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Public acceptance of renewable energy technologies from an abstract versus concrete perspective and the positive imagery of solar power

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ABSTRACT

Public acceptance and perception of renewable energy sources are key factors for successfully accomplishing an energy transition. In this light, developing effective policy and communication measures necessitates understanding how people perceive energy systems. Accordingly, the present study aimed to shed light on people's imagery of solar power, one of the renewable energy sources with the highest potential. Results revealed that almost unanimously people associate solar power with highly positive imagery and that visual characteristics are especially prevalent. The successful realization of renewable energy projects requires policymakers to draw on reliable data about public acceptance of renewables. In response to this need, the present study examined whether assessing public acceptance of renewables on a more concrete level (i.e., by addressing drawbacks) can result in a different, more reliable acceptance rating than assessment on an abstract level, as done at present in opinion polls. Results showed that people do not think about drawbacks related to renewables when they consider it from a general, more abstract, perspective. However, when downsides are specifically addressed, people integrate these into their evaluation, thus diminishing acceptance. Even the highly positive imagery of solar power is relativized and acceptance decreases. These findings have several important implications for policymakers.

1. Introduction

Facing an energy crisis in 1979, former President of the United States, Jimmy Carter, erected solar panels on the roof of the White House. At a time when people had suddenly become aware of the finite nature of the energy sources that had been depended upon, this act highlighted the need to shift to renewable energy sources. The solar panel installation on the White House was aimed to provide a symbol of the aspired energy transition. However, a few years later, as the energy crisis subsided, the solar panels on the roof of the White House were removed along with the idea of an energy transition. The same inertia or lack of implementation was seen in other countries. Despite enthusiasm about alternative energy systems, projects to promote renewable energies were only implemented very tentatively, with no real effort to exploit their full potential. However, a few decades later, the topic of energy transition (re)gained considerable importance, especially after the nuclear accident at Fukushima Daiichi in March 2011. Discussions about the acceptance of nuclear power and the promotion of renewable energies were reinitiated. Several countries began to reconsider their energy policies and explore strategies to ensure future energy supply while pursuing the goal of more sustainable energy production through increased investments in renewable energy sources (Ming et al., 2016; Wang and Chen, 2012). Switzerland and Germany even decided to (gradually) phase out nuclear energy (Bundesrat, 2011b; Bundesregierung, 2011).

The key to achieving a successful energy transition, besides overcoming substantial technical challenges, is public acceptance. At first, the question of acceptability might seem unproblematic because several studies on people's attitudes toward renewable energies, based on public opinion polls for example, have reported high general acceptance of renewables (e.g., Eurobarometer, 2014). With respect to the actual implementation of a project, however, policymakers face considerable local resistance and lack of support. For a successful and more efficient realization of renewable energy projects, it is crucial to obtain more valid data about public acceptance of renewable energy systems. Therefore, the aim of the present research is to provide representative data on public acceptance and perception of renewable energies, which represents a suitable and reliable decision base for the implementation of renewable energy projects at a local level and for the development of communication strategies. Particular focus is placed on the public perception of one of the most promising renewable energy production technologies: solar power.

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1.1. The Swiss electricity supply situation

The nuclear accident in Fukushima had a direct influence on the energy policies of several countries (Ming et al., 2016). In reaction to this incident, some countries—including Switzerland—decided to withdraw from nuclear power completely. Formerly considered a valid option for climate change mitigation because of its low carbon dioxide emissions (Dones et al., 2004), nuclear energy no longer seemed to represent a suitable alternative to ensure a reliable energy supply in Switzerland. Therefore, the Swiss Federal Council and the Swiss parliament decided to gradually phase out nuclear energy (Bundesrat, 2011b). This means that the five nuclear power plants currently operating in Switzerland will be gradually decommissioned once their operational lifetime, as specified by safety guidelines, expires, and they will not be replaced by new ones. As a result of this decision, a relevant energy production technology will no longer be available in the future. In order to achieve sustainable and climate-friendly coverage of the increasing energy demand, two strategic approaches are key in Switzerland's proposed new energy strategy: first, the reduction of energy consumption through more efficient use of energy and voluntary curtailment behavior (i.e., sufficiency) and second, increased reliance on renewable energy (Akademien der Wissenschaften Schweiz, 2012; Bundesrat, 2011a). Further pillars of the new energy strategy are electricity imports and, if necessary, construction of gas-fired power plants.

A successful sustainable energy transition calls for substantial promotion of new renewable energies (e.g., photovoltaic energy, wind energy, geothermal energy). Hydropower is Switzerland's most important domestic source of renewable energy for electricity production. In 2015, hydroelectric power plants accounted for the largest share of electricity generation in Switzerland, with about 60% of the total annual electricity produced, followed by nuclear power plants, which contributed about 34% (BFE, 2016a). The potential of hydroelectric power is, however, almost exhausted. Thus, hope lies on new renewable energy sources, which, with a share of only about 4.3% of the total electricity production in Switzerland, presently play only a minor role and have considerable potential for expansion (BFE, 2016b). Of the new renewable energy systems, photovoltaics are considered to have the greatest technical potential in Switzerland (Akademien der Wissenschaften Schweiz, 2012; Andersson et al., 2011). It is assumed that by 2050, it is possible to meet about 20% of the current electricity demand in Switzerland through the use of photovoltaic systems (BFE, 2016c).

1.2. Public acceptance of renewable energy and the unique position of solar power

Renewable energy systems and sustainable energy policies generally enjoy high public acceptance in several countries (Eurobarometer, 2011; Visschers and Siegrist, 2014). The vast majority of Europeans (90%) think that national governments should set targets to increase renewable energy consumption by 2030 (Eurobarometer, 2014). Also, energy consumers positively perceive green electricity, which has gained market acceptance (Borchers et al., 2007; Kaenzig et al., 2013; Litvine and Wüstenhagen, 2011). Further, the introduction of green defaults is also generally well received by consumers (Kaenzig et al., 2013) and has proven to be effective for fostering the consumption of green electricity (Pichert and Katsikopoulos, 2008; Sunstein and Reisch, 2014). Renewable energy systems are much more favorably perceived than nuclear power and fossil fuels (Eurobarometer, 2011; Spence et al., 2010). Unlike nuclear power, people associate renewables with higher collective benefits and lower collective costs; these are two main drivers of technology acceptance (for an overview, see Perlaviciute and Steg, 2014).

Solar power is a renewable energy source that particularly stands out when it comes to public perception and acceptance. Electricity production using energy from the sun is the alternative energy system that enjoys the highest public acceptance and support (e.g., Borchers et al., 2007; Eurobarometer, 2011; Kaenzig et al., 2013; Spence et al., 2010). This may be due to the positive symbolic value inherent in this energy source, which people perceive as producing the most environmentally-friendly form of energy (Tampakis et al., 2013). Recent research suggests that the positive symbolic meaning associated with solar power evokes positive feelings toward this technology, which subsequently influence people's perception and decision making related to solar power and may even result in biased judgments in risk assessments of this technology (Siegrist and Sütterlin, 2014). The symbolic attributes assigned to renewable energy systems are crucial for their acceptance and may be even more predictive of renewable energy acceptance than instrumental attributes (Noppers et al., 2014). Research on the acceptance of energy-related infrastructure projects has also stressed the importance of the symbolic meaning related to energy production systems and related infrastructure (cf. Devine-Wright, 2009).

1.3. The affective imagery of energy production technologies

The symbolic meaning attributed to a stimulus can be conceived of as a part of people's mental representation of the stimulus object. A mental representation is an imagery, a spontaneous association, that automatically comes to a person's mind when thinking about a stimulus. It is shaped by learning and experience and always goes along with an affective evaluation (Slovic et al., 1998). Affective and cognitive evaluations are interactive, and both influence judgment and behavior (e.g., Loewenstein et al., 2001; Slovic et al., 2004; Sütterlin and Siegrist, 2016; Wilson and Arvai, 2006). According to the affect heuristic proposed by Slovic and colleagues (Slovic et al., 2007), people base their judgments and decisions on the positive or negative feelings that arise in relation to objects, images, or other stimuli. Affective associations are strongly predictive of judgments and behaviors related to various domains such as climate change (Leiserowitz, 2006; Lorenzoni et al., 2006), gene technology (Connor and Siegrist, 2011), and electromagnetic fields (Siegrist et al., 2005). Research on affective imagery related to energy production has mainly focused on people's perception of issues related to nuclear power (Keller et al., 2012; Peters and Slovic, 1996; Slovic et al., 1991). Only a few recent studies have expanded the investigation of affective imagery to include other energy production technologies (Lee, 2015; Truelove, 2012) or the development of other energy sources (Boudet et al., 2014).

Given the increasing importance of renewable energy technologies and the crucial role of public acceptance in their successful implementation, surprisingly little is known about the affective imagery of renewable energy systems (Lee, 2015; Truelove, 2012). The two studies that have investigated the affective imagery of renewable energy systems suggest that renewables are associated with fewer negative aspects than nuclear, coal, and natural gas and that people generally hold more positive feelings about renewables (Lee, 2015; Truelove, 2012). A deeper understanding of people's mental representation of a technology is necessary to reveal concerns or potential misconceptions and one-sided thinking that could result in biased judgments. These insights are crucial because they point to possible challenges in communication and policy measures. However, research on the mental representation of renewables, and on solar power as one of the new renewable energy systems with the highest potential (Midttun, 2012) in particular, is largely lacking. To the best of our knowledge, only one study conducted in Germany has assessed the imagery associated with solar power (Lee, 2015). The results revealed that the participants associated solar power with the following aspects or characteristics: “clean,” “solar panels,” “cost,” “renewable and alternative resource,” and “sun and warmth.” However, these findings were based on student samples from a single city in Germany. Data based on a student sample are an unsuitable basis from which to draw conclusions about the