the Facility Manager/Final Customer.

Financial Manager: develops the best possible offer (euro/KWh) to the Facility Manager/Final Customer.

Building Management System (BMS): monitors and controls the energy consumption at home, in a building, in a commercial building and so on.

Weather Forecast Service: provides to the Operations Manager or to the Energy Information Provider (EIP) the predicted weather for the interval being estimated.

5.3.2.7 Contracts/Regulations

Electricity retailers, who in aggregate buy from the wholesale market, and generators who in aggregate sell to the wholesale market, are exposed to the price and volume changes and to protect themselves from volatility, they will enter into "hedge contracts" among them. The structure of these contracts varies in regional markets due to different conventions and market structures. However, the two simplest and most common forms are simple fixed price forward contracts for physical delivery and contracts for differences where the parties agree a strike price for defined time periods. In the case of a contract for difference, if a resulting wholesale price index (as referenced in the contract) at any time period is higher than the "strike" price, the generator will refund the difference between the "strike" price and the actual price for that period. Similarly a retailer will refund the difference to the generator when the actual price is less than the "strike price".

Many other hedging arrangements, such as swing contracts, Virtual Bidding, Financial Transmission Rights, call options and put options are traded in sophisticated electricity markets. In general these arrangements are designed to transfer financial risks between participants.

Many regional markets have achieved some success and the ongoing trend continues to be towards the deregulation and introduction of competition in the energy markets. However, in 2000/2001 on the U.S. market major failures occurred, such as the California electricity crisis and the Enron debacle that caused a slowdown in the pace of change and in some regions an increase of market regulation had to be applied and thus the competition between players was not as easy as it used to be. However for the longer term, the trend towards more open and competitive markets is inevitable.

5.3.2.8 Scenario Overview

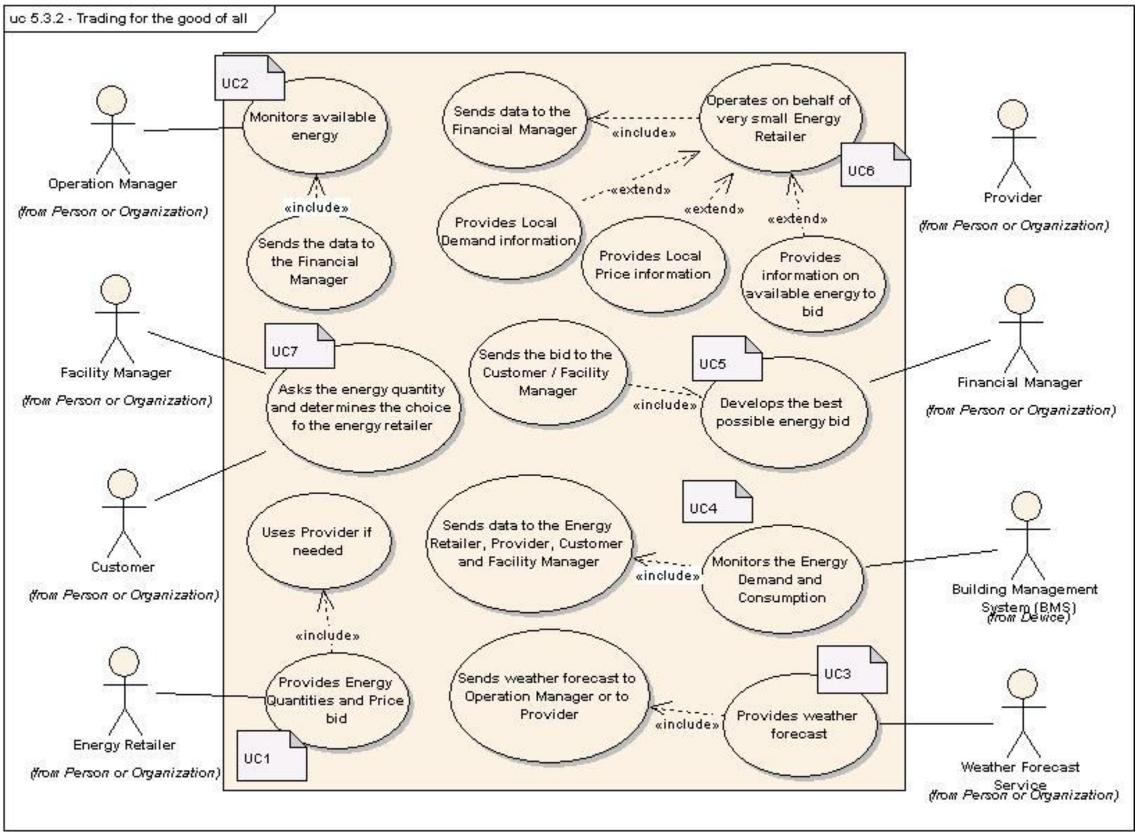

Figure 23: WP6_TS_SC2 Scenario UML Diagram

5.3.2.9 Use Cases Analysis

5.3.2.9.1 Provides Energy Quantities and Price Bid - WP6_ TS_SC2_UC1

The Energy Retailer collects economical bids from a myriad of local Prosumer and provides its best offer to the customer or to the facility manager. If the energy retailer is a small entity, it can ask these information to an external Provide (Energy Information Provider).

5.3.2.9.2 Monitors Available Energy - WP6_ TS_SC2_UC2

The Operations manager monitors in real time the "available energy capacity" by the energy retailer and send this information to its Financial manager.

5.3.2.9.3 Provides Weather Forecasts - WP6_ TS_SC2_UC3

The Weather Forecast Service provides to the Operations Manager or to the Energy Information Provider (EIP) the predicted weather information for the interval being estimated. This can be very useful, to make forecasts about the energy sources generation capabilities depending on the wind, sun light availability etc.

5.3.2.9.4 Monitors the Energy Demand and Consumption - WP6_ TS_SC2_UC4

The BMS system monitors and controls the energy consumption at home, in a building, in a commercial building, etc,. and at the same time creates a final user profile in order to forecast its energy needs. Then, all these data are sent to the information Provider, to the customer and to the facility manager.

5.3.2.9.5 Develops the best possible energy bid - WP6_ TS_SC2_UC5

The financial manager, taking into account the operations manager or the EIP information, develops the best possible offer (euro/KWh) to the Facility Manager or to the Final Customer.

5.3.2.9.6 Operates on Behalf of Very Small Energy Retailer - WP6_ TS_SC2_UC6

If the energy retailer is a very small entity, it can ask the information to an external Provider (Energy Information Provider) that provides the pricing Information, the present local demand and the available energy to bid. Moreover the EIP performs forecasts for the future energy demand coming from the Facility Manager or the Final Customer.

5.3.2.9.7 Asks Energy Quantity and Determines the Choice of the Energy Retailer - WP6_ TS_SC2_UC7

The customers or the facility managers receive the energy quantity & price bids coming from the financial managers of the various energy retailers in competition. Then they determine from whom and how much energy to buy.

5.3.3 Trading flexible capacity

5.3.3.1 Scenario ID: WP6_TS_SC3

5.3.3.2 Brief Description

Some "prosumers" may have spare loads (negative = extra generation, positive = extra consumption) that can be used by others to balance their energy needs. The marketplace is where the exchange happens.

5.3.3.3 Narrative

This use case describes how ICT infrastructure and market mechanisms can be used for trading the flexible loads for demand side management purposes. The Grid Operator monitors the electricity network using the Network Management System. In case there are overloads or voltage problems detected, the problem is reported to DSM companies through the marketplace. Then, each DSM submits an offer to the marketplace for solving the issue. The marketplace selects a number of offers which jointly solve the network issue. The selected DSMs are now responsible to solve the issue. The objective is to derive real/reactive power changes required to alleviate the violations in the network. The DSM sends the signal to smart home control boxes of his customers. The control boxes send the signal to intelligent devices at the smart home as well as to electric vehicles.

5.3.3.4 Actor (Stakeholder) Roles

Scenario		**Description**
WP6_TS_SC3		
Actor Name	**Actor Type (Person, device , system,…)**	**Actor Description**
MDMS	System	Meter data management system functions. This is one major component used for aggregation and disaggregation tasks.
Enterprise service bus	System	The system responsible for the data exchange between different components
Grid Operator	Corporation	It is an actor that generates/ distributes the electricity to the grid users and generates detailed information of the electricity transactions and operations.
NMS (Network Management System)	System	Network management system, used for monitoring, supervisory control and operation of electrical network.
DSM (Demand Side manager)	Corporation	DSM collects meter readings for the network based application and sends control signals to customers (load management).
Marketplace	System	The marketplace system, which supports the Trading/brokering within the energy market.
Customer	Person	The main actor accessing to the consumption information, residing in a single apartment or single house or building in which energy is consumed.

Building Management System (BMS)	Device	A system used to monitor and control the energy consuming devices in apartments, buildings and malls
Smart Meter	Device	Grid device or add-on device (provided by the grid operator, grid user or the customer himself) that measures in detail the consumption of customer premises
Electric Vehicle	Device	EVs are the major source for consuming or providing energy
Intelligent devices	Device	Devices that can adapt their consumption according to the signal received by the control box

Table 30: WP6_TS_SC3 Actors Description

5.3.3.4.1 Scenario Actors Overview

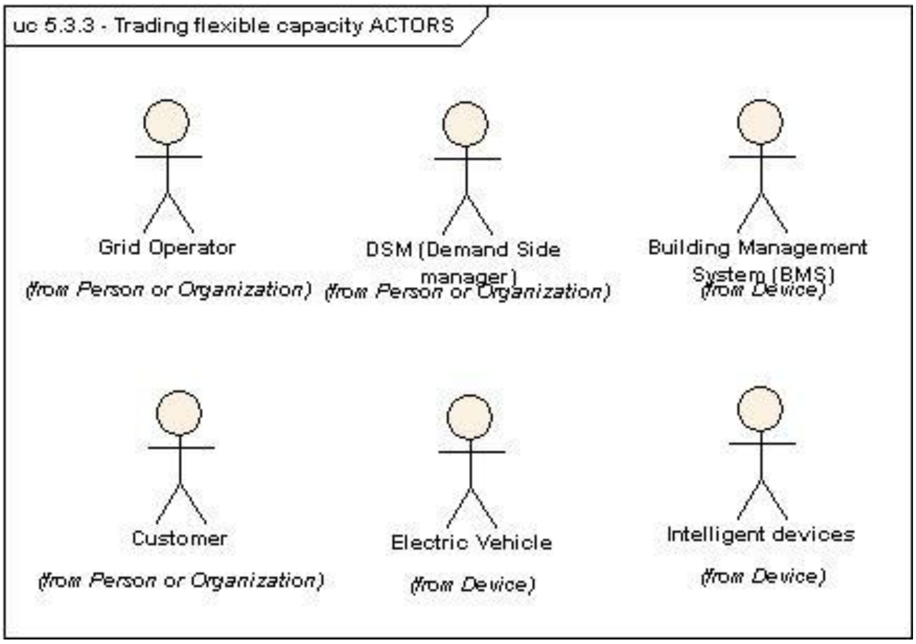

Figure 24: WP6_TS_SC3 Actors Overview

5.3.3.5 Information Exchanged

Information Object Name	Information Object Description
Meter Readings	Meters readings on a regular basis from the consumption and the generation for the last time interval, as pre-configured (e.g., last 15min).
Congestion Problem Signal	In case there are overloads or voltage problems detected, this signal is send from the Grid Operator via the marketplace to the DSMs.
Offer	The DSMs send Offers to the Marketplace for (partly) solving the current network issue. These Offers include prices.
Message of Acceptance/Rejection	A message from the Marketplace that tells the DSMs that their offer was/wasn’t accepted.
Consumption/Generation Signal	The DSM sends a signal to the control boxes to increase/decrease consumption/generation.
Balancing Signal	The Smart-Home Control Boxes send signals to intelligent devices/EVs for balancing the electricity.

Table 31: WP6_TS_SC3 Information Exchange

5.3.3.6 Services

Service Name	Services provided
Smart Metering	Already established service available beforehand.
Controlling Smart Houses	The DSM can control the prosumption of their customers via Smart-Home Control Boxes.
Controlling Devices	The Smart-Home Control Boxes can control the presumption of the connected devices.
Marketplace services	The Marketplace provides services for collecting network issues, distributing information, collecting and selecting offers. Selecting offers is achieved in a way that issues are solved and low costs are realized.
Network management	The network management system provides services for monitoring, supervisory control and operation of electrical networks.

Table 32: WP6_TS_SC3 Services

5.3.3.7 Contracts/Regulations

Contracts/Regulation	Impact on Functions
Contract between the DSM & Customers	Each DSM has contracts with the Customers, which allow controlling their devices to a certain extend. The contract specifies the number of times and the degree that this control is allowed and also the V2G conditions.
Contract between the DSM & Grid Operator	This contract defines the areas that each DSM has influence and the regulations between the demand side management and the grid, e.g., it specifies the consequences (penalties) if a DSM does not provide the promised offer.

Table 33: WP6_TS_SC3 Contracts and Regulation

5.3.3.8 Scenario Overview

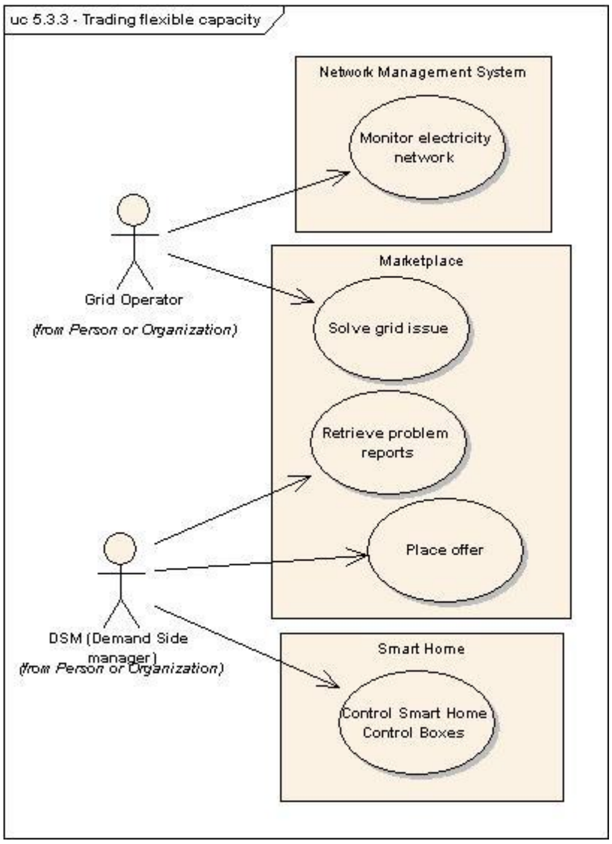

Figure 25: WP6_TS_SC3 Scenario UML Diagram

5.3.3.9 Use Case Analysis

5.3.3.9.1 Monitor Electricity Network- WP6_TS_SC3_UC1

The grid operator constantly monitors the electricity network, using the network management system.

5.3.3.9.2 Solve Grid Issue – WP6_TS_SC3_UC2

When there is a network issue, the grid operator requests a solution to solve it. The request is send to the marketplace, where the DSMs can retrieve problem reports and place their offers to (partly) solve a problem. Finally, the marketplace selects offers that jointly solve the issue.

5.3.3.9.3 Retrieve Problem Reports– WP6_TS_SC3_UC3

The DSMs retrieve problem reports from the marketplace. This allows them to assemble an offer to (partly) solve a problem.

5.3.3.9.4 Place Offer– WP6_TS_SC3_UC4

The DSMs place their Offers for (partly) solving a network issue and get an answer, a Message of Acceptance/Rejection, from the marketplace.

5.3.3.9.5 Control Smart Home Control Boxes – WP6_TS_SC3_UC5

When a DSM has successfully placed an offer, he adjusts the energy consumption/production of their Customers. To this end, he sends Consumption/Generation Signals to the Smart-Home Control Boxes, which in turn control intelligent devices/EVs via Balancing Signals.

5.3.4 Energy Markets for Neighborhoods

5.3.4.1 Scenario ID: WP6_TS_SC4

5.3.4.2 Brief Description

In the emerging infrastructure of Smart Grids, the production, distribution and management of energy will be a reality. Taking into consideration local conditions and data, one might better locally optimize its operation. As such market-driven interactions at local (neighborhood) level may motivate energy to be traded locally by the producers and consumers. This might (i) better cover the local energy needs (increase efficiency) and (ii) assist the DSO to better assess the situation and plan his actions.

Via the local market, individuals as well as groups of Prosumers can communicate their energy needs directly. The last brings market concepts to the business transactions among the users, which might introduce new opportunities as well as new revenue sources to the participants. A typical such example investigated within the NOBEL project (www.ict-nobel.eu) is the ability to use public infrastructure (e.g. the public lighting system) as a flexible balancing market actor (see Figure 9).This would enable the community to investigate an additional source of revenue by offering its flexibility to consume (e.g. by turning lights on) when too much production is available as well as to lower its consumption (e.g. by turning lights off) when it is needed.

5.3.4.3 Narrative

A neighborhood is a geographically localized community within a larger city, town or suburb sharing a common service infrastructure. In some countries, neighborhoods are often given official or semi-official status, serving to represent administrative division found immediately below the district level. Generally a neighborhood is a group of households and public services served by the same local electricity Distribution System Operator (local DSO) which are geographically localized in the same area. Thus, the neighborhood unit within the project refers to the capability to manage electricity related services. In this way, usually a local DSO will always manage at least one neighborhood, but there are also cases where a single local DSO manages several neighborhoods, as it happens nowadays in most cities.

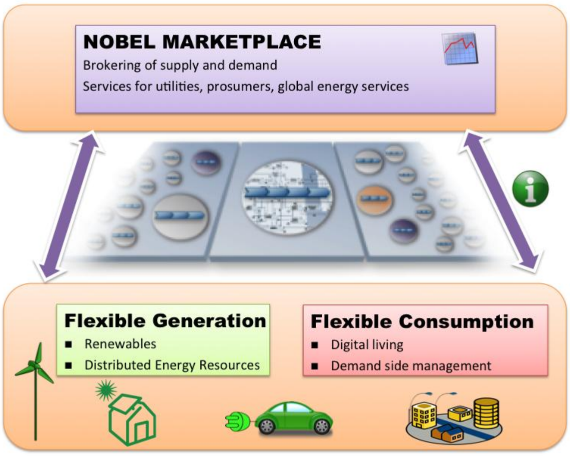

Figure 26: Marketplace Overview

In the future smart city, several of its neighborhoods will be supplied by different local Distribution System Operators (DSOs) who coordinate with a few Transmission System Operators (TSO). The local DSOs are in charge of providing the last mile infrastructure, distributing the electricity to the end users according to the contracts they have with the different suppliers. Each local DSO is controlling and monitoring a number of neighborhoods.

Each neighborhood is expected to have an Electricity Monitoring and Control System (NOEM), assisting the DSO in having the overview by providing analytics as well as enabling the management of the energy. The information that such services will process and depend upon, come from the network (smart meters, local distribution equipment, concentrators, network analyzers, etc.), the Prosumers interacting with the network through a brokerage agent front-end (BAF), or the relevant local DSO. A NOEM is a mash-up application composed by various enterprise services provided within the project and is expected to be cloud-hosted (Figure 27)

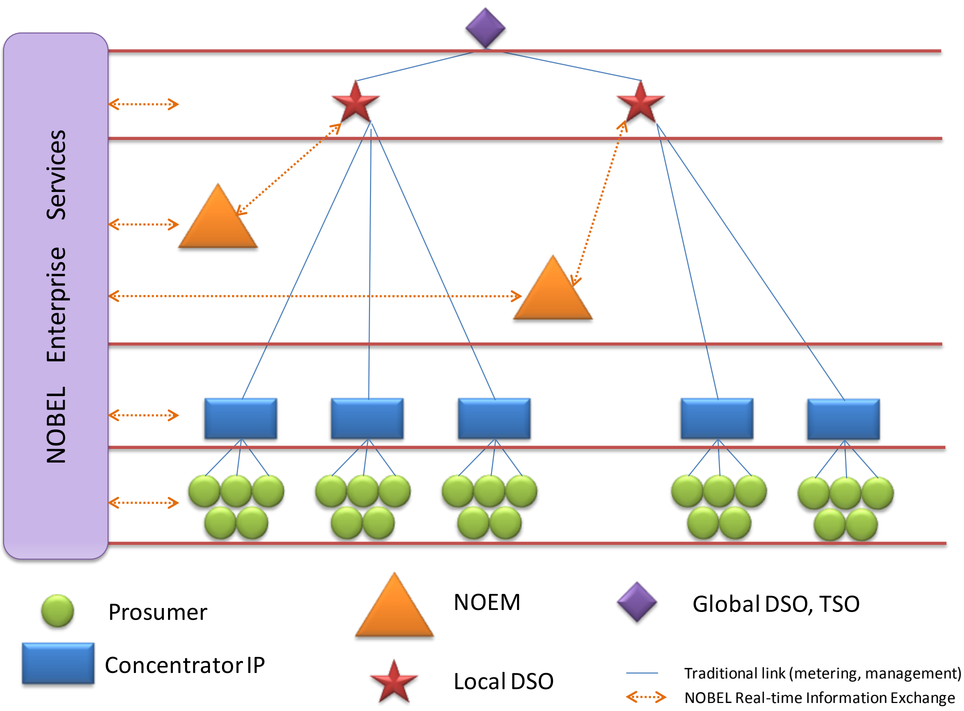

Figure 27: Example: Potential Market Structure

Another mash-up application is the Brokerage Agent Front-End (BAF). This application is targeting mostly modern mobile devices, is again depending on a mash-up of several services to provide it with real-time data, and fosters direct interaction with the user who can not only receive info, e.g. energy consumption, but also can connect, e.g. to the online marketplace, to buy and sell electricity. Of course similar functionality will be available via a web portal accessible also by normal desktop and laptop computers. The objective of the BAF is the design and development of a tool for standard Prosumers to interact with its brokerage agent. This tool provides to the Standard Prosumer (STP) a user-friendly and easy to use front-end to interact with the brokerage system managing the efficiency of its electrical demand. The front-end enables the active communication between the energy management system and its end users. In typical examples, the local Distribution System Operator Transmission System Operator may interact with the users and provide incentives in order to affect the behavior of the consumers e.g. multiple tariffs. The Brokerage Agent Front-End is accessible from a wide variety of wired and wireless devices – PCs, smart phones and PDAs – in order to achieve access to the energy data anywhere, anytime, in any form easily and effectively.

The Neighborhood Oriented Public Lighting Monitoring and Control System (NOPL) is the example of a Commercial/Senior Prosumer interacting with the NOEM. Commercial Prosumers require internal energy management processes, which impose some constraints not necessarily observed by normal STPs, but also provides new capabilities to improve the energy efficiency of the target neighborhood. In the case of a public lighting system as the one used in the NOBEL project, the main constraint would be the need to respect at any time the contractual obligation of providing a public service: major disruptions on the service could affect not only the well-being of citizens but also its security and safety. In this way the monitoring capabilities should be highly robust, which may limit the number of feasible energy-saving solutions. The NOPL will make available to the NOEM information related to consume energy through the Data Capturing and Processing service, as an STP would do. Alarms on the behavior of the lighting grid will be treated internally, and only the ones affecting the neighborhood grid performance will be propagated to the NOEM – e.g. an unexpected demand due to heavy rain requiring more electricity than planned is an event of interest for the local DSO.

Market driven interactions lie in the heart of the emerging Smart-Grid infrastructure. The bidirectional information exchange will put the basis for cooperation among the different entities, as they will be able to access and correlate information that up to now either was only available in a limited fashion (and thus unusable in large scale) or extremely costly to integrate. From the business side new, highly distributed business processes will need to be established to accommodate these market evolutions. The traditional static customer processes will increasingly be superseded by a very dynamic, decentralized and market-oriented process where a growing number of providers and consumers interact. Such an infrastructure is expected to be pervasive, ubiquitous and service-oriented. However the biggest issue to be tackled for all of these to be made a reality would be the development of open interoperable approaches (NIST, 2010). Various roadmaps such as the one drafted by the Smart Grids European Technology Platform (2010) as well as the Federation of German Industries (2010) provide an insight on the challenges and directions.

5.3.4.4 Actor (Stakeholder) Roles

Theme		**Description**
WP6_TS_SC4		
Actor Name	**Actor Type (Person, device , system,…)**	**Actor Description**
DSO	Organization	The DSO responsible for the neighborhood.
Energy Retailer	Corporation	A company that delivers/sells electricity to Facility Manager and/or to a customer.
Marketplace Operator	Organization	The marketplace for contract brokering needs to be operated as a system. Depending on the underlying business model, this could be a for-profit or a non-profit, or a profit-sharing organization.

Prosumer	Person	The typical producer or consumer of energy. He interacts by himself with the marketplace.
Prosumer Community	Person	A group of prosumers located in the same neighborhood, i.e., a geographically localized community within a larger city.
Commercial Prosumer	Organization	An industrial/commercial/public infrastructure responsible entity, e.g. a chemical factory, public lighting system, shopping mall.
Provider	Corporation	It is an actor providing various services based on for example the energy monitoring and optimization at the customer premises
Smart Meter	Device	Grid device or add-on device (provided by the grid operator, grid user or the customer himself) that measures in detail the consumption of customer premises

Table 34: WP6_TS_SC4 Actors Description

5.3.4.4.1 Scenario Actors Overview

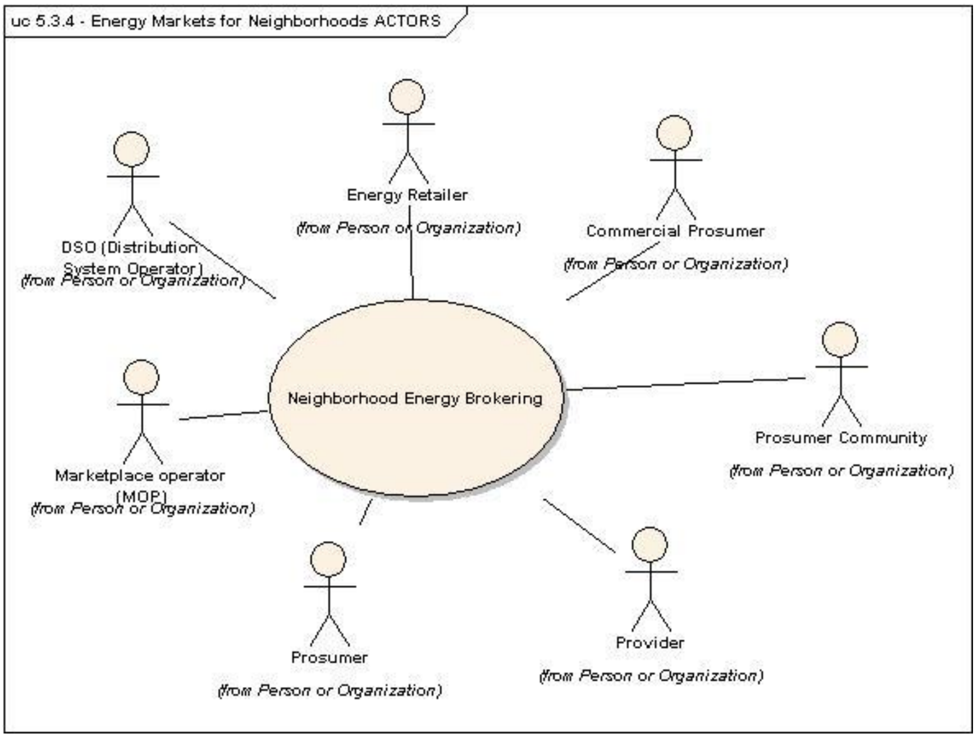

Figure 28: WP6_TS_SC4 Actors Overview

5.3.4.5 Information Exchanged

Information Object Name	Information Object Description
Metering data	Metering information on energy produced and/or consumed.
Load Flexibility	Flexibility to shift load (e.g. by rescheduling processes).
Price	Bid/Ask prices representing the wishes of the market participants.
Overall transacted load	The overview of aggregated transacted load is provided as a figure so that the DSO can adjust his planning.
Load	Energy that can be sold on the market.

Table 35: WP6_TS_SC4 Information Exchange

5.3.4.6 Services

Service Name	Services provided
Energy Monitoring	The services under this category are responsible for delivering data related to the energy consumption and/or production of a device.
Energy Prediction	The prediction of energy presumption may assist the prosumer in optimizing his strategy on buying or selling energy on the marketplace.
Energy Brokering	The services under this category implement brokering capabilities that allow customers to participate in an electricity marketplace. These services provide the functionality required for its users to trade electricity.
Informational Services	Value added informational services to the participants of the marketplace. This could be e.g. overall energy transacted over time, alarms, notifications, and downtime.
Security Services	Authentication, authorization, rating etc.
Privacy Services	Enable privacy preservation for the participants in the marketplace (where possible).
Clearing Service	Clearing after the transaction has taken place.

Table 36: WP6_TS_SC4 Services

5.3.4.7 Contracts/Regulations

Contracts/Regulation	Impact on Functions
Contract between all market actors and the marketplace	This might be via simple registration, however true identity verification will be needed for clearing and dispatching of energy.
Prosumer and energy retailer	Although some energy will be transacted via the marketplace, a contract between the prosumer and the energy retailer has to be in place to cover non-marketplace energy consumed.
Prosumer and DSO	A contract exists between the prosumer and the DSO for energy dispatching.
Actor-to-actor contract	A transaction in the marketplace leads to an indirect contract between the transacting parties in the marketplace, e.g. between two prosumers.

Table 37: WP6_TS_SC4 Contracts and Regulation

5.3.4.8 Scenario Overview

Within a neighborhood marketplace, several scenarios can be realized. These include:

- Buying and selling energy
- Buying and selling energy signature flexibility (re-schedulable loads)
- Interacting with value added energy services (e.g. analytics, prediction, marketplace aggregation services etc.)
- Rating of available marketplace actors
- Energy information for the smart city based on the transactions over the marketplace

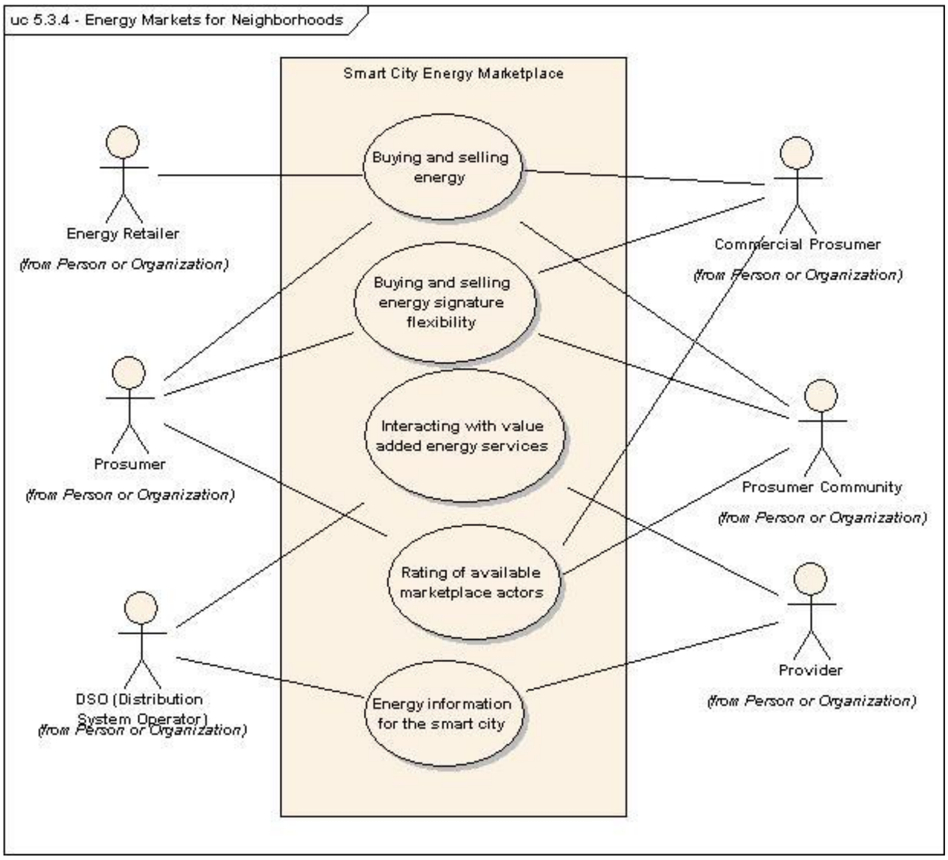

Figure 29: WP6_TS_SC4 Scenario UML Diagram

5.3.4.9 Use Cases Analysis

5.3.4.9.1 Buying and Selling Energy – WP6_TS _SC4_UC1

This is the main use case for the neighborhood marketplace. Prosumers can buy and sell energy. This could be either interactive or passive (e.g. via automatic trading agents).

5.3.4.9.2 Buying and Selling Energy Signature Flexibility – WP6_ TS _SC4_UC2

Here the prosumers are able to trade their flexibility to the energy behavior. Some base load will need to be there. However the flexibility on top can be traded and the prosumer behavior accordingly adjusted.

5.3.4.9.3 Interacting with Value Added Energy Services – WP6_ TS _SC4_UC3

In a marketplace several value added service providers will provide marketplace relevant services to the users. These could be for instance aggregated buys/sells, analytics on e.g. weather, estimation auxiliary services etc.

5.3.4.9.4 Rating of Available Marketplace Actors – WP6_ TS _SC4_UC4

Ratings are be available in the marketplace and will enable the prosumers to consider them prior to transactions in order to enhance prosumer's risk management analysis. This can be coupled with automated recommender systems and is expected to have an impact on the transactions of the neighborhood marketplace.

5.3.4.9.5 Energy Information for the Smart City – WP6_ TS _SC4_UC5

Based on the transactions as well as additional in marketplace offered services, energy information analytics for the smart city can be acquired. This also includes a partial prediction of the smart city behavior (including the prosumers) based on the transactions done in the marketplace.

5.3.5 Supplier Side Local trading

5.3.5.1 Scenario ID: WP6_TS_SC5

5.3.5.2 Brief Description

Taking a closer look to the role of the Supplier, the objective of this scenario is to balance the energy flow among e-Islands, taking into consideration Generators at a regional level. When a deficit/surplus at a local level (e.g. city, regional) occurs, the Supplier can operate on the market to trade energy within the Marketplace either to cover the excess in demand or in production.

5.3.5.3 Narrative

A Supplier may want to increase the effectiveness and efficiency of the electricity supply at low voltage level by balancing the energy flow among a controlled eIslands, taking into consideration small local Generators too. In order to distribute the sufficient amount of energy, a Supplier needs to know the forecast in terms of e-Islands demand/production at different time periods through Microgrid Operators.

When a deficit/surplus occurs, the Supplier has to react and poll the market to trade energy within the Energy Market Service.

5.3.5.4 Actor (Stakeholder) Roles

Scenario		**Description**
WP6_TS_SC5		
Actor Name	**Actor Type (Person, device , system,…)**	**Actor Description**
Provider	Corporation	It is an actor providing various services based on for example the energy monitoring and optimization at the customer premises
Marketplace	System	The marketplace system, which supports the Trading/brokering within the energy market.
Microgrid Operator	System	A system that is able to foresee demand/production for an e-Island at different granularity of time.

Table 38: WP6_TS_SC5 Actors Description

5.3.5.4.1 Scenario Actors Overview

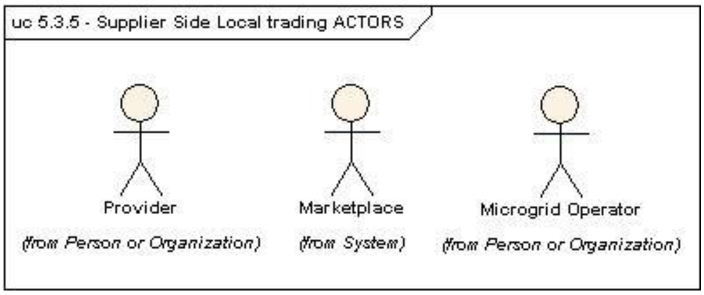

Figure 30: WP6_TS_SC5 Actors Overview

5.3.5.5 Information Exchanged

Information Object Name	**Information Object Description**
e-Island demand/production forecast	It contains a forecast about the demand/production of an e-Island at different granularity of time.
Transaction receipt	It takes into consideration the results of the transaction in terms of energy amount exchanged, price defined, time of transaction and delivery time.

Local generator reliability	It contains a description of the reliability of a Local Generator concerning the forecast about his production.

Table 39: WP6_TS_SC5 Information Exchange

5.3.5.6 Services

Service Name	Services provided
Forecasting Service	Service which can foresee the demand/production for a e-Island in different time frame.
Energy Marketplace Service	The Marketplace provides services for offering and buying energy, enabling energy transaction.
e-Island Aggregation Service	Through this service the Provider is able to aggregate and filter energy consumption/production information related to e-Islands.

Table 40: WP6_TS_SC5 Services

5.3.5.7 Contracts/Regulations

Contracts/Regulation	Impact on Functions
Energy Trading	Providers have to subscribe a contract with the Marketplace in order to operate on that.
National regulation about energy exchanges between e-Island	Usually the national regulation already rules these kinds of relationships and exchanges.

Table 41: Contracts and Regulation

5.3.5.8 Scenario Overview

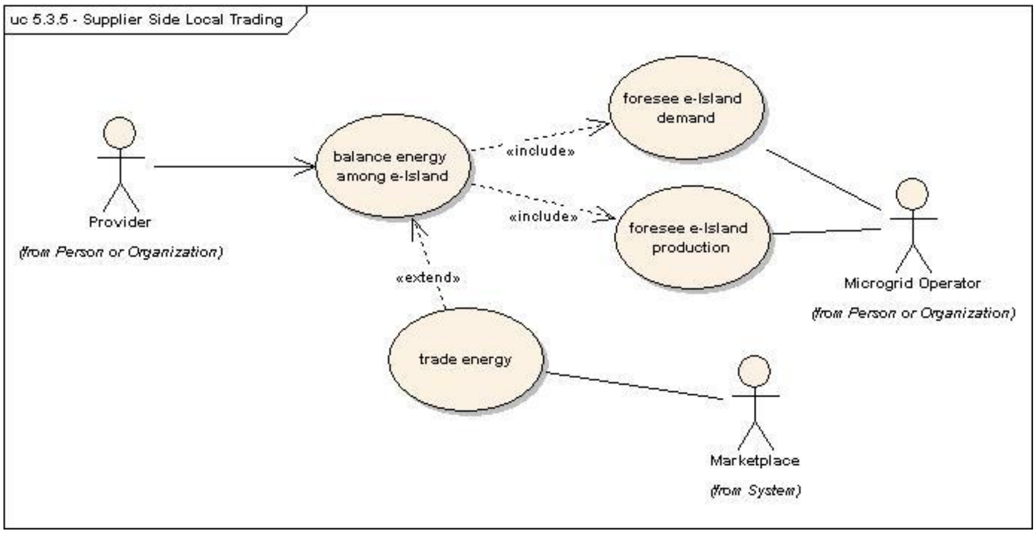

Figure 31: WP6_TS_SC5 Scenario UML Diagram

5.3.5.9 Use Cases Analysis

5.3.5.9.1 Balance Energy Among e-Island - WP6_ TS _SC5_UC1

This use case considers that the Provider can assure the balancing of the energy among e-Islands, leveraging on market mechanisms. In fact they can sell the energy surplus of one e-Island and vice versa, he can purchase the missing energy both by trading energy. More details are on the UC – Trade Energy.

5.3.5.9.2 Trade Energy WP6_TS_SC5_UC2

This use case takes in account the use of the Marketplace where Providers can trade energy.

The Provider able (Subscribed and authorized)) to operate on the Marketplace can provide their offerings and can look for the offering provided by the other ones.
The energy provider can provide a generic (for all the other participants) or targeted (for a specific market participant) offering. The trading is moderated and managed by an external actor which is in fact the Marketplace Operator (normally assigned by the national governments).

5.3.5.9.3 Foresee e-Island Demand WP6_TS_SC5_UC3

Currently the demand is estimated, based on a statistical approach taking in consideration historical energy (generation/distribution/consumption) data and weather forecasts. Anyway the new technologies such as, Home/building smart metering, sensors and ICT application for the data analyses and prediction could improve deeply this state of the art and the reliability of the data that is provided.
Accurate and efficient forecasts for short-term and long-term horizons of energy consumption as well as for requests, with time shifts are a fundamental precondition for dynamic and fine-grained scheduling of energy demand.

5.3.5.9.4 Foresee e-Island Production WP6_TS_SC5_UC4

The e-Islands Energy production is provided from different sources and from different small providers. For this reason the production forecast is very difficult to assemble considering that it is influenced by many external variables.
Lots of methods having the objective of improving the Production forecasts (and demand, too) exist.
They include:

- concept such has micro-request (to handle the energy demand and supply on an household level);
- the use of historical data combined with weather forecasts;
- aggregation of the micro-request in order to get wider analysis at regional level.

6. Conclusion and ICT relevance of the use cases

In this deliverable an analysis, identification and specification of relevant use cases for the FINSENY project in the area of the Electronic Market for Energy (eMarket4E) has been carried out.

Considering the whole range of possible services and scenarios in the area of the eMarket4E was a complex endeavor. This is as a huge amount of services can be defined, tackling the increasing needs of handling services for a wide community of users that offer their products and services in a transformed and dynamic energy market place.

In section 4 the choices made and methodology chosen are clearly explained, in a way that the reader understands why we have organized the use cases in 3 big business cases applicable to the eMarket4E:

1. Information and final user contracts about energy use
2. Demand Side Management
3. Energy Trading

The evaluation process followed a systematic methodological approach which has been established by the IntelliGrid project and subsequent work (IEC/PAS 62559). Careful discussions between all FINSENY work packages on the methodology as well as focus and range of use cases lead to a consistent approach throughout the project.

For the eMarket4E scenarios that can be found in the deliverable, the ICT relevance is intrinsic to the scenarios in principle, because of the fact that the Marketplace relies heavily on Internet-based applications or portals, handling information that is facilitated to the various marketplace players in the form of Web Services or APIs. The “Marketplace heart” is thus the Internet.

Nevertheless, below a couple of tables is appended that presents in a summarised way how the use cases impact relevant ICT criteria.

ICT Requirements	SCENARIOS				
	WP6_IFUCEU_SC1	WP6_IFUCEU_SC2	WP6_IFUCEU_SC3	WP6_IFUCEU_SC4	WP6_IFUCEU_SC5
Communication (e.g. QoS, bandwidth, latency, reliability, determinism, grade of distribution)	This scenario will require real -time communication. Reliability should be high although high bandwidth is not needed. The data distribution will be regular over a 24h period.	An information system for the final users, requires real-time communication with medium latency but with high reliability.	Monitoring the available kind of energy in real-time requires communication with medium bandwidth and a high grade of distribution.	In order to avoid acceptance problems of the electronic marketplace, high reliability is needed as well as a not too low latency.	* same as for WP6_IFUCEU_SC1
Data and context management (e.g. volume, models, mining, grade of distribution)	The volume of instant data is not high. But large amounts of data are to be saved on a server. Context management is key to determine information of various devices well identified. A high number of parameters will be needed for the profile of customers and devices.	The huge number of smart meters leads to a large grade of data distribution.	High demand for context-based and filtered data management to create models on user energy buying habits.	For reliable forecasts of grid load and energy demand, huge amounts of historical data need to be analyzed with intelligent-data-analysis techniques.	* same as for WP6_IFUCEU_SC1
Processing (demand, grade of distribution)	Processing will depend on the simulation capabilities of the service. If the latter are not offered for energy consumption, no big processing engines will be needed.	Availability of high capability servers to face the numerous information requests on the Web portal.	Very high demand of computing resources dedicated at the automata SW entity which observes and stores the final user energy buying habits.	Forecasting grid load and energy demand leads to a high demand of computing resources to face the amounts of historical data. Distribution is not necessary but might be employed for better scalability.	* same as for WP6_IFUCEU_SC1

Service integration (openness, standard interfaces)	The service will need to follow Web 2.0 guidelines and openness. Mostly Web-based interfacing technologies will be used.	Seamless integration of 3rd-party services for the Web site management and its interface with relational databases.	Integration of 3rd-party services (e.g. technical consultant service, business forecast).	Standards are needed to facilitate a free market. In particular electronic energy contracts need to be standardized and legally binding.	* same as for WP6_IFUCEU_SC1

Table 42: Use Case ICT Relevance Summary (1)

ICT requirements	SCENARIOS					
	WP6_DSM_SC1	WP6_TS_SC1	WP6_TS_SC2	WP6_TS_SC3	WP6_TS_SC4	WP6_TS_SC5
Communication (e.g. QoS, bandwidth, latency, reliability, determinism, grade of distribution)	In this service, latency, reliability and determinism is key to have a real effect on the demand curve (the user and service provider will have to trust the service quality). Latency will not be demanding (200 ms) but low latency is absolutely required. Reliability (no packet loss) is mandatory (ADSL level).	Reliability is a key factor for negotiating contracts and exchange energy on the marketplace. Low latency is also important for guarantying the effectiveness of energy transactions.	To monitor the energy needs of the clients and the energy price of the competitors requires communication with high reliability and high QoS.	Monitoring the available kind of energy in real-time requires communication with medium bandwidth and a high grade of distribution.	In order to avoid acceptance problems of the electronic marketplace, high reliability is needed as well as a not too low latency.	Real-time monitoring of the demand and production at e-Island level requires medium/high bandwidth and low latency in order to produce aggregated next to real-time reliable forecasting. Reliability is also important for the energy transaction on the marketplace.
Data and context management (e.g. volume, models, mining, grade of distribution)	Since almost real-time dynamic tariff schemes should be targeted, data volume will be high, and the management of the related contracts would be demanding because of the potential high amount of users.	The volume of instant data is not so high, but contract related information, energy transactions have to be stored on servers. More, huge amounts of historical data about consumption and production need to be analyzed in order to produce accurate forecasts of	The forecast of the energy needs and of the floating bid price requires models that make use of intensive data-mining processes.	High demand for context-based and filtered data management to create models on user energy buying habits.	For reliable forecasts of grid load and energy demand, huge amounts of historical data need to be analyzed with intelligent-data-analysis techniques.	The volume of instant data is quite high, due to the huge amount of distributed sources. Techniques of intelligent data analysis must be used to aggregate e-Islands demand/production and to produce reliable forecasts.

		energy demand/production.				
Processing (demand, grade of distribution)	The processing requirement in the servers can be really high since users should be able to simulate their energy consumption using advanced models that take into account the functionality of several devices.	High processing demand of computing resources is needed to face the potential huge amount of customers who have installed DERs at household level and want to join the marketplace.	Forecasting grid load and energy demand leads to a high demand of computing resources to face the amounts of historical generation and consumption data and intelligent-data-analysis techniques.	Very high demand of computing resources dedicated at the automata SW entity which observes and stores the final user energy buying habits.	Forecasting grid load and energy demand leads to a high demand of computing resources to face the amounts of historical data. Distribution is not necessary but might be employed for better scalability.	High processing demand is needed to enable both a fine-grained forecasting at e-Island level.
Service integration (openness, standard interfaces)	This service will have to be provided over the Internet, using Web interfaces. The protocols employed should be standard (TCP/IP, HTTPS, DES/AES for security).	Standard interfaces and protocols have to be used. The openness of the functionalities would enable an easy integration of 3rd-party services (e.g. forecasting services, incentives provider, etc.). Electronic energy contracts have to follow standards, too.	Integration with the weather forecast service and with the energy information provider.	Integration of 3rd-party services (e.g. technical consultant service, business forecast).	Standards are needed to facilitate a free market. In particular electronic energy contracts need to be standardized and legally binding.	Standard interfaces and protocols have to be used, so that aggregation and forecasting services can be easily integrated. Moreover, different providers have to be able to access the marketplace by integrating its own system.

Table 43: Use Case ICT Relevance Summary (2)

7. References

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