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How do companies decide? Emotional triggers and drivers of investment in natural gas and biogas vehicles



Natalia Saukkonen*, Teemu Laine, Petri Suomala

Cost Management Center, Tampere University of Technology, PO Box 541, FI-33101 Tampere, Finland

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ABSTRACT

Management research recognizes that companies' investment decisions are driven not only by objective techno-economic models but also by emotion. Alternative fuel vehicle (AFV) investments offer an appealing context in which to study this interaction in energy source decisions, as they are influenced by a diverse set of analytical and emotional elements ranging from fuel costs to environmental values. This study examines companies' vehicle investment decision making in Finland and focuses on the interaction between objective facts and subjective feelings along with the process of choosing the vehicles' energy source.

This article is based on an interventionist case study. Switching path analysis technique (SPAT) was used to investigate companies' switches from conventional fuels to natural gas or biogas. This article contributes to the discussion of AFV adoption by unveiling companies' decision-making triggers, investment criteria and the use of information sources in the decision-making processes. The findings regarding the decision-making dynamics between these factors are transferable to other energy investments. However, the content of the triggers and drivers varies across contexts and may change over time, because vehicles as investment objects have different meanings for different organizational actors depending on their organizational role, investment use context, and personal preferences.

1. Introduction

1.1. The decision-making process is a black box

Energy research has studied energy-related behavior and decision making in the consumer and public sector, but research on such behavior in companies is rather limited [1] despite companies' large impact on the world's energy investments and use. The actual role of different information sources as objective and subjective inputs¹ in companies' energy source decision-making processes is unknown [3]. Traditionally, energy research interprets energy source choices, such as transportation fuel choices, as techno-economic comparisons (see e.g., [4–8]). These comparative calculations include market information (e.g., fuel costs) and measured factors (e.g., technological performance or emission data). These comparisons give companies suggestions about suitable and optimal investment alternatives. However, these suggestions do not necessarily lead to an investment decision according to the found optimum. Often, these calculations are simply used by suppliers to persuade customer companies to make investments. Even though a

supplier can demonstrate the cost savings and environmental benefits of adopting the new energy solution, the message might not reach or convince the customer or even fit the customer's decision-making process and criteria. The customer may invest in the new technology for environmental reasons, as a pioneering project, or to differentiate itself from competitors. The mismatch of the supplier's message and customer companies' decision-making criteria can hinder the adoption of new energy technologies.

Broadly speaking, the paper builds on and extends the existing human-centered energy research, where companies' decision making is driven by individuals who collect and interpret information about the business context and related energy aspects [1; 3]. More specifically, the contribution of the article is related to the following questions explicitly outlined in the agenda of *Energy Research and Social Sciences* [9]: “What types of information and feedback are most effective at influencing energy producers and users? (Question 20 in [9])” and “How do people make decisions about energy when those decisions necessitate tradeoffs? (Question 30 in [9])” The article focuses on the dynamics of decision making, involving information about complicated phenomena

* Corresponding author.

E-mail addresses: natalia.saukkonen@tut.fi (N. Saukkonen), teemu.j.laine@tut.fi (T. Laine), petri.suomala@tut.fi (P. Suomala).

¹ The subjective and objective inputs are distinct in this paper: Objective inputs represent the shared understanding of information in the field, including mainly quantitative facts on prices, emissions, and technologies, as well as shared calculation practices. Subjective inputs include the given meanings and interpretations of this information as well as perceptions, values, and emotional triggers. Subjective inputs shape the communication on the objective information; together, they affect the actual investment behavior [2].

as well as other triggers and drivers of decisions.

In the context of energy source choices, alternative fuel vehicles (AFVs) represent an interesting case example of decision making. Despite the progress in developing necessary technologies and infrastructure, as well as the increased public interest in sustainable solutions, challenges remain in promoting the wider acceptance of AFVs by the general public [10]. The factors hindering the diffusion of new vehicle technologies can be understood more thoroughly by looking at the individual companies' investment decision-making processes. AFV investments represent an example of an energy source decision with multiple criteria, including various facts and valuations. In addition to the techno-economic optimum found through emission and financial calculations, subjective elements such as the vehicle brand, origin of the fuel, and maturity (e.g., pioneer nature) of the technology can also affect the investment decision. However, little is known about the actual inputs and their effects on companies' AFV investment decisions. Instead, the academic literature has studied in detail several crucial factors affecting vehicle purchases and related fuel choices in the consumer context (see e.g., [11–14]), as well as consumers' sensitivity to fuel prices (see e.g., [15–17]).

This study examines the triggers and other inputs in companies' vehicle fleet investment decision-making processes. The research objective is to empirically explore the interaction of objective and quantifiable factors (i.e., facts) and subjective emotions and values (i.e., feelings) initiating and affecting the AFV investment decision-making process. The study aims to answer the following research question: What kind of interaction between objective and subjective inputs influences companies' AFV investment decision-making processes? We used the switching path analysis technique (SPAT) [18] to trace the chain of events, triggers, and decision-making criteria that made the parties involved realize the investment. The empirical data in this paper consist of in-depth analyses of seven investment cases based on qualitative interviews of the decision makers (customers). An investment calculation tool was designed for visualizing the costs of different vehicle alternatives, thus allowing interviewees to focus on non-quantitative factors. The interviews are supplemented with extensive analyses of the technology under examination, the technology provider (case company), and the use context in Finland.

The case is not merely about Finnish AFV investments, but also about the triggers and drivers underlying innovative energy investments in a broader sense, unveiled by the SPAT analysis. In practice, the content of the triggers and drivers may vary across contexts and change over time, but the results of the paper regarding the dynamics of those decisions are transferable to other contexts. Finland is an example of a country with ambitious environmental targets. Lately, it has exerted much effort into promoting biogas production and utilization. A major part of these efforts comes from the government-owned case company (i.e., technology provider), which is currently also the largest biogas provider in the Nordic countries. There are still very few gas vehicles in Finland, and only a few companies have switched to biogas from conventional fuels. Thus, the interviewed companies represent true early adopters in the field. In decision making, Finnish companies tend to have low hierarchical boundaries and high managerial freedom to work independently [19], which affects the interpretation of the results on decision-making processes also in this study.

The remainder of this paper is structured as follows. The literature review begins with outlining the current understanding of AFV adoption. Then, it presents the existing discussions on subjective and objective inputs in managerial decision-making processes and introduces and elaborates upon SPAT as a critical incident technique to unveil the characteristics of a decision-making process. The research methodology presents the interventionist work in a case context (i.e., the engagement with the technology provider and the customer interview strategy for unveiling the decision-making processes). The findings from the technology provider and the interviews are synthesized at the end. The discussion and conclusion section presents the implications of this

paper and discusses the interaction of subjective and objective inputs as well as their influence in triggering investment behavior. Lastly, this paper discusses the limitations of this research approach and provides suggestions for future studies, emphasizing the need to understand the impact of subjective inputs on energy-related decision-making behavior.

2. Literature review

2.1. Companies as early investors in alternative energy sources

The adoption of AFVs is considered one of the most important strategies to address the issues of air quality, climate change, and energy dependence on oil-exporting nations. For example, in Finland, road transportation accounts for approximately 20% of the total greenhouse gas emissions per year [20]. This figure highlights the large potential of new technologies with a lower greenhouse gas economy, especially now that their cost competitiveness compared with conventional solutions has improved.

To enable the wider adoption of AFVs, Garling and Thøgersen [21] suggested three promising early adopter groups that should be targeted first with marketing actions: (a) public sector organizations, (b) "green" companies, and (c) multicar households whose transportation need, values, and lifestyle are compatible with owning an AFV. To date, the academic literature has focused on studying the consumer sector as early adopters of AFVs [22]. It has studied in detail the factors affecting vehicle purchases in the consumer context (see e.g., [11–14,23]) and consumers' sensitivity to fuel prices (see e.g., [15–17]). Moreover, there is an ongoing discussion on the aesthetic, emotional, and sensory responses to driving [24] and the effect of different automobile cultures on individuals' car driving [25]. Consumer choices are affected by the influence of both subjective and objective elements. For early consumer adopters of hybrid electric vehicles (HEVs) or electric vehicles (EVs), savings from fuel efficiency constituted only a small part of the reason for adoption [26]. Other justifications included symbolic meanings, such as a strong ethical belief in protecting the environment or opposing war, a desire to reduce dependence on foreign oil, gaining social standing through commitment to the environment, an assertion of individualism, and embracing new technology [26]. Heffner et al. [26] underlined the importance of understanding the meanings as well as their construction and communication for policy makers and others hoping to promote these new types of vehicles.

Green public procurement serves as one instrument for countries developing greener vehicle markets [21]. The procurement procedures follow legislation, formal structures, and routinized mechanisms with an underlying motivation for treating potential suppliers fairly and transparently. One way to enhance the adoption of greener vehicles in public organizations is to incorporate green criteria into the already criteria-based and bureaucratic procurement process [27]. In the European Union, the Directive on the Promotion of Clean and Energy-Efficient Road Transport Vehicles (2009/33/EC) requires public authorities to take into account the lifetime energy and environmental impacts of vehicles, including energy consumption, CO₂ emissions, and other pollutant emissions. However, recent research has noted that information asymmetries and diverging interests between the legislator ("principal") and the procurement departments ("agents") [28] have hindered AFV adoption in the public sector.

By focusing mainly on decision-making mechanisms on the consumer and green public procurement side, academic research has neglected companies as the third significant group of potential early adopters of AFVs. For example, 30% of new passenger car registrations and 91% of new light-duty truck registrations are made by companies in Finland [29]. Company cars play a remarkable role in renewing countries' passenger car fleets, as they operate with faster renewing volumes than consumer cars. In many segments such as employee cars, delivery services, and taxi businesses, used passenger vehicles are

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