

DSO ROLE IN THE DEPLOYMENT OF SMART CITIES SOLUTIONS: THE CASE OF THE LISBON URBAN SHARING PLATFORM AS A SERVICE PROVIDER

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ABSTRACT

Urban areas have been growing, both in size and population, which has led to rising problems related to demography, climate change, energy consumption and mobility. The need for providing solutions to these challenges, and achieve the targets proposed for a clean transition, motivated cities and its stakeholders to develop alternative and innovative urban planning strategies and tools to overturn them, based on new technology and integrated infrastructure to meet citizens and business needs.

This article explains the type of challenges the Portuguese DSO is facing in cities, specifically in Lisbon, the data that is being collected, how it will be shared and how different stakeholders, including the citizen will be impacted by the new Urban Sharing Platform, developed by the Sharing Cities Programme. (<http://www.sharingcities.eu/>).

INTRODUCTION

Cities are facing several challenges related to climate change, mobility constraints, high energy consumption and increasing demographic levels. From 2001 to 2017, the Lisbon Metropolitan area has seen a population increase of 5.7% [1], mainly in suburban areas. Smart city solutions have risen to face these challenges and, consequently, achieve the targets imposed by the 2030 climate & energy framework: decrease greenhouse gas emissions by at least 40% compared to 1990 levels; introduce a renewable energy share of at least 27% and improvement in energy efficiency of at least 27% [2]. In a smart and sustainable ranking of 28 European capital cities, Lisbon ranked in 14th position [3]. Over the last years, Lisbon has invested in the deployment of several measures to achieve these targets related with sustainable urban mobility solutions (e.g. bike sharing scheme with electric bikes, the deployment of one of the largest networks of electric vehicles charging stations, 39% of municipal fleet composed by electric vehicles, increase of 36% in electric vehicle sales in Portugal from 2017 to 2018 [4], among others) and energy efficiency (promoting implementation of energy management systems, introduction of smart meters for energy monitoring at a residential area, installation of PV, etc.).

As a consequence of these innovative and alternative solutions, the shape of the cities and the lives of its citizens is changing, particularly in what concerns governance and the role of influential stakeholders that play a major part in

the functioning of cities, such as Distribution System Operators (DSO). Furthermore, digitalization, the amount of urban data and of new software have also been increasing alongside the promotion of smart cities. City leaders and operators, including public and private organizations and companies, need to evaluate and decide how data will be collected and made accessible [5]. Data platforms, that can collect and aggregate the data created from the different sources, rise as an essential tool to extract their value from the data that comes. However, these platforms are also profoundly interlinked with socio-technical variables. Technical and governance challenges and collaborative forums that need to be continually negotiated by all the actors involved in the process, within and outside city administration [6].

CHALLENGES FOR DSO IN THEIR ROLE ON PROMOTING SMART CITIES SOLUTIONS

Currently DSO are facing several challenges and demands from consumers and authorities. At the same time, they still have to provide reliable services, comply with demands of decreasing greenhouse gas emissions, increase energy efficiency and raise the share of renewable energy. These challenges are related to the growing electrification of society, such as those concerned with mobility. Additionally, consumer behaviour is also a challenge, leading to more investment on programs such as demand response programs to help consumers manage their consumption. Finally, DSO also need to consider security and privacy challenges, since the growing digitalisation of cities and citizens entails a larger exposure to cyber-threat. DSO takes a key role on the communities they serve, and Lisbon is not an exception. No one knows city infrastructure better than DSO which puts us in a unique position to help develop smart cities that connect basic neighbourhood infrastructure to synergistically improve operational excellence, revenue potential and sustainable lifestyle. As more distributed energy resources come online, DSO face the challenge of maintaining grid resiliency and stability while meeting the demands of customers who may increasingly pursue energy independence by installing solar, wind or on-site energy systems. All of these challenges require a smart DSO in order to maintain operational excellence and at the same time sharing open data relevant in the context of smart cities.

DSO already incorporate advanced technologies for mapping, meter reading and SCADA systems in their

internal systems. The next step must be to integrate some internal systems with urban sharing platforms and obtain additional relevant data through smart meters in the smart cities context. Obviously this amount of data needs a special concern in terms of cybersecurity therefore it is important to develop some technologies in order to encrypt and share data

The transition towards more renewable energy, diversified supplies and digital disruption are creating opportunities, challenges and some threats for the security of the global energy infrastructure.

There are 3 current trends that contribute to system disruption:

1. Decarbonisation and Electrification: critical elements to achieve low carbon objectives, through new innovative technologies are key to increase flexibility of the grid, such as electric vehicle, smart charging, storage or virtual power plants. As an illustration of this impact, replacing all combustion cars for EVs in Europe would increase electricity consumption by 25% and reduce CO₂ emissions by 30%. It is estimated that 2.2 trillion € in investment in the electricity sector in Europe will be needed in the next 20 years, of which 50% in renewable energy.

2. Decentralization in generation: Transforming consumers into active elements of the system will bring enormous pressure on grid management. Energy efficiency, solar photovoltaic, micro-grids, storage, prosumages are key issues, in a context in which the increase of distributed generation is expected and in a scenario in which the cost of solar distributed is estimated to decrease 70% over the next 10 years. This will lead to an even greater decentralization of the sector and can/will evolve in new business models with high market capitalization without physical assets: uber, amazon, airbnb, blockchain

3. Digitalization of the grid with smart meters, smart sensors, or better, the now called “dust of sensors”, the IoEverything and other technologies beyond the meter and the collaborative urban platforms, aggregators such as those developed in Sharing Cities in Lisbon, London and Milan. Digitalization is also related to the relationship with the customer, mainly in what concerns an energy system that is evolving to the web system, in which we moved from a central and traditional generation system to a mix of wind and solar energy, along with distributed resources. The system operators have to manage this new dynamic, digital and distributed grid with millions of interconnected people who can generate, store, manage and consume energy. As such, an active customer relationship manager must be one of the new roles to be defined for DSO according to the Clean Energy for all Europeans Package. Yet, Customers check their email every 36 minutes or 10 minutes for ages between 18 and 36, yet only interact with their *electricity provider for 9 minutes in 12 months (on average accordingly with the study Revealing the values of the new energy consumer/Accenture 2011/12).*

These three trends act in a virtuous cycle, allowing, amplifying and reinforcing development and their

individual contributions. Together they pave the way for a system where traditional boundaries between producers, distributors and customers are blurred, increasing the complexity of the system and its own governance.

This is a reinvention of the very role of utilities, a new market design, in need of a new European regulatory framework that can support the most efficient energy system, according to the new roles of the DSO. These DSO, anticipating this context in order to help the strategic decision in this sector and ensure the sustainability of the business itself, are attentive and intervening in this new ecosystem of energy that has become a web system: where there are new rules of engagement and digital relationship.

SHARING CITIES LIGHTHOUSE PROGRAMME

This H2020 programme aims to achieve a wide scale deployment of smart cities solutions, shifting the thinking to decarbonized and local renewables and to make the active engagement of citizens a reality. It also demonstrates how the innovative use of technologies and new products can improve city life and can help our cities to be safer, cleaner, smarter and more social, by improving urban mobility, energy efficiency in building and carbon emissions.

The vision of Sharing Cities is of a more agile and more collaborative smart cities market that dramatically increases the speed and scale at which we implement smart solutions across European cities. By sharing solutions, practices, experiences and results, and by improving the way city data is managed, the Sharing Cities programme is co-creating an improving living environment and at the same time reducing energy costs.

The demonstration districts in ‘lighthouse’ cities Lisbon, London and Milan is implementing replicable urban digital solutions and collaborative models. The Royal Borough of Greenwich in London, Porta Romana/Vettabbia in Milan and downtown Lisbon is retrofitting buildings, introducing shared electric mobility services, and installing energy management systems, smart lamp posts and an urban sharing platform through engaging with citizens. ‘Fellow’ cities Bordeaux, Burgas and Warsaw are co-developing, validating, or implementing the above solutions.

The URBAN SHARING PLATFORM (USP) and CITY DATA

As defined by the Sharing Cities Programme the Urban Sharing Platform (USP) is an overarching collection of technical components, capabilities, standards, guidelines and processes, which provides functions and services that enable a Smart City. The main purpose of the USP is to aggregate data and control from a wide variety of devices and sensors, store and process the data, and support visualization of the information to the city and citizens, which enables better use of the city resources. The reference architecture which supports the different platform flavours of the lighthouse cities (London, Milan

and Lisbon) is represented in the following picture (Figure 1).



Figure 1. USP Reference Architecture

The API and Data Sharing (top) layer supports the seamless access and presentation of platform information to city stakeholders (citizens, city managers, commerce etc.) by a variety of tools: API and service marketplace, business intelligence capabilities, data visualization and dashboards. It defines standard interfaces and provide end-users with seamless integration with the USP as for data and function access.

Some outstanding examples may be referred as clients of the USP at this layer; city integrated operational centres with data visualisation capabilities (as for example the energy consumption graphic represented in Figure 2) and end-user applications for citizen engagement which access to data through well-defined APIs.

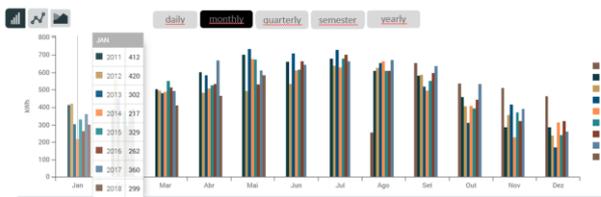


Figure 2 - Municipality Energy Consumption

Over the USP, Altice Labs developed an application for Lisbon citizens to change behaviour and boost sustainability (<http://www.alticelabs.com/en/index.html>). Through gamification and Nudge theory, users gain tokens for their sustainable activities such as energy savings, use of bikes and e-cars, purchase in local shops supporting local communities as schools. Tokens are then exchanged with physical rewards, creating a Digital Social Market (DSM) (Figure 3).



Figure 3 - Digital Social Market (Lisbon)

The Data Storage and Analytics layer is responsible for the persistence of the data, in all its different forms (structured, non-structured, geographic, pair-values etc.), that is used and managed by the USP. It also offers effective and efficient mechanisms to query and retrieve the data, to control the data flow, and to support analytical capabilities of the solution.

Through open and private APIs provided at the previous layer it is possible to access and monetise raw or processed information from different data providers.

The Device Sharing (bottom) layer supports data collection from the cities sensors and devices, providing connectivity and low level data aggregation when needed. Sensing layer of data feeds for both legacy and new devices, through the use of gateways and directly to more intelligent devices sharing capabilities. It also provides direct integration with city and external data sources that may be open or private in nature.

Other internal components provide supporting functions such as identity management, service brokering, service monitoring, integration with external cloud-based “XaaS” features etc. Specific interfaces to these components may vary in each city because they are tightly linked to the specific tools and solutions used to implement these logical functions.

In Lisbon, energy, mobility and environmental data providers interact with the USP through well-defined APIs, as represented in figure 4. The platform has been implemented by Altice Labs and partners as CEIIA (<https://www.ceiia.com/>), EMEL (<https://www.emel.pt/>), EDP Distribuição (<https://www.edpdistribuicao.pt/>), LEN - Lisboa E-Nova (<https://lisboaenova.org/wp/en/homepage-en/>) and the CML - Municipality of Lisbon (<http://www.cm-lisboa.pt/en>) provide the needed smart city IoT data to populate the USP.



Figure 4 - Lisbon Platform

Besides the Digital Social Market (DSM) and integrated with the USP there are two other important components which at different levels contribute to the global vision of the city energy sustainability. They have been named:

- SEPS (Sustainable Energy Planning System) and
- SEMS (Sustainable Energy Management System)

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