Online engagement for sustainable energy projects: A Systematic review and framework for integration

Danielle Barrios-O'Neill
University of Ulster / B9 Energy

Geertje Schuitema
University College Dublin

Corresponding Author:

Danielle Barrios-O'Neill
Phone: +44 (0)75 1306 3783
Email: barriosdanielle@gmail.com

1. Introduction

Gaining engagement from the public is a major precondition for organisations in the energy sector to achieve sustainability targets (Innes & Booher, 1999; Fredericks & Foth, 2013). An underlying assumption regarding consumer engagement is that provision of information is likely to increase knowledge and awareness amongst consumers, which in turn can have a significant impact on perceptions, beliefs, and attitudes toward energy transitions (see for example Røpke et al., 2010; Kozinets et al., 2012; Tait & Hansen, 2013). However, in order to enhance engagement, there are a number of challenges for the industry on how to communicate with consumers. Given that relatively new online and interactive communication tools, particularly social media, are available now as a consumer engagement tool, thorough consideration should be given to their usefulness in optimising consumer engagement, while simultaneously mitigating involved risks (Foster & Linehan, 2013).

This paper investigates current and imminent challenges to supporting transitional energy behaviours among consumers, foregrounding the potentials of strategic interactive media engagement in the sustainable energy sector. The main aim of this paper is to address the question, how can the energy sector increase engagement from consumers using online and interactive media communications? Toward this aim a systematic literature review was conducted, consulting discourse and practices from planning, energy and infrastructure, marketing, public engagement and consultation policy, and interactive media engagement. Based on this review, five key challenges to consumer engagement related to online communication and five potential solutions to these challenges were identified (see Table 1). The challenges and solutions are overlapping and complementary; the relationships between these will be addressed. The solutions to key challenges form the basis of a coherent framework—the Socially Dynamic Communications Framework (SDCF)—which the authors propose as a method of developing and integrating innovative communications processes

involving online media. We focus on relationships between consumers and organisations with coherent communications goals related to sustainable energy management; this can include private sector suppliers, developers, governments, NGOs, trade organisations, educators, and academic research bodies.

1.1 Reasons to engage consumers online

Research consistently finds digital and social media engagement in the green sector to be both relevant and worthy of further investigation (Foster et al., 2010; Krätzig & Kretzschmar, 2014). It is well understood that potential risks of failing to cultivate relationships with energy consumers can be detrimental to energy projects (Harvey & Brereton, 2005; Korschun & Du, 2013). However, no study has yet addressed how the broad-scale dynamics of digital and social media-influenced communications affect energy understanding and consumption, and few have addressed the impact of changed behaviours on energy networks and infrastructure. Nor has there been any in-depth investigation of potentials for the use of digital and social media for energy engagement, possibly due to unfamiliarity with potentials or fear of perceived risks (Røpke, 2010; the exception is Elefant, 2011). Several early studies have investigated the effectiveness of digital communications and data gathering for sustainability projects (Røpke, 2010; Vervoort, 2010; Simmhan et al., 2011). However, there is little if any existing research that synthesises findings or compares levels of effectiveness in ways that are specific to sustainable energy communications.

A major factor in the decision to engage consumers via online communication is likely to be the continuing rise of digital and particularly social media use each year, with half of adults in the US and UK expected to be active on social media in 2014 (US Office for National Statistics, 2013; Duggan & Smith, 2013). There is a rising expectation that

organisations engage with consumers online, to provide access to information, customer service or entertainment (Gross, 2007). While many organisations are keen to engage the public, the potential for exploiting interactive and particularly social media to increase consumer engagement is largely underutilised. This is possibly due to the risks or perceived risks associated with social media use, for example communications compliance issues specific to utilities and developers, negative publicity related to resistance of unfamiliar technologies such as anti-wind and anti-smart meter groups (Menegaki, 2012). While risks of negative publicity certainly exist online, they are often perceived to be greater than they are; research has indicated that some negative engagement on social media is to be expected and can be managed with appropriate response strategies (Gensler et al., 2013), a lack of organisational responsiveness on social media from organisations can leave a vacuum in which negativity is more likely to persist and proliferate (Elefant, 2011). For all of the above, the benefits afforded by online monitoring and engagement are found to help avoid public relations issues that may occur online, and at most, to directly encourage engagement from consumers by addressing the key challenges identified in section 3.2 (Langley & Broek, 2010; See-To & Ho, 2014).

The benefits largely of interactive communications hinge on conversational modes of engagement, by which information flows between organisation and consumer, rather than simply from the organisation to the consumer. The effects of two-way information flow can increase engagement by building trust between consumers and organisations, and creating a sense of social or personal investment on the part of consumers (Singh et al., 2008; Trusov et al., 2009). For consumers, two-way information flow can increase the quality of their brand or product experience, and this in turn can increase positive feeling toward the brand and purchase intention (Nambisan & Watt, 2011; See-To & Ho, 2014). There has been a demonstrated need for community-based, social marketing interventions around the

implementation of new sustainable energy technologies (such as smart meters), where it has been shown that information provision alone leads to products becoming less effective over time (McKenzie-Mohr, 2000; Abrahamse et al, 2005).

This represents a critically underexploited opportunity for productive, value-creating engagement online, particularly as sustainable energy initiatives are likely to have an advantage on social media platforms, as arguments for sustainable energy use are often understood best in a social context, motivated by social responsibilities and with successful adoption often linked to community involvement (Mandarano et al., 2010). Representations of the networked nature of energy use may also translate more easily on the web, where networks are ubiquitous, and where the dominant demographic (those aged between 18 and 49, having some higher education) overlaps substantially with those most likely to be accepting of sustainable energy concepts and technologies (Wüstenhagen et al., 2007; Paladino & Pandit, 2012). Furthermore, the most active subgroup on social media, users aged 25-34, overlap with those most likely to become early adopters, a category of consumers willing to tolerate product complexity and beta-stage glitches to reap long-term benefits of innovation (Faiers & Neame, 2006). This indicates important opportunities to reach users who are likely to be open to engagement with energy initiatives via interactive media.

2. Methods

This study was carried out according to a Narrative Synthesis (NS) framework using a process developed originally by Popay et al. (2006) and further refined by Roen et al. (2006), Arai et al. (2007), and Rodgers et al. (2009). NS is a method of systematic review enabling investigation of research questions with potentially broad informing subject areas (Popay et al., 2006). NS relies primarily on textual description to summarise findings of multiple types of studies, and can involve mapping these against a conceptual framework (Leamy et al.,

2011). The selection of NS for use in this study reflects the need to create thematic coherence among data sets (both qualitative and quantitative), in order to categorise key areas of challenge and relevant solutions, in a largely unexplored, interdisciplinary area. In addition, NS has proven useful in assessing the use of interventions in influencing behaviour, including how the intervention works, why, and for whom (Popay et al., 2006). NS consists of three steps designed to ensure optimal transparency and robustness; these are developing a theory of change, developing a preliminary synthesis, exploring relationships within and between studies, and assessing the robustness of the synthesis (Arai et al., 2007).

2.1 Theory of change and preliminary synthesis

Popay et al. describe the "theory of change" as "the chain of causal assumption that link programme resources, activities, intermediate outcomes and ultimate goals" which guides the systematic review process (2006, p. 12). This study's theory of change is that online communication strategies are likely to be useful in engaging consumers, largely through the provision by organisations of social and technological contexts for understanding energy transitions. To investigate why, how, and for whom this is true, the review employed a comprehensive search strategy of English language literature using a broad set of terms, and searching linked concepts (for example, both "interactive" and "digital"), to maximise sensitivity. A total of 12 databases was used resulting in the identification of 147 total studies based on the following inclusion criteria:

1) objectives and outcomes relate to central research question of the review[1];
2) contain prescriptions and guidance;
3) are available in downloadable/printable format.

[1] Please contact the first author for a full list of search terms and databases used.

The following exclusion criteria and exemptions were used, which narrowed this to 70 studies:

1) Publication date
    a. excluded all papers published before 1990 ;
    b. excluded all papers related to interactive media and smart grid before 2000.[2]
2) Publication source
    a. excluded items published by non-peer-reviewed sources, *except:*
    b. included 5 reports fitting all other criteria which were published by organisations that regularly perform research to inform policy.[3]

Three items emerged after the original search process, but fit criteria and were deemed relevant.[4] In total 73 papers were included, falling within the topic areas of environmental planning, energy and infrastructure (50 papers apply to this topic); marketing and business (25 papers); community planning, consultation/public engagement and consultation policy (31 papers); and (interactive) media engagement (48 papers), where most selected studies involve more than one of the topic areas listed. [5]

2.2 Relationships within and between studies

The 73 selected papers, discussing potential challenges and solutions relevant to the area of engagement with energy sustainability, were compiled and studied for relationships suggesting common themes or categories (see Popay, 2006, "thematic analysis", p. 18). These categories were identified through a process of reading and re-reading the selected studies, focusing on identifying applicability to the central question of the review, each

[2] The authors chose to exclude items involving interactive media and/or smart grid between 1990 – 2000 as major advances were made in both areas during this time, and it is likely that items published before 2000 on either subject will not be informed by state of the art theory and practice. See
[3] IAP, 2007; Bittle et al., 2009; Duggan & Smith, 2013; Latta et al., 2013; Smith, 2014.
[4] Sundar, 2008; Latta et al., 2013; Smith, 2014.
[5] Please contact the first author for a full list of included papers.

study's limitations and findings, and, where relevant, classifying key points as potential challenges to engagement with sustainable energy initiatives, or, alternately, potential solutions to engagement challenges.

To illustrate the process of building categories thematically: in attempting to engage users in planning issues via social media, Evans-Cowley and Hollander (2010) found combinations of in-person and online participation to be more effective than online communication alone. This theme was recurrent in other selected papers; for example, Vervoort et al. (2010) describe the importance of varying "levels of engagement" including online and live methods (p. 614), and Mooij (2007) suggests integrating "multilevel" ICT "across time, place, and media" to facilitate a rich learning process (p. 1513). If a theme recurred six times or more, a challenge was identified. In this example, the challenge identified was that of "reaching greater numbers of consumers" (challenge 4). There is also an identified solution in Evans-Cowley and Hollander (2010), a combination of online and offline participation events. This was translated in solution 4: "Diversity in presentation format and tone" (see Table 1). Based upon the identified challenges and solutions, the study proposes a conceptual framework, the SDCF (Figure 1). This simultaneously presents a visualisation of relationships between challenges/solutions and ongoing communications programmes, and a possible sequence for application of principles. The proposal of the SDCF aligns with the NS method of developing conceptual models based upon review findings in order to link together key issues and key processes (Popay et al., 2006). Broadly, the categories of challenge and solution correspond by number: section 3.3.1 demonstrates how the challenge of gathering, understanding and using consumer data (challenge 1) is addressed by implementation of aggregation and analysis procedures (solution 1). For clarity, these also correspond to the order of steps in the SDCF process. In practical terms, there are a variety of interconnections and overlaps among challenges and solutions; for example, the challenge of

reducing risk related to mistrust and misinformation can be answered by all of the solutions in different ways, as the following discussion will illustrate. In short, each solution indicates a method of addressing one or more of the challenge types identified.

2.3 Robustness of synthesis

The NS approach was used in order to analyse the complex multidisciplinary nature of the research topic, and the current lack of cohesive data structures within it, problems impeding focused policy solutions in this area thus far (Victor, 2008; Pierce & Paulos, 2012). NS's thematic synthesis is extremely useful in that is allows us to clearly address major opportunities, difficulties and risks involved with sustainable energy engagement processes in the context of the contemporary information economy by presenting broad causal relationships, while also providing specific practical guidance concerning practical implementation of solutions, as gleaned from the relevant literature (see Popay et al., 2006, "conceptual models", p. 20).

A potential limitation of this method is that outcomes will not reflect the complete range of possibilities and risks related to interactive media engagement and sustainability. It should be recognised that the systematic review does not offer a complete picture or a set of discrete answers, but rather a partial picture, and that the theoretical insights are meant to add to the understanding of the mechanisms underlying the reported results (Popay, 2006). NS also poses a limitation concerning consistency in identifying relevant findings and studies. As the first systematic review on the topic of interactive engagement with sustainable energy, analysis and outcomes are presented as indicative rather than comprehensive. The framework is intended to provide a basis for refinement by future research using complementary methods, including empirical testing (Leamy et al., 2011).

3. Results

3.1 Challenges to consumer engagement in energy transitions

On project scales, consumer engagement can describe active engagement with energy transitions, including technologies (eg. remote energy control devices), products (eg. installing solar panels) or developments (eg. acceptance of a local wind farm). Organisations across sectors currently face a number of significant challenges to consumer engagement in energy transitions, some of which can be addressed with interactive media. Challenges and solutions identified in the systematic review are presented in Table 1. Each of the listed challenges relates largely to one of the proposed solutions and principles of the SDCF (see section 3.3 and Figure 1). Interdependencies among varying challenges/solutions will also be discussed.

3.3 Addressing the challenges: proposing solutions and principles of the SDCF

3.3.1 Solution 1: Aggregation and analysis of relevant data

- *Challenge 1: Gathering and processing consumer data effectively.*

One recurring theme in the literature regarding how the sector can increase engagement from consumers relates to the need for more effective ways to harness the power of consumer data in designing engagement approaches, in order to target consumers more efficiently and to serve them more effectively. Several studies assessing the use of interactive media note the capacity of these media to help produce, collect and collate user data (Li & Du, 2011; Simmhan et al., 2011; Gensler et al., 2013). As part of a network such as an electricity grid, aggregation and analysis are a means by which unstructured or semi-structured information can become meaningful and useful. In the SDCF, these processes serve the same purpose; digital and particularly social media provide copious amounts of

contextual data that can assist in this process. Data relevant to energy communications scenarios can take a variety of forms, including but not limited to:

- platform-specific, often pre-summarised analytics data such as that available from Facebook and Google Analytics;
- syntactic and semantic data automatically filtered or manually selected from published content across many platforms, for example Twitter or web forums;
- qualitative and quantitative data drawn from online polls and questionnaires;
- content- or subject-specific data generated by public challenges and competitions;
- varied engagement data gathered from participation in events such as online games, email campaigns, and webinars.

Collating and re-presenting data can help users at every level, including energy producers, consumers, and advocates, to better understand the energy network: who is engaged with what type of energy, why, and how; what problems they might have; what solutions are available. This information has potential value for producers and consumers alike as it is made public and accessible. Although access to information on its own is not always likely to influence behaviour, information in context is more likely to have an impact (Bogost, 2007; Vervoort et al., 2010). Simultaneously, by aggregating consumer data, organisations can more accurately assess what is valuable to the public and make better efforts to offer that value (Rundle-Thiele, et al., 2008; Nambisan & Watt, 2010). Simultaneously, it is important to consider public concerns regarding privacy and data protection, as that may trigger public resistance against data aggregation, a risk that can arise as a result of implementing interactive solutions (Krishnamurti et al., 2012).

Used here to refer to the process of dividing and identifying trends in collected data, analysis crystallises findings that may be meaningful for an organisation hoping to

communicate more effectively, particularly findings likely to influence how energy communications are received by the public, including:

- political makeup of an area;
- common economic concerns;
- social context, including diversity, education, age/gender demographics, and population density;
- local technological infrastructure;
- local environmental groups and interests;
- sentiment concerning the organisation, project, or similar projects;
- need for a particular product or service;
- questions for which the project may be able to supply a productive response.

Aggregation and analysis can also help projects identify social influencers or so called "block leaders", volunteers that help to spread information on specific topics (Hopper & Nielsen, 1991). It appears that information spread on a peer-to-peer basis has a greater impact on purchasing and behaviour than organisation-to-consumer communications (Chu & Kim, 2011; Gensler et al., 2013). Analysis of social data can assist a project in mapping its stakeholder network accurately, sensitively segmenting consumers, and providing information tailored to specific groups.

The process of collecting social data is varied, and can range from using relatively simple, free online tools to developing highly sophisticated automated systems. While the ideal combination of social platforms will differ by project, the combination of a website and a Facebook account is the current baseline. If a project only uses these two, it can begin simple data tracking via user-friendly Google Analytics, Facebook Insights, and bit.ly. However, as mentioned before, it is crucial to do this in a way that consumer privacy and data protection is ensured and perceived as such by consumers. On the other end of the spectrum

are bespoke, purpose-built apps for data generation like *Wattsup,* created by the Lincoln Social Computing Research Centre to collect, summarise and visualise users' energy consumption in real time, similar to in-home smart meters (Foster et al., 2010). Other projects have made use of crowdsourcing techniques for qualitative data collection, ranging from simply asking people what they think about relevant issues, to facilitating the creation of specialised solutions to existing or hypothetical problems (Ross & Tomlinson, 2010). An example is the Los Angeles Smart Grid Demonstration Project, which works directly with infrastructure, aggregating data from sources ranging from smart meters to social networks, and using advanced analytics and data mining to forecast energy use patterns to be fed back to the grid (Simmhan et al., 2012).

3.3.2 Solution 2: Responsiveness toward consumers

- *Challenge 2: Reducing risks related to mistrust and misinformation.*

Lack of consumer trust in energy development and supply organisations, and government structures around development and supply, is a significant barrier to consumer engagement, and thus to the growth for the green energy sector and for most infrastructure-scale innovations (Huijts, Midden, & Meijnders, 2007; Haggett, 2011). Among energy consumers there appears to be a lack of relationship with the energy sector, possibly because the energy network is largely invisible and its products intangible (Devine-Wright et al., 2010). This represents a lost opportunity, as there is an abundance of research demonstrating that where stronger relationships with energy consumers are created through frequent interaction, loyalty to organisations increases, as does knowledge of what an organisation is offering, and willingness to share related information with others (Yannopoulou et al., 2010). Wolsink (2000), speaking on wind energy development, suggests that often people are not against renewable technologies themselves, but are rather primarily against the people who

want to build the infrastructure. Toke et al. (2008) make a similar point, stating that negative attitudes toward developers and corporations can be powerful in dampening industry growth, particularly in countries "which do not have networks of support for … renewable energy to counter the messaging of anti-groups" (p. 47). Social responsiveness serves a number of purposes, including building trust, increasing interest as users realise their social actions have reactions, and helping to manage the risks associated with introducing new technologies, products and ideas (Laroche et al., 2012; Krätzig & Warren-Kretzschmar, 2014). It should be noted that involving interactive media technologies in participatory processes can also complicate the issue of trust, where, for example, citizens have accused planners of using more sophisticated methods to manipulate them (Evans-Cowley & Hollander, 2010). For this reason, the introduction of new technologies to engage consumers should be handled sensitively, and reactions should be monitored carefully.

The SDCF proposes two types of responsiveness communications programmes can employ: direct responsiveness to comments and questions raised by users in the network, and indirect responsiveness to trends identified in relevant data. Direct responsiveness indicates communication with users in real time, for instance answering a question via Twitter, or replying rapidly to a Facebook comment. This strengthens feeling of commitment in users, an important factor for enhancing consumer trust (Yamagishi & Yamagishi, 1994). Further, direct response enables an organisation to increase public awareness of its role in the energy network and enhance brand reputation (Gensler et al., 2013).

Indirect responsiveness occurs via changes to project content or communications. An example is when a project

- answers a frequently asked question on the project website, in a tweet or through an infographic;
- targets user groups who are underserved;

- alters the design of a project or product to suit user needs;
- alters the design of the user consultation process to suit user needs.

Indirect responsiveness largely serves to help increase the transparency of project information, and to position a project clearly within the energy network in ways that will be helpful to growing user relationships (Mandarano et al., 2011). There is a consensus in engagement literature that making the act of response understood (for example, in the form of "You said, we did") is beneficial to users' level of engagement and trust in a project or organisation (IAP, 2007).

Several studies suggest that energy grid technologies will increasingly require active, two-way involvement whereby users inform the grid network of their energy needs, desires, habits, and plans either indirectly through data or directly via system tools such as smart meters (Simmhan, et al., 2011; Pierce & Paulos, 2012). In these ways energy users become "co-creators of value" within the energy network (Honebein et al., 2009, p. 2). At the same time, ambitious digital engagement programmes can help test future energy applications at an early stage, and begin normalising two-way dialogue earlier than is strictly necessary to promote a shift in this direction among users (Pierce & Paulos, 2012). Projects that have taken a responsive approach include ones like Good Energy, a UK renewable electricity supplier that employs Facebook daily to invite comment ("Energy security, what do you think?") or present the outcomes of public feedback ("This is what you told us …").

While empowering users through feedback and observable impact, responsiveness can also be a buffer against the risks associated with negative publicity, for example the complaints of disappointed customers posted online, or anti-renewable energy social media campaigns. Gensler et al. (2013) notes that in "the unique context of social media … more passive strategies may frustrate disappointed customers and may motivate them to vent their negative feelings on a large scale through their social network" (p. 249). A number of studies

also suggest that diplomatic and empathetic responses from an organisation, including corrections to misinformation where necessary, can be a means of building trust and involvement (Haggett, 2009; Toke et al., 2008).

3.3.3 Solution 3: Transparency of language and process

- *Challenge 3: Building stronger relationships with consumers.*

Accurate representation is a key concern for projects that aim to affect energy transitions, as misinformation and misunderstanding are causes of substantial loss for both private companies and the green energy sector (Sheppard, 2011; Twitchen & Adams, 2012). Sustainable energy projects have the task of making information both clear and accurate, aims that often compete as information associated with energy networks can be exceedingly technical and complex. Transparency is used to refer to ways in which interactive communications can make project information as presented to users, and the project itself, more clear (Bogost, 2007; Vervoort, 2010).

Devine-Wright et al. (2010) explored the knowledge gap concerning energy network supply in the UK, querying the public's understanding of how electricity reaches the home, who is responsible for the supply, and what the phrase "National Grid" means to energy consumers, as well as to assess general beliefs about infrastructure development. The study found that a majority of participants seem to perceive electricity networks as "cables and wires" rather than as human beings and organisations; the authors suggest that "organisational invisibility coupled with low expectations of participatory involvement" is likely to provoke public opposition and delay in creating new energy infrastructure (p. 4127).

Transparency of process and information can also be used to address challenge 2, reducing risks related to mistrust and misinformation. Key issues of trust for sustainable energy projects are likely to include problems of language or terminology, and problems of

perceived or actual organisational reticence concerning project intentions (Devine-Wright, 2007; Haggett, 2011). The use of formal or technical language in relation to new technologies is a factor frequently cited as obfuscating information and alienating users (see for example Schroeter & Houghton, 2011; Krätzig & Warren-Kretzschmar, 2014). A solution to this is to make organisational processes of decision-making as transparent as possible, and to provide opportunities for public participation and influence where possible (Gross, 2007). In addition, if any information needs to be withheld from the public for reasons of sensitivity or security, it is important "to admit the nature of what is being withheld and why, rather than risking the discovery of such secrecy, with subsequent adverse reactions" (Rowe & Frewer, 2000, p. 15).

In seeking to make information clearer, organisations must also manage the risk of becoming incorrect, reductive or simplistic in their representations. As Latta et al. (2013) point out, where correct information can quickly and easily go viral, so can inaccurate information, particularly where the inaccurate version "has a strong simple story, and the reality is complex" (p. 6). In this respect, source credibility is a major factor influencing trust in information provided in online environments (Metzger & Flanigin, 2013; Sundar, 2008; Westerman, Spence & Van der Heide, 2012). Sundar (2008) argues that the credibility evaluations largely depend on four technological features: modality (the structure of the message; eg. text, audio or video), agency (the source of information), interactivity (system responsiveness) and navigability (the ease of locating relevant information). These features are assumed to serve as heuristics deciding source credibility, also relevant to challenge 4: reaching greater numbers of consumers.

3.3.4 Solution 4: Diversity in presentation format and tone

- *Challenge 4: Reaching greater numbers of consumers.*

A common type of challenge emerging from the literature is that of engaging new and diverse audiences in order to support the success of sustainable energy campaigns, products and services (see for example Rundle-Thiele & Paladino, 2008; Pierce & Paulos, 2012). Diversity refers to the variety of ways that information can be represented to the network, concerning information from the network, and is used to emphasise how re-packaging of information for new audience segments can increase access and interest. Research suggests that offering a variety of formats increases likelihood of users seeing, understanding and sharing information onward; it is also noted generally that showing is more effective than telling (Krätzig & Warren-Kretschmar, 2014). Bittle et al. explain that "offering different channels for participation can increase participant numbers" and diversity among participants, as there are positive relationships between the variety of information presentation types, and the number of people who are likely to respond (2009, p. 12).

Diversity also helps to build relationships by making processes and information more transparent (challenge 3); a professional report published on a company website, for example, is likely to be significantly less clear for the average user than the same information adapted to a more visual or simpler format such as an infographic, a series of vivid, simply-worded social media posts, or a video animation (cf. 'modality'; Sundar, 2008). Indeed social media tools are adept at addressing a broad range of learning and decision-making styles, as they can richly contextualise complex energy options through conversational systems of recommendation, relationship, personal and group identification (Zappen, 2005; Mooij, 2007). For example, in 2013 Vestas launched *Act on Facts*, a digitally-based, global campaign that delivers messages on global contexts for wind energy across a project website, Facebook and Twitter feeds and a YouTube channel, having at the time of this printing over 3,000 followers on Facebook. Campaigns are likewise diverse; for an example, Siemens US recently commissioned the adaptation by an English composer of Strauss's *Blue Danube*

using the sounds of wind turbines. Framing wind turbine noise, occasionally a point of contention, as a thing of beauty, the commission was used to power an accompanying publicity campaign for wind energy via online video, blogs and social media (Oliva, 2014).

Gensler et al. (2013) assert that vividness and interactivity are factors likely to stimulate engagement and sharing (Sundar, 2008); to this end, images and infographics that evoke the meaning of data very quickly are useful. It has also been shown that engaging content is often that which relates closely to practical issues or tangible elements of users' daily lives, particularly when knowledge is likely to be unfamiliar (Strengers, 2011). This also helps to counter the sense that one person's decisions will not make a difference (Langley & Broek, 2010). In a 2011 infographic, the European Wind Energy Association expressed the amount of carbon saved by wind energy worldwide (140 megatonnes) as the more legible "71 million cars off the road," or "33% of the EU's car fleet" (EWEA, 2011).

Again, however, there is the risk of inaccurate information or reductive explanations proliferating in the guise of fact; in rendering information diversely, communications teams should seek to simplify the often complex concepts surrounding energy networks without sacrificing accuracy, searching instead for ways to clarify key points, visualise data in new ways, or combine presentation methods (Latta et al., 2013; Sundar, 2008). A growing number of energy projects are combining face-to-face events with online activities as part of ongoing engagement processes, for example running workshops and public meetings in combination with online, social media campaigns. This works well for planning projects where continuous consultation is required, in educational contexts, and in policy-building community engagement processes (Bittle et al., 2009; Pierson-Smith, 2012). The aim in these cases is often to provide a continuous process of knowledge-building for a specific group, for example the students on a course or the residents of an area local to a proposed renewable energy development. These engagement programmes work toward goals such as gaining

planning consent, reaching a local energy target, or engaging a certain number of people in a given area. Among relatively small groups of users, this approach can not only increase access but also invigorate the social sidewalk-life of shared (real and digital) space, where awareness and interaction can grow organically in response to information events (Evans-Cowley & Hollander, 2010). A study by Schroeter and Houghton suggests that having opinions acknowledged and made visible to others in technologically-augmented real spaces, in this case a public screen displaying text messages, can be a source of interest for users who might otherwise not have engaged (2011).

Another method of representing content diversely is in the growing field of "serious games," specifically designed to engage players across a variety of platforms to promote collective problem-solving informed by real-world issues and constraints, an approach with promising outcomes with regard to, in particular, reaching younger demographics (Bogost, 2007; McGonigal, 2011; Barrios-O'Neill & Hook, 2012). On the other side of this coin, however, is the issue of the so-called "digital divide", relationships among demographics and tech savviness related to age, income, and geographic area that can lead to methods being unsuccessful with some groups (Gordon & Koo, 2008; Smith, 2014). This is another reason to include both traditional and innovative engagement methods, and to collect and assess data on different consumer groups (challenge 1).

3.3.5 Solution 5: Interactive dissemination of information

- *Challenge 5: Encouraging proactive consumer behaviour.*

The final challenge identified emerges from recent articles discussing the need for more involved decision-making and energy management from consumers, and relates to the potentials of participatory communication models to support greater proactivity (Simmhan et al., 2011; Gensler et al., 2013). Any behaviour that approaches energy resources actively

rather than passively—from researching energy supplier options, to sharing information about a development socially, to managing household energy use more efficiently—could be described as proactive behaviour. While there is a common assumption that access to knowledge changes behaviour, research doesn't tend to support this, finding more often that social and emotional processes play a greater role (Kratzig & Kretschmar, 2014). The use of interactive engagement methods can support the proliferation of new social norms, and more proactive energy behaviours, by using what interactive networked platforms have to offer that traditional platforms don't, including social sharing, simulations of real-world processes, and interactive visualisations. The benefits of more proactive consumer behaviour range from more robust energy systems to greater public awareness of the operations of energy systems.

Wüstenhagen et al. (2007) describes the adoption of a new product, or acceptance of an innovative technology, as "a communication process between individual adopters and their environment", through which the normalising of a product or organisation makes it more compelling for individuals (p. 2685). Social media operates according to this principle, with a dynamic characterised by trending topics, the so-called viral spreading of information (Laroche et al., 2012). As a result, while the aims of dissemination differ depending on sector and organisational goals—a renewable energy trade organisation might hope to raise general awareness about the reasons to support renewable energy in a particular region, while a private sector organisation might hope to increase public understanding about a new product—social media remains sensitive to communications that are shareable, and sharing is interactive (Pierson-Smith, 2012; Zaglia, 2013). A number of studies have found that for "green power programs" in particular, success is more likely when communications "appeal to a sense of community and can rely on implicit or explicit social norms and values" (Wiser, 1998, p.113).

Many organisations have already begun taking advantage of the tools and possibilities of interactive dissemination, from simple design to directly asking users to share content. Ecotricity, UK-based green electricity supplier, has a strong interactive profile, frequently posting photos submitted by users and images and facts designed to be shared, which get consistently high sharing rates. Siemens Energy disseminates a shareable Picture of the Week on its Facebook page and Twitter feed, highlighting the uses of its technology around the world. Action for Renewables (UK) hosted a t-shirt design contest promoted through social media, which generated sharable content for the project and users in the form of the design themselves, which reframed the project based on user ideas and values (2014). For bespoke communications solutions, such as a website designed to increase engagement with a local energy project, the ability to share information can be built into the tool, by including social sharing links on every page, conspicuous buttons for RSS feeds, and obvious places to leave comments or ask questions. Singh et al. (2008) note that user-generated communications can be effective at breaking through the influx of media because they have user credibility and pertain directly to what users deem important. Pierce and Paulos (2012) recommend allowing users to design products and processes in order to amplify "feelings of ownership and responsibility" (p. 668). While there is no one-size-fits-all approach to engagement or behaviour change, creating opportunities for web-enabled interaction, particularly interaction that engages users socially, appears to have promise for energy initiatives. Furthermore, analysis and aggregation of consumer data can be used to build increasingly effective dissemination strategies, by yielding insights in earlier stages about the social habits and concerns of consumers.

4. Discussion

4.1 Implications for Research

The key contribution of the SDCF is that it provides a tool for addressing the key issues of social impact and risk that inhibit the use of digital platforms to their full potential, specific to organisations interesting in promoting greater energy sustainability. This is particularly appropriate for application in increasing consumer engagement in energy transitions, as effective communication is shown to be an essential factor in mitigating the risks associated with lack of information and mistrust that continue to be problematic for the sector, and are shown to stall industry growth (Haggett, 2011). The SDCF differs from traditional organisational communications processes in that it integrates new methods that reflect the social nature of energy networks and optimise opportunities for social feedback and two-way communication. The term "dynamic" is essential, highlighting the importance of continuous change in the way communications strategy is formed and executed. By tailoring its strategy over time to create increasingly relevant and compelling messages and products, an organisation can amplify social interaction around the project or brand, leading to increasingly numerous and information-rich streams of social feedback (Langley & Broek, 2010; Laroche et al., 2012).

A variety of technological approaches to smart energy distribution research and development have been proposed to evolve the current system (Røpke et al., 2010; Vervoort et al., 2010). Many of these approaches employ smart grid technologies, so called for their capacity to optimise network availability by applying principles including automated analysis, increased transparency and increased responsiveness (Hassan & Radman, 2010). A common theme of many approaches is a need for integrated informatics and increased two-way communications elements within energy systems, through the development of specialised tools or using existing digital and social networks in specialised ways (Gungor et

al., 2011; Sheppard, 2011); there is a growing opportunity for productive research in the area of digital and social media capabilities within and relative to energy network development, with potential applications for organisations involved in generation, distribution, and supply. This review and framework provide an initial way into what can be a highly productive research field, particularly as more links are realised between socio-technical and resource management systems. The SDCF is a starting point for exploring, among other questions, how existing interactive tools can be employed for productive engagement with energy issues, how emerging tools can be shaped, and how new tools can be developed.

Future research should consider broad implications of new forms of communication for the electricity grid, including prototyping socially interactive tools that will work in connection with the hardware, software and network practicalities associated with the emergence of smart grid technologies (Simmhan et al., 2011). This is especially true as world-leading economies including the USA, China, Australia and the United Kingdom have launched substantial research and development initiatives in smart grid applications and technologies (Gungor et al., 2011). There is a distinct need to investigate interactive communications strategy relative to energy organisation type, for example how government organisations can meet challenges specific to their sector, or even more specifically, how renewable energy projects in development such as offshore wind farms can address unique risks related to reputation and trust, and how consumers can become more involved in the smart grid. To authors' knowledge, there is only one existing study of this nature from Elefant (2011) focusing on legal considerations for utilities engaging on social media. Benefits will also be derived from investigating how to achieve organisation-specific, social media-specific goals, such as converting energy consumers to brand advocates using social media (Zaglia, 2013).

5. Conclusions and Policy Implications

Despite a paradigm-shift in social communications, the methods and examples outlined demonstrate that it is certainly possible for industry stakeholders to utilise features of existing social processes to achieve greater public awareness and understanding of energy issues, products and services on a project scale, increasing the likelihood of sustainable consumer energy use patterns on a larger scale. From a policymaking perspective, it is important to be aware of how value is created for users of the energy network through provision of and access to more and better information from energy organisations, and also how this value feeds back into the energy network through energy efficiency measures, company revenue, and sector growth. These are outcomes with significance on local, regional, national and international scales, and with impacts relevant to economic and environmental agendas. Two-way communications involving proactive users and organisations will become useful to energy delivery systems, as they are applied to problems of pricing, network load and curtailment and blackouts, and can contribute to the improvement of system reliability, robustness, availability, and scalability (Gungor et al., 2011). Furthermore, it is not coincidental that the identified solutions forming the central principles of the SDCF correspond to processes within smart delivery grid systems: in order to synch productively with energy systems, communications systems must be constructed in similar ways. In the SDCF as well as in a smart grid system, key information is aggregated from across the network; information is analysed, either by automated systems or at a manual control centre; information is made visible and multichannel; and information is disseminated rapidly back across the network in a variety of formats (Hassan & Radman, 2010; Li et al., 2010).

Positive outcomes can be achieved or supported by projects such as the integration of smart metering with social media and website interactions, the monitoring of social data to

predict energy usage, the development of company mobile applications for monitoring and controlling energy use remotely, the use of social media for local energy production and the support of microgrids, the development of web applications to assist energy producers in selling and distributing energy via the grid, any number of energy process simulations, and the use of new kinds of interactive games to engage energy users with grid dynamics and personal energy supply. A circumspect understanding of the uses and benefits of digital and social media engagement for energy projects will allow policymakers to formulate more specific guidance on digital and social media for projects in development, including requirements for formal and informal public consultation, as very little guidance in this area currently exists.

Furthermore, energy development and infrastructure policy can benefit from knowledge of the linked trajectories of social media communications networks and future grid technologies, which is likely to be significant in terms of how social data will be used in future. Knowledge of the relationship may directly influence the design of smart grid features and the development of public engagement schemes. The findings of this and future studies on the uses of digital and social media to support energy network transitions will ideally shape the agenda and priorities of both national digital strategies compatible with innovative energy communications, strategic research priorities in an area with broad technological and social significance, and educational policy supporting sustainable energy use, a key issue for younger generations, in technologically and socially relevant ways. In the medium term, the contributions made here including the introduction of the larger topic have vast potential to support the achievement of sustainable, competitive and reliable energy markets.

For energy network organisations it will be useful to understand how integrating dynamic communications into existing frameworks enhances relationships with users and increases effectiveness of communication. While web-enabled engagement campaigns have a

good deal of promise for sustainable energy initiatives, there are also a number of issues that have potential to become problematic in terms of ethics and corporate responsibility, which are important to note. Energy organisations will face a number of legal and industry codes and regulations regarding accurate and fair online marketing practices (Elefant, 2011), and for engagement processes to be genuinely inclusive, a mix of traditional and web-enabled solutions are likely to be necessary (Evans-Cowley & Hollander, 2009). There is also the issue of the energy demand related to internet use; although the shift to a "paperless" digital society appears in many ways to be environmentally sound, it can be argued that computers are part of the energy problem, where increases in domestic energy consumption can be linked to the normalisation of energy intensive computers and other internet-enabled devices (Foster et al., 2011). In the development of online strategy, organisations should assess and account for any new risks associated with online communications, in broad legal terms as well as specifically with regard to organisational aims and audiences, and address these prior to the development of engagement campaigns. Risk and opportunity should be cooperative drivers in development of socially dynamic engagement strategy, where both are given dedicated, project-specific analysis and are evaluated against monitored performance outcomes over time.

Energy is a social resource, and our management of it must take into account the social conditions in which we live. The SDCF, as an integrated communications production method as well as an iterative evaluation process, can support organisations in increasing engagement from energy consumers by taking advantages of the benefits of two-way, responsive communication. The value created through application is likely to feed back into the energy network—for consumers and organisations—through increased energy efficiency measures, increased revenue surrounding new products, and greater social acceptance of energy transitions and technologies more broadly. Simultaneously, as Willard (2009)

observes, “sustainable development is a transformative goal and traditional tools will never lead to social transformation. It is only in shaping the quality and quantity of daily interactions amongst people that we have a chance to shape more sustainable systems” (p. 29). It has also been noted that attempts to change individual behaviours regarding sustainable consumption often struggle to take into account the dynamics of social change, including technological change (Pierce & Paulos, 2012). Influencing how people use energy will require influencing how they understand energy; this in turn will require new tools for communicating with and understanding consumers.

The literature review indicates that these social processes are likely to be best influenced through dynamic, user-centric social interactions in order to be meaningful in contemporary social and technological contexts, and furthermore, and that these types of interactions will become integral to future energy delivery systems (Tsoukalas & Gao, 2008; Honebein et al., 2009; Pierce & Paulos, 2012; Simmhan et al., 2012). While some organisations are likely to cite a lack of control in digital and social media as a risk large enough to justify avoiding ambitious, web-enabled communications strategies, the majority of engagement and marketing literature emphasises a greater risk inherent in not engaging with users online (Elefant, 2011). To this end, an awareness of the variety of tools, their uses and potentials must be spread within the energy sector, as we now operate in an energy landscape characterised by diversely shared resources, whose limited availability will require ever more prudent and productive users.

Acknowledgements

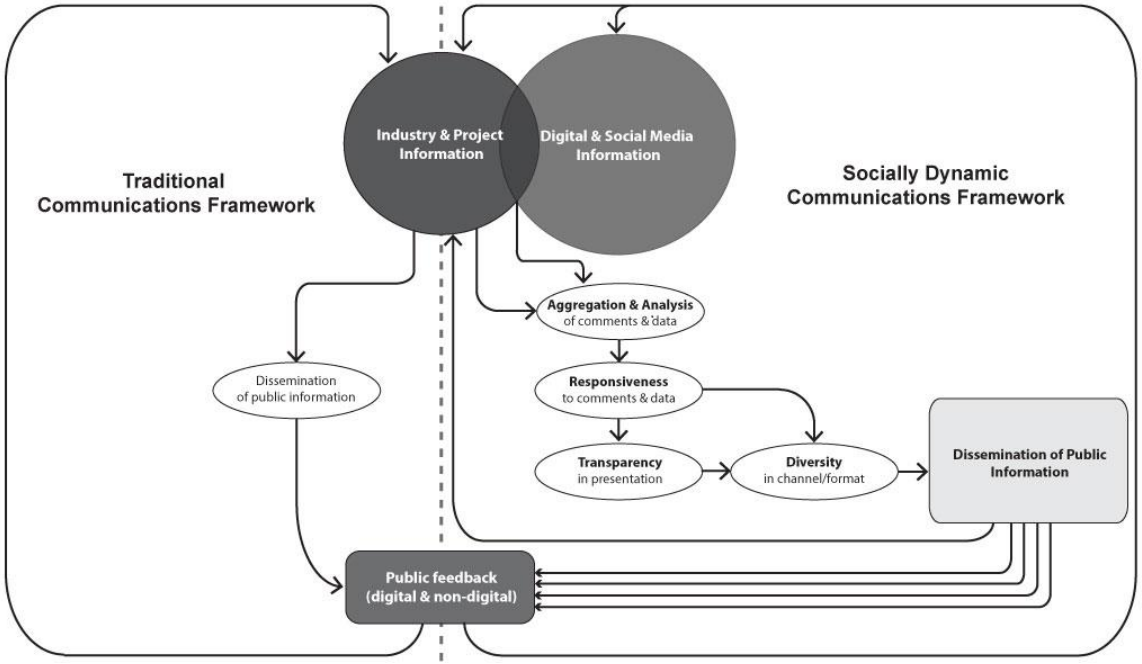
The authors are grateful to B9 Energy Offshore for supporting this research.

Table 1.
Overview of challenges and solutions identified in systematic review.

Challenges	Solutions
1. Gathering and processing consumer data effectively	1. **Aggregation and analysis** of relevant data
2. Reducing risks related to mistrust and misinformation	2. **Responsiveness** toward consumers
3. Building stronger relationships with consumers	3. **Transparency** of language and process
4. Reaching greater numbers of consumers	4. **Diversity** in presentation format and tone
5. Encouraging proactive consumer behaviour	5. **Interactive** dissemination of information

Note: Phrases in bold link to steps in the SDCF (see Figure 1).

Figure 1.
Socially Dynamic Communications Framework



References

Abrahamse, W., Steg, L., Vlek, C., Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. Journal of Environmental Psychology 25, 273-291.

Roen, K., Arai, L., Roberts, H. and Popay, J. (2006) 'Extending systematic reviews to include evidence on implementation: methodological work on a review of community-based initiatives to prevent injuries', Social Science and Medicine, vol 63, no 4, pp 1060-71.

Arai, L., Britten, N., Popay, J., Roberts, H., Petticrew, M., Rodgers, M., & Sowden, A. (2007). Testing methodological developments in the conduct of narrative synthesis: a demonstration review of research on the implementation of smoke alarm interventions. Evidence & Policy, 3(3), 361-383.

Barrios-O'Neill, D., & Hook, A. (2012). Jumping between the Layers: Alternate reality games and literature. In N. Whitton & Alex Moseley (Eds.), Using games to enhance learning and teaching: A beginner's guide. London: Routledge.

Bittle, S., Haller, C., & Kadlec, A. (2009). Promising practices in online engagement. Centre for Advancement in Public Engagement. New York, NY.

Bogost, Ian (2007). Persuasive Games: The expressive power of video games. Cambridge, MA: MIT Press.

Corner, A., & Randall, A. (2011). Selling climate change? The limitations of social marketing as a strategy for climate change public engagement. Global Environmental Change, 21(3), 1005–1014.

Devine-Wright, P. (2007). Reconsidering public attitudes and public acceptance of renewable energy technologies: A critical review. Research Councils Energy Programme. Manchester: University of Manchester School of Environment and Development.

Devine-Wright, H., & Sherry-Brennan, F. (2010). Visible technologies, invisible organisations: An empirical study of public beliefs about electricity supply networks. Energy Policy, 38(8), 4127–4134.

Elefant, C. (2011). The "power" of social media: Legal issues and best practices for utilities engaging social media. Energy Law Journal, 32(1), 1–56.

European Wind Energy Association. (2013). Wind energy facts. http://www.ewea.org/wind-energy-basics/facts/ (Accessed 19 August 2014). Brussels, Belgium: EWEA.

Evans-Cowley, J., & Hollander, J. (2010). The new generation of public participation: Internet-based participation tools. Planning Practice and Research, 25(3), 397–408.

Faiers, A., & Neame, C. (2006). Consumer attitudes towards domestic solar power systems. Energy Policy, 34(14), 1797–1806.

Foster, D., Lawson, S., Blythe, M., Cairns, P., & Pool, B. (2010). Wattsup?: Motivating reductions in domestic energy consumption using social networks. Proceedings of NordiCHI 2010, (pp. 78–187). Reykjavic, Iceland: NordiCHI.

Foster, D., & Linehan, C. (2013). "Liking" carbon: can social media play a role in carbon management? Carbon Management, 4(1), 1–4.

Fredericks, J., & Foth, M. (2013). Augmenting public participation: Enhancing planning outcomes through the use of social media and web. Australian Planner, 50(3), 244–256.

Gensler, S., Völckner, F., Liu-Thompkins, Y., & Wiertz, C. (2013). Managing brands in the social media environment. Journal of Interactive Marketing, 27(4), 242–256.

Gordon, E., & Koo, G. (2008). Placeworlds: Using virtual worlds to foster civic engagement. Space and Culture, 11(3), 204–221.

Gross, C. (2007). Community perspectives of wind energy in Australia: The application of a justice and community fairness framework to increase social acceptance. Energy Policy, 35(5), 2727–2736.

Gungor, V. C., Sahin, D., Kocak, T., Ergut, S., Buccella, C., Cecati, C., & Hancke, G. P. (2011). Smart grid technologies: Communication technologies and standards. IEEE Transactions on Industrial Informatics, 7(4), 529-539.

Haggett, C. (2009). Implications of alternative mitigation responses: Renewable energy. In Lever-Tracy, Constance (Ed.) Handbook of climate change and society, London: Routledge.

Haggett, C. (2011). Understanding public responses to offshore wind power. Energy Policy, 39(2), 503–510.

Harvey, B., & Brereton, D. (2005). Emerging models of community engagement in the Australian minerals industry. In Proceedings of International conference on engaging communities (pp. 1-15). Brisbane, AU: United Nations & Queensland University.

Hassan, R., & Radman, G. (2010). Survey on smart grid. Proceedings of the IEEE SoutheastCon (pp. 210–213). Charlotte, NC: Advancing Technology for Humanity.

Honebein, P. C., Cammarano, R. F., & Donnelly, K. a. (2009). Will smart meters ripen or rot? Five first principles for embracing customers as co-creators of value. The Electricity Journal, 22(5), 39–44.

Hopper, J. R., & Nielsen, J. (1991). Recycling as altruistic behaviour. Normative and behavioural strategies to expand participation in a community recycling program. Environment and Behavior, 23, 195-220.

Huijts, N. M. A., Midden, C. J. H., & Meijnders, A. L. (2007). Social acceptance of carbon dioxide storage. Energy Policy, 35(5), 2780-2789.

Innes, J. E., & Booher, D. E. (1999). Consensus Building and Complex Adaptive Systems. Journal of the American Planning Association, 65(4), 412–423.

International Association for Public Participation. (2007). IAP2 Spectrum of Public Participation. Louisville, CO.

Korschun, D., & Du, S. (2013). How virtual corporate social responsibility dialogs generate value: A framework and propositions. Journal of Business Research, 66(9), 1494–1504.

Kozinets, Robert V.; Belz, Frank-Martin; McDonagh, P. (2012). Social media for social change. In Mick, D.G., Pettigrew, S., Pechmann, C. & Ozanne, J. (Eds.) Transformative consumer research for personal and collective well-being. London: Routledge.

Krätzig, S., & Warren-Kretzschmar, B. (2014). Using interactive web tools in environmental planning to improve communication about sustainable development. Sustainability, 6(1), 236–250.

Krishnamurti, T., Schwartz, D., Davis, A., Fischhoff, B., de Bruin, W., Lave, L., & Wang, J. (2012). Preparing for smart grid technologies: A behavioural decision research approach to understanding consumer expectations about smart meters. Energy Policy, 41(0), 790-797.

Langley, D., & Broek, T. Van Den. (2010). Exploring social media as a driver of sustainable behaviour : case analysis and policy implications. In Proceedings of the Internet Politics and Policy Conference (pp. 16-17). Oxford: Oxford University.

Laroche, M., Habibi, M. R., Richard, M.O., & Sankaranarayanan, R. (2012). The effects of social media based brand communities on brand community markers, value creation practices, brand trust and brand loyalty. Computers in Human Behavior, 28(5), 1755–1767.

Latta, S., Mulcare, C. & Zacharzewski, A. (2013). In the goldfish bowl: science and technology policy dialogues in a digital world. Oxford, UK: Sciencewise Expert Resource Centre.

Leamy, M., Bird, B., Le Boutillier, C., Williams, J. & Slade, M. (2011). Conceptual framework for personal recovery in mental health: systematic review and narrative synthesis. The British Journal of Psychiatry: The Journal of Mental Health 199(6): 445-452.

Li, F., Member, S., Qiao, W., & Sun, H. (2010). Smart transmission grid: Vision and framework IEEE Transactions on Smart Grid 1(2), 168–177.

Mandarano, L., Meenar, M., & Steins, C. (2011). Building social capital in the digital age of civic engagement. Journal of Planning Literature, 25(2), 123–135.

McGonigal, J. (2011). Reality is broken: Why games make us better and how they can change the world. London: Random House.

McKenzie-Mohr, D. (2000). New ways to promote pro-environmental behavior: Promoting sustainable behavior: An introduction to community-based social marketing. Journal of Social Issues, 56(3), 543-554.

Menegaki, A. N. (2012). A social marketing mix for renewable energy in Europe based on consumer stated preference surveys. Renewable Energy, 39(1), 30–39.

Metzger, M. J., & Flanagin, A. J. (2013). Credibility and trust of information in online environments: The use of cognitive heuristics. Journal of Pragmatics, 59, 210-220.

Mooij, T. (2007). Design of educational and ICT conditions to integrate differences in learning: Contextual learning theory and a first transformation step in early education. Computers in Human Behavior, 23(3), 1499–1530.

Nakarado, G. L. (1996). A marketing orientation is the key to a sustainable energy future. Energy Policy, 24(2), 187–193.

Nambisan, P., & Watt, J. H. (2011). Managing customer experiences in online product communities. Journal of Business Research, 64(8), 889–895.

Oliva, Sheila (2014). Turning Wind Energy into a Waltz. https://blogs.siemens.com/energymix/stories/2320/. (Published 29 July). Raleigh, NC: Siemens.

Paladino, A., & Pandit, A. P. (2012). Competing on service and branding in the renewable electricity sector. Energy Policy, 45(2012), 378–388.

Peirson-Smith, A. T. J. (2012). Embracing social media to enhance public participation in Hong Kong. In Conference Proceedings: Energy Future (pp. 1-5). Porto, Portugal: International Association for Impact Assessment.

Duggan, M. & Smith, A. (2013). Social media update. Washington, DC: Pew Research Center.

Pierce, J., & Paulos, E. (2012). Beyond energy monitors : Interaction, energy, and emerging energy systems. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 665-674). Raleigh, NC: Association for Computing Machinery.

Popay, J., Roberts, H., Sowden, A., Petticrew, M., Arai, L., Rodgers, M., Britten, N., Roen, K., & Duffy, S. (2006). Guidance on the conduct of narrative synthesis in systematic reviews: a Product from the ESRC methods programme. Institute for Health Research, Lancaster University.

Røpke, I., Christensen, T.H., & Jensen, J.O. (2010). Information and communication technologies – A new round of household electrification. Energy Policy 38(4), 1764-1773.

Ross, J., & Tomlinson, B. (2010). How games can redirect humanity's cognitive surplus for social good. Computers in Entertainment, 8(4), 1–4.

Rowe, G., & Frewer, L. J. (2000). Public participation methods: A framework for evaluation. Science, Technology & Human Values, 25(1), 3–29.

Rundle-Thiele, S., Paladino, A., & Apostol, S. A. G. (2008). Lessons learned from renewable electricity marketing attempts: A case study. Business Horizons, 51(3), 181–190.

Schroeter, R., & Houghton, K. (2011). Neo-planning : location-based social media to engage Australia's new digital locals. In Proceedings of Planning Institute of Australia National Congress. Canberra: Planning Institute of Australia.

Scott, M., Bullock, C., & Foley, K. (2013). "Design matters": Understanding professional, community and consumer preferences for the design of rural housing in the Irish landscape. Town Planning Review, 84(3), 337–370.

See-To, E. & Ho, K. (2014). Value co-creation and purchase intention in social network sites: The role of electronic word-of-mouth and trust – A theoretical analysis. Computers in Human Behaviour 31, 182-189.

Sheau-Ting, L., Mohammed, A. H., & Weng-Wai, C. (2013). What is the optimum social marketing mix to market energy conservation behaviour: an empirical study. Journal of Environmental Management, 131, 196–205.

Sheppard, D. C. (2011). Social solutions for climate change mitigation and adaptation : Cross cultural lessons from Denmark to the intersect: The Stanford Journal of Science, Technology & Society, 4(1), 67–91.

Simmhan, Y., Zhou, Q., & Prasanna, V. (2011). Semantic information integration for Smart Grid applications. In Kim, J. & Lee, M. (Eds.) Green IT: Technologies and Applications. London: Springer.

Singh, T., Veron-Jackson, L., & Cullinane, J. (2008). Blogging: A new play in your marketing game plan. Business Horizons, 51(4), 281–292.

Smith, A. (2014). Older adults and internet use. Washington, DC: Pew Research Center.

Strengers, Y. (2011). Designing eco-feedback systems for everyday life. In Proceedings of the Annual Conference on Human Factors in Computing Systems. Vancouver, CA: Association for Computing Machinery.

Sundar, S. S. (2008). The MAIN Model: A Heuristic Approach to Understanding Technology Effects on Credibility. In M. J. M. a. A. J. Flanagin (Ed.), Digital Media, Youth, and Credibility (pp. 73–100). Cambridge, MA: The MIT Press.

Tait, M., & Hansen, C. J. (2013). Trust and governance in regional planning. Town Planning Review, 84(3), 283–312.

Toke, D., Breukers, S., Wolsink, M. (2008). Wind power deployment outcomes: How can we account for the differences? Renewable and Sustainable Energy Reviews 12(4), 1129-1147.

Tsoukalas, L. H., & Gao, R. (2008). From smart grids to an energy internet : Assumptions, architectures and requirements. IEEE Deregulation, Restruction and Power Technologies 3, 94-98.

Trusov, M., Bucklin, R. E., & Pauwels, K. (2009). Effects of word-of-mouth versus traditional marketing: Findings from an Internet social networking site. Journal of Marketing, 73(5), 90–102.

Twitchen, C., & Adams, D. (2012). Using web technology to increase levels of public participation in planning. Town Planning Review, 83(6), vii–xiv.

Vervoort, J.M., Kok, K., van Lammeren, R., & Veldkamp, T. (2010). Stepping into futures: Exploring the potential of interactive media for participatory scenarios on social-ecological systems. Futures 42(6), 604-616.

Victor, L. (2008). Systematic reviewing in the social sciences: Outcomes and explanation. Enquire 1(1): 32-46.

Westerman, D., Spence, P. R., & Van Der Heide, B. (2012). A social network as information: The effect of system generated reports of connectedness on credibility on Twitter. Computers in Human Behavior, 28(1), 199-206.

Willard, T. (2009). Social networking and governance for sustainable development. International Institute for Sustainable Development. Winnipeg, CA.

Wolsink, M. (1996). Dutch wind power policy: Stagnating implementation of renewables. Energy Policy 24(12), 1079-1088.

Wüstenhagen, R., Wolsink, M., & Bürer, M. J. (2007). Social acceptance of renewable energy innovation: An introduction to the concept. Energy Policy, 35(5), 2683–2691.

Wymer, W. (2010). Rethinking the boundaries of social marketing: Activism or advertising? Journal of Business Research, 63(2), 99–103.

Yamagishi, T., Yamagishi, M. (1994). Trust and commitment in the United States and Japan. Motivation and Emotion 18, 129–166.

Zaglia, M. E. (2013). Brand communities embedded in social networks. Journal of Business Research, 66(2-2), 216–223.