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Domain operational models design (M6)

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Executive Summary

Smart Urban Isle is a project involving several technical and economic aspects that impact directly with governmental rules in the project participating countries. As expected, there are some European Directives that guide most of national regulations regarding SUI topics. From all of them, there are three main directives that should be highlighted:

- Directive 2010/31/EU on Energy performance of buildings which promotes the improvement of the energy performance of buildings within the Union, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness.
- Directive 2012/27/EU on Energy Efficiency which establishes a common framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union's 2020 20 % headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date.
- Directive 2009/28/EC on the promotion of the use of energy from renewable sources which stablishes a common framework for the promotion of energy from renewable sources. It sets mandatory national targets for the overall share of energy from renewable sources in gross final consumption of energy and for the share of energy from renewable sources in transport.

Moreover, additional topics such emission trading system, Energy-related Products (ErP) or rules for the internal market in electricity are also taken into account.

The project defines a Smart Urban Isle as "s*calable, flexible and inter connected urban space*" that employ the last trends in bioclimatic architecture and renewable energy technology to provide a sustainable and self-sufficient environment. Thanks to the information and communications technology, SUI develops a strategy that integrates power control and the optimization of the internal resources and the environment and creates synergies between buildings and energy systems making use of the scale advantages for renewable energy utilization and storage solutions. SUIs are composed by three domains: "bioclimatic building design", "management platform" and "urban isle mini-networks".

Accordingly, several challenges need to be faced and resolved. Throughout the project, all the PPs will deal with common issues that attach the global SUI concept, these are named as general challenges and are divided into two types: technical and non-technical. Integration of individual solutions and implementation of them are issues to be solved in between the technical challenges and how to get all the information and how innovative the concept is between the non-technical ones.

As a result of the analysis done of the identified challenges, a list of initial requirements is generated. To this mean, every requirement should be compared to a reference scenario in order to make them comparable. Thus, each expert field (bioclimatic architecture, management platform and mini-networks) has its own indicators allowing an easy comparison between them. Also, general indicators are identified. These indicators can be applied to all fields as they deal with economic and common indicators applicable to all.

In conclusion, each expert field will deal with its own innovative issues.

Bioclimatic architecture

The building scale contributes to the Smart Urban Isle in aiming at a local scale balance between consumption and production of the public building and the surrounding buildings. The SUI concept will contribute to the large-scale balance allowing to match different profiles of demand and generation. Bioclimatic design plays a key role in smoothing the peak loads and favouring a reduction in building and neighbourhood energy demand.Therefore, in the commencement of the design works, both for new developments and energy refurbishment of existing ones, the domain of bioclimatic architecture and landscape should be addressed, so as to initially reduce as much as possible the energy needs.The final impact of each domain could be measured in terms of decarbonization/m2 of the isle, considering the same initial investment and the incurred comfort on environmental levels.

Management platform

The SUI micro - network can be perceived as a network of objects (physical) which communicate together with active interaction, enabled by Internet devices and systems. The resulting energy system is significantly different from the conventional grid, particularly in terms of digitized nature, multi-directional flow of data and energy and active interaction between actors and components.

We will develop a software application to control, manage and monitor the Smart Urban Isle in order to characterize and supervise the status of the SUI. We will make use of existing and new ICT systems (personal mobile phones, sensors...) all over the SUI area. They are the *SUI Probes* that will bring online and fresh data to describe the SUI evolution over time.

We assume that every citizen/resident of the SUI area will soon have a smartphone so every person is able to interact with one personal device (individual SUI Probe). The future of smart cities will be surely based on the use of smartphones among other smart devices.

SUI's residents will install the SUI App in their smartphones, which will be interacting with the Management Platform. Through the installation of an app, the users will be connected to the management platform. This app will provide real-time information and will be a tool for residents to communicate directly with the manager and other SUI users. By cross-correlating different datasets, we can automate root-cause analysis of App sourced data and complaints. This way, we will be able to collect the following data:

- Geographical position. The aggregation of such positions will show the energy balance between the generation spots and the consumers
- Social networks. Information in social networks will be revised to detect interesting information for the SUI as they can be important issues for the users, such as new and existing problems, weather conditions, etc.
- Noise level. Using the micro of the smartphone we can have a map of noise in the SUI
- Light intensity. Using the sensors of the build-in camera we can analyse the light intensity surrounding each resident (indoor and outdoor)
- Connection with wearables (heart rhythm…)
- Electromagnetic waves around each user (Bluetooth, wifi,…)
- Infrared cameras can provide temperatures around a user
- Barometer. We can have the weather conditions in the SUI and even future predictions

- Podometer. We can detect the health conditions of the residents in the SUI and take decisions related to that
- Humidity sensor. We can map the humidity level in different areas of the SUI
- Thermometer. We can map the temperatures in different areas of the SUI and even in different buildings
- Ultraviolet sensors. We can analyse the ultraviolet radiation and take decisions related to that

Mini-networks

In this project a SUI will explore an optimum (financial, technical and energetic) between building measures and network measures, operated in a smart way by the management platform.

Through the advancement in the smart meter sector and further digitalization, new opportunities arise for efficient and smart applications. Furthermore, the convergence of energies offers potential to develop energy efficient and sustainable communities.In a next step a sufficiently large SUI may even offer balancing energies to the distribution operator and help stabilize the grid. All these considerations are not only valid for the power micro grids but also for the heating / cooling micro grids.

With the new development of decentralized, also bidirectional grids, the SUI model represents a new core unit within an energy-grid. Thus, the impact of the individual domains can be seen as follows:

- The individual domain is not only consumer but also producer of energy (PV, CHP etc.)
- The individual domain has the capacity to store energy (electric and/or thermal) or is connected to such energy stores
- The individual domain is part of a load management system
- The individual domain is possibly part of a DC mini-grid
- Connection to general AC, gas, heat or cooling grids is just one possible energy source