Open data and energy analytics

Nastasi, Benedetto; Manfren, Massimiliano; Noussan, Michel

DOI
10.3390/en13092334

Publication date
2020

Document Version
Final published version

Published in
Energies

energies

MDPI

Editorial

Open Data and Energy Analytics

Benedetto Nastasi [1,2,*], Massimiliano Manfren [3] and Michel Noussan [4,5]

1 Department of Planning, Design and Technology of Architecture, Sapienza University of Rome, Via Flaminia 72, 00196 Rome, Italy
2 Department of Architectural Engineering & Technology, TU Delft University of Technology, Julianalaan 134, 2628BL Delft, The Netherlands
3 Faculty of Engineering and Physical Sciences, University of Southampton, Boldrewood Innovation Campus, Burgess Rd, Southampton SO16 7QF, UK; m.manfren@soton.ac.uk
4 Fondazione Eni Enrico Mattei, Corso Magenta 63, 20123 Milano, Italy; michel.noussan@feem.it
5 Department of Energy, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy
* Correspondence: benedetto.nastasi@outlook.com

Received: 10 March 2020; Accepted: 30 April 2020; Published: 7 May 2020

check for updates

Abstract: This pioneering Special Issue aims at providing the state-of-the-art on open energy data analytics; its availability in the different contexts, i.e., country peculiarities; and at different scales, i.e., building, district, and regional for data-aware planning and policy-making. Ten high-quality papers were published after a demanding peer review process and are commented on in this Editorial.

Keywords: open data analytics; energy planning; smart cities; open energy governance; urban database; energy mapping; building dataset; energy modelling; data mining; machine learning

1. Overview

Open data and policy implications coming from data-aware planning require collection and the pre- and postprocessing as operations of primary interest. These procedures require that data are freely available to people and decision-makers. Openness is, therefore, the best way. Referring to the relationship between data and energy, public administrations, governments, and research bodies are promoting the construction of reliable and robust datasets (i) to pursue policies coherent with the sustainable development goals, as well as (ii) to allow citizens to make informed choices. Energy engineers and planners must provide the simplest and most robust tools to collect, process, and analyze data, to offer solid data-based evidence for future projections at building, district, and regional scales for an effective systems planning.

For all these reasons, researchers encouraged by the call for papers shared their original works in the field of ''Open Data and Energy Analytics''. Among the numerous submissions, the following 10 successfully passed the review process.

2. A Short Review of the Contributions to This Issue

Cutting-edge outcomes of ongoing and recently ended European research projects are published in this Special Issue. In detail, two H2020 projects, namely, PLANHEAT and HOTMAPS, are the sources of innovative results published in three original articles.

The paper authored by Fremouw et al. [1] deals with the role played by open data in supporting urban transition planning, thanks to the energy potential mapping within the H2020 project PLANHEAT. The aim of the paper is to identify the principal recurring issues in energy data acquisition and processing to overcome the existing barriers in data availability. An increase of the quality of energy mapping tools follows the relevance and availability of energy data. Thanks to the activities of the HOTMAPS project, Pezzutto et al. [2] present the design of an open-source toolbox to support urban planners, energy agencies, and public administrations for planning the heating and cooling supply at different scales. A bottom-up approach is used to collect and analyze market data related to space heating and domestic hot water systems and their performance in Europe. Within the same HOTMAPS project, Müller et al. [3] face the challenge of uncertainties coming from different databases and from large differences in available datasets among EU countries. A top-down approach is proposed, and a comparison between country-level and municipal-level building stock data is made for gross floor area and energy demand for space heating and domestic hot water. Transparency and regular update of datasets fostered by the increase of smart meters installation are crucial to support and effective energy planning.

Moreover, this Special Issue presents also different research works dealing with the potential of gathering useful information from available data in different fields, both for performance assessment and future scenarios design.

Korkovelos et al. [4] illustrate an overview of open-access geo-spatial data and GIS-based electrification models aiming to support SDG7, with a detailed discussion on their role in answering complex policy questions. Their research work presents an updated version of the Open-Source Spatial Electrification Toolkit (OnSSET-2018), which is described in detail and applied to a case study in Malawi, comparing the cost of different electrification options by 2030. The results highlight that the optimal mix includes off-grid PV systems for two-thirds of the population, and power grid extension for the rest. The sensitivity analysis provides additional insights on the crucial role of electricity demand projections in the optimal electrification solution.

Electricity data can also support a better evaluation of the distributors' performance, as described by Ganhadeiro et al. [5] in a case study in Brazil. The authors propose an improved methodology to better assess how environmental variables affect the energy efficiency of electricity distribution companies. The methodology presented by the authors can be extended to other countries where there is at least some influence of private sector in energy distribution, or any other regulated service.

Another interesting case for the potential of data in supporting energy analyses is presented by De Kok et al. [6], who focus on the use of user-generated contents in social media to understand and improve the energy consumption behavior of individuals. The authors highlight the interesting potential of social media content as a complementary support to other sources, thanks to the massive amount of data and the low cost of analysis. Thanks to an image and text processing pipeline, relevant information can be extracted to describe different energy-consuming activities. The strengths and weaknesses of this approach are presented, by applying the method to two case studies in Amsterdam and Istanbul.

Zipperle and Orthofer [7] present an innovative open-source interface for MESSAGEix model, named d2ix. MESSAGEix is an optimization model for strategic energy planning and integrated assessment of energy–engineering–economy–environment systems, including effects such as emissions, economic development, land and water use, and health implications. It can be linked also to the general-economy MACRO model to incorporate feedback between prices and demand levels for energy and commodities. The d2ix interface enables concise presentation and editing of model input data and increases the accessibility and transparency of the modelling processes, reducing barriers and simplifying collaborative working.

In the narrow field of energy efficiency in the built environment, Attanasio et al. [8] propose a methodology for the automatic estimation of building primary energy demand related to space heating and to the characterization of the relationship between the latter and the main building features. The methodology was tested using an energy performance certificate database with 90,000 flats in Piedmont region (Italy) and four machine learning algorithms. The methodology can be used for quick estimation of expected building energy demand as well as setting credible targets for improving building performance.

Another application of data analysis techniques in the built environment is presented by Manfren and Nastasi [9]. They describe an integrated workflow from parametric energy performance analysis to model calibration. A passive house building is a case study that seeks to show an effective and transparent way to link design and operation performance analysis together with reducing the efforts in modelling and monitoring by providing parametric performance boundaries. These performance boundaries are used to ease monitoring process and to identify insights in a simple, robust, and scalable way.

Finally, Vialetto and Noro [10] present an application of Internet of Things (IOT) and Industry 4.0 concepts to the industrial energy efficiency. A clustering modelling approach for the short-term forecasting of energy demand in industrial facilities is shown. The forecasting model is applied to an industrial facility (wood processing industry) with simultaneous heat and electricity demand, where it proves to be effective, with a very small error in the order of 3%.

Author Contributions: Conceptualization, B.N.; writing—original draft preparation, B.N., M.M., and M.N.; writing—review and editing, B.N., M.M., and M.N. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Fremouw, M.; Bagaini, A.; De Pascali, P. Energy Potential Mapping: Open Data in Support of Urban Transition Planning. *Energies* **2020**, *13*, 1264. [CrossRef]
2. Pezzutto, S.; Croce, S.; Zambotti, S.; Kranzl, L.; Novelli, A.; Zambelli, P. Assessment of the Space Heating and Domestic Hot Water Market in Europe—Open Data and Results. *Energies* **2019**, *12*, 1760. [CrossRef]
3. Müller, A.; Hummel, M.; Kranzl, L.; Fallahnejad, M.; Büchele, R. Open Source Data for Gross Floor Area and Heat Demand Density on the Hectare Level for EU 28. *Energies* **2019**, *12*, 4789. [CrossRef]
4. Korkovelos, A.; Khavari, B.; Sahlberg, A.; Howells, M.; Arderne, C. The Role of Open Access Data in Geospatial Electrification Planning and the Achievement of SDG7. An OnSSET-Based Case Study for Malawi. *Energies* **2019**, *12*, 1395. [CrossRef]
5. Ganhadeiro, T.G.L.; Christo, E.D.S.; Meza, L.A.; Costa, K.A.; Souza, D.P.M. Evaluation of Energy Distribution Using Network Data Envelopment Analysis and Kohonen Self Organizing Maps. *Energies* **2018**, *11*, 2677. [CrossRef]
6. De Kok, R.; Mauri, A.; Bozzon, A. Automatic Processing of User-Generated Content for the Description of Energy-Consuming Activities at Individual and Group Level. *Energies* **2019**, *12*, 15. [CrossRef]
7. Zipperle, T.; Orthofer, C.L. d2ix: A Model Input-Data Management and Analysis Tool for MESSAGEix. *Energies* **2019**, *12*, 1483. [CrossRef]
8. Attanasio, A.; Savino Piscitelli, M.; Chiusano, S.; Capozzoli, A.; Cerquitelli, T. Towards an Automated, Fast and Interpretable Estimation Model of Heating Energy Demand: A Data-Driven Approach Exploiting Building Energy Certificates. *Energies* **2019**, *12*, 1273. [CrossRef]
9. Manfren, M.; Nastasi, B. Parametric Performance Analysis and Energy Model Calibration Workflow Integration—A Scalable Approach for Buildings. *Energies* **2020**, *13*, 621. [CrossRef]
10. Vialetto, G.; Noro, M. Enhancement of a Short-Term Forecasting Method Based on Clustering and kNN: Application to an Industrial Facility Powered by a Cogenerator. *Energies* **2019**, *12*, 4407. [CrossRef]