

Editorial

Editorial on the Special Issue Entitled “Regulatory Frameworks Addressed to Promote Renewable Energy Sources and Microgrids. Regulatory Constraints and Implications on Conception, Design and Energy Management of Microgrids”

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Abstract: As renewable energy sources and microgrids have developed, the need to use a transversal approach for dealing with issues on the design and energy management of these assets is clear. Although renewable energy sources and microgrids are used within the electricity sector in a significant number of countries, the technical and scientific literature often dismisses the effects that in-force regulatory frameworks have on this type of assets. This Special Issue aims to enlighten readers on the relationship between the electricity sector's regulatory frameworks and microgrids, providing clear evidence on the need to consider regulatory constraints in their design and energy management.

Keywords: microgrids; regulatory frameworks; energy management; design; self-consumption; net metering; feed-in tariff; renewable energy



Citation: de la Hoz, J.; Martín, H.; Matas, J. Editorial on the Special Issue Entitled “Regulatory Frameworks Addressed to Promote Renewable Energy Sources and Microgrids. Regulatory Constraints and Implications on Conception, Design and Energy Management of Microgrids”. *Energies* **2023**, *16*, 5059. <https://doi.org/10.3390/en16135059>

Received: 19 July 2022

Revised: 7 October 2022

Accepted: 27 February 2023

Published: 29 June 2023



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1. Introduction

As renewable energy sources and microgrids have developed, the need to use a transversal approach for dealing with issues on the design and energy management of these assets is clear.

Although renewable energy sources and microgrids are used within the electricity sector in a significant number of countries, the technical and scientific literature often dismisses the effects that in-force regulatory frameworks have on this type of asset.

In some cases, it is necessary to consider the effect of the legal framework on these energy assets, especially when providing recommendations for sizing or energy management strategies for real situations. In this case, it should be mandatory to embed regulatory constraints into decision making. As stated in our previous works [1,2], considerable differences in energy management solutions may exist, depending on whether regulatory constraints are embedded into an energy model's decision making.

Unfortunately, these effects are customarily ignored, if not despised, when analyzing the objective functions used to design or manage microgrids [3]. In this regard, this Special Issue aims to highlight the intricacies and relations of regulatory frameworks and the conception, design, and energy management of microgrids.

2. What May Readers Expect from Reading the Articles in this Special Issue?

A given reader will find six articles published in this Special Issue, entitled “Regulatory Frameworks Addressed to Promote Renewable Energy Sources and Microgrids. Regulatory Constraints and Implications on Conception, Design and Energy Management of Microgrids”. The titles of these articles are as follows:

- Reviewing and Exploring the Qualitative Impacts That Different Market and Regulatory Measures Can Have on Encouraging Energy Communities Based on Their Organizational Structure [4];

- Analysis of the Net Metering Schemes for PV Self-Consumption in Denmark [5];
- Prosumers' Behavior under a Regulation That Encourages Strict Self-Sufficiency. The Case of Spanish Photovoltaic Micro-Generation [6];
- Individual vs. Community: Economic Assessment of Energy Management Systems under Different Regulatory Frameworks [7];
- A Comprehensive Model for the Design of a Microgrid under Regulatory Constraints Using Synthetical Data Generation and Stochastic Optimization [8];
- Dynamic Modeling of Multiple Microgrid Clusters Using Regional Demand Response Programs [9].

The order of these articles has been carefully selected to provide the reader with a deeper understanding of the interplay between new technological and economic solutions for microgrids (P2P, aggregation, wholesale and local markets, etc.) and one of the most relevant constraints of these solutions, namely regulatory frameworks. Of course, reading the articles in this order is just a suggestion. Still, by following this order, the reader will gradually realize how important regulatory frameworks are for the conception, sizing, and management of energy assets, including microgrids.

In the first article [4], the authors offer an exhaustive compilation and review of the in-force regulatory frameworks that affect energy communities in Spain. Next, considering the Spanish regulatory reality, the authors identify five organizational strategies for the energy communities, including the use of microgrids. Although the article focuses on energy communities, this analysis also incorporates individual or single consumer vision (see the first strategy). Then, the authors choose relevant measures to encourage the development of these energy communities, such as market aspects, aggregation, peer-to-peer trading, and self-consumption, when these energy communities are confronted with the regulatory reality. As a result, it is possible to see that some relevant topics of analysis and discussion in the scientific literature, such as peer-to-peer trading or aggregation, are still not contemplated by some of the current regulatory frameworks. Among the measures that were analyzed, the authors stress self-consumption as a reliable tool for the promotion of energy communities, including their use of microgrids. As the authors state, this phenomenon can be extrapolated to other European countries.

After reading the first article of this Special Issue, the reader should notice that regulatory frameworks can hamper some of the most relevant measures for promoting energy communities and renewable energy systems. The reader should also identify the importance of self-consumption (or equivalent) as a development tool of distributed generation. In this regard, it seems advisable to focus on this regulatory mechanism in the following readings. Concerning this topic, we suggest reading two papers in this Special Issue that specifically analyze some of Europe's most representative frameworks: the Danish self-consumption scheme [5] and the Spanish self-consumption scheme [6].

With regards to the Danish self-consumption scheme, the authors describe the different existing connection types and their associated metering points. In the same way, they provide the definition and algebraic expressions for each of these metering points and their connection with the Danish electricity billing system. Using a case study, the authors demonstrate the importance of choosing the most suitable option for the energy asset under analysis among several alternatives within the Danish regulatory framework. Their results demonstrate how important this selection is concerning consumers' economic effects.

Regarding the Spanish self-consumption scheme, in the third article [6], the authors depict this current situation in relation to microgeneration. The analysis performed by the authors helps the reader understand how current regulatory constraints can shape the energy management of energy assets. In this regard, their results highlight the subordination of energy assets to regulatory constraints.

At this point, the reader will be aware of the implications of regulatory constraints in the energy management strategies of a microgrid and the impact on its economic results. Therefore, it is expected that the need to embed these constraints when sizing current

energy assets or deciding their energy management will be discernable. With this in mind, we suggest reading the fourth [7] and fifth articles [8].

In the fourth article, the authors determine the energy management of a microgrid asset for a single consumer and an energy community in order to find which approach is better. To determine the best solution, the authors provide a clear and comprehensive description on how to model microgrid assets while considering physical, economic, and regulatory constraints. In this regard, the reader is given a clear description of most representative regulatory structures used to promote renewable energy assets (such as the FIT scheme, net-metering schemes, and self-consumption schemes). In addition, the relationship between these structures and the economic model (including operation and maintenance costs and consumers' energy bill structure) is clearly defined, as well as their link to the objective function. The obtained results demonstrate that different regulatory constraints (FIT, net-metering, and self-consumption) inform different energy system management strategies. These results are consistent with those obtained by the authors in previous works [1,2], and they corroborate the conclusions provided by the second [5] and third [6] articles in this Special Issue.

With regards to the design of microgrids, in the fifth article [8], the authors describe a model that is used to size a microgrid with regulatory constraints in mind. The case study described in this article is solved using two-stage stochastic programming, and the sizing results incorporate the regulatory framework's effects.

Last but not least, the sixth article focuses on one of the possible future sources of income for microgrids, aggregation and frequency control. The authors provide a dynamic model that addresses multiple microgrid clusters with different types of renewable energy assets and energy storage systems.

3. Conclusions

This Special Issue aims to inform the reader on the relation between the electricity sector's regulatory frameworks and microgrids' design and energy management. The articles published in this Special Issue demonstrate the preeminence of regulatory frameworks on microgrid assets, which can hamper the establishment of some relevant solutions, such as peer-to-peer trading or aggregation. They also demonstrate the effects of regulatory frameworks on the design and energy management of microgrids. As can be deduced from the articles in this Special Issue, when considering real microgrid applications, it should be mandatory to embed regulatory constraints to guarantee optimal design and energy management solutions.

Author Contributions: Conceptualization, methodology, formal analysis, and writing—review and editing of the original manuscript were equally shared by J.d.l.H., H.M. and J.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Acknowledgments: We thank *Energies* for the trust and support shown during the process of this Special Issue. During the procedure, eleven submissions to this Special Issue resulted in six published papers. We want to thank all the authors for their efforts in contributing to this Special Issue.

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

References

1. De la Hoz, J.; Martín, H.; Alonso, A.; Carolina Luna, A.; Matas, J.; Vasquez, J.C.; Guerrero, J.M. Regulatory-framework-embedded energy management system for microgrids: The case study of the Spanish self-consumption scheme. *Appl. Energy* **2019**, *251*, 113374. [[CrossRef](#)]
2. De la Hoz, J.; Alonso, A.; Coronas, S.; Martín, H.; Matas, J. Impact of Different Regulatory Structures on the Management of Energy Communities. *Energies* **2020**, *13*, 2892. [[CrossRef](#)]
3. Naz, M.N.; Mushtaq, M.I.; Naeem, M.; Iqbal, M.; Altaf, M.W.; Haneef, M. Multicriteria decision making for resource management in renewable energy assisted microgrids. *Renew. Sustain. Energy Rev.* **2017**, *71*, 323–341. [[CrossRef](#)]

4. Eichman, J.; Torrecillas Castelló, M.; Corchero, C. Reviewing and Exploring the Qualitative Impacts That Different Market and Regulatory Measures Can Have on Encouraging Energy Communities Based on Their Organizational Structure. *Energies* **2022**, *15*, 2016. [[CrossRef](#)]
5. Martín, H.; de la Hoz, J.; Aliana, A.; Coronas, S.; Matas, J. Analysis of the Net Metering Schemes for PV Self-Consumption in Denmark. *Energies* **2021**, *14*, 1990. [[CrossRef](#)]
6. Mir-Artigues, P.; del Río, P. Prosumers' Behavior under a Regulation That Encourages Strict Self-Sufficiency. The Case of Spanish Photovoltaic Micro-Generation. *Energies* **2021**, *14*, 1114. [[CrossRef](#)]
7. Alonso, À.; de la Hoz, J.; Martín, H.; Coronas, S.; Matas, J. Individual vs. Community: Economic Assessment of Energy Management Systems under Different Regulatory Frameworks. *Energies* **2021**, *14*, 676. [[CrossRef](#)]
8. Alonso, À.; de la Hoz, J.; Martín, H.; Coronas, S.; Salas, P.; Matas, J. A Comprehensive Model for the Design of a Microgrid under Regulatory Constraints Using Synthetical Data Generation and Stochastic Optimization. *Energies* **2020**, *13*, 5590. [[CrossRef](#)]
9. Rostami, Z.; Ravadanegh, S.N.; Kalantari, N.T.; Guerrero, J.M.; Vasquez, J.C. Dynamic Modeling of Multiple Microgrid Clusters Using Regional Demand Response Programs. *Energies* **2020**, *13*, 4050. [[CrossRef](#)]

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