UNIVERSIDADE D
COIMBRA

Lurian Pires Klein

REVEALING SOCIAL VALUES IN THE CONTEXT OF PEER-TO-PEER ENERGY SHARING

A METHODOLOGICAL APPROACH

Doctoral Thesis on Sustainable Energy Systems (SSE) co-supervised by Professor Manuel Carlos Gameiro da Silva & Professor Giovanni Allegretti and submitted to the Department of Mechanical Engineering, Faculty of Science and Technology, University of Coimbra

Coimbra, June 2021

ACKNOWLEDGEMENTS

There are many who helped me along my Ph.D. journey in different ways and I want to take a moment to thank them.

Firstly, I delightedly recognise the funding received from the Portugal 2020 Programme under the Operational Programme for Competitiveness and Internationalisation (Call nº 31/SI/2015), and from the European Union (EU) under the European Regional Development Fund (POCI-01-0247-FEDER-018015) for the development of the case studies assessed in this Ph.D. thesis.

I also gratefully acknowledge the financial support received from the Nippon Foundation and the Tokyo Foundation for Policy Research for the development of my research, namely under the Sylff Fellowship in 2017, the Sylff Research Abroad in 2019, and the Sylff COVID-19 Relief in 2020. It is an immense privilege to be part of a selective network of leaders that are capable of transcending geopolitical, ethnic, cultural, and other differences to contribute to pressing global issues confronting the natural environment and contemporary world. As a Sylff fellow, I had support to delve deep into the Social Sciences & Humanities dimension of smart energy systems, allowing me to work on the frontlines of social & environmental change, guided by a personal vision of strengthening democratic values, reducing energy poverty and injustice, promoting international cooperation and environmental protection, and advancing human achievements in the sustainable energy field. For that, I am forever grateful.

My deep appreciation also goes to my Ph.D. thesis supervisors for their constant guidance, feedback, support, and encouragement throughout the years I spent undertaking my research, as well as for the facilitation of numerous fruitful discussions that allowed me to sharpen my thinking and take my research to a higher level. Thank you for your insightful comments and challenging questions that incented me to widen my research from so many perspectives, and that personally represent lifelong learnings to be also applied in other dimensions of my life.

I would also like to stress my most heartfelt gratitude to Virtual Power Solutions – A Cleanwatts Company (VPS) for supporting me enormously in so many different ways, especially with the mammoth opportunity to be immersed in an intellectually stimulating, multidisciplinary, and collaborative environment that allowed me to fully exert my leadership qualities, entrepreneurial mindset, inventiveness, and analytical reasoning skills towards the conceptualisation, design, implementation, management, and validation of the first peer-to-peer energy sharing pilot projects in Portugal that were used as case studies in my Ph.D. research. Every single colleague who makes up the stellar workforce at VPS helped me in some way with their unique talents and qualifications (in many ways exceeding my own expectations), making me realise the immense privilege I have in being part of the VPS family. I would particularly like to single out Luisa Matos for her great effort to inspire co-workers to work collaboratively towards collective goals, transcending ethnic,

cultural, and other differences to effect real collective change. In fact, I have never worked with a person who gives as much importance to leaving a positive legacy in the world as she does. Not only that, but Luisa always tries to lift the spirits of those around her with her permanently warm, cheerful attitude, which positively impacts the work of everyone around her. I believe these characteristics represent all that is good in our company, which is only true because of her. For me, these are her most noble attributes that make her a true leader to the core of her essence.

I am also particular thankful to Dr. Dominique Hes for enlightening me with the first glance of my research pathway, as well as for inspiring me to always think beyond conventional boundaries as to harness the power of our collective ingenuity to fashion a world of our choosing.

I also greatly appreciate the support received during my research visit at LUT School of Engineering Science & LUT School of Energy Systems during the final stage of my Ph.D. – thank you Dr. Helina Melkas, Dr. Samuli Honkapuro, and associated research teams for always being so supportive of my work and for providing me with your invaluable advice, stimulating discussions, and feedback on my research. A special thank you goes to Dr. Gonçalo Mendes for facilitating that opportunity in the first place and for his camaraderie that I so very much value. The LUT team has a lengthy proven track record of pristine research and professional work on topics of personal interest for my Ph.D. thesis, and I will always cherish the fact that they opened their doors to me with such an open heart.

This Ph.D. would not have been possible without the support extended by the city council and renewable energy community members from Alfândega da Fé, Penela, and Vila Real. Their patience during the numerous public sessions and group discussions undertaken with them, as well their willingness to help me by answering numerous surveys, e-mails, and phone calls is very much appreciated. The strong relationship we built during the long years I managed the pilot project was fundamental for the successful completion of my Ph.D. research.

Last but not the least, I am forever indebted to my family and dear friends for their perennial emotional support throughout the pursuit of my doctoral degree, and without whom, I would not have had the courage to embark on this journey in the first place - you earned it right along with me.

ABSTRACT

The peer-to-peer energy sharing concept refers to flexible, decentralised, synergistic, and direct exchanges of (often the case) distributed renewable electricity between grid-connected end-users. Fundamentally, peer-to-peer energy sharing models are based on complex social networks that thrive on the local embeddedness and social wiring among end-users, rather than on competing economic self-interests. This challenges the traditional approach of energy markets, which is usually characterised by a rigid top-down hierarchical structure that leads to individualistic and antagonistic behaviours at the end-user level.

By evidencing the intricate social interconnectedness that characterises peer-to-peer energy sharing models, this Ph.D. research argues that these models might influence the social values systems of those directly involved with it. Nonetheless, the scientific literature still fails to provide fit-for-purpose methodologies that can transfer the inherently qualitative nature of social values into quantitative measures in the context of peer-to-peer energy sharing. In view of that, this Ph.D. research aims to provide the first systematic investigation of the social values-based dimension of peer-to-peer energy sharing models. To do so, it developed the first overarching social values-based assessment framework that allows the identification of underlying social values associated with peer-to-peer energy sharing model. This framework was trialled and validated in three pilots in Portugal from the Community S demonstration project - the first to have validated the concept of peer-to-peer energy sharing in real-life settings and under real market conditions before its deregulation in the country. Because of that, this Ph.D. research also demonstrated and validated the business model behind the Community S project, as well as the end-user engagement framework that guaranteed its sucessful roll out.

The impact of the social values-based assessment framework was analysed. A valuable element of this framework is the overarching reference list of 194 individual social values that can be explicitly associated with peer-to-peer energy sharing interactions, which were categorised under 33 social value macro themes for operationalisation purposes. Results suggest that 26 out of the 33 social value macro themes were considered validly "active" in the context of the pilot sites, including: belonging, achievement, responsibility, resilience, altruism, influence, emancipation, awareness, participation, collaboration, collectivity, dialogue, support, commitment, motivation, impartiality, progress, professionalism, environmentalism, purpose, originality, personal development, wellbeing, effect change, advocacy, and long-sightedness. The social values-based framework also allowed participants to make inferences about the nature of each active social value uncovered. In this respect, participants perceived these 26 active social value macro themes as previously existing social values that were reinforced by the peer-to-peer energy sharing activities. Participants also identified coercion as a social value macro theme that did not relate to peer-to-peer energy sharing. These results are scalable provided that the result interpretations drawn here are put in perspective and validated through the cohesive validity check on a case-by-case basis proposed by this Ph.D. research.

All is all, This Ph.D. research defends that there must be a fundamental shift in the way that social values are accounted for in the transition towards a desirable carbon-neutral future. Since only part of the overall value created by peer-to-peer energy sharing models seems to be assimilated into market relations, this Ph.D. research highlighted the need to demonstrate the real impact of what can be truly achieved with peer-to-peer energy sharing, instead of just what is easily quantifiable. For that, social values should be considered core outcomes of peer-to-peer energy sharing services provision and commissioning, rather than just an incremental externality. In conclusion, this Ph.D. research expects to create a new social values-based language that is explicitly associated with peer-to-peer energy sharing.

Keywords: peer-to-peer energy sharing; social value assessment; valuation; energy community; renewable energy trading; user-centric energy services

RESUMO

O conceito de partilha de energia entre pares refere-se às transações diretas, descentralizadas, sinérgicas e flexíveis do excedente de produção fotovoltaica entre utilizadores finais conectados entre si pela rede de energia. Fundamentalmente, os modelos de partilha de energia entre pares são baseados em redes sociais complexas que prosperam na integração local e na interconexão social entre os utilizadores finais, em vez de interesses econômicos individualizados e concorrentes. Isso desafia a abordagem tradicional dos mercados de energia, que geralmente é caracterizada por uma estrutura hierárquica rígida de cima para baixo que leva a comportamentos individualistas e antagônicos ao nível do utilizador final.

Ao evidenciar a intrincada interconexão social que caracteriza os modelos de partilha de energia entre pares, esta tese de doutoramento argumenta que tais modelos podem vir a exercer certa influência nos sistemas de valores sociais das pessoas diretamente envolvidas com eles. No entanto, a literatura científica ainda não oferece metodologias capazes de avaliar objetivamente a natureza inerentemente qualitativa dos valores sociais no contexto da partilha de energia entre pares. Em vista disso, esta tese de doutoramento visa fornecer a primeira investigação sistemática da dimensão dos valores sociais associada aos modelos de partilha de energia entre pares. Para isso, esta tese de doutoramento desenvolveu o primeiro quadro metodológico abrangente capaz de identificar valores sociais subjacentes associados à partilha de energia entre pares. Este quadro metodológico foi testado e validado em três pilotos em Portugal sob a tutela do projeto demonstrador Community S - o primeiro a ter validado o conceito de partilha de energia entre pares em cenários reais e em condições reais de mercado antes da sua desregulamentação no país. Por causa disso, esta tese de doutoramento também demonstrou e validou o modelo de negócios por trás do projeto Community S, bem como o quadro metodológico de envolvimento dos participantes desenvolvido sob medida para garantir a sua implementação bem-sucedida.

O impacto do quadro metodológico de avaliação dos valores sociais foi analisado. Um elemento valioso deste quadro metodológico é a lista de referência de valores sociais que abrange 194 valores sociais individuais distintos e explicitamente associados à partilha de energia entre pares - categorizados em 33 macro valores sociais (ou seja, macro temas) para fins de operacionalização dos valores sociais. Os resultados sugerem que 26 dos 33 macro temas foram considerados validamente "ativos" no contexto dos três pilotos, incluindo: sentimento de pertença, realização, responsabilidade, resiliência, altruísmo, influência, emancipação, consciêncialização, participação, colaboração, identidade comunitária, diálogo, suporte, comprometimento, motivação, imparcialidade, progresso, profissionalismo, consciência ambiental, propósito, originalidade, desenvolvimento pessoal, bem-estar, impacto, defesa (de uma causa) e visão de longo prazo. O quadro metodológico proposto também permitiu aos participantes fazer inferências sobre a natureza de cada macro tema ativo revelado. A este respeito, os participantes concluiram que os 26 macro temas ativos representam valores sociais previamente existentes que foram reforçados pela partilha de energia entre pares. Os participantes também identificaram coerção

como um macro tema não relacionado à partilha de energia entre pares. Esses resultados são escaláveis, desde que as interpretações dos resultados aqui traçadas sejam colocadas em perspectiva e validadas caso-a-caso por meio do quadro de validação coeso proposto nesta tesa de doutoramento.

Em suma, esta tese de doutoramento defende que deve haver uma mudança estrutural na forma como os valores sociais são valorizados na atual transição energética rumo à descarbonização. Uma vez que apenas parte do valor geral criado pelos modelos de partilha de energia entre pares parece ser assimilado pelas relações de mercado, esta tese de doutoramento reforça a necessidade de demonstrar o impacto real alcançado pelos modelos de partilha de energia entre pares, em vez de apenas o que pode ser quantificável. Para isso, os valores sociais devem ser considerados como aspectos centrais do fornecimento e comissionamento de serviços de partilha de energia entre pares, ao invés de apenas uma externalidade incremental. Por fim, esta tese de doutoramento espera ter criado uma nova linguagem centrada em valores sociais que está explicitamente associada à partilha de energia entre pares.

Palavras-chave: partilha de energia entre pares; avaliação de valor social; avaliação da partilha de energia entre pares; comunidade de energia; serviços de energia centrados no utilizador final

NOMENCLATURE

Acronyms

VPS	*Virtual Power Solutions*
ICT	*Information and Communications Technology*
P2P	*Peer-to-Peer*
SES	*Sustainable Energy Systems*
EfS	*Energy for Sustainability*
SSH	*Social Sciences & Humanities*
PV	*Photovoltaic*
COMPETE 2020	*Operational Programme for Competitiveness and Internationalisation*
EU	*European Union*
FEDER	*European Regional Development Fund*
GECAD	*Research Group on Intelligent Engineering and Computing for Advanced Innovation and Development*
R&D	*Research & Development*
REC	*Renewable Energy Community*
LV/MV	*Low / Medium Voltage*
MV/HV	*Medium / High Voltage*
ERSE	*Energy Services Regulatory Authority*
NAT	*Network Access Tariffs*
TNO	*Transmission Network Operator*
DSO	*Distribution Network Operator*
HV/EHV	*High / Extra High Voltage*
RED II	*Renewable Energy Directive*
DGEG	*Directorate General for Energy and Geology*
UGS	*Global Use of System*
CIEG	*Costs of General Economic Interest*
CSO	*Civil Society Organisation*
VBI	*Values-Based Indicator*
LVBI	*Localised Values-Based Indicator*
P2P-SVT	*P2P energy sharing-related Social Value Theme*

LIST OF ORIGINAL PUBLICATIONS

This Ph.D. research is based on the following 3 publications, referred as Research Paper I-III. An authorship contribution statement for each publication is included in the Appendix Section.

Research Paper I Klein, L., Allegretti, G., Hes, D., Melkas, H. (2021). *Revealing social values in the context of peer-to-peer energy sharing: A methodological approach*. Sustainable Futures, vol. 3, pp. 100043, Copyrights 2021 Elsevier Ltd., Available at: https://doi.org/10.1016/j.sftr.2021.100043

Research Paper II Klein, L., Matos, L., Allegretti, G. (2020). *A Pragmatic Approach Towards End-User Engagement in the Context of Peer-to-Peer Energy Sharing*. Energy 2020, vol. 205, pp. 118001, Copyrights 2020 Elsevier Ltd., Available at: https://doi.org/10.1016/j.energy.2020.118001

Research Paper III Klein, L., Krivoglazova, A., Matos, L., Landeck, J., de Azevedo, M. (2020). *A Novel Peer-to-Peer Energy Sharing Business Model for the Portuguese Energy Market*. Energies, vol. 13(1), 125, Copyrights MDPI Ed., Available at: https://doi.org/10.3390/en13010125

Additional publications made under this research topic

1. Adams, S., Brown, D., Cárdenas Álvarez, J.P., Chitchyan, R., España Forero, J.M., Fell, M., Hahnel, U., Hojckova, K., Johnson, C., Klein, L., Montakhabi, M., Say, K., Singh, A., Watson, N. (2021). *Defining the social and economic value propositions and success factors of peer-to-peer, community self-consumption, and transactive energy models*. Renewable And Sustainable Energy Reviews (submitted for publication).
2. Annala, S., Klein, L., Matos, L., Sirpa, R., Olli, K., Narayanan, A., Honkapuro, S. (2021). *Framework to Facilitate Electricity and Flexibility Trading within, to, and from Local Markets*. Energies 2021, vol. 14, pp. 3229; doi: 10.3390/en14113229.
3. Repo, S., Kilkki, O., Annala, S., Klein, L., Matos, L., Sousa, J.E., Albuquerque, S. (2021). *DOMINOES – a roadmap to integrated local energy market operation and management*. In Proceedings of the 26th International Conference & Exhibition on Electricity Distribution (CIRED 2021), Geneva, Switzerland, Sep. 20-23, 2021.
4. Yassmine, M.; Mendes, G.; Honkapuro, S.; Landeck, J.; O'Callaghan, T.; Chaves, J.; Krivoglazova, A.; Pinho da Silva, N.; Souza e Silva, N.; Klein, L. (2020). *Comparative Assessment of Demand Response Participation in Selected European Balancing Markets*.

In Proceedings of the 2020 17th International Conference on the European Energy Market (EEM); doi: 10.1109/EEM49802.2020.9221975.

5. Klein, L., Matos, L., Allegretti, G. (2019). *Capturing Values Within Peer-to-Peer Energy Sharing Systems*. In Proceedings of the International Conference on Environmental Psychology (ICEP) 2019, Symposium on Sharing Power: A psychological perspective on peer-to-peer energy trading and collective energy schemes, University of Plymouth, United Kingdom, September 4-6, 2019.
6. Klein, L., Matos, L., Allegretti, G. (2019). *The Impact of a Tailored End User Engagement Framework on a Peer-to-Peer Energy Sharing Initiative: An Empirical Study*. In Proceedings of the 4th International Conference on Energy and Environment: Bringing Together Engineering and Economics (ICEE 2019), Guimarães, Portugal, May 16-17, 2019.
7. Klein, L., Matos, L., Landeck, J. (2018). *Review on the main flexible residential loads with potential to participate in Demand Response Programmes*. In Proceedings of the 4th DREAM-GO Workshop: Demand Response Approaches for Real-Time Renewable Energy Integration, Institute of Engineering - Polytechnic of Porto, Oporto, Portugal, January 16-17, 2019; https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5c1b56407&appId=PPGMS.
8. Klein, L., Allegretti, G., Hes, D., Matos, L. (2018). *A Social Values-Based Perspective on Peer-to-Peer Energy Sharing Systems*. 5th European Conference on Behaviour and Energy Efficiency (BEHAVE 2018), Zurich, Switzerland, September 6-7, 2018, doi: 10.21256/zhaw-1370.
9. Annala, S., Mendes, G., Honkapuro, S., Matos, L., Klein, L. (2018). *Comparison of Opportunities and Challenges in Demand Response Pilots in Finland and Portugal*. 15th International Conference on the European Energy Market (EEM 2018), Łódź, Poland, June 27-29, 2018, IEEE Xplore, pp. 1-5, doi: 10.1109/EEM.2018.8469894, ISSN 2165-4093. Available at: https://ieeexplore.ieee.org/document/8469894.
10. Klein, L., Matos, L., Basílio, S., Landeck, J. (2017). *Community S: An Energy Sharing Approach Towards Energy Systems*. In Proceedings of the 3rd International Conference on Energy and Environment - Bringing Together Engineering and Economics, Chapter XI - Energy Systems, Oporto, Portugal, June 29-30, 2017, ISBN 978-972-95396-9-5, ISSN 2183-3982.
11. Klein, L., Antunes, C., Lopes, M., Hes, D. (2016). *The value-adding role of social capital on net positive energy design at the regenerative neighborhood level*. In Lopes, M., Antunes, C., Martins, A., Silva, L. (Eds.). In Proceedings of the 4th European Conference on Behaviour and Energy Efficiency (Behave 2016), Coimbra, Portugal, September 8-9, 2016, ISBN 978-989-95055-9-9.

INDEX

1. INTRODUCTION

1.1 Background and motivation

The disruptive reconfiguration of the energy sector is being largely influenced by the ongoing co-evolution of the techno-economic, socio-cultural, socio-environmental, and political-institutional agendas across the globe in the face of a desirable carbon-constrained future [1]. The overarching advances in Information and Communications Technology (ICT) aligned with the fast-paced integration of distributed renewable energy sources in the energy grid are changing the way that end-users are procuring, perceiving, and consuming energy-related products and services [3]. This transformation of the energy sector enables the emergence of novel user-centric energy market models that disrupt the entire energy value chain, as they unlock the delivery of new value streams in the form of energy and non-energy outcomes and services to meet new end-users' expectations [3].

At the core of these user-centric energy market models lies the peer-to-peer (P2P) energy sharing concept [2], which refers to flexible, decentralised, synergistic, and direct exchanges of (often the case) distributed renewable electricity between grid-connected[1] end-users [4]. Under this perspective, prosumers[2] can directly trade their surplus distributed renewable generation with other grid-connected end-users who are in electricity deficit rather than sell it to the distribution network [2,4].

P2P energy sharing models can be organised under different not-for-profit governance schemes that combine non-commercial economic aims with environmental and social objectives [5,6]. As a result of this growing global ethos, end-users become more empowered to transact their energy assets in their own terms and explore the benefits of their local embeddedness, threatening the well-established hegemonic role of traditional players in energy markets [4,7]. Although this vision does not necessarily imply the complete upheaval of the energy sector[3] [8], it still highlights opportunities to address dysfunctional arrangements of the current energy market, including the shortcomings of the existing power dynamics.

[1] The term "grid-connected end-users" does not necessarily imply a connection to the main energy grid, but rather a grid connection between two or more end-users (either through the main energy grid or private wire networks such as the case of islanded energy communities / microgrids).

[2] I.e., those who play the dual role of consumers and producers of electricity [4].

[3] Ruotsalainen et al. [8] explains that this relates to the concept of societal experimentation, where change is progressively experienced in waves of innovation rather than in one go, due to the fact that some incumbent actors try to hold on as much as possible to the status quo while others try to foster innovation as fast as possible.

Fundamentally, P2P energy sharing models enables the creation of far more accessible, distributed, democratised, collaborative, sustainable, and socially-just energy networks in comparison with traditional energy market models. That is because P2P energy sharing models are based on complex social networks that thrive on the social interconnectedness among end-users, rather than on competing economic self-interests. This challenges the traditional approach of energy markets, which is usually characterised by a rigid top-down hierarchical structure that leads to individualistic and antagonistic behaviours at the end-user level [4].

By evidencing the intricate social wiring and local embeddedness that characterises P2P energy sharing models, this Ph.D. research argues that these models might play a wider contributive role in social values systems. Hence, this Ph.D. research aims to investigate whether P2P energy sharing models influence the social values systems of the end-users directly involved with it. This research angle perfectly fits the scope of the Sustainable Energy Systems (SES) doctoral programme of the Energy for Sustainability (EfS) and MIT Portugal initiatives at the University of Coimbra, given that this programme focuses on the development of interdisciplinary interventions to address pressing, highly complex global issues confronting the energy sector from a sustainable and system-wide perspective.

1.2 Statement of the problem

Although competition and its pervasive features[4] seems to be the predominant approach of traditional energy market models, Favini [10] has shown that competition is not an inherently dominant human behaviour trait – at least not more so than collaboration. Competition is only present in the collective ethos due to political manoeuvre that promotes the ruling industrial, for-profit economic model that demands competition to function and that informs, among other things, the design and operation of traditional energy market models [10]. Yet, P2P energy sharing models operate in an alternative not-for-profit economic model, striving in the promotion of synergistic collaboration and collective resilience between different peers – which opposes the notion of competition. This foundational aspect of P2P energy sharing systems finds support in the work of Lieberman [11], who argued that the mechanisms behind the social brain tend to favour prosocial behaviours over selfish or antagonistic behaviours [11]; and Melamed et al. [12], who explained that human social networks are wired to be altruistic even when multiple interests are at stake.

The pertinence of the P2P energy sharing concept is particularly heightened nowadays in the face of the COVID-19 crisis that is ravaging the foundations of the contemporary world. The fast pace

[4] E.g., competitive self-interests, consumerism, environmental degradation, inequality, market concentration and political capture that inhibit regulations that counteract these trends [9].

of the development of this pandemic is forcing societies to create more agile, resourceful, and collective responses that often transcends geopolitical borders, inflexible financial systems, existent supply chain structures, and power dynamics. Uren [13] argues that the shared responses that are coming forth to address this pandemic indicate a systemic change in mental models, namely by signifying social norms and societal behaviours for collective actions. Potentially, the COVID-19 crisis could be a catalyst for systemic reforms in the energy sector, providing societies with a renewed approach towards energy production, distribution, transmission, sale, and usage [13] – much in line with the guiding principles that fundament the P2P energy sharing concept.

The arguments abovementioned are reinforced by the energy-related Social Sciences & Humanities (SSH) literature that states that the radical change that is currently observed in energy systems is likely driving the transformation of societal systems and vice-versa [8,14].

In view of the abovementioned, this Ph.D. research proposes to look at P2P energy sharing models from a social values-based angle. Yet, when looking back at academia, most research efforts on P2P energy sharing are limited to a reductionist techno-economic ethos that tends to rule out any element that is neither easily quantifiable nor profit-oriented.

This Ph.D. research defends that there must be a fundamental shift in the way that social values are accounted for in the transition towards a desirable carbon-neutral future. Since only part of the overall value created by P2P energy sharing models seems to be assimilated into market relations, this Ph.D. research highlighted the need to demonstrate the real impact of what can be truly achieved with P2P energy sharing, instead of just what is easily quantifiable. For that, social values should be considered core outcomes of P2P energy sharing services provision and commissioning, rather than just an incremental externality. This means moving from a strict profit-oriented perspective focused on economic outcomes towards a wider perspective that also encompasses non-market outcomes, such as the case of social values. However, up to now there are no fit-for-purpose methodologies in the scientific literature that can transfer the inherently qualitative nature of social values into quantitative measures in the context of P2P energy sharing.

1.3 Objectives and research questions

This Ph.D. research aims to provide the first systematic investigation of the social values-based dimension of P2P energy sharing models. In view of that, the main objective set by this Ph.D. research is to conceptualise, design, implement, and validate the first operational social values-based assessment framework that allows the identification of underlying social values associated

with P2P energy sharing – thus highlighting the importance of valuation[5] processes in this context. By doing so, this Ph.D. research expects to scrutinise and answer the following four main Research Questions (RQ):

RQ 1 *Is it possible to reveal, demonstrate, and operationalise the inherently qualitative social values-based dimension of P2P energy sharing models with scientific rigour? If so, how?*

RQ 2 *How to distinguish the nature of the uncovered social values associated with P2P energy sharing models?*

RQ 3 *How to move highly complex and abstract concept definitions from vague normative statements to their operationalisation?*

RQ 4 *How to validate and scale up the valuation process proposed in this Ph.D. research?*

This Ph.D. research formulated four initial hypotheses (H) to distinguish the nature of the underlying social values associated with P2P energy sharing models (as per RQ2):

H 1 *The social value emerged from the ground up because of the P2P energy sharing.*

H 2 *The social value already existed before the P2P energy sharing and was reinforced by it.*

H 3 *An antagonistic version of the social value already existed before the P2P energy sharing but was modified by it.*

H 4 *The social value did not apply to the P2P energy sharing.*

Furthermore, to answer the four main Research Questions, it is imperative to address some structuring aspects of P2P energy sharing models.

The first structuring aspect relates to the definition of the case study. In the absence of any existing P2P energy sharing case study in Portugal at the time of the development of this Ph.D. research (bearing in mind that it was carried out years before the deregulation of P2P energy sharing in the country), it was necessary to propose a case study from the ground up. Therefore, this Ph.D. research conceptualised, designed, implemented, and validated the first P2P energy sharing pilot project that was ever trialled in Portugal in real-life settings and under real-market conditions, entitled *Community S*.

Secondly, considering the central role of end-users in P2P energy sharing models, it was also necessary to conceptualise, design, implement, and validate the first fit-for-purpose end-user engagement framework tailored in the context of P2P energy sharing, as a means to guarantee the sucessful roll out of the pilot project abovementined.

In view of that, this Ph.D. research also aims to address the following two Research Sub-Questions (RSQ):

[5] According to Kenter et al. [20], valuation refers to formal research related to analysis or decision-making processes that explicitly express or deduce values (of various types). In this sense, it is important to distinguish valuation from valuing, as the latter refers to "informal and largely implicit processes that are not bound to any particular setting" [20].

RSQ 1 *How to effectively engage end-users in the context of P2P energy sharing?*

RSQ 2 *What are the immediate implications of the existing regulatory barriers on the implementation of P2P energy sharing models in Portugal? How to address these barriers?*

1.4 Outline of the research

This Ph.D. research is constituted by 6 main chapters and an appendix section. The chapters are organised as follows: Chapter 1 introduces the topics under scrutiny in this Ph.D. research, including the background information and motivation for undertaking this research, the main objectives and research questions, and the outline of the reseach. Chapter 2 defines the concept of social value, and summarises the main take aways from the scientific literature on P2P energy sharing from 3 different angles: (i) the social-values based perspective; (ii) the end-user engagement perspective; and (iii) the business model perspective. Chapter 3 describes the case study analysed in this Ph.D. research. Chapter 4 details the fit-for-purpose social values-based framework designed to reveal social values in the context of P2P energy sharing. Chapter 5 discusses the main outcomes from the implementation of the proposed methodology. Chapter 6 summarises the main conclusions of this Ph.D. research, including its main contributions; unsolved issues; and suggestions for further research.

The Appendix Section consists of 7 appendices, of which the last 3 refer to the main research papers published in the context of this Ph.D. research and that were combined to form its overall structure:

- **Research Paper I** (Klein et al., 2021) devised the first overarching social values-based assessment framework that allows the identification of underlying social values associated with P2P energy sharing models, which was trialled and validated in 3 different pilots in Portugal. This publication aimed to open new pathways to better comprehend the nuances of the social values-based dimension of P2P energy sharing models, as well as create a new social values-based language that is explicitly associated with these models.
- **Research Paper II** (Klein et al., 2020b) proposed a pragmatic end-user engagement framework constructed around the P2P energy sharing context that was trialled and validated in 3 different pilots in Portugal. This publication aimed to provide good practices related to the design and implementation of future P2P energy sharing initiatives.
- **Research Paper III** (Klein et al., 2020a) presented a novel peer-to-peer energy sharing business model developed specifically for the context of the Portuguese energy market, which was successfully trialed and validated in 3 different pilots in Portugal under real market conditions – years before the deregulation of P2P energy sharing in the country. This paper proposed an innovative P2P energy tariff for end-users connected by the same

low voltage network, which resulted in direct financial benefits to them. This publication aimed to challenge the restrictive regulatory framework in Portugal and help to build the emerging consumer-centric energy regime of the future.

STATE-OF-THE-ART

2.1 A social values-based perspective on peer-to-peer energy sharing models

As previously explained, this Ph.D. research aims to investigate whether P2P energy sharing models influence the social values systems of the end-users directly involved with it. In the existing scientific literature, there are few studies looking at the less tangible SSH facets of P2P energy sharing models. In summary, Giotitsas et al. [15] proposed a theoretical framing for P2P energy sharing based on the decommodification of energy and production of common value. Jogunola et al. [16] highlighted that the donation of surplus decentralised generation can fulfil non-economic goals. Moret and Pinson [17] demonstrated fairness among end-users in distributed negotiation mechanisms. Biggs [18] uncovered that the main social drivers for end-user engagement in prosumerism are greater control, autonomy, and independence. Van der Schoor and Scholtens [19] concluded that greater social cohesion is a main motivation for end-user engagement in local energy communities. Roberts et al. [5] explained that the main social objectives of an energy community are openness, democratic participation and governance, effective ownership and control, and the provision of benefits for its members.

Even more sparse is the literature on the social values-based perspective of P2P energy sharing models. The most informative conceptual work is the essay written by Ruotsalainen et al. [8], which offered a hope-filled vision of a decentralised, renewable-based P2P society by 2050 – a future society that embraces culture and values as key forces driving and deriving from the energy transition. These authors argue that, if their desirable 2050 vision comes to reality, it will imply the emergence of more complex social structures with broader consequences for society (e.g., culture, values, lifestyles, and power structures). Therefore, Ruotsalainen et al. [8] innovated by proposing the incorporation of the social values-based dimension into the conceptualisation of P2P energy sharing models. Still, their vision remained mostly at the abstract level of theoretical conceptualisation, analogy, and aspiration, failing to provide any concrete approach to reach this vision - e.g., in the forms of an analytical framework, a specific methodology or empirical data.

In line with the foregoing, this Ph.D. research aims to address the existing knowledge gap by providing the first systematic investigation of the social values-based dimension of P2P energy sharing models. Specifically, this Ph.D. research devised an overarching social values-based assessment framework that allows the identification of underlying social values associated with P2P energy sharing interactions.

2.1.1 An actionable understanding of the concept of social values

This Ph.D. research emphasises the need to consider social values paramount not just in relation to core P2P energy sharing service outcomes, but also from the way that these P2P energy sharing services are designed and delivered to society. Hence, it is fundamental to provide a clear definition of what "social values" means in this Ph.D. research.

Firstly, there is not a single authoritative definition of social values mainly due to multiple theoretical underpinnings across different SSH disciplines that defined this term from their own disciplinary orientations. Illustratively, Harder et al. [21] explained how diverse the interpretations of the broader term "value" are, citing the work of Horáková [22] that identified 180 distinct definitions within the SSH literature.

Secondly, this theoretical debate usually diverges from present-day practice, which usually offers more actionable understandings of this term. Nonetheless, it is still difficult to find a clear taxonomy of social values, thus highlighting how multifaceted this term is. Hence, this Ph.D. research coined its own actionable interpretation of this term (see below), which was adapted from different definitions provided by ESDinds [23]:

> *Social values are enduring beliefs defined by groups, organisations, or individuals, in their own cultural and social contexts, that define which specific modes of conduct (i.e., behaviours) or end states (i.e., outputs) are personally or socially preferable to their opposite - thus providing the basic rules that govern human interactions, indicating what is good or bad, desirable or undesirable, and eventually driving meaningful cultural and social changes.*

Illustratively, ESDinds [23] provided a few examples of what social values might represent in practical terms: individual or collective goals (e.g., prosperity, wellbeing, happiness or satisfaction); principles of social ethics (e.g., justice, solidarity or altruism); material versus spiritual priorities (e.g., moderation, contentment, detachment or frugality); community values (e.g., unity in diversity, tolerance or participation); or individual qualities of character (e.g., independent thinking, courage, confidence, trustworthiness, honesty, resilience, adaptability or creativity). These examples are not intended to represent a comprehensive listing of social values, but merely expose some ideas to spur further thought and discussion on its meaning.

By coining its own actionable interpretation of social values, this Ph.D. research attempted to move this abstract concept from vague normative statements to its operationalisation for research purposes. That is, this interpretation of social values was passed on to the end-users to help them transform this complex concept into their specific language / cultural assumptions.

2.2 End-user engagement in the context of peer-to-peer energy sharing

Although some insights on end-user engagement can be drawn from the scientific literature on user-centric energy markets, to date no systematic investigation has been carried out in this regard. Illustratively, Gui et al. [24] advocated that that end-user involvement is largely determined by their access to meaningful information related to their participation in these markets, as well as by whether and how they perceive ownership, control, and trust. Meanwhile, Parag and Sovacool [4] explained that end-users usually prefer not to get involved with energy-related matters and tend to have a negative perspective on changing energy behaviour. Also, Parag [25] argued that the management of such markets represents a complex challenge as they are constituted by distinct groups of actors who play alternating roles and who have different motivations and preferences to be part of it. All things considered, at present the insights found in the scientific literature are essentially limited to the analysis of drivers that hinder or determine end-user engagement in user-centric energy markets. Hence, best practices to engage end-users in user-centric energy markets are not yet known.

As explained by Klein et al. [26], the shy efforts oriented to the investigation of end-user engagement in user-centric energy markets can be explained by the mechanistic worldview through which this concept is often studied, which tends to focus on its techno-economic attributes to the detriment of its qualitative attributes. Nevertheless, this Ph.D. research defends that evaluating these market models strictly from their techno-economic perspective represents a reductionist approach that only taps on part of their full potential. In view of this, this Ph.D. research aims to add value to the existing literature by proposing, to the best of knowledge, the first operational end-user engagement framework that is specifically tailored to the context of P2P energy sharing.

To do so, this Ph.D. research analysed the broader literature review on community engagement as to identify key take-aways that could guide the development of a framework constructed around P2P energy sharing – i.e., to identify which critical structural elements (i.e., strategies and mechanisms) should compose the core of this framework as to ensure its effectiveness.

In the review carried out by Valkering et al. [27] on the main strategies to engage end-users in smart energy behaviour (i.e., behaviour associated with energy efficiency, load flexibility, and renewable energy generation), these authors identified some critical success factors: (i) to segment end-users in different groups, and to identify which end-user engagement mechanisms and approaches best suit each segment; (ii) to develop innovative services / products that are clearly seen as added value for end-users, as to minimise the perception that the participation in smart grid projects is burdensome; (iii) to collect empirical evidence about the impact of different combinations of end-user engagement approaches to discover key success factors (e.g., pricing mechanisms, monetary/non-monetary incentives, feedback information and channels, etc.); (iv) to further evaluate which communication channels, information, and marketing mechanisms better engage end-users in smart grid projects; (v) to improve the understanding on how non-energy stakeholders (i.e., those besides traditional energy players) impact end-user engagement processes; (vi) to

uncover which approaches or mechanisms enable end-user empowerment (i.e., need to change the perception of end-users as merely consumers to customers/citizens); (vii) to improve the understanding on which aspects of new energy market structures contribute to end-user engagement; and, finally, (viii) to improve the understanding on how to upscale end-user engagement strategies implemented in pilot projects (that often-only target "early adopters") to larger scale rollouts that usually embrace more diversified end-user segments.

In the review carried out by Hes and Du Plessis [28] on participation in sustainable development projects, the authors defended the need to shift the current dominant community engagement approach from one that is based on a reductionist "regulation for compliance" narrative, informed by quantitative, performance-based indicators and largely driven by competition or individual interests, towards one that is based on a more relational narrative and that puts stakeholders at the heart of any development process [28]. The authors also explained that to thrive in this paradigm shift, new end-user engagement frameworks must comply with the following: (i) to give a voice to end-users to build shared visions that embrace their multiple, contrasting points-of-view (i.e., ongoing integration); (ii) to promote capacity-building so that end-users understand their unique roles in the project, see themselves as an integral part of the project narrative, and eventually become its future stewards (i.e., ongoing ownership); and (iii) to stimulate the continuous transformation of the end-users themselves (i.e., ongoing feedback).

2.3 A peer-to-peer energy sharing business model for the Portuguese energy market

As previously explained, it can be inferred that by disintermediating the energy supply model, P2P energy sharing models aim to push the makeover of traditional energy networks from an overly controlled, outdated, unidirectional, and centralised model towards a far more collaborative, accessible, adaptive, networked, distributed, and sustainable one. This contemporary shift in power relations brought forth by the P2P energy sharing concept challenges common practice in energy markets, threatening to overturn well-established hierarchies, and urging traditional players to redesign their operations and value chains for the delivery of innovative energy products and services aligned with the P2P energy sharing concept [4,7].

A fast-growing number of research has arisen in recent years in an attempt to define the first techno-economic attributes of P2P energy sharing models, thus uncovering trends, open issues and insights into future research directions from a techno-economic standpoint. Illustratively, Roy et al. [29] provided insights into the impacts of P2P energy trading through pool aggregation on different stakeholders; Zhang et al. [30] presented the design and interoperability aspects of components for P2P energy trading in a microgrid; Zhang et al. [31] designed a P2P energy trading platform and

simulated P2P energy trading using game theory; AGL Energy Limited [32] evaluated the potential value of virtual P2P energy trading using distributed ledger technology for customers and market participants; Jogunola et al. [16] reviewed and classified the literature on transaction-based energy frameworks based on structures, controls, trading methods, optimisation techniques and communication models; Liu et al. [33] formulated an internal price model and the cost model of P2P prosumers inside a microgrid considering the willingness of load shifting; Long et al. [34] proposed a two-stage aggregated control to enable P2P energy sharing in community microgrids; Zhou et al. [35] proposed a three-stage evaluation methodology to assess the economic performance of P2P energy sharing models; Zhou et al. [36] developed a multiagent framework to simulate P2P energy sharing; to name a few.

Additionally, the first trials to implement P2P energy sharing models in real market conditions have started emerging – namely in the Netherlands, Germany, the UK, the USA, Australia, and is steadly spreading worldwide [37,38].

Nonetheless, P2P energy sharing business models are yet very little put into practice due to the rigid energy market structures and the slow pace of the evolution of regulatory frameworks across the globe – hence very few innovative P2P energy sharing business model structures are known. Fundamentally, refashioning the highly regulated energy industry represents a cumbersome task that may only be feasible if the P2P energy sharing concept is translated into a wide array of tangible business models across the world that demonstrate its advantages and benefits, thus creating enough momentum to disrupt the status quo within which conventional energy market models are conceptualised.

3. CASE STUDY

3.1 Case study description

The case study under scrutiny is the *Community S* project[6], which represents the first demonstration project to have ever trial the concept of P2P energy sharing in real-life settings and under real market conditions in Portugal [39,40,41]. Due to the novelty of the *Community S* project, it can be inferred that it played a central role in the deregulation of P2P energy sharing in the Portuguese energy landscape.

This demonstration project was scrutinised through three different perspectives: a novel business model perspective [39]; an end-user engagement perspective [40]; and a social values-based perspective [41], which refer to the 3 main Research Papers that underpinned the development of this Ph.D. research.

The *Community S* project was trialled in 3 different municipalities in Portugal: Alfândega da Fé, Penela, and Vila Real (Lordelo) [39,40,41]. Each municipality represented a low-voltage renewable energy community pilot composed of 4 public buildings equipped with photovoltaic (PV) panels (i.e., prosumers), and on average 41 resident citizens (i.e., consumers) that were selected by convenience sampling [40], as presented in Table 1.

Table 1. Configuration of each pilot in the *Community S* project [39,40,41].

Pilots	**No. of inhabitants**	**No. of consumers**	**No. of prosumers**
Alfândega da Fé	4,607 in 2017 [43]	55 households	4 public buildings with PV panels (City Hall, Municipal Library, Municipal Market, Cultural Centre)
Penela	5,521 in 2017 [43]	36 households	4 public buildings with PV panels (Multipurpose Pavilion, Penela School Centre, Espinhal School Centre, Municipal Library and Auditorium)
Vila Real (Lordelo)	3,169 in 2013 [44]	32 households	4 public buildings with PV panels (Public Indoor Swimming Pool Facility; Sports Centre; Árvores School Centre, Vila Velha Museum)

Specifically, the target citizens were defined following the same premises of the European Values Study [42]: citizens aged 18 or older (without upper age limit) that resided in private households in one of the 3 pilots during the development of the *Community S* project.

[6] R&TD Co-Promotion Project no. 18015 under call no. 31/SI/2015 SI I&DT, also known as *NetEffiCity - Virtual Power Networks Efficient Management*.

The *Community S* project was officially launched in September 2016, however, the deployment of the pilots only started in January 2018 [40], lasting 6 months (i.e., from January to June 2018).
The *Community S* project was co-funded by the Portugal 2020 Programme under the Operational Programme for Competitiveness and Internationalisation (Call nº 31/SI/2015), and by the EU under the European Regional Development Fund (POCI-01-0247-FEDER-018015), with a total budget of 711,737 € (Grant Agreement nº 18015) [39].
The consortium involved in the development of this project comprised 3 private and public entities with distinct backgrounds who joined efforts to comprehensively demonstrate the feasibility of the proposed solution, including [39]:

- Virtual Power Solutions (VPS)[7]: Leader of the consortium. VPS is a technology-based company that focused on the provision of smart and interconnected hardware and software solutions to enable the validation of the user-centric services offered in the *Community S* project.
- Energia Simples[8]: An energy retailer / aggregator that focused on the validation of the P2P energy sharing business model proposed in the *Community S* project.
- Research Group on Intelligent Engineering and Computing for Advanced Innovation and Development (GECAD)[9]: Research & Development (R&D) centre of the Institute of Engineering at the Polytechnic of Porto that focused on the development of algorithms for the optimisation of the user-centric services offered in the *Community S* project.

3.2 A peer-to-peer energy sharing business model for the Portuguese energy market

In this section, the main results derived from Research Paper III [39] are presented. It primarily focuses on the presentation of the P2P energy sharing business model that was specifically tailored for the Portuguese energy market, and successfully trialled and validated in the 3 pilots proposed in the *Community S* project – the first of its kind in Portugal.

[7] https://www.vps.energy/

[8] https://www.energiasimples.pt/

[9] http://www.gecad.isep.ipp.pt/

3.2.1 Implementation

The proposed business model envisioned the creation of 3 low voltage Renewable Energy Communities (RECs), where all its members were in geographic proximity and under the same Low / Medium Voltage (LV/MV) transformer substation.

These low voltage RECs were structured so that each municipality (i.e., prosumers) shared with its citizens (i.e., consumers) the surplus distributed generation from PV systems installed in public buildings[10]. Hence, the core idea behind the proposed business model was the equitable distribution of surplus renewable generation from public buildings among participating citizens (instead of injecting it in the distribution grid as per business as usual) [39].

It is important to highlight that the demonstration of the *Community S* project (2016–2018) preceded the deregulation of P2P energy sharing activities in the Portuguese legal landscape, which only took effect in 2020 through Decree-law No. 162/2019 [45].

When the *Community S* project was conducted, the existing Portuguese regulatory framework (i.e., Decree-Law No. 153/2014 [46]) discouraged the generation of surplus electricity for prosumers by establishing an unattractive Feed-In tariff for this parcel of electricity. That is, the price that prosumers used to get from their net export of surplus renewable generation to the Medium / High Voltage (MV/HV) distribution grid was approximately 90% of the average monthly price in the wholesale electricity market in the Iberian Peninsula [39]. Simply put, this means that prosumers had to sell their surplus renewable generation at a rate 10% lower than the rate of the purchased electricity from the distribution grid [39].

Furthermore, the Final Sales tariff paid by final consumers connected to low voltage networks in Portugal is until now higher than that paid by final customers connected to the medium or high voltage networks, given that the electricity used by the former has to access greater distribution network routes to reach its endpoint [39]. That is because the methodology chosen by the Energy Services Regulatory Authority (ERSE) to calculate energy tariffs is based on the principle of tariff additivity [47] – meaning that the Final Sales tariff paid by final consumers represent a sum of different supply activity tariffs associated with the use of energy network infrastructures for the delivery of electricity. Illustratively, the structure of the traditional Final Sales tariff presented to final customers in the liberalised Portuguese energy market is obtained through the sum of the following tariffs (Fig. 1):

[10] PV systems in public buildings generate surplus electricity during periods of low to nearly-zero electricity consumption within their facilities - e.g., lunch hours; vacation periods; public holidays; weekends; before and after working hours; etc. [39].

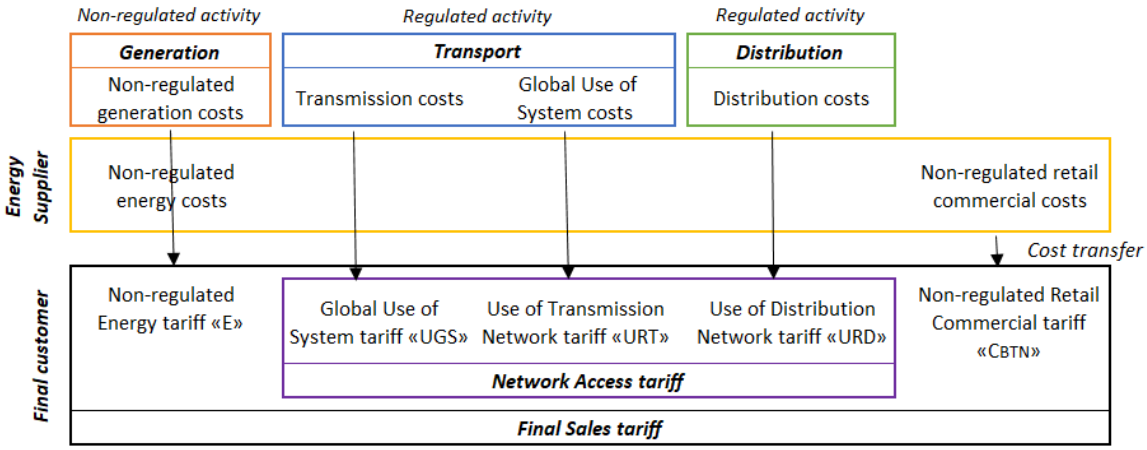


Fig. 1. Components of the Final Sales tariff presented to final customers in the liberalised Portuguese energy market [47].

However, by proposing the creation of low voltage RECs, the surplus distributed generation would have been primarily consumed locally within the boundaries of the low voltage distribution network, resulting in lower net exports of surplus renewable generation to higher voltage levels (i.e., medium or high voltage network routes), as well as in an overall energy tariff reduction for consumers, and higher profits for prosumers – i.e., the P2P energy sharing tariff [39].

That is because the P2P energy sharing tariff proposed in the *Community S* project was exempt from the costs associated with Network Access Tariffs (NAT) at higher voltage levels (i.e., medium and high voltage networks) that were not in use during the P2P energy sharing [39]. This was achieved by subtracting the regulated NAT associated with medium and high voltage networks from the traditional Final Sales tariff offered by consumers [39].

It is fundamental to highlight some remarks regarding the proposed approach. As put by Park and Yong [38], the notion that a consumer can buy electricity from a specific prosumer is only logical from a market clearing perspective. At the physical level (i.e., the low voltage network), however, one cannot identify the source of the electricity that flows within the low voltage network into each household. In other words, technically seen, the surplus generation from prosumers cannot be stamped nor distinguished from other electricity sources and cannot be sent to targeted locations. Therefore, the P2P energy sharing interactions had to be demonstrated through financial simulations rather than through physical electricity trading per se [39], and the participating citizens benefited from the advantages of P2P energy sharing by receiving monthly discounts in their energy bills that were equivalent to the costs savings they would have had through the purchase of surplus renewable generation in a desirable deregulated scenario [39].

The benefits from participating in the *Community S* project were calculated based on the real-time monitoring and control of energy consumption and renewable generation in each participating building (i.e., public buildings and households) [39]. Each participant received a smart energy management system to optimise their energy consumption based on the availability of distributed surplus generation within their low-voltage renewable energy community or advantageous price signals [39]. Hence, in practical terms, participants were asked to keep their smart energy

management equipment fully operational during the trial period (i.e., from January to June 2018) as to provide consistent data for the simulations of the P2P energy sharing [39].

3.2.2 Results

All things considered, the feasibility of the proposed business model was highlighted in Research Paper III [39], which would have benefited all stakeholders involved with P2P energy sharing in a deregulated scenario in Portugal.

Illustratively, consumers would have paid a reduced price for the electricity bought from grid-connected prosumers in comparison to the electricity bought from utilities, as in that case they would be exempt to pay for the total amount of NAT charges [39]. During the 6-month trial period, the economic benefit would have accumulated to 3.0-3.4 € per consumer, depending on the contracted energy tariff of each consumer [39].

Similarly, prosumers would have made bigger profits by trading surplus generation within the low voltage REC rather than selling it to the distribution grid, since by the time the *Community S* project was conducted, the Feed-In tariff was 10% lower than the rate of the electricity purchased from the distribution grid [39]. Illustratively, during the 6-month trial period, this profit would have accumulated to approximately 90.2 € for the 4 public buildings in Alfândega da Fé [39].

Furthermore, it would have strategically benefited Transmission and Distribution Network Operators (i.e., TNOs & DNOs, respectively), as P2P energy sharing transactions in low voltage RECs would have reduced the congestion in MV/HV distribution networks and High / Extra High Voltage (HV/EHV) transmission lines [39]. Consequently, this would result in the alleviation of grid maintenance costs, in the mitigation of transmission and distribution losses, in the adjournment of investments related to the reinforcement of transmission lines and, altogether, in the balancing of the energy grid [39].

The business model also highlighted that an additional variable could be considered in a renewed NAT (referring to a security of supply insurance), since that the P2P energy sharing communities would still be connected to these higher voltage networks as a means to provide security of supply in case of shortages within the low voltage grid level [39]. This represents a reasonable recommendation from an economic perspective, especially considering that the margin of the proposed NAT reduction is fairly wide (ranging from 22.1% to 56.4%, depending of the energy tariff structure of each end-user) [39]. Nonetheless, this idea went beyond the scope of the demonstration project and was considered as potential future work.

Due to the highly innovative nature of the *Community S* project, it represented a valuable reference model that helped pushing the restrictive and outdated national regulatory framework in Portugal, thus helping to build the emerging new energy regime on P2P energy sharing in the country [39].

3.2.3 The new regulatory framework on peer-to-peer energy sharing in Portugal

As previously explained, the *Community S* project played a central role in the deregulation of P2P energy sharing in the Portuguese energy landscape, given that it represents the first demonstration project to have ever trial the concept of P2P energy sharing in real-life settings and under real market conditions in Portugal [39,40,41],

In view of that, Portugal recently took the first steps towards the deregulation of P2P energy trading in 2020, namely by transposing the EU Renewable Energy Directive (RED II) into an enabling national regulatory framework (Decree-law No. 162/2019 [45]) for the facilitation of REC and collective self-consumption initiatives in the country – which represents an instrumental step to reach a 47% share of renewables in the gross final energy consumption by 2030 [45].

Repo et al. [48] carried out a thorough analysis of the context of the regulatory transposition of the EU RED II in Portugal, stating that it was carried out in a partial manner to allow the responsible executive governmental agencies[11] to gradually improve the national legal framework in view of best practices from the field. On that note, while Portugal represents the EU Member State that most literally transposed the EU RED II provisions as it is [49].

Collective self-consumption in Portugal: the referred Decree-Law introduced major modifications in the self-consumption regime of electricity, guiding it towards the increased use of renewable energy; modification of net metering requirements; definition of a 15-minute interval for the monitoring and treatment of energy-related data; allowance of collective self-consumption schemes via the association of several production and consumption facilities; facilitation of the development and implementation of RECs, as well as the integration of electrical energy storage infrastructures; and favouring market-based sales of electricity [45]. Among other things, the Decree-Law formulates that the collective self-consumption schemes must be based on the association of consumers and prosumers that are in geographic proximity for energy sharing [45]. It also introduces a new, dully qualified entity to be appointed by the respective members of the collective self-consumption scheme, entitled Self-Consumption Management Entity, that shall legally represent them before operators and administrative entities [45].

Renewable energy communities in Portugal: in terms of rights, duties, monitoring of renewable generation and commercial relationship for RECs, the same rules of collective self-consumption apply with the appropriate adaptations, such as the power to produce, consume, store, and sell renewable energy through power purchase agreements; share their renewable generation within their members; participate in all suitable energy markets, both directly and through aggregation, in a non-discriminatory manner [45]. RECs are also fully responsible for imbalances causes to the national energy grid, being responsible for settling such imbalances or for delegating it to a market participant or its designated representative [45]. This is reinforced by the referred Decree-Law

[11] I.e., the Directorate General for Energy and Geology (DGEG); ERSE; and the government official for the energy sector [45].

which states that any natural or legal, public, or private stakeholder can openly and voluntarily participate in RECs, putting emphasis on the roles of SMEs, municipalities, and domestic customers in it [45].

Decree-law No. 162/2019 [45] in currently under reform (Public Consultation no. 93 [50]) as to create a clearer set of rules for collective self-consumption schemes and RECs, with emphasis on the inclusion of energy storage activities and the possibility of implementing pilot projects (e.g., in 2021, a pilot project will be launched to test more sophisticated P2P energy sharing algorithms). Also, it proposes the partial exemption from the payment of NAT charges in these cases, as well as the total or partial exemption from the payment of Global Use of System (UGS) tariff chages [50] - namely referring to the Costs of General Economic Interest (CIEG) [51]. All is all, it is worth noting that the evolution of the existing national regulatory approach on P2P energy sharing in Portugal is aligned with the business model structure proposed in the *Community S* project.

All in all, although Portugal has started taking the first steps to comply with the EU-wide provisions on energy communities, it still must be further developed to reach full maturity in this topic. At present, a handful of RECs and collective self-consumption schemes (e.g., in the forms of neighbourhoods, condominiums, private social security institutions, municipal buildings and industrial complexes) started growing across Portugal, which are awaiting the decision of the responsible executive governmental authorities to receive their formal recognition.

3.3 End-user engagement in the context of peer-to-peer energy sharing

In this section, the main results derived from Research Paper II [40] are presented. It primarily focuses on the conceptualisation and design of the first operational end-user engagement framework ever constructed in the context of P2P energy sharing, which was trialled and validated in the 3 pilots proposed in the *Community S* project.

It is important to highlight that this work was carried out during the demonstration of the *Community S* project (2016–2018), which preceded the deregulation of P2P energy sharing activities in the Portuguese legal landscape that only happened in 2020 [40].

3.3.1 Implementation

The end-user engagement framework devised in the *Community S* project consisted of 4 different steps: (i) categorisation of end-users; (ii) definition of the different phases of the end-user engagement process; (iii) design of the end-user engagement strategies for each phase of the end-user engagement process; and (iv) compilation of appropriate mechanisms to enable the proposed end-user engagement strategies [40].

As the first step of the implementation of the end-user egagement framework, end-users were categorised in 3 main segments according to their level of involvement with the project [40]. This differentiation allowed the *Community S* consortium to interact differently with each end-user group through the promotion of personalised end-user engagement strategies [40]. They were:

Early adopters: This end-user segment represented highly motivated and proactive participants who were naturally engaged with the project due to intrinsic reasons [40]. Generally, early adopters were always present in the awareness-raising sessions promoted by the consortium in each pilot and were always prone to engage with the activities associated with the project [40]. This end-user segment was subdivided in: (i) early adopters without any issue (i.e., those who never had any considerable issue in the project); and (ii) early adopters posed with correctable issues (i.e., those who were posed with mendable issues that temporarilly affected their participation in the project) [40].

Stalled starters: This end-user segment included those end-users who were eager to participate in the project but could not do so because of greater reasons that surpassed the problem-solving capabilities of the *Community S* consortium [40]. This end-user segment was subdivided in: (i) stalled starters due to technical issues (i.e., those posed with unavoidable technical problems); and (ii) stalled starters due to personal issues (i.e., those posed with personal problems that were not connected to the project) [40]. Since the constraints affecting the participation of stalled starters could not be overcome by the *Community S* consortium, they were not targeted by the end-user engagement process [40].

Indifferent end-users: This end-user segment included those who were enrolled in the project but were either not motivated or not interested in contributing to its development [40]. This end-user segment represented the most challenging segment to be dealt with since they were much less prone to change despite the many efforts made by the consortium to engage them [40]. Hence, it required regular stimulus from the *Community S* consortium to either become more involved with the project or to overcome temporal barriers that were obstructing their participation in the project (e.g., false perceptions or no perceptions at all about the purpose of the project) [40]. In view of this, the *Community S* consortium created an end-user engagement routine with them to retain / raise their interest in the project, taking into consideration that this routine could not be overly intrusive or repetitive in order not to cause an antagonistic effect on these end-users [40]. This end-user segment were subdivided in: (i) indifferent end-users with “irreversible” reasons (i.e., those not prone to change at all); and (ii) indifferent end-users with “reversible” reasons (i.e., those prone to change) [40].

As the second step of the implementation of the end-user egagement framework, Valkering et al. [27] suggested dividing the end-user engagement process in distinct phases (i.e., Activation and Continuation phases) – each of which entails different end-user engagement strategies and mechanisms.

Activation phase: it represents the initial phase of the end-user engagement process, when end-users still perform energy-related actions in a mechanical and routinely manner as they are still influenced by rooted old habits [40]. In view of this, end-user engagement strategies in this phase should be geared towards supporting and reinforcing new energy-related practices to influence the development of new smart energy behaviours [40].

Continuation phase: it allows end-users to incorporate and consolidate in their daily lives the new smart energy behaviours acquired in the Activation phase [40]. The Continuation phase requires end-users to explicitly reconsider and redefine rooted old habits through their active participation in smart grid programmes to encourage them to make more informed and educated energy-related decisions [40]. As new energy-related practices are adopted over time by end-users, the new smart energy behaviour gradually becomes more customary [40].

Considering that the trial period of the *Community S* project was 6-month long (i.e., January - June 2018), the Activation phase was defined as the period between January and March 2018 and the Continuation phase as the period between April and June 2018 [40].

As the third step of the implementation of the end-user egagement framework, and based on the recommendations abovementioned, the *Community S* consortium tailored specific strategies for each phase of the end-user engagement process [40], which are summarised in Table 2 and described below:

Table 2. Recommended end-user engagement strategies for the Activation and Continuation phases implemented in the *Community S* project.

End-user engagement phase	Suitable strategies
Activation phase	(i) provide added value; (ii) understand end-users; (iii) capacity building and awareness-raising; (iv) create commitment and appeal
Continuation phase	(i) effective feedback and pricing schemes; (ii) variety of intervention methods; (iii) ease of use; (iv) social comparison; (v) reflection and learning

Provide added value: it involved guaranteeing data privacy, data security and comfort gains to end-users; applying financial incentives; providing information services; and ensuring various forms of end-user control that can substitute automated procedures whenever necessary [40]. The consortium addressed the following aspects of data privacy: (i) data minimisation – only data related to the project activities was collected, stored and processed, and data was analysed in an aggregated manner; (ii) data transparency – the reported data was accurate and came from a trustworthy source; and (iii) end-user empowerment – permission requests were sent to end-users for the access of sensitive information from their smart energy management equipment [40].

Regarding data security, the consortium ensured that data was properly encrypted and that the communication protocols used to enable the smart grid infrastructure were reliable and secure [40]. Regarding financial incentives, a new energy tariff associated with a progressive P2P energy sharing business model was offered to end-users [40]. Regarding the provision of information services, the consortium created a wide array of mechanisms (i.e., communication channels and marketing techniques) to induce end-user engagement among all different end-user segments in the *Community S* project [40]. Finally, in terms of ensuring end-user control, participants were the primary responsible for keeping the smart energy management equipment fully functional (which represented a fundamental criterion for their proactive participation in the project) [40]. Also, accession to the new energy tariff designed for the purposes of the project was optional and did not affect the participation of end-users that opted not to do it [40].

Understand end-users: it involved identifying different end-user groups and applying tailored engagement strategies to each group [40]. End-users were identified and segmented in 3 different main segments in the *Community S* project [40]. This approach allowed the *Community S* consortium to tailor different end-user interaction strategies and mechanisms to reach all of them throughout the development of the project [40].

Capacity building and awareness-raising: it involved educating and providing proper training and capacity building to end-users prior to the implementation of the technologies proposed in the project to overcome potential knowledge and information barriers [40]. End-users received didactic manuals for the proper installation and use of the smart energy management system – this was the first measure in the line of action towards capacity building [40]. Furthermore, remote technical support via telephone or email and socio-technical interventions in households were carried out as more overarching measures to tackle issues that were temporarily affecting the participation of some end-users in the project [40]. Additionally, public awareness-raising sessions were held in each pilot to foment project-related discussions about the proposed solution as well as to promote a shared understanding around the P2P energy sharing concept [40].

Create commitment and appeal: it involved taking advantage of social processes as facilitators of end-user engagement strategies [40]. This included guaranteeing trust in their involvement with the project; involving end-users in the early stages of the project implementation; involving role models respected by the group of end-users; providing credible testimonials from other end-users; coping with free-rider effects (i.e., end-users taking advantage from certain benefits without having contributed to obtaining them); promoting effective marketing strategies to create a sense of desire for what is being proposed in the project, etc. [40]. The *Community S* consortium aimed to promote emotional appeal for the core idea of the project through effective marketing strategies (e.g., by emphasising the key benefits of participating in the first P2P energy sharing initiative in the country and by setting up a new energy-related "lifestyle" associated with this innovative initiative) [40]. Additionally, trust was gradually established in the pilots through regular, personalised, one-to-one interactions between the consortium and end-users throughout the development of the project [40]. Furthermore, even though this project did not represent a bottom-up approach, end-users were

partially involved in the early stages of the project implementation (e.g., the selection of new participants for the project was done through referrals from end-users that were already inserted in the project - i.e., snowball effect) [40]. The consortium had to cope with the free-rider effects with those end-users that were indifferent to the objectives of the project but got involved with it either due to social pressure or because they wanted to get a smart energy management equipment for free [40]. Finally, regarding the involvement of role models in the project, it was essential to have highly respected people participating in the project as end-users (e.g., the mayor in one of the pilots and the president of the parish council in another) [40].

Effective feedback and pricing schemes: it involved linking different energy tariffs, compelling feedback mechanisms and communication strategies to achieve an optimal response from end-users [40]. It was particularly important to ensure a continuous flow of information to maintain high levels of end-user involvement [40]. Regarding the content of the feedback, different types of information can be delivered to end-users (e.g., current and expected energy consumption profiles; consumption forecasts in energy bills; historical comparisons of consumption; disaggregation of consumption by electrical equipment; social feedback, etc.) [40]. Direct feedback (e.g., real-time energy consumption and consumption history) and social feedback (i.e., comparison with others) generally tend to be more effective than indirect feedback (e.g., feedback processed via billing) [40]. Other general recommendations include linking feedback directly to specific actions and ensuring that feedback is interactive and sufficiently disaggregated [40]. The recommendations presented in this strategy were translated into the design of monthly performance reports that were periodically sent to end-users during the trial period [40], as illustrated in Appendix A.

Variety of intervention methods: it involved the creation of a variety of end-user-interaction schemes to address all end-user categories [40]. This strategy was translated into the creation of a variety of end-user engagement mechanisms that are presented in Table 3 [40].

Ease of use: it involved the creation of intuitive designs to facilitate the operation of new devices and schemes to minimise the potential knowledge and information barriers perceived by end-users [40]. Additionally, it included adequate and proactive support and services [40]. The *Community S* consortium tried to anticipate and answer questions before end-users even ask them through the setup of a Frequently Asked Questions tab within the project's official website as to mitigate potential knowledge barriers [40]. Additionally, awareness-raising sessions, monthly performance reports, remote technical support via telephone or email and socio-technical interventions in households were also enforced throughout the project development as to provide adequate support and services [40].

Social comparison: it involved the comparison of the impact of new smart energy behaviours between end-users [40]. This is based on the inherently competitive nature of people and on the effectiveness of social feedback to influence behaviours [40]. This strategy was incorporated in the monthly performance reports sent to all end-users, which allowed the comparison of the individual performance of each end-user with the performances of other end-users within the same pilot, as

well as the comparison of the global performance of each pilot with the global performances of the two other pilots [40].

Reflection and learning: it involved taking reflection and learning as fundamental factors to deal with the complexity and uncertainty of the technical, social and other dimensions of smart grid innovations (e.g., comparing end-users' expectations at the start and end of the project; monitoring and evaluating the project development for its replicability; inserting the initiative into wider programs with clear objectives, etc.) [40]. End-users were asked to respond to a satisfaction survey at the end of the project that evaluated their satisfaction as participants in the project, as well as a social-values based questionnaire that aimed to reveal the social-values based dimension of P2P energy sharing initiatives [40]. Furthermore, the messages related to the *Community S* project were disseminated through broad communication alongside other topics pertaining to sustainability, energy planning, and climate change, to name a few examples [40]. Additionally, this demonstration project was developed under the scope of the Portugal 2020 programme, which has well-defined goals for the sustainable development of the country in terms of resource use efficiency, as well as clear guidelines to ensure the replicability of all projects developed under its umbrella [40].

Another pivotal step of the end-user engagement process in the *Community S* project was devising a compilation of appropriate mechanisms that enabled the implementation of the end-user engagement strategies beforementioned [40]. These mechanisms represented different communication channels and marketing techniques, including: (i) monthly performance reports; (ii) P2P energy sharing contracts; (iii) remote technical support via telephone or e-mail & socio-technical interventions in households; (iv) awareness-raising sessions; (v) prize draws; (vi) website; (vii) local media; (viii) questionnaires [40]. They are fully described in Research II [40]**.** These mechanims were combined and promoted in different ways during each phase of the end-user engagement process [40], as detailed in Table 3:

Table 3. Recommended mechanisms to enable end-user engagement strategies in the *Community* S project.

End-user engagement phase	**Activation phase**	**Continuation phase**
Suitable mechanisms	i) awareness-raising sessions ii) remote technical support via telephone or email iii) direct socio-technical interventions in households iv) monthly performance reports v) innovative P2P energy sharing tariff structure vi) news reported by local media vii) content promoted through the *Community S* website	i) remote technical support via telephone or email ii) direct socio-technical interventions in households iii) monthly performance reports iv) innovative P2P energy sharing tariff structure v) prize draws vi) questionnaires vii) content promoted through the *Community S* website

3.3.2 Results

The evaluation of the impact of the end-user engagement framework proposed in the *Community S* project is discussed below.

Namely, the result analysis revealed that a prominent positive social stimulus during the Activation phase of the end-user engagement process led to a higher participation rate through the Continuation phase [40]. This allowed to conclude that this prominent positive social stimulus resulted in greater awareness among end-users in the short term, which most certainly evoked a higher sense of free will to commit and proactively participate in the project in the medium and long terms [40]. On the other hand, the absence of positive social stimulus led to higher rates of unawareness and negligence among end-users during the Activation phase of the end-user engagement process [40]. These unmotivated, passive end-users were purposefully targeted and prioritised by the end-user engagement routines proposed in this chapter, and results found that the proposed approach was rather effective in gradually empowering them and raising their awareness in the medium and long terms [40].

It also became clear that indifferent end-users with irreversible reasons were not prone to change regardless the personalised end-user engagement routines trialled by the project consortium [40]. Based on that, this Ph.D. research proposes that this end-user segment should be outcasted from the project development as soon as they are identified [40]. In the same line of thought, it was identified that the promotion of a more exhaustive end-user qualification process among potential participants prior to the project implementation led to a great reduction in the number of stalled starters in the project – as per the case of Vila Real (Lordelo) [40]. This allowed to conclude that the end-user identification and categorisation process should be ideally carried out in between the conceptualisation and implementation of the project [40].

All things considered, it could be inferred that the proposed end-user engagement routines for the Activation phase were highly effective in engaging indifferent end-users with reversible reasons, whereas the routines for the Continuation phase were successful in sustaining the engagement levels of all active end-user segments [40]. In view of that, this Ph.D. research advocates that all the personalised end-user engagement mechanisms were instrumental in the successful implementation of the proposed framework [40].

In light of the literature review beforementioned, this Ph.D. research agrees to a certain extent with Gui et al. [24] that end-user involvement is largely determined by their access to meaningful information related to their participation in these markets, since the results uncovered in this chapter allowed to conclude that this argument was only valid for some end-user segments – hence the need to promote end-user identification and categorisation [40]. This is also valid as an effective solution to address the challenge posed by Parag [25] related to the difficulty in managing user-centric energy markets due to the number of different end-user typologies that they entail [40]. Finally, the argument that end-users tend to perceive changes in energy behaviour and involvement in energy-related matter negatively, as defended by Parag and Sovacool [4], was only felt in this analysis

within specific end-user segments, which once again proves the effectiveness of carrying out end-user identification and categorisation [40].

In terms of future research opportunities, focus should be given on the implementation of the proposed end-user engagement framework under different circumstances (considering for that matter other viable P2P energy sharing business models, legal frameworks, socio-economic backgrounds, geographic locations, pilot scales, end-user segments, etc.) as to produce a wider breadth of results that can be compared to the findings presented in this chapter. Ideally, the proposed framework should be trialled out in countries where the P2P energy sharing concept is already fully deregulated to lessen the level of abstraction of this concept and consequently deepen the engagement of end-users [40].

Also, this Ph.D. research asserts that the proposed end-user engagement framework could be potentially beneficial when set within a wider context of social innovation (e.g., in the broader context of the sharing economy), since when end-users are more aware of their proactive roles in socioenvironmental innovations, and when those chronically indifferent end-users are identified and removed right away, the end results become optimised [40].

Finally, this Ph.D. argues that the creation of comprehensive tools that enable the full roll out of P2P energy sharing (e.g., a virtual marketplace that provides an automated and optimised end-user experience) will help to create a stronger societal involvement with this concept, since these tools can bring this concept closer to everyday social practices [40].

3.4 Experiment setup

The dual role I held as both head project manager of the *Community S* project and head researcher of the valuation process informed the creation of a innovative experiment setup. That is because this unique dual position not only gave me direct access to a pioneering case study to scrutinise an uncharted research topic as a researcher, but also gave me enough freedom to guide the decision-making processes related to the *Community S* project according to my own ingenuity as head project manager, backed up by my hierarchical superiors. In this sense, I believe that each role potentialized the other by stimulating increased experimentation, innovation, and complexity that resulted in richer and more mature goals for both the *Community S* project and the valuation process.

Nonetheless, a significant caveat to this innovative experiment setup was that both roles were developed in a learning-by-doing process[12] precisely because of their embedded level of

[12] Learning-by-doing is both a conceptual designation and a pedagogical approach related to the process whereby learning is a form of dedicated cognitive effort – i.e., a matter of doing; an active, effortful process [52].

innovativeness. In other words, by being on the frontiers of professional and academic knowledge, I gained expertise producing knowledge and making sense of my work and academic experiences in a proactive, empirical, creative, but prudent way, and by relating the acquired knowledge to underpinning substantive theories. In this way, it was possible to create mental connections between the defined frontiers of knowledge and how to expand them through the innovative experiment setup, resulting in the transfer of knowledge to new settings. Based on that, the generalisability, incisiveness, and replicability aspects of this Ph.D. research must be approached with caution, and validated on a case-by-case basis as later explained in Section 5.10.

4. METHODS

This chapter is dedicated to the presentation of the methods devised in Research Paper I [41], which focused on the investigation of the social values-based dimension of P2P energy sharing.

4.1. Overview

To date, there is no fit-for-purpose methodology that can transfer the inherently qualitative nature of social values into quantitative measures for data analysis purposes in the context of P2P energy sharing. This is because social values are generally perceived as intangible and unmeasurable due their inherently qualitative nature [21,52,54,55]. Therefore, to achieve the objectives set by this Ph.D. research, it became critical to understand whether it was necessary to develop a scientifically sound social values-based framework from the ground up or repurpose any existing framework that is known for the valuation of P2P energy sharing models.

4.2. A social values-based assessment framework focused on P2P energy sharing

Harder et al. [21] critically analysed and compared the most influential values-based frameworks within academia[13], highlighting in detail their most common drawbacks. Firstly, these frameworks (plus others not encompassed by the comparison analysis carried by Harder et al. [21], such as the case of the Keeney [56]) were built based on the context of previous decades, with outdated notions of values and value structures, thus not being completely fit to contemporary days [21]. Secondly, they represent closed, prescribed models, given that they were all constructed as external, top-down frameworks that precluded co-design and participatory approaches with the respondents [21]. Finally, they proposed predefined and rigid lists of values to respond to that are not contextually relevant and that do not capitalise on local interpretations [21]. In response to these limitations, Harder et al. [21] co-created from the ground up a modern-day, empirically based, scientifically sound, grassroot framework for valuation processes entitled the *WeValue* toolkit.

[13] Allport-Vernon-Lindzey Study of Values; Rokeach Values Survey; Values and Lifestyle Segmentation; Schwartz Values Survey; Portrait Values Questionnaire; Schlater's framework; Competing Values Framework; and Organizational Values Questionnaire, apud [21].

The *WeValue* toolkit was originally devised to provide Civil Society Organisations (CSOs) with a methodology that allowed them to uncover the unique underlying social values deriving from their educational work on sustainable development [23]. This means that face validity was the core guiding principle of the *WeValue* toolkit – i.e., the underlying social values deriving from the measurements had to be considered representative from the CSOs' perspectives to be validated [23].

The *WeValue* toolkit made possible to operationalise and measure social values by transforming subjective interpretation into objective assessment. To do so, the toolkit contains a reference list of 166 generic Values-Based Indicators (VBIs) that can be directly linked to social values. While social values have multiple nuances that can be subjectively interpreted in different ways by different people due to its inherently subjective nature[14] [23], VBIs are objective in nature since they represent an "expression of values in commonly understood units" or the "measure of the importance of something" [20]. Hence, by measuring these VBIs that are objective in nature (using different assessment methods and tools as per the discussion that follows), their correlated underlying social values that are subjective in nature are implicitly measured by extension [23]. A schematic representation of this process is shown in Fig. 2.

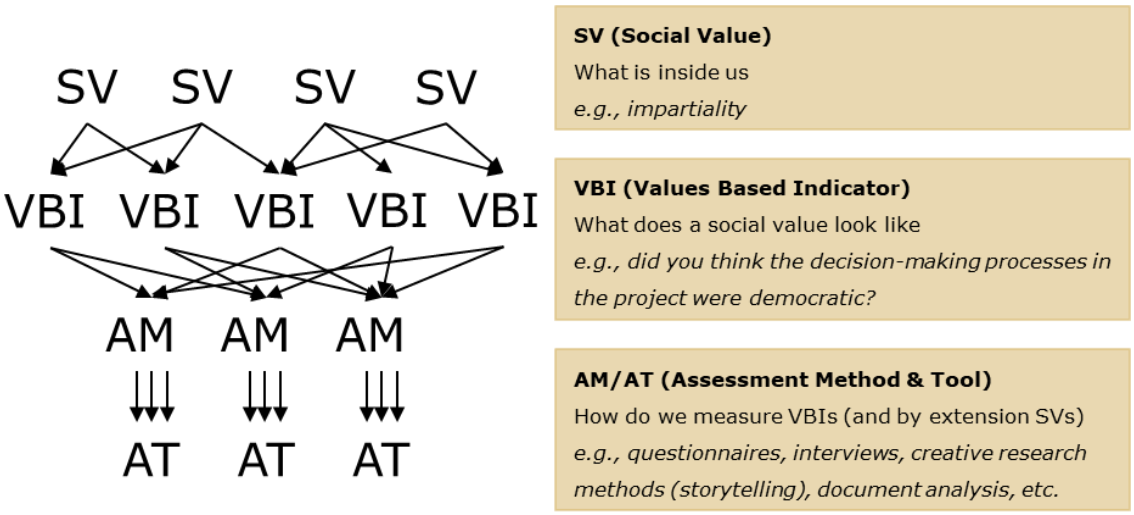


Fig. 2. Schematic representation of how the *WeValue* toolkit operationalises and measures social values.

ESDinds [23] indicates that the association of VBIs and social values (entitled "value mapping") is a subjective exercise, and that there is no one-to-one, universally valid link between a specific VBI and an individual social value. Hence, these associations can be multiple and mutually inclusive, representing an interpretative decision rather than an inherent property of each individual LVBI per se [23] – as further explained in subsection 5.5.

[14] e.g., one's interpretation of a given social value might differ from someone else's interpretation, and even overlap with another person's interpretation of a different social value [23]

The *WeValue* toolkit introduces two distinct methodological approaches to operationalise and measure social values: (i) the Indicator pathway and (ii) the Value pathway [21,23,52,55]. A synopsis detailing the 8 exploratory phases involved in each methodological approach is presented in Fig. 3.

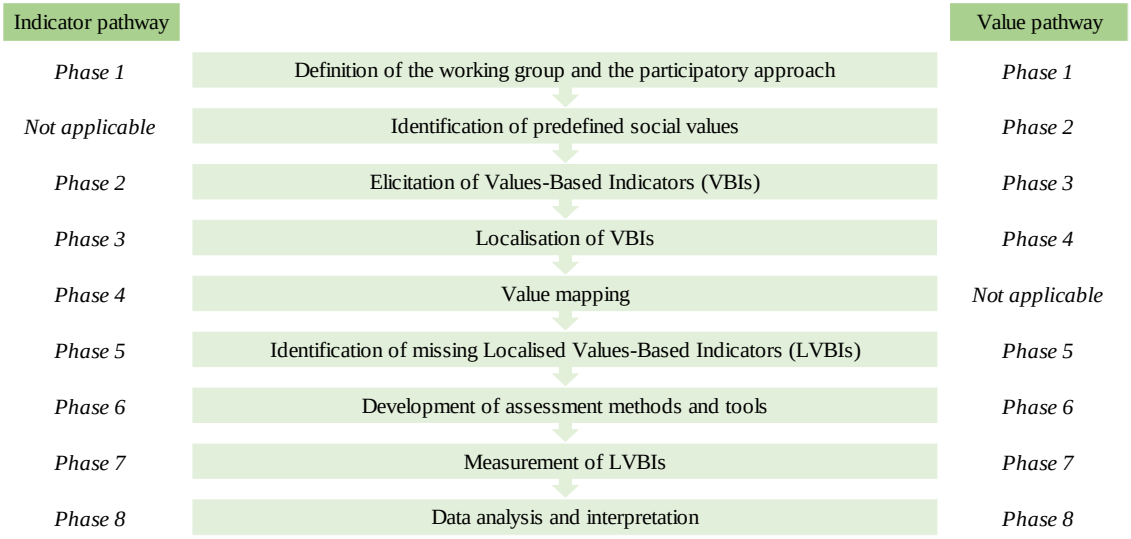


Fig. 3. Schematic representation of the Indicator and Value pathways as proposed by the *WeValue* toolkit [Adapted from 57].

The Indicator Pathway is recommended when the purpose of the valuation process is to identify underlying social values that are not known *a priori*. Alternatively, the Value Pathway is recommended when predefined social values are known beforehand and the valuation serves to understand whether these specific social values translate into real action – i.e., whether they are "active" in a specific context [57].

This toolkit was purposefully built to have a polycentric approach, meaning that it holds transferability validity, which allows it to be systematically applied in different contexts [57]. Because of that, it has been applied in a wide range of different settings over the years, including secondary schools, universities, health services, religious groups, companies, indigenous communities, etc. [21,52]. Despite that, the *WeValue* toolkit is yet to be applied in the context of P2P energy sharing models.

Based on the abovementioned, this Ph.D. research reviewed, repurposed, and redesigned the Indicator Pathway, aiming to create the first operational social values-based assessment framework that can uncover underlying social values associated with P2P energy sharing models.

In the following section, this Ph.D. research describes the step-by-step implementation of the proposed social values-based assessment framework in the 3 pilots devised in the *Community S* project.

5. RESULTS AND DISCUSSION

This chapter is dedicated to the presentation of the main results derived from the implementation of the social values-based assessment framework focused on P2P energy sharing that was trialled and validated in the 3 pilots of the *Community S* project, as presented in Research Paper I [41].

5.1 Phase 1: definition of the working group and the participatory approach

Phase 1 refers to convening an appropriate working group to carry out the valuation process [23]. To do so, stakeholders that could play a role in the valuation process were mapped out and grouped in two distinct categories: the core and the wider working groups. The latter included participating end-users (i.e., energy consumers and prosumers) that were selected by convenience sampling and municipal representatives from the 3 pilots in the *Community S* project. The former was composed of a qualified group of academic experts and project managers that was heterogeneous in terms of academic / professional competencies and gender to enrich the discussions and widen the reach of the valuation process, including:

- Evaluator A (male), who played a dual role of head researcher of this Ph.D. research and head project manager of the *Community S* project. Therefore, Evaluator A was a stakeholder with high expertise on the social values-based dimension of P2P energy sharing models and high influence over the development of the *Community S* project.
- Evaluator B (male), who played the role of an external academic expert with high expertise on the main concept under scrutiny in this Ph.D. research but limited influence over the development of the *Community S* project.
- Evaluators C and D (females), who played the roles of associate project managers of the *Community S* project. Hence, Evaluators C and D were stakeholders with limited expertise on the main concept under scrutiny in this Ph.D. research but high influence over the development of the *Community S* project.

Apart from convening a working group, phase 1 also refers to defining the level of participation of those stakeholders in the valuation process [23]. Naylor et al. [58, apud 23] proposed four distinct levels of participation in project valuation using VBIs: (i) consultation; (ii) cooperation; (iii) participation; and (iv) full control, as explained in Table 4.

Table 4. Potential participatory approaches proposed by the We Value toolkit.

Level of participation	**Description**
Consultation	In the simplest level of participation, project leaders are solely involved in all decision-making processes, seeking input from the wider stakeholder group only once to propose the valuation to them. In this level of participation, project leaders are responsible for defining appropriate VBIs and measurement methods, designing assessment tools, collecting data, interpreting results, and reporting back to the wider stakeholder group
Cooperation	In this level of participation, although the wider stakeholder group provides advice and input to decision making processes, the main responsibility still lies with project leaders. Illustratively, project leaders might define a primary VBI list to be assessed and then ask for inputs from the wider stakeholder group; project leaders might design the assessment tools that will be implemented by someone from the wider stakeholder group; or project leaders might analyse the collected data, but will incorporate the feedback from the wider stakeholder group on the collected data into the final evaluation report
Participation	In this level of participation, project leaders and the wider stakeholder group have equal decision-making power. In this sense, they work together as a unified group to define appropriate VBIs and measurement methods, to design assessment tools and to analyse and interpret results
Full control	In the highest level of participation, the wider stakeholder group has full control over decision-making processes in all stages of the evaluation (i.e., definition of appropriate VBIs and measurement methods, design of assessment tools and analysis and interpretation of results), with eventual expertise advice from project leaders in specific areas

Source: Adapted from ESDinds [23].

Based on the particular configuration of the *Community S* project (i.e., organisational structure, timeframe, budget, human resources, etc.), the participatory approach was viewed here as cooperation since the valuation process was mainly structured by the core working group, but guided by inputs, responses and feedback-loops from the wider stakeholder group. In this level of participation, although the wider stakeholder group provides advice and input to decision making processes, the main responsibility still lies with project leaders [23]. In this sense, rather than asking the wider working group to actively participate in all phases of the valuation process, they were rather asked to mainly to validate and provide further inputs on the inferences made by the core working group in each of these phases – as further detailed in section 5.8.

5.2 Phase 1.1: identification and assessment of gatekeeper(s)

In qualitative research, gatekeepers are essentially effective communicators responsible to analyse, filter, translate, and control which and when information is passed on to others [59]. Gatekeepers usually play a dual role: on the one hand, they represent a means of information transfer between parties; on the other hand, they represent intermediaries that filter and translate the perceptions, expectations, and ideas of one group to the other, thus bridging their communication [59]. Because of that, gatekeepers have a decisive role in shaping "(…) *the public's knowledge of the totality of actual event occurring in reality*" [60].

In view of that, the core working group decided to design and integrate a supplementary assessment layer (i.e., Phase 1.1) into the proposed methodology to identify and assess the main gatekeeper(s) involved in the valuation process, acknowledging their fundamental role in bridging information exchange and knowledge sharing between the core and the wider working group.

With regards to the identification of gatekeeper(s), the core working group jointly acknowledged Evaluator A as the main gatekeeper involved in the valuation process, due to the dual role he held as both head project manager of the *Community S* project and head researcher of the valuation process. By acknowledging the role of the gatekeeper, the core working group was able to creatively optimise the message delivery in the *Community S* project.

As for the assessment of Evaluator A as the main gatekeeper, a pre- and a post-survey were designed by Evaluator B (i.e., the external academic expert) to analyse and compare the gatekeeper's dual perspectives. Given that the valuation process and the *Community S* project were simultaneously developed, it was possible that the two roles held by Evaluator A overlapped at some point, potentially compelling him to make decisions that either favoured one role over the other or reinforced one role due to the other. Depending on which of these scenarios prevailed, the information exchange and knowledge sharing between the core and the wider working group might have been either impaired or heightened.

In view of that, the pre- and the post-survey were precisely devised to help the gatekeeper to maintain a constant "reflectiveness" about ethical and practical risks associated with his dual role. In practice, these surveys sought to be "mental checklists" that accompanied the gatekeeper during the valuation process, posing questions from his two perspectives and examining their trade-offs, overlaps and eventual short-circuits. By highlighting changes in the gatekeeper's self-reported behaviour, expectations, knowledge, awareness, attitude, and priorities during the valuation process, this supplementary assessment layer aimed at mitigating aspects of expectation bias[15].

The gatekeeper's responses to the pre- and the post-survey can be found in Appendix B (Table 5). As explained by Evaluator B (i.e., the external academic expert), the main purpose of this supplementary assessment layer was to foster deeper reflections about the valuation process rather

[15] Expectation bias stands for the tendency to "*believe, certify, and publish data that agree with the (gatekeeper's) expectations for the outcome of an experiment, and to disbelieve, discard, or downgrade the corresponding weightings for data that appear to conflict with those expectations*" [61].

than draw any definitive conclusions about it. According to the analysis carried out by Evaluator B, the comparison of survey responses revealed the gatekeeper's full awareness of the influence of his research-oriented mindset on a higher degree of analysis of the innovative dimension of the *Community S* project – most likely because he was inserted in an intellectually stimulating R&D environment surrounded by legal uncertainties that needed to be driven and challenged. In that sense, Evaluator B recognised the gatekeeper's personal view that each role positively reinforced the other.

As far as it regards interpersonal interactions with the core and the wider working groups (i.e., end-users and the project consortium team), the gatekeeper' self-reported responses suggested that he put greater focus on aspects of "otherness" as the valuation process developed. Illustratively, he started putting more value on others' perspectives that were misaligned with the guiding principles of the Ph.D. research, recognising them as silver linings with the potential to increase the overall complexity and scope of the valuation process. This seems to have spurred considerably deeper engagement, participation, and enthusiasm among all involved actors during the valuation process, allowing them to express themselves in ways much closer to their hearts, as exemplified in the following end-users' anecdotes extracted from the storytelling exercise (Appendix D):

> *(...) I am a more participative and active citizen, concerned about adopting more environmentally friendly behaviours. And we go further by sharing!*

> *(...) I found out that our consumption could be minimised, saving the family's budget and the environment, so I changed all the lighting to LED and the washing machine for a more efficient one. I also installed photovoltaic panels for self-consumption. (...) All the good you do to others later will come back to you. Long life to the sense of sharing and to sustainable communities!*

This indicates that the gatekeeper put emotions, affections, and feelings as framing aspects not only of his interpersonal relationship with the objects of the Ph.D. research, but also of the proposed methodology – which resonates with the concept of "*corazonar*" proposed by Sousa [62]. Under this perspective (also known as warming up of reason), knowledge and active commitment are never mobilised solely based on reasons, concepts, thoughts, analyses, or arguments – to do so, they must also be warmed up with emotions, affections, and feelings [62].

In view of the abovementioned, Evaluator B linked the gatekeeper's *modus operandi* to the persuasion heuristic proposed by Cialdini [63], which relates to six scientifically grounded, universal principles of influence[16] that persuade people to comply with the widest range of circumstances. That is, by resorting to these six "mental shortcuts" to communicate with the core and the wider stakeholder groups (whether consciously or not), the gatekeeper managed to efficiently nudge their behaviour towards a consistent engagement during the valuation process.

[16] i.e., reciprocation; commitment / consistency; authority; social proof; scarcity; and liking [63].

All in all, it is worth mentioning that the late design and integration of this supplementary assessment layer into the methodological pathway (i.e., while the *Community S* was already ongoing) might have partially undermined the comparison of survey responses, since many difficult managerial decisions had already been made (e.g., the inclusion of Vila Real (Lordelo) as a third pilot site). Additionally, considering that this supplementary assessment layer was solely based on the gatekeeper's self-reported data, the core working group also acknowledged that the survey responses might present some degree of Hawthorne effect, which stands for the idea that individuals might modify some aspects of their behaviour due to their awareness of being observed [64].

5.3 Phase 2: elicitation of Values-Based Indicators (VBIs)

In phase 2, the appointed working group should review the original list of 166 draft VBIs developed by the *WeValue* toolkit extract the most contextually relevant for measurement [23]. The output of this phase should be a new list of VBIs that only includes those selected by the working group.

In this Ph.D. research, each evaluator from the core working group was firstly asked to elicit individually those VBIs that they found the most relevant to avoid conformity bias. The elicitation process used the weighting criteria: *1 – not applicable; 2 – not so relevant; 3 – relevant; 4 – very relevant*. An in-depth deliberation followed to gauge whether each evaluator found the exercise relevant, easy, and educative. In general lines, this short-listing exercise was perceived as burdensome due to the amount of draft VBIs to be analysed. Also, it was unanimously agreed that the selected VBIs were perceived as expressive of social values-content (i.e., they were understood in terms of social values) and were strongly connected to the context of this Ph.D. research.

Whenever there were differences between evaluators about a specific VBI and at least one evaluator had a very strong feeling about it, the consensus of two / three out of four was taken as valid. A few VIBs referred to the same core question, hence they were jointly revised and merged through proper rewording (namely VBIs 30-33; 36-37-38; 40-41; 73-81; 103-104; and 107-108). The outcome of this phase was the collective selection of a total of 31 VBIs (see Table 6) that moved forward to phase 3.

Table 6. Elicitation of relevant draft Values-Based Indicators (VIBs) as proposed in phase 2 of the methodological pathway.

No.	Draft Values-Based Indicator (VBI) description	Evaluators				Deliberation
		A	B	C	D	
1	Everyone has their place in the team	4	3	1	1	YES (2nd round)
2	Everyone knows what their responsibilities are within the team	4	1	1	1	NO
3	Everyone feels responsibility for their part of the work	4	4	3	1	YES (2nd round)
4	Everyone knows what the final goal of his / her work is, as well as the work of the whole entity	4	4	3	4	YES
5	People feel that they are encouraged to fulfil their responsibilities	4	1	1	1	YES
6	People feel that they are given autonomy and trust to fulfil their responsibilities	4	3	1	1	YES
7	People feel that they are supported to fulfil their responsibilities	4	4	1	1	NO
8	Work environment is supportive of people being able to fulfil their responsibilities in their families or personal relationships	1	1	1	1	NO
9	Work environment is supportive of people being able to act with care in their families or personal relationships	1	1	1	1	NO
10	People follow through on their commitments	4	4	4	1	YES
11	Partners are trusted to follow through on their commitments without the need for formal agreements	4	2	1	1	NO (2nd round)
12	People feel that they are trusted to follow through on their commitments	2	1	1	1	NO
13	Goals are reviewed between committed parties to determine what has and has not been achieved	2	2	1	3	NO
14	Decision-making processes are ethical	2	1	1	1	NO
15	Decision-making processes are democratic	2	4	1	4	YES
16	Decision-making processes provide for equal representation	1	3	1	4	NO
17	Decision-making takes into account the social, economic and environmental needs of future generations	2	3	1	4	NO
18	People participate actively in reaching the entity’s goals	4	1	1	4	NO
19	People participate actively in making decisions about issues that affect their lives	4	2	1	4	YES
20	People participate actively in developing the entity’s code of ethics	1	1	1	1	NO
21	People participate actively in developing procedures to deal with unethical conduct	1	3	1	1	NO (2nd round)
22	People feel that there is transparent communication	2	1	2	4	NO

23	Entity is transparent about the processes of decision-making	2	4	1	4	NO
24	Entity is transparent about the outcomes of decision-making	2	3	1	4	NO
25	People feel that there is the right information flow	3	1	2	4	NO
26	Entity shares information openly with people	3	1	3	3	YES (2nd round)
27	Regular monitoring of how people are treated	1	4	1	1	NO
28	Action is consciously taken to improve the ways that people are treated	1	4	1	4	YES
29	Teams include members with different characteristics (e.g., gender, culture, age, and other aspects of individual differences such as personality)	1	2	1	1	NO
30	Different points of view are heard and incorporated	2	4	1	4	YES (2nd round) (31 – 33 merged)
31	People feel that different approaches are valued	2	1	2	2	NO
32	Trusted partners are given flexibility to do things differently within prescribed structure	1	2	1	1	NO
33	Learning processes accommodate different learning styles	1	4	1	1	YES (2nd round) (31 – 33 merged)
34	People feel that their own individual identity and approach is respected	2	1	1	1	NO
35	People feel that their worth is acknowledged	4	4	1	4	YES
36	Women feel that they are valued	1	3	1	1	YES (2nd round) (36 – 37 – 38 merged)
37	Women feel that they have equal access to information	1	1	1	1	
38	Women feel that they are given equal opportunities to participate in decision-making processes	1	3	1	1	
39	People have self-respect	1	2	1	1	NO
40	People are inclusive (talk to everyone and no one is left out)	1	3	1	1	YES (2nd round) (40 – 41 merged)
41	People respect the differences in others	1	4	1	1	
42	People appreciate the differences in others	1	1	1	1	NO
43	People find ways to understand the differences in others	1	4	1	1	NO

44	Entity acts in a manner that is impartial and non-discriminatory (not discriminating on the basis of nationality, ethnic origin, colour, gender, sexual orientation, creed or religion)	1	4	1	1	YES
45	People learn freely together, regardless of nationality, ethnic origin, skin colour, gender, sexual orientation, creed, or religion	1	1	1	1	NO
46	People share information freely, regardless of nationality, ethnic origin, skin colour, gender, sexual orientation, creed, or religion	1	1	1	1	NO
47	People share their skills and abilities freely with one another, regardless of nationality, ethnic origin, skin colour, gender, sexual orientation, creed or religion	1	2	1	1	NO
48	Differences of opinion are acknowledged and valued through dialogue	3	3	1	1	YES
49	Conflicts are resolved through dialogue	1	4	1	1	NO
50	Open dialogue exists between project partners	3	1	1	1	NO
51	People are able to suspend their own standpoints during dialogue and listen to those of others	1	1	1	1	NO
52	Conflict resolution leads to learning and growth	3	3	1	1	YES
53	Individuals express their own opinions	3	3	1	1	NO
54	People feel that they have an equal opportunity to express their opinions	3	2	1	1	NO
55	Action is consciously taken to give everyone an equal opportunity to express their opinions	1	1	1	1	NO
56	People feel encouraged to express their opinions	3	3	1	1	NO
57	Action is consciously taken to encourage people to express their opinions	1	1	1	1	NO
58	People feel that their opinions are respected	3	1	1	1	NO
59	People feel that everyone’s opinions are respected	3	4	1	1	NO
60	People become aware of how their existing knowledge, skills, resources and / or traditions can contribute to a project or the whole entity	4	4	1	4	NO
61	People feel that they are encouraged to contribute their existing knowledge, skills, networks, resources and / or traditions to a project or the whole entity	4	1	3	4	NO
62	Action is consciously taken to encourage people to contribute their existing knowledge, skills, networks, resources and / or traditions to a project or the whole entity	3	1	1	4	NO
63	People feel that their own knowledge, skills, networks, resources and / or traditions have already contributed to the outcomes of the project or entity	4	2	1	4	YES

64	People feel that their contributions to the entity are acknowledged	4	1	1	3	NO
65	Entity respects and acknowledges the contributions of others to its work, and gives credit for the outcomes to those who contributed	4	3	1	3	NO
66	People feel that they are encouraged to explore their own ideas and / or reflect on their own individuality	1	1	1	1	NO
67	People are taking the opportunity to explore their own ideas and / or reflect on their own individuality	1	1	1	1	NO
68	People feel that they have been given the opportunity to explore the wisdoms, traditions, and values that they already hold, rather than having something imposed upon them	1	2	1	1	NO
69	People feel that they are encouraged to develop their own visions and goals for projects, and / or for the whole entity	1	2	1	1	NO
70	People are taking the opportunity to develop their own visions and goals for projects, and / or for the whole entity	1	1	1	1	NO
71	People feel that they are encouraged to develop programs, identify problems, and deliver solutions on their own	1	2	2	1	YES
72	People are taking the opportunity to develop programs, identify problems and deliver solutions on their own	1	1	2	1	NO
73	People investigate what is right and good by themselves, rather than adopting other people's opinions	4	3	1	1	YES (2nd round) (73 – 81 merged)
74	Entity's activities or events have a motivating effect on participants	4	1	1	1	NO (2nd round)
1	Entity's activities or events connect participants emotionally to the community of life	4	3	1	1	NO (2nd round)
76	People feel that they are encouraged to reach their potential	4	3	1	4	NO
77	People feel that their personal needs for development in the workplace are met	1	1	1	1	NO
78	People feel that they are provided with opportunities for personal growth	3	4	1	4	NO (2nd round)
79	Entity has a culture of learning	4	3	1	1	NO
80	People have an attitude of learning towards their development	2	1	1	1	NO
81	People reflect critically on what is necessary to learn	4	2	3	1	YES (2nd round) (73 – 81 merged)
82	People are not afraid to make mistakes	1	3	1	1	NO
83	Mistakes are understood as opportunities to learn and improve	1	4	1	1	NO (2nd round)
84	People feel that the work environment is pleasant and harmonious	1	1	1	1	NO
85	People are perceived to be respectful in their interactions with others	1	3	1	1	NO

86	People treat each other with kindness	1	1	1	1	NO
87	People speak courteously to each other	1	1	1	1	NO
88	People introduce ideas to others with respect, humility and patience	1	2	1	1	NO
89	People are perceived to be trustworthy	2	1	1	1	NO
90	People are perceived to be truthful	2	1	1	1	NO
91	People are perceived to be honest	2	4	1	1	NO (2nd round)
92	People are perceived to be transparent	2	3	1	1	NO
93	People are perceived to practice integrity in their interactions with others	2	1	1	1	NO
94	People do not back-bite about others within the entity	1	1	1	1	NO
95	People feel that they create something better or greater as a group than on their own	4	4	4	4	YES
96	People feel that they can participate in the vision and activities of the entity or project without compromising their personal beliefs or values	1	1	1	1	NO
97	Group norms exist	4	4	1	1	YES
98	People follow the group norms	4	3	1	4	NO (2nd round)
99	People's behaviour is consistent with their words	4	1	4	1	YES
100	People strive to become conscious of their value system	4	1	1	1	YES (2nd round)
101	People can identify applicable ethical values in a given context	4	1	1	1	NO
102	People strive to put their personal values into practice	3	1	1	1	NO (2nd round)
103	Actions of individuals are consistent and in harmony with the core principles promoted by the entity	4	4	1	1	YES (103 – 104
104	People strive to bring their lives into accordance with the entity's values	4	1	1	3	merged)
105	Leaders act as living representatives of the principles they espouse	1	1	1	1	NO
106	People feel inspired by the way that leaders live their principles	4	1	3	1	NO
107	As a result of the entity's messages or activities, people start their own personal initiatives with similar goals	4	1	4	3	YES (107 – 108
108	As a result of the entity's messages or activities, people's personal lifestyles include more conscious pro-environmental behaviours	4	4	1	4	merged)
109	As a result of the entity's messages or activities, people establish new organisations or groups	4	4	1	1	YES

110	People have demonstrated the ability to replicate a project or approach in other communities or organisations	4	1	1	3	YES
111	People invest their own time and resources in activities that benefit the environment or society	4	1	4	4	YES
112	Entity aims to provide people with educational opportunities that empower them to contribute actively to sustainable development	4	3	4	1	NO
113	People have a sense of power that they can effect change	4	4	1	4	YES
114	Entity allows local groups who have an interest in their work to contribute their ideas or become partners on a project	1	3	1	4	NO
115	Partners trust that each shares a commitment and willingness to collaborate for a similar vision	4	1	1	4	NO (2nd round)
116	Entities are willing to work with each other because they respect each other	1	1	1	4	NO
117	People are productive	2	1	1	4	NO
118	People are creative	1	2	1	1	NO
119	Decisions made in the entity are supported	3	1	1	1	NO
120	People feel that they are treated equitably and with fairness	2	3	3	1	NO
121	Recruitment processes are conducted in a way that is perceived as fair to all applicants	2	2	4	1	NO
122	Remuneration / payment policies are perceived as fair by all involved	1	2	1	1	NO
123	Human resource management policies are perceived as fair by all involved	1	1	1	1	NO
124	People treat each other with equity and fairness	1	3	1	1	NO
125	Truth-seeking, non-judgmental, confidential channels are in place for individuals / teams seeking guidance on the application of ethics, reporting violations and examining violations of ethics	1	2	1	1	NO
126	People trust the channels that are in place for individuals / teams seeking guidance on the application of ethics, reporting violations and examining violations of ethics	1	1	1	1	NO
127	Performance goals are measured	1	3	4	1	NO
128	Performance goals are communicated internally or externally	1	3	4	1	NO
129	Financial integrity is assessed	1	1	1	1	NO
130	Financial integrity is communicated internally or externally	1	1	1	1	NO
131	Resource use efficiency is measured	1	1	1	1	NO
132	Resource use efficiency is communicated internally or externally	1	4	1	1	NO

133	People have respect for nature	1	1	3	4	NO
134	Action is consciously taken to contribute to a greater respect for nature	3	4	4	4	NO (2nd round)
135	People understand the complexity of natural systems	1	1	1	4	NO
136	Action is consciously taken to contribute to a greater understanding of the way nature is organised in systems and cycles	1	3	1	2	NO
137	Action is consciously taken to contribute to a greater understanding of the natural world as a source of personal fulfilment	1	3	1	3	NO
138	The environment and community of life is celebrated	4	1	1	1	NO
139	Entity is aware of the interconnectedness between the environment and their sphere of activity	2	1	3	4	NO
140	People are aware of the connectedness between their religion and the environment	1	1	1	1	NO
141	Entity acts to reduce its environmental impact or remedy its contribution to environmental problems	2	3	4	4	NO
142	Entity is aware of its environmental impact or its contribution to environmental problems	2	1	4	4	NO
143	Entity has successfully reduced its environmental impact or remedied its contribution to environmental problems	2	2	3	4	NO
144	Entity strives to have a positive effect on the natural environment	3	1	1	4	NO
145	Entity recognises its role as a protector of the natural environment	3	2	1	4	NO
146	Entity acts to protect the environment, without waiting for governments or others to act first	4	3	4	4	YES
147	Entity is open to dialogue about alternative means of production that have less negative impact, no impact, or a positive impact on the environment	2	4	1	1	NO
148	Entity implements a policy of purchasing environmentally sustainable products, e.g., recycled paper, even if cheaper alternatives exist	1	4	1	4	NO
149	Entity implements a policy of procuring some or all its energy from renewable sources	1	4	4	4	NO
150	Entity implements a policy of reducing carbon emissions	1	1	4	4	NO
151	Entity implements a policy of sustainable waste management, e.g., recycling or reducing waste	1	2	1	4	NO
152	Number of activities / projects towards the goal of environmental sustainability	1	4	2	4	NO
153	Number of activities / projects for raising awareness of environmental sustainability	1	1	1	4	NO
154	Quality of process of activities or projects aiming to achieve or promote environmental sustainability	1	1	1	1	NO
155	Action is consciously taken to share with others how to protect and restore the natural environment	1	1	1	3	NO

156	Education is undertaken to raise awareness and capabilities for the organisation to act according to principles of environmental sustainability	4	4	1	1	NO
157	Entity actively seeks to work with others who will increase their ability to improve the environment	1	3	1	4	NO
158	Long term commitments to protect the environment are created	2	1	4	1	NO
159	Long term commitments to protect the environment are adhered to	3	2	1	1	NO (2nd round)
160	Entity contributes positively to society by working to address social problems or global issues	3	1	1	3	NO
161	Entity implements a policy of ethical investment	1	2	1	1	NO
162	Number of activities / projects towards the goal of addressing the social aspects of sustainability	1	4	1	1	NO
163	Number of activities / projects for raising awareness of the social aspects of sustainability	1	1	1	1	NO
164	Quality of process of activities or projects aiming to achieve or promote social aspects of sustainability	1	4	1	1	NO
165	Entity’s activities or events create a safe environment for people	1	1	3	1	NO
166	Work is viewed as a form of service	4	3	2	1	YES

5.4 Phase 3: localisation of Values-Based Indicators (VBIs)

The 166 draft VBIs of the *WeValue* toolkit were designed to be concise and generic trigger statements that can be customised to become locally comprehensible and contextually relevant [23]. This "localisation" exercise is precisely what gives the *WeValue* toolkit its polycentric approach [23].

In this Ph.D. research, the draft VBIs selected from phase 2 were customised by the core working group to clearly articulate the social values-based dimension of P2P energy sharing models, whilst still being understandable to the wider working group – thus becoming Localised Values-Based Indicators (henceforward LVBIs). As explained by ESDinds [23], it is fundamental to consider the varying levels of literacy among respondents and the potentially different interpretations of the underlying meaning of the VBIs for each of them. Hence, the working group translated the selected VBIs to European Portuguese using a more informal language to address their specific sociodemographic characteristics. This approach was based on Marinho [65, apud 40], who argued that informal communication represents a crucial factor to further incentivise knowledge sharing, since it reinforces social structures in ways that surpass formal boundaries of organisational communication.

The localisation exercise was first carried out individually by each evaluator within the core working group to avoid conformity bias. Then, an in-depth deliberation session aimed to attune their different perspectives and reach a consensus about the meaning of each LVBI, making them as objective as possible to avoid double meanings, and meet the criteria of measurability, reliability, and usability. Also, following ESDinds [23] suggestions, the localisation exercise aimed to present some degree of generality to be relevant across other P2P energy sharing initiatives, and to allow external evaluators to compare their local results. Table 7 presents the deliberation around the "localisation" process, and the final list of LVBIs for measurement that was sent to the wider working group for their validation (i.e., "face validity"). This is further scrutinised in phase 7.

Table 7. "Localisation" process of turning the selected draft Values-Based Indicators (VBIs) into Localised Values-Based Indicators (LVBIs) as proposed in phase 3 of the methodological pathway.

No.	Draft VBI	Final LVBI (European Portuguese)	Final LVBI (English)
1	Everyone has their place in the team	Sentiu que teve o seu espaço dentro do projeto?	Did you feel that you had your own place in the project?
3	Everyone feels responsibility for their part of the work	Sentiu-se responsável pela sua respetiva contribuição no projeto?	Did you feel responsible for your own contribution to the project?
4	Everyone knows what the final goal of his / her work is, as well as the work of the whole entity	Sabia qual era o propósito de sua contribuição no projeto, bem como qual era a contribuição do projeto para a sua comunidade e país?	Did you know what the purpose of your contribution to the project was, as well as what was the project's contribution to your community and country?
5	People feel that they are encouraged to fulfil their responsibilities	Sentiu-se encorajado(a) a cumprir com as suas responsabilidades no projeto?	Did you think that the events and activities promoted by the project motivated you to fulfil your responsibilities in the project?
6	People feel that they are given autonomy and trust to fulfil their responsibilities	Sentiu que a equipa deu-lhe autonomia para cumprir com suas respetivas responsabilidades no projeto?	Did you feel the project consortium gave you autonomy and trusted you to fulfil your project responsibilities on your own?
10	People follow through on their commitments	Acha que cumpriu com os seus compromissos no projeto?	Did you think you fulfilled your commitments with the project?
15	Decision-making processes are democratic	Acha que os processos de tomada de decisão no projeto foram democráticos?	Did you think the decision-making processes in the project were democratic?
19	People participate actively in making decisions about issues that affect their lives	Passou a sentir-se mais apto(a) a tomar decisões sobre outras questões que afetam a sua vida?	Did you become more able to make better decisions on other issues affecting your life?
26	Entity shares information openly with people	Sentiu que a equipa partilhou informações abertamente com todos os participantes?	Did you feel that the project consortium shared information openly with all participants?
28	Action is consciously taken to improve the ways that people are treated	Sentiu que a equipa tomou iniciativa para melhorar a experiência dos participantes no projeto?	Did you feel that the project consortium took the initiative to improve the participants' experiences in the project?

30	Different points of view are heard and incorporated	Sentiu que houve diferentes meios de comunicação para atender os diferentes pontos de vista dos participantes?	Did you feel that there were different communication channels so that each participant could learn about the project in their own way?
33	Learning processes accommodate different learning styles		
35	People feel that their worth is acknowledged	Sentiu que o valor da sua participação no projeto foi reconhecido?	Did you feel that the value of your participation in the project was recognised?
36	Women feel that they are valued	Sendo mulher, sentiu que a partilha de energia pode de alguma forma contribuir para uma maior igualdade de género?	… did you feel that P2P energy sharing initiatives can somehow contribute to greater gender equality?
37	Women feel that they have equal access to information		
38	Women feel that they are given equal opportunities to participate in decision-making processes		
40	People are inclusive (talk to everyone and no one is left out)	Sentiu que a partilha de energia representa uma alavanca para construir relações mais solidárias e inclusivas entre os participantes (em comparação com as relações que já existiam antes)?	Did you feel that P2P energy sharing is a lever to build more solidary and inclusive relationships between participants (compared to the relationships that already existed before)?
41	People respect the differences in others		
44	Entity acts in a manner that is impartial and non-discriminatory (not discriminating on the basis of nationality, ethnic origin, colour, gender, sexual orientation, creed or religion)	Sentiu que todos atuaram de uma maneira não-discriminatória com relação às diferenças dos participantes ou da equipa do projeto (nacionalidade, género, cor de pele, etc)?	Did you feel that everyone acted in a non-discriminatory manner with respect to the differences of the participants or the project team (e.g., on the basis of nationality, gender, skin colour, etc.)?
48	Differences of opinion are acknowledged and valued through dialogue	Acredita que o diálogo entre os participantes e a equipa foi capaz de reconhecer e valorizar diferentes opiniões?	Did you believe that different opinions were acknowledged and valued through dialogue between participants and the project consortium?
52	Conflict resolution leads to learning and growth	Sentiu que a resolução de conflitos no desenvolvimento do projeto resultou em novas aprendizagens?	Did you feel that conflict resolution during the project development resulted in learning and growth?

63	People feel that their own knowledge, skills, networks, resources and / or traditions have already contributed to the outcomes of the project or entity	Acredita que as seus próprios conhecimentos ou competências contribuíram para o desenvolvimento do projeto?	Did you believe that your own knowledge or skills contributed to the development of the project?
71	People feel that they are encouraged to develop programs, identify problems and deliver solutions on their own	Sentiu-se mais capacitado(a) para refletir criticamente e procurar soluções para problemas por conta própria, ao invés de adotar opiniões preestabelecidas?	Did you feel more empowered to critically reflect and seek solutions to problems on your own, rather than adopting preestablished opinions?
73	People investigate what is right and good by themselves, rather than adopting other people's opinions		
95	People feel that they create something better or greater as a group than on their own	Sentiu que estava a criar algo em comunidade que era maior e melhor do que algo que conseguiria caso estivesse sozinho(a)?	Did you feel that you were creating something collectively that was bigger and better than something you could ever create if you were on your own?
97	Group norms exist	Considera que existiram regras de grupo a ser respeitadas dentro do projeto?	Do you consider that there were group norms to be respected in the project?
99	People's behaviour is consistent with their words	Acredita que seu comportamento no projeto era congruente com aquilo que dizia fazer?	Do you believe your behaviour in the project was consistent with what you said you were doing?
100	People strive to become conscious of their value system	Acha que se esforçou para se conscienciализar sobre o sistema de valores sociais que fundamentou o projeto?	Do you think you worked hard to raise awareness about the social values system that underpinned the project?
103	Actions of individuals are consistent and in harmony with the core principles promoted by the entity	Passou a se esforçar para adotar um estilo de vida mais alinhado aos valores promovidos pelo projeto?	Did you strive to adopt a new lifestyle more aligned with the social values promoted by the project?
104	People strive to bring their lives into accordance with the entity's values		

107	As a result of the entity's messages or activities, people start their own personal initiatives with similar goals	Passou a ter um estilo de vida com hábitos mais coletivos e altruístas?	Did you feel that you adopted a new lifestyle with more collective and altruistic habits?
108	As a result of the entity's messages or activities, people's personal lifestyles include more conscious pro-environmental behaviours		
109	As a result of the entity's messages or activities, people establish new organisations or groups	Acha que o projeto estimulou o desenvolvimento de um senso de comunidade entre os participantes?	Do you think the project stimulated the development of a community identity among participants?
110	People have demonstrated the ability to replicate a project or approach in other communities or organisations	Sentiu que ganhou novas competências para replicar os princípios do projeto noutros contextos de sua vida?	Did you feel that you gained new skills to replicate the principles of the project in other contexts of your life?
111	People invest their own time and resources in activities that benefit the environment or society	Passou a investir mais tempo e recursos em atividades que beneficiam a natureza ou a comunidade?	Did you start investing more time and resources in activities that benefit the environment or your community due to your participation in the project?
113	People have a sense of power that they can effect change	A participação no projeto deu-lhe a sensação de que pode causar mudanças no meio em que vive?	Did your participation in the project give you the feeling that you can effect changes in the environment in which you live?
146	Entity acts to protect the environment, without waiting for governments or others to act first	Acredita que o projeto estabeleceu objetivos inovadores voltados para a sustentabilidade, indo além da legislação atual e das propostas de governo?	Do you believe the project has set novel sustainability goals that goes beyond current legislation and governmental action?
166	Work is viewed as a form of service	Viu a sua participação no projeto como uma forma de serviço comunitário (ao invés de um benefício meramente individual)?	Did you see your participation in the project as a form of community service (rather than a purely individual benefit)?

5.5 Phase 4: value mapping

Phase 4 relates to an exercise entitled value mapping – i.e., the association of each LVBI with at least one social value that is expressive of this indicator, and the preferred combination of several LVBIs to measure each individual social value [23]. ESDinds [23] indicates that this is a subjective exercise, and that there is no one-to-one, universally valid link between a specific LVBI and an individual social value. Hence, these associations can be multiple and mutually inclusive, representing an interpretative decision rather than an inherent property of each individual LVBI per se [23].

In this Ph.D. research, this exercise was firstly carried out separately by each evaluator of the core working group and then discussed collectively for validation, before proposing it to the wider working group. According to the ESDinds [23], this interactive dialogue promotes "transformational learning", which stands for the ability to clearly articulate personal social values-related perceptions in a shared vocabulary that is understood by all.

The core working group agreed that asking the wider working group to elicit a set of social values individually for each LVBI would be a strenuous exercise due to the limited social values-related vocabulary that society typically upholds, often struggling to articulate in words their particular social value systems. Because of this value-discourse gap [32], the core working group predicted the unfolding of two potential scenarios: (i) the wider stakeholder group would either oversimplify the task of eliciting social values due to the Dunning-Kruger Effect[17]; or (ii) they would drop the task out by believing it is overly cumbersome and abstract.

To address this issue, the core working group proposed an alternative methodological approach for phase 4. Specifically, Evaluator A (i.e., the main gatekeeper) compiled from scratch the first overarching reference list of 166 individual social values that is explicitly associated with P2P energy sharing interactions, and that could be used as point of reference for respondents in the mapping of LVBIs to social values (see Table 8).

Table 8. List of P2P-SVTs and its associated individual social values.

No.	P2P-SVT	Social value(s) that can be linked to this P2P-SVT (English / European Portuguese)
1	belonging	accessibility (acessibilidade); belonging (62xpectati de pertença / inserção); identification (identificação); inclusiveness (inclusividade); integrativeness (integratividade)
2	achievement	accomplishment (62xpectati); achievement (realização)

[17] A bias that leads someone to assume that a concept is overly simple due to the lack of depth of knowledge on it [66].

3	responsibility	accountability (responsabilidade); duty (dever); responsibility (responsabilidade)
4	gratitude	appreciation (apreciação / valorização); contentment (contentamento); gratitude (agradecimento); happiness (felicidade)
5	recognition	acknowledgement (reconhecimento); recognition (reconhecimento)
6	resilience	adaptability (adaptabilidade); dynamism (dinamismo); flexibility (flexibilidade); resilience (resiliência)
7	altruism	altruism (altruísmo); assistance (assistencialismo); caring (zelo); compassion (compaixão); concern for others (preocupação com outros); generosity (generosidade); helpfulness (solicitude); goodwill (bondade); selflessness (abnegação); solidarity (solidariedade); volunteering (voluntarismo / colocar-se à disposição); willingness (boa vontade)
8	coercion	authoritarianism (autoritarismo); coercion (coerção); control (63xpecta); discipline (disciplina); obedience (obediência); power (poder); order (ordem); rigour (rigor)
9	influence	influence (influência); leadership (liderança); power (poder); status (estatuto)
10	emancipation	autonomy (autonomia); capacity building (desenvolvimento de competências); capability (capacitação); confidence (confiança), critical thinking (pensamento crítico); emancipation (emancipação); empowerment (capacitação / emancipação); free will (livre arbítrio); freedom (63xpectati); independence (independência); independent thinking (pensamento próprio)
11	awareness	awareness (consciencialização); concern (preocupação); consciousness (maior discernimento); knowledge (conhecimento); education (educação); learning (aprendizagem); understanding (maior entendimento)
12	participation	compliance (conformidade); contribution (contribuição); participation (participação)
13	collaboration	collaboration (colaboração); cooperation (cooperação); interactivity (interatividade); reciprocity (reciprocidade); sharing (partilha); synergy (sinergia); teamwork (trabalho de equipa)
14	collectivity	commonality (comunalidade); common sense (senso comum); community / collectivity / sense of group (63xpectati de coletividade / grupo / identidade comunitária); connection (conexão); locality (localidade); oneness (63xpectati de unidade); shared prosperity (prosperidade partilhada); togetherness (união); unity (63xpectati de unidade)
15	dialogue	communication (comunicação); dialogue (diálogo)
16	support	coordination (coordenação); guidance (orientação); service (assistência / serviço); support (suporte); backing (suporte)
17	transparency	clearness (clareza); comprehensibility (compreensibilidade); directness (objetividade); intelligibility (inteligibilidade); openness (transparência); palpability (palpabilidade); perceptibility (perceptibilidade); tangibility (tangibilidade); transparency (transparência)
18	trust	credibility (credibilidade); honesty (honestidade); loyalty (lealdade); reliability (confiabilidade); trust (confiança); trustworthiness (fidedignidade)

19	commitment	commitment (comprometimento); dedication (dedicação); determination (determinação); diligence (diligência); effort (empenho); engagement (envolvimento); involvement (envolvimento)
20	motivation	active citizenship (cidadania ativa); drive (motivação); encouragement (encorajamento); initiative (iniciativa); inspiration (inspiração); interest (interesse); motivation (motivação); optimism (otimismo); proactivity (proatividade); wilfulness (força de vontade / obstinação); zeal (ardor, entusiasmo)
21	impartiality	democracy (democracia); social equality (igualdade social); equity (equidade); ethics (ética); fairness (imparcialidade); gender equality (igualdade de gênero); impartiality (imparcialidade); integrity (integridade); social justice (justiça social)
22	progress	development (desenvolvimento); growth (crescimento); improvement (melhoria); progress (progresso); success (sucesso); prosperity (prosperidade)
23	professionalism	formalism (64xpectati); professionalism (profissionalismo)
24	environmentalism	environmentalism / care for nature (consciência 64xpectati); sustainability (sustentabilidade)
25	purpose	focus (foco); meaning (significado); purpose (propósito); vision (visão)
26	originality	authenticity (autenticidade); creativity (criatividade); innovativeness (inovatividade); insightfulness (perspicácia); originality (originalidade); pioneering spirit (pioneirismo); resourcefulness (desenvoltura / criatividade); uniqueness (singularidade)
27	personal development	personal development (desenvolvimento pessoal); personal growth (desenvolvimento pessoal); self-expression (auto-expressão)
28	respect	respect for others (respeito pelos outros); tolerance (tolerância)
29	wellbeing	satisfaction (satisfação); wellbeing (bem estar)
30	effect change	impact (impacto); make a difference (fazer a diferença); effect change (promover mudanças); significance (relevância); usefulness (utilidade); utility (64xpecta / benefício); value creation (geração de valor)

This reference list was compiled based on different institutional core statements and international SSH sustainable development reports that cut across different understandings of social values [23,42,67,68]. These 166 social values were clustered into 30 different macro themes based on similar meanings, espousing one discrete social value that is representative of each macro theme to name this macro theme (e.g., belonging stood for belonging, identification, inclusiveness, integrativeness, etc.).

Borrowing from Ribeiro et al. [69], "*values are cultural, context specific, evolving with time and affected by previous learning"*. Hence, this reference list of P2P energy sharing-related Social Value Themes (henceforth P2P-SVTs) was intended to represent a reasonably representative list of the main social values associated with P2P energy sharing models, rather than a universal, rigid, and complete list of all existing social values.

The P2P-SVT reference list directly addresses what ESDinds [23] calls the Häagen-Dazs effect. That is, when people are asked to enact social values by themselves (as originally proposed in the Indicator pathway), they tend to either use a vocabulary that is often poor or limited to their own particular socio-cultural context, or even not be able to express them whatsoever. However, by coming across the P2P-SVT reference list, they are exposed to a much broader social values-related vocabulary, allowing them to potentially enrich their discourse, make connections that were lying below conscious level and go through a self-realisation process that were previously not possible – i.e., the "Häagen-Dazs effect" [23].

In view of that, the P2P-SVT reference list was created to allow the wider working group to match social values more easily and assertively to those LVBIs that they perceive as relevant, consequently making social values more tangible and understandable. By the end of this transformational process, respondents should have a clearer idea of the social values that are representative of what is important to them [23].

5.6 Phase 5: identification of missing Localised Values-Based Indicators (LVBIs)

In phase 5, the core working group should clarify whether any fundamental social value is still not being addressed by the compilation of LVBIs [23]. If that is the case, they should define whether to proceed with the valuation process without addressing this gap, or to design additional LVBIs from scratch to reflect the missing social value(s) in question [23]. If new LVBIs are to be designed, ESDinds [23] proposes to validate them through "face validity"[18], so that the operationalisation and measurement of social values can occur with a plausible level of scientific rigour.

In this Ph.D. research, the core working group concluded that none of the draft VBIs from the *WeValue* reference list addressed aspects of hierarchical pressure / stimulus, which represented a relevant social value theme to be scrutinised under the context of the *Community S* project. As discussed by Klein et al. [40], that was because the municipal authority in one of the pilots was determined to get people to participate in the project, which could have be seen from a negative perspective (as hierarchical pressure) or positive perspective (as hierarchical stimulus). In view of that, after proper deliberation, the core working group created an additional LVBI description to address this gap, linking it to its correlated social values, as detailed in Table 9.

Table 9. Identification of a missing LVBI and its correlated social values.

[18] Respondents should determine if they recognise the LVBI subsets as coming from them [23].

No.	LVBI description	Identified social value(s) that can be linked to the referred LVBI	Other social value(s) that can be linked to the referred LVBI
167	Did you feel somehow coerced / forced to participate in any of the project activities?	Authoritarianism, control, coercion	Discipline, obedience, power, order, rigor

5.7 Phase 6: development of assessment methods and tools

Phase 6 relates to the design of context-appropriate assessment methods and tools, following the criteria defined by Podger et al. [52]: (i) methodological rigour, richness, and reliability of results; (ii) adaptability to the target respondents and project specificities; (iii) ease of use resources for replicability.

ESDinds [23] described several assessment methods and tools that were previously used by other organisations working with the *WeValue* toolkit, noting that the combination of different assessment methods to measure each LVBI heightens the chances to uncover its nuances, thus increasing the validity and meaningfulness of the collected evidence. Furthermore, ESDinds [23] recommends encompassing at least one assessment method that is not based on self-reported data to avoid sampling errors and social desirability bias among respondents. Based on that, this Ph.D. devised different assessment methods and tools as summarised in Table 10 and defined below.

It is worth noting that the proposed social values-based questionnaire was defined as the core assessment tool of the valuation process, whilst the others were used as supplementary instruments to either reinforce or refute the findings from the social values-based questionnaire.

Table 10. Identification of the assessment methods and tools promoted in this Ph.D. research.

Type of collected evidence	Assessment methods	Assessment tools
Evidence based on what participants think, feel, and understand	Questionnaires	Social values-based questionnaire
		Ex-ante assessment questionnaire
		Ex-post assessment questionnaire
	Creative research methods	Storytelling
Evidence based on what participants do and say in their daily activities	Observation-based methods	Unstructured observation
Evidence based on what is said or what is written about the project	Document analysis	Project website
		Associated scientific publication
Evidence based on what can be directly seen, counted, or measured	Indirect measures	Numerical data analysis of the end-user involvement with the project

		Numerical data analysis of the responses to the social values-based questionnaire

5.7.1 Social values-based questionnaire

The social values-based questionnaire was specifically designed for the respondents' self-valuation of their participation in the *Community S* project, and was sent in an online, customised, and dynamic format via SurveyGizmo [70]. The main functions enabled by the SurveyGizmo's Professional License were: (i) survey logic; (ii) question repeating / piping; (iii) question options randomisation; (iv) report data filters; (v) instruction elements; (vi) progress bar removal; and (vii) survey diagnosis, as explained in Table 11.

Table 11. Description of the main functions enabled by the SurveyGizmo's Professional License [70].

Function	**Description**
Survey logic	Survey logic is a decision point between two questions that conditions the flow of the questionnaire depending on the respondent's response. In other words, this function allows the creation of logic rules that only unlock conditioned follow-up questions / pages based on the specific answer to a previous question or other logic conditions. This function allows to deliver customised questionnaires for each respondent, sparing them from survey fatigue and consequently improving the quality of the collected data. In the context of this Ph.D. research, whenever a given respondent answered Strongly Disagree, Disagree or N/A to a given LVBI, this indicator was hidden by default in the follow-up phase of the valuation process (where this respondent was asked to make correlations between indicators and P2P-SVTs)
Question repeating / piping	Question repeating / piping allows to repeat previously collected data later in the questionnaire. This function allows repeating a question based on the respondent's response to this given question on a previous page. In the context of this Ph.D. research, whenever a given respondent answered Agree or Strongly Agree to a given LVBI, then this indicator was repeated by default in the follow-up phase of the valuation process (where this respondent was asked to make correlations between indicators and P2P-SVTs)
Questions / answer options randomisation	SurveyGizmo allows randomising the order of questions and / or answer options in the questionnaire, thus preventing bias introduced by question order and / or survey fatigue. The built-in randomisation features of SurveyGizmo uses true randomisation, which means that it does not ensure even representation of elements (i.e., it randomly shuffles the order of the questions and / or answers on a given page for each participant)
Security	SurveyGizmo adds an extra layer of security to data collection (called Secure Socket Layer) by using secure links (i.e., https) that ensure the questionnaire link is encrypted

	(using Rivest–Shamir–Adleman encryption) and data is securely transferred to the SurveyGizmo servers
Report data filters	This function allows filtering data in the reporting phase by question answers, response status, response IDs and questionnaire links, or even create advanced filters with multiple conditions / groups of conditions. Illustratively, it was used to filter data by pilot to perform data comparison between them and draw further conclusions for each sample group. Furthermore, it was also used to exclude by default disqualified or test data from the data analysis in the final report
Text / instruction elements	This function allows to create an introduction with instructions at the beginning of the questionnaire and / or at the beginning of each section of the questionnaire. This was particularly useful to instruct those end-users that could not participate in the final workshop where Evaluator A explained in detail each section of the questionnaire to those that were present in this event
Remove progress bar	This function was wittingly enabled to further avoid bias introduced by survey fatigue. That is, since the survey encompassed several steps and demanded various actions from end-users, the working group decided it would be wiser to hide the progress bar to make the entire process appear less cumbersome to end-users
Survey diagnostics	This internal function analyses the estimated length, fatigue score and accessibility score of the questionnaire. The estimated length and fatigue score are based on the number of questions in the questionnaire. On the other hand, the accessibility score checks for non-accessible questions, assigning a score and displaying any potential issues with questions that are not accessible or might present usability issues. Both the fatigue score and accessibility score are shown in a gauge / speedometer chart. Ideally the single-point needle should register on the green part of the gauge for these two parameters. The survey  diagnosis of the questionnaire promoted in this Ph.D. research is given in Fig. 4: **Fig. 4.** Estimated length, fatigue and accessibility score of the proposed questionnaire [70].

These functions prevented several different types of biases from manifesting — e.g., anonymity option that mitigated conformity bias; the built-in questions / answer options randomisation that prevented bias introduced by question order (e.g., default effect) and / or survey fatigue; and the removal of the progress bar that further avoided bias introduced by survey fatigue.

A generic, static, and translated[19] template of the social values-based questionnaire is given in Appendix C.

[19] This questionnaire was originally sent to respondents in European Portuguese but was translated to English in Appendix C for illustration purposes.

5.7.2 Ex-ante assessment questionnaire

Description: the ex-ante assessment questionnaire sought to capture end-users' self-reported feedback on their main motivation for participating in the *Community S* project. This questionnaire, composed of a single open-ended question, was presented to end-users at the kick-off of the *Community S* project in each pilot as part of the work plan that structured the project development. The survey data was coded and analysed manually by the core working group.

Practical implementation: the open-ended, unstructured answers represented a fruitful textual source of evidence about how end-users felt, understood, and thought about the *Community S* project in the very early stage of the project implementation. To uncover such evidence, this Ph.D. research performed rigorous text classification on these unstructured texts, using a method entitled topic detection (also known as topic modelling or topic analysis). Through this method, it was possible to break down, extract and categorise the most relevant parts-of-speech tags or key phrases from textual data into topics that summarise its core ideas, giving a complete picture of the topics discussed in a text corpus [78].

Result analysis: The analysis of the unstructured data is shown in Table 12.

Table 12. End-users' main motivations for participating in the *Community S* project.

User ID	**Describe your main motivation for participating in the *Community S* project (translated from European Portuguese)**	**Motivation topic**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	To reduce the energy bill and contribute to a project that may be of interest to the municipality, its residents and even to the country	x						x	
2	To control my energy consumption in real-time, which is associated with the creation of a consumption profile that can lower my energy bill	x	x						
3	To participate in this Ph.D. research associated with alternative means of electricity generation and energy sharing			x	x	x	x		
4	Since I have a very high energy consumption and energy bill, I want to know more about this project to reduce my monthly energy-related expenses	x							
5	To monitor the energy efficiency in my home, thus reducing my energy consumption	x	x						
6	I have an interest in environmental and energy issues		x	x					
7	To reduce my energy bill and monitor my energy consumption	x	x						
8	To reduce my energy bill and understand my energy consumption in real-time, thus reducing energy waste	x	x	x					
9	To reduce my energy bill	x							
10	To participate in a self-sufficient and sustainable community; to increase my energy autonomy; to reduce my energy bill; to make a more rational use of electricity through energy monitoring and control	x	x	x		x	x		

11	To reduce my energy bill, considering that nowadays the electricity price is high	x							
12	1) To reduce the monthly energy bill. 2) To participate in a pioneering research project, which aims to involve the community, academia, and the political realm (i.e., the municipality of Alfândega da Fé). 3) To participate in a project that promotes the municipality of Alfândega da Fé and its population. 4) To raise awareness about the efficiency of renewable energy (i.e., solar energy). 5) To increase the knowledge about the implementation of solar energy at home, so that I can implement such systems in my home in the future through my own means. 6) To raise awareness about sustainable energy	x	x	x	x	x	x	x	
13	To reduce my energy consumption	x							
14	To participate in a sustainable community; to reduce my energy bill; to increase my energy autonomy	x		x		x	x		
15	I am paying too much money with energy and I am motivated to reduce my energy costs	x							
16	To understand which appliances consume more energy and be able to act in order to reduce my energy bill in the future	x	x						
17	To reduce my energy bill	x							
18	To monitor and control my energy consumption	x	x						
19	To know my energy consumption		x						
20	To monitor the energy consumption in my home		x						
21	To monitor the energy consumption in my home		x						
22	Energy efficiency control to reduce my energy bill	x	x						
23	To reduce my energy bill and monitor my energy consumption	x	x						
24	Savings in the energy consumption	x							
25	Energy savings, as well as to deepen my knowledge on means to save energy with environmentally friendly equipment	x	x	x					
26	I find it a very interesting and value-adding project since it allows us to control our energy expenses, which results in the reduction of our energy consumption and our energy bills. It is also a curious project to me that I would like to know more about	x			x				
27	To reduce my energy bill and control my energy consumption	x	x						
28	In addition to increase my energy savings, I like the idea of being able to participate in this interesting pilot project that will trial the concept of solar energy sharing, which can also contribute to the reduction of the carbon footprint	x		x	x	x	x		
29	Due to my high energy consumption, it would be interesting to understand which appliances consume more energy, and thus in the future to be able to better manage my energy consumption and	X	x		x				

	the purchase of new appliances. As it is a pioneer project, why not?								
30	To reduce my energy bill and control my energy consumption	x	x						
31	To control my energy consumption towards an improved energy efficiency	x	x						
32	To reduce my energy bill and control my energy consumption	x							
33	To reduce my energy bill and control my energy consumption	x	x						
34	I want to participate in this project because it is innovative and allows me to reduce my energy bill	x			x				
35	To understand how much electricity my appliances spend at home and then reduce their energy consumption	x	x						
36	To reduce my energy bill	x							
37	To participate in a pilot project				x				
38	Energy savings	x							
39	To monitor my energy consumption		x						
40	I intend to participate in the project because it is innovative and can lead to the effective monitoring and control of my electricity consumption, thus reducing my energy bill	x	x		x				
41	I intend to participate in the project because it is innovative and can lead to the effective monitoring and control of my electricity consumption, thus reducing my energy bill	x	x		x				
42	To reduce my energy bill, as well as understand where exactly I spend energy the most	x	x						
43	To reduce my energy bill, as well as understand where exactly I spend energy the most	x	x						
44	The power to reduce my monthly energy bill, as well as monitor and control my energy consumption to become more educated in energy efficiency and energy saving matters	x	x						
45	To reduce my energy bill	x							
46	To reduce my energy bill; to monitor my energy consumption; to reduce GHG emissions; to use energy in a more responsible way	x	x	x					
47	I live in a single-family house with a photovoltaic system and with solar collectors for domestic hot water. I already have some knowledge in the field of energy efficiency, but I intend to increase my knowledge as well as improve my energy behaviour to reduce my energy bill	x	x	x		x			x
48	To monitor my energy consumption		x						
49	To have access to my energy consumption in real time and control the most energy-intense equipment in my home; To have access to a more advantageous electricity tariff plan; To participate in an innovative project	x	x		x				
50	To reduce my energy bill	x							

51	This is an innovative and exciting project, and I expect to have some support to reduce my energy bill	x			x				
52	To reduce my energy bill, as well as understand where exactly I spend energy the most	x	x						
53	Household economy while using the Earth's natural resources	x		x					
54	To control and reduce my energy consumption	x	x						
55	To make buildings more sustainable and reduce the energy consumption	x		x					
56	To reduce my energy bill	x							
57	I believe that renewable energy is the future of the planet			x		x			
58	To protect the environment			x					
59	A more rational use of energy	x							
60	A more rational use of energy	x							
61	We would like to participate in this interesting project since we are an ecological, technology-driven family			x	x				
62	To monitor my energy consumption		x						
63	To better understand my monthly energy consumption as well as the measures I should adopt to reduce it	x	x						
64	It seems to me an interesting idea to be able to share energy from renewable sources from municipal buildings during periods when there is excess production. In addition to being able to lower my energy bill, it also motivates me all the environmental benefits brought upon by the project	x		x	x	x	x		
65	To use energy in a smarter way and share it with the community		x			x	x		
66	I would like to participate in this project to take advantage of the excellent availability of energy sources in my region, as well as to reduce my energy bill at the end of the month	x		x		x			
67	My motivation is essentially based on environmental concerns, and the possibility of installing an energy production solution with photovoltaic panels considering my energy consumption		x	x		x			
68	I was present in the awareness-raising session and I found interesting the idea of the creation of a community – even better if I can reduce my energy bill at the end of the month	x					x		
69	To improve environmental quality and reduce energy consumption	x		x					
70	I think the project is innovative, considering that it considers the community and the environment through renewable energy sharing. My concern with the protection of the environment is also because I have installed solar panels in my house for domestic hot water. The motto "The planet is not ours, we just borrowed it from our children" is more valid than ever now			x	x	x	x		

71	We intend to integrate this innovative and collective project, which is set within the same ecological, entrepreneurial, and self-sustainable vision we have for our touristic enterprise located in Quinta das Pontes			x	x	x	x		
72	Optimisation of the energy consumption in my home and participation in an innovative project related to the sharing of energy resources	x			x	x	x		
73	To contribute to the energy consumption reduction through renewable energy sharing	x		x		x	x		
74	Because it is an innovative system and I want to save energy	x			x				
75	I hope to regularly contribute to the project development with suggestions for improvement from an end-user perspective. As for the project, I find it positive and extremely important in view of the sustainable future it instils in our children through the use of energy resources that respect the environment and the promotion of a community lifestyle. I also consider very positive the fact that the project is being carried out in a municipality based in the interior of the country, which can become a reference knowledge centre for new pilots that demonstrate, improve and mature our Portuguese products and services for the global market, thus helping the local and national economy		x	x	x	x	x	x	x

It is worth noting that approximately 61% of participants provided answers to this open-ended question (i.e., 75 out of 123 end-users that initially enrolled in the project). Hence, given that the data set in this Ph.D. research was not too extensive, the topic detection was done manually with a proper level of accuracy and efficiency, which allowed to derive meaning and reveal patterns across the end-users' multiple personal viewpoints on the main drivers for participating in the *Community S* project.

Specifically, the content of these open-ended answers was categorised into 8 different motivation topics. Each motivation topic was correlated with their main corresponding P2P-SVT(s), as presented in Table 13. Additionally, the frequency in which these motivation topics appeared in the end-users' answers are showcased in Fig. 5.

Table 13. Description of each motivation topic uncovered from the text classification of end-users' answers, along with their main corresponding P2P-SVT(s).

Code	Motivation topic	Frequency	Description of the motivation category	Main corresponding P2P-SVT(s)
1	Reduce the energy bill / consumption	58 (77.3%)	This is related to the desire to achieve greater energy-related goals	Achievement (no. 2) and improvement (no. 22)

2	Monitor and control energy use in real-time	38 (50.7%)	This is linked with awareness-raising for energy-related behavioural change	Awareness (no. 11)
3	Lift a pro-environmental mindset	23 (30.7%)	This is associated with caring for nature	Environmentalism (no. 24) and advocacy (no. 31)
4	Participate in an innovative project	18 (24%)	This is connected to the will to be part of an innovative project	Innovativeness (no. 26)
5	Increase one's own autonomy	16 (21.3%)	This is related to a desire to become more autonomous (e.g., emancipation from energy utilities)	Emancipation (no. 10)
6	Join a collective / sharing movement	13 (17.3%)	This is linked to a sense of collectivity and shared prosperity	Collectivity (no. 14)
7	Be part of something with a high-level outreach	3 (4%)	This is associated with a desire to effect change that resonates across boundaries	Effect change (no. 30) and long-sightedness (no. 32)
8	Provide personal inputs to the development of the project	2 (2.7%)	This relates to the wilfulness to personally contribute to the project development	Contribution (no. 12) and wilfulness (no. 19)

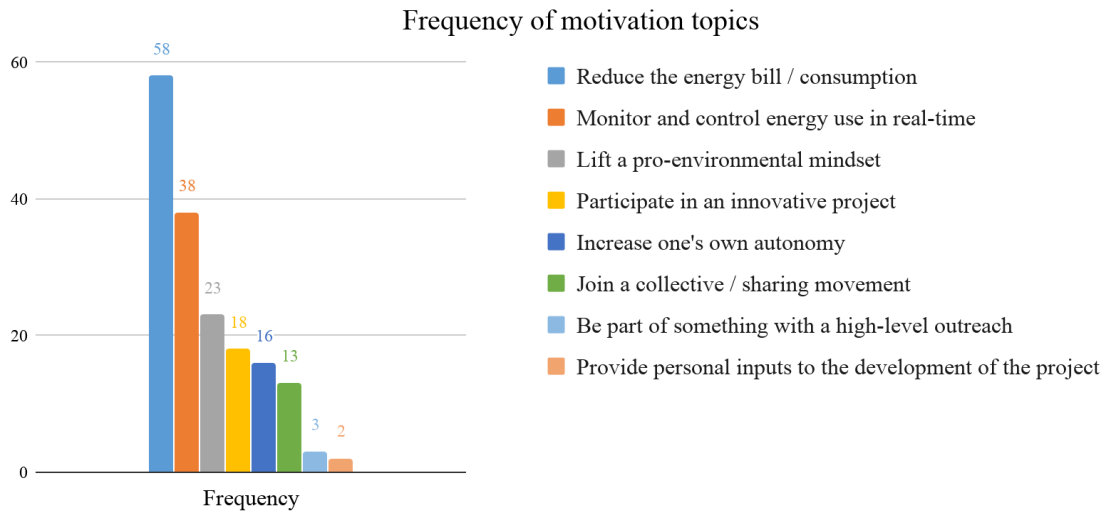


Fig. 5. Frequency in which each motivation topic appears in the end-users' answers.

Apart from <advocacy> and <long-sightedness>, all other P2P-SVTs presented in Table 13 had already been uncovered by the main social values-based questionnaire, where they were categorised as existing P2P-SVTs that were reinforced by the P2P energy sharing activities. Hence, the evidence collected in Table 13 emphasizes these conclusions.

As for the <advocacy> and <long-sightedness>, end-users suggested to include them *a posteriori* in the proposed methodology as new P2P-SVTs. Because of their late acknowledgement, they were

not as thoroughly assessed in this Ph.D. research as the other P2P-SVTs. Considering this, their uncovering in this phase of the valuation process indeed evidences their existence among end-users.

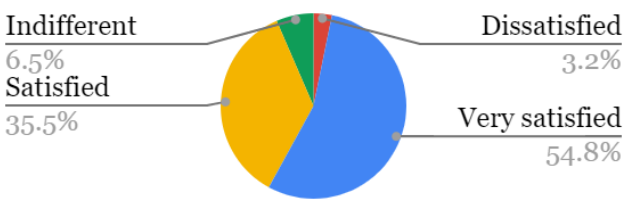
5.7.3 Ex-post assessment questionnaire

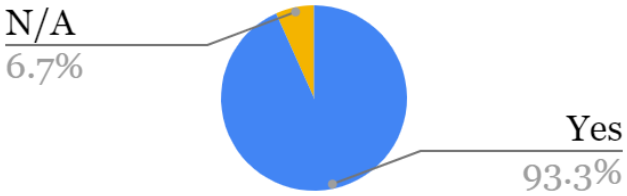
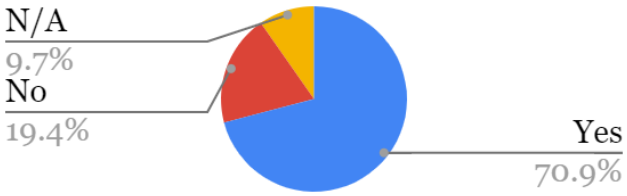
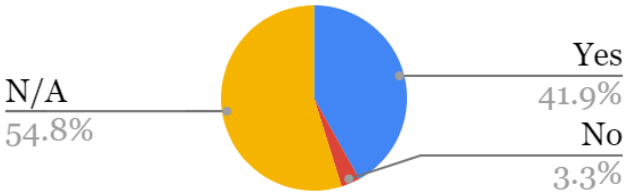
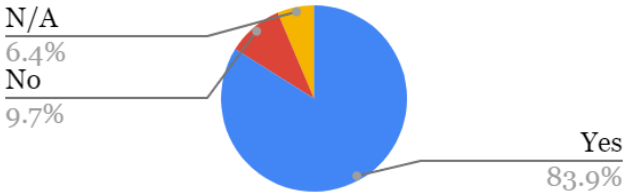
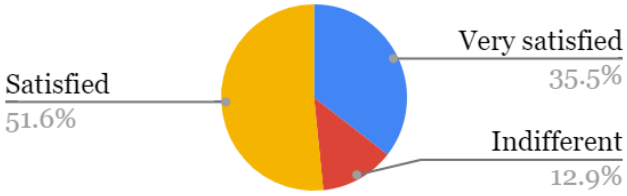
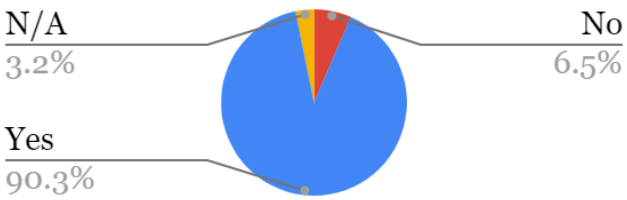
Description: the ex-post assessment questionnaire sought to capture end-users' self-reported feedback on their perceptions, expectations, knowledge, awareness, attitude and priorities towards the *Community S* project after it ended. This online questionnaire was created using Google Forms and was composed of 7 structuring multiple-choice questions. The survey data was coded and analysed manually by the core working group.

Practical implementation: all active participants were also asked to answer an ex-post online questionnaire once the *Community S* project ended, representing a valuable textual source of evidence about how end-users felt, understood, and thought about the *Community S* project in its final stage of deployment. The online survey was created using Google Forms and was composed of 7 structuring multiple-choice questions (see Table 14 for details). It was sent to all active end-users right before the end of the project, remaining open for new entries for 2 weeks after it was sent.

Result analysis: A total of 31 end-users filled in the online survey, which corresponds to approximately 47% of total active end-users in all 3 pilots at the end of the project according to Klein et al. [39]. Table 14 shows the results related to the end-users' perceptions about the *Community S* project, along with the correlation between each multiple-choice question and its main corresponding P2P-SVT(s) (as per the perception of the core working group), using a method called text analysis.

Table 14. Results of the online questionnaire related to the end-users' perceptions about the *Community S* project, along with the correlation between each question and its main corresponding P2P-SVT(s).

Questions	**Answers**	**Main corresponding P2P-SVT(s)**
1. What is your overall level of satisfaction with the *Community S* project and the achieved results (in comparison with the		Satisfaction (no. 29)

stipulated objectives)?		
2. Do you think that P2P energy sharing will become feasible in the future?		Significance (no. 30) and long-sightedness (no. 32)
3. Do you believe that the home energy management system was instrumental for the optimisation of energy use in your home?		Support (no. 16)
4. Do you think that the tailor-made P2P energy sharing contract offered under the scope of the *Community S* project brought any potential advantage?		Acknowledgement (no. 5)
5. Did the monthly performance reports that were sent to you had the necessary information to help you optimise your energy use?		Capacity-building (no. 10) and learning (no. 11)
6. How satisfied are you with the support and information provided by the consortium during the project implementation?		Support (no. 16) and satisfaction (no. 29)
7. Would you participate in any other similar project related to Renewable Energy Communities in the future, should		Participation (no. 12); collectivity (no. 14); significance (no. 30) and long-sightedness (no. 32)

the opportunity arise?		

End-users showcased high levels of agreements with the core statements of all questions in the online survey (apart from question 4), thus reinforcing findings for their corresponding P2P-SVTs. It is worth noting that <long-sightedness> appears twice in this analysis, further emphasizing its existence among end-users[20].

Lastly, 54.8% of end-users replied with N/A to question 4, which relates to the P2P energy sharing contract tailored by the consortium under the scope of the *Community S* project. This is justified by Klein et al. [40], who explained that "*signing up to this energy contract was not compulsory and thus did not affect the participation of those that opted not to do it*". That is, end-users who did not sign up to this contract did not acknowledge their full benefits as well as those that did it. Hence, <acknowledgement> was not validated in this specific case.

5.7.4 Storytelling

Description: The *WeValue* toolkit incentives the creation of creative methods to uncover the reaction and values judgment of participants through indirect means. Against this backdrop, this Ph.D. research tailored a storytelling exercise, which represents a specific narrative method for sensemaking that allows delving into deeper realities through the exploration of the symbolisms conveyed by stories [79].

This exercise was purposefully designed as both a primary method for sensemaking and a translation mechanism between theory and practice, since it allowed the working group to better understand how end-users perceived, interpreted, and incorporated the concepts of *social values* and *P2P energy sharing* into their daily lives.

The assessment of the storytelling exercise was interpretative and adopted a social constructionist perspective. This approach is in line with a primary aspect of storytelling explained by Rotmann et al. [80], that its lessons cannot be final nor definitive because storytelling copes with uncertainty, multiple perspectives and the absence of a single solution to tackle problems – hence, they should be open to multiple rounds of reinterpretation.

[20] As previously explained, this P2P-SVT was later added to the proposed methodology as a suggestion from end-users.

The storytelling exercise design followed the top-down structural textual approach proposed by Bamberg[21] [78]. Specifically, it drew inspiration from the work from Rotmann et al. [80], who structured storytelling in a "fairy tale story spine" format. This format is typically framed by specific trigger sentences that clearly mark the beginning, middle and end of the story, following a sequential structure composed of: (i) an optional abstract, (ii) the setting / exposition, (iii) the problem / crisis / complication, (iv) the action geared towards a resolution, (v) the resolution or failure, and (vi) the closure. Rotmann et al. [80] also explained that this storytelling format is extremely useful since it 'pre-digests' facts and the morale of the story in a way that resembles the well-known structure of childhood stories.

In this Ph.D. research, the proposed sequential structure of the storytelling exercise was: (i) once upon a time (…); (ii) every day, I (...); (iii) however, by participating in the project, I (...); (iv) because of that, I (...); (v) nonetheless (...); (vi) until, finally (...); (vii) and, ever since then, (...); (viii) the end (see Fig. 6 for details). Note that the sequential composition of the storytelling exercise was segmented by tailor-made linguistic markers (resembling paragraphs or episodes of the story) that temporally followed each other and were stringed together by a causal contingency. Altogether, the episodic sequential arrangement that emerged ultimately composed the full story and what it is all about.

COMMUNITY • S
Sharing · Solar · Storage · Sustainable · Smart

Note that all information provided in this storytelling exercise will be assessed in a confidential and aggregated way (i.e., your answers will not be analysed individually)
– All answers are optional –

What is your name?

What is your profession? For whom do you work?

Can you briefly describe what do you understand by social values? *(in the sense that the Community S project might generate new social values, reinforce existing social values, or modify antagonistic social values)*

TELL US A BRIEF STORY RELATING TO YOUR PARTICIPATION IN THIS P2P ENERGY SHARING PROJECT

Once upon a time (...) *(here you should briefly explain the background / setting and who you are!)*

[21] This approach focuses on the overall conceptual structure of the story - i.e., the story's overall sequential composition in episodes that in turn belongs to a wider plot structure [78].

Every day, I (...) *(here you should tell us how you used to behave before participating in the project – i.e., old habits, patterns, behaviours, values)*

However, by participating in the project, I (...) *(indicate here habits, patterns, behaviours and / or values that arose from the ground up, were reinforced or were changed due to your participation in the project)*

Because of that, I (...) *(indicate here what was the impact of these new habits, patterns, behaviours and / or values on your daily life)*

Nonetheless (...) *(indicate here what went wrong or unexpectedly and why)*

Until finally (...) *(indicate here how the situation described above was solved)*

And, ever since then, (...) *(indicate here what were the greatest lessons, values, habits and behaviours / moral of this story and next steps)*

The end.

Fig. 6. Template of the storytelling exercise showcasing its sequential structure.

Practical implementation: the implementation of the storytelling exercise involved 10 different storytellers, who were selected based on their availability to create a story after the end of the final public sessions that took place in each pilot upon the end of the project. Storytellers were asked to narrate their first-hand, personal experiences (i.e., their feelings, reactions and value judgments) about their participation in the P2P energy sharing activities that took place in the project. The trigger sentences devised in the "fairy tale story spine" format led storytellers to narrate their experiences with strong logic and plausibility, but also with a high degree of customisation and freedom of expression. The benefit of such method is that it supported the transformation complex concepts (such as the cases of *social values* and *P2P energy sharing*) into the language and cultural assumptions from the storytellers' unique worldviews. This allowed the core working group to cut through different points-of-view of a heterogeneous group of end-users to make sense and derive meaning of the collected data from the other assessment methods promoted in this Ph.D. research. Additionally, it allowed the core working group to identify central issues that were transversal to all those involved in this exercise.

Result analysis: a transcription of the storytellers' stories and their respective valuation is provided in Table 15 (Appendix D).

As a first analytical step, this Ph.D. research analysed the storytelling exercise as a translation mechanism between theory and practice. That is, the core working group analysed how storytellers described the concept of social values in their own words in order to probe the level of clarity of this concept in their mindsets. The central concern about this step was whether the awareness-raising sessions promoted by the core working group were effective in educating end-users about this concept during the project development. By that time, it was unclear whether storytellers'

descriptions would be sufficiently rich, given the high level of abstractionism and subjectivity of this concept. In effect, the collected data revealed answers that were rich in details and complexity, with very pragmatic definitions as to as to what social values meant to them (both socially and individually). This is evidenced in the examples showcased below:

> *Social values are states-of-mind that reflect the common and individual good. Social values are socially accepted individual behaviours.*
>
> *Social values are your own established rules.*
>
> *Social values are the set of characteristics that determine and form how people or organisations connect or interact with each other. From this perspective, it seems to me that this project can generate a set of social, ethical and moral values of mutual help between people. I believe that projects involving various actors may be more successful than individual ones, since they generate values of participation, well-being, and satisfaction for contributing to a common good.*

From all 10 answers, only 2 storytellers did not provide a definition for social values (i.e., 20% of the group). The analysis of the collected answers indicated that storytellers were able to make sense of a complex concept that laid beneath consciousness, suggesting a strong commitment and interest in the project and a (possible) shared social dimension. In conclusion, this allowed to validate four different processes that were mutually complementary in this exercise: (i) knowledge transfer from the core working group to the wider working group (in which storytellers are included at), and possibly within the wider working group; (ii) validation of the storytellers' experiences; (iii) sensemaking; and (iv) cathartic release.

As a second analytical step, this Ph.D. research analysed the storytelling exercise as a method. That is, the core working group valuated the storytellers' stories to give visibility to the potential social values-based dimension embedded in them. Specifically, it involved seeking out for word tags in their stories that could be directly correlated with the P2P-SVTs from Table 8. The valuation process is detailed in Table 15 (Appendix D) and the list of P2P-SVTs uncovered in the storytelling exercise is: <curiosity / expectation>, <altruism>, <capacity building>, <awareness>, <participation>, <sharing>, <community>, <support>, <wilfulness>, <motivation>, <development>, <professionalism>, <environmentalism>, <innovativeness>, <personal development>, <satisfaction>, <effect change>, <advocacy>, <long-sightedness>.

The analysis of these results allowed to draw some interesting remarks. Firstly, two new social values that were not previously enacted elsewhere were uncovered by the storytelling exercise. Namely, they refer to "curiosity" and "expectation", which were combined to create the new P2P-SVT showcased in Table 16.

Table 16. List of the new P2P-SVT and its associated individual social value terms derived from the storytelling exercise.

Code	P2P-SVT	P2P-SVT (in European Portuguese)	Social value(s) that can be linked to this P2P-SVT
33	curiosity	curiosidade	curiosity (curiosidade); expectation (81xpectative); eagerness (ânsia); inquisitiveness (curiosidade); inquiringness (indagação); interestingness (interesse)

Secondly, the nature of the 17 P2P-SVTs uncovered in this valuation process differed from each other, namely:

- <Curiosity>, <capacity building>, <participation>, <sharing>, <community>, <support>, <development>, <professionalism>, <innovativeness>, <personal development>, <satisfaction>, and <effect change> were mainly categorised as P2P-SVTs that arose anew as per the stories told.
- <Awareness> and <environmentalism> were mainly categorised as P2P-SVTs that had their existent antagonistic versions modified as per the stories told.
- There was no agreement as to the nature of <altruism>, <wilfulness>, and <motivation>.

It was also evident that the stories told fit the *learning* genre proposed by Janda and Topouzi [82]. That is because, essentially, these stories revealed episodes of discontent and disharmony that were eventually solved, leading to a positive shift in attitude and new life lessons due to the satisfaction with the problem resolution experienced by the storytellers. Analysing individual stories and identifying their genre as they evidenced changes and critical junctures in their narrative allowed the core working group to trace common high and low points across the collected stories, which would not be possible by using alternative research procedures.

Another transversal aspect common to all collected stories was that storytellers were not able to dedicate their whole narratives to the specific context of the P2P energy sharing activities promoted in the project, but rather to their broad experience with the project. This Ph.D. research suggests that this effect might refer to the sensemaking process of trying to explain something complex / unfamiliar by comparing it with something simpler / more familiar [83]. That is, since the P2P energy sharing activities promoted in the project had to be oversimplified in the form of financial rebates due to the lack of a legal framework to enable its full roll out [39], it became quite difficult for end-users to grasp their direct involvement with these activities. Nonetheless, since they were involved in many other complementary activities in the project that indirectly impacted the P2P energy sharing activities (such as the case of proactively using the smart home energy management system for energy use optimisation in households), they shifted the focus of their stories to a more familiar theme that better reflected their involvement with the project. This showcases the high level of resourcefulness and commitment of the group of storytellers in the process of making sense of complex issues. Hence, this Ph.D. research concludes that storytelling was uniquely positioned to access the meanders of the human mind and understand the factors underpinning the rationale behind a given story, which otherwise would not have happened in case this Ph.D. research had selected another analytical method.

5.7.5 Unstructured observation

Description: an assigned expert closely observes how participants interact with each other and what they do and say in each situation. To avoid biased assessments, this method should be carried out by at least two independent observers, who discuss their observations afterwards to reach a valid conclusion. In this Ph.D. research, Evaluators A, C and D carried out unstructured observation[22] exercises during the awareness-raising sessions in each pilot.

Practical implementation: as a result of the unstructured observation exercises, evaluators A, C and D jointly agreed that the City Council of Alfândega da Fé might have exerted some form of social pressure or stimulus on public employees to participate in the project (potentially in the form of <coercion>). This particular behaviour was scrutinised by Klein et al. [40], who concluded that the participation in the project was predominantly voluntary rather than coerced, thus corroborating the findings for <volunteering> (categorised as an existing social value that was reinforced by the P2P energy sharing activities), and <coercion> (categorised as a social value that does not apply to the P2P energy sharing activities).

5.7.6 Document analysis

Description: It refers to the systematic analysis of documents generated by or related to the project under scrutiny to seek for evidence about specific VBIs.

Practical implementation: In this Ph.D. research, the working group performed a comprehensive analysis of all documentation associated with the *Community S* project to uncover any evidence about underlying VBIs associated with it. Namely, the assessed documentation included: mission, targets and goals statements as well as strategic and action plans stated in the *Community S* official website (http://community-s.vps.energy/); and the techno-scientific project reports or any associated scientific publication.

Result analysis (project website): The *Community S* official website presented a trustworthy overview of the project's main objectives and outcomes. The analysis of the website content involved seeking out for word tags that could be directly correlated with some of the P2P-SVTs from Table 8. The evidence found is presented in Table 17.

Table 17. P2P-SVTs uncovered from the analysis of the *Community S* website.

Key word tags or phrases from textual data (original)	**Key word tags or phrases from textual data (English)**	**Interpretation**

[22] When the observation flows organically to detect behaviours that were not defined *a priori*

A primeira solução desenhada para dar inicio à uma comunidade sustentável	*The first solution designed to give start to a sustainable energy community*	Both "The first solution" and "innovative concept" imply <innovativeness>, <vision> and <influence>, whereas "sustainable energy community" evokes <environmentalism> and a <sense of group>
(...) é um projeto demonstrador que vai lançar em Portugal um conceito inovador de comunidade de energia sustentável (...)	*(…) it is a demonstration project that will launch in Portugal an innovative concept of sustainable energy community (…)*	
(...) envolvendo participantes do município oferecendo uma solução de gestão de energia para as suas casas	*(…) involving citizens by offering them an energy management solution for their homes*	"Involving citizens" implies <involvement> and <inclusion>
Os municípios de Alfândega da Fé, Penela e Vila Real foram os escolhidos para demonstrar os benefícios ambientais, económicos e sociais deste conceito inovador	*The municipalities of Alfândega da Fé, Penela and Vila Real were chosen to demonstrate the environmental, economic and social benefits of this innovative concept*	Once again, "innovative concept" appears evoking <innovativeness>, <vision> and <influence>, whereas "environmental, economic and social benefits" implies <achievement>, <prosperity>, <value creation> and <environmentalism>
Promovendo iniciativas ao nível da comunidade (...)	*Promoting community-level initiatives (...)*	"Community-level initiatives" implies a <sense of group>, <initiative> and <integration>
(...) com a criação de comunidades de energia sustentável que juntam vários edifícios e casas para testar modelos de partilha de energia entre eles	*(…) with the creation of sustainable energy communities that bring together different buildings and households to test out models of energy sharing between them*	Once again, "sustainable energy community" appears evoking <environmentalism> and <sense of group>. Furthermore, both "bring together" and "sharing between them" evokes <integration>, <sharing> and <collectivity>
(...) ultrapassando as limitações das soluções atualmente disponíveis	*(…) overcoming the limitations of currently available solutions*	Both "new paradigms" and "overcoming the limitations of currently available solutions" evokes <accomplishment>, <progress>, <vision>, <originality> and <to make a difference>. On the other hand, "local level" implies <belonging> and <community>
(...) de modo a permitir novos paradigmas de gestão dos recursos energéticos a nível local	*(…) in order to enable new paradigms of energy resources management at the local level*	

Furthermore, Table 18 presents the frequency in which the identified P2P-SVTs appear in the *Community S* website. This evidence reinforces the conclusions made via the questionnaire analysis, since all the identified P2P-SVTs in Table 18 were categorised by participants as existent social values that were reinforced by the P2P energy sharing activities. Therefore, it can be assumed

that the *Community S* website presents trustworthy qualitative, values-related information regarding the project.

Table 18. Frequency in which the identified P2P-SVTs appear in the *Community S* website.

No.	P2P-SVT	Social value(s) that can be linked to this P2P-SVT	Frequency
1	belonging	accessibility; belonging; inclusion; integration	5
2	achievement	accomplishment; achievement	3
9	influence	influence; leadership; power; status	3
13	collaboration	collaboration; cooperation; reciprocity; sharing; synergy; teamwork	2
14	collectivity	common sense; community / collectivity / sense of group; connection; oneness; shared prosperity; unity	6
19	commitment	commitment; dedication; determination; diligence; effort; engagement; initiative; involvement; proactivity; wilfulness; zeal	2
22	progress	development; growth; improvement; progress; success; prosperity	3
24	environmentalism	environmentalism / care for nature; sustainability	3
25	purpose	focus; meaning; purpose; vision	5
26	originality	creativity; innovativeness; insightfulness; originality; resourcefulness; uniqueness	5
30	effect change	impact; make a difference; effect change; significance; usefulness; utility; value creation	3

Result analysis (associated scientific publication): the work carried out by Klein et al. [40] assessed the impact of a novel end-user engagement framework on the same Portuguese pilots trialled in this Ph.D. research. The results uncovered in this document revealed many insightful behavioural patterns that corroborated the findings and interrelationships derived from the implementation of the main social values-based questionnaire, as presented in Table 19.

Table 19. P2P-SVTs uncovered from the analysis of an associated scientific publication.

Key word tags or phrases from textual data	Interpretation
(...) the proposed approach was rather effective in empowering them and raising their awareness in the medium and long terms	This sentence reinforces findings for <effect change>, <empowerment>, <awareness>, and <achievement>, which were all categorised as existing social values reinforced by the P2P energy sharing activities
(...) the prominent positive social stimulus resulted in greater awareness among end-users in the short term, which most certainly evoked a higher sense of free will to commit and proactively participate in the project in the medium and long terms	A prominent positive social stimulus (from the autarchy) represents a form of <support>, thus reinforcing the conclusions for this social value which was categorised as an existing one that was reinforced by the P2P energy sharing activities. Also, this sentence also corroborates findings for <freedom>,

	<commitment> and <participation>, which were also categorised as existing social values reinforced by the P2P energy sharing activities
(...) the proposed end-user engagement routines for the Activation phase were highly effective in engaging indifferent end-users with reversible reasons, whereas the routines for the Continuation phase were successful in sustaining the engagement levels of all active end-user segments	This sentence reinforces findings for <engagement> and <accomplishment>, which were both categorised as existing social values reinforced by the P2P energy sharing activities

5.7.7 Indirect measures

Description: in the case of indirect measures, evidence was collected without the need to observe nor interact with participants. The *WeValue* toolkit reinforces that the working group must clearly define that the indirect measures that are under assessment are related to well-defined VBIs.

Practical implementation: numerical data analysis of the main social values-based questionnaire's responses represents a fruitful source of indirect measures, covering for instance: (i) the percentage of end-users that answered it; (ii) number of female respondents; (iii) willingness to further collaborate with the valuation process; (iv) participation in the awareness-raising sessions promoted throughout the project implementation; (v) technical support received (either via telephone or *in situ* visits paid by the project consortium).

The numerical data analyses of end-user involvement in the project also represented a valuable source of indirect measures, namely in the forms of number of "Early Adopters", and "Indifferent End-users" that were successfully converted to other end-user segments.

Result analysis (numerical data analysis of the end-user involvement with the project):

- **Number of "Early Adopters":** According to Klein et al. [40], this end-user segment represents "(...) *highly motivated and proactive participants who were naturally engaged with the project due to intrinsic reasons*". By the end of the project all pilots showcased a high absolute number of early adopters in comparison with the total amount of participants [40], namely:
    - Alfândega da Fé: 27 early adopters among 55 participants (i.e., 49% of the total number of participants);
    - Penela: 20 early adopters among 36 participants (i.e., 56% of the total number of participants);
    - Vila Real (Lordelo): 19 early adopters among 32 participants (i.e., 59% of the total number of participants).

Their absolute numbers in comparison with the total number of participants in each pilot represented a good indicator for <integration>, <adaptability>, <capacity building>, <awareness>, <participation>, <cooperation>, <effort>, <encouragement>, <focus>, and <personal growth>.

- **Number of "Indifferent End-users" that were successfully converted to other end-user segments:** As explained by Klein et al. [40], the segment of indifferent end-users represented passive end-users *"(...) who were enrolled in the project but were neither motivated nor interested in contributing to its development.*" Hence, they represented the most difficult segment to be dealt with since they were much less prone to change despite the many efforts made by the consortium to engage them. In view of this great challenge, the successful engagement of this end-user segment represented a good measurement of the presence of P2P-SVTs related to <integration>, <adaptability>, <capacity building>, <awareness>, <participation>, <cooperation>, <effort>, <encouragement>, <focus>, and <personal growth>.

  As shown in Klein et al. [40], all pilots successfully engaged indifferent end-users, as seen in the reduction of the number of end-users in this segment from the beginning to the end of the project:

  - Alfândega da Fé: from 23 to 18 indifferent end-users (i.e., an overall reduction of 22%);
  - Penela: from 24 to 12 indifferent end-users (i.e., an overall reduction of 50%);
  - Vila Real (Lordelo): from 24 to 13 (i.e., an overall reduction of 54%).

  Hence, results are reinforced for the abovementioned P2P-SVTs.

Result analysis (numerical data analysis of the responses to the social values-based questionnaire):

- **Percentage of end-users that answered the main social values-based questionnaire:** 27 out of 66 active end-users by the end of the project (i.e., 41% of total active participants). This data can be directly correlated with <accountability>; <participation>; <collaboration>; <commitment>; and <motivation>, thus reinforcing the findings for these P2P-SVTs.
- **Number of female respondents:** 13 out of 27 respondents (i.e., 48% of total respondents). This data is evenly distributed and can be directly linked to <gender equality>, thus reinforcing the findings for this specific P2P-SVT.
- **Willingness to further collaborate with the valuation process:** 16 out of 27 respondents (i.e., 59% of total respondents). This data can be directly correlated with <accountability>, <participation>, <collaboration>, <commitment>, and <motivation>, thus reinforcing the findings for these P2P-SVTs.
- **Participation in the awareness-raising sessions promoted throughout the project implementation:**
  - In all of them: 6 out of 27 respondents (i.e., 22% of total respondents);

- Partially (in some of them): 18 out of 27 respondents (i.e., 67% of total respondents);
- None of them: 3 out of 27 respondents (i.e., 11% of total respondents).

By analysing this data, approximately 89% of respondents participated in either one of all the public sessions promoted by the project consortium, thus evidencing the presence of P2P-SVTs related to <accountability>, <participation>, <collaboration>, <commitment>, and <motivation>.

- **Technical support received (either via telephone or in situ visits paid by the project consortium):**
  - Never had technical issues: 6 out of 27 respondents (i.e., 22% of total respondents);
  - Received technical support and the technical issue was solved: 18 out of 27 respondents (i.e., 67% of total respondents);
  - Received technical support and the technical issue was not solved: 2 out of 27 respondents (i.e., 7% of total respondents);
  - Had technical issues but never received technical support: 1 out of 27 respondents (i.e., 4% of total respondents).

  This data showcases the presence of P2P-SVTs related to <communication>, <support >, <diligence>, and <professionalism>.

5.8 Phase 7: measurement of Localised Values-Based Indicators (LVBIs)

Phase 7 focuses on the measurement of LVBIs using the social values-based questionnaire sent via SurveyGizmo. Since the participatory approach was defined as cooperation, and to avoid fatigue and biases among the wider working group, they were not asked to directly participate in all phases of the implementation of the social values-based assessment framework – which was primarily carried by the core working group. Instead, they were asked to validate and provide further thoughts on the inferences made by the core working group in phases 3 and 4 of the methodological approach, as per the schematic representation presented in Fig. 7.

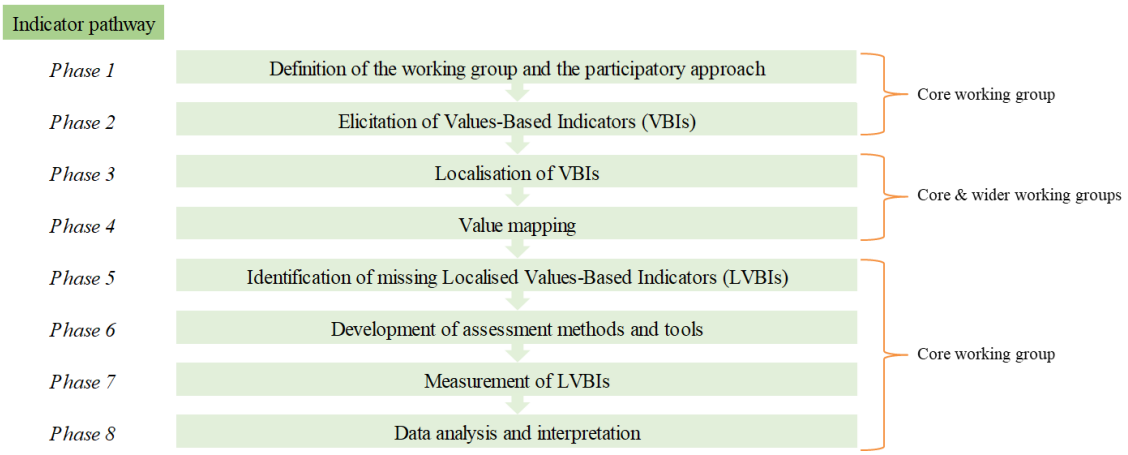


Fig. 7. Schematic representation of the participation of the core & wider working groups in the implementation of the methodological approach.

In other words, respondents (i.e., the wider working group) performed the following tasks within phases 3 and 4 of the methodological approach: firstly, they were asked to validate the localisation exercise from phase 3 by rating each LVBI as individual Likert-type items. Secondly, they were asked to validate the value mapping exercise from phase 4, using for that end the reference list of P2P energy sharing-related Social Value Themes (P2P-SVT). Thirdly, they were asked to reflect about the nature of each enacted P2P-SVT, allowing the core working group to draw final conclusions about the social values-based dimension of the *Community S* project.

5.8.1 Step 1: validation of Localised Values-Based Indicators (LVBIs)

In the first step of the SurveyGizmo questionnaire, respondents were asked to rate the 32 elicited LVBIs (see Fig 8) as 5-point Likert-type items[23]: <Strongly Agree (SA) — Agree (A) — N/A — Disagree (D) — Strongly Disagree (SD)>. These 32 LVBIs were displayed online to respondents under 4 different macro-themes to break this exercise into different substeps and consequently avoid survey fatigue (i.e., attentional bias) (as illustrated in Appendix C).

[23] Likert-type items represent popular psychometric item scoring schemes that usually refers to a series of unique, stand-alone questions, each of which measures a specific construct (e.g., a personality trait or attitude) on its own [71]. Because of that, the performance of each item should be assessed individually and any formal inferences about them as a group should be avoided [72,73]. In this Ph.D. research, given that each LVBI represented a tailored, stand-alone declarative statement related to target P2P-SVTs, they were treated as Likert-type items.

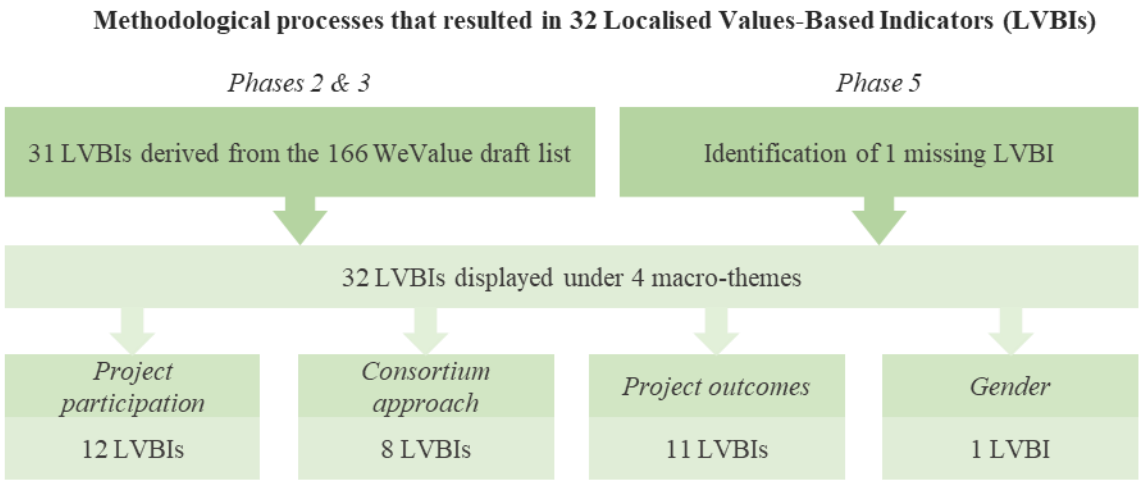


Fig. 8. Schematic representation of the methodological processes that resulted in 32 LVBIs displayed under 4 macro-themes.

The frequency distribution of answers for each LVBI is visually represented in a diverging stacked bar chart[24] (Fig. 9) and further detailed in Table 20.

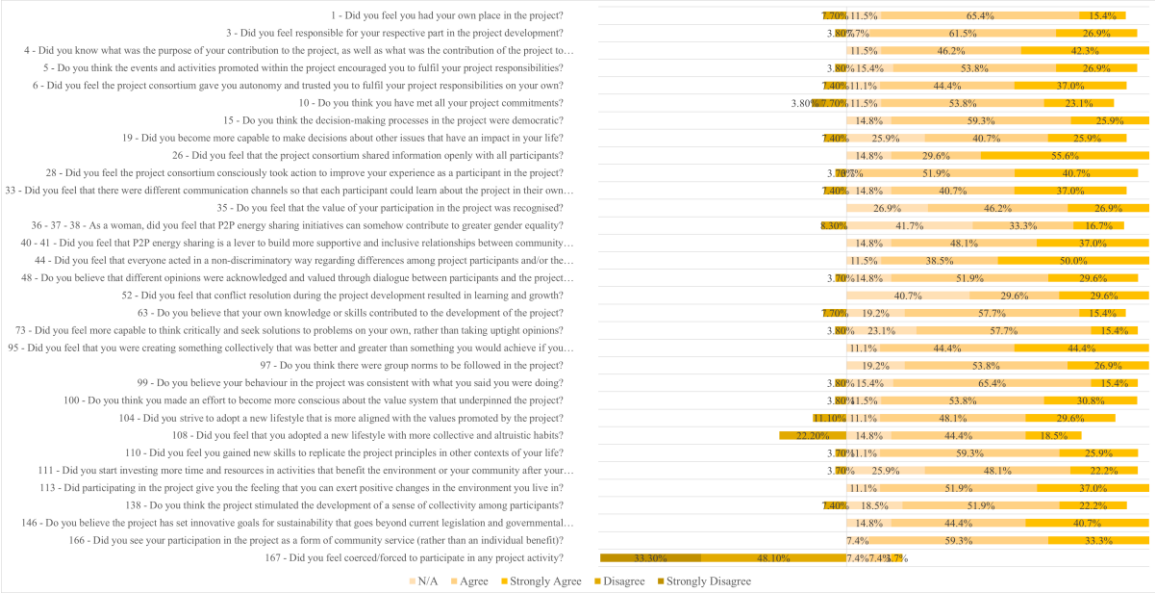


Fig. 9. Frequency distribution for all Likert-type LVBIs.

An item-by-item analysis of the diverging stacked bar chart (Fig. 9) allows to conclude that responses for all LVBIs were highly concentrated in the <Strongly Agree> and <Agree> categories. LVBI no. 167 ("Did you feel coerced / forced to participate in any project activity?") was the only outliner item, having most responses concentrated in the <Disagree> category. This is of importance for this Ph.D. research, since LVBI no. 167 was purposefully tailored as a negatively

[24] Since Likert-type items belong to the ordinal measurement scale, non-parametric statistics are the most appropriate procedures to draw valid statistical conclusions from them, including: (i) modes or medians for central tendency and (ii) frequencies for variability [74]. Also, diverging stacked bar charts can be equally effective to visually represent the responses at the item level [75].

expressed statement to test out the reliability of respondents. That is, due to its inherently negative undertone, responses for this item should be reversely anchored / oriented in contrast to the responses for all other items with more neutral or positive undertones.

Table 20. Analysis of the Likert-type LVBIs and interpretation of results.

No.	LVBI description	Response categories					No. of responses	Central tendency	
		SA (5)	*A (4)*	*N/A (3)*	*D (2)*	*SD (1)*		*Median*	*Mode*
1	Did you feel that you had your own place in the project?	15.4%	65.4%	11.5%	7.7%	0%	26	4	4
3	Did you feel responsible for your own contribution to the project?	26.9%	61.5%	7.7%	3.8%	0%	26	4	4
4	Did you know what the purpose of your contribution to the project was, as well as what was the project's contribution to your community and country?	42.3%	46.2%	11.5%	0%	0%	26	4	4
5	Did you think that the events and activities promoted by the project motivated you to fulfil your responsibilities in the project?	26.9%	53.8%	15.4%	3.8%	0%	26	4	4
6	Did you feel the project consortium gave you autonomy and trusted you to fulfil your project responsibilities on your own?	37.0%	44.4%	11.1%	7.4%	0%	27	4	4
10	Did you think you fulfilled your commitments with the project?	23.1%	53.8%	11.5%	7.7%	3.8%	26	4	4

15	Did you think the decision-making processes in the project were democratic?	25.9%	59.3%	14.8%	0%	0%	27	4	4
19	Did you become more able to make better decisions on other issues affecting your life?	25.9%	40.7%	25.9%	7.4%	0%	27	4	4
26	Did you feel that the project consortium shared information openly with all participants?	55.6%	29.6%	14.8%	0%	0%	27	5	5
28	Did you feel that the project consortium took the initiative to improve the participants' experiences in the project?	40.7%	51.9%	3.7%	3.7%	0%	27	4	4
33	Did you feel that there were different communication channels so that each participant could learn about the project in their own way?	37.0%	40.7%	14.8%	7.4%	0%	27	4	4
35	Did you feel that the value of your participation in the project was recognised?	26.9%	46.2%	26.9%	0%	0%	26	4	4
36 – 37 – 38	Did you feel that P2P energy sharing initiatives can somehow contribute to greater gender equality?	16.7%	33.3%	41.7%	8.3%	0%	12	4	3

40 - 41	Did you feel that P2P energy sharing is a lever to build more solidary and inclusive relationships between participants (compared to the relationships that already existed before)?	37.0%	48.1%	14.8%	0%	0%	27	4	4
44	Did you feel that everyone acted in a non-discriminatory manner with respect to the differences of the participants or the project team (e.g., based on nationality, gender, skin colour, etc.)?	50.0%	38.5%	11.5%	0%	0%	26	5	5
48	Did you believe that different opinions were acknowledged and valued through dialogue between participants and the project consortium?	29.6%	51.9%	14.8%	3.7%	0%	27	4	4
52	Did you feel that conflict resolution during the project development resulted in learning and growth?	29.6%	29.6%	40.7%	0%	0%	27	4	3
63	Did you believe that your own knowledge or skills contributed to the development of the project?	15.4%	57.7%	19.2%	7.7%	0%	26	4	4
73	Did you feel more empowered to critically reflect and seek solutions to	15.4%	57.7%	23.1%	3.8%	0%	26	4	4

	problems on your own, rather than adopting preestablished opinions?								
95	Did you feel that you were creating something collectively that was bigger and better than something you could ever create if you were on your own?	44.4%	44.4%	11.1%	0%	0%	27	4	5
97	Do you consider that there were group norms to be respected in the project?	26.9%	53.8%	19.2%	0%	0%	26	4	4
99	Do you believe your behaviour in the project was consistent with what you said you were doing?	15.4%	65.4%	15.4%	3.8%	0%	26	4	4
100	Do you think you worked hard to raise awareness about the social values system that underpinned the project?	30.8%	53.8%	11.5%	3.8%	0%	26	4	4
104	Did you strive to adopt a new lifestyle more aligned with the social values promoted by the project?	29.6%	48.1%	11.1%	11.1%	0%	27	4	4
108	Did you feel that you adopted a new lifestyle with more collective and altruistic habits?	18.5%	44.4%	14.8%	22.2%	0%	27	4	4

110	Did you feel that you gained new skills to replicate the principles of the project in other contexts of your life?	25.9%	59.3%	11.1%	3.7%	0%	27	4	4
111	Did you start investing more time and resources in activities that benefit the environment or your community due to your participation in the project?	22.2%	48.1%	25.9%	3.7%	0%	27	4	4
113	Did your participation in the project give you the feeling that you can effect changes in the environment in which you live?	37.0%	51.9%	11.1%	0%	0%	27	4	4
138	Do you think the project stimulated the development of a community identity among participants?	22.2%	51.9%	18.5%	7.4%	0%	27	4	4
146	Do you believe the project has set novel sustainability goals that goes beyond current legislation and governmental action?	40.7%	44.4%	14.8%	0%	0%	27	4	5
166	Did you see your participation in the project as a form of community service (rather than a purely individual benefit)?	33.3%	59.3%	7.4%	0%	0%	27	4	4
167	Did you feel somehow coerced / forced to participate	3.7%	7.4%	7.4%	48.1%	33.3%	27	2	2

	in any of the project activities?								

5.8.2 *Step 2: validation of the value mapping exercise*

In the second step of the SurveyGizmo questionnaire, respondents were asked to validate the default value mapping proposed by the core working group in phase 4. The default value mapping was done to avoid survey fatigue among respondents (i.e., attentional bias). They could nonetheless propose alternative associations between LVBIs and P2P-SVTs at their own discretion or suggest new social values other than those encompassed by the P2P-SVT reference list.

Table 21 presents the overall results from this task. The general trend observed in the analysis of Table 21 is the overall agreement about the default associations (86.7% - 100%), allowing to conclude that the default value mapping was fully accepted by respondents.

Table 21. Level of agreement of respondents towards the links between each LVBI and the respective P2P-SVTs associated by default by the working group.

No.	Localised Values-Based Indicators (LVBIs)	Associated P2P-related Social Value Themes (P2P-SVT(s))	Do you agree with the association of these P2P-SVTs with the indicator?		Which other P2P-SVT(s) would you correlate with this indicator? (OPTIONAL)	Which associated P2P-SVT(s) would you eliminate from the default correlation? (OPTIONAL)	No. of responses
			NO	*YES*			
1	Did you feel that you had your own place in the project?	**Inclusion;** recognition	*	Yes (100.0%)	*	*	17
3	Did you feel responsible for your own contribution to the project?	**Responsibility;** contribution; involvement	*	Yes (100.0%)	*	*	20
4	Did you know what the purpose of your contribution to the project was, as well as what was the project's contribution to your community and country?	**Purpose;** contribution; involvement; recognition; effect change	*	Yes (100.0%)	*	*	19
5	Did you think that the events and activities promoted by the project motivated you to fulfil your responsibilities in the project?	**Motivation;** responsibility; involvement	*	Yes (100.0%)	*	*	18
6	Did you feel the project consortium gave you autonomy and trusted you to fulfil your project responsibilities on your own?	**Emancipation;** trust; responsibility	*	Yes (100.0%)	*	*	20

10	Did you think you fulfilled your commitments with the project?	**Accomplishment;** responsibility; contribution; dedication	*	Yes (100.0%)	*	*	18
15	Did you think the decision-making processes in the project were democratic?	**Impartiality;** inclusion; recognition; credibility	*	Yes (100.0%)	*	*	19
19	Did you become more able to make better decisions on other issues affecting your life?	**Capacity building;** learning; personal development; satisfaction; achievement; effect change	*	Yes (100.0%)	*	*	16
26	Did you feel that the project consortium shared information openly with all participants?	**Transparency;** credibility; commitment; impartiality; dialogue; responsibility; support; professionalism	*	Yes (100.0%)	Appreciation (valorização, interesse) (5.0%)	*	20
28	Did you feel that the project consortium took the initiative to improve the participants' experiences in the project?	**Support;** commitment; responsibility; professionalism	No (5.3%)	Yes (94.7%)	*	*	19
30 – 33	Did you feel that there were different communication channels so that each participant could learn about the project in their own way?	**Inclusion**; impartiality; responsibility; support; adaptability; professionalism; involvement; respect	*	Yes (100.0%)	Control (controlo) (5.9%)	*	17
35	Did you feel that the value of your participation in the project was recognised?	**Recognition;** inclusion; satisfaction; motivation; appreciation	*	Yes (100.0%)	*	*	16
36 – 37 – 38	… did you feel that P2P energy sharing initiatives can somehow contribute to greater gender equality?	**Gender equality**; inclusion; inspiration; effect change; recognition; respect; satisfaction	*	Yes (100.0%)	*	*	6

40 – 41	Did you feel that P2P energy sharing is a lever to build more solidary and inclusive relationships between participants (compared to the relationships that already existed before)?	**Solidarity;** inclusion; cooperation; sense of community; make a difference	*	Yes (100.0%)	*	*	19
44	Did you feel that everyone acted in a non-discriminatory manner with respect to the differences of the participants or the project team (e.g., on the basis of nationality, gender, skin colour, etc.)?	**Respect;** impartiality; inclusion; concern for others; unity	*	Yes (100.0%)	*	*	21
48	Did you believe that different opinions were acknowledged and valued through dialogue between participants and the project consortium?	**Dialogue;** impartiality; inclusion; transparency; involvement; credibility; participation; support; engagement; collaboration; professionalism; appreciation; recognition; concern for others	*	Yes (100.0%)	*	*	18
52	Did you feel that conflict resolution during the project development resulted in learning and growth?	**Learning;** personal development; accomplishment; recognition; value creation	No (6.7%)	Yes (93.3%)	*	*	15
63	Did you believe that your own knowledge or skills contributed to the development of the project?	**Contribution;** inclusion; recognition; dedication; improvement; influence; collaboration; satisfaction	No (6.7%)	Yes (93.3%)	*	*	15
73 –81	Did you feel more empowered to critically reflect and seek solutions to problems on your own, rather than adopting preestablished opinions?	**Emancipation;** learning; personal development; value creation; satisfaction; achievement	No (13.3%)	Yes (86.7%)	*	*	15

95	Did you feel that you were creating something collectively that was bigger and better than something you could ever create if you were on your own?	**Collectivity;** integration; contribution; motivation; value creation; support; satisfaction; recognition; resilience; altruism; collaboration; involvement; development; purpose	*	Yes (100.0%)	*	*	20
97	Do you consider that there were group norms to be respected in the project?	**Control;** teamwork; coordination; duty	No (5.6%)	Yes (94.4%)	*	*	18
99	Do you believe your behaviour in the project was consistent with what you said you were doing?	**Honesty;** accountability; impartiality; acknowledgement; credibility	*	Yes (100.0%)	*	*	21
100	Do you think you worked hard to raise awareness about the social values system that underpinned the project?	**Awareness;** responsibility; acknowledgement; critical thinking; involvement; motivation; significance	*	Yes (100.0%)	*	*	20
103 – 104	Did you strive to adopt a new lifestyle more aligned with the social values promoted by the project?	**Adaptation;** capacity building; awareness; achievement; personal development; focus; motivation; impact; satisfaction	*	Yes (100.0%)	*	*	17
107 – 108	Did you feel that you adopted a new lifestyle with more collective and altruistic habits?	**Concern for others;** adaptability; community; proactivity; value creation; personal development; vision; satisfaction	*	Yes (100.0%)	*	*	13
110	Did you feel that you gained new skills to replicate the principles of the project in other contexts of your life?	**Personal development;** emancipation; consciousness; utility; satisfaction; purpose; drive; initiative; influence; achievement; appreciation; acknowledgement; adaptability	No (9.1%)	Yes (90.9%)	*	Emancipation (emancipação) (4.5%)	22

111	Did you start investing more time and resources in activities that benefit the environment or your community due to your participation in the project?	**Environmentalism; collectivity;** empowerment; selflessness; belonging; awareness; contribution; inspiration; make a difference; purpose; personal development; respect; satisfaction; acknowledgement; resilience; influence; sharing; prosperity; fairness; dedication; long-sightedness	No (5.6%)	Yes (94.4%)	Long-sightedness (olhar para o futuro) (5.5%)	*	18
113	Did your participation in the project give you the feeling that you can effect changes in the environment in which you live?	**Empowerment;** contribution; wilfulness; make a difference; purpose; personal development; satisfaction; recognition; resilience; influence	*	Yes (100.0%)	Resourcefulness (alternativas) (5.0%)	*	20
138	Do you think the project stimulated the development of a community identity among participants?	**Collectivity;** concern for others; inclusion; cooperation; contribution; consciousness; capability; responsibility; recognition; resilience; drive; impact; backing; wellbeing; commitment; social justice; prosperity	No (5.6%)	Yes (94.4%)	*	*	18
146	Do you believe the project has set novel sustainability goals that goes beyond current legislation and governmental action?	**Innovativeness;** development; purpose; value creation; environmentalism; contribution; status; achievement; advocacy	*	Yes (100.0%)	Advocacy (pressão no governo) (4.3%)	*	23
166	Did you see your participation in the project as a form of community service (rather than a purely individual benefit)?	**Collectivity;** concern for others; inclusion; cooperation; contribution; consciousness; capability; responsibility; recognition; resilience; drive; impact; organization;	*	Yes (100.0%)	*	*	21

		wellbeing; purpose; commitment; social justice; prosperity					
167	Did you feel somehow coerced / forced to participate in any of the project activities?	**Authoritarianism;** influence	*	Yes (100.0%)	*	*	17

Furthermore, respondents suggested 6 new individual social value terms, including: *interesse* (interest); *valorização* (appreciation); *controlo* (control); *futuro* (long-sightedness); *alternativas* (resourcefulness); and *pressão no governo* (advocacy)[25]. From these suggestions, only resourcefulness and advocacy were not yet encompassed by the P2P-SVT reference list. After some refinement by the core working group, two new P2P-SVTs were devised (see Table 22). This is a clear manifestation of the "Häagen-Dazs effect", thus reinforcing the validity of the proposed methodology.

Table 22. List of new P2P-SVTs and their associated individual social values derived from the respondents' suggestions.

No.	P2P Social Value Themes (P2P-SVTs)	Value(s) that can be linked to this P2P-SVT
31	advocacy / activism / militancy	advocacy; activism; militancy; influence peddling; backing; championing; endorsement
32	long-sightedness / aspiration / contemplation	long-sightedness; aspiration; contemplation; intention; expectancy; anticipation; prospect; foresight; forethought; outlook; prescience; projection; desire; wish; hope

5.8.3 Step 3: classification of the enacted P2P energy sharing-related Social Value Themes (P2P-SVTs)

In the third step of the SurveyGizmo questionnaire, respondents were asked to reflect about the nature of each P2P energy sharing-related Social Value Themes (P2P-SVTs) they enacted in the previous step. That is, they were asked to categorise each enacted P2P-SVT in one of the 4 initial hypotheses set in Research Question 2 about their origin:

- Hypothesis 1 (H1): If the enacted P2P-SVT arose from the ground up because of the P2P energy sharing activities.
- Hypothesis 2 (H2): If the enacted P2P-SVT already existed and was reinforced by the P2P energy sharing activities.
- Hypothesis 3 (H3): If an antagonistic version of the enacted P2P-SVT existed but was modified by the P2P energy sharing activities.
- Hypothesis 4 (H4): If the enacted P2P-SVT did not apply to P2P energy sharing activities.

Table 23 presents the overall results from this task. This data is illustrated in Fig. 10.

[25] Evaluator A spoke by phone with the respective respondents to understand the underlying meaning of those suggestions for social values before translating them from European Portuguese to English.

Table 23. Respondents' inferences on the origin of each P2P-SVT.

No.	P2P-SVT	Hypotheses				No. of responses
		H1	H2	H3	H4	
1	belonging	13.6%	81.8%	-	4.5%	22
2	achievement	9.5%	76.2%	4.8%	9.5%	21
3	responsibility	13.6%	77.3%	-	9.1%	22
4	gratitude	18.2%	77.3%	-	4.5%	22
5	recognition	18.2%	68.2%	-	13.6%	22
6	resilience	21.7%	73.9%	-	4.3%	23
7	altruism	13.6%	81.8%	-	4.5%	22
8	coercion	9.1%	18.2%	27.3%	45.5%	22
9	influence	9.1%	77.3%	-	13.6%	22
10	emancipation	9.1%	86.4%	4.5%	-	22
11	awareness	18.2%	81.8%	-	-	22
12	participation	27.3%	72.7%	-	-	22
13	collaboration	22.7%	77.3%	-	-	22
14	collectivity	31.8%	68.2%	-	-	22
15	dialogue	4.5%	90.9%	-	4.5%	22
16	support	22.7%	77.3%	-	-	22
17	transparency	13.6%	77.3%	-	9.1%	22
18	trust	13.6%	77.3%	-	9.1%	22
19	commitment	18.2%	77.3%	-	4.5%	22
20	motivation	22.7%	72.7%	-	4.5%	22
21	impartiality	18.2%	68.2%	-	13.6%	22
22	progress	18.2%	77.3%	-	4.5%	22
23	professionalism	13.6%	81.8%	-	4.5%	22
24	environmentalism	18.2%	77.3%	-	4.5%	22
25	purpose	9.1%	77.3%	-	13.6%	22
26	originality	27.3%	68.2%	-	4.5%	22
27	personal development	4.5%	90.9%	-	4.5%	22
28	respect	4.5%	81.8%	-	13.6%	22
29	wellbeing	13.6%	81.8%	-	4.5%	22
30	effect change	27.3%	72.7%	-	-	22

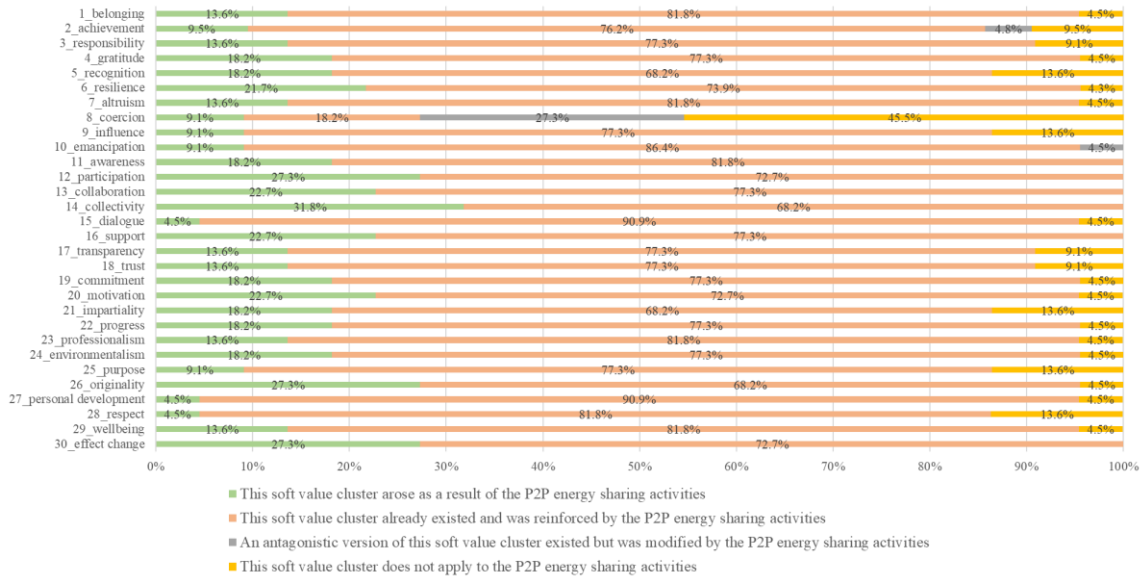


Fig. 10. Frequency distribution for all Likert-type P2P-SVTs.

The analysis of Fig. 10 allows to conclude that respondents tended to agree that all P2P-SVTs already existed and were reinforced by the P2P energy sharing activities. However, this is not the case for <coercion>, which was the only P2P-SVT considered not to be applied to the P2P energy sharing activities.

Further remarks are revealed when the individual frequency distributions of responses are visualised per hypothesis, as described in Tables 24-27:

Table 24. Frequency distribution for answers measuring existent P2P-SVTs that already existed and were reinforced by the P2P energy sharing activities.

Existent P2P-SVTs that already existed and were reinforced by the P2P energy sharing activities	**Frequency (%)**
15_dialogue; 27_personal development	90.9%
10_emancipation	86.4%
1_belonging; 7_altruism; 11_awareness; 23_professionalism; 28_respect; 29_wellbeing	81.8%
3_responsibility; 4_gratitude; 9_status; 13_collaboration; 16_support; 17_transparency; 18_trust; 19_commitment; 22_progress; 24_environmentalism; 25_purpose	77.3%
2_achievement	76.2%
6_resilience	73.9%
12_participation; 20_motivation; 30_effect change	72.7%
5_recognition; 14_collectivity; 21_impartiality; 26_originality	68.2%
8_coercion	18.2%

Table 24 reveals that <dialogue> and <personal development> were the best representatives of existent P2P-SVTs that already existed and were reinforced by the P2P energy sharing activities.

Table 25. Frequency distribution for answers measuring new P2P-SVTs that arose from the P2P energy sharing activities.

New P2P-SVTs that arose from the P2P energy sharing activities	Frequency (%)
14_collectivity	31.8%
12_participation; 26_originality; 30_effect change	27.3%
13_collaboration; 16_support; 20_motivation	22.7%
6_resilience	21.7%
4_gratitude; 5_recognition; 11_awareness; 19_commitment; 21_impartiality; 22_progress; 24_environmentalism	18.2%
1_belonging; 3_responsibility; 7_altruism; 17_transparency; 18_trust; 23_professionalism; 29_wellbeing	13.6%
2_achievement	9.5%
8_coercion; 9_influence; 10_emancipation; 25_purpose	9.1%
15_dialogue; 27_personal development; 28_respect	4.5%

Table 25 illustrates that <collectivity> was the best representative of a P2P-SVTs that arose anew as a result of the P2P energy sharing activities.

Table 26. Frequency distribution for answers measuring antagonistic P2P-SVTs that were changed by the P2P energy sharing activities.

Antagonistic P2P-SVTs that were changed by the P2P energy sharing activities	Frequency (%)
8_coercion	27.3%
2_achievement	4.8%
10_emancipation	4.5%

As can be seen in Table 26, <coercion> was the best representative of an antagonistic P2P-SVTs that was changed by the P2P energy sharing activities, with 27.3% of agreement among respondents. This individual response distribution is approximately 6 times higher than the other two other P2P-SVTs encompassed in this hypothesis, showcasing that <coercion> is a clear outlier in the data.

Table 27. Frequency distribution for answers measuring P2P-SVTs that did not apply to the P2P energy sharing activities.

P2P-SVTs that do not apply to the P2P energy sharing activities	Frequency (%)
8_coercion	45.5%
5_recognition; 9_influence; 21_impartiality; 25_purpose; 28_respect	13.6%
2_achievement	9.5%
3_responsibility; 17_transparency; 18_trust	9.1%
1_belonging; 4_gratitude; 7_altruism; 15_dialogue; 19_commitment; 20_motivation; 22_progress; 23_professionalism; 24_environmentalism; 26_originality; 27_personal development; 29_wellbeing	4.5%

6_resilience	4.3%

Finally, Table 27 reveals that <coercion> was also the greatest representative of a P2P-SVT that did not apply to the P2P energy sharing activities, with 45.5% of agreement among respondents (approximately 3 times higher than the second highest rated P2P-SVT).

5.9 Phase 8: data analysis and interpretation

A summary of the results obtained from the data collection using each assessment method and tool devised in phase 6 are presented in Table 28. This table was created so that the final conclusions can be visualised for each of the 33 P2P-SVT that was identified during the valuation process (see Fig. 11), including any potential value-behaviour gap.

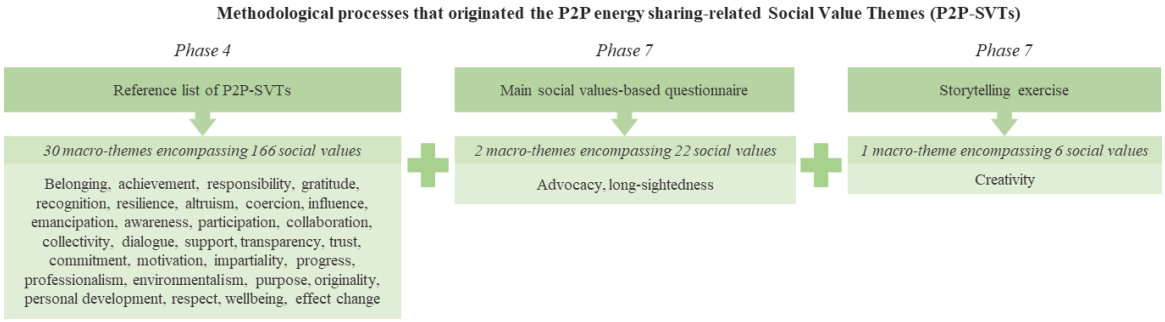


Fig. 11. Schematic representation of the methodological processes that originated the 33 P2P energy sharing-related Social Value Themes (P2P-SVTs).

Table 28. Drawing of conclusions for each Peer-to-Peer Social Value Theme (P2P-SVT).

Legend			
Hypotheses	*Hypothesis 1*	The uncovered social value was created from the ground up as a result of P2P energy sharing	**H1**
	Hypothesis 2	The uncovered social value already existed and was reinforced by P2P energy sharing	**H2**
	Hypothesis 2	An antagonistic version of the uncovered social value already existed but was modified by P2P energy sharing	**H3**
	Hypothesis 4	The uncovered social value did not apply to P2P energy sharing	**H4**

Assessment tools	*Questionnaires*	Social values-based questionnaire	**AT1**
		Ex-ante assessment questionnaire	**AT2**
		Ex-post assessment questionnaire	**AT3**
	Creative Research Methods	Storytelling	**AT4**
	Observation-based methods	Unstructured observation	**AT5**
	Document Analysis	Project website	**AT6**
		Associated scientific publication	**AT7**
	Indirect Measures	Numerical data analysis of the end-user involvement with the project	**AT8**
		Numerical data analysis of the responses to the social values-based questionnaire	**AT9**

P2P-SVT	**Social values terms linked to this P2P-SVT**	**Associated LVBIs**	**P2P-SVT identification using each assessment tool** (N/A – not identified; YES – identified; INC – inconclusive)								
			AT1	**A2**	**AT3**	**AT4**	**AT5**	**AT6**	**AT7**	**AT8**	**AT9**
1. belonging	accessibility; belonging; identification; inclusiveness; integrativeness	LVBIs: 1; 15; 33; 36-37-38; 40-41; 44; 48; 63; 95; 111; 138; 166	H2	N/A	N/A	N/A	N/A	YES	N/A	YES	N/A
2. achievement	accomplishment; achievement	LVBIs: 10; 19; 52; 73; 104; 110; 146	H2	YES	N/A	N/A	N/A	YES	YES	N/A	N/A

3. responsibility	accountability; duty; responsibility	LVBIs: 3; 5; 6; 10; 26; 28; 33; 97; 99; 100; 138; 166	H2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	YES
4. gratitude	appreciation; contentment; gratitude; happiness	LVBIs: 35; 48; 110	H2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5. recognition	acknowledgement; recognition	LVBIs: 1; 4; 15; 35; 36-37-38; 48; 52; 63; 95; 99; 100; 110; 111; 113; 138; 166	H2	N/A	INC	N/A	N/A	N/A	N/A	N/A	N/A
6. resilience	adaptability; dynamism; flexibility; resilience	LVBIs: 33; 95; 104; 108; 110; 111; 113; 138; 166	H2	N/A	N/A	N/A	N/A	N/A	N/A	YES	N/A
7. altruism	altruism; assistance; caring; compassion; concern for others; generosity; helpfulness; goodwill; selflessness; solidarity; volunteering; willingness	LVBIs: 40-41; 44; 48; 95; 108; 111; 138; 166	H2	N/A	N/A	YES	N/A	N/A	YES	N/A	N/A
8. coercion	authoritarianism; coercion; control; discipline; obedience; power; order; rigour	LVBI: 97	H4	N/A	N/A	N/A	YES	N/A	YES	N/A	N/A
9. influence	influence; leadership; power; status	LVBIs: 63; 110; 111; 113; 146; 167	H2	N/A	N/A	N/A	N/A	YES	N/A	N/A	N/A
10. emancipation	autonomy; capacity building; capability; confidence; critical thinking; emancipation; empowerment; free will; freedom; independence; independent thinking	LVBIs: 6; 19; 73; 100; 104; 110; 111; 113; 138; 166	H2	YES	YES	YES	N/A	N/A	YES	YES	N/A
11. awareness	awareness; concern; consciousness; knowledge; education; learning; understanding	LVBIs: 19; 52; 73; 100; 104; 110; 111; 138; 166	H2	YES	YES	YES	N/A	N/A	YES	YES	N/A
12. participation	compliance; contribution; participation	LVBIs: 3; 4; 10; 48; 63; 95; 111; 113; 138; 146; 166	H2	YES	YES	YES	N/A	N/A	YES	YES	YES

13. collaboration	collaboration; cooperation; interactivity; reciprocity; sharing; synergy; teamwork	LVBIs: 40-41; 48; 63; 95; 97; 111; 138; 166	H2	N/A	N/A	YES	N/A	YES	N/A	YES	YES
14. collectivity	commonality; common sense; community / collectivity / sense of group; connection; locality; oneness; shared prosperity; togetherness; unity	LVBIs; 40-41; 44; 95; 108; 111; 138; 166	H2	YES	YES	YES	N/A	YES	N/A	N/A	N/A
15. dialogue	communication; dialogue	LVBIs: 26; 48	H2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	YES
16. support	coordination; guidance; service; support; backing	LVBIs: 26; 28; 33; 48; 95; 97; 138; 166	H2	N/A	YES	YES	N/A	N/A	YES	N/A	YES
17. transparency	clearness; comprehensibility; directness; intelligibility; openness; palpability; perceptibility; tangibility; transparency	LVBIs: 26; 48; 99	H2								
18. trust	credibility; honesty; loyalty; reliability; trust; trustworthiness	LVBIs: 6; 15; 26; 48; 99	H2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19. commitment	commitment; dedication; determination; diligence; effort; engagement; involvement	LVBIs: 3; 4; 5; 10; 26; 28; 33; 48; 63; 95; 100; 108; 110; 111; 113; 138; 166	H2	YES	N/A	YES	N/A	YES	YES	YES	YES
20. motivation	active citizenship; drive; encouragement; initiative; inspiration; interest; motivation; optimism; proactivity; wilfulness; zeal	LVBIs: 5; 35; 36-37-38; 95; 100; 104; 110; 111; 138; 166	H2	N/A	N/A	YES	N/A	N/A	N/A	YES	YES
21. impartiality	democracy; social equality; equity; ethics; fairness; gender equality; impartiality; integrity; social justice	LVBIs: 15; 26; 33; 36-37-38; 44; 48; 99; 111; 138; 166	H2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	YES
22. progress	development; growth; improvement; progress; success; prosperity	LVBIs: 63; 111; 138; 146; 166	H2	YES	N/A	YES	N/A	YES	N/A	N/A	N/A
23. professionalism	formalism; professionalism	LVBIs: 26; 28; 33; 48; 95	H2	N/A	N/A	YES	N/A	N/A	N/A	N/A	YES

24. environmentalism	environmentalism / care for nature; sustainability	LVBIs: 111; 146	H2	23x	N/A	YES	N/A	YES	N/A	N/A	N/A
25. purpose	focus; meaning; purpose; vision	LVBIs: 4; 95; 100; 104; 108; 110; 113; 146; 166	H2	N/A	N/A	N/A	N/A	YES	N/A	YES	N/A
26. originality	authenticity; creativity; innovativeness; insightfulness; originality; pioneering spirit; resourcefulness; uniqueness	LVBI: 146	H2	YES	N/A	YES	N/A	YES	N/A	N/A	N/A
27. personal development	personal development; personal growth; self-expression	LVBIs: 19; 52; 73; 104; 108; 110; 111; 113	H2	N/A	N/A	YES	N/A	N/A	N/A	YES	N/A
28. respect	respect for others; tolerance	LVBIs: 33; 36-37-38; 44; 111	H2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29. wellbeing	satisfaction; wellbeing	LVBIs: 19; 35; 36-37-38; 63; 73; 95; 104; 108; 110; 111; 113; 138; 166	H2	N/A	YES	YES	N/A	N/A	N/A	N/A	N/A
30. effect change	impact; make a difference; effect change; significance; usefulness; utility; value creation	LVBIs: 4; 19; 36-37-38; 40-41; 52; 73; 95; 104; 108; 110; 111; 113; 138; 146; 166	H2	YES	YES	YES	N/A	YES	YES	N/A	N/A
31. advocacy	advocacy; activism; militancy; influence peddling; backing (a cause); championing; endorsement	LVBI: 146	H2	YES	N/A	YES	N/A	N/A	N/A	N/A	N/A
32. long-sightedness	long-sightedness; aspiration; contemplation; intention; expectancy; anticipation; prospect; foresight; forethought; outlook; prescience; projection; desire; wish; hope	LVBI: 111	H2	YES	YES	YES	N/A	N/A	N/A	N/A	N/A
33. curiosity	curiosity; expectation; eagerness; inquisitiveness; inquiringness; interestingness	N/A	N/A	N/A	N/A	YES	N/A	N/A	N/A	N/A	N/A

The analysis of Table 28 allowed to conclude that the results for 27 out of the 33 P2P-SVTs enacted in the valuation process were reinforced by at least two assessment methods and tools envisioned in this Ph.D. research. Illustratively, <participation> was identified by 7 out of the 9 assessment methods and tools, followed by <emancipation> and <awareness> that were identified by 6 of them and so on. This means that those 27 P2P energy sharing-related Social Value Themes (P2P-SVTs) were validly "active" in the context of the *Community S* project.

On the other hand, the same conclusion cannot be reached for <gratitude>, <recognition>, <transparency>, <trust>, and <respect> since they were uncovered by the main social values-based questionnaire but were not further identified by any other supplementary assessment method and tool. Similarly, <curiosity> was uncovered by the storytelling exercise as a P2P-SVT that arose from the ground up in the *Community S* project but was also not further validated by other assessment means. Therefore, the potential value-behaviour gap for those 6 P2P-SVTs was not dismissed, and so they could not be considered "active" P2P-SVTs in the context of the *Community S* project.

Finally, in terms of the nature of the "active" P2P-SVTs, respondents tended to agree that they were existent P2P-SVTs that were reinforced by the P2P energy sharing activities. Coercion, however, was the only framed as a P2P-SVT that does not apply to the P2P energy sharing activities.

5.10 Validity of the valuation process

According to Bell and Morse [84], the nature of social values is so complex that "the act of measurement may change the very thing that is attempting to be measured". Nonetheless, this argument does not invalidate any attempt to measure social values, provided that it is acknowledged and properly addressed through a cohesive validity check [84].

Messick [76, apud 21] defined the concept of validity as "*an overall evaluative judgment of the degree to which empirical evidence and theoretical rationales support the adequacy and appropriateness of interpretations and action on the basis of (sic) modes of assessment*". In other words, validity is not an inherent property of any methodological approach *per se*, but rather of the result interpretations drawn from its use – which must resonate with the points-of-view of those involved with it [76, apud 21]. Since result interpretations might be valid for one specific purpose but invalid for another, every aspect of the proposed methodological approach must be validated on a case-by-case basis, starting from the core constructs that informed its development [21]. This rationale became the guiding principle for the definition of the appropriate validity check for the valuation process proposed in this Ph.D. research, which follows:

- Phase 1: the validity relied on convening a multifaceted working group that reflected all stakeholder typologies involved in the valuation process, as well as on defining a context-

appropriate participatory approach. This Ph.D. research added a supplementary validity layer to this phase of the methodological pathway by identifying and evaluating the gatekeeper(s) involved in the valuation process. This was done through the promotion of a pre- and a post-survey that were purposefully tailored and delivered to avoid expectation and memory biases.

- Phase 2: the validity relied on the proper elicitation of a list of draft VBIs that were within the scope of the valuation process and that sufficiently represented it. This activity was designed and carried out in a way to purposefully avoid conformity bias.
- Phase 3: the validity relied on the proper customisation of the selected draft VBIs into LVBIs that adequately reflected the specific domain under scrutiny in the valuation process, whilst still being associated with the draft VBIs they derived from. This activity was also designed and carried out in a way to purposefully avoid conformity bias, whilst meeting the criteria of measurability, reliability, and usability.
- Phase 4: the validity relied on the proper 'mapping' of LVBIs to social values (i.e., value mapping). Since this activity was based on interpretative decisions, this activity was designed and carried out to avoid conformity bias, as well as to leverage on interactive dialogue sessions to promote transformational learning. This Ph.D. research added a new validity layer to this phase of the methodological pathway by tailoring an overarching P2P energy sharing-related social values reference list that helped respondents to answer the social values-based questionnaire, thus addressing the Häagen-Dazs effect whilst avoiding the Dunning-Kruger Effect and respondents' fatigue (i.e., attentional bias). This reference list was validated through face validity with the wider working group.
- Phase 5: the validity relied on the proper identification of missing LVBIs, in case any fundamental social values associated with the purpose of the valuation process was still missing from the value mapping exercise. This activity was validated through face validity with the wider working group.
- Phase 6: the validity relied on the selection of context-appropriate assessment methods and tools to measure the elicited set of LVBIs. This activity was validated following 3 criteria: (i) methodological rigour, richness, and reliability of the results; (ii) adaptability to the target respondents in each pilot and to the specificities of the project under analysis; (iii) ease of use and low demand resources for their replicability. Illustratively, the social values-based questionnaire was build using the Professional License of SurveyGizmo, which prevented several different types of biases from manifesting (e.g., anonymity option that mitigated conformity bias; the built-in questions / answer options randomisation that prevented bias introduced by question order (e.g., default effect[26]) and / or survey fatigue; and the removal of the progress bar that further avoided bias introduced by survey fatigue).

[26] Default effect bias refers to the tendency to favour the default option whenever given a choice between several different options [85].

Another example was the unstructured observation that was carried out from different perspectives (i.e., Evaluators A, C and D's perspectives) as to avoid biased assessments, and that was further validated through face validity (as explained in Klein et al. [40]).

- Phase 7: the validity relied on the collection of unbiased data. This activity was validated by using a combination of different assessment methods and tools to measure each LVBI (of which at least one of them did not rely on self-reported data) to avoid sampling errors and the effect of social desirability bias among respondents.
- Phase 8: the validity relied on unbiased data analysis, which was validated by different scholars to avoid expectation bias, the illusion of validity[27], and the framing effect[28].

[27] Illusion of validity refers to the illusion that "*one's judgments is accurate, especially when available information is consistent or inter-correlated*" [86].

[28] The framing effect refers to reaching different conclusions from the analysis of the same data based on how this data is presented [87].

6. CONCLUSIONS AND FURTHER WORK

6.1. Contributions provided by this Ph.D. research

First and foremost, the main contributions provided by this Ph.D. research to the scientific literature on P2P energy sharing were the conceptualisation, design, and development of: (i) the first social values-based assessment framework focused on P2P energy trading; (ii) the first end-user engagement framework focused on P2P energy trading; (iii) and the first Portuguese business model on P2P energy trading — all trialled and validated in the first project to have demonstrated the concept of P2P energy sharing in Portugal under real market conditions and in real-life settings before the deregulation of such activities in the country. While the social values-based dimension of P2P energy sharing was the primary focus of this Ph.D. research, the end-user engagement and business model perspectives were developed as supplementary work as they represented structuring aspects of P2P energy sharing models.

This Ph.D. research argued that there must be a fundamental shift in the way that social values are accounted for in the transition towards a desirable carbon-neutral future. Since only part of the overall value created by P2P energy sharing models seems to be assimilated into market relations, this Ph.D. research highlighted the need to demonstrate the real impact of what can be truly achieved with P2P energy sharing, instead of just what is easily quantifiable. For that, social values should be considered core outcomes of P2P energy sharing services provision and commissioning, rather than just an incremental externality. This means moving from a strict profit-oriented perspective focused on financial outcomes towards a wider perspective that also encompasses non-market outcomes, such as the case of social values. However, up to now there were no fit-for-purpose methodologies in the literature able to transfer the inherently qualitative nature of social values into quantitative measures in the context of peer-to-peer energy sharing. Based on that, this Ph.D. research devised the first overarching social values-based assessment framework that allows the identification of underlying social values associated with peer-to-peer energy sharing models.

The conceptual design of this framework was inspired by the *WeValue* toolkit, which was revised, repurposed, trialled, and validated in 3 pilots in Portugal. These pilots were developed under the umbrella of the *Community S* project — the first to have trialled and validated the concept of P2P energy sharing in Portugal under real market conditions and in real-life settings before the deregulation of such activities.

As discussed, the framework was highly effective in drawing conclusions for 27 of the 33 social values themes enacted in this Ph.D. research (i.e., belonging, achievement, responsibility, resilience, altruism, coercion, influence, emancipation, awareness, participation, collaboration, collectivity, dialogue, support, commitment, motivation, impartiality, progress, professionalism,

environmentalism, purpose, originality, personal development, wellbeing, effect change, advocacy, and long-sightedness). That is, they were considered validly "active" in the context of the *Community S* project. Among them, <coercion> was mainly categorised as a social value that did not apply to the P2P energy sharing activities, while the other 26 social value themes were mainly categorised as existing social values that were reinforced by the P2P energy sharing activities.

Furthermore, if these social values are scrutinised under the 4 initial hypotheses set by this Ph.D. research, <dialogue> and <personal development> become the best representative of existent social value themes that were reinforced by the P2P energy sharing activities; <collectivity> becomes the best representative of a new social value theme that emerged from the ground up as a result of the P2P energy sharing activities; and <coercion> becomes the best representative of an antagonistic social value theme that existed and was modified by the P2P energy sharing activities, as well as of a social value theme that did not apply to P2P energy sharing activities.

Additionally, this Ph.D. research coined its own actionable understanding of social values to help end-users transform this abstract concept into their specific language and cultural assumptions. Data analysis indicates that end-users were able to make sense of this concept that laid beneath consciousness, suggesting knowledge transfer, sensemaking, strong commitment and interest in the project, and a (possible) shared social dimension among them.

All in all, by developing the first overarching social values-based assessment framework focused on peer-to-peer energy sharing models and by trialling and validating it in real-life settings, this Ph.D. research expects to leave a valuable contribution to both academia (in the form of a legacy to the field of peer-to-peer energy sharing) and the professional realm (in the form of scientifically valid managerial good practices associated with peer-to-peer energy sharing models).

6.2. Answers for the research questions

This section aims to answer the three Research Questions (RQ) and three Research Sub-Questions (RSQ) formulated in this Ph.D. research.

RQ 1	*Is it possible to reveal, demonstrate, and operationalise the inherently qualitative social values-based dimension of P2P energy sharing models with scientific rigour? If so, how?*

Yes, it is possible to reveal, demonstrate, and operationalise the inherently qualitative social values-based dimension of P2P energy sharing models with scientific rigour.

To do so, this Ph.D. research created the first operational social values-based assessment framework that allows the uncovering of underlying social values associated with P2P energy sharing models. Previously to that, there were no fit-for-purpose methodologies that could transfer the inherently qualitative nature of social values into quantitative measures for data analysis purposes in the context of P2P energy sharing.

The conceptual design of this framework was inspired by the *WeValue* toolkit, which was revised, repurposed, trialled, and validated in 3 pilots in Portugal. In essence, the social values-based assessment framework works by transforming subjective interpretation into objective assessment in an 8-phase process. In other words, it measures objective indicators that are directly linked to subjective social values; by measuring them, their correlated social values are implicitly measured by extension.

RQ 2 *How to distinguish the nature of the underlying social values associated with P2P energy sharing models?*

This Ph.D. research formulated four initial hypotheses (H) to distinguish the nature of the underlying social values associated with P2P energy sharing models:

H 1 The social value emerged from the ground up because of the P2P energy sharing.

H 2 The social value already existed before the P2P energy sharing and was reinforced by it.

H 3 An antagonistic version of the social value already existed before the P2P energy sharing but was modified by it.

H 4 The social value did not apply to the P2P energy sharing.

These hypotheses were purposefully embedded into the design of the social values-based assessment framework as to enable the analysis of each uncovered social value against this backdrop (see Section 5.8.2 for details).

All in all, the result analysis allowed to conclude that, in the context of the *Community S* project, <collectivity> was the best representative of a new social value theme that emerged as a result of the P2P energy sharing activities (H1); <dialogue> and <personal development> were the best representative of existent social value themes that were reinforced by the P2P energy sharing activities (H2); and <coercion> was the best representative of an antagonistic social value theme that existed and was modified by the P2P energy sharing activities (H3), as well as of a social value theme that did not apply to P2P energy sharing activities (H4).

RQ 3 *How to move highly complex and abstract concept definitions from vague normative statements to their operationalisation?*

This was achieved in this Ph.D. research by thoroughly addressing the Häagen-Dazs effect – which fundamentally refers to the inability to deliberate about a given subject due to a poor or limited knowledge on that subject. To counteract that, end-users were constantly exposed to the concepts relevant to this Ph.D. research (e.g., the concepts of P2P energy sharing and social values) from different angles and through different means. This Ph.D. research also coined its own actionable understanding of social values as to help end-users transform this abstract concept into their specific language and cultural assumptions. All in all, it aimed at creating a new social values-based language that is explicitly associated with P2P energy sharing.

End-users also received supporting instruments to help them enrich their discourse – e.g., the provision of a P2P-SVT reference list presented in Section 5.5 (Phase 4).

Finally, the core constructs that informed the design of the social values-based assessment framework were purposefully meant to push end-users to make connections that were lying below conscious level, as well as go through self-realisation processes.

All things considered, the result analysis indicates that end-users were able to make sense of these concepts that laid beneath consciousness, suggesting knowledge transfer, sensemaking, a broader vocabulary, strong commitment and interest in the project, and a (possible) shared social dimension among them.

RQ 4 *How to validate and scale up the valuation process proposed in this Ph.D. research?*

Due to inherently qualitative nature of this Ph.D. research, a rigorous and cohesive validity check was created to allow the validation of every aspect of the valuation process on a case-by-case basis, starting from the core constructs that informed its development – as previously described in Section 5.10.

Fundamentally, this was done to maintain a constant "reflectiveness" about the less tangible aspects of the valuation process and support the adequacy and appropriateness of the result interpretations drawn from its implementation. This was also fundamental to support its scalability, considering that result interpretations might be valid for one specific purpose but invalid for another.

By doing so, multiple biases were acknowledged and properly addressed throughout the valuation process – e.g., expectation bias; memory bias; conformity bias; attentional bias; the Häagen-Dazs effect; the Dunning-Kruger Effect; the default effect; the social desirability effect; the illusion of validity; the framing effect; to name a few.

RSQ 1 *How to effectively engage end-users in the context of P2P energy sharing?*

To effectively engage end-users in the context of P2P energy sharing, and in view of the absence of any existing fit-for-purpose framework, this Ph.D. research had to conceptualise, design, implement, and validate the first end-user engagement framework tailored in the context of P2P energy sharing (as detailed in Section 3.3).

The effectiveness of the proposed end-user engagement framework was validated in the 3 pilots proposed in the *Community S* project. Specifically, the proposed framework was effective in raising awareness and empowering unmotivated, passive end-users in an initial phase of the project implementation, as well as in retaining the interest of motivated end-users during a later phase. Furthermore, the empirical analysis allowed to conclude that participation in the project was predominantly voluntary rather than coerced. The proposed end-user engagement framework contributed to the scientific literature by facilitating and guiding the succesful roll out of future P2P energy sharing models.

RSQ 2 *What are the immediate implications of the existing regulatory barriers on the implementation of P2P energy sharing models in Portugal? How to address these barriers?*

The implementation of the *Community S* project preceded the deregulation of P2P energy sharing activities by years. In view of that, P2P energy sharing, collective self-consumption and renewable energy communities were nonexistent concepts in the Portuguese energy landscape.

As explained in Section 3.2, when the *Community S* project was conducted, prosumers had to compulsorily injected their surplus renewable generation in the distribution grid (if not stored), and were poorly compensated by it with unattractive Feed-In tariffs.

Furthermore, due to the principle of tariff additivity, the electricity price paid by final consumers connected to low voltage networks is until now higher than that paid by final customers connected to the medium or high voltage networks up to today, given that the electricity used by the former has to access greater distribution network routes to reach its endpoint.

The Community S addressed these outdated regulatory frameworks by proposing the first P2P energy sharing business model to be trialled in Portugal in real-life settings and under real market conditions. The proposed business model envisioned the creation of 3 low voltage RECs, within which public buildings (i.e., prosumers) equitably shared their surplus renewable generation among participating citizens (i.e., consumers), instead of injecting it in the distribution grid as per business as usual.

Nonetheless, due to the existing regulatory barriers abovementioned, the P2P energy sharing interactions had to be demonstrated through financial simulations rather than through physical electricity trading per se. Also, participating citizens benefited from the advantages of P2P energy sharing by receiving monthly discounts in their energy bills that were equivalent to the costs savings they would have had through the purchase of surplus renewable generation in a desirable deregulated scenario. All in all, the proposed business model was only be validated from a market clearing perspective, since at the physical level (i.e., the low voltage network) the surplus renewable generation from prosumers cannot be stamped nor distinguished from other electricity sources and cannot be sent to targeted locations.

However, as detailed in Subsection 3.2.3, Portugal recently took the first steps towards the deregulation of P2P energy trading in 2020, namely by creating an enabling national regulatory framework for the facilitation of REC and collective self-consumption initiatives in the country. This enabling national regulatory is currently undergoing a public consultation for its ammendment, proposing, among other things, the partial exemption from the payment of NAT charges in these cases, as well as the total or partial exemption from the payment of the CIEG. All things considered, it is worth noting that the evolution of this enabling national regulatory in Portugal is aligned with the business model structure proposed in the *Community S* project – highlighting the positive legacy left by this demonstration project in the Portuguese energy landscape.

6.3. Unsolved issues and recommendations for future research

In terms of unsolved issues and recommendations for future research, this Ph.D. research recommends applying the proposed methodological approach in different P2P energy sharing initiatives (e.g., different P2P energy sharing business models; ownership, stewardship, or governance models; pilot sizes and scales; legal frameworks; geographic locations; a more diverse target group; etc.), or increasing the complexity of the methodological steps (e.g., add other relevant social value themes to the P2P-SVT reference list; include additional assessment tools that do not rely on self-reported data; etc.), provided that the result interpretations drawn in this Ph.D. research are put in perspective and validated through a cohesive validity check on a case-by-case basis. This can be done by following and adapting the validity check performed by and described throughout this Ph.D. research.

This Ph.D. research seems to have appeared in a timely manner in view of the number of research topics under the European Green Deal call with SSH relevance[29], which showcases the European Commission's current level of commitment with this thematic. Furthermore, the progressive methodological contribution offered by this Ph.D. research framed on the Portuguese reality can play a fundamental role in the further improvement of the existing national regulatory framework [45] that enables the development of peer-to-peer energy sharing inititatives in the country.

In conclusion, this Ph.D. research expects to open new pathways to better comprehend the nuances of the social values-based dimension of peer-to-peer energy sharing systems, as well as create a new social values-based language that is explicitly associated with P2P energy sharing.

[29] Area 1 (Increasing Climate Ambition: Cross sectoral challenges); Area 4 (Energy and resource efficient buildings); Area 9 (Strengthening our knowledge in support of the European Green Deal); and Area 10 (Empowering citizens for the transition towards a climate neutral, sustainable Europe) [88].

REFERENCES

This reference list is presented in alphabetic order in Appendix E for ease of reading.

1. Delina, L., Janetos, A. (2018). Cosmopolitan, dynamic, and contested energy futures: Navigating the pluralities and polarities in the energy systems of tomorrow. Energy Research & Social Science, vol. 35, pp. 1–10.
2. Long, C., Wu, J., Zhang, C., Cheng, M., Al-Wakeel, A. (2017). Feasibility of peer-to-peer energy trading in low voltage electrical distribution networks. Energy Procedia, vol. 105, pp. 2227–2232.
3. Navigant (2018). Energy Cloud 4.0: Capturing Business Value through Disruptive Energy Platforms. White paper, Navigant Consulting Inc.: Chicago, IL, USA.
4. Parag, Y., Sovacool, B. (2016). Electricity market design for the prosumer era. Nature Energy, vol. 1, no. 16032.
5. Roberts, J., Frieden, D., Gubina, A. (2019). Energy Community Definitions. Compile Project: Integrating Community Power in Energy Islands funded by the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 824424. Available at: https://www.compile-project.eu/
6. Caramizaru, A. and Uihlein, A. (2020). Energy communities: an overview of energy and social innovation, EUR 30083 EN, Publications Office of the European Union, Luxembourg, doi:10.2760/180576.
7. Koirala, B., Koliou, E., Friege, J., Hakvoort, R., Herder, P. (2016). Energetic communities for community energy: a review of key issues and trends shaping integrated community energy systems. Renewable and Sustainable Energy Reviews, vol. 56, pp. 722–744.
8. Ruotsalainen, J., Karjalainen, J., Child, M., Heinonen, S. (2017). Culture, values, lifestyles, and power in energy futures: a critical peer-to-peer vision for renewable energy. Energy Research & Social Science, vol. 34, pp. 231–239.
9. Hinton, J.B. (2020). Fit for Purpose? Clarifying the Role of Profit for Sustainability. Journal of Political Ecology, vol. 27(1), pp. 236–262.
10. Favini, J. (2020, Jan 23). What if Competition Isn't As "Natural" As We Think? [Blog post], Slate. Retrieved from https://slate.com/technology/2020/01/darwin-competition-collaboration-evolutionary-biology-climate-change.html
11. Lieberman, M., (2013). Social: Why Our Brains are Wired to Connect. Crown Publishing Group, New York.
12. Melamed, D., Simpson, B., Abernathy, J. (2020). The robustness of reciprocity: Experimental evidence that each form of reciprocity is robust to the presence of other forms of reciprocity. Science Advances, vol. 6(23), doi: 10.1126/sciadv.aba0504
13. Uren, S. (2020, March 12). COVID-19: a dress rehearsal for the climate emergency? [Blog post], Forum for the Future. Retrieved from https://www.forumforthefuture.org/blog/covid-19-climate-emergency

14. Jasanoff, S., and Kim, S.H. (2013). Sociotechnical imaginaries and national energy policies. Science as culture, vol. 22(2), pp. 189–196.
15. Giotitsas, C., Pazaitis, A., and Kostakis, V. (2015). A peer-to-peer approach to energy production. Technology in Society, vol. 42, pp. 28–38.
16. Jogunola, O., Ikpehai, A., Anoh, K., Adebisi, B., Hammoudeh, M., Son, S.-Y., and Harris, G. (2017). State-Of-The-Art and Prospects for Peer-To-Peer Transaction-Based Energy System. Energies, vol. 10, no. 2106.
17. Moret, F., and Pinson, P. (2019). Energy Collectives: A Community and Fairness based Approach to Future Electricity Markets. IEEE Transactions on Power Systems, vol. 34(5), pp. 3994–4004, doi: https://doi.org/10.1109/TPWRS.2018.2808961
18. Biggs, C. (2016). A resource-based view of opportunities to transform Australia's electricity sector. Journal of Cleaner Production, vol. 123, pp. 203–217.
19. Van der Schoor, T., and Scholtens, B. (2015). Power to the people: local community initiatives and the transition to sustainable energy. Renewable & Sustainable Energy Reviews, vol 43, pp. 666–675.
20. Kenter, J.,O'Brien, L., Hockley, N., Ravenscroft, N., Fazey, I., Irvine, K., Reed, M., Christie, M., Brady, E., Bryce, R., Church, A., Cooper, N., Davies, A., Evely, A., Everard, M., Fish, R., Fisher, J., Jobstvogt, N., Molloy, C., Orchard-Webb, J., Ranger, S., Ryan, M., Watson, V., Williams, S. (2015). What are shared and social values of ecosystems?. Ecological Economics, vol. 111, pp. 86–99.
21. Harder, M., Velasco, I., Burford, G., Podger, D., Janoušková, S., Piggot, G., Hoover, E. (2014). Reconceptualizing “effectiveness” in environmental projects: can we measure values-related achievements?. Journal of Environmental Management, vol. 139, pp. 120–134.
22. Horáková, N. (2005). Co je pro nás v životě důležité?. Naše společnost, vol. 3(2), pp. 8–12.
23. ESDinds (2010). The development of indicators and assessment tools for CSO projects promoting values-based education for sustainable development. Deliverable Number 17: Project Final Report to European Commission Seventh Framework Programme (FP7/2007-2013) (amended version, resubmitted 23 September 2011).
24. Gui E., Diesendorf M., MacGill I. (2017). Distributed energy infrastructure paradigm: Community microgrids in anew institutional economics context. Renewable and Sustainable Energy Reviews, vol. 72, pp. 1355–1365, doi: https://doi.org/10.1016/j.rser.2016.10.047
25. Parag, Y. (2015). Beyond energy efficiency: a ‘prosumer market’ as an integrated platform for consumer engagement with the energy system. In: ECEEE 2015 summer study proceedings e foundations of future energy policy, Belambra Presqu'île de Giens, France, pp.15–23.
26. Klein, L., Allegretti, G., Hes, D., Matos, L. (2018). A social values-based perspective on peer-to-peer energy sharing systems. In: Proceedings of the 5th European conference on behaviour and energy efficiency (BEHAVE 2018), Zurich, Switzerland, September 6–7, 2018.

27. Valkering, P., Laes, E., Kessels, K., Uyterlinde, M., Straver, K. (2014). How to engage end-users in smart energy behaviour? EPJ Web of Conferences, 79 (2014) 04003, doi: https://doi.org/10.1051/epjconf/20137904003
28. Hes, D., Du Plessis, C. (2015). Designing for hope: pathways to regenerative sustainability. London: Earthscan by Routledge; 2015.
29. Roy, A.; Bruce, A.; MacGill, I. The Potential Value of Peer-to-Peer Energy Trading in the Australian National Electricity Market. In Proceedings of the Asia-Pacific Solar Research Conference, Canberra, Australia, 29 November–1 December 2016.
30. Zhang, C.; Cheng, M.; Zhou, Y.; Long, C. A Bidding System for Peer-to-Peer Energy Trading in a Grid-connected Microgrid. Energy Procedia 2016, 103, pp. 147–152.
31. Zhang, C.; Wu, J.; Zhou, Y.; Cheng, M.; Long, C. Peer-to-Peer energy trading in a Microgrid. Appl. Energy 2018, 220, 1–12.
32. AGL Energy Limited (2017). Peer-to-Peer Distributed Ledger Technology Assessment – Virtual Peer-to-Peer Energy Trading Using Distributed Ledger Technology: Comprehensive Project Assessment Report; AGL Energy Limited: Sydney, Australia, 2017. Available online: https://arena.gov.au/assets/2017/10/Final-Report-MHC-AGL-IBM-P2P-DLT.pdf
33. Liu, N., Yu, X., Wang, C., Li, C., Ma, L., Lei, J. (2017). An energy-sharing model with price-based demand response for microgrids of peer-to-peer prosumers. IEEE Transactions on Power Systems, vol. 32, pp. 3569–3583.
34. Long, C., Wu, J., Zhou, Y., Jenkins, N. (2018). Peer-to-peer energy sharing through a two-stage aggregated battery control in a community Microgrid. Applied Energy, vol. 226, pp. 261–276.
35. Zhou, Y., Wu, J., Long, C., Cheng, M., Zhang, C. (2017). Performance Evaluation of Peer-to-Peer Energy Sharing Models. Energy Procedia, vol. 143, pp. 817–822.
36. Zhou, Y., Wu, J., Long, C. (2018). Evaluation of peer-to-peer energy sharing mechanisms based on a multiagent simulation framework. Applied Energy, vol. 222, pp. 993–1022.
37. Zhang, C., Wu, J., Long, C., Cheng, M. (2016). Review of existing peer-to-peer energy trading projects. Energy Procedia, vol. 103, pp. 147–152.
38. Park, C., Yong, T. (2017). Comparative review and discussion on P2P electricity trading. Energy Procedia, vol. 128, pp. 3–9.
39. Klein, L., Krivoglazova, A., Matos, L., Landeck, J., de Azevedo, M. (2020). A Novel Peer-to-Peer Energy Sharing Business Model for the Portuguese Energy Market. (MDPI, Ed.) Energies, vol. 13(1), 125, doi: https://doi.org/10.3390/en13010125
40. Klein, L., Matos, L., Allegretti, G. (2020). A Pragmatic Approach Towards End-User Engagement in the Context of Peer-to-Peer Energy Sharing. Energy 2020, vol. 205, pp. 118001, doi: https://doi.org/10.1016/j.energy.2020.118001
41. Klein, L., Allegretti, G., Hes, D., Melkas, H. (2021). Revealing social values in the context of peer-to-peer energy sharing: A methodological approach. Sustainable Futures, vol. 3, pp. 100043, doi: 10.1016/j.sftr.2021.100043

42. Wolf, C., Jónsdóttir, G.A., Reeskens, T., Ernst Stähli, M. (2017). European Values Study 2017: Integrated Dataset (EVS 2017) - Matrix Design Data. GESIS Data Archive, Cologne. ZA7502 Data file Version 1.0.0, doi: https://doi.org/10.4232/1.13092.
43. Pordata: Base De Dados Portugal Contemporâneo (2017). Lisboa: Fundação Francisco Manuel dos Santos, n.d. Available at: https://www.pordata.pt/Municipios.
44. INE: Statistics Portugal (2012). Censos 2011 (Dados Definitivos), Quadros de Apuramento por Freguesia. Available at: https://censos.ine.pt/xportal/xmain?xpid=CENSOS&xpgid=censos2011_apresentacao.
45. Official Gazette of the Republic of Portugal (2019). Decree-law No. 162/2019. Official gazette of the republic of Portugal No. 206/2019, series I from October 25, 2019. Environment and Energy Transition - XXI Government – Portuguese Republic, pp. 45–62. Available at: https://data.dre.pt/eli/dec-lei/162/2019/10/25/p/dre
46. Official Gazette of the Republic of Portugal (2014). Decree-Law No. 153/2014. Official Gazette of the Republic of Portugal No. 202/2014, Series I from October 10, 2014. Portuguese Ministry of Environment, Land-Use Planning and Energy, pp. 5298–5311. Available at: https://data.dre.pt/eli/dec-lei/153/2014/10/20/p/dre/pt/html
47. Energy Services Regulatory Authority (2017). How Electricity Tariffs Are Calculated. Available at: http://www.erse.pt/consumidor/electricidade/querosabermais/comosaocalculadasastarifasdeelectricidade/Paginas/default.aspx
48. Repo, S., Kilkki, O., Annala, S., Klein, L., Matos, L., Sousa, J.E., Albuquerque, S. (2021). DOMINOES – a roadmap to integrated local energy market operation and management. In Proceedings of the 26th International Conference & Exhibition on Electricity Distribution (CIRED 2021), Geneva, Switzerland, Sep. 20-23, 2021.
49. Hannoset, A., Leen. P., Tuerk, A. (2019). Energy Communities in the EU - Task Force Energy Communities. Deliverable D3.12.d Developed Under the Scope of the INTENSYS4EU Project. Available at: https://www.h2020-bridge.eu/wp-content/uploads/2020/01/D3.12.d_BRIDGE_Energy-Communities-in-the-EU-2.pdf
50. Energy Services Regulatory Authority (2021). Public Consultation no. 93 – Proposal to reform the regulation on self-consumption of electricity. Available at: https://www.erse.pt/atividade/consultas-publicas/consulta-p%C3%BAblica-n-%C2%BA-93/
51. Official Gazette of the Republic of Portugal (2020). Dispatch No. 6453/2020. Official Gazette of the Republic of Portugal No. 118/2020, Series II from June 19, 2020. Office of the Assistant Secretary of State for Energy, Environment, and Climate Action, pp. 136–137. Available at: https://dre.pt/web/guest/pesquisa/-/search/136167767/details/normal?q=despacho+n.%C2%BA%206453%2F2020
52. McDaniel, M.A., Frey, R.F., Fitzpatrick, S.M., Roediger III, H.L. (Eds.) (2014). Integrating Cognitive Science with Innovative Teaching in STEM Disciplines, Washington University in St. Louis, Missouri, US, doi: http://dx.doi.org/10.7936/K75Q4T1X.

53. Podger, D., Velasco, I., Luna, C., Burford, G., Harder, M. (2012). Can values be measured? Significant contributions from a small civil society organization through action research. Action Research, vol. 11, pp. 8–30.
54. Burford, G., Hoover, E., Velasco, I., Janoušková, S., Jimenez, A., Piggot, G., Podger, D., Harder, M. (2013). Bringing the "missing pillar" into sustainable development goals: Towards intersubjective values-based indicators. Sustainability, vol. 5(7), pp. 3035–3059.
55. Burford, G., Hoover, E., Stapleton, L., Harder, M. (2016). An Unexpected Means of Embedding Ethics in Organizations: Preliminary Findings from Values-Based Evaluations. Sustainability, vol. 8(7), pp. 1–22.
56. Keeney, R. (1996). Value-focused thinking: a path to creative decisionmaking. Harvard University Press, United States, 1996, ISBN 9780674931985. Available at: https://www.hup.harvard.edu/catalog.php?isbn=9780674931985
57. ESDinds (2015). WeValue: understanding and evaluating intangible impacts of projects or organisations, University of Brighton, Brighton, UK.
58. Naylor, P. J., Wharf-Higgins, J., Blair, L., Green, L., & O'Connor, B. (2002). Evaluating the participatory process in a community-based heart health project. Social Science & Medicine, vol. 55(7), pp. 1173–1187, doi: http://dx.doi.org/10.1016/S0277-9536(01)00247-7
59. De Meyer, A. (1984). A technological lifecycle approach to the organisational factors determining gatekeeper activities. R&D Management, vol. 14(4), pp. 239–246, doi: https://doi.org/10.1111/j.1467-9310.1984.tb00520.x
60. DeFleur, M., DeFleur, M. (2009). Mass Communication Theories: Explaining Origins, Processes, and Effects. Allyn & Bacon.
61. Jeng, M. (2006). A selected history of expectation bias in physics. American Journal of Physics, vol. 74 (7), pp. 578–583, doi: 10.1119/1.2186333.
62. Santos, B.S. (2018). The End of the Cognitive Empire: The Coming of Age of Epistemologies of the South. Duke University Press, ISBN 9781478000150.
63. Cialdini, R.B. (2001). The science of persuasion. Scientific American, vol. 284, pp. 76–81.
64. McCambridge, J., Witton, J., Elbourne, D.R. (2014). Systematic review of the Hawthorne effect: new concepts are needed to study research participation effects. J Clin Epidemiol, vol. 67 (3), pp. 267–77.
65. Marinho, S. (2006). O papel do Gatekeeper na comunicação informal das organizações: um estudo de caso em I&D. Revista Latinoamericana de Ciencias de la Comunicación, Organicom, pp. 1807–3026.
66. Kruger, J., Dunning, D. (1999). Unskilled and Unaware of It: How Difficulties in Recognizing One's Own Incompetence Lead to Inflated Self-Assessments. Journal of Personality and Social Psychology, vol. 77(6), pp. 1121–1134, doi: 10.1037/0022-3514.77.6.1121.
67. Corcoran, P.B. (Ed.) (2005). The Earth Charter in Action: Toward a Sustainable World. Royal Tropical Institute (KIT), Amsterdam, The Netherlands, ISBN: 90-6832-177-3.

68. Leisinger, K. (2014). Global Values for Global Development. Sustainable Development Solutions Network (SDSN), Foundation Global Values Alliance, Switzerland.
69. Ribeiro, M.M., Hoover, E., Burford, G., Buchebner, J., Lindenthal T. (2016). Values: a bridge between sustainability and institutional assessment: a case study from BOKU University. International Journal of Sustainability in Higher Education, Emerald Group Publishing Limited, vol. 17(1), pp. 40–53, doi: https://doi.org/10.1108/IJSHE-12-2014-0170.
70. SurveyGizmo (2018). Plans & Pricing. Available at: https://www.surveygizmo.com/plans-pricing/
71. Clason, D.L., Dormody, T.J. (1994). Analyzing data measured by individual Likert-type items. Journal of Agricultural Education, vol. 35(4), pp. 31–35.
72. Bishop, P., Herron, R. (2015). Use and Misuse of the Likert Item Responses and Other Ordinal Measures. International Journal of Exercise Science vol. 8(3), pp. 297–302.
73. Jamieson, S. (2004), Likert scales: how to (ab)use them. Journal of Medical Education, vol. 38(12), pp. 1217–1218.
74. Boone, H. and Boone, D. (2012). Analyzing Likert Data. The Journal of Extension, vol. 50(2), pp. 1–5. Available at: https://joe.org/joe/2012april/tt2.php
75. Robbins, N.M., Heiberger R.M. (2011). Plotting Likert and other rating scales. JSM Proceedings. Survey Research Methods Section. Alexandria, VA: American Statistical Association, pp. 1058–1066.
76. Messick, S. (1995). Validity of psychological assessment: validation of inferences from persons' responses and performances as scientific inquiry into score meaning. Am. Psychol., vol. 50, pp. 741–749.
77. Keller. P.A., Harlam, B., Loewenstein, G., Volpp, K.G. (2011). Enhanced active choice: A new method to motivate behavior change. Journal of Consumer Psychology, vol. 21, pp. 376–383.
78. Allan, J. (Ed.) (2002). Introduction to Topic Detection and Tracking, Springer US, Boston, MA, pp. 1–16.
79. Chautard, T., Collin-Lachaud, I. (2019). Introducing the storytelling analysis methodology in marketing: Principles, contributions and implementation. Recherche et Applications En Marketing (English Edition), vol. 34(3), pp. 27–46, doi: https://doi.org/10.1177/2051570719841225
80. Rotmann, S., Mourik, R., & Goodchild, B. (2015). Once Upon a Time...How to tell a good energy efficiency story that 'sticks'. Stockholm: In: ECEEE 2015 Summer Study, Proceedings: First Fuel Now, June 1-6, pp. 113–122.
81. Bamberg, M. (2012). Narrative analysis. Washington, DC: In: H. Cooper (Editor-in-chief), APA handbook of research methods in psychology (3 volumes), APA Press.
82. Janda, K. B., Topouzi, M. (2015). Telling tales: using stories to remake energy policy. Building Research & Information, vol 43(4), pp. 516-533, doi: 10.1080/09613218.2015.1020217.

83. Gross, R. (2017). Psychology in Historical Context: Theories and Debates. London: Routledge. doi: https://doi.org/10.4324/9781315544304
84. Bell, S., Morse, S. (2008). Sustainability Indicators: Measuring the Immeasurable?. Earthscan, 2008, ISBN: 1844072991, 9781844072996.
85. Keller, P.A., Harlam, B., Loewenstein, G., Volpp, K.G. (2011). Enhanced active choice: A new method to motivate behavior change. Journal of Consumer Psychology, vol. 21, pp. 376–383.
86. Dierkes, M., Antal, A.B., Child, J., Ikujiro, N. (2003). Handbook of Organizational Learning and Knowledge. Oxford University Press, p. 22, ISBN 978-0-19-829582-2.
87. Plous, S. (1993). The psychology of judgment and decision making. McGraw-Hill. ISBN 978-0-07-050477-6.
88. European Comission (2019). The European Green Deal. Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, Document 52019DC0640, Brussels. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1588580774040&uri=CELEX:52019DC0640

APPENDIX

Appendix A: illustration of a monthly performance report

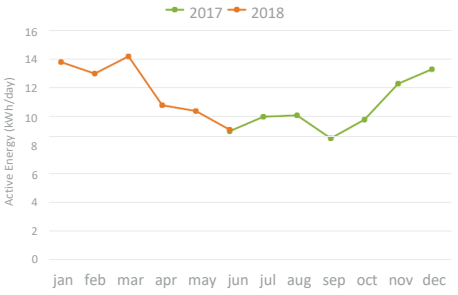
COMMUNITY • S
Sharing · Solar · Storage · Sustainable · Smart

Monthly Performance Report
JUNE 2018

Name:	Energy supplier:
Address:	Contracted energy tariff:
Cloogy's serial nº:	Contracted power:

Evolution of your monthly consumption in 2018

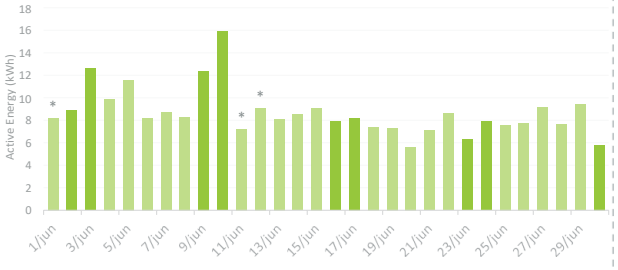
Monthly consumption: **260.6 kWh***
Daily consumption: **9 kWh**



Electricity consumption in the first quarter of the year (i.e., Jan, Feb, and Mar) is typically higher due to the impact of winter.

Your consumption profile in June 2018

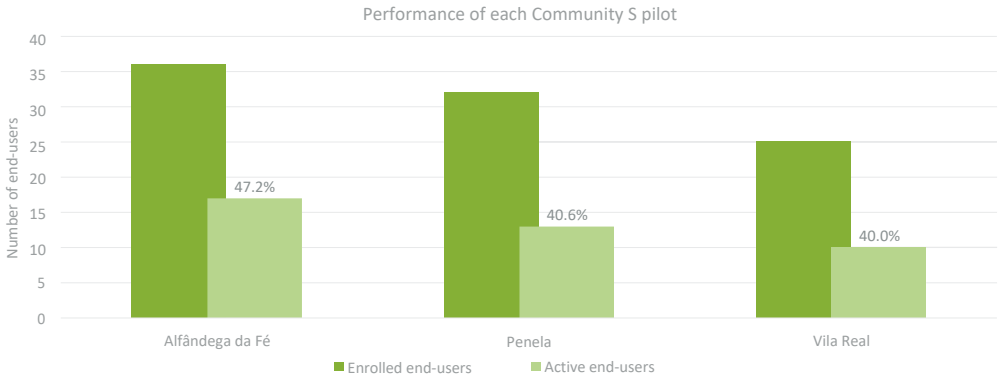
Peak consumption: **June 10 (Sunday)**
Lowest consumption: **June 20 (Wednesday)**



In the days marked with an asterisk (*), > 10% of data collection is missing.

Performance comparison between the 3 pilots

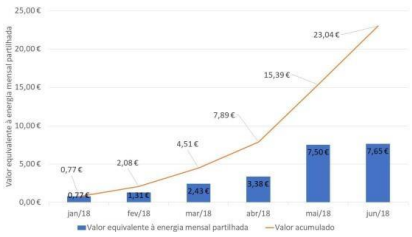
This performance comparison takes into account the ratio between the number of end-users enrolled in the each pilot and the number of end-users who have the smart energy management equipment operating continuously throughout the month June 2018.



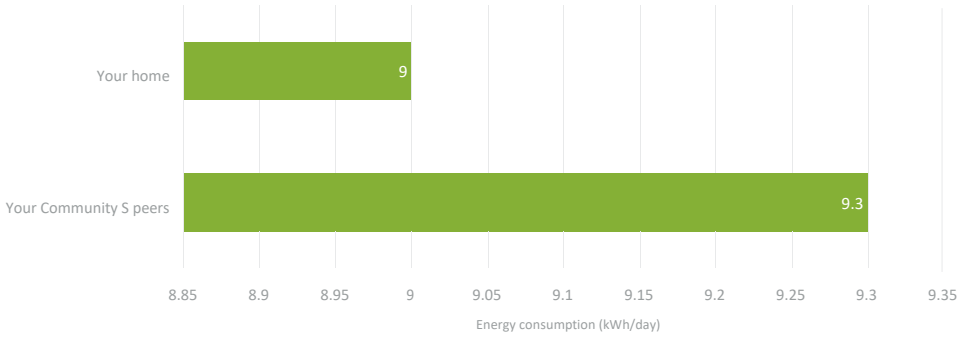
In June 2018, the best performing Community S pilot was Alfândega da Fé, since approximately 47% of its end-users kept the smart energy management equipment functional most of the time.

P2P energy sharing in your Community S pilot

You can only benefit from these rebates in your energy bill (which are equivalent to the surplus energy generation from PV cells in your municipality's public buildings) in case you adhere to the exclusive *Community S* energy contract tailored for the context of this demonstration project.



Your average daily consumption VS the average daily consumption of your peers



P2P energy sharing with you

The total renewable energy that was shared with you in June 2018 was **169,9 kWh.**

This is equivalent to...

...the avoided CO2 emission of 59.5 kg.

...the CO2 absorbed by 1.5 trees over a 10-year period.

...the CO2 emitted by a car while traveling 297.3 km.

Appendix B: gatekeeper's pre- and post-survey responses

Table 5. Gatekeeper's pre- and post-survey responses.

Pre-survey	**Post-survey**
The pre-survey was answered before the start of the valuation process by Evaluator A on July 25, 2018.	*The post-survey was answered after the end of the valuation process by Evaluator A on November 10, 2019 without any recent pre-survey consultation to avoid the effect of memory bias (i.e., to reduce the chances of recalling any reported memory)*
Questions to Evaluator A as head project manager of a demonstration project with specific goals	
1) As a project manager, do you feel any "conflict of interest" between your needs to fulfil project goals versus research goals? If yes, describe with example(s). Yes. In my view, my research objectives have altered the way I see the project as a manager. In this sense, as a manager, I'll try my best to direct the project progress towards reaching results that will feed into my research, which doesn't necessarily represent the easiest way to carry out my work if I was only a project manager.	*1) As a project manager, have you felts any "conflict of interest" between your needs to fulfil project goals versus research goals? If yes, describe with example(s).* Yes. I had to restructure the public awareness sessions I conducted in each pilot as to also encompass my research-related activities (e.g., research explanation, questionnaire implementation, etc.). Apart from that, everything else landed well since my work as a project manager reinforced my work as a researcher and vice-versa (e.g., the end-user engagement strategies I implemented as project manager facilitated my work as a researcher).
2) Honestly, which of your two roles you feel is more important to you? I have always felt the researcher's hat more important than the manager's hat. That is because the Ph.D. research was the main reason why I came to Portugal and the manager role was only the pathway I found to transform my research goals into reality.	*2) Honestly, which of your two roles has been more important to you during the project development? Did the order of importance reverse at some point?* The researcher "hat" was the most important to me, since my doctoral research was the main reason why I came to Portugal in the first place. Hence, I saw my project manager "hat" as a fundamental role to play in order to enable the development of my research. However, in some crucial moments of the project development (e.g., implementation of the end-user engagement strategies, project kick-off, project closure, etc.), I momentarily felt the project manager "hat" prevailed.

3) Do you see any constraint that forces you to rush the project development? If yes, do you think it can affect your research? At the moment, my biggest time constraints are related to wrapping up my research methodology and designing the final questionnaire before the last formal workshop of the project, which is when I intend to contact the participants regarding my research. I feel that I shouldn't miss this opportunity as it will be during this specific event that the participants will recall about their participation in the project and thus will be more prone to contribute to the development of my research. In this sense, I do think that I cannot miss this timing and that it has the power to affect my research projects. Also, I am somehow constrained by the bureaucracy of the University of Coimbra, who is financing the payment of my research tools. The slow pace in which the institution releases the payment can also have an impact on the success of my Ph.D. research.	*3) Which constraints forced you to prolong the time of the project development, or dedicate less time to it? Was there any moment of rush or inertia? Did project timings and deadlines affect your research somehow? Give examples.* I had several moments of either inertia or rush throughout the development of the *Community S* project. The most illustrative example might be when the consortium had to include a third pilot in the project due to the lack of engagement in one of the two original pilots envisioned in the project. This was justified by the overwhelming fires that raged across Portugal, together with local elections, which hindered the progress of the project during a specific time frame. This situation created inertia that did not allow me to move the project forward as project manager. On the other hand, once a third pilot was formally recognised in the project, the consortium rushed to put this pilot at the same level of development as the other two pilots. My research was directly impacted by the situation abovementioned, and I had to be resilient and flexible enough to "dance according to the music".
4) Do you think you will have time to rescue the missing parts of your research after finishing your "managerial" tasks or will it be too late? I think so. That is because the managerial tasks will be finished by September 2018 and my Ph.D. goes until October 2019. This means I have one full year to focus on the analysis of data and writing of my thesis before the due date of my Ph.D. programme. However, the greatest personal challenge in 2019 will be to cope work life and research life, as I will keep working in order to finance my studies.	*4) Did you have time to dedicate yourself to your research during the "managerial" tasks, or did this only happen after the end of these tasks? Do you think the "managerial" tasks ended too late? With regards to the "social" dimension of the project (which required more commitment of you), was it affected by your dual role? Or, on the contrary, did it benefit from this dual role?* Managing both roles concomitantly during the development of the *Community S* project was very challenging and excruciating, but I believe I managed it the best way I could. Even though the project end was postponed in 6 months, I see it from a very positive perspective since my research matured better during this time. As an example, due to the project delay, I managed to publish two scientific papers (one related to the project's novel business model and the other related to the end-user engagement framework created for the project) that further informed the development of my research.

5) As a project manager, do you feel entitled to allow some distortions of reality (e.g., omitting data, overestimating anecdotal findings, choosing your interlocutors based on convenience) to "fold" results so that you can feel that you have reached your original goals? Yes. As a project manager I do have some flexibility to mask the raw reality of the project development, but I honestly do not intend to do so as I am very much driven by my researcher mindset – which forces me to look at data as it is rather than as I wanted it to be.	*5) As a project manager, have you ever been tempted to allow some distortions of reality (e.g., omitting data, overestimating anecdotal findings, choosing your interlocutors based on convenience) to "fold" results so that you can feel that met your original goals? Have you done that? Did your "researcher self" intervene sometimes, suggesting you to let things go in their own direction without any interference?* Even though I had enough "room" to do so, I never did it as to ensure methodological rigour, replicability, and comparability of results. This is evident in the validity check I performed throughout the project development.
6) As a project manager, list in descending order the 5 most important social values emerging from the project that you think can positively affect its reproduction in the short-term: Awareness, responsibility, participation, accomplishment, motivation.	*6) As a project manager, list in descending order the 5 most important social values emerging from the project that you think can positively affect its reproduction in the short-term:* 1 – awareness; 2 – purpose; 3 - originality; 4 – motivation; 5 – support.
7) As a project manager, list in descending order the 5 most important values that you think can impact the mainstreaming and scaling up of the project in the long-term: Empowerment, (capacity building & critical thinking), sense of belonging, sense of community, environmentalism.	*7) As a project manager, list in descending order the 5 most important values that you think can impact the mainstreaming and scaling up of the project in the long-term:* 1 – sense of community; 2 – altruism; 3 - emancipation; 4 – effect change; 5 – environmentalism.
8) As a gatekeeper (i.e., someone with the power to make important decisions and impose them on others), which decision-making processes you think this role can impact? In my view, the field in which I have the most direct impact on others and consequently on the project results is end-user engagement, since I have complete freedom to choose the engagement methods and tools to be used in the project as well as when to implement them.	*8) As a gatekeeper (i.e., someone with the power to make important decisions and impose them on others), which decision-making processes you think this role impacted?* As a gatekeeper, I was the main actor bridging the information between the two ends of the spectrum of stakeholders in the *Community S* project (i.e., end-users in one side and policymakers and academia in the other). Hence, I believe I most impacted end-users by helping them to absorb the highly complex concepts of peer-to-peer energy sharing and social values in a way that could be translated and reinterpreted by them in their own ways. Additionally, I believe I impacted policymakers and academia by interpreting and disseminating my research findings in a way that could both directly impact

	policymaking in Portugal and enrich the scientific knowledge on the qualitative realm of peer-to-peer energy sharing.
9) Do you believe that participants will grow with this project? Explain your answer. Yes, with exceptions. I think the only ones that can really take something positive out of this project are those participants that I call "early adopters". By early adopters, I refer to those participants that are prone to test out new technology, that are inclined to embrace innovation and are willing to actively participate in the project to reach its collective goals. These people can afford to act not entirely in a return driven manner, driven by non-monetary reasons such as the wish to increase independence from the utilities or to actively support Portugal's energy transition. These are the ones I see that can learn and grow exponentially through their participation in the project.	*9) Do you believe that participants grew with this project? Explain your answer. Did you have any surprise (related to the participation of collaborators and participants) or unexpected discovery during these months?* Definitely yes. Many participants went from completely unaware citizens to highly informed advocates of energy communities and their benefits. I often encountered participants that went beyond what was asked from them, such as the case of one men that changed his old fridge after monitoring its energy usage in real-time with the smart home energy monitoring equipment he got from the project. Although I also had negative surprises during the project development (e.g., end-users that had to withdraw from the project due to sickness in the family), in an overall I believe I had much more positive takeaways from it.
10) As a project manager, do you think that the final pilot sites selected for the case study will produce different results than originally thought? Yes. The two municipalities originally selected as pilots in this project (i.e., Penela and Alfândega da Fé) had different sociodemographic and political backgrounds than the third municipality that was included as a pilot in the project a posteriori (i.e., Lordelo - Vila Real). Because of the specificities of the third pilot, it is inevitable to say that the final results of the project will be different than the original setting of the project.	*10) As a project manager, do you think that the final pilot sites selected for the case study produced different results than originally thought?* Yes, especially in relation to hierarchical pressure / stimulus. That is because the municipal authority in one of the pilots was determined to get people to participate in the project, which could be seen from a negative perspective (as hierarchical pressure) or positive perspective (as hierarchical stimulus). This rationale was scrutinised in a paper soon to be sent for publishing.
11) As a project manager, do you care about the multiple "perceptions" of different project participants (e.g., consortium colleagues and citizens)? Do you think your attention to their feelings, fears, insecurities, enthusiasms, and other perceptions will be continuous or intermittent (e.g., you might eventually have different priorities and won't be able to care for it)?	*11) As a project manager, did you care about the multiple "perceptions" of different project participants (e.g., consortium colleagues and citizens)? Do you think your attention to their feelings, fears, insecurities, enthusiasms, and other perceptions has been continuous or intermittent (e.g., you might have had different priorities and forgot about taking care of it at some point)?*

The way I dealt with the different stakeholders' perceptions about the project is relative. From the perspective of colleagues within the organisational side of the project, I felt that each partner had distinct responsibilities related to the project development so their inputs regarding their specific roles in the project didn't necessarily had to pass through my personal acceptance in order to be validated - they just had to be aligned with the principles of the project from a macro level view. From the perspective of the participants, however, I felt that as a project manager I gave a lot of attention to the way that they perceived the project. This can be seen in the way that the consortium modified the pathway of the project development to embrace many of the participants' inputs and overviews about it along the way. I see that my manager perspective in this sense was heavily influenced by my research perspective, being the latter the dominant one. Even though I wished to take into consideration the participants' inputs in a homogeneous and continuous way throughout the development of the project, this was simply not feasible as I was constrained by time or resources to be able to do so. Therefore, my priorities within the project set the pace in which I can interact with participants during the development of the project.	During the development of the *Community S* project, I was the main responsible for the development of an end-user engagement framework to engage participants in a meaningful and efficient way. Hence, end-users were distinguished in 3 main segments (and 6 subsegments) according to their level of involvement with the project, allowing the project consortium to interact differently with each end-user group through the promotion of customised end-user engagement schemes for each of them. Since the assessment of end-users represented a rather dynamic process (meaning that their behaviour pattern had to be constantly checked for changes), my attention was perennial throughout the project development.
12) As a project manager, how bold you think you are in terms of going beyond the existing legislation, and favouring its creative interpretation to produce new frontiers of meaning? I am fully committed to it. The *Community S* project, of which I am the project manager, aims to implement the first peer-to-peer energy sharing trial in Portugal. The project's business model was design in a very particular way to suit the specificities of the Portuguese energy market context.	*12) As a project manager, how bold do you think you have been in terms of going beyond the existing legislation, and favouring its creative interpretation to produce new frontiers of meaning? Did you have the opportunity to do it and ignored?* Modesty aside, I believe I have been extremely bold with regards to that. Since October 25, 2019, the Portuguese government opened for public consultation a new legal framework that will enable for the very first time the development of peer-to-peer energy sharing activities in Portugal from 2020 onwards. The *Community S* project predates this governmental milestone by 4 years, since it demonstrated the concept of peer-to-peer

At present, there is no legislation to support the development of such innovative initiatives and thus the project expects to push legislation forward by validating in real life settings the multiple benefits of the peer-to-peer energy sharing concept. In this sense, I consider myself bold enough to enlarge this frontier of knowledge within the energy sector.	energy sharing in real-life settings and real market conditions in Portugal between 2016-2018. Given all the overarching efforts the project consortium made to disseminate the project findings and results across different medias, I am positive that this demonstration project helped to push forward the makeover of outdated energy policies in the country.
13) As a project manager, how free are you to make your own choices? Do you think your bosses agree with your line of thought or disagree? In my view, my superiors gave me full support to fulfil my research endeavours. As project manager of this specific project, they put their trust in me to direct the development of the project in the way I think its best. This singular work condition (based on trust and transparency) gave me enough flexibility to make decisions related to the development of project that would invariably have spill over effects on my research. As illustration, in order to boost the participation and engagement rates in the final stage of the development of the project, they allowed me to raffle some equipment to the participants. Also, they have allowed me to use part of the final official workshop of the project (which is originally designed to present results of the project to the public) to promote my research and distribute my research questionnaires, thus demonstrating their full support on my research.	*13) As a project manager, how free were you to make your own choices? Do you think your bosses agreed with your line of thought or disagreed? Have you felt alone or misunderstood at some point?* Quite the opposite. My boss and every work colleague involved in the development of the *Community S* project was incredibly supportive throughout the project development. As the main project manager, I was free to execute the project the way I felt more strongly about whilst still remaining within the goals and objectives set in the project's Grant Agreement.
14) As a project manager, do you feel your "researcher self" as a burden? Yes. Sometimes, it would be easier if I were just a project manager. That is because my research needs represent an additional effort to my normal workload, thus raising the complexity and level of demand of my work.	*14) As a project manager, have you ever felt that your "researcher self" was a burden or were there times when you felt that being a researcher enriched you?* I didn't specifically feel my "researcher self" as a burden, but I did feel overwhelmed by the fact that I had multiple roles to perform at the same time. However, after everything passed, I felt incredible richer by the fact that I had multiple roles to perform, since it created a feedback loop that reinforced the specific facets of each.
15) As a project manager, do you feel committed to transparency and understandability of all stages of the project development?	*15) As a project manager, did you really feel committed to transparency and understandability of all stages of the project development?*

I try to be as transparent as possible in my work endeavours, as well as understand all stages of the project development. Naturally, the development of the project is affected by multiple factors of different nature, thus those stages of the project development that cannot be fully envisioned a priori need to be managed through the "learning by doing" method. In such cases, the decision-making processes tend to be less open or clear, but as a project manager I always try to address this lack of openness or clarity a posteriori with stakeholders once the consortium successfully overcome these stages.	Yes, since because I had to analyse, interpret and publish different facets of the project results, following strict guidelines required either by the funding entities or scientific journals, which made me very committed to transparency and to understanding all stages of the project development.
16) As a project manager, how much do you trust the politicians who committed to this project? In what aspects do your trust and possible mistrust apply? I personally have a few trust issues with the politicians involved in this project that were just reinforced with time. Specifically, I felt that their involvement with the project had only an extrinsic motivation - i.e., their behaviour in the project was driven by external rewards only, such as political promotion or praise. This could be felt in Penela during mid-2017, which was when municipal elections were in effect and thus their engagement in the development of the project dropped heavily. This was one of the drivers that forced us to bring into the project a third pilot to increase the number of total engaged participants. On the other hand, however, I think that the same extrinsic motivation can have a positive impact in the project. If we take the case of Alfândega da Fé as illustration, I feel that the politicians there had a proactive and somehow "aggressive" attitude towards participants to keep them involved in the project - just to ensure good final results that could be used as political promotion or praise in the future. If we look at the data derived from the project, it can be inferred that the participation rates in Alfândega da Fé were slightly higher than in the other two pilots, allowing us to	*16) As a project manager, how do you assess the level of trust you had in the politicians who committed to this project? In what aspects did your trust and possible mistrust apply?* From all stakeholders involved in the project, I would trust them the least. That is because the development of the project (especially in the beginning) was very much tied to their political agendas and interests. Hence, the project consortium struggled to get things done due to this mismatch. As previously explained, this was one of the main reasons for the need to add a third pilot to the project, since there was very little engagement from the public authorities in one of the original pilots to get citizens to participate in the project.

conclude that this extrinsic behaviour can also lead to positive influences in the project.	
17) If you are to imagine "surprises" to be discovered until the end of the project, in which areas of human behaviour you believe they are more likely to happen? I would guess that the main surprise will be associated with social values associated with sense of belonging or community identity.	*17) Can you tell me some positive "surprises" discovered during the project development? Can you list some emerging problems that you did not foresee in your "Plan B"?* I believe that the surprises were already explained in question 13. As for emerging problems, due to the innovative nature of the *Community S* project, much of the project development happened on a "learn as you go" basis. Hence, multiple problems that were not foreseen appeared – most especially during the process of end-user segmentation. Illustratively, the participation of some "early adopters" in the project was affected by different "correctable" issues with their smart energy management equipment. Identifying these issues was a cumbersome task for the project consortium, since the root of their causes greatly varied between each other (i.e., some were purely technical, whereas others were due to end-user unawareness). Examples include: (i) low battery of the components of the smart energy management equipment; (ii) loss of WIFI signal due to the unplugging of the internet router from the power source at night; (iii) unplugging of the smart energy management equipment due to the false perception that it reduced internet traffic; among others.
18) Do you believe that this project offers space for real peer-to-peer interactions or do you see power imbalances between the participants and the project consortium? Given that this is the first ever peer-to-peer energy sharing initiative to be implemented in Portugal (without no legal framework or previous real case studies to support it), the concept of peer-to-peer cannot be implemented in practice in its full potential.	*18) Do you believe that this project offered space for real peer-to-peer interactions or were there power imbalances between the participants and the project consortium?* The *Community S* project was a pioneering project that demonstrated for the first time the concept of peer-to-peer energy sharing in Portugal under real-life settings and real market conditions; because of that, it suffered a lot of different drawbacks that hindered the full roll-out of the project. Namely, by the time the project was developed, there was no legislation in force that allowed true peer-to-peer energy trading in the country, nor the physical network connections that allowed electrons to be traded between peers per

Within the scope of this demonstration project, a progressive peer-to-peer energy sharing business model was trialled in the three pilots under real market conditions. In each pilot, the excess electricity generation from photovoltaic panels in public buildings was distributed equitably with participating households in the form of rebates in their monthly electricity bills. In terms of the limitation of this business models, households were taken only as consumers for the sake of simplification of the project, as well as for funding limitations that did not allow us to finance photovoltaic cells to every participant in the project. Because of that, a power imbalance was indirectly created between those who give away surplus electricity generation (i.e., the public buildings) and those that receive it (i.e., households). Also, I consider that the peer-to-peer effect won't be felt in its full extent by the participants because they won't receive the surplus electricity per se, but only rebates on their electricity bill that are equivalent to the surplus that COULD HAD been shared IF there was a legal framework to support such transactions within the Portuguese energy grid. With that said, I think that the highly innovative purpose of this project is a constraint in itself to reach its full potential.	se. The project overcame these barriers by financially simulating the economic benefits of these peer interactions and by passing these incentives onto end-users as a means to validate the concept. Nonetheless, participating end-users were immersed in an overarching end-user engagement plan powered by gamification strategies (competitions, reward schemes, etc.) that deeply involved them in the project.
19) Are you really interested in issues of gender, age, disability, cultural imbalances, or are they just a burden imposed on your work? I wasn't until you (i.e., Giovanni Allegretti) shed light onto these issues and onto the important to evaluate them within peer-to-peer energy sharing systems. Before we had that conversation, these issues were simply invisible to me since I had never considered them as a transversal element in my work, thus I tended to overlook them.	*19) If you judge your behaviour* a posteriori, *do you think you were really interested in issues of gender, age, disability, cultural imbalances, or were they treated more like a burden imposed on your work? Did the reflections induced by the pre-survey affect your view of these issues?* I was indeed first induced to reflect about these subtle dimensions of my research after talking with you about them. Rather than a burden, I saw them with a lot of motivation because I understood the depth that my research can reach depending on the angles from which I decided to look at it. In view of that, the working group and I have included a

However, shedding light onto invisible elements is precisely what I aim to do with my research (by uncovering a values-based dimension of peer-to-peer energy sharing systems, which is qualitative in nature, therefore invisible). In this sense, by discovering that all these elements could also be evaluated within my research made me more motivated to pursue it.	few social values-based indicators that specifically look at these subtle dimensions. Nonetheless, due to different restraints (time, budget, human resources, etc.) and most importantly focus, I did not scrutinise them very deeply, since each could easily stand as unique Ph.D. topics on their own.
20) Are there issues where you try to safeguard your role as a gatekeeper, preventing others from expressing their ideas or making decisions with you? Sort of. As a gatekeeper, I had to filter much of the opinions or ideas expressed by others in relation to their feasibility. Since I was directly responsible for the design and development of the project, I was the most aware among all stakeholders about the limitations and potential of the project. This didn't mean I felt as the only actor entitled for an opinion in the project, but I had to critically analyse every input given during decision making processes associated with the project development.	*20) Are there issues where you tried to safeguard your role as a gatekeeper, preventing others from expressing their ideas or making decisions with you?* If that ever happened, I was not aware of it. I tried to be as open as possible with regards to being a gatekeeper and receiving inputs from others.
21) How do you think your mother language and image as a Brazilian might positively or negatively impact participants? Do you feel any form of xenophobia towards you? I was afraid it could have somehow a negative impact when I first started developing the project. That is because the three municipalities selected as pilots in the project were in less developed and less populated areas of the country. Because of that, in my view, they could have had some resistance against anything that was heterogeneous to their social norms or social reality, as a way to protect or reinforce the social cohesion of their local homogeneous social group. For my surprise, however, I feel the opposite way during the development of the project. With time, I feel that the participants and I developed strong bonds with each other, as I frequently had to contact them directly either through phone calls, workshops or visits in loco. When I must contact them, I always feel an informal	*21) How do you think your mother language and image as a Brazilian positively or negatively impacted participants? Have you ever felt any form of xenophobia towards you?* At first, I thought this could be a barrier to overcome but what I felt in practice never really justified that. The fact that I am Brazilian did not impacted the project development, and by the end of it I felt that all end-users were quite fond of me and vice-versa.

and very friendly tone in their voice, which in my view translates into signs of a healthy relationship. The resistance and distrust that I felt in the beginning of the project was mainly related to the fact that they did not know the consortium of companies that promoted the project, and the participants gave me no reason to believe that my background had an impact in that. This distrust was eventually overcome by assigning local representatives within each municipality that would bridge and equalise the initial conversations between the participants and the consortium.	
22) Do you think you are careful enough to translate terms from / to English when talking to people? Partially. I only started paying attention to the foreign language barrier when one of the participants corrected my speech during the first workshop I promoted when I mentioned the name of one piece of technology in English while the Portuguese word also exists. I think this barrier was invisible for me until that moment because my work involves a lot of cooperation with international partners, which obliges me to communicate in English most of the time. Even my job title in the company is in English, as well as many of the products we commercialise. After this particular situation with the participant, however, I started putting a lot of effort in adjusting the way I communicate with people in accordance with their individual backgrounds.	*22) Were you careful enough to translate terms from / to English when talking to people? Did the reflections induced by the pre-survey affect your view of these issues?* Yes, this was more seriously considered after the initial deliberations we had around this topic. This eventually become a pivotal point to be scrutinised under my role as gatekeeper. Not only things were translated into English, but the entire social values-based questionnaire was constructed using a more informal version of European Portuguese as a means for end-users to effectively grasp the concepts being presented to them.
23) Do you really care about positive societal changes? Yes. That is the core principle of my research and it was precisely the main reason that made me delve deep into it.	*23) Do you think you really cared about positive societal changes? If yes, how much in relation to the beginning of your research?* Yes, so very deeply. For me, positive societal changes are the life call I respond to, so I take it very seriously – much more after the beginning of my research, given that my knowledge about it and how to operationalise it have grown immensely since then.

24) Do you really care about sustainability, or is it simply a trendy discourse that will help you securing future work? I do deeply believe in sustainability and the need to create a more sustainable planet for the future generations. I have this principle deeply rooted in my heart and it can be proven by the way I see life and do things in life.	*24) Did you really care about sustainability, or was it simply a trendy discourse to help you securing future work? Did this discourse facilitate your relations with your colleagues or project participants at some point? If yes, how and to what extent?* Yes, for the same reasons stated in question 23. I see sustainability and positive societal changes as intertwined concepts – one cannot strive without the other.
N/A	*24.b) As a project manager, do you think you valued the opportunities offered by your research scholarships to present your work abroad and consequently improve the quality of the project?* I honestly could not have taken more advantage than I did, both as project manager and researcher. By the end of 2019, I participated in 27 conferences, 7 international trade fairs / business events, and 8 summer schools around the globe. I also got two scholarships from the Tokyo Foundation for Policy Research & The Nippon Foundation to further support the development of my academic research, both at my home institution and abroad. Finally, I co-founded a startup named Energy Summer, which partially benefits from the know-how acquired during my Ph.D. research the *Community S* project development.
Questions to Lurian as an independent researcher who wants to discover more than the project seems to allow	
25) How broader do you think your research scope is in relation to the project scope? Which aspects of both do not overlap? The main core of my Ph.D. research is broader than the scope of the *Community S* project. As way of explanation, the *Community S* project aims to deliver the first peer-to-peer energy sharing initiative in Portugal. To do so, the consortium designed and trialled a specific system architecture and an innovative business model in three pilots within the country to validate the peer-to-peer energy sharing concept within the Portuguese energy market.	*25) How do you see today the width of your research scope in relation to the project scope? Which aspects of both did not overlap? Did some of your expectations exceed reality (both positively and negatively)?* The scope of my research was different than the scope of the *Community S* project. Hence, I had to add extra effort to develop it whilst managing the project. The aspect that most "overlapped" with my research was the end-user engagement framework I developed as project manager, which reinforced some of the findings from the social values-based framework I developed as independent researcher. In terms of expectation, I was positively impressed by the fact that the findings for the social value theme entitled

My Ph.D. research project uses the *Community S* project as a testbed to trial a complementary methodology that intends to uncover the values-based dimension of peer-to-peer energy sharing systems, thus building upon the *Community S* project to expand even further the knowledge frontier associated with peer-to-peer energy sharing systems.	"coercion" using the end-user engagement framework were later validated using the social values-based framework. Negatively speaking, the situation narrated in question 16 was the most expressive for me.
26) As a researcher, do you feel any "conflict of interest" between your need to fulfil project goals as project manager and your research goals? If yes, please give concrete examples. I feel that the role of project manager gives me enough flexibility to direct the development of the project as I see fit, thus allowing me to fulfil most of my needs as a researcher. However, a big portion of my work as a project manager in the *Community S* project is parallel to my goals as a sole researcher, which sometimes hinders the progress of my research. In this sense, I feel that there is some sort of "conflict of interest" between my dual facets of a researcher-project manager in contrast with the sole facet of a researcher.	26) As a researcher, did you feel any "conflict of interest" between your need to fulfil project goals as project manager and your research goals? If yes, please give concrete examples. Yes, since the project deadlines were more stringent than my Ph.D. deadlines, sometimes I felt I had to prioritise the project development at the expense of my Ph.D., namely by "accommodating" the development of my Ph.D. in the pace of the project development. A concrete example about this particular situation was given in question 1 already.
27) As a researcher, do you feel tempted to "distort" the reality and "fold" results so that you can feel you have fulfilled your original goals? No. I am fully committed to analyse data as it is, encompassing both "good" and "bad" results. What is important in this sense in my view is to establish validity links in order to showcase the effort in developing a research that is replicable, trustworthy, valid and generalisable within the scientific literature.	*27) As a researcher, were you ever tempted to "distort" the reality and "fold" results so that you could feel you fulfilled your original goals?* The same answer given to question also 5 applies here.
28) As a researcher, list in descending order the 5 most important social values emerging from the project that you think can determine short-term effects: Awareness, responsibility, participation, accomplishment, motivation (note that these values selection do not differ from the question associated with the manager perspective).	*28) As a researcher, list in descending order the 5 most important social values emerging from the project that you think can determine short-term effects:* 1 – awareness; 2 – purpose; 3 - originality; 4 – motivation; 5 – support.

29) As a researcher, list in descending order the 5 most important social values that you think can determine interesting effects in the long-term: Empowerment, (capacity building & critical thinking), sense of belonging, sense of community, environmentalism (note that these values selection do not differ from the question associated with the manager perspective).	*29) As a researcher, list in descending order the 5 most important social values that you think can determine interesting effects in the long-term:* 1 – sense of community; 2 – altruism; 3 - emancipation; 4 – effect change; 5 – environmentalism.
N/A	*29.b) Which contributions you think you gave to the research community and to your field of research? Did somebody help you to visualise the added value?* My Ph.D. thesis aims to develop the first overarching social values-based assessment framework that allows the identification of underlying social values associated with peer-to-peer energy sharing models. By doing so, the main contribution of my Ph.D. to the research community is the methodology that allows to operationalise and identify which social values are "active" in the context of peer-to-peer energy sharing, which in turn creates a new social values-based language that is explicitly associated with P2P energy sharing. The main people that helped me to visualise the added value of my research was firstly you, who opened up for me so many out-of-the-box mind pathways where my research could fit into that I lost count already; Dominique Hes that introduced me the concept of peer-to-peer energy sharing and positive development back in 2013 when this was not even a trend; and Helina Melkas, who fomented and facilitated many fruitful discussions about my thesis along with other academic researchers when I was in a research abroad visit at LUT in 2019. Apart from these, the feedback I got from my participation in all the events mentioned in question 24.b. also helped me to situate the overall contribution of my research in comparison with the existing literature in this field of research.
30) As a researcher, do you feel that your "manager self" is a burden? Please, explain.	*30) As a researcher, have you ever felt that your "manager self" was a burden? Please, explain.* Sometimes yes, especially considering what was already described in question 26.

Yes. Because of the reasons explained in question 26, the level of complexity of my work would be less of a burden if I were solely a researcher, and not a project manager AND researcher.	
31) As a researcher, how free do you feel to research what you really want? Is your researcher role tied somehow to your role as project manager? I feel very much free to research exactly what I want. The role as a manager came after my role as a researcher, and the project I manage at work only represents the testbed in which I will trial my research methodology. In this sense, it does not dictate the development of my research.	*31) As a researcher, how free did you feel to research what you really wanted? Was your researcher role tied somehow to your role as project manager?* My research was not tied to the hat of project manager at all. Since I played the dual role of project manager and independent researcher, I had certain flexibility to "play with the music" and try to make both roles compatible and not antagonistic. Also, by playing the role of project manager, I was never tied to the whims of someone else. Because of that, I felt free to do what I wanted, and I performed the research I always wanted to do.
32) Do you think that the project could take other directions in case it had another project manager instead of you? Yes, but in a negative way. I feel that I have done so much more than any other project manager would do because the level of importance of a project of that nature had a very personal meaning to me, going beyond a more work assignment to represent the fulfilment of a life objective. In this sense, I put a lot of extra effort to deepen the level of complexity of the project so it could also embrace my objectives as a researcher. My commitment to the project will be visible (hopefully) in the final assessment of the official national agency who is financing and overlooking the development of the project (i.e., ANI - Agência Nacional de Inovação).	*32) Do you think that the project could have taken other directions in case it had another project manager instead of you?* Completely and thoroughly. The project only reached the level it reached because I had plenty of intrinsic motivation to make it as successful as possible. My entire Ph.D. was dependent on the success of the *Community S* project, and I went above and beyond to keep its development smoothly on track.
33) As a researcher, how often do you talk to your "manager self" to look at the project from different angles in search of variables that can be useful for your research? Does your "researcher self" win? Give examples. I think this was already answered in questions 1, 2, 13 and 31. In summary, my researcher role overtakes the project manager role is virtually all scenarios and thus	*33) As a researcher, how often have you talked to your "manager self" to look at the project from different angles in search of variables that can be useful for your research? Did your "researcher self" win? Give examples.* This happened from time to time, and depending on the scale of the request, the "researcher self" managed to win. A perfect example is the one given in question 1.

my research dictates the way I develop my work as project manager. A good example was given in question 13.	
34) In what areas do you think citizens are most uncomfortable with their role in the project? I have the impression that a few participants feel somehow indirectly "forced" to participate in the project by the City Council in one of the pilots. I noticed that by their lack of care about the project whenever the consortium tried to solve technical problems in their household. Given that the participation in this project was voluntary, this sort of behaviour should not be seen. Additionally, I feel that my final research questionnaire will be kind of a burden to some of the participants because of the depth of questions being asked. Because of that, I only intend to distribute a secondary open-question survey to those that openly declare that are willing to be further contacted to discuss about their participation in the project.	*34) In what areas do you think citizens were most uncomfortable with their role in the project?* I believe they were mostly uncomfortable in the very beginning of the project development, most specifically in the "activation phase" of their engagement in the project. That is because at that moment it was still difficult for them to grasp all complex concepts being introduced by my research, making it difficult for them to fully realise their role.
35) As a researcher, how much trust do you have in the politicians who committed to this project? In what aspects do your trust and possible mistrust apply? My answer regarding politicians is identical to what I answered in question 16. As for other partners in this consortium, I think the effort that they put into this project does not equal mine. That was already explained in question 32 but the level of importance I give to this project is much greater than theirs because of the inevitable association I make with my Ph.D. research, which is a life goal I set for my life.	*35) As a researcher, how much trust you had in the politicians who committed to this project? In what aspects do your trust and possible mistrust apply?* The same answer given to question also 16 applies here.
N/A	*35.b) Do you feel your bosses encouraged your "manager self" to follow your research goals? Do you think they also appreciated your role as a researcher beyond the managerial one?*

	Yes, and this is very much evidenced by the "added role" I assumed in the company as the "person to go" with any subject related to the Social Sciences & Humanities aspects of the energy sector. Furthermore, this is evidenced in the type of R&D projects we started focusing at, which are also related to the very same aspects.
36) As a researcher, do you feel you are really committed to the transparency and understandability of all stages of the project development? I try to be as transparent as possible in my research endeavours, as well as understand all stages of its development. Naturally, the development of my research is affected by multiple factors of different nature, thus those stages of the project development that cannot be fully envisioned a priori need to be managed through the "learning by doing" method - similarly to what happens in my work. In such cases, the decision-making processes tend to be less clear, however I address this lack of clarity by establishing a priori validation links that guarantee the reliability, validation, and generalisation of such decision-making processes.	*36) As a researcher, did you feel really committed to the transparency and understandability of al stages of the project development?* The same answer given to question also 15 applies here.
37) Do you really feel that there is shared decision-making in this project, or participants are sometimes used as laboratory guineapigs? The *Community S* project was originally designed to be implement in a top-down approach in the selected pilots. This means that the participants had little room to give their inputs in the way that the project was structured. This does not mean, however, that the participants were taken as "laboratory guinea pigs". In fact, they were always incentivised to comment on the way that the project was being carried out, as well as on ways to improve it. Their inputs were always appreciated and analysed with care by the consortium. To illustrate this, two participants installed photovoltaic cells onto their roofs while participating in the project and asked the consortium if it was also possible to monitor their distributed electricity generation,	*37) Did you feel that there was real shared decision-making in this project, or participants were sometimes used as laboratory guineapigs? As a researcher, did you do it (i.e., used participants as guineapig to test your theories)?* I do not think that all processes encompassed shared decision-making between the project consortium and participants, but that is okay, provided that this is acknowledged and not falsely promoted. As a matter of fact, the first phase of the social values-based framework I developed during my Ph.D. actually refers to defining the level of participation of stakeholders in the valuation process to be carried out. Based on the configuration of my research (i.e., organisational structure, timeframe, budget, human resources, etc.), the participatory approach was viewed as cooperation, since although participants provided advice and inputs to decision making processes, the main responsibility still lies with project leaders. Nonetheless, I would never categorise them as laboratory guineapigs.

which was quickly accepted by the consortium as it would enrich the data being collected in the project. To develop a demonstration project (i.e., a project in which the first foundation of a highly innovative concept will be laid in the real world), it is fundamental to have end-user engagement and proactive participation to be able to validate the concept that is being demonstrated. With that in mind, the consortium of the *Community S* project did their best to keep participants motivated, by establishing a direct communication link between them and the participants, by promoting awareness workshops in every pilot, by solving technical problems in loco in the households that needed it, by creating multiple prize draws, by delivering highly informative reports to participants, just to name a few actions taken during the project development. With that said, it is clear that the consortium tried to include participants in decision-making processes whenever possible, even with the constraints imposed by a top-down approach towards project development.	
38) As a researcher, do you really believe in the replicability and scalability of this type of project? In terms. The business model layer and system architecture layer designed in the *Community S* project suit the Portuguese energy market and thus should be replicable and scalable in any other setting within Portugal. Nonetheless, I believe results could vary greatly in contrast with results from the first three pilots as they represent very specific sociodemographic and institutional conditions that cannot be found anywhere else in Portugal.	*38) As a researcher, do you really believe in the replicability and scalability of this type of project?* I do, and this has grown exponentially in the past few years – as seen in the gradual transposition of EU directives on energy communities into national legal frameworks in EU member states, aligned with the bloom of different initiatives being trialled around the globe. In terms of the social values-based assessment framework developed within my Ph.D. research, it is scalable provided that result interpretations are put in perspective and validated through a cohesive validity check on a case-by-case basis. This can be done by following and adapting the validity check performed and described in my research, which is expected to be published soon.

39) As a researcher, do you think that your "manager self" can make more to increase the transparency and understandability of all stages of the project development? Given the time and resources constraints, no. Although the two roles are being analysed separately in this interview, in practice it was very hard to disassociate one from the other. With that said, I think my researcher mindset influenced a lot the way I perceived the project as a manager, pushing me to do as much as I could as a manager to increase my outputs as a researcher. In this sense, transparency, and understandability of all development stages of the project were two highly considered elements in this project.	*39) As a researcher, do you feel that your "manager self" could have done more to increase the transparency and understandability of all stages of the project development?* Personally, no. Distinguishing both roles in practice was more complex than imagined, and I believe the methodological mindset of my "researcher self" did not allow my "manager self" to go another direction. Hence, I put a lot of effort to make processes as transparent and understandable as possible for everyone, taking into consideration the timeframe and financial resources available at that time.
N/A	*40) As a researcher, do you think you valued the opportunities offered by your research scholarships to present your work abroad and improve the quality of the project?* The same answer given to question also 24.b. applies here.

Appendix C: social values-based questionnaire template

***COMMUNITY S* QUESTIONNAIRE**

- Page 1 -

1) How did you see your participation in the project?

Localised Values-Based Indicators	**SA**	**A**	**N/A**	**D**	**SD**
Did you feel that you had your own place in the project?	( )	( )	( )	( )	( )
Did you feel responsible for your own contribution to the project?	( )	( )	( )	( )	( )
Did you know what the purpose of your contribution to the project was, as well as what was the project's contribution to your community and country?	( )	( )	( )	( )	( )
Did you think that the events and activities promoted by the project motivated you to fulfil your responsibilities in the project?	( )	( )	( )	( )	( )
Did you think you fulfilled your commitments with the project?	( )	( )	( )	( )	( )
Did you feel that the value of your participation in the project was recognised?	( )	( )	( )	( )	( )
Did you feel that everyone acted in a non-discriminatory manner with respect to the differences of the participants or the project team (e.g., on the basis of nationality, gender, skin colour, etc.)?	( )	( )	( )	( )	( )
Did you believe that your own knowledge or skills contributed to the development of the project?	( )	( )	( )	( )	( )
Do you consider that there were group norms to be respected in the project?	( )	( )	( )	( )	( )
Do you believe your behaviour in the project was consistent with what you said you were doing?	( )	( )	( )	( )	( )
Do you think you worked hard to raise awareness about the social values system that underpinned the project?	( )	( )	( )	( )	( )
Did you see your participation in the project as a form of community service (rather than a purely individual benefit)?	( )	( )	( )	( )	( )

- Page 2 -

2) How did you see the project consortium's approach?

Localised Values-Based Indicators	**SA**	**A**	**N/A**	**D**	**SD**
Did you feel the project consortium gave you autonomy and trusted you to fulfil your project responsibilities on your own?	( )	( )	( )	( )	( )
Did you think the decision-making processes in the project were democratic?	( )	( )	( )	( )	( )
Did you feel that the project consortium shared information openly with all participants?	( )	( )	( )	( )	( )
Did you feel that the project consortium took the initiative to improve the participants' experiences in the project?	( )	( )	( )	( )	( )
Did you feel that there were different communication channels so that each participant could learn about the project in their own way?	( )	( )	( )	( )	( )
Did you believe that different opinions were acknowledged and valued through dialogue between participants and the project consortium?	( )	( )	( )	( )	( )
Did you feel that conflict resolution during the project development resulted in learning and growth?	( )	( )	( )	( )	( )
Did you feel somehow coerced / forced to participate in any of the project activities?	( )	( )	( )	( )	( )

3) As a result of your participation in the project and what you learned about P2P energy sharing…

Localised Values-Based Indicators	**SA**	**A**	**N/A**	**D**	**SD**
Did you become more able to make better decisions on other issues affecting your life?	( )	( )	( )	( )	( )
Did you feel that P2P energy sharing is a lever to build more solidary and inclusive relationships between participants (compared to the relationships that already existed before)?	( )	( )	( )	( )	( )
Did you feel more empowered to critically reflect and seek solutions to problems on your own, rather than adopting preestablished opinions?	( )	( )	( )	( )	( )
Did you feel that you were creating something collectively that was bigger and better than something you could ever create if you were on your own?	( )	( )	( )	( )	( )
Did you strive to adopt a new lifestyle more aligned with the social values promoted by the project?	( )	( )	( )	( )	( )
Did you feel that you adopted a new lifestyle with more collective and altruistic habits?	( )	( )	( )	( )	( )
Did you feel that you gained new skills to replicate the principles of the project in other contexts of your life?	( )	( )	( )	( )	( )
Did you start investing more time and resources in activities that benefit the environment or your community due to your participation in the project?	( )	( )	( )	( )	( )

Did your participation in the project give you the feeling that you can effect changes in the environment in which you live?	( )	( )	( )	( )	( )
Do you think the project stimulated the development of a community identity among participants?	( )	( )	( )	( )	( )
Do you believe the project has set novel sustainability goals that goes beyond current legislation and governmental action?	( )	( )	( )	( )	( )

- Page 4 -

4) Gender?

( ) Male

( ) Female

( ) Other

5) As a woman...[30]

Localised Values-Based Indicators	**SA**	**A**	**N/A**	**D**	**SD**
… did you feel that P2P energy sharing initiatives can somehow contribute to greater gender equality?	( )	( )	( )	( )	( )

- Page 5 -

6) Now, please reflect on the social values associated with each indicator with which you agreed or strongly agreed in the previous sections

Localised Values-Based Indicators	**Associated social value(s)**	**Do you agree with this association? (YES OR NO)**	**Which other social value(s) would you associate with this**	**Which social value(s) would you remove from this association?** (OPTIONAL)

[30] Question 5 only appeared for those who marked “female” as an answer in the online SurveyGizmo’s questionnaire.

			indicator? (OPTIONAL)	
Did you feel that you had your own place in the project?	Inclusion; recognition			
Did you feel responsible for your own contribution to the project?	Responsibility; contribution; involvement			
Did you know what the purpose of your contribution to the project was, as well as what was the project's contribution to your community and country?	Purpose; contribution; involvement; recognition; effect change			
Did you think that the events and activities promoted by the project motivated you to fulfil your responsibilities in the project?	Motivation; responsibility; involvement			
Did you feel the project consortium gave you autonomy and trusted you to fulfil your project responsibilities on your own?	Emancipation; trust; responsibility			
Did you think you fulfilled your commitments with the project?	Accomplishment; responsibility; contribution; dedication			
Did you think the decision-making processes in the project were democratic?	Impartiality; inclusion; recognition; credibility			
Did you become more able to make better decisions on other issues affecting your life?	Capacity building; learning; personal development; satisfaction; achievement; effect change			
Did you feel that the project consortium shared information openly with all participants?	Transparency; credibility; commitment; impartiality; dialogue; responsibility; support; professionalism			
Did you feel that the project consortium took the initiative to improve the participants' experiences in the project?	Support; commitment; responsibility; professionalism			

Did you feel that there were different communication channels so that each participant could learn about the project in their own way?	Inclusion; impartiality; responsibility; support; adaptability; professionalism; involvement; respect			
Did you feel that the value of your participation in the project was recognised?	Recognition; inclusion; satisfaction; motivation; appreciation			
… did you feel that P2P energy sharing initiatives can somehow contribute to greater gender equality?	Gender equality; inclusion; inspiration; effect change; recognition; respect; satisfaction			
Did you feel that P2P energy sharing is a lever to build more solidary and inclusive relationships between participants (compared to the relationships that already existed before)?	Solidarity; inclusion; cooperation; sense of community; make a difference			
Did you feel that everyone acted in a non-discriminatory manner with respect to the differences of the participants or the project team (e.g., based on nationality, gender, skin colour, etc.)?	Respect; impartiality; inclusion; concern for others; unity			
Did you believe that different opinions were acknowledged and valued through dialogue between participants and the project consortium?	Dialogue; impartiality; inclusion; transparency; involvement; credibility; participation; support; engagement; collaboration; professionalism; appreciation; recognition; concern for others			
Did you feel that conflict resolution during the project development resulted in learning and growth?	Learning; personal development; accomplishment; recognition; value creation			
Did you believe that your own knowledge or skills contributed to the development of the project?	Contribution; inclusion; recognition; dedication; improvement; influence; collaboration; satisfaction			
Did you feel more empowered to critically reflect and seek solutions to problems on your own, rather than adopting preestablished opinions?	Emancipation; learning; personal development; value creation; satisfaction; achievement			

Did you feel that you were creating something collectively that was bigger and better than something you could ever create if you were on your own?	Collectivity; integration; contribution; motivation; value creation; support; satisfaction; recognition; resilience; altruism; collaboration; involvement; development; purpose			
Do you consider that there were group norms to be respected in the project?	Control; teamwork; coordination; duty			
Do you believe your behaviour in the project was consistent with what you said you were doing?	Honesty; accountability; impartiality; acknowledgement; credibility			
Do you think you worked hard to raise awareness about the social values system that underpinned the project?	Awareness; responsibility; acknowledgement; critical thinking; involvement; motivation; significance			
Did you strive to adopt a new lifestyle more aligned with the social values promoted by the project?	Adaptation; capacity building; awareness; achievement; personal development; focus; motivation; impact; satisfaction			
Did you feel that you adopted a new lifestyle with more collective and altruistic habits?	Concern for others; adaptability; community; proactivity; value creation; personal development; vision; satisfaction			
Did you feel that you gained new skills to replicate the principles of the project in other contexts of your life?	Personal development; emancipation; consciousness; utility; satisfaction; purpose; drive; initiative; influence; achievement; appreciation; acknowledgement; adaptability			
Did you start investing more time and resources in activities that benefit the environment or your community due to your participation in the project?	Environmentalism; collectivity; empowerment; selflessness; belonging; awareness; contribution; inspiration; make a difference; purpose; personal development; respect; satisfaction; acknowledgement; resilience; influence; sharing; prosperity; fairness; dedication; long-sightedness			
Did your participation in the project give you the feeling that you can effect changes in the environment in which you live?	Empowerment; contribution; wilfulness; make a difference; purpose; personal development; satisfaction; recognition; resilience; influence			
Do you think the project stimulated the development of a community identity among participants?	Collectivity; concern for others; inclusion; cooperation; contribution; consciousness; capability; responsibility;			

	recognition; resilience; drive; impact; backing; wellbeing; commitment; social justice; prosperity			
Do you believe the project has set novel sustainability goals that goes beyond current legislation and governmental action?	Innovativeness; development; purpose; value creation; environmentalism; contribution; status; achievement; advocacy			
Did you see your participation in the project as a form of community service (rather than a purely individual benefit)?	Collectivity; concern for others; inclusion; cooperation; contribution; consciousness; capability; responsibility; recognition; resilience; drive; impact; organization; wellbeing; purpose; commitment; social justice; prosperity			
Did you feel somehow coerced / forced to participate in any of the project activities?	Authoritarianism; influence			

- Page 6 -

7) ***Reflect on the origin of the following social values***

Social value theme	**They emerged as a result of the project**	**They already existed and were reinforced by the project**	**Their antagonistic versions already existed but were modified by the project**	**They do not apply to the project**
Belonging	( )	( )	( )	( )
Achievement	( )	( )	( )	( )
Responsibility	( )	( )	( )	( )
Gratitude	( )	( )	( )	( )
Recognition	( )	( )	( )	( )
Resilience	( )	( )	( )	( )
Altruism	( )	( )	( )	( )
Coercion	( )	( )	( )	( )

Influence	( )	( )	( )	( )
Emancipation	( )	( )	( )	( )
Awareness	( )	( )	( )	( )
Participation	( )	( )	( )	( )
Collaboration	( )	( )	( )	( )
Collectivity	( )	( )	( )	( )
Dialogue	( )	( )	( )	( )
Support	( )	( )	( )	( )
Transparency	( )	( )	( )	( )
Trust	( )	( )	( )	( )
Commitment	( )	( )	( )	( )
Motivation	( )	( )	( )	( )
Impartiality	( )	( )	( )	( )
Progress	( )	( )	( )	( )
Professionalism	( )	( )	( )	( )
Environmentalism	( )	( )	( )	( )
Purpose	( )	( )	( )	( )
Originality	( )	( )	( )	( )
Personal Development	( )	( )	( )	( )
Respect	( )	( )	( )	( )
Wellbeing	( )	( )	( )	( )
Effect Change	( )	( )	( )	( )

PERSONAL DATA

8) Do you accept being contacted for further discussion about the topics addressed by this questionnaire?

( ) Yes

( ) No

9) What is your name? (please fill in this field if you agree to be contacted later)

Data privacy*: your responses will be reviewed confidentially and in an aggregated way*.

10) What is your email? (please fill in this field if you agree to be contacted later)

Data privacy*: your responses will be reviewed confidentially and in an aggregated way*.

11) To which renewable energy community did you belong to?

( ) Alfândega da Fé

( ) Penela

( ) Vila Real (Lordelo)

12) Did you Participate in the public sessions held at the City Council to learn more about the project?

( ) Yes (in all session)

( ) Partially (only in some of the sessions)

( ) No

13) Did you received any technical support from the project consortium (via calls or in situ support) to solve any pending issue with your smart home energy management system?

( ) No (I never had any technical problem)

( ) Yes (I received technical support and my pending problem was solved)

( ) Yes (I received technical support however the problem could not be solved)

( ) No (I had technical problems however I never received technical support)

( ) Other option (please describe):

Appendix D: Storytellers' stories and their respective valuation

Table 15. Transcription of the storytellers' stories and their respective valuation.

Legend			
User code	***Alfândega da Fé***	End-user number 1 from Alfândega da Fé	***AF.1***
		End-user number 2 from Alfândega da Fé	***AF.2***
		End-user number 3 from Alfândega da Fé	***AF.3***
		End-user number 4 from Alfândega da Fé	***AF.4***
		End-user number 5 from Alfândega da Fé	***AF.5***
	Penela	End-user number 1 from Penela	***PE.1***
		End-user number 2 from Penela	***PE.2***
	Vila Real (Lordelo)	End-user number 1 from Vila Real (Lordelo)	***VR.1***
		End-user number 2 from Vila Real (Lordelo)	***VR.2***
		End-user number 3 from Vila Real (Lordelo)	***VR.3***

User code	**Describe what do you understand by social values?**	**Storytelling**	**Valuation**
AF.1	It represents every way of reacting towards a certain topic or activity without compromising others. It represents helping, sharing, and being motivated to have	*Once upon a time (…)* a curious participant motivated to improve the sustainability of my energy usage at home and in the workplace. *Every day, I (...)* used to think: how can I save energy in my household? How can I know which appliances consume more energy? Where exactly can I reduce my energy consumption? *However, by participating in the project, I (...)* had the opportunity to be part of a sustainable community, where I raised awareness on the need to turn off equipment that consumes energy in standby mode and on verifying which appliances have high energy expenditure. I became a more careful and concerned person to reduce my energy bill and perhaps improve / contribute to a better environment.	curiosity (no tag); capacity building (10); concern (11); participation (12); sharing (13); community (14); support (16); wilfulness (19);

	good actions throughout life, whether on a personal, professional, or environmental level	*Because of that, I (...)* gained more sustainable habits and my behaviour improved, which enhanced my values for the benefit of future generations. *Nonetheless (...),* many technical failures and the desire to give up arose. *Until finally (...),* with the support and motivation of the project consortium, the obstacles were solved. *And ever since then (...)* I am a more participative and active citizen, concerned about adopting more environmentally friendly behaviours. And we go further by sharing!	motivation (20); professionalism (23); sustainability (24); effect change (30); long-sightedness (32)
AF.2	Creating a sense of sharing between partners, friends, and the community at large. Knowing that we are saving our planet from the harms of polluting sources of energy	*Once upon a time (…)* a father of a son who, together with his wife, tries to have a successful personal life and professional life, namely with good financial health. *Every day, I (...)* did not care about electrical consumption; I was just outraged by the high consumption. *However, by participating in the project, I (...)* found out that our consumption could be minimised, saving the family budget and the environment - so I changed all the lighting to LED, changed the washing machine for a more efficient one. I also installed photovoltaic panels for self-consumption. *Because of that, I (...)* reduced consumption by approximately 30€ per month. I have a greater concern in turning off what is not necessary to be connected, I also check more assiduously the consumption of my electrical appliances. *Nonetheless (...),* during the installation of photovoltaic panels, I noticed that EDP (i.e., the energy retailer) should also have changed my energy meter, since these old ones like mine do not make bidirectional readings (for energy consumption and energy production). *Until finally (...),* I called EDP to alert them about this problem, saying that they should not install photovoltaic panels without also changing old energy meters. *And ever since then (...)* all the good you do to others later will come back to you. Long life to the sense of sharing and to sustainable communities!	solidarity (7); capacity building (10); concern (11); sharing (13); community (14); sustainability (24); personal development (27); effect change (30); advocacy (31)
AF.3	How to act in a particular situation. The way you characterise a certain person. In the context	*Once upon a time (…)* a stubborn girl. *Every day, I (...)* had no notion of the amount of energy expended unnecessarily. *However, by participating in the project, I (...)* realised that certain equipment could be turned off as they consumed large amounts of energy, causing great economic and environmental waste. However, my participation was not very significant since I had very little energy usage in my household due to renovation works during the implementation of the project.	concern for others (7); capacity building (10); concern (11); compliance (13); collectivity (14);

	of this project, a new way of sharing that makes us think differently and in a certain way begin to value other concepts	*Because of that, I (...)* after the follow-up support provided by the project consortium, even with little energy use in my household, it was possible to start changing some old habits. *Nonetheless (...),* my house is still uninhabited due to renovation works. *Until finally (...),* energy consumption was not very high, but I could see some abnormal patterns and some bad habits. *And ever since then (...)* despite the situation beforementioned, I have been able to realise that this project is or could be a valuable asset and will have a strong environmental and economic impact on families and on a large scale. This experience was an individual lesson that made me rethink several issues (even social), with regard to the sharing of energy in a community (collective lesson) in search of a sustainability and a population increasingly informed and sensitised to the change of habits and attitudes. To finish, small gestures make a difference.	support (16); development (22); professionalism (23); sustainability (24); personal development (27); effect change (30)
AF.4	N/A	*Once upon a time (...)* a 36-year-old man, married to a wife that was very little concerned over environmental issues. *Every day, I (...)* used to go behind her back to turn off the appliances and lights. *However, by participating in the project, I (...)* started to see that I could optimise the use of the appliances in my home. *Because of that, I (...)* every night I turned off the sockets so that the devices would not be on standby. *Nonetheless (...),* my daughter once said to me: *"Dad, at school my teacher says that we should always turn off the lights to save energy".* *Until finally (...),* I made my wife listen to our daughter, and since then we have never left the house, nor never went to sleep, without making sure there are no appliances wasting energy unnecessarily in our home. *And ever since then (...)* I realised I can have a much smaller ecological footprint.	capacity building (10); consciousness (11); sustainability (24)
AF.5	Values are states-of-mind that reflect the common and individual good. Values are socially accepted individual behaviours	*Once upon a time (...)* *Every day, I (...)* tried to cultivate energy saving habits, in an empirical but uncontrolled way. *However, by participating in the project, I (...)* gained a tool to monitor my energy expenditures / consumption, being able to see if the energy saving habits were effective or not. *Because of that, I (...)* started to reduce my energy costs, thinking more often about the environmental and economic benefits. *Nonetheless (...),* my monitoring system lost communication with the platform and I could not understand why... I was lost.... Panic!!	emancipation (10); consciousness (11); collectivity (14); support (16); professionalism (23); sustainability (24); personal

		Until finally (...), an e-mail from the project manager indicated that it could be due to exhausted batteries, which were then replaced - and everything went back on track again. *And ever since then (...)* I became aware of energy sharing networks / communities. I am reviewing my electricity supply contract, installing photovoltaic panels for self-consumption, as well as benefiting from personal (via financial savings) and collective benefits (via sustainable communities for the sake of the environment).	development (27); effect change (30)
PE.1	N/A	*Once upon a time (…)* a family of 4 (two adults and two girls). *Every day, I (...)* that spent energy without paying attention and that always left many appliances on. *However, by participating in the project, I (...)* started to better control energy expenditures. By installing smart plugs, I could better understand which appliances spent the most and tried to change their consumption patterns. I also started turning off appliances when they were not used. *Because of that, I (...)* realised how much energy was spent unnecessarily. *Nonetheless (...),* *Until finally (...),* *And ever since then (...)* I can control my energy expenditures and also became aware of other things.	capacity building (10); concern (11); sustainability (24); personal development (27)
PE.2	Values are the set of characteristics that determine and form how people or organisations connect or interact with each other. From this perspective, it seems to me that this project can generate a set of social, ethical, and moral values of	*Once upon a time (…)* a man who was unaware that it would be ever possible to share energy between buildings. Moreover, I was unaware of my energy consumption and did not understand how to act with the data obtained only from energy bills. In this way, I joined the *Community S* project. *Every day, I (...)* wondered about the energy consumption in my household, as well as the price charged for it. However, I did nothing or had any habits of monitoring my energy consumption. *However, by participating in the project, I (...)* started using the smart home energy management system provided by the project consortium, as well as the platform to monitor consumption and understand my energy waste. *Because of that, I (...)* used this system daily and created habits to understand when and how much the energy consumption of my household were. I was thus able to reduce my energy consumption as well as the price to be paid for it. *Nonetheless (...),* there were some communication problems between equipment that could jeopardy the objectives that were initially established by the project. *Until finally (...),* with some perseverance and interest in the project, I tried to solve these problems.	capacity building (10); concern (11); participation (12); perseverance (19); interest (20); sustainability (24); personal development (27); satisfaction (29)

	mutual help between people. I believe that projects involving various actors may be more successful than individual ones, since they generate values of participation, well-being, and satisfaction for contributing to a common good	*And ever since then (...)* I realised the pattern of my energy consumption, how much my home appliances spent / consumed and created habits to turn the equipment on and off whenever necessary, as well as at what time they should be used. In conclusion, I am satisfied with the results obtained and with my participation in this project.	
VR.1	Values towards sharing with other participants	*Once upon a time (...)* a person who was invited to participate in the innovative project with several other participants, as if we were a community. I agreed to participate in the project with great curiosity and expectation. *Every day, I (...)* checked the consumption of some of my home appliances with the use of smart plugs (e.g., fridge and freezer), as well as when their consumptions were higher or lower. Nonetheless, the smart home energy management system had some signal failures and so sometimes I could not visualise real-time monitoring, until I managed to get everything to work properly again with the support of the project consortium. *However, by participating in the project, I (...)* checked every day the energy consumption of my appliances, switching the equipment connected to the smart plugs to check the energy consumption of all of them. *Because of that, I (...)* started to have the concern of at least once a week to graphically see the weekly consumptions of my home appliances in the online platform of the smart home energy management system. *Nonetheless (...),* I stopped having this concern since there was nothing new to see, given that the results were the same. *Until finally (...),* I ended up changing my energy retailer to Energia Simples (one of the project partners that offered the P2P energy sharing contract) and started to pay a lower price for the energy.	curiosity (no tag); expectation (no tag); capacity building (10); awareness (11); participation (12); sharing (13); collectivity (14); support (16); success (22); professionalism (23); innovativeness (26)

		And ever since then (...) I became aware of the energy consumption of the appliances in my house, which made me realise I needed to buy new ones. In short, I really enjoyed my participation in this innovative project, and I am convinced that it had a successful conclusion.	
VR.2	Due to my participation in this project, I realised that we could help ourselves and others by having small changes in old habits, which implies a change of values that hitherto did not exist	*Once upon a time (…)* someone who, with some curiosity, decided to accept the challenge of monitoring some of my energy expenditures. *Every day, I (...)* used to leave the coffee machine, the computer and TV on standby mode for hours and even days. *However, by participating in the project, I (...)* started turning off the TV, the coffee machine, and the computer instead of leaving them on for hours on end. *Because of that, I (...)* found out I was able to save energy and began to think that, if many people were to have the same attitude, the result would be very beneficial the humankind. *Nonetheless (...),* I could not monitor all appliances. *Until finally (...),* I started changing which home appliances were connected to the smart plugs every week as to understand the consumption patterns of each of them. *And ever since then (...)* I realised that if we were all part of this project, we could achieve high energy savings, which could be distributed among people in need - this would certainly be a valuable asset to humanity, particularly from a social and environmental perspective.	curiosity (no tag); capacity building (10); concern (11); collectivity (14); progress (22); sustainability (24); effect change (30)
VR.3	Values are your own established rules	*Once upon a time (…)* a consumer who, like most consumers, did not care about the energy consumption of home appliances. *Every day, I (...)* used my home appliances without paying attention to their energy consumption, blindingly trusting on their efficiency. *However, by participating in the project, I (...)* started monitoring the expenses and consumption of my home appliances. *Because of that, I (...)* noticed that one of my home appliances had an abnormal energy consumption, far above expected. *Nonetheless (...),* after replacing this appliance, I found out that my energy consumption dropped considerably. *Until finally (...),* my electricity bill decreased about 20-30€ per month, representing a reduction of about 23-33% in comparison to the previous month. That is, it decreased from an average of 80-90€ to 60-70€.	curiosity (no tag); concern for others (7); capacity building (10); concern (11); collectivity (14); sustainability (24); personal development (27); effect change (30)

		And ever since then (...) I regularly monitor the consumption of my home appliances to check if there is a need to replace them and minimise unnecessary costs. I will also start monitoring the energy use of my family and friends.	

Appendix E: Refence list in alphabetic order

1. AGL Energy Limited (2017). Peer-to-Peer Distributed Ledger Technology Assessment – Virtual Peer-to-Peer Energy Trading Using Distributed Ledger Technology: Comprehensive Project Assessment Report; AGL Energy Limited: Sydney, Australia, 2017. Available online: https://arena.gov.au/assets/2017/10/Final-Report-MHC-AGL-IBM-P2P-DLT.pdf
2. Allan, J. (Ed.) (2002). Introduction to Topic Detection and Tracking, Springer US, Boston, MA, pp. 1–16.
3. Bamberg, M. (2012). Narrative analysis. Washington, DC: In: H. Cooper (Editor-in-chief), APA handbook of research methods in psychology (3 volumes), APA Press.
4. Bell, S., Morse, S. (2008). Sustainability Indicators: Measuring the Immeasurable?. Earthscan, 2008, ISBN: 1844072991, 9781844072996.
5. Biggs, C. (2016). A resource-based view of opportunities to transform Australia's electricity sector. Journal of Cleaner Production, vol. 123, pp. 203–217.
6. Bishop, P., Herron, R. (2015). Use and Misuse of the Likert Item Responses and Other Ordinal Measures. International Journal of Exercise Science vol. 8(3), pp. 297–302.
7. Boone, H. and Boone, D. (2012). Analyzing Likert Data. The Journal of Extension, vol. 50(2), pp. 1–5. Available at: https://joe.org/joe/2012april/tt2.php
8. Burford, G., Hoover, E., Stapleton, L., Harder, M. (2016). An Unexpected Means of Embedding Ethics in Organizations: Preliminary Findings from Values-Based Evaluations. Sustainability, vol. 8(7), pp. 1–22.
9. Burford, G., Hoover, E., Velasco, I., Janoušková, S., Jimenez, A., Piggot, G., Podger, D., Harder, M. (2013). Bringing the "missing pillar" into sustainable development goals: Towards intersubjective values-based indicators. Sustainability, vol. 5(7), pp. 3035–3059.
10. Caramizaru, A. and Uihlein, A. (2020). Energy communities: an overview of energy and social innovation, EUR 30083 EN, Publications Office of the European Union, Luxembourg, doi:10.2760/180576.
11. Chautard, T., Collin-Lachaud, I. (2019). Introducing the storytelling analysis methodology in marketing: Principles, contributions and implementation. Recherche et Applications En Marketing (English Edition), vol. 34(3), pp. 27–46, doi: https://doi.org/10.1177/2051570719841225
12. Cialdini, R.B. (2001). The science of persuasion. Scientific American, vol. 284, pp. 76–81.
13. Clason, D.L., Dormody, T.J. (1994). Analyzing data measured by individual Likert-type items. Journal of Agricultural Education, vol. 35(4), pp. 31–35.
14. Corcoran, P.B. (Ed.) (2005). The Earth Charter in Action: Toward a Sustainable World. Royal Tropical Institute (KIT), Amsterdam, The Netherlands, ISBN: 90-6832-177-3.
15. De Meyer, A. (1984). A technological lifecycle approach to the organisational factors determining gatekeeper activities. R&D Management, vol. 14(4), pp. 239–246, doi: https://doi.org/10.1111/j.1467-9310.1984.tb00520.x

16. DeFleur, M., DeFleur, M. (2009). Mass Communication Theories: Explaining Origins, Processes, and Effects. Allyn & Bacon.
17. Delina, L., Janetos, A. (2018). Cosmopolitan, dynamic, and contested energy futures: Navigating the pluralities and polarities in the energy systems of tomorrow. Energy Research & Social Science, vol. 35, pp. 1–10.
18. Dierkes, M., Antal, A.B., Child, J., Ikujiro, N. (2003). Handbook of Organizational Learning and Knowledge. Oxford University Press, p. 22, ISBN 978-0-19-829582-2.
19. Energy Services Regulatory Authority (2017). How Electricity Tariffs Are Calculated. Available at: http://www.erse.pt/consumidor/electricidade/querosabermais/comosaocalculadasastarifasdeelectricidade/Paginas/default.aspx
20. Energy Services Regulatory Authority (2021). Public Consultation no. 93 – Proposal to reform the regulation on self-consumption of electricity. Available at: https://www.erse.pt/atividade/consultas-publicas/consulta-p%C3%BAblica-n-%C2%BA-93/
21. ESDinds (2010). The development of indicators and assessment tools for CSO projects promoting values-based education for sustainable development. Deliverable Number 17: Project Final Report to European Commission Seventh Framework Programme (FP7/2007-2013) (amended version, resubmitted 23 September 2011).
22. ESDinds (2015). WeValue: understanding and evaluating intangible impacts of projects or organisations, University of Brighton, Brighton, UK.
23. European Comission (2019). The European Green Deal. Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, Document 52019DC0640, Brussels. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1588580774040&uri=CELEX:52019DC0640
24. Favini, J. (2020, Jan 23). What if Competition Isn't As "Natural" As We Think? [Blog post], Slate. Retrieved from https://slate.com/technology/2020/01/darwin-competition-collaboration-evolutionary-biology-climate-change.html
25. Giotitsas, C., Pazaitis, A., and Kostakis, V. (2015). A peer-to-peer approach to energy production. Technology in Society, vol. 42, pp. 28–38.
26. Gross, R. (2017). Psychology in Historical Context: Theories and Debates. London: Routledge. doi: https://doi.org/10.4324/9781315544304
27. Gui E., Diesendorf M., MacGill I. (2017). Distributed energy infrastructure paradigm: Community microgrids in anew institutional economics context. Renewable and Sustainable Energy Reviews, vol. 72, pp. 1355–1365, doi: https://doi.org/10.1016/j.rser.2016.10.047
28. Hannoset, A., Leen. P., Tuerk, A. (2019). Energy Communities in the EU - Task Force Energy Communities. Deliverable D3.12.d Developed Under the Scope of the INTENSYS4EU Project. Available at: https://www.h2020-bridge.eu/wp-content/uploads/2020/01/D3.12.d_BRIDGE_Energy-Communities-in-the-EU-2.pdf

29. Harder, M., Velasco, I., Burford, G., Podger, D., Janoušková, S., Piggot, G., Hoover, E. (2014). Reconceptualizing “effectiveness” in environmental projects: can we measure values-related achievements?. Journal of Environmental Management, vol. 139, pp. 120–134.
30. Hes, D., Du Plessis, C. (2015). Designing for hope: pathways to regenerative sustainability. London: Earthscan by Routledge; 2015.
31. Hinton, J.B. (2020). Fit for Purpose? Clarifying the Role of Profit for Sustainability. Journal of Political Ecology, vol. 27(1), pp. 236–262.
32. Horáková, N. (2005). Co je pro nás v životě důležité?. Naše společnost, vol. 3(2), pp. 8–12.
33. INE: Statistics Portugal (2012). Censos 2011 (Dados Definitivos), Quadros de Apuramento por Freguesia. Available at: https://censos.ine.pt/xportal/xmain?xpid=CENSOS&xpgid=censos2011_apresentacao.
34. Jamieson, S. (2004), Likert scales: how to (ab)use them. Journal of Medical Education, vol. 38(12), pp. 1217–1218.
35. Janda, K. B., Topouzi, M. (2015). Telling tales: using stories to remake energy policy. Building Research & Information, vol 43(4), pp. 516-533, doi: 10.1080/09613218.2015.1020217.
36. Jasanoff, S., and Kim, S.H. (2013). Sociotechnical imaginaries and national energy policies. Science as culture, vol. 22(2), pp. 189–196.
37. Jeng, M. (2006). A selected history of expectation bias in physics. American Journal of Physics, vol. 74 (7), pp. 578–583, doi: 10.1119/1.2186333.
38. Jogunola, O., Ikpehai, A., Anoh, K., Adebisi, B., Hammoudeh, M., Son, S.-Y., and Harris, G. (2017). State-Of-The-Art and Prospects for Peer-To-Peer Transaction-Based Energy System. Energies, vol. 10, no. 2106.
39. Keller, P.A., Harlam, B., Loewenstein, G., Volpp, K.G. (2011). Enhanced active choice: A new method to motivate behavior change. Journal of Consumer Psychology, vol. 21, pp. 376–383.
40. Keller. P.A., Harlam, B., Loewenstein, G., Volpp, K.G. (2011). Enhanced active choice: A new method to motivate behavior change. Journal of Consumer Psychology, vol. 21, pp. 376–383.
41. Kenter, J.,O'Brien, L., Hockley, N., Ravenscroft, N., Fazey, I., Irvine, K., Reed, M., Christie, M., Brady, E., Bryce, R., Church, A., Cooper, N., Davies, A., Evely, A., Everard, M., Fish, R., Fisher, J., Jobstvogt, N., Molloy, C., Orchard-Webb, J., Ranger, S., Ryan, M., Watson, V., Williams, S. (2015). What are shared and social values of ecosystems?. Ecological Economics, vol. 111, pp. 86–99.
42. Klein, L., Allegretti, G., Hes, D., Matos, L. (2018). A social values-based perspective on peer-to-peer energy sharing systems. In: Proceedings of the 5th European conference on behaviour and energy efficiency (BEHAVE 2018), Zurich, Switzerland, September 6–7, 2018.
43. Klein, L., Allegretti, G., Hes, D., Melkas, H. (2021). Revealing social values in the context of peer-to-peer energy sharing: A methodological approach. Sustainable Futures, vol. 3, pp. 100043, doi: 10.1016/j.sftr.2021.100043

44. Klein, L., Krivoglazova, A., Matos, L., Landeck, J., de Azevedo, M. (2020). A Novel Peer-to-Peer Energy Sharing Business Model for the Portuguese Energy Market. (MDPI, Ed.) Energies, vol. 13(1), 125, doi: https://doi.org/10.3390/en13010125
45. Klein, L., Matos, L., Allegretti, G. (2020). A Pragmatic Approach Towards End-User Engagement in the Context of Peer-to-Peer Energy Sharing. Energy 2020, vol. 205, pp. 118001, doi: https://doi.org/10.1016/j.energy.2020.118001
46. Koirala, B., Koliou, E., Friege, J., Hakvoort, R., Herder, P. (2016). Energetic communities for community energy: a review of key issues and trends shaping integrated community energy systems. Renewable and Sustainable Energy Reviews, vol. 56, pp. 722–744.
47. Kruger, J., Dunning, D. (1999). Unskilled and Unaware of It: How Difficulties in Recognizing One's Own Incompetence Lead to Inflated Self-Assessments. Journal of Personality and Social Psychology, vol. 77(6), pp. 1121–1134, doi: 10.1037/0022-3514.77.6.1121.
48. Leisinger, K. (2014). Global Values for Global Development. Sustainable Development Solutions Network (SDSN), Foundation Global Values Alliance, Switzerland.
49. Lieberman, M., (2013). Social: Why Our Brains are Wired to Connect. Crown Publishing Group, New York.
50. Liu, N., Yu, X., Wang, C., Li, C., Ma, L., Lei, J. (2017). An energy-sharing model with price-based demand response for microgrids of peer-to-peer prosumers. IEEE Transactions on Power Systems, vol. 32, pp. 3569–3583.
51. Long, C., Wu, J., Zhang, C., Cheng, M., Al-Wakeel, A. (2017). Feasibility of peer-to-peer energy trading in low voltage electrical distribution networks. Energy Procedia, vol. 105, pp. 2227–2232.
52. Long, C., Wu, J., Zhou, Y., Jenkins, N. (2018). Peer-to-peer energy sharing through a two-stage aggregated battery control in a community Microgrid. Applied Energy, vol. 226, pp. 261–276.
53. Marinho, S. (2006). O papel do Gatekeeper na comunicação informal das organizações: um estudo de caso em I&D. Revista Latinoamericana de Ciencias de la Comunicación, Organicom, pp. 1807–3026.
54. McCambridge, J., Witton, J., Elbourne, D.R. (2014). Systematic review of the Hawthorne effect: new concepts are needed to study research participation effects. J Clin Epidemiol, vol. 67 (3), pp. 267–77.
55. McDaniel, M.A., Frey, R.F., Fitzpatrick, S.M., Roediger III, H.L. (Eds.) (2014). Integrating Cognitive Science with Innovative Teaching in STEM Disciplines, Washington University in St. Louis, Missouri, US, doi: http://dx.doi.org/10.7936/K75Q4T1X.
56. Melamed, D., Simpson, B., Abernathy, J. (2020). The robustness of reciprocity: Experimental evidence that each form of reciprocity is robust to the presence of other forms of reciprocity. Science Advances, vol. 6(23), doi: 10.1126/sciadv.aba0504
57. Messick, S. (1995). Validity of psychological assessment: validation of inferences from persons' responses and performances as scientific inquiry into score meaning. Am. Psychol., vol. 50, pp. 741–749.

58. Moret, F., and Pinson, P. (2019). Energy Collectives: A Community and Fairness based Approach to Future Electricity Markets. IEEE Transactions on Power Systems, vol. 34(5), pp. 3994–4004, doi: https://doi.org/10.1109/TPWRS.2018.2808961
59. Navigant (2018). Energy Cloud 4.0: Capturing Business Value through Disruptive Energy Platforms. White paper, Navigant Consulting Inc.: Chicago, IL, USA.
60. Naylor, P. J., Wharf-Higgins, J., Blair, L., Green, L., & O'Connor, B. (2002). Evaluating the participatory process in a community-based heart health project. Social Science & Medicine, vol. 55(7), pp. 1173–1187, doi: http://dx.doi.org/10.1016/S0277-9536(01)00247-7
61. Official Gazette of the Republic of Portugal (2014). Decree-Law No. 153/2014. Official Gazette of the Republic of Portugal No. 202/2014, Series I from October 10, 2014. Portuguese Ministry of Environment, Land-Use Planning and Energy, pp. 5298–5311. Available at: https://data.dre.pt/eli/dec-lei/153/2014/10/20/p/dre/pt/html
62. Official Gazette of the Republic of Portugal (2019). Decree-law No. 162/2019. Official gazette of the republic of Portugal No. 206/2019, series I from October 25, 2019. Environment and Energy Transition - XXI Government – Portuguese Republic, pp. 45–62. Available at: https://data.dre.pt/eli/dec-lei/162/2019/10/25/p/dre
63. Official Gazette of the Republic of Portugal (2020). Dispatch No. 6453/2020. Official Gazette of the Republic of Portugal No. 118/2020, Series II from June 19, 2020. Office of the Assistant Secretary of State for Energy, Environment, and Climate Action, pp. 136–137. Available at: https://dre.pt/web/guest/pesquisa/-/search/136167767/details/normal?q=despacho+n.%C2%BA%206453%2F2020
64. Parag, Y. (2015). Beyond energy efficiency: a 'prosumer market' as an integrated platform for consumer engagement with the energy system. In: ECEEE 2015 summer study proceedings e foundations of future energy policy, Belambra Presqu'île de Giens, France, pp.15–23.
65. Parag, Y., Sovacool, B. (2016). Electricity market design for the prosumer era. Nature Energy, vol. 1, no. 16032.
66. Park, C., Yong, T. (2017). Comparative review and discussion on P2P electricity trading. Energy Procedia, vol. 128, pp. 3–9.
67. Plous, S. (1993). The psychology of judgment and decision making. McGraw-Hill. ISBN 978-0-07-050477-6.
68. Podger, D., Velasco, I., Luna, C., Burford, G., Harder, M. (2012). Can values be measured? Significant contributions from a small civil society organization through action research. Action Research, vol. 11, pp. 8–30.
69. Pordata: Base De Dados Portugal Contemporâneo (2017). Lisboa: Fundação Francisco Manuel dos Santos, n.d. Available at: https://www.pordata.pt/Municipios.
70. Repo, S., Kilkki, O., Annala, S., Klein, L., Matos, L., Sousa, J.E., Albuquerque, S. (2021). DOMINOES – a roadmap to integrated local energy market operation and management. In Proceedings of the 26th International Conference & Exhibition on Electricity Distribution (CIRED 2021), Geneva, Switzerland, Sep. 20-23, 2021.

71. Ribeiro, M.M., Hoover, E., Burford, G., Buchebner, J., Lindenthal T. (2016). Values: a bridge between sustainability and institutional assessment: a case study from BOKU University. International Journal of Sustainability in Higher Education, Emerald Group Publishing Limited, vol. 17(1), pp. 40–53, doi: https://doi.org/10.1108/IJSHE-12-2014-0170.
72. Robbins, N.M., Heiberger R.M. (2011). Plotting Likert and other rating scales. JSM Proceedings. Survey Research Methods Section. Alexandria, VA: American Statistical Association, pp. 1058–1066.
73. Roberts, J., Frieden, D., Gubina, A. (2019). Energy Community Definitions. Compile Project: Integrating Community Power in Energy Islands funded by the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 824424. Available at: https://www.compile-project.eu/
74. Rotmann, S., Mourik, R., & Goodchild, B. (2015). Once Upon a Time...How to tell a good energy efficiency story that 'sticks'. Stockholm: In: ECEEE 2015 Summer Study, Proceedings: First Fuel Now, June 1-6, pp. 113–122.
75. Roy, A.; Bruce, A.; MacGill, I. The Potential Value of Peer-to-Peer Energy Trading in the Australian National Electricity Market. In Proceedings of the Asia-Pacific Solar Research Conference, Canberra, Australia, 29 November–1 December 2016.
76. Ruotsalainen, J., Karjalainen, J., Child, M., Heinonen, S. (2017). Culture, values, lifestyles, and power in energy futures: a critical peer-to-peer vision for renewable energy. Energy Research & Social Science, vol. 34, pp. 231–239.
77. Santos, B.S. (2018). The End of the Cognitive Empire: The Coming of Age of Epistemologies of the South. Duke University Press, ISBN 9781478000150.
78. SurveyGizmo (2018). Plans & Pricing. Available at: https://www.surveygizmo.com/plans-pricing/
79. Uren, S. (2020, March 12). COVID-19: a dress rehearsal for the climate emergency? [Blog post], Forum for the Future. Retrieved from https://www.forumforthefuture.org/blog/covid-19-climate-emergency
80. Valkering, P., Laes, E., Kessels, K., Uyterlinde, M., Straver, K. (2014). How to engage end-users in smart energy behaviour? EPJ Web of Conferences, 79 (2014) 04003, doi: https://doi.org/10.1051/epjconf/20137904003
81. Van der Schoor, T., and Scholtens, B. (2015). Power to the people: local community initiatives and the transition to sustainable energy. Renewable & Sustainable Energy Reviews, vol 43, pp. 666–675.
82. Wolf, C., Jónsdóttir, G.A., Reeskens, T., Ernst Stähli, M. (2017). European Values Study 2017: Integrated Dataset (EVS 2017) - Matrix Design Data. GESIS Data Archive, Cologne. ZA7502 Data file Version 1.0.0, doi: https://doi.org/10.4232/1.13092.
83. Zhang, C., Wu, J., Long, C., Cheng, M. (2016). Review of existing peer-to-peer energy trading projects. Energy Procedia, vol. 103, pp. 147–152.

84. Zhang, C.; Cheng, M.; Zhou, Y.; Long, C. A Bidding System for Peer-to-Peer Energy Trading in a Grid-connected Microgrid. Energy Procedia 2016, 103, pp. 147–152.
85. Zhang, C.; Wu, J.; Zhou, Y.; Cheng, M.; Long, C. Peer-to-Peer energy trading in a Microgrid. Appl. Energy 2018, 220, 1–12.
86. Zhou, Y., Wu, J., Long, C. (2018). Evaluation of peer-to-peer energy sharing mechanisms based on a multiagent simulation framework. Applied Energy, vol. 222, pp. 993–1022.
87. Zhou, Y., Wu, J., Long, C., Cheng, M., Zhang, C. (2017). Performance Evaluation of Peer-to-Peer Energy Sharing Models. Energy Procedia, vol. 143, pp. 817–822.

Research Paper I

Revealing social values in the context of peer-to-peer energy sharing: A methodological approach

Authors	Lurian P. Klein; Giovanni Allegretti; Dominique Hes; Helinä Melkas
Journal	Sustainable Futures (ISSN: 2666-1888)
Publisher	Elsevier Ltd.
Type	Open Access
Status	Published
Full reference	Klein, L., Allegretti, G., Hes, D., Melkas, H. (2021). Revealing social values in the context of peer-to-peer energy sharing: A methodological approach. Sustainable Futures, vol. 3, pp. 100043
DOI information	10.1016/j.sftr.2021.100043

Authorship contribution statement

As this Ph.D. research contains research papers published in collaboration with other peers, an authorship contribution statement with the specification of the contribution of each co-author in each research paper is recommended.

A distinction is made between nine types of contributions: research design; methodology; literature review; data collection; data analysis; results discussion; writing — original draft preparation; writing — review and editing; main authorship.

Title of the research paper	Revealing social values in the context of peer-to-peer energy sharing: A methodological approach
Authors	Lurian P. Klein (L.K.); Giovanni Allegretti (G.A.); Dominique Hes (D.H.); Helinä Melkas (H.M.)

Ph.D. researcher	Lurian Pires Klein	**UC ID**	2015268381
Doctoral course	Sustainable Energy Systems (SES/EfS) doctoral program at the University of Coimbra		

	Co-authors			
Type of contribution	**L.K.**	**G.A.**	**D.H.**	**H.M.**
Research design	x	x	x	
Methodology	x	x	x	
Literature review	x			
Data collection	x			
Data analysis	x	x		x
Results discussion	x	x	x	x
Writing —original draft preparation	x			
Writing — review and editing	x	x	x	x
Main authorship	x			

Signatures

Lurian P. Klein (L.K.): _____

Giovanni Allegretti (G.A.): _____

Dominique Hes (D.H.): _____

Helinä Melkas (H.M.): _____

Research Paper II

A Pragmatic Approach Towards End-User Engagement in the Context of Peer-to-Peer Energy Sharing

Authors	Lurian P. Klein; Luisa M. Matos; Giovanni Allegretti
Journal	Energy (ISSN: 0360-5442)
Publisher	Elsevier B.V.
Type	Subscription
Status	Published
Full reference	Klein, L., Matos, L., Allegretti, G. (2020). A Pragmatic Approach Towards End-User Engagement in the Context of Peer-to-Peer Energy Sharing. Energy, vol. 205, pp. 118001
DOI information	10.1016/j.energy.2020.118001

Authorship contribution statement

As this Ph.D. research contains research papers published in collaboration with other peers, an authorship contribution statement with the specification of the contribution of each co-author in each research paper is recommended.

A distinction is made between nine types of contributions: research design; methodology; literature review; data collection; data analysis; results discussion; writing — original draft preparation; writing — review and editing; main authorship.

Title of the research paper	A Pragmatic Approach Towards End-User Engagement in the Context of Peer-to-Peer Energy Sharing
Authors	Lurian P. Klein (L.K.); Luisa M. Matos (L.M.); Giovanni Allegretti (G.A.)

Ph.D. researcher	Lurian Pires Klein	**UC ID**	2015268381
Doctoral course	Sustainable Energy Systems (SES/EfS) doctoral program at the University of Coimbra		

	Co-authors		
Type of contribution	**L.K.**	**L.M.**	**G.A.**
Research design	x	x	
Methodology	x	x	
Literature review	x		
Data collection	x		
Data analysis	x		
Results discussion	x	x	x
Writing —original draft preparation	x		
Writing — review and editing	x	x	x
Main authorship	x		

Signatures

Lurian P. Klein (L.K.): Lurian Klein

Luisa M. Matos (L.M.): Luisa Matos

Giovanni Allegretti (G.A.): Giovanni Allegretti

Research Paper III

A Novel Peer-to-Peer Energy Sharing Business Model for the Portuguese Energy Market

Authors	Lurian P. Klein; Aleksandra Krivoglazova; Luisa M. Matos; Jorge Landeck; Manuel de Azevedo
Journal	Energies (ISSN 1996-1073)
Publisher	MDPI
Type	Open Access
Status	Published
Full reference	Klein, L., Krivoglazova, A., Matos, L., Landeck, J., de Azevedo, M. (2020). A Novel Peer-to-Peer Energy Sharing Business Model for the Portuguese Energy Market. (MDPI, Ed.) Energies, vol. 13(1), 125, doi: 10.3390/en13010125
DOI information	10.3390/en13010125

Authorship contribution statement

As this Ph.D. research contains research papers published in collaboration with other peers, an authorship contribution statement with the specification of the contribution of each co-author in each research paper is recommended.

A distinction is made between nine types of contributions: research design; methodology; literature review; data collection; data analysis; results discussion; writing — original draft preparation; writing — review and editing; main authorship.

Title of the research paper	A Novel Peer-to-Peer Energy Sharing Business Model for the Portuguese Energy Market
Authors	Lurian P. Klein (L.K.); Aleksandra Krivoglazova (A.K.); Luisa M. Matos (L.M.); Jorge Landeck (J.L.); Manuel de Azevedo (M.A.)

Ph.D. researcher	Lurian Pires Klein	**UC ID**	2015268381
Doctoral course	Sustainable Energy Systems (SES/EfS) doctoral program at the University of Coimbra		

	Co-authors				
Type of contribution	**L.K.**	**A.K.**	**L.M.**	**J.L.**	**M.A.**
Research design	x	x	x	x	x
Methodology	x	x	x	x	x
Literature review	x	x			
Data collection	x	x			
Data analysis	x	x			
Results discussion	x	x	x	x	x
Writing —original draft preparation	x	x			
Writing — review and editing	x	x			
Main authorship	x				

Signatures

Lurian P. Klein (L.K.): Lurian Klein

Aleksandra Krivoglazova (A.K.):

Luisa M. Matos (L.M.): Luisa Matos

Jorge Landeck (J.L.): Jorge Landeck

Manuel de Azevedo (M.A.): PEREIRA DE AZEVEDO MANUEL MARIA - Y4716120F Assinado de forma digital por PEREIRA DE AZEVEDO MANUEL MARIA - Y4716120F Dados: 2021.04.26 08:39:05 +01'00'