



# Price or performance? A probabilistic choice analysis of the intention to buy electric vehicles in European countries

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## ABSTRACT

Traditional choice models perform poorly in understanding the determinants of the adoption of new products. First, data on pioneers and early adopters are biased towards specific performance characteristics of the product and the socio-demographic characteristics of the consumers. Second, surveys on the intention to buy underperform in detecting movements of those who do not intend to buy, who are the majority in the case of new products. Probabilistic choice models try to overcome these issues. By using survey data on electric vehicles, we theoretically contribute to this stream of literature and empirically estimate the impact of specific performance improvements and price reduction on the probability of consumers switching from non-intention to buy to intention to buy. Results show that price reduction is the most important triggering factor for the diffusion of electric vehicles, as it determines more than other factors the transition of consumers from the non-intention to the intention to buy an electric vehicle. The improvement in the driving range constitutes the second most important factor for low initial values of the stated intention to buy, while the possibility of recharging at home matters significantly more for consumers with high initial values of the stated intention to buy.

## 1. Introduction

The quest for the worldwide market of electric vehicles has just begun. At the moment, Toyota, Tesla, and Volkswagen seem to have the greatest chance of success despite the tangible differences of their concepts of the future electric vehicle. It is hard to predict whether the killer improvement, characterising the dominant design of next generation vehicles, will be the price reduction, as happened a century ago for the Ford-T, or the development of key technical attributes such as the driving range (battery autonomy), the speed of recharge, or the horsepower. As for other innovative products and services, an elected tool to estimate the potential market for this innovation consists of the analysis of the purchase intentions of consumers. Indeed, psychological approaches combined with important contributions from the marketing literature can help identify consumers' attitudes towards innovations and the determinants of purchase intentions, which are often used to predict the sales of existing products over time, as they are assumed to be good indicators of consumers' purchasing behaviour (Sun and Morwitz, 2010; Arts et al., 2011). The analysis of consumers' purchasing intentions is an important issue also for policy makers, who might decide to implement specific interventions to stimulate the

diffusion of new (sustainable) products and services. However, a well-known stylized fact in marketing research is that choice models underperform in detecting movement among consumers who are not yet convinced to buy. Without data on actual purchases, surveys asking for a binary intention to buy do not predict future actual purchases very well. On the contrary, stated probabilities to purchase are more reliable. We contribute to the relatively recent literature of empirical models in elicited or survey choice probabilities, focusing on the determinants of the adoption of electric vehicles.

The objective of this article is to highlight which improvements in electric vehicles are most likely to affect the purchasing intentions of consumers who are not yet convinced to buy an electric vehicle. In doing so, we will be able to identify the most profitable direction for companies' innovative efforts that will enhance their competitiveness. More specifically, the key question is whether electric vehicles still lack performance, or companies should just focus on price reduction. The analysis relies on data from a survey concerning 3594 individuals in 6 different European countries - France, Germany, Spain, Italy, Poland and the United Kingdom –carried out between March and June 2012. We have specific information on consumers' purchasing intentions towards electric cars, which is measured as a probability – ranging from 0

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to 1 - and not as a dichotomous variable as in most existing surveys. This stated probability to buy correlates with consumers' personal characteristics that are observable only to a certain extent. Furthermore, consumers also choose specific improvements and state the resulting change (increase) in the purchasing probability. This poses interesting methodological challenges. Following [Juster \(1966\)](#) and [Manski \(1999\)](#), we theoretically develop an empirical model, in which the researcher does not observe the realization of the purchasing decision as in a random utility model, but observes, conversely, an ex-ante probability to purchase a specific good. This allows us to borrow from the literature on elicited choices, although the data show some limits since they have been collected with a survey and not generated within a controlled experimental setting. However, the survey design permits us to estimate the impact of specific improvements. Moreover, the key innovative contribution of our empirical model is that we do not focus on the overall distribution of the stated probability, but on the most interesting case for companies and policy makers, that is the probability of switching to the intention to buy (from non-intention to buy) following specific quality enhancements, conditional not only to socio-demographics characteristics, but also to the initial pre-enhancement probability to purchase. As such, consumers who are either already convinced to adopt before any improvement or who do not change their mind after the improvements as less interesting from a managerial and marketing perspective. Our model can be used to identify the relevant improvements that contribute most to the diffusion of electric vehicles, by focusing on those consumers who switch from non-intention to intention to buy.

The article is structured as follows. [Section 2](#) discusses the literature on the intention to buy, focusing specifically on new green products. [Section 3](#) presents some evidence on the global market for electric vehicles and on the characteristics of the existing products. [Section 4](#) describes the survey data and presents the methodology, deriving the model to be tested. [Section 5](#) shows the results, while [Section 6](#) illustrates the managerial implications and conclusions.

## 2. What determines the intention to buy a green product?

The literature has widely discussed the determinants of the adoption of innovations, which usually concern the attributes of the technology, the adopters' characteristics, and the features of the social environment. Attributes of the technology refer to technical/aesthetic features and their perception varies depending on the perception of potential adopters ([Davis, 1989](#); [Attewell, 1992](#); [Goodhue and Thompson, 1995](#); [Rogers, 2003](#); [Teo et al., 1999](#); [Mole et al., 2004](#)).<sup>1</sup> Adopters' characteristics concern both personal information (age, gender, nationality etc.) and the degree of individual innovativeness, the knowledge/competences and the experience of consumers ([Bettman and Park, 1980](#); [Von Hippel, 1986](#); [Goldsmith and Flynn, 1992](#); [Kerstetter and Cho, 2004](#); [Guerzoni, 2010](#)). The impact of the social environment can be understood in terms of fads, fashions, and interpersonal influence and network effects ([Abrahamson, 1991](#); [Bikhchandani et al., 1992](#); [Roehrich, 2004](#); [Clark and Goldsmith, 2006](#); [Guerzoni and Nuccio, 2014](#)). Indeed, interpersonal communication, whether in the form of word of mouth or in the form of external influence is a crucial mechanism through which individuals get in touch with the innovations.

When measuring adoption, scholars use both purchasing intentions and actual purchasing behaviour ([Jamieson and Bass, 1989](#)), although the two phenomena are quite different ([Arts et al., 2011](#)). The adoption intention, which is the specific interest of the present paper, is associated with the desire of consumers to purchase a new product: it refers

to the consumer's state of mind before the actual purchase takes place and depends on the level of information and perceptions the consumer has at that time. Intentions are typically used to predict the sales of existing products over time, as they are assumed to be good indicators of consumers' purchasing behaviour ([Sun and Morwitz, 2010](#); [Arts et al., 2011](#)). Research in social psychology suggests that intentions should be the best predictor of an individual's behaviour, because they allow each individual to independently incorporate all relevant factors that may influence his or her actual behaviour ([Fishbein and Ajzen, 1975](#)). In this context, the so-called theory of planned behaviour gives insights to predict the variety of intentions and behaviours and has been extensively used to analyse consumers' attitudes towards green products and, in particular, towards electric vehicles.

With reference to the intention to buy and use green products, scholars have looked at the role of emotions, beliefs and values, considering the individual motivations behind pro-environmental attitudes ([Barr et al., 2001](#); [Gardner and Stern, 2002](#); [Jansson et al., 2010](#); [Oliver and Rosen, 2010](#)).<sup>2</sup> According to [Coad et al. \(2009\)](#), the transition towards cleaner technologies depends both on intrinsic and on extrinsic motivations behind consumer behaviour. Intrinsic motivations concern a personal sense of responsibility, while extrinsic motivations mostly regard financial incentives, but can also include positive social feedback.

Turning to the specific case of electric cars, the literature has widely examined the determinants of the intention to buy an electric vehicle, through discrete choice models that rely either on stated preferences or on actual data ([Hidrue et al., 2011](#); [Axsen and Kurani, 2013](#); [Kim et al., 2014](#)). Most studies focus on adopters' demographic characteristics and cars' technical features to explain the adoption process, but some have identified additional determinants of the intention to buy electric vehicles, such as environmental attitudes, information search mechanisms and the overall diffusion of electric vehicles ([Ewing and Sarigollu, 2000](#); [Egbue and Long, 2012](#); [Axen and Kurani, 2012](#); [Kim et al., 2014](#)).

For example, [Heffner et al. \(2007\)](#) show that individuals with high levels of environmental awareness choose to buy an electric vehicle as a symbol of their ideas. Using a sample of Californians, [Kahn \(2007\)](#) provides evidence that pro-environmental consumers are on average more likely to purchase hybrid electric cars compared to non-environmentalists and that they are more willing to commute using public transport. [Gallagher and Muehlegger \(2011\)](#) corroborate these results: they found that social preferences for environmental quality and energy security are the most important determinants of consumer adoption of hybrid electric vehicles. In particular, social preferences increased the adoption of green cars more than policy interventions, such as tax incentives. [Axsen et al. \(2011\)](#) investigate the role of social influences in the formation of consumer perceptions and preferences for pro-environmental technologies, using the example of electric vehicles. They show that a reduced environmental impact of the battery and the possibility to save money on fuel costs are important factors driving consumers' choice. Individual perceptions and the intention to buy electric vehicles are also influenced by public opinion and by individual social networks ([Sjoberg, 1998](#); [Lane and Potter, 2007](#); [Axen and Kurani, 2012](#); [Kim et al., 2014](#)).

Notwithstanding the importance of pro-environmental attitudes and behaviours, scholars agree that consumers will decide to buy an electric vehicle only if they perceive them to have a better performance compared to conventional vehicles. In particular, [Ewing and Sarigollu \(2000\)](#) show that environmental concerns are important determinants of the intention to buy electric cars, but cannot offset the differences in performance with conventional motorized vehicles, even in the presence of governmental subsidies. They show the inherent technical characteristics of the vehicle - performance, charging time and driving

<sup>1</sup> Some scholars focus explicitly on the concept of perceived risk ([Bettman, 1973](#); [Ostlund, 1974](#)), stating that the adoption of a new product (new technology) is a risky decision because there might be undesirable consequences related to the disruption of consumers' existing routines and to possible conflict with existing beliefs.

<sup>2</sup> In particular, [Jansson et al. \(2010\)](#) show that values, beliefs, norms and habits are important determinants of the willingness to adopt environmental friendly cars.

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