

BUILDING SMART CITIES TOGETHER

SHARINGCITIES



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D.5.10. REPORT

SCIENTIFIC PUBLICATIONS

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PURPOSE OF THE REPORT

The proposal of the project stated that “two scientific publications where lighthouse cities will present their project outcomes and more specifically what technologies and solutions were developed together with private partners” would be produced. After three years of implementation, some of the solutions implemented in the three lighthouse cities of Sharing Cities have been analysed and used by academics and scientists in their research. This report gathers information on all the scientific publications that used Sharing Cities measures to support and illustrate their research.

The list demonstrates the interest of researchers and academics to analyse the implementation and the added-value of smart cities measures developed by the project. The scientific publications which have so far used Sharing Cities as a reference focussed on several aspects such as building retrofit or the energy performances of smart cities.

List of scientific publications indexed:

Title	Authors	Date
An Exergy Analysis for Milano Smart City	Francesco Causone, Andrea Sangalli, Lorenzo Pagliano, Salvatore Carlucci	March 2017
Enabling Energy Smart Cities through Urban Sharing Ecosystems	Maurilio Zuccalà, Emiliano Sergio Verga	March 2017
Monet: An Innovative System to Manage Energy Services	Maurizio Bigoloni, SaraFilipponi	March 2017
Assessing energy performance of smart cities	Francesco Causone, Andrea Sangalli, Lorenzo Pagliano and Salvatore Carlucci	August 2017
The effect of weather datasets on building energy simulation outputs	Silvia Erba, Francesco Causone, Roberto Armani	October 2017
Addressing the challenges of public housing retrofits	Cláudia Sousa Monteiro, Francesco Causone, Sónia Cunha, André Pina, Silvia Erba	October 2017

The vehicle relocation for electric free-floating car-sharing services	Roberto Nocerino, Paola Tresca, Maurizio Bruglieri, Alessandro Luè and Luca Studer	April 2018
Smart energy systems for sustainable smart cities: Current developments, trends and future directions	Edward O'Dwyer, Indranil Pan, Salvador Acha, Nilay Shah	March 2019

COLLECTION OF PUBLICATIONS

- **“An exergy analysis for Milano smart city”, Francesco Causone, Andrea Sangalli, Lorenzo Pagliano, Salvatore Carlucci, in Energy Procedia**

Abstract: Cities represent fundamental hubs in the world’s energy-flow network, and their role is expected to gain further relevance in the next decades, following the ongoing urbanization process.

Reducing energy use and increasing energy efficiency are crucial aspects for both existing and planned cities, and many policies have been established to pursue these objectives. However, in smart cities, as the ones envisioned in many on-going research projects, energy should also be used in a smart way, that is reducing the energy degradation in terms of capacity to generate useful work.

Starting from the literature, the paper proposes an analysis method, based on exergy, to support smart city planning, with the aim to provide the decision maker with a useful tool to compare and understand the energy-smartness of different scenarios, and to address future energy urban policies. Possibilities and limitations of the analysis method are discussed via the application to the city of Milano that committed to become a smart city.

Link: <https://www.sciencedirect.com/science/article/pii/S1876610217302825?via%3Dihub>

- **“Enabling energy smart cities through urban sharing ecosystems”, Maurilio Zuccalà, Emiliano Sergio Verga, in Energy Procedia**

Abstract: In order to build real smart cities, heterogeneous data from different sources has to be properly collected, integrated and shared. In this paper, a real district scale example of urban sharing ecosystem based on co-competition is presented. This digital ecosystem enables data sharing that can be synergically applied to different sectors relevant to the urban context, e.g., energy and transportation, in order to create innovative solutions for energy monitoring, citizen engagement, and evaluation and monitoring at district and city level.

Link: <https://www.sciencedirect.com/science/article/pii/S1876610217302783>

- **“Monet: An Innovative System to Manage Energy Services”, Maurizio Bigoloni and Sara Filipponi in Energy Procedia**

Abstract: The “Mastering and Operate Next generation of Energy of Things” (Monet) is an innovative solution for energy efficiency services. It supports monitoring, controlling and remote management of field devices in order to offer advanced energy management services, towards Active Demand. It is a multi-tenant platform, able to address the needs of multiple stakeholders. Monet can manage third party field devices installed in different areas and connected to internet with the aim to obtain energy monitoring and management. Monet can be also interfaced to other asset management systems and service platforms, in order to exploit a comprehensive set of data and tools. The system has been applied in the Universal Exposition EXPO 2015 in Milano, integrated with the smart grid therein installed, to manage the exposition area as a real smart city. An evolution of the system has been applied in “Smart Recharge Island” (SRI), an innovative microgrid project for the Piedmont region, to manage the generation and the consumption of data in the Environmental Park.

The system will be used in Sharing Cities Horizon 2020 funded project, as a complete dashboard for energy building manager and municipality manager. In this paper both the system architecture and concept, and the challenges encountered during the implementation of SRI will be reported as interesting lessons learned in designing a solution for energy efficiency and microgrid load management.

Link: <https://journals.sagepub.com/doi/10.1177/0143624417725220>

- **“Assessing energy performance of smart cities”, Francesco Causone, Andrea Sangalli, Lorenzo Pagliano and Salvatore Carlucci, in SAGE journals**

Abstract: The massive urbanization process registered since 1950s and projected to continue for the coming decades is posing a crucial issue for the management of existing cities and the planning of future ones. Smart cities are often envisioned as ideal urban environments where the different dimensions of a city, such as economy, education, energy, environment, finance, etc., are managed in an effective and proactive way. Nevertheless, in order to reach this remarkable and challenging objective, analysis tools are required to create scenarios that are able to inform policy makers’ decisions. Focusing on energy, this paper proposes an analysis method, based on exergy, to support smart city planning. It may help the decision makers to assess the energy-smartness of different scenarios, and to address urban energy policies. Possibilities and limitations of the analysis method are discussed via the application to the cities of London, Milan, and Lisbon that committed to become smart cities.

Practical application: The paper summarizes a study on the possibilities and limitations of adopting an assessment technique, based on exergy, in order to evaluate the energy-smartness of policies in existing and future smart cities. As highlighted in the paper, building’s energy uses have a huge share of many cities’ energy breakdown. Thus, professionals in the building industry will be interested in the paper not only because it refers to smart cities, but because the built environment plays a pivotal role in them. Professionals may also refer to this study to perform a similar analysis in other urban environments to support decision makers.

Link: <https://journals.sagepub.com/doi/10.1177/0143624417725220>

- **“The effect of weather datasets on building energy simulation outputs”** Silvia Erba, Francesco Causone, Roberto Armani, in energy Procedia

Abstract: Results of dynamic energy simulations of buildings are affected by many uncertainties, which are the main reason of the performance gap registered between simulated and operational performance. They depend mostly on the incorrect modelling of building components and their properties, the inadequate characterization of operational schedules, the limitations in the simulation algorithms used by energy simulation software, the quality and reliability of data contained in weather files. The first three limiting factors are somehow under the control and capacity of the person in charge of the simulation, that, nevertheless, may not always be able to get detailed building specifications to identify the correct set-points and schedules, or to choose an alternative simulation software. The information contained in weather datasets are, however, completely out of the control of the person in charge of the simulation that may only assume them as a boundary condition. Unfortunately, not all the weather databases show the same level of data accuracy; moreover, they may refer to a climate that substantially changed in the last decades. The effects on building energy simulation results, played by different weather files referred to the city of Milan, is showed and discussed, highlighting the substantial performance difference depending on them.

Link: <https://www.sciencedirect.com/science/article/pii/S1876610217346957?via%3Dihub>

- **“Addressing the challenges of public housing retrofits”** Cláudia Sousa Monteiro, Francesco Causone, Sónia Cunha, André Pina, Silvia Erba, in Energy Procedia

Abstract: European directives are pushing EU member states to promote energy retrofits of their building stocks. Nevertheless, building renovation stagnates due to many issues, including financial, informational, behavioral, educational and other challenges. All of these increase for the public housing sector, where specific problems such as fuel poverty and social exclusion sum up to common problems such as the tenant-landlord dilemma. On the other hand, public housing represents an important asset for local governments, both in terms of economic and social value. By improving the quality of life and the economic resilience of inhabitant of public housing, local authorities may obtain long-term returns for social inclusion, and citizens’ wellbeing. Following this perspective, the municipalities of Milan and Lisbon committed, within the larger framework of the EU funded Sharing Cities project, to promote the renovation of some pilot public housing estates. The design process, the objectives, the expected outcomes and the monitoring and assessment process are described in the paper, trying to highlight the potential benefit for tenants, local governments and, in the long run, for the whole society.

Link: <https://www.sciencedirect.com/science/article/pii/S1876610217347343?via%3Dihub>

- **“The vehicle relocation for electric free-floating car-sharing services”**, Roberto Nocerino, Paola Tresca, Maurizio Bruglieri, Alessandro Luè and Luca Studer, in

Proceedings of 7th Transport Research Arena TRA 2018, April 16-19, 2018, Vienna, Austria

Abstract: Free-floating is the new paradigm of car-sharing. These services enable one-way trips freely within a specified area, overcoming the need of a network of stations, that characterizes station-based services. Despite the increase of level of service for the users, free-floating poses a problem for the spatial distribution of the vehicles, due to a possible unbalance between the users-demand and the availability of vehicles. In such cases, the service provider has to develop strategies to reallocate the vehicles and restore an optimal distribution of the fleet of the car-sharing service. In case of free-floating services using electric-vehicles, the problem is even more complicated, due to the need of plug-in the vehicles to charging stations when needed. The paper presents a new model for vehicle relocation problem for an electric free-floating service, where cars are moved by operators of the service provider to keep the system balanced, generating a challenging pickup and delivery problem. The proposed algorithm has been designed and calibrated using real data from the city of Milan.

Link: <https://zenodo.org/record/1484940#.XHATDuhKg2y>

- **“*Smart energy systems for sustainable smart cities: Current developments, trends and future directions*”, Edward O’Dwyer, Indranil Pan, Salvador Acha, Nilay Shah, in Applied Energy**

Abstract: Within the context of the Smart City, the need for intelligent approaches to manage and coordinate the diverse range of supply and conversion technologies and demand applications has been well established. The wide-scale proliferation of sensors coupled with the implementation of embedded computational intelligence algorithms can help to tackle many of the technical challenges associated with this energy systems integration problem. Nonetheless, barriers still exist, as suitable methods are needed to handle complex networks of actors, often with competing objectives, while determining design and operational decisions for systems across a wide spectrum of features and time-scales. This review looks at the current developments in the smart energy sector, focussing on techniques in the main application areas along with relevant implemented examples, while highlighting some of the key challenges currently faced and outlining future pathways for the sector. A detailed overview of a framework developed for the EU H2020 funded Sharing Cities project is also provided to illustrate the nature of the design stages encountered and control hierarchies required. The study aims to summarise the current state of computational intelligence in the field of smart energy management, providing insight into the ways in which current barriers can be overcome.

Link: <https://www.sciencedirect.com/science/article/pii/S0306261919300248>

Sharing Cities has also been mentioned in several presentations during conferences gathering scientists and experts on specific topics. Hereunder is a list of these events:

Topic of the presentation	Conference	Authors
Understanding citizens' engagement and practices on sustainable mobility and energy efficiency in the deployment of smart cities infrastructures	<i>Proceedings of the 3rd Energy for Sustainability International Conference 2017. Designing Cities & Communities for the Future</i> , on 8-10 February 2017, Funchal, Portugal	Catarina Rolim, Joana Ribeiro, Renata Lajas, André Pina, Carlos Silva
Consumer insights on energy efficiency retrofit measures and business models	<i>ISIE-ISSST 2017: Science in Support of Sustainable and Resilient Communities</i> , on 25-29 June 2017, Chicago, USA	Catarina Rolim, Cátia Sousa, André Pina
Analysis of energy savings potential of building retrofitting at urban scale	<i>ISIE-ISSST 2017: Science in Support of Sustainable and Resilient Communities</i> , on 25-29 June 2017, Chicago, USA	Sónia Cunha, Cláudia Sousa Monteiro, André Pina
The use of multi-detailed building architypes in urban energy modelling	<i>Building Simulation conference</i> in August 2017, San Francisco, USA	Sónia Cunha, Cláudia Sousa Monteiro, André Pina
Energy transition enhanced by sharing energy management systems on local energy districts	<i>24th International Conference on Electricity Distribution</i> , on 7-8 June 2018, Ljubljana, Slovenia	Sónia Cunha, Vera Nunes, Jorge Moreira, Claudia Sousa Monteiro, António Aires Mateus, Catarina Rolim, Cátia Sousa
Development of a Digital Social Market to Promote Sustainable and Energy Efficient Behaviour: Lisbon Pilot	<i>5th European Conference on Behaviour and Energy Efficiency</i> , on 6-7 September 2018, Zurich, Switzerland	Catarina C. Rolim, Maria J. Caneiras, Carlos S. Silva
Dynamics of attitudes, intentions and behaviours in e-cycling	<i>hEART 2018 – 7th Symposium of the European Association for Research in Transportation</i> , 5-7 September 2018, Athens, Greece	N. Daina, C. Latinopoulos, F. Manca, K. Zavitsas, A. Sivakumar, J W Polak

Digital Social Market: Lisbon Pilot	<i>Presentation at Innovative Eco-city Conference, 27-28 September 2018, Warsaw, Poland</i>	Catarina Rolim, Telma Mota
DSO Role in the Deployment of Smart Cities Solutions: The case of Lisbon Urban Sharing Platform as a Service Provider	<i>Accepted 25th International Conference on Electricity Distribution, 3-6 June 2019, Madrid, Spain</i>	Vera Nunes, Carolina Carli, Catarina Rolim, Manuel Dordio, Telma Mota

IMPACT AND LESSONS LEARNT

This interest in the project from the academic world proves the cutting-edge innovation brought by Sharing Cities and its impact on urban environments. The assessment of smart city technologies' value appears to be critical for the transformation of cities and their transition to become more sustainable. The scientific evidence brought by these publications will contribute to the uptake of solutions by other cities which will have the empirical confirmation of the added-value of some smart city solutions. The scientific evidence could also play a crucial role in convincing decision-makers to invest in such solutions. Subsequently, this scientific reassurance on innovative solutions can also ease the market uptake, with more suppliers providing solutions to local authorities.

The list of publications above is not exhaustive as at least three other publications, which use the Sharing Cities project as a reference, are currently in a reviewal and approval process. Sharing Cities' outcomes will certainly be used as a reference for other scientific publications to be published over the next years, especially after results from the evaluation and monitoring period are exploitable. These scientific publications will represent a legacy for the project as some will be used to build on and further develop the solutions implemented in the demonstration sites of the three lighthouse cities.