sustainability

MDPI

Article

Renewable Energy Prosumers in Mediterranean Viticulture Social–Ecological Systems

Ines Campos [1,*], Esther Marín-González [1], Guilherme Luz [1], João Barroso [2] and Nuno Oliveira [3]

[1] Centre for Ecology, Evolution and Environmental Changes (CE3C), Faculty of Sciences, Lisbon University, 1649-004 Lisboa, Portugal; emgonzalez@fc.ul.pt (E.M.-G.); gpluz@fc.ul.pt (G.L.)
[2] Sustainability Plan for Wines of Alentejo, Comissão Vitivinícola Regional Alentejana, 7005-485 Évora, Portugal; joao.barroso@vinhosdoalentejo.pt
[3] Ecosystem management, Esporão SA, 1400-315 Lisboa, Portugal; nuno.oliveira@esporao.com
* Correspondence: iscampos@fc.ul.pt

Received: 8 November 2019; Accepted: 27 November 2019; Published: 29 November 2019

check for updates

Abstract: The significant energy demands of wine production pose both a challenge and an opportunity for adopting a low-carbon, more sustainable and potentially less expensive energy model. Nevertheless, the (dis)incentives for the wider adoption of local production and self-consumption of energy (also known as "prosumerism") from renewable energy sources (RESs) are still not sufficiently addressed, nor are the broader social–ecological benefits of introducing RES as part of a sustainable viticulture strategy. Drawing on the social–ecological systems (SESs) resilience framework, this article presents the results of a Living Lab (an action-research approach) implemented in Alentejo (South of Portugal), which is an important wine-producing Mediterranean region. The triangulation of results from the application of a multi-method approach, including quantitative and qualitative methods, provided an understanding of the constraining and enabling factors for individual and collective RES prosumer initiatives. Top enablers are related to society's expectation for a greener wine production, but also the responsibility to contribute to reducing carbon emissions and energy costs; meanwhile, the top constraints are financial, legal and technological. The conclusions offer some policy implications and avenues for future research.

Keywords: prosumers; renewable energy sources; Mediterranean wineries; constraints and enablers; social–ecological system; resilience

1. Introduction

Energy producers and consumers using renewable energy sources (RESs), often referred to as RES prosumers [1–3], may play an important role in the transformation of the energy system [4,5], which could evolve from a centralized and fossil-fuel-based model to a decentralized low-carbon system [6,7].

Notwithstanding the relevance of adopting RESs across most economic and industrial sectors [8,9], viticulture and winemaking are particularly relevant. According to Smyth and Russel [10], between 0.41 kg to 2 kg of CO_2 per wine bottle is released into the atmosphere, which could result in a total carbon footprint for the wine industry of 76.3 million tonnes of CO_2 (p. 1990). The same study concludes that if the global wine industry replaces its electricity needs with solar photovoltaics (PV), this renewable alone would eliminate 10.9 million tonnes of CO_2. Thus, adopting a renewables-based energy model is an important option in dealing with carbon-intensive agriculture practices, such as wine production [11,12].

Mediterranean wine-producing regions are vulnerable to climate change impacts, such as extreme weather events (e.g., irregular precipitation patterns, severe droughts, and heat waves), loss of biodiversity and soil degradation [13,14]. These regions require a long-term strategy to both mitigate and adapt to climate change impacts [13,15–17]. In this context, the high energy demands of wine production pose both a challenge and an opportunity for adopting a low-carbon, more sustainable and potentially less expensive energy model [18,19]. Furthermore, as vine-growers and winemakers become self-consumers of the energy they produce (i.e., become prosumers), new forms of collaboration may emerge that can increase this sector's adaptability and resilience to external challenges (e.g., climate change).

Alentejo in Portugal is a wine-producing region with a warm temperate climate and Mediterranean and Continental characteristics. It is, therefore, a case study for examining the interactions between viticulture and winemaking and the use of renewable energy sources.

Despite recent advances in the study of prosumers as key players in the energy transition [2], including prosumers in the wine market [20], a better understanding of the constraining and enabling factors that may act as (dis)incentives for local production and self-consumption of renewables in the wine sector is still needed. Some studies focused on the barriers faced by winemaking companies when adopting RESs [11,20]. Yet, in order to understand the transformative potential of prosumerism, it is critical to go beyond the individual adoption of RES systems and understand the potential for collaboration between viticulturists and winemakers with other social actors (municipalities, residents or other farming industries). New business models and governance arrangements may emerge through new collective self-consumption schemes involving these different actors.

This paper draws on the social–ecological systems (SESs) resilience framework [21] to analyse factors leading to a wider adoption of RES prosumerism in Alentejo's winemaking region. As an SES, winemaking is dependent on interrelated and co-evolving ecological, social and economic aspects. The sector is particularly dependent on a high (fossil fuel) energy expenditure [10]. Decentralised renewable energy production could reduce energy costs, as well as carbon emissions [22]. Thus, a wider adoption of a novel energy production and consumption model may increase SES resilience in winemaking.

The goal of this paper is to understand what the enabling and constraining factors are for individual and collective RES prosumers in the wine sector. The collective aspect is of importance, since we hypothesize that some factors acting as disincentives for individual prosumers may become incentives for collective initiatives. The paper also aims to capture how viticulturists and winemakers perceive the adoption of renewables, namely as a specific answer to a problem (e.g., the need to reduce energy costs) or as part of a strategy that aims to increase the resilience of the wine SES. This distinction is relevant since it can shape the way RESs are adopted through the establishment of interactions with other sub-systems (e.g., water management, land management, consumer behaviours and community engagement), and through collaborations with local communities and other stakeholders (e.g., tourism officers and local administrations). To understand this, the study draws on a co-creation approach (Living Labs).

The Living Labs (LLs) approach [23] is a form of participatory action-research [24,25], characterised by involving a multi-stakeholder community who shares a common goal. Setting up a LL provides an innovation space where new ideas, concepts, services or prototypes are co-created by the stakeholders to respond to a need and/or to find integrated solutions to problems [26,27]. For instance, Niitamo and colleagues [27] referred to LLs as an "emerging Public Private Partnership concept in which firms, public authorities and citizens work together to create, prototype, validate and test new services, businesses, markets and technologies in real-life contexts" (p. 45). Thus, the key characteristics of LLs are an active user involvement, real-life setting, involving multi-stakeholders, drawing on multiple methods (qualitative and quantitative) for data collection and analysis and following a co-creation approach [23].

Likewise, as a constellation of actors, including those that interact daily with the SES (e.g., vine growers and winery managers, often over generations of winemakers), a LL can replicate the functioning of an SES, integrating resilience thinking, increasing the capacity for learning and innovation and providing a space for adaptive co-management [28].

This study draws on the results of the first research cycle of a Living Lab named "RES for Sustainable Alentejo Viticulture". The LL brought together researchers, vine growers, managers and owners of wineries, entrepreneurs, companies working in the RESs sector, and the Alentejo Regional Winegrowing Commission (Comissão Vitivinícola Regional Alentejana (CVRA)), which is a private institution responsible for certifying, controlling and protecting Alentejo's wine production. The key goal set by the LL stakeholders was to develop a new energy model for the wine SES and contribute to CVRA's sustainability programme by promoting and facilitating the adoption of RES. Following a multi-method approach, qualitative and quantitative methods were applied to develop baseline knowledge on the potential of RES prosumerism in the context of viticulture.

We proceed as follows: the SES resilience framework and the Alentejo wine SES are explained in Section 1.1. The multi-method approach is described in Section 2 and the results are given and discussed in the following Sections 3 and 4, respectively. Finally, the conclusion distils our main findings and provides some policy implications and avenues for future research.

1.1. Social–Ecological Systems Resilience Framework and the Alentejo Wine SES

Natural and human systems are interdependent and require an interdisciplinary and integrated approach to understand the co-evolution of social and ecological elements [29]. The SES framework results from the meeting of socio-cultural and ecological sciences in an effort to achieve an integrated analysis of complex problems (e.g., resource depletion and climate change) [30,31].

SESs are dynamic systems, their elements are anything but stable; instead, they are constantly co-evolving, adapting or transforming through ongoing interactions within the bio-physical and socio-cultural environment. SESs are also complex, non-linear systems, which leads to unforeseeable outcomes emerging from the capacity of the system to adapt, cope with, re-arrange or renew itself [32,33]. As an SES cannot be controlled, command-and-control approaches to ecosystem management need to give way to an adaptive co-management approach [28]. The approach relies on the building-up of social networks and on the collaboration of multiple stakeholders (e.g., researchers, practitioners, local communities and policymakers), who embody different forms of knowledge, thus harnessing the potential of a system to deal with change.

According to Carl Folke, resilience is both a quality of an SES and a way of thinking since it refers to the ability of a system to absorb shocks, but also to its capacity for "renewal, re-organization, and development" [21] (p. 254) and to "the degree to which the system can build and increase the capacity for learning and adaptation" [21] (p. 260). Innovation is a scale within the SES, which may increase the adaptability of the system and/or help manage its resilience. Thus, innovation is central to resilience thinking as it may help change dominant patterns in order to harness the SES potential for transformative change.

Adaptability is a quality of resilience and losing one implies losing the other, leaving the system more vulnerable to environmental, social, economic or political shocks. Within the SES framework, "adaptability is referred as the capacity of people in a social-ecological system to build resilience through collective action, whereas transformability is the capacity of people to create a fundamentally new social-ecological system when ecological, political social or economic conditions make the existent system untenable" [21] (p. 262). Collective action is therefore a critical element for enabling either the adaptability or transformability of a system.

Alentejo's wine culture, a set of viticulture and vine growing practices leading to wine production and consumption, is an example of a social–ecological system. The region has traditionally been characterized by agro–silvo–pastoral systems [34,35]. The use of the land, adapted to its Mediterranean climate, included regions of evergreen forest (olive and oak trees), grazing areas and cultivation. Since the late twentieth century, Alentejo has witnessed a growth in intensive and extensive cultivation, as well as socioeconomic and policy changes, resulting in increased land abandonment, land degradation and high soil losses [36]. Sustainable agriculture and the capacity to attract population back to rural areas are considered essential strategies to tackle these problems [37,38]. Furthermore, Mediterranean wine regions are extremely vulnerable to the impacts of climate change due to their already high climate variability and propensity for extreme events (such as heat waves) [39] and soil degradation [13].

The availability of water for irrigation is becoming a persistent problem that can lead to serious water shortages in the future depending on different climate change scenarios [12,14]. However, irrigation is increasingly used in viticulture and winemaking, and consequently, energy needs are also increasing as a direct function of water use in the different processes carried out (i.e., irrigation, grape harvesting, cleaning of equipment, etc.) [10].

Renewable energy sources (RESs) have multiple benefits across the full cycle of viticulture and winemaking processes. This is well described in a study by Smyth and Russel [10], who show how RES can be integrated from the initial process of site preparation—using electric vehicles and equipment—to soil and disease control—using soil solarisation techniques to help retain heat in the soil and as a form of pest control and frost protection—as well as the use of PV-powered pumping systems for irrigation. For oenology, the needs of heating, cooling and maintenance of a controlled environment can be partially satisfied by both PV and thermal solar energy. Smyth and Russel equally mention the destemming, crushing and pressing processes of winemaking, arguing for the use of different solar solutions at each step.

Regarding solar photovoltaics, as well as other renewable energies (solar thermal, hydro from private dams and biomass), recent in-depth studies of eight Alentejo wineries [40–42] indicate that investments in renewables will allow for reductions in carbon emissions of between 19% and 35%. Thus, in the context of local energy production and self-consumption (i.e., prosumerism), the Alentejo wine SES shows a high potential for utilising both solar and biomass. Additionally, as they become RES prosumers, winemakers could potentially reduce energy bills and increase energy efficiency, which would create an upsurge in profits and reduce dependency on energy price fluctuations [43,44]. Alentejo may also be considered an example of a "wine tourism cluster" [45]; the growth of sustainable wine tourism may be a driver for attracting people to the region, creating new green jobs and helping to fight land abandonment [46].

2. Materials and Methods

In an SES, knowledge procurement results from the meeting of various knowledge systems and is gained through an ongoing learning process [47]. In this context, the wine SES benefits from the interaction between scientific knowledge (i.e., oenology) and traditional and local ecological knowledge [48,49]. Therefore, the methodology applied aimed to capture this transdisciplinarity [35].

2.1. Multi-Method Approach

The multi-method approach included a workshop, field diary notes and a questionnaire. The triangulation of the methods provided a good understanding of the constraining and enabling factors for increasing the adoption of RES technologies in the wine SES.

First, a "needs-assessment" workshop was conducted with the participation of LL stakeholders, including representatives of 10 wineries in the region. The participating wineries were among the largest companies in the region, including representatives of a cooperative of wineries. About a third of the participants were already using RESs, with installed capacities between 60 kW to 250 kW (photovoltaic). Another group had small installations and sought to increase their adoption of RESs, and finally, the last group had not yet installed any RES system. The workshop provided an overview of the challenges and opportunities regarding becoming RES prosumers from the perspective of local viticulture and winemaking employees and managers. A world café, i.e., a participatory method that facilitates debate involving a group of people working on different interconnected topics [37], was used to discuss barriers and opportunities for winemaking companies to adopt RESs.

Second, two case studies were explored, which we refer to as Company E and Company S. These companies were chosen because both come from a tradition of sustainable viticulture and winemaking in the region. Company E has been producing wine in the region for 40 years and has been innovating through its experimental land use management approach. Company S comes from a tradition of winemakers (which has been the family business for about 350 years), and its owners aim to continue increasing their knowledge through harmonising their past legacy with innovation and experimentation. Both companies are using RESs in their wineries and aim to continue increasing their installed capacity. Company E has an installation of 250 kW next to its grape vines, while Company S has a PV installation of 90 kW on the winery's rooftop. Despite being in the same region, there are key differences between the two in terms of energy needs due to the difference in the volume of wine produced and irrigation needs (e.g., Company E irrigates, while Company S does not).

Lastly, an online questionnaire was given (in Portuguese). The questionnaire included seven closed questions (see Table 1) and one open question. The response options of the questions were informed by the results of the first "needs-assessment" workshop and by the notes collected during the field trips to wineries in the region. The questionnaire was produced using the Google forms app and shared via email (between February and April 2019). It was given to a total of 1800 registered viticulturists in the region, of which 280 were also winemakers. Data regarding the collection of registered viticulturists was provided by CVRA, who also sent out the questionnaire to its members. With 59 valid responses (see Table S1), the sample was not representative of the entire sector; however, with a confidence level of 90% and a sample error of 10%, the sample size was statistically significant for the collection of wine producers in the region (N = 55), which corresponded to the main target population.

Table 1. Challenges and opportunities for a renewable energy source (RES)-based energy system in Alentejo's Wine social–ecological system (SES) online questionnaire (translated from Portuguese).

Question	Response Options
1. Does your wine company or cooperative have installed RES systems?	No, we do not have systems installed, nor intend to No, but we intend to have RES systems installed in the future Yes, we have installed RES systems
1.1. Why?	Open question (optional)
2. What renewable energies does your company/cooperative produce or plan to produce in the near future?	We do not intend to produce renewable energies Solar photovoltaics (PV) Solar Thermal Wind Energy Biogas Other
3. What is the regulatory regime of your current and future RES installation(s)?	We do not intend to produce renewable energies Self-consumption unit Small-production unit Former micro-generation scheme Do not know Other
4. What other technologies are in use in your wineries' energy system?	Thermal storage Electricity storage Smart meters Demand-side management systems Not applicable Other
5. If you produce or intend to locally produce energy from renewable sources, would you be interested in selling excess energy to other companies or local entities?	On a scale from 1 (not interested) to 6 (very interested)

Table 1. *Cont.*

Question	Response Options
6. In your opinion, what are the top five challenges constraining your local production and self-consumption of renewable energies?	Systems adapted to the seasonality of viticulture Cost of storage technologies Capacity of current storage technologies Cost of electric vehicles Initial cost of installation of photovoltaic system Cost of renewable technologies Low remuneration of surplus electricity sold to the grid Limitation of 250 kW of installed capacity in small production units Capacity of renewables to ensure a continuous and safe supply Adapting viticulture to the impacts of climate change in Alentejo Changes in landscape due to renewables Difficulty in accessing relevant information
7. In your opinion, what are the top five opportunities that motivate your local production and self-consumption of renewable energies	Capacity of installing and using renewable technologies Transition to electric mobility (e.g., introducing electric vehicles in grape harvesting) Rises in oil prices Decrease in the prices of renewables Decreased dependence on future price fluctuations in the energy market Possibility of selling excess energy to the grid New green jobs Good company image (sustainability) Expectations of society for a cleaner environment Decrease carbon emissions from wine production in Alentejo Adapt the wine industry to the impacts of climate change in Alentejo Other

3. Results

The following sections present the viticulturists and winemakers' perspectives regarding the constraining and enabling factors for adopting RESs, but also concerning the way RES adoption is perceived in the context of a wider sustainability approach.

Although this study has focussed on RESs, including different technologies, such as solar thermal, photovoltaic, wind, biomass, hydro or biogas, Living Lab stakeholders have addressed mainly solar photovoltaics and expressed little interest in discussing other technologies. This is possibly due to wind energy not having a high potential in the region, hydro energy being confined to private dams, and biomass and biogas appearing to be less appealing than solar energy (although throughout the LL interactions, researchers frequently mentioned the potential of biomass).

3.1. Needs Assessment Workshop: Constraints and Enablers

Factors acting as constraints and enablers are related to financial, regulatory and technological aspects, as well as environmental and socioeconomic aspects.

Concerning constraining financial factors, viticulturists and winemakers highlighted the initial cost of an installation of photovoltaic systems, which is the most commonly used renewable in the region. Additionally, the high cost of storage technologies (batteries) is also a problem. The payback period of the initial investment for a solar panel installation would take up to between 7 to 12 years (depending on the installed capacity). However, wineries were not yet able to profit from selling surplus energy to another consumer. Until October 2019, Portuguese law (i.e., Decree-Law 153/2014, Self-Consumption Law) allowed the sale of surplus energy to the grid (in a system of self-consumption) for a low price (90% of the average wholesale market price). A new law for collective self-consumption (Decree-Law 162/2019) was issued in October 2019, yet it does not include any additional support schemes (such as feed-in-tariffs) for the compensation for surplus energy. Given the high environmental and economic costs of using batteries, prosumerism would be more attractive if financial compensation for locally produced electricity sold to the grid was higher.

On the other hand, the progressively lower prices and increase in productivity of solar panels appeared as opportunities. Workshop participants also agreed they would like to reduce their dependency on fossil fuels and on the fluctuations of energy market prices. It was found that should the Portuguese self-consumption law change to allow selling or exchanging surplus energy directly with other consumers (e.g., village residents, municipality or other farmers), this would enable new investments since the return on investment could be higher.

Regarding constraining technological factors, participants found that storage technologies are not yet sufficiently developed (and have high environmental costs, linked to lithium extraction), but a major challenge for wineries is that any energy model must be adapted to the seasonality of production activities. This poses a problem for the installed capacity and the contracted capacity. If wineries opt for an installation that covers the peak energy needs of the harvest season, which corresponds to the months when solar energy is abundant (i.e., between July/August and October/November), there will be a significant surplus for most of the year. Should the Portuguese law allow seasonal contracted capacity for farmers, this would provide a good incentive. On the upside, new RES technologies tend to be cheaper and increasingly easier to install and use. Also, the development of electric vehicles, including electric tractors, could offer an important incentive since surplus energy could be used to charge these vehicles' batteries.

Regarding environmental issues, producers mostly pointed to enabling factors and incentives to act. Alentejo is perceived as a region with an enormous solar potential due to its warm Mediterranean climate and its geographic characteristics. All agreed that wine production is a high energy intensity activity and the need to reduce carbon emissions is an important driver for adopting RES. Not surprisingly, viticulturists and winemakers are concerned with the need to adapt viticulture to the impacts of climate change and its consequences (e.g., soil degradation, alteration of grape properties and wine quality and increased fire risk), and to increase the resilience to external shocks, such as eventual energy supply disruptions.

Regarding sociocultural factors, workshop participants referred to some constraints, namely a cultural resistance to change, including among those who work in viticulture. There is a prevailing notion that renewables are not yet capable of ensuring a continuous and safe supply. Nevertheless, integrating RES was found to be good marketing for wine companies, who would be meeting society's expectations for a cleaner and more sustainable environment. The possibility of creating new "green jobs" was also mentioned.

3.2. Field Notes: A Holistic Perspective

The owners and managers of the two wineries visited (i.e., Company E and Company S) showed a holistic perspective about winemaking. In these wineries, adopting renewables was understood as part of a broader ecological vision, wherein the environmental, economic and social domains are intrinsically connected. These winemakers were aware of the impacts of climate change and the need for an energy transition in the sector.

In both wineries, caring for the soils by reducing or eliminating chemical pesticides and fertilizers was considered a crucial part of a more sustainable business. While in Company E, all production is already organic, in Company S, the owners opted for not irrigating, gradually moving toward an organic production and adopting soil regeneration techniques using organic compost. One of the owners of Company S explains that: "Vines can have small roots, but if you irrigate, they get addicted to water. If they have no water, roots can grow up to five metres to find water, and the vines become more resilient to weather changes."

In Company E, climate change adaptation is well-integrated into wine production. The company had a testbed of nearly 200 grape varieties to study which are better adapted to climate change impacts and their consequences.

Ensuring water and energy efficiency and adopting circular economy strategies are important targets for both wineries. In Company S, biomass from the by-products of destemming was used as soil compost. In Company E (who produces both wine and olive oil), olive stones were used to produce biomass for heating purposes.

Company E had a photovoltaic installation of 250 kW, but the owners aimed to increase it to a 500-kW installed capacity, which would provide 50% of energy needs during the peak season. Company E's managers were also considering using storage to supply energy during peak hours when it is more expensive. As one engineer explained, this would allow for switching off the grid connection in these periods and to use stored energy, as well as energy from the photovoltaic station. As storage costs decrease, this option will become increasingly viable.

When considering direct exchanges with other prosumers, the managers of the two wineries agree that this would be important to incentivise the adoption of RES technologies. Both wineries would be interested in developing business models that would promote a wider adoption of RES by other economic agents in the region, where RES prosumers would be able to directly exchange their surplus energy.

3.3. Questionnaire on Barriers and Opportunities

Of the 59 grapevine growers and wineries who responded to the questionnaire, only 5% did not plan to implement any RES production, 47.5% had installed RES systems, while 47.5% planned to integrate RES production in the future.

Regarding the reasons for installing (or not) RES systems, 20 respondents provided an answer (this was the only open question included in the form). The key words mostly used were "sustainability of the company", "lack of information" and "high investment". Responses to this open question stressed the value of RESs as part of a more environmentally and economically sustainable policy for the company. Four respondents pointed out the benefit of saving on energy costs, as well as the benefit of using RESs together with water-pumping systems. The need for more information and the high cost of initial investments was mentioned by three respondents. One respondent pointed out that the high cost was particularly restrictive given that there are other investment priorities related to the wineries' core businesses. Finally, the possibility of lowering dependency on conventional fuels and centralized systems was also mentioned by one respondent, and bureaucracy and administrative hurdles for installing solar panels were referred to as a problem by another.

Concerning the main energy source used, solar photovoltaics was the most common (36), followed by combinations of solar PV and thermal (18) (Figure 1). There were no responses indicating that biogas was used.

Up until 2019, the Portuguese self-consumption law had defined two types of small-scale RES installations, namely small production unit (UPP) (of up to 250 kW), in which all energy is injected to the grid (this type of unit does not allow self-consumption and is to be discontinued in 2020); and small self-consumption units (UPAC), which should be dimensioned according to local energy consumption needs. When asked about the regulatory regime of an existing or future RES installation in their winery or property (Figure 2), 23 responded they were covered (or planned to be) by the UPAC regime, 11 have had an UPP and 3 were using both types of units. Additionally, up until 2012, the regulatory framework for RES micro-generation included a feed-in-tariff (FIT), which has ended. Yet, 5 respondents (who must have installed their systems before 2012) were still benefiting from the previous legal regime, in combination or not with others. Finally, 2 respondents replied "None" and 15 replied "don't know". Those that "didn't know" corresponded to some of the respondents who did not yet have an installation but were planning to. Also, some respondents did not know which regime their installation fitted into.

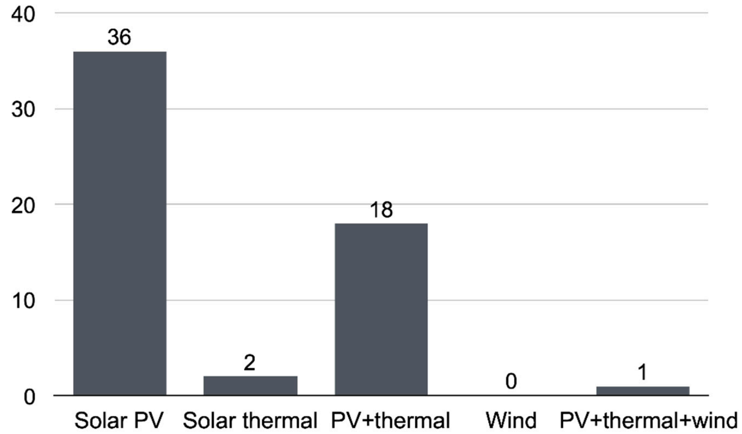

Figure 1. RESs used or planned to be used by the viticulture or winemaking companies (The (y) axis shows number of replies; and the (x) axis the response options).

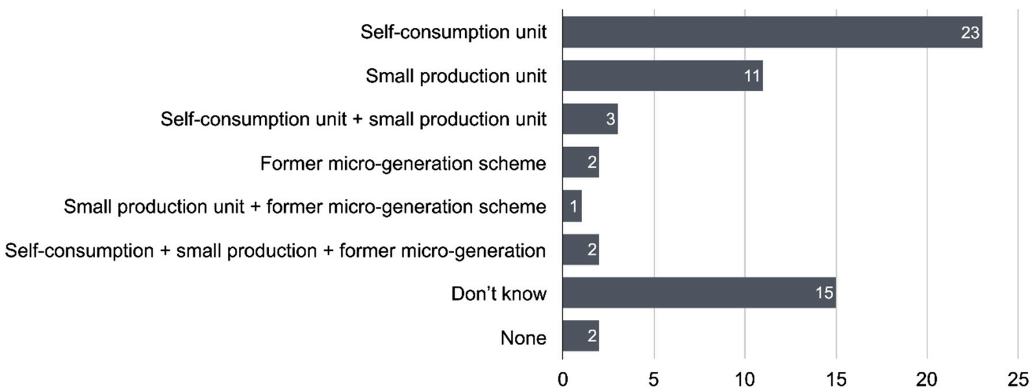

Figure 2. Regulatory regime of the current or future (planned) RES production unit (The (y) axis shows the response options; and the (x) axis the number of replies).

Overall, grape and wine producers were pretty (31%) or very interested (64%) in selling their surplus energy to another company, local entity or consumer (see Figure 3). Until October 2019, this was not allowed in Portugal, yet a law for collective self-consumption (Decree-Law 162/2019 for collective self-consumption and renewable energy communities) is coming into force in early 2020.

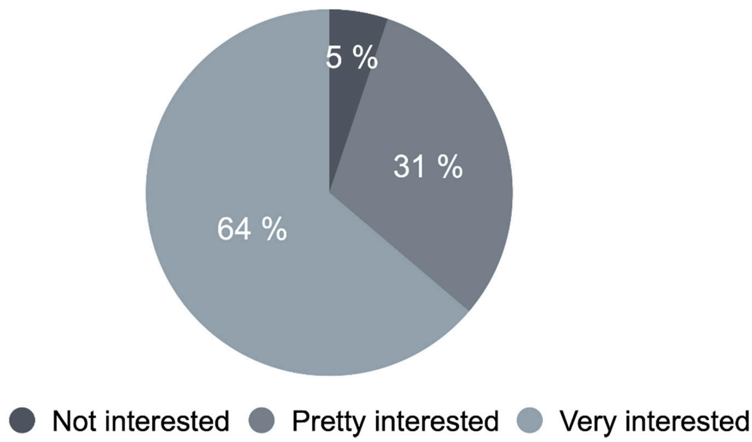

Figure 3. Interest in selling surplus energy to other companies or consumers (in percentage).

Concerning the challenges constraining the production and self-consumption of renewables, the top three options (of the 13 response options, plus the option "others") were the cost of the installation of photovoltaic systems (83.1%), followed by the cost of storage technologies (62.7%) and the low renumeration for surplus energy sold to the grid (49.2%) (Figure 4).

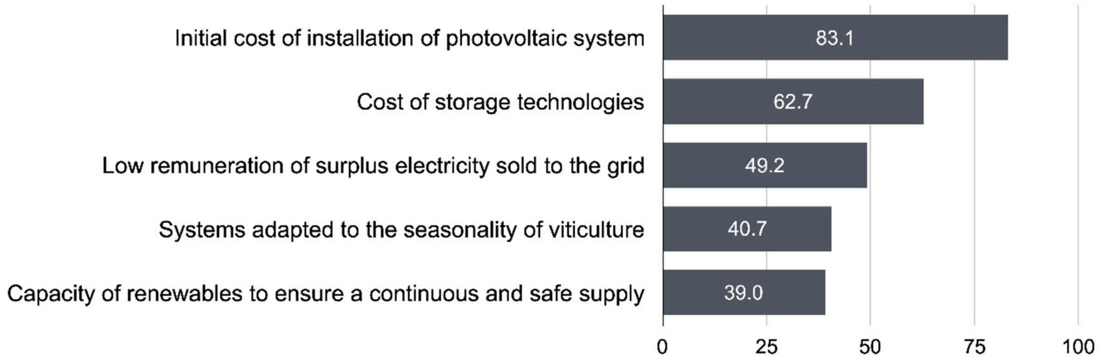

Figure 4. Top five challenges that constrain RES production and self-consumption (in percentages).

Regarding the opportunities motivating the production and self-consumption of renewables in grape and wine producers, the top three options (of the 13 response options, plus the option "others") were a good company image (71.2%) and meeting the expectations of society for a cleaner environment (71.2%), followed by a reduced dependency on future price fluctuations in the energy market (61.0%) (Figure 5).

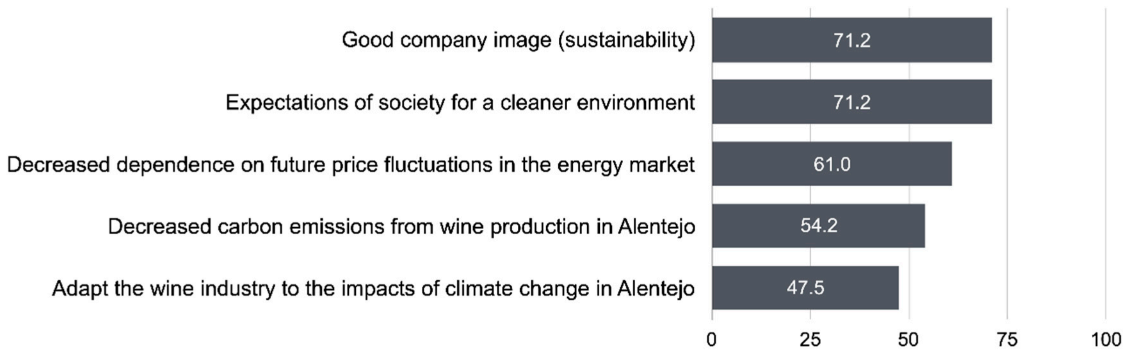

Figure 5. Top five opportunities that motivate RES production and self-consumption (in percentage).

3.4. Triangulation of Results

Results of the different methods applied show a strong agreement in the findings obtained between the workshop and the online questionnaire, while the field notes reinforced the environmental and cultural factors. The most relevant and correlated factors found in the workshop and questionnaire were the following:

The key constraining factors were the initial cost of installing PV systems, the high cost of storage technologies and a low remuneration of surplus electricity sold to the grid and/or not being possible to sell surplus energy to other consumers or prosumers. This last aspect was especially relevant since 95% of the questionnaire respondents seemed to be in favour of this possibility (see Figure 5). Another correlated and relevant legal challenge is the need for RES systems to be adapted to the seasonality of viticulture and winemaking practices (allowing for an optimized installed capacity). This result was also confirmed through the field notes.

The key enabling factors were gaining a good company's marketing image (sustainability); meeting society's expectations for environmental sustainability; reducing dependency on future energy price fluctuations and dependency on fossil fuels; development of RES technologies (including electric vehicles, which could provide a use to surplus energy from local installations); and the prospect of reducing carbon emissions from wine production.

While most constraints related to financial, regulatory and technological reasons (in this order), the key enabling factors were social, environmental and technological (also in this order).

The field notes provided some additional findings regarding the perspectives of winemakers related to a sense of responsibility to contribute to climate change mitigation, as they are aware of the need to reduce emissions and seem open to experiment and adopt new RES-based solutions.

4. Discussion

Portuguese vine-growers and winemakers are aware of the need to transform the current energy sub-system within the wine SES to increase its resilience. Moreover, these stakeholders expressed their views on the interlinkages between soil regeneration, irrigation needs and energy sources. RES prosumerism is seen as part of a broader strategy for preserving and restoring local ecosystem services, which includes climate adaptation measures (e.g., testing different grape varieties, choosing not to irrigate and reducing or eliminating the use of chemical pesticides and fertilizers). In this context, traditional local and ecological knowledge is a significant asset for viticulture realities, supporting the claim for the importance of different systems of knowledge in building SES resilience [49,50]. A holistic perspective of the social, economic and environmental dimensions seems prevalent, and beyond quantity, the quality of wine production is constantly measured against the consequences of inaction in the context of climate change.

When reflecting on the enabling and constraining factors for integrating a higher share of RES and becoming prosumers, winemakers considered different interrelated aspects.

RES prosumerism is seen as an economic benefit. Similarly, a study of Spanish wineries showed that the use of RES for energy production can reduce energy bills and increase energy efficiency in the sector [43]. Using RES is also perceived to be important for the marketing of a greener and more environmentally sustainable wine company, which is relevant for wine tourism. From the stakeholders' perspectives, there is a strong correlation between the companies' marketing images and wine tourism, which is consistent with the literature on wine tourism and sustainability [51,52].

In the context of Alentejo, by creating new "green jobs", introducing RES was also understood to prevent, or even reverse, land abandonment. This topic has been explored in detail by Zambon and colleagues who presented the case of agro-energy districts, such as in the Italian wine sector, arguing that these represent a new future for viticulture [53], creating new economic opportunities for local communities, whilst developing new viticulture practices.

Despite the high cost of initial investments, the environmental, economic and social benefits that may come with a wider update of renewables are important incentives. Related to this, the personal values of managers and winery owners could play an important role as an incentive to seek for more sustainable practices, which was also concluded in studies of wineries in the United States and New Zealand [54,55].

Thus, the transition to a new energy model in which viticulturists and winemakers become RES prosumers is perceived to be more than a decarbonization strategy, it is also seen as a business strategy (e.g., reducing energy costs), a marketing and innovation strategy (with benefits for wine tourism) and a strategy against land abandonment in the region (e.g., creating new jobs, involving local communities and developing new partnerships).

Technological and technical-related cultural aspects are equally relevant, and some winemakers were wary of the capacity of renewable technologies to respond to the high energy needs of wineries, in particular, during the harvest season, which is consistent with the study of Garcia-Casarejos and colleagues [11] who clearly identified a group of wineries in Spain with this perspective. Changing cultures was identified as a barrier since it requires managers to thoroughly explain to their teams the benefits of introducing RES technologies.

Financial and regulatory aspects appeared as key constraints for individual producers. Regulatory barriers were also found in the study of the adoption of RES in Spanish wineries, where "administrative obstacles" were thought to be reinforcing the reluctance of some wineries in not investing in renewables [11]. However, the regulatory barriers in the Portuguese case were linked to self-consumption policies. The impossibility of selling surplus energy to other consumers appeared as a top constraint, which strengthens the argument that collective action is important to further develop the integration of RESs in the sector. Legal frameworks for self-consumption are currently changing in Portugal to allow, for the first time, setting up collective self-consumption schemes and renewable energy communities (i.e., new Decree-Law 162/2019). These changes will open the way to innovative collaborative business schemes that are likely to provide more attractive options and promote investment of individual wineries in RES systems [44]. The issue of the seasonality of production activities is equally a key constraint which could be resolved by new legislations, allowing for seasonal capacity contracts for farmers who use RESs, or even specific tax benefits.

The results indicate there was a drive to work together in developing collective solutions that accelerate the adoption of RES in the sector. Despite being competitors in the market, Alentejo winemakers seemed to recognize a benefit in developing new partnerships and networks when it comes to adopting RES. Working collectively, prosumers could set up business models that would provide new opportunities to increase RES adoption [56], and would therefore increase the adaptability and transformability of the SES. New business models could include peer-to-peer schemes [7], setting up community energy services involving a nearby village or other wineries [57] or using excess energy during the non-peak harvest season to charge electrical vehicles [58]. Allowing wineries to offer new services, such as charging electric cars [59], could imply a collective self-consumption scheme where other actors participate (e.g., cooperatives, municipalities and villages) [60], with mutual benefits for those involved [61,62]. Finally, integrating RESs in winemaking could also offer a better final product for the increasing number of consumers who value environmentally friendly wines [51,63].

5. Conclusions

Sustainable viticulture is intertwined with the environmental, economic and cultural domains in which it develops. Viticulturists and winemakers in the Alentejo region are aware of the necessity to understand and manage vineyards as complex ecosystems in which environmental aspects, but also technical and cultural practices, shape crop features and wine quality. The practice of viticulture and winemaking can be part of a global transition to low-carbon and more sustainable production and consumption patterns through conferring winemakers with the role of RES prosumers. Regions, such as Alentejo, are extremely vulnerable to climate change, yet offer optimal geographic and climatic conditions for mainstreaming the use of RESs. Despite the focus on winemaking, the conclusions of this study offer equally relevant insights for research on the integration of RES prosumerism in other farming sectors.

The top constraining factors were financial and legal, while top enabling factors were related to environmental reasons and to meeting society's expectations for a cleaner and greener environment in relation to sustainable production. These were valuable incentives for RES prosumerism, more so in Alentejo where wine tourism is an increasingly important revenue source.

Given the key identified hindering factors, agriculture subsidies should help finance small-scale RES production and self-consumption schemes. New business models, involving the collaboration of different stakeholders and local communities, seem fundamental to incentivising a wider uptake of RES prosumerism in wineries and other farming activities. Legislation should be as flexible as possible to allow for bottom-up creativity and innovative solutions for adopting renewables. New energy and sustainability policies for the sector and for the region, as well as climate change mitigation and adaptation plans, need to seriously consider the need to support the development of new business models, which make it more attractive for winemakers and other farmers to invest in RES technologies as part of their business.

Future research and innovation studies should focus on developing winemaking business models (which are also applicable to other agro-industry sectors) that integrate new services through collective schemes (e.g., energy cooperatives) and new governance arrangements where companies collectively benefit from energy exchanges and provide new services, including sustainable tourism services. Research should consider the economic benefits of a higher share of RES prosumers in viticulture and winemaking activities, but also explore other social and cultural benefits, including the role of a more resilient winemaking SES in the fight against land abandonment in Alentejo and other Mediterranean viticulture regions.

Finally, the approach used in this study, namely Living Labs, offered a platform for collective action, and co-management and co-creation approaches, that are capable of addressing the complexity of an SES and contributing to build up resilience. Thus, Living Labs can be used as a tool to increase a systems' adaptability and resilience in other SES studies.

Supplementary Materials: The following are available online at http://www.mdpi.com/2071-1050/11/23/6781/s1, Table S1: Respostas do Formulário.

Author Contributions: The two first authors, I.C. and E.M.-G. have equally contributed to the investigation and to the final draft of the paper. Together, the two authors have conceptualized the study, developed and implemented the methodology, collected data and analysed the results. I.C. has coordinated the writing of the full final draft of the paper, to which E.M.-G. has contributed mainly in the methodology and results sections, including the production of the final graphs (i.e., Figures 1–5). The final draft was also extensively discussed by both first authors. G.L. has reviewed the manuscript and contributed to the design and implementation of the methodology, validation and investigation, including data collection. J.B. and N.O.'s contributions to the paper were related with the validation of some of the data presented, and resources, as well as reviewing and editing the paper's content regarding the Alentejo wine industry and its potential role regarding prosumerism.

Funding: This research was funded by the European Union's Horizon 2020 research and innovation programme under grant agreement no. 764056. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the funding authorities. The funding authorities are not responsible for any use that may be made of the information contained therein. The Centre for Ecology, Evolution and Environmental Changes to which the three authors are affiliated, received national funds through FCT (Fundação para a Ciência e a Tecnologia) in the frame of the project UID/BIA/00329/2019

Acknowledgments: The authors acknowledge all those who participated in the Living Lab work (wine companies, wine cooperatives, researchers and invited experts). A special thanks to CVRA (the Wines of Alentejo) for facilitating contacts with wine producers and other stakeholders, and for collaborating with our research team throughout the Living Lab process.

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

References

1. De Vries, G.W.; Boon, W.P.C.; Peine, A. User-led innovation in civic energy communities. *Environ. Innov. Soc. Transit.* **2016**, *19*, 51–65. [CrossRef]
2. Butenko, A. User-Centered Innovation and Regulatory Framework: Energy Prosumers' Market Access in EU Regulation. 2016. Available online: http://dx.doi.org/10.2139/ssrn.2797545 (accessed on 30 May 2019).
3. Bellekom, S.; Arentsen, M.; van Gorkum, K. Prosumption and the distribution and supply of electricity. *Energy Sustain. Soc.* **2016**, *6*, 22. [CrossRef]
4. CE Delft. *The Potential of Energy Citizens in the European Union*; CE Delft: Delft, The Netherlands, September 2016; Available online: https://www.cedelft.eu/publicatie/the_potential_of_energy_citizens_in_the_european_union/1845 (accessed on 25 August 2019).
5. Van der Schoor, T. Local Citizen Initiatives and Transitions to Energy Sustainability. Available online: https://research.hanze.nl/ws/portalfiles/portal/3444082/107.Local_citizen_initiatives_SB13_Oulu_vdSchoor_1_.pdf (accessed on 25 July 2019).
6. Newbery, D.M. Towards a green energy economy? The EU Energy Union's transition to a low-carbon zero subsidy electricity system—Lessons from the UK's Electricity Market Reform. *Appl. Energy* **2016**, *179*, 1321–1330. [CrossRef]
7. Morstyn, T.; Farrell, N.; Darby, S.J.; McCulloch, M.D. Using peer-to-peer energy-trading platforms to incentivize prosumers to form federated power plants. *Nat. Energy* **2018**, *3*, 94. [CrossRef]

8. Dóci, G.; Vasileiadou, E.; Petersen, A.C. Exploring the transition potential of renewable energy communities. *Futures* **2015**, *66*, 85–95. [CrossRef]
9. Croonenbroeck, C.; Lowitzsch, J. From Fossil to Renewable Energy Sources. In *Energy Transition: Financing Consumer Co-Ownership in Renewables*; Lowitzsch, J., Ed.; Springer International Publishing: Cham, Switzerland, 2019; pp. 29–58. ISBN 978-3-319-93518-8.
10. Smyth, M.; Russell, J. 'From graft to bottle'—Analysis of energy use in viticulture and wine production and the potential for solar renewable technologies. *Renew. Sustain. Energy Rev.* **2009**, *13*, 1985–1993. [CrossRef]
11. Garcia-Casarejos, N.; Gargallo, P.; Carroquino, J. Introduction of Renewable Energy in the Spanish Wine Sector. *Sustainability* **2018**, *10*, 3157. [CrossRef]
12. Galbreath, J.; Charles, D.; Oczkowski, E. The Drivers of Climate Change Innovations: Evidence from the Australian Wine Industry. *J. Bus. Ethics* **2016**, *135*, 217–231. [CrossRef]
13. Fraga, H.; García de Cortázar Atauri, I.; Malheiro, A.C.; Santos, J.A. Modelling climate change impacts on viticultural yield, phenology and stress conditions in Europe. *Glob. Change Biol.* **2016**, *22*, 3774–3788. [CrossRef]
14. Fraga, H.; Malheiro, A.C.; Moutinho-Pereira, J.; Santos, J.A. An overview of climate change impacts on European viticulture. *Food Energy Secur.* **2012**, *1*, 94–110. [CrossRef]
15. Malheiro, A.; Santos, J.; Fraga, H.; Pinto, J. Climate change scenarios applied to viticultural zoning in Europe. *Clim. Res.* **2010**, *43*, 163–177. [CrossRef]
16. Costa, J.M.; Vaz, M.; Escalona, J.; Egipto, R.; Lopes, C.; Medrano, H.; Chaves, M.M. Modern viticulture in southern Europe: Vulnerabilities and strategies for adaptation to water scarcity. *Agric. Water Manag.* **2016**, *164*, 5–18. [CrossRef]
17. Mozell, M.R.; Thach, L. The impact of climate change on the global wine industry: Challenges & solutions. *Wine Econ. Policy* **2014**, *3*, 81–89.
18. Galitsky, C.; Worrell, E.; Radspieler, A.; Healy, P.; Zechiel, S. *BEST Winery Guidebook: Benchmarking and Energy and Water Savings Tool for the Wine Industry*; Lawrence Berkeley National Laboratory: Berkeley, CA, USA, 2005.
19. FAO. *The State of Food and Agriculture. Climate Change, Agriculture and Food Security*; FAO: Rome, Italy, 2016.
20. Dressler, M. Prosumers in the wine market: An explorative study. *Wine Econ. Policy* **2016**, *5*, 24–32. [CrossRef]
21. Folke, C. Resilience: The emergence of a perspective for social-ecological systems analyses. *Glob. Environ. Change* **2006**, *16*, 253–267. [CrossRef]
22. Johnson, V.; Hall, S. Community energy and equity: The distributional implications of a transition to a decentralised electricity system. *People Place Policy Online* **2014**, *8*, 149–167. [CrossRef]
23. Haukipuro, L.; Väinämö, S.; Hyrkäs, P. Innovation Instruments to Co-Create Needs-Based Solutions in a Living Lab. *Technol. Innov. Manag. Rev.* **2018**, *8*, 22–35. [CrossRef]
24. Campos, I.S.; Alves, F.M.; Dinis, J.; Truninger, M.; Vizinho, A.; Penha-Lopes, G. Climate adaptation, transitions, and socially innovative action-research approaches. *Ecol. Soc.* **2016**, *21*. [CrossRef]
25. Schaffers, H.; Guzman, J.G.; Merz, C. An Action Research Approach to Rural Living Labs Innovation. 2008. Available online: https://www.semanticscholar.org/paper/An-Action-Research-Approach-to-Rural-Living-Labs-Schaffers-Guzm%C3%A1n/4c8d3706527ee4b0752e17c014da6362b7b25b26?citationIntent=background#citing-papers (accessed on 25 August 2019).
26. Schumacher, J.; Feurstein, K. Living Labs–the user as co-creator. In Proceedings of the 2007 IEEE International Technology Management Conference (ICE), Sophia-Antipolis, France, 4–6 June 2007; pp. 1–6.
27. Santonen, W.T.; Creazzo, L.; Griffon, A.; Bódi, Z.; Aversano, P. Cities as Living Labs–Increasing the Impact of Investment in the Circular Economy for Sustainable Cities. 2017. Available online: https://ec.europa.eu/research/openvision/pdf/rise/cities_as_living_labs.pdf (accessed on 26 August 2019).
28. Armitage, D.R.; Plummer, R.; Berkes, F.; Arthur, R.I.; Charles, A.T.; Davidson-Hunt, I.J.; Diduck, A.P.; Doubleday, N.C.; Johnson, D.S.; Marschke, M.; et al. Adaptive co-management for social–ecological complexity. *Front. Ecol. Environ.* **2009**, *7*, 95–102. [CrossRef]
29. Liu, J.; Dietz, T.; Carpenter, S.R.; Alberti, M.; Folke, C.; Moran, E.; Pell, A.N.; Deadman, P.; Kratz, T.; Lubchenco, J.; et al. Complexity of Coupled Human and Natural Systems. *Science* **2007**, *317*, 1513–1516. [CrossRef]
30. McGinnis, M.D.; Ostrom, E. Social-ecological system framework: initial changes and continuing challenges. *Ecol. Soc.* **2014**, *19*, art30. [CrossRef]

31. Ostrom, E. A General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science* **2009**, *325*, 419–422. [CrossRef] [PubMed]
32. Folke, C.; Carpenter, S.R.; Walker, B.; Scheffer, M.; Chapin, T.; Rockström, J. Resilience Thinking: Integrating Resilience, Adaptability and Transformability. *Ecol. Soc.* **2010**, *15*. [CrossRef]
33. Garmestani, A.S.; Benson, M.H. A Framework for Resilience-based Governance of Social-Ecological Systems. *Ecol. Soc.* **2013**, *18*, art9. [CrossRef]
34. Correia, T.P. Threatened landscape in Alentejo, Portugal: the 'montado' and other 'agro-silvo-pastoral' systems. *Landsc. Urban Plan.* **1993**, *24*, 43–48. [CrossRef]
35. Guimarães, M.H.; Guiomar, N.; Surová, D.; Godinho, S.; Pinto Correia, T.; Sandberg, A.; Ravera, F.; Varanda, M. Structuring wicked problems in transdisciplinary research using the Social–Ecological systems framework: An application to the montado system, Alentejo, Portugal. *J. Clean. Prod.* **2018**, *191*, 417–428. [CrossRef]
36. Jones, N.; de Graaff, J.; Rodrigo, I.; Duarte, F. Historical review of land use changes in Portugal (before and after EU integration in 1986) and their implications for land degradation and conservation, with a focus on Centro and Alentejo regions. *Appl. Geogr.* **2011**, *31*, 1036–1048. [CrossRef]
37. Campos, I.; Vizinho, A.; Truninger, M.; Penha Lopes, G. Converging for deterring land abandonment: a systematization of experiences of a rural grassroots innovation. *Community Dev. J.* **2016**, *51*, 552–570. [CrossRef]
38. Huntjens, P.; Pahl-Wostl, C.; Rihoux, B.; Schlüter, M.; Flachner, Z.; Neto, S.; Koskova, R.; Dickens, C.; Nabide Kiti, I. Adaptive Water Management and Policy Learning in a Changing Climate: A Formal Comparative Analysis of Eight Water Management Regimes in Europe, Africa and Asia: Adaptive Water Management and Policy Learning in a Changing Climate. *Environ. Policy Gov.* **2011**, *21*, 145–163. [CrossRef]
39. Sadras, V.; Moran, M.; Petrie, P. Resilience of grapevine yield in response to warming. *OENO ONE* **2017**, *51*. [CrossRef]
40. Baêta, S.A. de A. Promoção Do Uso Eficiente De Água E Energia Em Unidades De Produção Vitivinícola: Estudos De Caso Da Adega Mayor E Granacer. Ph.D. Thesis, Lisbon University, Lisboa, Portugal, 2016.
41. Lopes, C.W. Promoção Do Uso Eficiente De Água E Energia Em Unidades De Produção Vitivinícola: Estudos De Caso Da Adega Cooperativa De Vidigueira, Cuba E Alvito, Herdade Das Servas E Roquevale. Ph.D. Thesis, Lisbon University, Lisboa, Portugal, 2017.
42. Mendonça, A.M.R. Promoção Do Uso Eficiente De Água E De Energia Em Unidades De Produção Vitivinícola: Estudo Dos Casos Da Herdade Dos Grous E Herdade Da Mingorra. Ph.D. Thesis, Lisbon University, Lisboa, Portugal, 2016.
43. Gómez-Lorente, D.; Rabaza, O.; Aznar-Dols, F.; Mercado-Vargas, M. Economic and Environmental Study of Wineries Powered by Grid-Connected Photovoltaic Systems in Spain. *Energies* **2017**, *10*, 222. [CrossRef]
44. Hall, S.; Roelich, K. Business model innovation in electricity supply markets: The role of complex value in the United Kingdom. *Energy Policy* **2016**, *92*, 286–298. [CrossRef]
45. Grimstad, S.; Burgess, J. Environmental sustainability and competitive advantage in a wine tourism micro-cluster. *Manag. Res. Rev.* **2014**, *37*, 553–573. [CrossRef]
46. Carrasco, I.; Castillo-Valero, J.-S.; Pérez-Luño, A. Wine Tourism and Wine Vacation as a Cultural and Creative Industry: The Case of the Bullas Wine Route. In *Cultural and Creative Industries*; Peris-Ortiz, M., Cabrera-Flores, M.R., Serrano-Santoyo, A., Eds.; Springer International Publishing: Cham, Switzerland, 2019; pp. 181–195. ISBN 978-3-319-99589-2. [CrossRef]
47. Olsson, P.; Folke, C. Local Ecological Knowledge and Institutional Dynamics for Ecosystem Management: A Study of Lake Racken Watershed, Sweden. *Ecosystems* **2001**, *4*, 85–104. [CrossRef]
48. Berkes, F.; Folke, C.; Gadgil, M. Traditional Ecological Knowledge, Biodiversity, Resilience and Sustainability. In *Biodiversity Conservation: Problems and Policies*; Perrings, C.A., Mäler, K.-G., Folke, C., Holling, C.S., Jansson, B.-O., Eds.; Springer: Dordrecht, The Netherlands, 1994; Volume 4, pp. 269–287. ISBN 978-0-7923-3140-7. [CrossRef]
49. Folke, C. Traditional Knowledge in Social–Ecological Systems. *Ecol. Soc.* **2004**, *9*, art7. [CrossRef]
50. Moller, H.; Berkes, F.; Lyver, P.O.; Kislalioglu, M. Combining Science and Traditional Ecological Knowledge: Monitoring Populations for Co-Management. *Ecol. Soc.* **2004**, *9*. [CrossRef]
51. Barber, N. Consumers' Intention to Purchase Environmentally Friendly Wines: A Segmentation Approach. *Int. J. Hosp. Tour. Adm.* **2012**, *13*, 26–47. [CrossRef]

52. Carmichael, B.A.; Senese, D.M. Competitiveness and Sustainability in Wine Tourism Regions: The Application of a Stage Model of Destination Development to Two Canadian Wine Regions. In *The Geography of Wine*; Dougherty, P.H., Ed.; Springer: Dordrecht, The Netherlands, 2012; pp. 159–178. ISBN 978-94-007-0463-3.
53. Zambon, I.; Colantoni, A.; Cecchini, M.; Mosconi, E. Rethinking Sustainability within the Viticulture Realities Integrating Economy, Landscape and Energy. *Sustainability* **2018**, *10*, 320. [CrossRef]
54. Marshall, R.S.; Akoorie, M.E.M.; Hamann, R.; Sinha, P. Environmental practices in the wine industry: An empirical application of the theory of reasoned action and stakeholder theory in the United States and New Zealand. *J. World Bus.* **2010**, *45*, 405–414. [CrossRef]
55. Cordano, M.; Marshall, R.S.; Silverman, M. How Do Small and Medium Enterprises Go "Green"? A Study of Environmental Management Programs in the U.S. Wine Industry. *J. Bus. Ethics* **2010**, *92*, 463–478. [CrossRef]
56. Boo, E.; Molinero, S.; Vicente, E.S. Novel Business Models and Main Barriers in the EU Energy System. 2016. Available online: https://zenodo.org/record/3479275#.Xd-httURXIU (accessed on 25 August 2019).
57. Dóci, G.K. Renewable Energy Communities. A Comprehensive study of Local Energy Initiatives in the Netherlands and Germany. Ph.D. Thesis, Vrije Universiteit Amsterdam, Amsterdam, The Netherlands, 2017.
58. Riedner, L.; Mair, C.; Zimek, M.; Brudermann, T.; Stern, T. E-mobility in agriculture: differences in perception between experienced and non-experienced electric vehicle users. *Clean Technol. Environ. Policy* **2019**, *21*, 55–67. [CrossRef]
59. Nigro, N.; Frades, M. Business Models for Financially Sustainable EV Charging Networks. 2015. Available online: https://www.c2es.org/site/assets/uploads/2015/03/business-models-ev-charging-infrastructure-03-15.pdf (accessed on 25 August 2019).
60. Ford, R.; Stephenson, J.; Whitaker, J. *Prosumer Collectives: A Review*; New Zealand's Smart Grid Forum; Centre for Sustainability, University of Otago: Dunedin, New Zealand, 2016; pp. 1–28.
61. Koirala, B.P.; Koliou, E.; Friege, J.; Hakvoort, R.A.; Herder, P.M. Energetic communities for community energy: A review of key issues and trends shaping integrated community energy systems. *Renew. Sustain. Energy Rev.* **2016**, *56*, 722–744. [CrossRef]
62. Herbes, C.; Brummer, V.; Rognli, J.; Blazejewski, S.; Gericke, N. Responding to policy change: New business models for renewable energy cooperatives – Barriers perceived by cooperatives' members. *Energy Policy* **2017**, *109*, 82–95. [CrossRef]
63. Schäufele, I.; Hamm, U. Consumers' perceptions, preferences and willingness-to-pay for wine with sustainability characteristics: A review. *J. Clean. Prod.* **2017**, *147*, 379–394. [CrossRef]