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OPEN LETTER

Peer-to-peer energy communities: regulatory barriers in the EU context

[version 1; peer review: 5 approved with reservations]

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v1 **First published:** 23 Dec 2022, **2**:147
https://doi.org/10.12688/openreseurope.15282.1
Latest published: 23 Dec 2022, **2**:147
https://doi.org/10.12688/openreseurope.15282.1

Abstract

The effects of climate change are already impacting people's quality of life worldwide. Evidence highlights the urgency in action to counteract this on-going process. Europe aims at fostering the green transition becoming climate neutral by 2050. The envisioned pathway encompasses an overhaul of the energy system including an increase in renewable energy production and end-user energy efficiency. The EU further recognizes the fundamental role of citizens and communities in addressing an effective transition. Within this framework, energy communities (EC) and peer-to-peer (P2P) energy trading are emerging as new opportunities for boosting green technologies in renewable energy and the smart grid sector, and for rising citizens' awareness of the theme. However, the implementation of P2P ECs in Europe entails complex legal challenges that cannot be solved only through sector-specific regulation. This open letter critically presents the experience gained in the H2020 NRG2peers project about the knowledge advancement in the regulatory context of the project pilot sites. These are located in four EU ecosystems (from innovators to laggards) that are: the Netherlands, Spain, Slovenia, and Italy. Each EC involved in the NRG2peers project is thus facing different challenges related to its specific socio-economic condition and energy market framework. These barriers need to be overcome and new tools will be delivered during the NRG2peers project. Moving from the lessons learnt at the pilot sites, both

Open Peer Review

Approval Status ? ? ? ? ?

	1	2	3	4	5
version 1 23 Dec 2022	? view	? view	? view	? view	? view

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Any reports and responses or comments on the

roadmaps at the regulatory level and an advisory app are under development to support the uptake of the next generation of European peer-to-peer Energy Communities.

Keywords
energy community, peer-to-peer, green transition, environmental regulations, renewable energy policies

article can be found at the end of the article.



This article is included in the Horizon 2020 gateway.



This article is included in the Sustainable Places 2022 collection.

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Author roles: Pigliautile I: Conceptualization, Methodology, Writing – Original Draft Preparation; **Breukers S**: Conceptualization, Methodology; **Boekelo M**: Conceptualization, Methodology, Writing – Review & Editing; **Carnero P**: Conceptualization, Methodology, Writing – Review & Editing; **Causone F**: Conceptualization, Methodology, Writing – Review & Editing; **Arko S**: Conceptualization, Methodology, Writing – Review & Editing; **Ferroni S**: Conceptualization, Methodology; **Pioppi B**: Conceptualization, Methodology, Writing – Review & Editing; **Pisello AL**: Conceptualization, Methodology, Writing – Review & Editing; **Solar A**: Conceptualization, Methodology, Writing – Review & Editing; **Swens J**: Conceptualization, Methodology, Writing – Review & Editing; **Tarpani E**: Conceptualization, Methodology, Writing – Review & Editing; **D'Oca S**: Conceptualization, Funding Acquisition, Methodology, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

Grant information: This research was financially supported by the European Union's Horizon 2020 research and innovation programme under the grant agreement No [890345](Towards a new generation of EU peer-to-peer Energy Communities facilitated by a gamified platform and empowered by user-centred energy trading mechanisms and business models. [NRG2peers]). Ilaria Pigliautile further thanks the Italian funding programme Fondo Sociale Europeo REACT EU—Programma Operativo Nazionale Ricerca e Innovazione 2014–2020 (D.M. n.1062 del 10 agosto 2021) for supporting their research though the Red-To-Green project.
The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

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How to cite this article: Pigliautile I, Breukers S, Boekelo M *et al.* **Peer-to-peer energy communities: regulatory barriers in the EU context [version 1; peer review: 5 approved with reservations]** Open Research Europe 2022, **2**:147 https://doi.org/10.12688/openreseurope.15282.1

First published: 23 Dec 2022, **2**:147 https://doi.org/10.12688/openreseurope.15282.1

Background

Green transition in the energy sector is an urgent need to effectively tackle current climate and energy crises. Energy generation from traditional fossil fuels is responsible for almost two thirds of global greenhouse gas emissions which are recognized to play a major role in climate change (Manabe, 2019). At the same time, the rise in share of renewable and locally generated energy in the whole energy mix that a community relies on would guarantee a higher level of energy security, increasing the overall resilience of the same community [from the energy security report of the International Energy Agency].

In this global panorama, the European Union (EU) decided to play a primary role setting ambitious targets for its Member States (MS) in order to become a climate-neutral continent by 2050. The European Green Deal aims at turning challenges into opportunities by decoupling economic growth from resource use and boosting the renewable energy production. In this view, the EU rose the target for greenhouse gas emission reduction up to 55% by 2030 in the Fit-to-55 package. Under the same framework and in response to the energy market disruption due to Russia's invasion of Ukraine, the European Commission presented the REPowerEU Plan supporting energy savings interventions and clean energy production. All the proposed actions should pave the way forward for the green transition but to achieve the proposed targets technical innovation is not enough (Kropp *et al.*, 2021) (Schönwälder, 2021). Individuals and local communities need to play an active role in the process: citizens must be aware of the impact of their actions and behaviours (Caramizaru & Uihlein, 2020).

Renewable Energy Communities (RECs) have been recognized in the Clean Energy Package which provides the enabling legislative framework at the European level (EU Directive 2018/2001). RECs consist of autonomous legal entities, based on open and voluntary participation, that are effectively controlled by their members located in the proximity of a renewable energy power plant owned by the same community. Members of a REC could be common citizens, small and medium-sized enterprises (SMEs) or local authorities, and the primary purpose of a REC is to provide environmental, economic, or social benefits to its members. The sprawl of RECs in the EU territory would allow RECs to directly engage citizens and empower consumers by disclosing the figure of the prosumer (electricity consumers also producing electricity from their own power plant, connected to the distribution network) thus boosting clean energy production thanks to a wider public acceptance of new plants and installations and the mobilisation of private capital (Wolsink, 2020). Furthermore, RECs represent a chance to optimize the usage of local and affordable energy (fighting energy poverty) through the provision of energy efficiency services to their members (Biswas *et al.,* 2022). Those services rely on digital infrastructures for a real-time balance between electricity production from local renewables and member consumptions while having the potential to reduce the overall energy consumption of the community and to prevent electric grid imbalance (Duch-Brown & Rossetti, 2020).

The diffusion of RECs and, therefore, renewables, is generating a shift in the whole energy sector pushing for a progressive change from a centralized to a decentralized system (Urishev, 2019). The new structure that is emerging is also reflected in the energy market change towards decentralized payment mechanisms such as the peer-to-peer (P2P), defined as the exchange of energy for monetary value between peers of a community (Soto *et al.*, 2021). Indeed, P2P makes the role of prosumers more attractive since it gives suppliers the possibility to independently choose the energy trading parameters, *e.g.,* the price per unit per energy or who to share the energy with (Tushar *et al.,* 2021). Moreover, P2P is a trading mechanism convenient also for consumers of the community that can purchase low-cost electricity from their neighbour.

Despite the benefits related to both RECs structure and P2P trading mechanism, these are still not extensively implemented in Europe, even if with distinctions among EU MSs (Tarpani *et al.,* 2022), due to lack in both technological and social innovation also supported by a proper regulatory framework. NRG-2PEERS is a Horizon 2020 project (Grant agreement ID: 890345) that aims at supporting the uptake of the next generation of European peer-to-peer Energy Communities. The project fosters the achievement of this goal by (i) moving from experiences of existing communities to frame a Readiness Level Framework and related indicators on multiple dimensions (Institutional, Market, Technological, Social); thus (ii) providing demand-response mechanisms to ensure energy optimization within the community accounting for multiple objectives, *i.e.,* financial savings for the REC members, CO_2 emissions reduction, and community energy resiliency; and finally (iii) adopting community-based nudging mechanisms that were recognized to be effective at incentivizing renewable production, consumption and behavioural change (Xu *et al.*, 2014). Furthermore, the project accounts for nine pilots distributed in four European countries that are characterised by different socio-economic backgrounds and regulatory frameworks. The involved countries also represent different levels of RECs implementation, namely: the Netherlands (innovators or early adopters), Spain (early majority), Slovenia (late majority), and Italy (laggard).

The following section presents the main barriers for a wide implementation of RECs in Europe that were recognized in the NRG2PEERS project mainly focusing on the outcomes of the ethnography-based qualitative studies conducted, *i.e.,* interviews and focus groups with different stakeholders in the four national ecosystems. Finally, solutions coming from the NRG2PEERS proposal on how to tackle those issues are presented, including roadmaps at regulatory level and an advisory app.

REC and P2P, main barriers at the EU level

An effective and extensive implementation of Energy Communities in Europe would require a comprehensive and holistic approach to the phenomenon accounting for the following dimensions:

- Institutional, the regulatory framework that rules ECs at national level, as transposition of the RED II (EU Directive 2018/2001). The transposition process needs to account for country-specific peculiarities to be effective and let energy communities (ECs) easily become part of the national ecosystem. Legal aspects mainly concern EC definition (legal entity forms, proximity or geographical limitations, required authorization and EC registration procedures, renewable power plants options, *etc*.), rights and obligations of the same EC, subsides availability and rules for accessing those subsides, but also the regulation of data ownership would be of primary importance to boost EC.
- Market, which includes the electricity market (how it is ruled, definition of different stakeholders' roles - including the prosumer- and regulation of the P2P) but also those sectors that impact the economic investment to be faced to set up and operate an EC (*e.g.,* technology).
- Technological and infrastructural, comprehending both physical and Information and Communication Technologies (ICTs) components to enable on-site energy generation, energy storage, energy distribution, and P2P energy trading. Monitoring, managing, and steering assets further belong to this dimension which supports the optimization of energy and cash flows among peers. Here, a great challenge consisting of ensuring inter-operability among systems to realize the aspired openness of ECs.
- Social, the capability of the community to understand and organise an EC. This could be further specified in two distinct dimensions related to the EC structure and the single member/user acceptance, respectively:
    - Organisational, dimension related to the stakeholders' ecosystem and human resources internally available for setting up an EC, accounting for knowledge and needed time resources, alignment of ambitions and expectations for the short, medium and longer term. This dimension further accounts for the coordination among relevant stakeholders and the agreement about EC scopes and members engagement.
    - User, individuals' understanding and acceptance of collective actions in ECs. The aspects influencing this dimension are related to user-friendliness with technological solutions or trust between members and companies providing services to the EC.

These four dimensions provide an overview of the complex framework that must be set to pave the way for an effective implementation of the EC model at national level. Difficulties in handling this complexity are reflected in the limited diffusion of ECs and P2P trading mechanism.

In laggard countries, such as Italy, there is still too much uncertainty on subsides and market regulation to provide a solid business model and engage private stakeholders (citizens, SMEs, *etc*.), so most of the existing communities are led by public authorities. Moreover, the design, implementation, and operation of an EC requires multiple technical skills and small Energy Service Companies (ESCOs) do not feel qualified to handle this new business. Also from a bureaucratic standpoint, required procedures for getting formal recognition of the EC (which is an undeniable condition to access EC related incentives) are generally considered too complex and time consuming such as those required for getting the authorization for the renewable energy plants installation. This complexity limits the promotion of EC initiatives.

The development of a sustainable and innovative business model is also limited in other ecosystems since uncertainties are not only regulatory-related, but account also for the technological dimension. Reliable ICT infrastructures o are fundamental in pursuing the foreseen decentralized energy system. Platforms for EC operation handle relevant flows of data associated to P2P trading or, more generally, to EC members consumption profiles. There is an urgent need of defining data ownership and clarifying the governance of the digital infrastructure. The whole electricity market design needs to be effectively revised to guarantee the applicability of the P2P mechanism while accounting for possible negative consequences of a free electricity market.

Finally, a legal definition of ECs and their internal regulation must be carefully evaluated. As social entities, EC are limited in their capacity of accessing bank guarantees so that a subsidy model is the preferred way for MSs to support ECs. Nevertheless, ECs openness, their fundamental characteristic of being open to anyone, means also that members have the right to step out and switch supplier at any time which may compromise the EC business plan. In a subsidy model, duties for members are also needed.

Regulatory roadmaps and the advisory app: tools for P2P EC uptake in Europe

NRG2PEERS supports the uptake of P2P EC in Europe by handling the complex framework depicted in the previous section thanks to both national regulatory roadmaps and the release of an Advisory App. The two tools approach the common purpose, *i.e.,* to support P2P EC uptake, through multiple perspectives since their envisioned final users are different.

The roadmap discusses, for each participant country, what is needed to provide a supportive environment for P2P EC moving from current conditions and taking into account all the dimensions related to EC implementation, *i.e.,* institutional, market, technological, and social. Final users of the roadmap are envisioned as local and regional policy actors interested in supporting P2P ECs, *e.g.,* municipalities, housing associations, distribution system operators, as well as national policy actors and energy sector actors. Therefore, each roadmap

concludes with suggestions on possible interventions (policy, legislative, or less formal) that could pave the way towards a more citizen-centred energy future that facilitates P2P EC. Here, the perspective towards the uptake of P2P EC is top-down.

On the other hand, the NRG2PEERS Advisory App is addressed to current or possible future members of an EC and thus it supports the P2P EC uptake with a bottom-up approach. The App aims at empowering citizens by sharing experiences from already established EC, including good practices or solutions to recurrent problems that a new-born community should be aware of. In this view, the Advisory App —under development at the time of writing— will consist of a static content, providing basic information and requirements on EC and P2P, and an interactive section, the forum, where everyone could provide its contribution or ask for suggestions from other users, on how to realize an EC or how to minimize the environmental impact of the EC. Furthermore, through the Advisory App users can access the Readiness Level Indicator Tool, built upon the recognized dimensions describing the context for the implementation of an EC, getting tailored recommendations on each dimension based on best practices.

The release of both national regulatory roadmaps and the Advisory App is expected within the NRG2PEERS project lifespan (prior to the end of August 2023). The impact of these solutions will strongly depend on their diffusion in NRG2PEERS involved countries and beyond, in the whole European territory. Actions are already planned in the project framework including the organization of Road Shows in all four participating countries where main stakeholders will be invited to participate, sharing the project's outcomes. Pilots' leaders will shed the light on required steps at policy level, as highlighted in the national roadmaps, during public events and dedicated meetings with local and national authorities. At the same time, the Advisory App will be used and populated, first of all, by members of the project pilots and thus will be promoted among the existing energy communities.

Ethics and consent

Ethical approval and consent were not required.

Data availability

No data are associated with this article.

Author contributions

Conceptualization, all; Methodology, all; Writing – Original Draft Preparation, Ilaria Pigliautile; Writing – Review and Editing, all.

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Open Peer Review

Current Peer Review Status: ? ? ? ? ?

Version 1

Reviewer Report 25 September 2024

https://doi.org/10.21956/openreseurope.16524.r33008

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Yuekuan Zhou
The Hong Kong University of Science and Technology, Hong Kong, Hong Kong

Reviewer's general comment: This paper explores peer-to-peer energy communities under regulatory barriers in the EU context. Unfortunately, it has concerns that this paper significantly deviates from the intended theme and is not fully completed. In order to help improve the paper quality, my suggestions and comments are shown below.
1) Abstract: Although the abstract provides detailed information about the research background, it fails to incorporate the research methods and main findings into the summary to better show the paper's importance and novelty.
2) Some crucial sections are missing, such as highlights, scientific gaps, results and discussion and a comprehensive conclusion. They should be added for a complete structure as a journal paper.
3)Background: Although background elaborates the importance of P2P and efficient behaviors of renewable energy communities to current climate and energy crises, barriers for the P2P in the renewable energy communities is not mentioned.
4) The involved countries represent different levels of renewable energy communities implementation, including Netherlands (innovators or early adopters), Spain (early majority), Slovenia (late majority), and Italy (laggard). However, special definitions (from innovators to laggard) are not further explained and relevant references are not mentioned for these definitions.
5) The end of the background indicates the following section as the main barriers for implementations of RECs focusing on groups with different stakeholders in the four national ecosystems. However, the subsequent sections do not follow the guidance.
In the "**REC and P2P, main barriers at the EU level"** section, barriers are not mentioned at all and P2P is only mentioned in the market regulation as a market solution without further discussion. Barriers should be first identified, then corresponding implementations should be subsequently clarified from institutional, market, technological and infrastructural, and social aspects to solve those barriers.
Furthermore, authors mention that this paper focuses on the outcomes of the ethnography-based qualitative studies conducted, i.e., interviews and focus groups with different stakeholders in the four national ecosystems. However, specific and detailed qualitative studies conducted in each country is not been described and analyzed, and there is a lack of comparisons between the

different circumstances among countries. All descriptions are too general and vague, lacking specific data and case studies to support them.
6) In the last section "**Regulatory roadmaps and the advisory app: tools for P2P EC uptake in Europe**", the project NRG2PEERS is used to handle the framework depicted in the previous section. If the entire discussion in the article is based on this project, it will be more appropriate to provide a detailed explanation of the project as a case study from the beginning, rather than introducing it at the end of the paper.
Regulatory roadmaps and the advisory app are detailed solutions served for P2P energy communities. However, what are the barriers still remain unclear. And the relationship between the project and different stakeholders in the four national ecosystems are not clear. Are all measures the same in all stakeholders or do they vary from country to country? Readers may also have these concerns.
7) There are no figures, tables or supporting data to support the presented viewpoints. The article predominantly relies on qualitative descriptions without incorporating any quantitative analysis. More data should be added to support author's views.
Overall, this manuscript needs to be revised and restructured.

Is the rationale for the Open Letter provided in sufficient detail? (Please consider whether existing challenges in the field are outlined clearly and whether the purpose of the letter is explained)
Yes

Does the article adequately reference differing views and opinions?
No

Are all factual statements correct, and are statements and arguments made adequately supported by citations?
Yes

Is the Open Letter written in accessible language? (Please consider whether all subject-specific terms, concepts and abbreviations are explained)
Yes

Where applicable, are recommendations and next steps explained clearly for others to follow? (Please consider whether others in the research community would be able to implement guidelines or recommendations and/or constructively engage in the debate)
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Renewable energy, building energy, zero-carbon district, P2P energy sharing and trading

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 13 July 2023

https://doi.org/10.21956/openreseurope.16524.r33000

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This article aims to discuss the regulatory barriers faced in implementing peer-to-peer (P2P) renewable energy communities (REC) in the EU context, based on the experience gained from the H2020 NRG2peers project. The topic is of significant interest and importance, particularly considering the hindrances these barriers pose to the real-world implementation of REC in many countries. The article comprises three main sections: Background, main barriers for REC and P2P at the EU level, and two tools developed within the NRG2peer project. However, there are some places that could benefit from further clarity and revisions prior to indexing. The major comments and suggestions are summarized below.

Overall structure:
In terms of the overall structure, it is recommended to add a conclusion section to provide a summary of the article's contents, main findings or key takeaways. This addition would enhance the completeness of the article.

Section 1:

- Section 1 (i.e., background) introduces current regulations related to reducing greenhouse gas emissions, the concept of REC, the benefits of P2P REC, and an overview of the NRG2peers project.

- To further clarify the research gap, it is suggested to expand on the sentence that briefly describes the gap by providing more details on the problem this article seeks to address. Now there is just one sentence briefly describing the research gap: ‘due to lack in both technological and social innovation also supported by a proper regulatory framework.

- Additionally, it would be helpful to make the aim of this study more specific, as the aims presented in the second-to-last paragraph refer to the broader objectives of the NRG2peers project.

Section 2:

- Section 2 (i.e., main barriers) presents four dimensions that need to be considered along with barriers from different angles, such as country development, business models, and data ownership.

- It would be beneficial to clarify whether these dimensions and barriers are derived from the NRG2peer project or reviewed from existing studies. Providing clarification at the beginning of this section would eliminate any ambiguity. If the results are obtained from the

NRG2peer project, including details about the methodology employed, such as the survey process and interviewees, would enhance the article's coherence.

- Furthermore, it would be useful to establish the connections between the four dimensions. While three dimensions align with the pillars of sustainability (economic, technological, and social), it is important to clarify how the institutional dimension fits into this framework. Utilizing a schematic diagram to illustrate the relationships between these dimensions would greatly aid readers' understanding.

- The remaining three paragraphs introduce additional barriers, but the logical connections between them are unclear. To enhance accessibility, grouping the barriers into different dimensions or types and summarizing them in a table would be beneficial.

- Lastly, a typographical error, "Reliable ICT infrastructures o are fundamental," appears in the fourth line of the second paragraph on Page 4, and it should be revised accordingly.

Section 3:

- Section 3 highlights the regulatory roadmaps and the advisory app developed within the NRG2peers project.

- While the two tools are interesting and hold promise for facilitating the large-scale implementation of P2P REC in the future, it would be advantageous to emphasize their connection to the barriers presented in the second section and the main aim of this article. Specifically, addressing how these tools can help overcome the identified barriers would add clarity and strengthen the article's content.

The reviewer hopes the comments can be helpful to the authors.

Is the rationale for the Open Letter provided in sufficient detail? (Please consider whether existing challenges in the field are outlined clearly and whether the purpose of the letter is explained)

Partly

Does the article adequately reference differing views and opinions?

Yes

Are all factual statements correct, and are statements and arguments made adequately supported by citations?

Partly

Is the Open Letter written in accessible language? (Please consider whether all subject-specific terms, concepts and abbreviations are explained)

Yes

Where applicable, are recommendations and next steps explained clearly for others to follow? (Please consider whether others in the research community would be able to implement guidelines or recommendations and/or constructively engage in the debate)

Not applicable

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Peer to Peer energy sharing; Energy community; Electric vehicles.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 05 July 2023

https://doi.org/10.21956/openreseurope.16524.r33007

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Sweta Malik
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Overall, the text provides a comprehensive overview of the barriers to implementing Energy Communities (ECs) and peer-to-peer (P2P) energy trading at the EU level. It identifies four key dimensions that need to be addressed: institutional, market, technological and infrastructural, and social. The text also discusses specific challenges faced by laggard countries like Italy and the importance of data ownership, ICT infrastructure, and regulatory clarity. Additionally, it mentions the need for a legal definition of ECs and the development of sustainable business models. The text concludes by introducing regulatory roadmaps and an advisory app as tools to support the uptake of P2P ECs in Europe.

Suggestions for Improvement:

1. Specify the country-specific regulatory challenges faced by each participant country.

2. Consider providing a brief overview of the NRG2PEERS project itself, including its objectives, methodology, and timeline.

3. Explore the regulatory implications of data ownership and privacy in P2P energy trading.

4. Discuss the potential benefits of aligning regulatory approaches and streamlining processes to facilitate cross-border cooperation and the scalability of ECs.

5. Include a discussion on the scalability and replicability of the proposed tools (regulatory roadmaps and the Advisory App) beyond the NRG2PEERS project. Address how their impact can extend to other European countries and contribute to a wider adoption of P2P ECs.

6. Consider incorporating a conclusion to summarize the main findings or contributions of the research.

7. Kindly mention clearly research gap and contributions

Is the rationale for the Open Letter provided in sufficient detail? (Please consider whether existing challenges in the field are outlined clearly and whether the purpose of the letter is explained)
Yes

Does the article adequately reference differing views and opinions?
Yes

Are all factual statements correct, and are statements and arguments made adequately supported by citations?
Yes

Is the Open Letter written in accessible language? (Please consider whether all subject-specific terms, concepts and abbreviations are explained)
Yes

Where applicable, are recommendations and next steps explained clearly for others to follow? (Please consider whether others in the research community would be able to implement guidelines or recommendations and/or constructively engage in the debate)
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Peer-to-Peer Energy Trading, Smart Grid, Policy, Regulations, Stanarization

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 03 July 2023

https://doi.org/10.21956/openreseurope.16524.r33005

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The article aims to provide an overview of current regulatory barriers to the implementation of energy communities and P2P energy trading within the context of the EU regulation. The article

starts by stating the need for Energy Communities, which is followed by a brief overview of the regulatory landscape and an overview of the NRG2Peer project. This is followed by the main section, which addresses four dimensions of the readiness level framework stated in the introduction and some broad key challenges or barriers to implementation. Finally, the article finishes by providing an overview of the current NRG2PEER roadmap and Advisory app.

While the article provides a brief overview of the regulatory landscape of Energy Communities, it is not clear what the article's main purpose is and should be specifically outlined in the abstract and in the introduction.

In the introduction/background section, an overview of the current regulatory landscape is given, however it would be beneficial also to include how Citizen Energy Communities differ from Renewable Energy Communities and why the focus here is explicitly on RECs. Further, RED II has defined the term "Peer-to-peer trading of renewable energy" which could be mentioned as it provides guidance for Member States for their national implementation of the directive. The introduction also provides a broad overview of the Readiness Level Framework used in this study as well as the different dimensions, however information or reference needs to be given for the specifics of the Readiness Level Framework, which is used further in the next section. Additionally, the authors state different countries and their levels of implementation, however no information or reference is provided for these statements. It would be helpful to explain terms such as "innovators or early adopters", "early majority, "late majority" and "laggard" and why countries have been labeled as such.

In the main section, first, the four dimensions previously mentioned in the introduction are addressed, followed by a discussion of additional challenges. It needs to be made clear how these sections are related to each other. A short paragraph on the methodological approach is missing as it is not clear whether these are the findings resulted from conducting interviews and focus groups with different stakeholders (which was mentioned in the last paragraph of the background section). If not, references should be provided on the origin of this information.

In the final section, the NRG2Peers roadmap is mentioned. As the roadmap is not specifically described, it is difficult to follow how the roadmap addresses challenges or barriers in the regulation discussed earlier. The roadmap and Advisory App are discussed separately without relating the content to the previous sections. Can these address regulatory barriers?

All in all, this paper tries to provide an overview of the current regulatory landscape as well as address regulatory barriers that hinder the scale-up of Energy Communities and P2P energy trading markets on the basis of the NRG2PEERs project. However, the article does not follow a clear rationale and misses to tie all sections together and link the findings on barriers with the findings from the NRG2Peer project.

Finally, the article would benefit from a concluding paragraph summarising the findings and providing a lessons learned or recommendations section for addressing regulatory barriers in the future.

The article could make a valuable contribution to highlighting the regulatory barriers to the implementation of ECs. Still, it needs to be revised to improve comprehensibility and highlight benefits of conducting projects such as NRG2PEERS.

Is the rationale for the Open Letter provided in sufficient detail? (Please consider whether existing challenges in the field are outlined clearly and whether the purpose of the letter is explained)
Partly

Does the article adequately reference differing views and opinions?
Partly

Are all factual statements correct, and are statements and arguments made adequately supported by citations?
Yes

Is the Open Letter written in accessible language? (Please consider whether all subject-specific terms, concepts and abbreviations are explained)
Yes

Where applicable, are recommendations and next steps explained clearly for others to follow? (Please consider whether others in the research community would be able to implement guidelines or recommendations and/or constructively engage in the debate)
Not applicable

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: My research focuses on scalability of P2P energy trading markets. I am specifically interested how these markets can scale beyond the pilot project stage while delivering social, technical and economic value.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 12 January 2023

https://doi.org/10.21956/openreseurope.16524.r30526

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The scope of the article is highly relevant and it is clear it departs from a robust body of work on the topic of energy communities and P2P.

The article departs in the "background" section from a detailed account of the European context, in terms of regulatory frameworks for the energy transition, leading up to the concept of Renewable Energy Communities, which is very informative and relevant. It also highlights the relevance of peer-to-peer trading in decentralized systems and the role of prosumers and energy communities, which is very clear and offers a coherent background to the article.

However, while the contents of the article are highly relevant and well referenced, and pertinent to current debates and literature on RECs and P2P, I find the article could benefit from a structure that is more focused on its key findings and more explicit about the research concerns being addressed and the results already attained. This approach would in my view considerably improve the article and its scholarly interest.

I try to provide below specific comments and some clear examples for the authors to consider:

First, in the second to last paragraph of the background section, we read “despite the benefits related to both the RECs structure and P2P trading mechanism, these are not extensively implemented in Europe”. This sentence nicely sets a problem statement that we hope will be addressed to some extent in the article.

Yet, in what follows, along this paragraph we learn more about what project NRG2PEERS will do to address this problem, rather than gaining a bit more insight into the problem. This is where I think the article could be improved. Rather than focussing on what project NRG2PEERS will bring, would be more interesting to read the key research questions that have already been tackled and early insight into the “main barriers for a wide implementation of RECs in Europe”.

In the same paragraph, for instance, the authors refer there are nine pilots in four EU countries, briefly categorizing them as innovators, late majority, laggards, etc. It would be important to have a brief description of what these categories mean, which also gives us more specific insight into the relevance of looking at these pilots and the key concerns that the project’s research is tackling. Thus, clearly framing the article’s problem statement.

On the other hand, the information in this paragraph related to the different other aspects of project NRG2PEERS can be in my view deleted (i.e., sentences from “The project fosters the achievement (…) to Xu et al.2014), since this information does not add additional inputs to the article’s aim, but rather tells us about the project (and the article is not about the project but about regulatory barriers to P2P energy communities in the EU context).

As it is now I learn more about the goals of the project than about the specific research questions/concerns that the article is addressing.

On that note, it would be also good to end the background section by spelling out a clear research concern that the article will tackle – e.g., what are the key barriers to the wide implementation of RECs in Europe, and what possible solutions are needed?

The abstract should also be more focused on what the article is bringing and less on describing the project.

Then the following section of the article is very clear in describing the different dimensions for the implementation of EC in Europe. However, this section heading is about 'barriers', yet the word barriers does not appear in the entire section.

First, there should be a sentence that clarifies how these dimensions relate to the main barriers – is it a framework to map out and identify critical barriers to implementation? Also, the description of the dimensions should include a note on their interactions and on the potential barriers that are derived from these dimensions. For instance, the Market dimension – what kind of barriers can be expected and/or have already been identified?

The description of the dimensions alone does not provide specific insight into the barriers. Then some of the examples provided – e.g. Italy, etc. would serve to illustrate the barriers, making a clear connection to them. For instance, what barrier/s does the Italy example illustrate?

As it is now, the short accounts from the pilot studies do not provide specific illustrations of specific barriers. In the two last paragraphs of this section, it is not clear if the text is still referring to Italy, or more broadly to problems that are general to all EU countries.

There is a typo in:" Reliable ICT infrastructures o are.."

Finally, it would be nice to have an accompanying figure illustrating these dimensions, and their interactions.

The last section of the article is centred on what the project NRG2PEERS will bring. Here it would be more relevant to the article if the solutions that are provided by the project are clearly interlinked with the barriers described previously. So the article moves from:

- Providing a clear question on what the barriers are to implementation
- Offering a summary of key barriers already identified with specific examples from the pilot studies
- Presenting a set of possible solutions – which are to be implemented by the project – in a way that makes the reader establish a clear connection with the barriers previously listed.

In the last section, it could be an option to organize the solutions by top-down and bottom-up, rather than by roadmaps and advisory app. This would invert the logic, but also link again to the barriers – there are barriers that are mainly at the social/citizens level, and others that are more striking at the top/institutional level. Finally, I'm missing a concluding paragraph, that again is more centred on the insights provided by the paper and less on the upcoming events of the project.

I hope these comments are useful for the authors and wish the best of luck with the article (and with the implementation of the project!)

Is the rationale for the Open Letter provided in sufficient detail? (Please consider whether existing challenges in the field are outlined clearly and whether the purpose of the letter is explained)

Yes

Does the article adequately reference differing views and opinions?

Yes

Are all factual statements correct, and are statements and arguments made adequately supported by citations?
Yes

Is the Open Letter written in accessible language? (Please consider whether all subject-specific terms, concepts and abbreviations are explained)
Yes

Where applicable, are recommendations and next steps explained clearly for others to follow? (Please consider whether others in the research community would be able to implement guidelines or recommendations and/or constructively engage in the debate)
Not applicable

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: My expertise is in social sciences and energy and sustainability research, including research into prosumers and energy communities, as well as energy citizenship. Overall I find that my expertise is well-suited for this review.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.