Article

Improving Public Attitude towards Renewable Energy

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Abstract: In recent years, the urgent necessity and tremendous opportunity to accelerate the transition to a low-carbon competitive economy has resulted in growth of long-term targets for renewable energy and energy efficiency, which are coming from policy bodies worldwide. The inherent distributed nature of renewable energies, together with the modularity of those technologies, brings opportunities for consumer empowerment in terms of participation. Nevertheless, there is still the need for increasing global awareness and enabling policies, to strengthen the citizen role in the energy system, facilitating their proactive participation as renewable energy purchasers, investors, and clean energy producers. Drawing from research interviews and the academic literature, this article conceptualizes the understanding of the need for improving public attitudes and explores the factors influencing the acceptance in terms of misconceptions, best communication practices, activities addressing public concerns, and potential actions to bolster public support towards renewable energy. Research interviews were conducted at a technical workshop on social acceptance of renewable energy, held in Abu Dhabi in October 2013, and the findings show that despite detecting an increasing trend towards greater and more active participation of citizens, many misconceptions together with insufficient and inefficient awareness and communication initiatives on renewable energies persist. The main conclusions can be used as a basis for formulating sustainable energy communication and awareness campaigns in order to enhance public acceptance and increase active participation in renewable energy technologies.

Keywords: public attitude; awareness; public concerns; misconceptions; renewable energy; interviews

1. Introduction

The promotion of low carbon energy technologies to palliate anthropogenic effects in climate is a central task for governments worldwide [1–3], which is moreover considered the most efficient path to assure a reliable, sustainable, and efficient future energy system [4]. However, often challenges, nontechnological issues, and interconnections affecting its deployment hinder the success of this promotion. The challenges faced by energy systems, among others, are the rapid depletion of fossil resources, air pollution, greenhouse gas emissions, nuclear risks, and the reliable integration of variable renewable energy technologies (RETs) [5,6], along with the growing importance of the nontechnological elements such as governance, participation, and the role of the people [7,8], together with the long-standing call for greater collaboration and interdisciplinary dialogue among researchers [9]. While there is intense discussion on the needed presence of these elements in policy, less attention was given, comparatively, to the technological issues. This fault traditionally leads to a low level of awareness and misconceptions about renewable energy technologies, which were consistently identified as the main important barriers to promote active citizen participation in the large-scale deployment of renewable energies [10–17] and it is considered a hurdle for the diffusion of renewable innovations. Moreover, it leads to neglecting the active role that citizens can play in the transformation of the energy system,

through choosing renewable energy technology in residential buildings [18], purchasing renewable electricity in greenmarkets [12,19–22], financing projects [23], or becoming renewable energy producers [8,24]. In this vein, citizens play a fundamental role in efficiency, which is also considered a fundamental pillar to achieve 100% renewable energy targets. Still, individuals, businesses, communities and nations need to be more aware of the energy they use and try to save energy wherever possible [25].

An overview of policy trends [26] shows that commitments are strengthening in terms of achieving energy targets (100% renewable energy and 2050 greenhouse gas reductions through cost-effective decarbonization [27]), and the adoption of overarching development goals to address climate change, following increasingly binding and restrictive legislation in that regard [3]. Moreover, elements such as the governance for competitive, secure, and sustainable energy, the achievement of greater transparency for consumers, an improved rationality of policies [3,4], along with public engagement—all for the sake of improving the relationship between energy transitions, democracy, and justice [28]—are of growing importance in policy portfolios. These elements built the new trends to foster engagement and awareness coming both from market and policy sectors, that can be separated into trends that are tailored to each renewable technology and user profiles, and more mainstreaming trends such as a shift towards empowering communities with the possibility to choose the best energy mix, along with evaluating new installations and adopting the most energy efficient behavior [29].

An overview of global status of renewables [27] shows that the construction of the new policy landscape in the present momentum is shaped by a series of elements where the role of the people underlies the effort. Some examples are cited below. First, the overarching support and promotion of renewable energy developments in nearly all countries [27], either driven through the commitment with energy targets and global agreements or through the global trends of low fossil fuel prices and selected renewable energy technologies price declines [27], resulted in the proposal of specific national policy agendas related to transition to renewables. Second, the increased awareness of RETs is reinforced by user engagement with a broad range of topics, from energy production to its consumption, including network management and integration.

The need to refresh research and energy policies, taking into account the role of people, is often framed under the all-embracing umbrella of nontechnological issues integration, even if this entails not only the identification nontechnical issues but envisions the complexity of the issues such as overcoming the gaps between policy headline targets, measured at a societal level of aggregation, and innovation performance and outcomes along with the valorization of the relationships between people and innovation and the participation in its adoption [30,31].

In the context of large-scale energy transitions, energy systems are considered, in practice, a problem of socio-energy system design due to its deep influence of broad patterns of social, economic, and political life and organization [32]. In this sense, new policy proposals, needed to gather up the significant changes accompanied by social, economic, and political shifts [32], and develop capabilities to address the complexity of the energy legislative ecosystem along with drivers to foster and strength a close relation with stakeholders, which runs parallel with faster societal changes and changes in business models [29].

The challenge of integrating people into energy policy has been addressed generally through primarily a social acceptance approach, even if where and whether this concept remains useful is in question. Furthermore, approaches related with the complexities of the governance of science and technology, along with the transfer of knowledge [33], and the effort to have a clearer understanding of the features and advantages of the diffusion and implementation of innovations are examples that address this challenge. These secondary approaches entail not only the contextualization of concerns, but also the possibility for updating technologies to provide a flexible user interface tailored to different stakeholder groups: operators/utilities, user communities, and financial institutions [29].

The governance of science and innovation, knowledge transfer, and production complexities affecting the integration of people is out of the scope of this paper, even if it comprises the aim of promoting *good governance of science* in terms of the right to all people to have access to high-quality information regarding democratic and transparent decision-making processes to achieve accountability and transparency. In this sense, efforts in this direction cause processes and transformational changes to arise, such as the development of new formats for public participation in decision making within the governance of science, changes in trust paradigms of scientists, and expertise and the participation in funding of research and development [34], among others.

In the case of the approaches concerning successful implementation of technologies, theoretical proposals indicate that a high consumer adoption rate requires a large number of members of a society to start using a new technology or innovation during a specific period of time [4,35–38]. Moreover, the diffusion process comprises a series of steps that range from (i) gaining knowledge about the innovation process; (ii) going forward to the process of forming an opinion (attitude) towards the decision process, whether to accept or reject an innovation (acceptance); (iii) implementing the decision; and finally, (iv) confirming the decision process, which shows whether or not the consumer is satisfied with the innovation [4]. Furthermore, several factors affect the rate and direction of the adoption of an innovation: availability of information, relative advantage of the innovation, and barriers to adoption. In this sense, concerning barriers to adoption, feedback between suppliers and consumers is considered a supply-side factor and the existence of adopters with different perceptions is considered a demand-side factor. In addition, culture, religion, or opinion leaders are considered traversal factors [4,39,40].

Thereby, as exposed, these two different approaches share the idea that the availability of accurate information, either to increase general awareness or to contribute to active empowering of consumers, is becoming part of the efforts towards the construction of the reliable, sustainable, and efficient energy system of the future where renewable technologies have a fundamental role.

As noted, the overarching approach when addressing participation of people in innovations is the social acceptance approach, which has been studied from very different backgrounds. Several concepts cohabit under the umbrella of social acceptance, for example, the evaluation of differences between *awareness*, *support*, *participation*, and *engagement*. It is important to distinguish between the process of forming an opinion, related with an attitude, and the decision process whether or not to accept or reject an innovation, as mentioned before, which is related with *acceptance*. Although *acceptance* is related with a decision process, it often entails the passive reaction to something externally characterized by a nondecision action. Therefore, *support* is a concept whereas *acceptance* seems more clearly to be action-oriented [41,42], implying *engagement*.

Moreover, social acceptance is an important factor within the socio-technical change approach that can be founded in rationales such as the energy transition. An example is consideration of the socio-energy systems approach [43], which advocates to understanding the challenges of the development towards sustainable energy systems through the assumption and recognition of the process as a socio-technical change, which comprises coevolutionary changes [44] between technologies, infrastructures, institutions, and people [44]. Furthermore, addressing these changes can be approached through a variety of theories and frameworks, which can also contribute to clarifying acceptance, adoption, use, or diffusion of technology [45,46]. Coevolutionary innovation frameworks for energy transition [47] redefine technologies, institutional ecological systems, business strategies, and user practices, which coevolve through mutual causal influences. As shown, the inclusion of general and specific social science approaches, when it comes to contextualizing such concepts, appears necessary and highly recommended [33,48,49]. This inclusion allows boarding the concepts, views, and the approaches. Examples of this approach are *social practice* [50] and *discourse theory*, for the approach of behaviors driven by beliefs, values, or lifestyles; *social construction of technology*, *socio-technical imaginaries*, *actor-network the-*

ory [51,52]; *sociology of expectations* or *universal theory of acceptance;* and the *use of technology* for accurate description [45,48,53–58]. For example, in the case of residential decision-making on energy use, there many models originating from conventional and behavioral economics, technology adoption theory, attitude-based models, and social and environmental psychology. Moreover, another example is the use of social practice theory for approaching the new social practice of purchasing electricity. Under this approach, the action is considered as an object of consumption and as an object of media, which provokes public discussion, critique, and encouragement to search for new solutions, such as collective mobilization to bargain with suppliers where citizen–consumer self-positioning drives a socially innovative form of energy governance and usage [50].

In the aim of changing present decision-making, based on assumptions about future effects of energy policy and updating technologies to provide a flexible user interface tailored to different stakeholder groups [29], the double role of people playing as citizens and consumers needs to be taken into account. These two roles trigger different patterns of thinking and sharing with others. For example, in their citizen-role, individuals must consent to measures and support implementation of innovations. In contrast, in their consumer-role they have to adopt and implement measures in their behavior [46,57].

Citizen behavior as consumers cannot be modeled without understanding the rules that govern those interactions [4]. Shared routines embedded in socio-technical systems configured the decisions of consumers at large, and policy rationale often ignores the fact that consumer behavior is not fully reducible to individuals making rational conscious decisions all the time [58]. In this vein, describing the complicated process of opinion formation and decision making can be arranged through socio-economic theories, which have the same goals: to explain how people make decisions, and form their attitudes, beliefs, norms, and values, and how these affect their behavior [4], and how life quality and justice are important for individual roles as citizens and consumers [57].

In this respect, the purpose of this paper is to understand the need for improving public attitudes towards renewable technologies and innovations. The authors underwrite that since societies generally make decisions based upon available information; low levels of awareness and persisting misconceptions or misinformation on renewable energies continue to be important impediments to increasing the penetration of these technologies. The findings presented in this paper show that there is an increasing trend towards greater and more active participation of citizens in the large-scale deployment of renewables. Nevertheless, an extensive number of misconceptions persist, along with insufficient and inefficient awareness and communication initiatives on renewable energies. A review of the literature [59] regarding the construction of the enquiring process, shows that when it comes to evaluating which form of participation citizens prefer, ranging from no participation, alibi participation, information, consultation, cooperation, or financial participation, citizens prefer information over financial participation. Moreover, it is important to note that questions generated through a participatory process, in comparison with questions obtained through academic literature review, presents differences. Further, the most remarkable motivation for participation in policy is located under the umbrella of addressing better decisions with wider political support and legitimacy as one of the most important reasons. In these terms, the accurate design of questions and the movement beyond the current idea of visualizing citizens framed as passive respondents to proposed projects [60], along with the preference of citizens for being involved in the informative and deliberative participation processes, illustrate the need for careful design of the participatory process, along with contextualization of the concepts.

This paper contributes in the following ways: First, general insights for understanding the need of improving public attitudes are presented. Second, and central to this paper, the methodology for the surveillance process is presented together with a review of the literature regarding the construction of the enquiring process, which leads to summarizing suggestions from existing strategies to develop this topic. These strategies can be, for example, taken in terms of clustering the concerns of the topic, such as misconceptions,

participation (energy stakeholders and activities), communication (of renewable energy technologies), and potential actions to bolster public support towards renewable energy; or in terms of clustering the surveillance process through the main issues founded in the theoretical construction of acceptance. For the purpose of this paper, the theoretical drivers of acceptance were *sitting issues* in terms of where to implement technology, *technology assessment issues* in terms of assessing if the technology is sufficiently safe or green, and *strategic planning and policy design issues* addressing the future, durability, etc. These issues were proposed in a workshop on social acceptance held in 2013 by International Renewable Energy Agency (IRENA) [61,62]. Finally, the findings from this workshop are presented.

2. Understanding the Need for Improving Public Attitudes toward Renewables

2.1. Most Common Misconception and Concerns

Energy systems based on renewables are not only feasible, but already economically viable and decreasing in cost every year [63]. However, low awareness levels and existing misconceptions about renewable energy technologies persist from the technical field to the policy arena. Both technical and policy bases are still discussing whether renewable energy systems can be reliable and achievable, taking into account some critical concerns. Elements regarding the consistency with mainstream energy-demand forecasts, supply to meet demand reliably, resilience to extreme climate events, transmission and distribution requirements, and ability to provision essential ancillary services [64] are some examples of arguments related to debating the feasibility of implementing a 100% renewable energy system. Policy, on the other hand, is focused in cost-effectively decarbonization [22], and the adoption of overarching goals to address climate change while balancing increasingly binding and restrictive legislation [8]. Moreover, citizens, formerly immersed in support and acceptance processes, are moving today to participate in governance and decision-making processes [28,65–68] and, step by step, to embrace a key role in producing, purchasing, and choosing renewable technologies and the best energy mix, along with adopting the most energy efficient behavior [29].

Traditionally, interaction of people with energy infrastructure and technology was approached by framing citizens as passive respondents to proposed projects [60]. This approach yields the dichotomous process of *support/resistance* as main ingredients of the social acceptance. Research addressing the differences between acceptance and acceptability defines the acceptance as behavior towards energy technologies and acceptability as an attitude towards new technologies, which also comprises an attitude towards possible behavior in response to the technology [69]. Acceptance, moreover, reflects a behavior that enables or promotes the use of a technology, rather than inhibiting or demoting its use. Despite this variety of concepts, often the ingredients of acceptance in terms of *support/resistance* are expressed by supporting the technology (because of its environmental benefits, for example) or can be expressed by protesting actions against the technology. Wüstenhagen et al. [70] proposed a description of the elements of social acceptance in renewable innovation and the factors affecting each of the elements in terms of *community acceptance*, *socio-political acceptance,* and *market acceptance* concepts. The first two concepts clarify the search of our drivers. Community acceptance refers to the specific acceptance of siting decisions and renewable energy projects by local stakeholders, particularly residents and local authorities. This is the arena where the debate around NIMBYism (not in my back yard) unfolds [70] as the body of research regarding the interactions with facilities and research projects. Affairs related with infrastructure locations traditionally played an important role in renewable energy policy, based on the oppositional responses by the public, which feedback into the conceptions held by decision makers [1,30,71,72]. Moreover, recent revisions of the approach show that despite careful siting, proximity has a strong influence on public attitudes to proposed projects; the nature, strength and spatial scale of this effect may vary according to the local context and the *value* of the land [71].

Socio-political acceptance in renewable energy technologies has been approached traditionally in terms of dealing with the barriers to its dissemination and has been present

since the beginning of the earliest technological developments. Research entailing the range of technical, economic, institutional, socio-cultural, and environmental barriers to renewable energy dissemination is vast and widely documented in literature [11–13,15,39,73–80]. Recent revision of socio-political approaches entails that issue in the market diffusion of cleaner technologies are not limited to *barriers* or *challenges* to top–down diffusion, given that prosumers do much to aid the diffusion of RETs [81].

2.2. Describing Participation

How participation in energy transitions can affect acceptance of RETs constitutes its own focus of research. Bidwell [22] proposes four questions affecting the participation in the energy decision: the *scope of the problem*, *purpose of participation*, *degree and time of inclusion* (*stakeholders*), and *allocation of the decision authority.* The first question, the *scope of the problem* refers to how the problem is defined, what issues or topics will be discussed, and what types of information and analysis are required, all expressing the interests in participating in the decision process. In this vein, a transition to RETs encompasses three possible types of problems: determining energy policy, planning for landscape uses, and developing renewable energy facilities. This question comprises the assessment of potential social and environmental impacts related to the placement of facility construction or operation and considers ways to minimize or mitigate these impacts.

The second question is the *purpose of participation*: for example, to increase the likelihood of successful project siting. The purpose of participation was enquired through seeking motivation. One of the most important reasons behind this was finding that the most remarkable motivation for participation in policy falls under the umbrella of addressing better decisions with wider political support and legitimacy.

The third question is the *degree and time of inclusion.* The drivers of this question are, on one hand, *who* should be included in the renewable energy decision processes, and on the other hand, the scope of this "who", understood as what the word *public* comprises, namely general public or stakeholders. In this sense, the general public is viewed as an unorganized collection of individuals and stakeholders that are viewed as groups, including governmental entities, businesses or trade associations, and nongovernmental organizations.

The last question is the *allocation of the decision authority* in terms of what role participants have in making the final decision on how these arrangements interact with other aspects of the decision process. This question is related to the citizen participation concept [82–87], which ranges through different scales of participation, from the lowest, i.e., *merely an opportunity for process sponsors to inform or educate participants* [83], to *citizen power*, where the public is empowered to make the choices. Levels of participation were widely studied from different points of view, from participation in policy to fostering democracy and governance of science and technology [65,82,88–91], to mainstream public participation in scientific research [86,87]. In the case of energy technologies, participation in energy infrastructure case studies [61,62,92–95], contextualization of participation as an approach [61,96–99], and participation of citizens as consumers [22,24,100], among other trends, can be highlighted.

2.3. Social Interactions with Renewables: Citizens, Consumers, and Prosumers

An achievable transition to a low-carbon and sustainable economy involves not only technologies, but also policies, user practices, a constant flow of information among stakeholders, and behavioral change among consumers [101]. In this vein, as noted, consumers are no longer mere adopters of renewable energy technologies (RET), but are essential to supporting the proliferation of sustainable energy technology in contexts where institutions and technology characteristics are not yet fully developed for the wide proliferation of RET [81].

Furthermore, the transition from the consumers to prosumers can be considered in terms of areas of influence, which can be *strategic* or *creative/collaborative*. Moreover, the actions can be located within the markets and within innovation systems, among others.

While prosumers are strictly energy customers who actively manage their own consumption and production of energy, the strategic actions regarding the market entails examples such as *green tariffs establishment*; *demand response systems modulation*, (including demanding incentive and price-based programs such as dynamic tariffs: time-of-use, real-time-price tariff, etc.); use and implementation of *smart metering information systems* (including smart meters, internet widgets and platforms, smart phone applications, in-home displays designed to share the information about the current electricity prices and its consumption between the household, and the energy supplier); and the adoption of *enabling* technologies (smart plugs, smart appliances, and home-area networks) that optimize, automate, and store electricity and modulate the consumption according to its market price and consumers requirements [13]. Furthermore, at operational level, while the basic forms of prosumer markets were subject to pilot schemes, peer-to-peer models [89,102,103], prosumer-to-interconnected or *island*-mode microgrids, and organized prosumer groups are examples of those proposed the most [81].

Creative and collaborative actions, in contrast, occur when consumers create new technology solutions, collaborate with other consumers, and share their ideas, knowledge, and inventions with peers in communities they have formed [81]. Examples are the new-to-the-world innovation developments and local adaptations to the renewable equipment itself, such as heat pumps, wood pellet burning systems, and solar heat and power [104].

Furthermore, as noted, when adopting a transitions perspective, consumers are reconceptualized as users who are important stakeholders in the innovation process, who share routines and enact system changes [58]. In these terms, social interactions leading to energy efficiency, production, and consumption can be framed as *citizens who are voluntarily consuming renewable energy*, *financing renewable energy*, and *producing and managing renewable energy*. While the possibility for households to contract 100% renewable electricity supply is largely extended in the main markets of the developed world, there are few reliable figures published on market shares for this option. Moreover, consumers that have voluntarily contracted 100% renewable energy supply have grown significantly in recent times [27,102].

In the case of citizens financing renewable energy, the smallest renewable energy installations are suitable for financing by individuals either directly (PV solar home systems) or collectively (cooperatives). Crowdfunding as a funding source for renewable and sustainable energy projects can play a significant role at the start of a renewable and sustainable energy project lifecycle. A variety of crowdfunding approaches may be used to finance the early stages of renewable energy development, particularly when stakeholders are the beneficiaries or the concerned groups are related to environmental protection and sustainability. Crowdfunding is also suitable to support research and development efforts of innovative green technology start-ups [23].

In the case of citizens producing renewable energy, the rapid increase in the number of consumers in Europe and the USA producing or storing electricity at home was possible due to the advances achieved in electricity generation and storage technologies coupled with declines in cost, the planned roll-out of smart metering, and favorable regulation. At the same time, globally, there are emerging markets and possibilities for home storage solutions that have the potential to improve the sustainability and efficiency of the electricity system and increase customer benefits [105]. This growth in technologies, combined with the changes in the electricity market, offers an unprecedented opportunity for anticipating interaction. Moreover, the emergence of the prosuming phenomenon presents interesting opportunities for a low-carbon energy system: millions of off-grid and self-sufficient agents managing their energy production and consumption autonomously—prosumers connected to a grid where consumers shift from being merely paying passive agents to active providers of energy services to the grid.

3. Methods

3.1. Advanced Social Acceptance, Increase in the Involvement of Citizens in the Energy Transition

Theoretical Approaches for Surveillance and Assessment

The complexities of the involvement of the citizens in the informative and deliberative participation processes illustrate the need for careful design of the participatory process. In this sense, the most common strategies in research regarding these topics are based on empirical evidences, conceptual works based on literature review and research trends, and modeling and simulation strategies. These methods are used for the diffusion and adoption of energy services [4,106] and the evaluation of consumer's response [58], under the umbrella of overcoming nontechnological priorities. Moreover, quantitative and qualitative methods of social science in terms of gathering empirical evidence and collecting the data necessary for scientific analysis are field experiments, survey questionnaire, semi-structured interviews, and online surveys.

The surveillance process, in terms of achieving empirical evidences, can be arranged among other strategies, through online surveys, questionnaires, semi-structured interviews/focus group discussions, standardized telephone surveys, or field studies [4]. Furthermore, the sources of data depend on the purpose of the analysis, sometimes data are also collected directly through the cooperation with energy suppliers, policy makers, or focus groups of consumers. Furthermore, the data are analyzed with statistical tools and hypotheses are usually demonstrated.

To assess the results, theories describing the process of opinion formation and decision making can be used, together with social science approaches such as *social practice and discourse theory*, for the approach to behaviors driven by beliefs, values, lifestyles; and the *social construction of technology*, *socio-technical imaginaries*, *actor–network theory* [51,52], *sociology of expectations* or *universal theory of acceptance,* and the *use of technology* for accurate descriptions [45,48,53–56], as mentioned in previous sections. From the field of energy research, for example, to model consumer energy behavior and to disseminate a particular innovation and service, social or economic theories were used. In the case of the residential decision making on energy use, for example, models originating from conventional and behavioral economics such as technology adoption theory, attitude-based models, and social and environmental psychology were used [4].

3.2. Framework to Develop the Surveillance Process

The aim of prevailing over the current thinking of citizens framed as passive respondents to proposed projects [60] together with the citizen preference to be involved in informative and deliberative participation processes, illustrate the need for careful design of the participatory process. In this vein, public perception of social acceptance was researched through the use of surveys, which often operationalized acceptance in very different ways and for various purposes, ranging from a democratic exercise to reformulating the decision making process, considering not only what experts know, but also what the public feels and thinks [107], to policy assessment purposes in terms of achieving effectiveness, efficiency, relevance, and coherence, and pursuing the inclusion of the added value to obtain stakeholder views on the effects and benefits of the policies [39,108–110].

A revision of the literature regarding the construction of the enquiring process, as illustrated throughout this paper, shows that the motivation for participation in policy intended to lead to better decisions with wider political support and legitimacy is one of the most important reasons behind carrying out this process. Moreover, when it comes to evaluating which form of participation citizens prefer, these range from no participation, alibi participation, information, consultation, cooperation, or financial participation, citizens prefer information over financial participation [95,111]. Furthermore, questions generated through a participatory process compared with questions obtained through academic literature review present differences [112].

In the case of renewables, even if assessing public acceptance at a concrete level (i.e., by addressing drawbacks) instead of an abstract level (surveys and opinion polls) can result in

a more reliable basis for policy decisions, acceptance decreases ratings due to the fact that people do not think about drawbacks related to renewables when they consider it from a general, more abstract, perspective. However, when downsides are specifically addressed, people integrate these into their evaluation, thus diminishing acceptance [111,113].

Taking into account these insights, the construction of the questions can be based on the following three factors: *the sitting issues* in terms of where to implement the technology; *the technology assessment issues* in terms of assessing if the technology is sufficiently safe or green; *and the strategic planning and the policy design issues* addressing the future, durability (how it may look in the future), and approach. As it developed throughout this study, this distinction is sometimes used as criterion for the contextualization of the concept of social acceptance, even if each of the factors can comprise transversal elements. For example, in the case of factors affecting the participation in the energy decision proposed by Bidwell [22], the *scope of the problem* question regarding a transition to RETs encompasses three possible aspects: determining energy policy, planning for landscape uses, and developing renewable energy facilities, which can be considered a siting issue.

Figure 1 shows a breakdown of concepts and factors affecting participation in energy decision adapted from Bidwell [22].
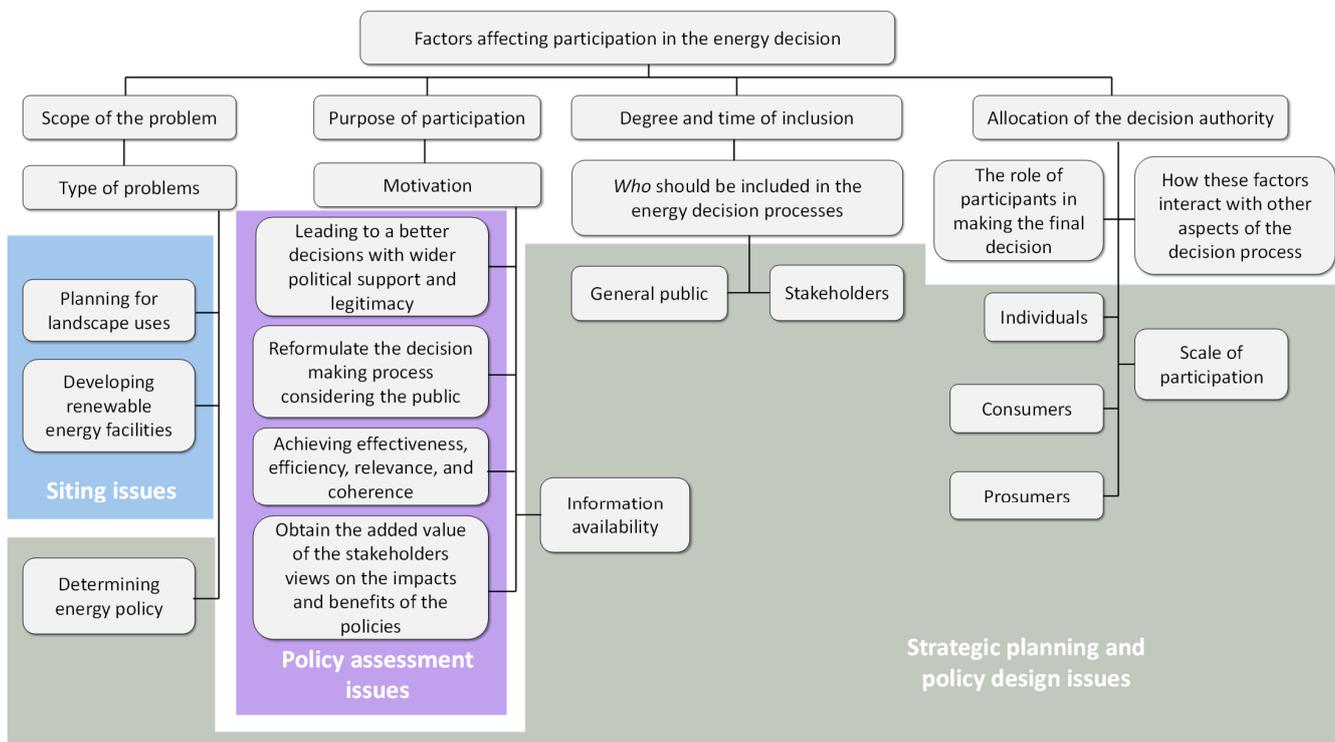
Figure 1. Concepts and factors affecting participation in energy decision based on Bidwell [22] and enriched by the authors.

Furthermore, another approach to concept and factors is the use of social indicators based on the role in affecting social acceptance to decode how the public views new technologies, and if it is possible for the public to discriminate between alternative technologies that deliver the same services [107]: measuring factors influencing attitudes in terms of acceptability [69], gauging the thresholds in terms of support [41], assessing acceptance and resistance [69], and measuring contestation and support in terms of physiological factors. This approach provides a measure of acceptance in terms of behavior for or against [69,114].

3.3. Survey Design

The method selected for this study was a combination between empirical evidence search and conceptual works based on literature review and research trends. Moreover, the

criteria to arrange the research questions and goals were enquiring the understanding of most common misconceptions, apprehensions, and activities addressing public concerns. The methodology was proposed as follows:

- Survey on the most common misconceptions and concerns.
- Interviews of renewable energy stakeholders on the result of the survey and enquiry on activities addressing public concerns.
- A technical workshop, for presentation and discussion of the results and to identify best practices in communicating renewable energy.
- Potential actions to bolster public support towards renewable energy.

3.4. Procedure

In the third session of the Assembly of the International Renewable Energy Agency (IRENA), the Secretariat was mandated to address the misconceptions on renewable energies [24]. The work was conducted in four steps as listed above, held in Abu Dhabi in October 2013 [25]; and (iv) potential actions to bolster public support towards renewable energy. The questions used in the questionnaire are listed in Appendix A.

4. Results

The questionnaire was answered by the attendees at the workshop, where representatives of institutions such as Renewable Energy Policy Network for the 21st Century (REN21), Greenpeace, Japan Renewable Energy Foundation (JREF), and European Solar Thermal Electricity Association (ESTELA), among others, were present. Over 350 answers were collected and analyzed.

Public concerns were divided into two groups: legitimate concerns and misconceptions. A misconception is a view or opinion that is incorrect because it is based on faulty thinking or understanding. A misconception is largely a result of knowledge gaps. The misconception is originated when information is not communicated properly due to lagging in quality or amount.

From April to June 2013, IRENA conducted a search of public domain documents available for concerns regarding renewable energy from communities around the world. A directory with 79 documents that cast doubts and raise questions about renewable energy in general or target particular renewable energy technologies was collated and analyzed. The collected documents contain 345 negative statements on various aspects of renewable energy [60]. Although many are technology-specific, they were categorized into ten distinct topics by synthesizing similar or related statements, as shown in Table 1.

Table 1. Results of most common public concerns on renewable energy.

Has environmental impacts	68
Are too expensive	63
Is intermittent and limited in applicable locations	52
Causes health and safety problems	35
Other resources are more viable to solve energy problems	33
Creates few jobs or economic benefits	26
Damages landscape and local communities	22
Technologies are still immature	18
Causes indirect externalities, e.g., food crisis, earthquakes	16
Consumes more energy than it produces	9
Others	3
Total	345

5. Discussion

Industry associations, civil society, and governmental organizations undertook initiatives based on the latest knowledge for demystifying misconceptions and proposed solutions to legitimate concerns, such as best management practices for reducing visual impact of renewable energy facilities or standards and certification schemes for sustainable

production of biofuels. Findings from the analysis together with discussion of results of existing initiatives to increase awareness and address public concerns on renewable energy are summarized as follows:

- A common message for all renewable energy technologies is missing. The awareness material analyzed from different renewable energy technology sectors sometimes overlap or even contradict. On the other hand, the conventional energy industries have a large communication power to defend their interest by discounting the potential of renewable energy and stimulating anti-renewables sentiment among the general public. Analyses show that misinformation on renewables in the media is often fomented by vested interests.

- Media engagement on renewable energy information is poor. On the other hand, initiatives aiming to increase awareness or to address public concerns are mostly one-way information provisions. More proactive communication, debates, briefings, and dialogue with media and opinion leaders are needed, which cover true facts and knowledge on the benefits and achievements of renewable energy. To avoid reinforcing misconceptions, a reactive approach should be used only in exceptional occasions when misconceptions on renewable energy are intensively debated at a global level.

- When addressing specific existing public concerns, misinformation (myths) and legitimate concerns should be treated separately. In the particular case of debunking myths, it is better to target the undecided majority rather than the unswayable minority.

The message should be easy to read, simple to understand, and succinct. Core facts should be presented visually. The message should be focused on disseminating the benefits of renewables and applying knowledge from behavioral economics.

For different target audiences, develop tailored information and use specific communication channels. Lean, mean, and easy to read content is more suitable for the general public, while more elaborated and specific information should be provided for policy makers, media, industry, and science. This also applies to addressing regional differences. Investing resources in good research prior to a campaign is helpful.

6. Conclusions

6.1. Regarding the Results of the Survey

An increasing number of countries around the world are enacting renewable energy policies driven by a range of factors, including energy security, job creation, greenhouse gases mitigation, and access to energy. The development towards sustainable energy systems involves behavioral changes. The role of citizens was mainly addressed as a potential powerful barrier to the deployment of renewable energy due to the lack of social acceptance. However, there is now evidence suggesting that the initial public resistance to renewable energies is being balanced by increasing citizen support and active participation in the deployment of renewable energies through voluntary renewable electricity purchase in green markets, direct finance of projects, and as renewable energy producers. In order to improve public attitude towards renewable energy, a general increase of awareness on these technologies is needed, along with addressing persistent public concerns, both legitimate and misconceptions.

As exposed, the availability of accurate information, either to increase general awareness or to contribute to active empowering of consumers, is becoming part of the effort towards the construction of a reliable, sustainable, and efficient energy system of the future, where renewable technologies have a fundamental role. In this vein, public media often channels the misconceptions when information is not communicated properly due to lagging in quality or amount. Misinformation on renewables in the media is often fomented by vested interests. Analysis of the existing communication efforts by renewable energy stakeholders shows that significant gaps persist when addressing public concerns.

Recommendations on how to improve renewable energy communication can be summarized as follows: (i) development of a common message for the full family of

renewable energy technologies based on their benefits; (ii) increase engagement with the media, be more proactive in communication; (iii) address misinformation and legitimate concerns separately; (iv) avoid reinforcing misconceptions, a reactive approach should be used in exceptional occasions when misconceptions on renewable energy are intensively debated at a global level; (v) the message should be easy to read, simple to understand, and succinct, with core facts presented visually; and (vi) develop tailored information for different target audiences.

6.2. Regarding the Framework to Develop the Surveillance Process

The criteria for constructing questions on issues related to *siting, technology assessment, strategic planning, and policy design* have been useful for unraveling the topics presented in concerns regarding renewables. However, this leaves unanswered questions, such as the origins of the misconceptions. As mentioned, this distinction is occasionally used as a criterion for the contextualization of the concept of social acceptance, even if each of the factors can comprise transversal elements, as shown in Figure 1.

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Appendix A

The questionnaire used in this paper had four questions:

1. Which are the questions you are facing most frequently and should be overcome to accelerate renewable energies acceptance?
2. Which arguments and evidence are you using to respond to those questions?
3. How is your organization coping with the public concern and negative campaigns?
4. What do you think are the most means of communication to improve the public image and acceptancy of renewable energy?

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