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From my perspective

Social and political impacts of renewable energy: Literature review

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ABSTRACT

The social and political perspectives are important considerations for renewable energy technologies. These perspectives may have impacts that are positive, negative, or a combination. Positive impacts can improve the adoption of certain technologies. Adverse impacts can reduce the intended benefits or even threaten the viability of a technologically promising technology. Since societal and political impacts are typically tightly inter-related they are being considered together. A literature review was performed to determine the criteria that are elements of the social and political perspectives. The literature review was supplemented with a review by experts to capture any additional criteria that were not specifically mentioned. The results are presented in this paper as taxonomy of criteria and sub-criteria for these perspectives. Over sixty criteria and sub-criteria are identified for the social and political perspectives. The perspectives and their criteria are important for decision making by policy makers, electric utilities, technology manufacturers, and research institutes. Having comprehensive sets of criteria can assist decision makers in ensuring that important aspects and impacts of the social and political perspectives are given due consideration and are not inadvertently omitted.

1. Introduction

Globally, renewable energy (also called "renewables") has been recognized as an imperative for satisfying the increasing long-term electricity needs of the developed and developing worlds. Renewables also mitigate the negative effects of climate change. The social and political perspectives can become important considerations for renewable energy technologies or projects. The impacts of these perspectives can potentially accelerate the adoption cycle or challenge the feasibility of the technology under consideration. Societal and political impacts are typically used interchangeably and are inter-related. Hence they are being considered together. Also, since the relationship between the socio-political perspectives and renewable energy decisions is bidirectional, that is influencing and being influenced, "impact" should imply the same.

Social impact may be defined as the effect on society and the well-being of the community and its members (i.e. families and individuals). Social impact also refers to "…the consequences of human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs and generally cope as member of society. The term also includes cultural impacts involving changes to the norms, values, and beliefs that guide and rationalize their cognition of themselves and their society" (Burdge et al., 2003). Society can be impacted by renewable energy decisions and may also affect future plans or decisions regarding renewable energy deployments or developments.

Political impact may be defined as the enactment of government policies and regulations that impact the development, deployment, growth, supply, and general effects of renewable energy. Market special interests or lobbies and the predisposition of the electric utilities also play an important role in defining political impact.

Socio-political impacts exist in all the four major stages of a renewable energy project lifecycle: planning and policy development, construction and implementation, operations and maintenance, and decommissioning or abandonment. Hence, the criteria should also reflect these temporal impacts.

The objective of this paper is to identify and classify the criteria and sub-criteria that play a role in impacting the socio-political perspectives. The process to achieve this objective was performed in two phases. The first phase involved a literature review to identify the criteria and sub-criteria. In the second phase experts were requested to validate the identified criteria and sub-criteria. They were also asked to recommend—based on their experience and judgment—any important additional criteria or sub-criteria that were missing from the findings. If a new criterion was suggested by one expert, it was confirmed by at least three of the other experts before it was included.

The literature review covered studies and research related to the social and political perspectives that impact renewable energy with a

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special consideration toward solar photovoltaic technologies (Sheikh and Kocaoglu, 2011). Each paper represented one or more perspectives. The sources for the review included the following databases: Academic Search Premier; Business Source Premier; Energy Citations Database (U.S. Department of Energy, Office of Scientific and Technical Information (OSTI)); EconLit; Engineering Village (Compendex); Information Sciences Institute (ISI); Web of Science; ISI Current Contents Connect; National Renewable Energy Laboratory (NREL) Publications Database; and the World Wide Web using Google.

To help validate the literature review findings, ten experts were selected. The experts had broad backgrounds in renewable energy with expertise in specific areas. Most of the experts had over ten years of experience. Some had twenty to forty years of experience. When the results of the literature were presented to the experts, they were able to identify several additional sub-criteria but no additional criterion. This was encouraging from the point of view of taxonomy development. The backgrounds and experience sets of the experts are given below.

- Expert 1: Over twenty years of experience in global business development, production, planning, and marketing of solar photovoltaic related products.
- Expert 2: Over twenty of years of experience in production and general management of solar photovoltaic and flat panel displays (both technologies use similar manufacturing facilities and methods).
- Expert 3: Over forty years of experience in executive management and research and development (R&D) in solar photovoltaic technologies, emerging renewable energy technologies, and consumer electronics.
- Expert 4: Over twenty-five years of experience in global business development and strategic planning with 5 years in solar photovoltaic strategic planning.
- Expert 5: Over ten years of experience in electronics industry and five years of experience in the energy industry with a focus on energy technology planning.
- Expert 6: Over thirty years of experience in the R&D of solar photovoltaic and renewable energy technologies at the National Renewable Energy Laboratory (NREL).
- Four graduate students in Engineering and Technology Management department at Portland State University, Oregon who had gained experience in renewable energy technologies via internships, courses, and research.

2. Social perspective

As with any energy source that has potential ubiquitous impact on large communities or nations, renewable energy should be analyzed with respect to its relationship with society for long-term acceptance and support. The social perspective typically involves the study of social interactions, social organization, and behavior patterns of groups. It also involves understanding the thoughts, feelings, and motivations of individuals as members of society. The social perspective entails the assessment of the reaction, benefits, and threats of renewable energy to society to enable a sustainable strategy in alignment with established social constructs.

In certain cases the impact on people can become the most important consideration. Hence for a meaningful study a social impact assessment should be part of a comprehensive assessment framework.

Four major criteria have been identified under the social perspective:

- S1: Public perception
- S2: Employment
- S3: Health and safety
- S4: Local infrastructure development

2.1. S1: public perception

Public perception is a social phenomenon based on popular opinion, media coverage, cultural underpinnings, and existing

Table 1
Public perception — sub-criteria.

Sub-criterion	References	Comments
Esthetics	(Elle et al., 2009; Torres-Sibille et al., 2009)	Esthetics deals with the appreciation of beauty especially in the sense of artistic appeal.
Visual impact	(Chiabrando et al., 2009)	For example, solar photovoltaics (PV) have an impact on the landscape through glare from reflection of direct sunlight.
Heterogeneous interests, values, and worldviews		Public perception is also shaped by varying (and potentially conflicting) interests, values, and perspectives or frames of reference (worldviews). This sub-criterion was recommended by the experts.
Engagement in public policy	(West et al., 2010; Douglas et al., 2010; Doukas et al., 2008; Aitken, 2010; Tsoutsos, 2005; Polatidis and Haralambopoulos, 2004a; Ehrhardt-Martinez and Laitner, 2010; Madlener et al., 2007)	Public perception is becoming an important consideration in renewable energy policy and public reviews in energy planning.
Conflict with planned landscape	(Wüstenhagen et al., 2007; Bierbaum and Fay, 2010; Gallego Carrera and Mack, 2010; Johansson and Neij, 2004; Linkov et al., 2006; Vanclay, 2003; Sovacool, 2009)	Globally, renewable energy deployments need to make accommodations for existing landscape planning especially in urban settings. Conflicts can significantly delay or even cause cancellation of projects.
Synergistic with quality of life improvement polices	(Chatzimouratidis and Pilavachi, 2008; Chen et al., 2009; Hiremath et al., 2007; Jebaraj and Iniyan, 2006; Ramachandra, 2009; Rofiqulislam et al., 2008).	Public perception is effected by how synergistic it is with quality if life improvement polices and living standards.
Impact on lifestyle	(Dincer, 2000); (Harmon and Cowan, 2009); (West et al., 2010).	The trend is toward the promotion of higher quality of life or living standards and any sub-criterion that aligns with this trend is favorably received.
Easy/convenient to use		This implies that consumers and households should not have any difficulty or hesitation in accessing or adopting the new form of energy source. This sub-criterion was recommended by the experts.
Social benefits	(Ahmed et al., 2010; Bakos et al., 2003; Celiktas and Kocar, 2009; Diakoulaki and Karangelis, 2007; Ramachandra, 2009; Sarzynski, 2010; EPIA, 2011; Verbruggen et al., 2010; West et al., 2010).	In studies and research pertaining to the United States, Greece, Turkey, China, and even the world, identification of societal benefits are key to gaining approval of renewable energy projects.
Social acceptance	(Assefa and Frostell, 2007; Bürer and Wüstenhagen, 2009; Chatzimouratidis and Pilavachi, 2008; Czaplicka-kolarz et al., 2009; EIA, 2008; IEA, 2010a; Gallego Carrera and Mack, 2010; Omer, 2008; Polatidis and Haralambopoulos, 2007a; Wüstenhagen et al., 2007)	Renewable energy and sustainability studies have been performed to determine the appropriate social acceptance indicators for renewable energy deployments.
Impact on property values	(Augustine et al., 2009; Bergek, 2010; Hinkle and Kenny, 2010)	
Impact on tourism	(Capros, 1988; Daim et al., 2009; Dlouhý et al., 2009; Georgopoulou, 1997; Hajeeh, 2010; Kaminaris et al., 2006; Papadopoulos and Karagiannidis, 2008; Polatidis and Haralambopoulos, 2004b; Reiche, 2004; Shen et al., 2010; Stirling, 2007; Terrados et al., 2007; Vanalphen et al., 2007)	

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