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Identifying and explaining public preferences for the attributes of energy technologies

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ABSTRACT

Public preferences play an important role in the debate about which technologies to include in a future energy system. However, these public preferences for specific technologies are often backed by little knowledge and they may change in different contexts. In this study, we identify a compact set of main attributes for energy technologies (and the energy system as a whole) based on the preferences expressed by a sample of 451 respondents. The preferences for these main attributes are related to the use of different information sources, prior knowledge, environmental awareness, and socio-demographic variables. The results show that 'risk of catastrophe', 'economic security', 'private costs and discomfort', 'spatial impact', and 'price' are the five main attributes that the public discerns. Further, specific information sources can target audiences with specific preferences for the attributes of energy technologies. Prior knowledge (*knowing*) about energy technologies can induce further the use of information sources, while environmental awareness (*caring*) promotes making trade-offs between attributes. Based on this research, policymakers can design better strategies to communicate information to the public about technological options and increase awareness about the necessity of changes to the energy system.

Contents

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1. Introduction

The European Union aims to increase the share of renewables in the energy system to 20% by 2020 [1]. Therefore, many European governments are increasingly using public resources to facilitate the transition from a traditional, fossil fuel-based energy system towards a more sustainable one. The reasons to stimulate this transition process include the growing concern about the effects of greenhouse gas emissions and the increasing energy dependence on politically instable countries [2,3].

Many studies have been conducted that attempt to identify factors that promote or inhibit the transition process [4–6]. A topic that has been less prominent in the transition debate, however, is the issue of the public acceptance of these new energy technologies [7]. However, the topic of public acceptance is becoming increasingly important for a number of reasons. Firstly, the development and promotion of sustainable energy technologies are publicly financed to a large extent. In a society where science is becoming increasingly more accountable to the general public [8,9], the views of the general public have to be taken into account in order to legitimize the innovation process [10]. Recently, it has been argued that the current debate about energy is mainly an elite debate, which fails to engage the opinion of the public [11] or in which it is often unclear how well the opinion of the public is represented [12]. Secondly, in recently liberalized energy markets, demand for a specific type of energy may directly influence the development of these energy sources. Finally, public opinion can be a decisive factor for the failure of a specific energy project [13,14]. For the aforementioned reasons, methods have been developed that attempt to manage the social acceptation of energy projects (see [15]).

Studies that look into public preferences as a measure of the acceptance of new energy technologies often limit themselves to a specific technology. Examples include carbon capture and sequestration [16], wind power [17,18], biomass [19,20], solar energy [21], and nuclear power [22,23]. Notable exceptions are the studies by Bergmann et al. [24], Borchers et al. [25], Zoellner et al. [26], Bergmann et al. [27], and Erbil [28] that consider a larger set of energy technologies, and meta-studies that combine the results of public preferences' studies [29]. Studies that consider a broad set of technologies are of great importance given the fact that future energy systems are likely to consist of multiple energy alternatives. They steer the public debate about energy in a more fundamental direction by asking what we want our entire future energy system to look like, instead of focusing on single projects or technologies.

Forming a preference requires making trade-offs between various attributes of the technologies (see for example [17]). Examples of the attributes of (new) energy technologies that were used earlier are the reduction of fossil fuel imports, land use, the creation of employment, and the price paid for energy [24,30]. These attributes are usually identified on an ad hoc basis through document studies and focus group research [24,31]. However, these methods are limited when it comes to generalization; they do not take into account how the population as a whole perceives an attribute. Moreover, in the eyes of the broader population, attributes identified in this manner can have conceptual overlaps. Therefore, it is desirable to identify a list of generic attributes of what the public considers when comparing energy technology options. Identifying this set of generic attributes – from a large sample, in a rigorous quantitative manner – provides a robust input for future studies that estimate preferences for energy technologies. Further, this approach can enrich the public debate and aid policymakers by comparing and choosing between technological alternatives. Finally, when asked for their opinions, individuals usually 'selectively use information that is part of the immediate task description, as well as information that is drawn selectively from memory or from various sources, such as what they've heard, read or seen on the news, to construct a response on the spot' [32]. This means that individuals often lack a full body of knowledge about a technology [14,29], which leads to opinions that can change easily over time [33]. Identifying the most important attributes of energy technologies provides decision criteria that can aid the public when choosing between technological alternatives. The result is that individuals can make well-meaning and persistent choices. This can strengthen the position of the public and its representatives in the political decision-making process.

The aim of this paper is threefold. First, we identify a set of generic attributes that are considered by the public when forming their preferences for energy alternatives. To this end, we reduce the long list of characteristics of energy technologies to a small number of comprehensible and non-overlapping attributes. Second, we aim to explore how these attributes are related to the use of information sources. Including the sources that people use for information gathering is important because it allows actors in the debate to design communication strategies that inform the public about new or existing technologies and supporting policies. Third, by relating the valuation of attributes to variables such as environmental awareness and prior knowledge about energy technologies as well as a set of socio-demographic control variables, we show that the heterogeneity of respondents partly explains preferences for attributes. Therefore, we add to earlier studies that explore heterogeneous preferences in the domain of energy and the environment [24,27,34,35]. Further, this enables a better understanding of these preferences and provides opportunities for policymakers and other participants in the energy debate to formulate communication strategies that target specific segments of the population.

Our empirical data consist of a survey with 451 respondents from the Dutch province of Utrecht. In the Netherlands, policies are currently being implemented to guide the transition towards a more sustainable energy system (see [36]), and many experiments with new forms of energy production are being conducted. This makes the Netherlands a suitable research case.

In the following section, we provide a short background on the importance of public preferences for attributes and on how to identify them and we further define the concepts and describe the models used. In Section 3, our empirical research methods are described. The results are presented in Section 4. Finally, Section 5 ends with conclusions and implications.

2. Public preferences and the energy debate

Public attention on the negative characteristics of energy production and consumption has increased over the past few decades. Acidification problems due to (coal-fired) power plants received attention in the 1980s and 1990s and led to the increased use of filtering techniques on power plants [37]. The nuclear accidents at Three Mile Island and Chernobyl led to a stagnation in the building of new nuclear power plants in the US and Europe [38]. Currently, the energy debate is largely influenced by the potential climate effects of carbon dioxide emissions resulting from the firing of fossil fuels, although the catastrophe at Fukushima has also reinvigorated the debate about nuclear energy. Increasing the use of renewable energy sources is a potential solution to the climate problem [39].

Many governments strive for an energy system that is clean, safe, and affordable. However, most of the available energy sources have (serious) drawbacks, and no single energy source can resolve all problems. The energy system of the future will therefore (also) be a mix of several energy sources. This means that trade-offs between attributes will have to be made in such a manner that sufficient public support is gathered [40]. Generally, the public