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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)	

Table 2
Employment — sub-criteria.

Sub-criterion	References	Comments
Job creation	(Alnatheer, 2005; Babinet et al., 2009; Bebic, 2008; Büsgen and Dürrschmidt, 2009; Chatzimouratidis and Pilavachi, 2008; Degroat et al., 2009; Hinkle and Kenny, 2010; Hiremath et al., 2007; Islam, 2004; Jager-Waldau, 2007; Kaya and Kahraman, 2010; Komor, 2009; Llera Sastresa et al., 2010; Lund and Mathiesen, 2007; Sarkar and Singh, 2010; Shen et al., 2010; Connor et al., 2009; Wei et al., 2010)	Normally, job creation is a key priority.
Addition to employment diversity	(Kowalski et al., 2009)	Employment diversity implies that for a healthy society different types of jobs should be created and co-exist with each other.
Availability of workforce	(Amer and Daim, 2010; Augustine et al., 2009; Clancy et al., 2004; Coggeshall and Margolis, 2010; Karvetski et al., 2009; Llera Sastresa et al., 2010; Margolis and Zuboy, 2006; McCrone et al., 2010)	Appropriate trained workforce for the generation and distribution of the targeted renewable energy is needed.
Poverty alleviation	(Goldemberg, 2004; Mulugetta, 2000; Nowak et al., 2006; Polatidis and Haralambopoulos, 2007b; Youm, 2000)	Developing countries need renewable energy enabled projects that can also alleviate poverty.
Production/manufacturing-sector employment	(Tsoutsos, 2005)	Employment gain in the manufacturing sector is a good indicator of long-term employment and industrial growth.
Total employment	(Llera Sastresa et al., 2010; REN21, 2008; Saaty et al., 1977; Tsoutsos, 2005; Wei et al., 2010)	Total employment is a key economic indicator of the health of a region or country.

reputation. It is a virtual truth that may or not be based on facts. Individuals or companies may attempt to do the right things but if the public perception of the entire industry or technology is negative then it becomes a challenge to make progress in the desired direction. Public perception may consist of a number of sub-criteria. Some of these have been identified in this paper and are summarized here in Table 1.

2.2. S2: employment

Employment is a key consideration for any government or society. Employment gives rise to economic well-being of individuals and society at-large. Politicians and statesmen have known job creation and sustained employment leads to a contented voting public whereas the opposite has high negative affect with the population clearly articulating its discontent and demanding reform. Employment not only refers to total employment but includes such sub-criteria as job creation, poverty alleviation, focus on specific job types, attention to manufacturing jobs, and ensuring that the workforce is properly trained for the new economy. It should be noted that the manufacturing sector is of particular importance for employment since it provides productivity growth, high quality jobs, and long-term social economic stability. Local or domestic manufacturing is also critical for the United States economy since a large portion of international trade is due to manufactured goods. It is also mainly responsible for the growing United States deficit due to imported manufactured goods (Przybocki et al., 2011). Renewable energy has the potential to play a significant role in fulfilling the employment criterion. Sub-criteria relating to employment are noted in Table 2.

2.3. S3: health and safety

To safeguard health and safety, governments and society need to protect safety, health, and welfare of the individuals, communities, and the workplace. Health and safety includes public safety, work safety, prevention or alleviation of long-term hazardous health effects. In general, it should also be an investment in the long-term health of society. Renewable energy also needs to take the sub-criteria that make up health and safety into account during energy source equipment production, operations or energy production, and during end-of-life decommissioning, dismantling, and disposable of equipment. The major health and safety sub-criteria are listed in Table 3.

Table 3
Health and safety — sub-criteria.

Sub-criterion	References	Comments
Public safety	(Talinli et al., 2010; Wang et al., 2009)	
Work safety	(IEA, 2010b);	
Hazardous health effects (accidental, long-term)	(Hamalainen and Karjalainen, 1992; Kammen and Pacca, 2004; Wüstenhagen et al., 2007)	
Investment in health of society (indirect)		Consideration of the long-term socio-economic benefits in maintaining a healthy society should have a role in the evaluation of the impact of any form of renewable energy. This sub-criterion was recommended by the experts.

Table 4
Local infrastructure development.

Sub-criterion	References	Comments
Development/improvement of infrastructure	(Polatidis and Haralambopoulos, 2007b)	Infrastructure is the basic structure needed for the operation of a society and typically includes roads, water supply, sewage, electricity, and communications.
Support of related industry		Related to development of economic and technology clusters for focused industrial growth. This sub-criterion was recommended by the experts.
Contribution to regional/local improvement		This sub-criterion was recommended by the experts.
Regional/local empowerment		This sub-criterion was recommended by the experts.

2.4. S4: local infrastructure development

Infrastructure is the basic structure needed for the operation of a society and typically includes roads, water supply, sewage, electricity, and communications. Local infrastructure development is commonly accepted as a key sub-criterion in economic growth. The beneficial impact of this is felt immediately during development in terms of direct jobs and indirect jobs with the multiplier effect of support industries. Infrastructure development also has a long-term benefit to the locality and region which consists of infrastructure improvements, promotion of related industry, and empowers the region to improve productivity and quality of life as shown in Table 4. (See Table 5.)

3. Political perspective

Many nations have realized that reliance on fossil fuels has significant negative implications with respect to energy supply and climate change. Renewable energy technologies are beginning to play an important role in the social and economic development of communities, regions, and nations. Politicians and governments are taking into account the increasing economic benefits related to the renewable energy industry. This industry increases employment and business opportunities, creates significant new federal and state tax revenue, and helps revitalize struggling communities. Strong government policies and incentives that favor the deployment of renewable energy are part of the political perspective. By evaluating this perspective, the impact of such criteria as policies, regulation (or deregulation) of electrical power markets, national R&D funding, compliance to codes and standards, and the perception of the electric utilities can be better understood.

Six criteria have been identified under the political perspective:

- P1: policies
- P2: regulation/deregulation of power markets
- P3: public/government R&D framework
- P4: codes/standards — compliance
- P5: perception/position of utilities
- P6: security

4. P1: policies

Renewable energy policies are typically at national or local levels and can mark the success or failure of a renewable energy source. Policy sub-criteria include: security, support for renewable energy and/or energy efficiency (such as Feed-in Tariffs (FITs) and Renewable Portfolio Standards (RPSs)), national energy independence (from fossil fuels), financing option with government backing, local sourcing, stipulated five-year or ten-year plans for renewable energy or energy efficiency, workforce training on new energy sources, and integration-with/or replacement-of existing power plants.

Table 5
Policies — sub-criteria.

Sub-criterion	References	Comments
Security	(Amer and Daim, 2010; Awerbuch, 2000; Hughes, 2009; Johnstone et al., 2009; Kobos et al., 2006; do Valle Costa et al., 2008; West et al., 2010)	Policies are moving away from least cost to portfolio based sourcing for energy security to avoid supply disruptions.
Support for renewable energy/energy efficiency	(Awerbuch, 2000; Barbose et al., 2008; Bolinger et al., 2008; Chiabrando et al., 2009; Harmon and Cowan, 2009; Kammen and Pacca, 2004; Kobos et al., 2006; Sovacool, 2009; Wüstenhagen et al., 2007)	Public policies include renewables portfolio standards and set-asides.
National energy independence	(Hughes, 2009);	The EU's biodiesel program and the US's renewable fuels program (Energy Independence and Security Act, 2007) are examples of replacement policies that are crafted to improve energy security.
Financing options/government backing	(Goetzberger and Hoffmann, 2005; Chalvatzis and Hooper, 2009)	
Local sourcing	(Rourke et al., 2010)	Certain countries (e.g. Canada) require partial local sourcing of renewable energy equipment for Feed-in Tariffs to be applicable.
5–10 year plans for renewable energy/energy efficiency	(Noimuddin and Taplin, 2009; Chang et al., 2003)	
Workforce training	(McRae et al., 2009; U.S. Energy Policy Act Of 2005, 2005)	
Integration/replacement of existing power plants	(Delucchi and Jacobson, 2010; Jebaraj and Iniyan, 2006)	Integrated energy planning is needed to reliably meet energy demands.

5. P2: regulation/deregulation of power markets

The electrical power markets are undergoing change through a political process that is a mixture of deregulation and regulation of

Table 6
Regulation/deregulation of power markets — sub-criteria.

Sub-criterion	References	Comments
RPS (Renewable Portfolio Standard)	(Payne et al., 2001; Ipakchi, 2009; Madlener and Stagl, 2005; Shum and Watanabe, 2009; Wei et al., 2010; Zouros et al., 2005)	
FIT (Feed-in Tariffs)	(Bemis, 1990; Büsgen and Dürrschmidt, 2009; Haas, 2003; Haas et al., 2011; Madlener and Stagl, 2005; Campbell, 2008; Johnstone et al., 2009; Popp et al., 2010; Wüstenhagen and Bilharz, 2006)	
Net-metering	(Payne et al., 2001; Green, 2000)	
Incentives	(Bergek, 2010; Bolinger and Wiser, 2008; Cansino and Pablo-romero, 2010; Dixon et al., 2010; Focacci, 2009; Frankl, 2008)	
Energy price controls/rate structure	(Dixon et al., 2010; Omer, 2008);	
Subsidies (tax credits, tax exemptions, etc.)	(Ahmed et al., 2010; Bürer and Wüstenhagen, 2009; Capros et al., 2007; Streimikiene and Šivickas, 2008; IEA, 2010b)	
Carbon tax	(Curtright et al., 2008; Drury et al., 2009; Kammen and Pacca, 2004; Kutscher, 2007)	
Cap and trade	(EPRI, 2003a; Fthenakis et al., 2009; Komor, 2009; Suna et al., 2008; Wei et al., 2010)	
Centralized/decentralized power	(Edinger and Kaul, 2000; Kaundinya et al., 2009; Coll-Mayor et al., 2007)	In either regulated or deregulated case power centralization or decentralization will continue to be a cause for constant debate.

certain aspects. This new paradigm is affecting both traditional fossil-fuel based and renewable energy generation and distribution. Regulation of the power markets can include sub-criteria such as Renewable Portfolio Standards (RPS) which require a clear renewable energy targets, Feed-in Tariffs (FIT) to benefit consumers which supply reverse energy to the grid, net-metering (with the meter reading energy received and supplied from the consumer), multiple types of incentives, energy price controls through rate structures (and this is a generalized form of FIT), subsidies (such as tax credits, tax exemptions, etc.), carbon tax (as a penalty for carbon dioxide pollution), cap and trade (also known as "allowance trading" or "pollution credits" to enable heavy polluters to buy credits), and promotion of centralized or decentralized power depending on the political climate (Table 6).

6. P3: public/government R&D framework

Government can play an important role in accelerating renewable energy technology development and deployment by funding research and providing a supportive research and development (R&D) framework. For example, in the United States, most of the national laboratories have had some form of renewable energy R&D in place for decades especially the National Renewable Energy Laboratory (NREL). This criterion consists of mainly three aspects or sub-criteria: support by government national laboratories, increased technology transfer activity to the private sector, and the execution of a strategic technology plan or roadmap (Table 7).

Table 7
Public/government R&D framework — sub-criteria.

Sub-criterion	References	Comments
Government labs R&D	(Mowery, 1998; Sagar and Holdren, 2002)	
Technology transfer	(Dincer, 2000; Gallagher et al., 2006; Mulugetta, 2000; Gessert and NREL, 2007; Sarkar and Singh, 2010; Streimikiene and Šivickas, 2008; IEA, 2010b; Verbruggen et al., 2010)	
Strategic technology plan/roadmap	(EPRI, 2003b; IEA, 2010c)	

7. P4: codes/standards — compliance

Compliance to the established codes and standards is an important aspect of protection to the renewable energy consumer and covers supply and demand. Policies are enacted to establish the standards and their enforcement. The major sub-criteria of this criterion include the United States Code (if the country being considered is the United States), national and international standards, and building and environmental safety standards (Table 8).

Table 8
Compliance of codes/standards — sub-criteria.

Sub-criterion	References	Comments
US code	The Code of Laws of the United States of America	The US Code is the compilation and codification of the general and permanent federal laws of the United States. [This sub-criterion was suggested by the experts.]
National/international standards	(Basso, 2008; Margolis and Zuboy, 2006; Nelson, 2010)	
Building/environmental safety standards	(Dixon et al., 2010; GTM-Research, 2010)	

8. P5: perception/position of utilities

In the United States, utilities are both commercial and political entities since they are regulated and have a powerful political lobby. In fact the fossil fuel lobbies (also known by some as the "dirty fuel lobbies") are some of the most powerful special interest groups in the United States. Their willingness or unwillingness to engage in the deployment of a selected renewable technology is an aspect that should not be ignored. Utilities will not be willing to adopt an energy source that is not aligned with their existing political and management structures. They may engage in delaying tactics to promote their position. Hence sub-criteria for this criterion are: conformance to existing political, legal, and management structures and the position of their political lobbies (Table 9).

Table 9
Perception/position of utilities — sub-criteria.

Sub-criterion	References	Comments
Conformance to existing political, legal, management constructs	(Schaller, 2004)	Utilities are accustomed to established business or regulatory practices and change is difficult.
Fossil fuel lobbies	(Linstone, 1981; Sovacool, 2008)	Oil and gas lobbyists are well-established.

9. P6: security

For the past decade national security has been in the top of mind of many governments and societies. Security is the responsibility of the government and is a primary public policy issue. Security consists of both energy supply stability and energy price stability. These are the two sub-criteria that comprise the security criterion. Disruption of the energy supply can be hazardous to the economy of a nation. Policies need to be in place for alternate sources of energy, for example renewable energy or national stock piles of fossil fuels. Even if governments cannot control the supply (especially in the case of fossil fuels) they may need to control the price through subsidies because history has proven that energy price escalation can lead to civil unrest. In assessing renewable energy technologies these security sub-criteria should be considered with respect to sourcing of raw materials for equipment such as rare metals—with limited global supply—used in certain thin-film photovoltaics (Table 10).

Table 10
Security — sub-criteria.

Sub-criterion	References	Comments
Energy supply stability	(Amer and Daim, 2010; Bilen et al., 2008; Cai et al., 2009; Doukas et al., 2008; Haas et al., 2011; Harmon and Cowan, 2009; Japan Energy Conservation Handbook, 2007; IEA, 2010b; Youm, 2000)	
Energy price stability	(Awerbuch, 2006; Menegaki, 2008; Omer, 2008; RofiqulIslam et al., 2008; Schilling and Esmundo, 2009; Shen et al., 2010)	

10. Conclusion and future work

In this paper, the social and political impacts of renewable energy have been presented as a taxonomy of criteria and sub-criteria under social and political perspectives (Table 11). For the social perspective, four criteria were identified through a literature review

Table 11
Criteria and sub-criteria for social and political perspectives.

Social (4 criteria)	
Public perception	
	Esthetics
	Visual impact
	Heterogeneous interests, values, and worldview
	Engagement in public policy
	Conflict with planned landscape
	Synergistic with quality of life improvement policies
	Impact of lifestyle
	Easy/convenient to use
	Legacy for future generations
	Social benefits
	Social acceptance
	Impact on property values
	Impact on tourism
Employment	
	Job creation
	Addition to employment diversity
	Availability of workforce
	Poverty alleviation
	Increase in production employment
	Increase in total employment
Health & safety	
	Public safety
	Work safety
	Hazardous health effects — product phase
	Hazardous health effects — operations phase
	Investment in health of society (indirect)
Local infrastructure development	
	Development/improvement of infrastructure
	Support of related industry
	Contribution to regional/local improvement
	Regional/local empowerment
Political (6 criteria)	
Policies	
	Security
	Support for renewable energy/energy efficiency
	National energy independence
	Financing options/government backing
	Local sourcing
	5–10 year plans for renewable energy/energy efficiency
	Workforce training
	Integration/replacement of existing power plants
Regulation/deregulation of power markets	
	RPS (Renewable Portfolio Standard)
	FIT (Feed-In Tariffs)
	Net-metering
	Incentives
	Energy price controls/rate structure
	Subsidies (tax credits, tax exemptions, etc.)
	Carbon tax
	Cap and trade
	Centralized/decentralized power
Public/government R&D framework	
	Government/national labs R&D
	Technology transfer
	Strategic technology plan/roadmap
Codes/standards — compliance	
	US code
	National/international standards
	Building/environmental safety standards
Perception/position of utilities	
	Conformance to existing political, legal, management constructs
	Fossil fuel lobbies
Security	
	Energy supply stability
	Energy price stability

together with expert advice. These criteria consisted of a total of twenty-seven sub-criteria. It is interesting to note that public perception had the most sub-criteria of thirteen that varied widely ranging, for example from esthetics to social benefits. Similarly, for the political perspective six criteria were identified consisting of (coincidently) twenty-seven sub-criteria. Policies and regulation had a similar high number of sub-criteria of eight and nine respectively. It may be potentially argued that the position of utilities be me a critical criteria, however further research is needed to validate such a claim. During the literature review no single criterion or sub-criterion emerged that was determined to be far more significant than the others in terms of socio-political impact of renewable energy. This implied that, at least on initial evaluation, no criterion or sub-criterion should be ignored.

The results of this research will be useful for researchers and industry practitioners that require comprehensive sets of social and political criteria with reference to renewable energy technologies. This is especially important for comparative and decision analyses in feasibility studies, policy making, and assessing market potential. An example of the use of these criteria is in the formation of a hierarchical decision model where panels of experts can rank the criteria and hence provide a comparative importance of alternatives under consideration. The research and results of such a model will be presented in a future paper.

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