SHARINGCITIES

Smart booklet

Sustainable Energy Management System

Towards an energy positive district

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LIST OF ACRONYMS

EV	Electric Vehicle
SEMS	Sustainable Energy Management System
SEPS	Sustainable Energy Planning System

LIGHTHOUSE CITY KEY

	Lisbon
	Royal Borough of Greenwich, London
	Milan

April 2020

This booklet was prepared through the collective knowledge from Sharing Cities and building on the experience of the wider context of the SCC01 Lighthouse programmes involving 17 projects, 116 cities and hundreds of partners. More information about the Lighthouse programmes can be found here.

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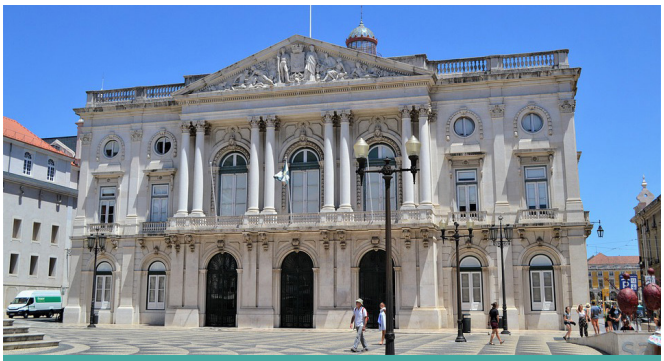
THE VALUE OF IMPLEMENTING SEMS

WHAT?

The Sustainable Energy Management System (SEMS) is a modular system which centralises information from, and control over, many local energy systems and devices. SEMS integrates heat, power, transport, and the built environment, combining data connectivity and the internet of things to optimise energy systems and strategies. For example, through the SEMS, you could see combined information about energy demand from your heating system and electric car chargers, which would be optimised in real time based on your desired outcomes.

WHY?

Cities account for about 65% of global energy demand and 70% of energy-related CO_2 emissions. The generation and consumption of energy poses challenges for urban areas: energy poverty, network reinforcement costs associated with increased electrification, air quality and load balancing. In a complex energy system, machine learning and advanced algorithms are able to process data inputs in real time; improving decision making, reducing system inefficiencies, and delivering financial, social and environmental benefits.



A SEMS is saving €5,000 per year in energy costs at Lisbon City Hall.

FINANCIAL VALUE

- Lower energy bills
- Revenues from capacity markets, balancing services and energy system flexibility

ENVIRONMENTAL VALUE

- Lower emissions
- Improved air quality

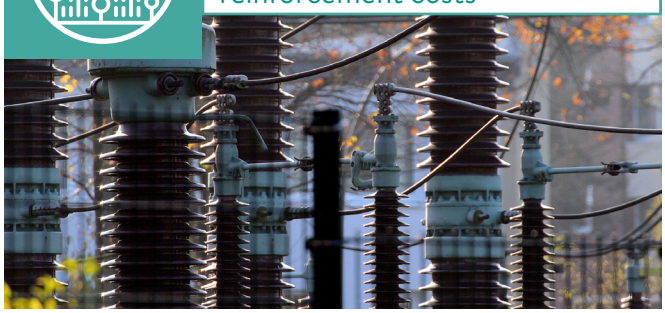
SOCIAL VALUE

- Reduced energy costs
- Improved home comfort
- More reliable energy supply

The average London household spends **€1,382*** a year on energy bills. In our trials, the SEMS is delivering a **10%** reduction.

ECONOMIC VALUE

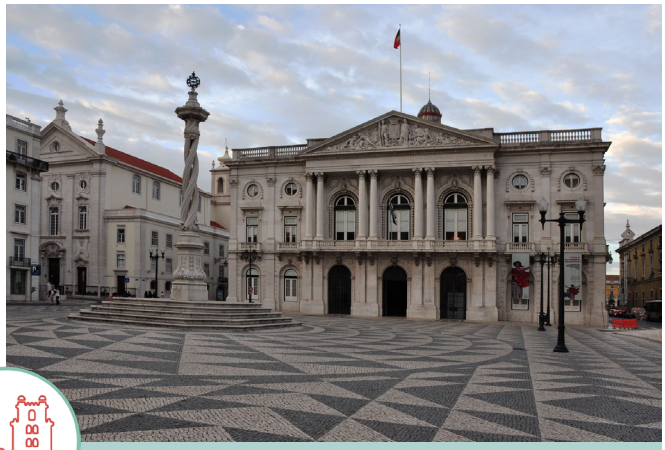
- Longer life of energy assets
- More distributed energy generation
- Reduced or delayed grid reinforcement costs



*Conversion rate: £1 = €1.18

SHARING CITIES SOLUTIONS

A SEMS is a common solution across our three lighthouse cities, but its implementation varies to account for the local conditions and priorities.



The SEMS in Lisbon is integrating existing energy generation and consumption assets at the historic City Hall. Smart meters, smart plugs, and water storage heaters with timer switches are being controlled in near real-time by trained members of staff to optimise energy use within the building. It reduces operating costs, maximises consumption of self-generated renewable energy, and improves comfort levels. At district level, the Sustainable Energy Planning System (SEPS) is a digital representation of the solar potential within the city. It supports investment decisions for solar photovoltaic and helps the municipality to more effectively target new renewable installations.

Milan has deployed SEMS in the Porta Romana district to increase consumption of local PV generated power, reduce grid consumption, and shift peak electricity demand.

The system automates and optimises renewable energy consumption for public and private buildings. It reduces energy costs, increases local consumption of renewable electricity, and reduces emissions. Milan is also using the SEMS to monitor energy supply and demand of electric vehicles (EVs) charging points, supporting decision making of municipal energy managers and asset owners to shift consumption and avoid grid constraint.

In London, the SEMS is performing predictive forecasting and energy balancing for new energy assets including a low carbon heat network at a social housing estate in Greenwich. The system is able to optimise performance based on a number of desirable outcomes including lowest operating cost, cheapest energy for residents, highest air quality, and lowest emissions. The system incorporates demand side response and renewable generation to optimise energy system performance and to provide grid services such as reducing peaks and shifting the energy demand.

DOES SEMS RESPOND TO MY NEEDS?

Your local context, including legislation and cultural conditions, affects the kind of SEMS that is ideal for your city, and the adjustments to the standard model that you may have to make. Here is a brief overview of key factors you will have to consider when planning your approach.

The SEMS in Lisbon is improving the energy performance of buildings in a UNESCO World Heritage site where traditional energy efficiency measures are prohibitively expensive.

Political leadership
Governance
Smart city & data strategy
Citizen engagement
Legal and regulatory

POLITICS, POLICY & REGULATION

London is a city that experiences a daily double-peak in electricity demand. These peaks put enormous pressure on the distribution network which would require expensive reinforcement without load-shifting and peak reduction.

Security
Lifestyles
Demography
Cultural heritage

SOCIAL & CULTURAL CONDITIONS

CITY 'PHYSIOLOGY'

Climate
Assets and infrastructure
Natural assets
Geography

The location of Lisbon in south-western Europe presents great opportunities for solar PV generation but also challenges, as mechanical cooling is extensively used. A flexible energy system helps to balance supply and demand.

ECONOMIC PERFORMANCE

Market readiness
Technology
Performance
Investment
Appetite for risk and innovation
Entrepreneur ecosystem

Milan is looking to implement innovation in the energy sector following a harsh and prolonged economic crisis. The SEMS represents a radical change in the way the energy system is operated, delivering immediate financial benefits.

TECHNICAL OPTIONS

The SEMS has been developed on the principle of open, interoperable, component-based modular architecture that delivers flexibility and choice for cities in selecting solutions to meet their specific requirements and take advantage of local assets.

There are five main considerations when setting-up a SEMS:

Data and communication technology

- What field devices and communication protocols will be deployed for measuring and monitoring
- What assets in your energy system can be controlled
- What external variables will be integrated into the control strategy
- A single 'general purpose data acquisition layer' can simplify data acquisition – for the SEMS in Sharing Cities, the Urban Sharing Platform performs this function

Interfaces

- Visualise the decision making process and subsequent outcomes to provide transparency and confidence in the system
- Online interfaces are easy to use, widely accessible and provide necessary security features
- Mobile applications allow building managers to access information remotely
- Simple dashboards provide important information at a glance
- Menus and drop-down options allow for easy navigation
- Rewards, alarms, and notifications retain engagement

Control strategy

- Advanced predictive controls optimise performance based on a forecast of the future
- Real time management eliminates latency inefficiency from the system
- Automation provides fast response rates while manual intervention allows building managers to supplement decision making with local knowledge
- Dynamic learning allows a SEMS to perform without complete information and refine performance over time
- Active demand and load management allows for predictive maintenance to identify potential issues before they occur
- A SEMS can support scenario planning to better inform decision making

Algorithms

- Features such as an algorithm engine will allow algorithms to be added by third parties or adapted to specific requirements
- System constraints, parameters and acceptable thresholds need to be defined
- A coordination layer will resolve district wide constraints and conflicts arising from local optimisation

System architecture and integration

- Local gateways and intermediary hubs provide scalability combined with system robustness
- A cloud server provides a simple solution for scalability but issues of security, liability and contingency need to be considered
- An embedded integration layer simplifies responsibility for operation and maintenance of the system by creating a clear demarcation between the assets, building and SEMS

FUNDING AND FINANCING

Finding the right business models and financing options is important to develop, implement and sustain the ongoing deployment of a SEMS.

OWNERSHIP

Maintaining city involvement is essential for a SEMS and the subsequent implications for a crucial aspect of city infrastructure: the energy system. Cities may elect to own and operate the SEMS directly, or work with the private sector. 100% ownership requires significant in-house resources and takes on all of the risk while partnering with a private organisation dilutes control but adds know-how and financing.

SELECTION OF A BUSINESS MODEL

Energy assets, monitoring sensors, management systems and even data are all proprietary rights within the energy system. Without a market incentive to collaborate or a regulatory requirement to standardise, integration of proprietary elements will not happen at a district or city scale. Therefore, a SEMS requires a city actor to act as project lead.

Roles

- City: Specify the system requirements, define assets for inclusion, determine co-ordination layers, procure technical support and define objectives.
- Technical Partners: Refine the design and specification, provide tailored algorithms, establish data monitoring and communication systems, provide data storage, implement control strategy.

In Sharing Cities, the business model varies across the three cities.

Lisbon commissioned delivery of its SEMS and pays for staff to be trained in operation and maintenance of the system which allows them to continue day-to-day operation. Large scale changes will be procured from third parties as required.

Greenwich and technical partners invested in the development of a new product which has replication potential. This product has used open source solutions and it is expected that in this form there would be no cost for its adoption or use; there will be costs for on-going maintenance and technical support.

Milan procured an 'off-the-shelf' product with minor personalisation and paid a license and maintenance fee for its continued deployment.

EXAMPLE COSTS OF THE SEMS PILOTS ACROSS LIGHTHOUSE CITIES

Greenwich	Lisbon	Milan
€850,000	€400,000	€215,000

COMMON CHALLENGES AND RECOMMENDATIONS

DEVELOP YOUR USE CASES AND KEY PERFORMANCE INDICATORS, IDENTIFY ANY SKILLS GAPS

Your unique city context means that a one-solution-fits-all approach to SEMS does not facilitate scale-up and replication

Consider the unique characteristics of your city, the assets available and the organisations involved. Be open and honest about the specific energy challenges in your city and focus on a couple of high priority issues. Consider your solution design before engaging in the tender process.

DEVELOP AN ASSET REGISTER

Existing assets have old or no data monitoring or control systems

Understand your existing energy assets, including the available data and control functionalities that they provide. Older assets will have limited control functionality and may require new sensors and meters for enabling data connections. In some cases, assets may need to be replaced or upgraded and it is better to know this as early as possible as it can be time consuming.

OPEN PROTOCOLS AND SYSTEM INTEROPERABILITY

It is difficult to anticipate further innovation in the energy system and the possible future needs

A SEMS is intended to free cities from technological lock-in. The modular nature allows new innovations to be introduced into the system without making the existing system redundant, saving time and money. Open protocols and system interoperability will allow you to integrate new objectives, assets and functionalities in the future without knowing now exactly what they might be.

SET REALISTIC AND ACHIEVABLE OBJECTIVES FOR SEMS THAT CONSIDER YOUR TECHNICAL AND RESOURCE LIMITATIONS

A SEMS is a highly technical solution that requires significant budget and resources

Some challenges, such as integrating EV charging points or forecasting energy demand in a public space are very complex, and while solutions are possible, they are expensive and time consuming, so factor this into your project plan.

INTEGRATE YOUR DELIVERY PLAN WITH OTHER PLANNED ACTIVITY IN YOUR CITY

A lack of awareness of other city development projects

An understanding of planned activity will inform the scope of the SEMS in your city and allow for a smoother integration of new functionalities, assets and systems. An awareness of the timelines for delivery will also improve project planning, enabling an anticipation of key periods of implementation and allowing for suitable resourcing.

Integrate your delivery plan with other planned activity in your city; aligning the scope of this activity with your aspiration for a SEMS. This might include building upgrades and retrofit, e-mobility infrastructure and vehicle deployment, and renewable energy installations.

BUILD AND MAINTAIN STRONG RELATIONSHIPS WITH PROJECT STAKEHOLDERS

A history of siloed approaches within the energy sector makes integration a practical challenge

In a sector that is not used to integrated collaborative approaches, having close relationships with your stakeholders will ease the implementation of technical solutions. More importantly, it is critical for establishing the contractual arrangements around data sharing, asset/network performance and actuation that are essential for the project to be delivered. A system-wide energy solution involves many different actors from wide ranging industries; many of these actors will have their own objectives which will regularly conflict or complicate the solution.

About Sharing Cities

Sharing Cities is a project to improve the lives of citizens across Europe, testing smart solutions for cleaner, more efficient cities. New systems for urban energy management, building retrofit, e-mobility and smart lampposts, are cutting carbon emissions in cities as well as making everyday life more affordable, comfortable and convenient for residents. Sharing Cities is testing and evaluating these smart city solutions together with citizens and creating channels to make them more affordable and better tailored to cities' needs. They are doing this through fostering international collaboration between cities and the private sector.

Additional information on Sharing Cities can be found on the website: http://www.sharingcities.eu

More information

Additional information and guidance about other smart cities projects can be found on the Smart Cities Information System's website: https://smartcities-infosystem.eu/solutionbooklets

UN. Global initiative for resource efficient cities, Paris, France, United Nations Environment Programme. https://resourceefficientcities.org

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