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A choice experiment on alternative fuel vehicle preferences of private car owners in the Netherlands

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ABSTRACT

This paper presents results of an online stated choice experiment on preferences of Dutch private car owners for alternative fuel vehicles (AFVs) and their characteristics. Results show that negative preferences for alternative fuel vehicles are large, especially for the electric and fuel cell car, mostly as a result of their limited driving range and considerable refueling times. Preference for AFVs increases considerably with improvements on driving range, refueling time and fuel availability. Negative AFV preferences remain, however, also with substantial improvements in AFV characteristics; the remaining willingness to accept is on average € 10,000–€ 20,000 per AFV. Results from a mixed logit model show that consumer preferences for AFVs and AFV characteristics are heterogeneous to a large extent, in particular for the electric car, additional detour time and fuel time for the electric and fuel cell car. An interaction model reveals that annual mileage is by far the most important factor that determines heterogeneity in preferences for the electric and fuel cell car. When annual mileage increases, the preference for electric and fuel cell cars decreases substantially, whilst the willingness to pay for driving range increases substantially. Other variables such as using the car for holidays abroad and the daily commute also appear to be relevant for car choice.

1. Introduction

Concerns over climate change and reduction of greenhouse gas emissions, and dependence of economies on foreign energy sources, have become reasons for extensive research on the use of alternative fuels in transport in the last 10–15 years. Recently the European Commission announced that by 2050 a 60% cut in transport-related CO_2 emissions compared to the year 2000 should be aimed for (European Commission, 2011). Alternative fuel vehicles (AFVs) are essential for reaching that goal, since passenger cars make up roughly 50% of transport-related CO_2 emissions in the EU (PBL, 2009). AFVs such as electric, fuel cell, (plug-in) hybrid and flexifuel cars use non-fossil fuels and have the potential to emit only a fraction of the CO_2 emissions that conventional petrol and diesel cars emit. Since AFVs are different in terms of costs and their ease of use, consumer preferences may be very different from conventional cars. This is why preferences for and market potential of AFVs have received wide attention since the mid-1970s.

Since the availability of AFVs on actual markets is still very limited, stated preference research is necessary in order to obtain insight into potential barriers to AFV adoption. Since the beginning of the 1980s many choice experiment studies have

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aimed to identify relevant factors in the market penetration of alternative fuel vehicles. This study contributes to this literature by performing an online stated choice experiment among private car owners in the Netherlands. Our main goals are to obtain insight into the preferences of private car owners in the Netherlands for AFVs, to uncover the car characteristics that affect these preferences, and to find out to what extent these characteristics need to change in order to make consumers indifferent between conventional cars and AFVs. We attempt to identify the (socio-demographic) characteristics of car buyers that are currently most susceptible to buy an AFV with the aim of uncovering interesting market segments and potential early adopters.

Our study has added value for several reasons. First, as we will show in the next section, most previous choice experiments on AFV preferences include a limited number of the attributes that have been shown to substantially affect AFV preferences. In particular experiments in which fuel time and fuel availability are combined are rare. Moreover, most studies compare preferences between one or two AFV types and the conventional technology. Few studies simultaneously include all AFVs that are currently considered as viable options for substantial CO_2 emission reductions. In our choice experiment we both include a wide range of car attributes and most of the AFV types that are currently considered to be viable. Our study is therefore more comprehensive and allows for more accurate and reliable estimates of the impact of different (pricing) policy measures on AFV adoption and CO_2 emissions.

Second, most of the existing studies were carried out in the USA and Canada and only limited empirical evidence is available for Europe (Dagsvik et al., 1996; Caulfield et al., 2010; Mabit and Fosgerau, 2011; Ziegler, 2012). The results of existing studies show substantial differences in stated preferences for AFVs and AFV characteristics both across and within countries. This is an indication that stated choice results from different countries are not directly interchangeable and that country specific experiments are necessary. The Dutch case may be of particular interest since it is potentially more suitable for vehicles with limited driving range due to its particular spatial characteristics. The largest cities are relatively small (400,000–700,000 inhabitants), concentrated in a fairly small area (roughly 100 square kilometers) which also includes many medium-sized cities and towns, and connected by a relatively dense network of highways.

Third, in our experiment we chose to include the current technology (petrol, diesel and LPG) in only a subset of the choice tasks. We estimate models on both the full sample and the subsample. By comparing the results for these two samples we can assess the effects of including a status quo choice option (that is, the current technology). More importantly, we are thus able to examine differences in marginal willingness to pay (WTP) and AFV market potential for the short term, with petrol, diesel and LPG cars as the current technology, and the long term, in which petrol, diesel and LPG cars may have been replaced by, for example, hybrid cars as the default technology.

Fourth, we make a distinction between buyers of new and secondhand cars. Preferences of secondhand car buyers may be quite different from that of new car buyers. This is especially relevant when we consider that currently, as a result of beneficial taxation rules, most AFVs sold in the Netherlands are company cars that will enter the secondhand private market in 3–4 years.

The paper is organized as follows. The next section presents the attributes and attribute levels used in our choice experiment. Section 3 explains the survey design and the data collection process. Estimation results are discussed in Sections 4 and 5, followed by a concluding section interpreting the results an indicating policy implications.

2. Choice attributes and attribute levels

Findings from the existing literature on AFV preferences show that next to purchase price and operating costs, driving range (Hensher and Greene, 2001; Mau et al., 2008; Train, 2008; Beck et al., 2011; Hidrue et al., 2011; Zhang et al., 2011; Maness and Cirillo, 2012), recharge time (Hidrue et al., 2011) and fuel availability (Horne et al., 2005; Potoglou and Kanaroglou, 2007; Mau et al., 2008; Train, 2008; Ziegler, 2012) may have substantial effects on consumer preferences for AFVs. Emission reduction is also signaled as an important factor (see Ewing and Sarigöllü, 1998; Batley et al., 2004; Potoglou and Kanaroglou, 2007; Beck et al., 2011; Hidrue et al., 2011; Maness and Cirillo, 2012; Ziegler, 2012). Although the study by Beck et al. (2011) does not look at AFVs specifically, their findings show that emission charging targeted specifically at vehicle emission rates may have substantial effects on vehicle purchase decisions. Table 1 gives an overview of the various attributes used in previous choice experiments on AFV preferences.

In addition to these findings from literature, consultations with policy makers from the Ministry of Energy, Agriculture and Innovation and the Ministry of Infrastructure and the Environment as well as stakeholders from the automotive sector provided information for the attribute selection process. Besides car type, which includes the conventional technology, the hybrid, plug-in hybrid, fuel cell, electric and flexifuel car, we included seven attributes in our design, that is, catalogue price, monthly costs, driving range, recharge/refueling time, additional detour time to reach a fuel or recharge station, number of available models, and policy measure. To ensure that the choice options were as close as possible to a respondents actual situation, the fuel type of the current technology and purchase price and monthly costs were made respondent specific. To this end, several questions were asked prior to the choice tasks to reveal information on the current car of respondents (that is, annual mileage, weight of the car, road tax exemption). Since characteristics of a next car may be very different from those of the current car due to job changes and changes in family or living situations, we also asked respondents to provide information on the presumed fuel type and purchase price of their *next* car. Below we discuss in detail the attributes and associated levels.