

THE SWEDISH FLEX-FUEL FAILURE

Linda Andersson^{1*}, Kristina Ek², Åsa Kastensson² and Linda Wårell²

1: Economics Unit
Luleå University of Technology
971 87 Luleå, Sweden
e-mail: linda.andersson@ltu.se

2: Luleå University of Technology
971 87 Luleå, Sweden
e-mail: kristina.ek@ltu.se, asa.kastensson@ltu.se, linda.warell@ltu.se

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Abstract

There is currently a governmental aim in Sweden to have a fossil fuel free vehicle fleet in 2030. Ethanol (E85) was introduced in Sweden ten years ago as an effort to decrease the dependence on fossil fuels. Several policy instruments were introduced simultaneously to stimulate an increased use of biofuels. Ethanol became the most commonly used biofuel in the Swedish market. However, since the end of 2012 the use of ethanol has decreased and today its promotion is considered to have failed. There are several possible reasons for the decline of ethanol. The price difference between ethanol and petrol has since the introduction diminished. In addition, during this ten year period there have been a number of debates, both in media and among researchers, concerning the pros and cons of ethanol as fuel. Altogether these issues may have affected the consumers' attitudes towards biofuels and their incentives to use ethanol. The purpose of this paper is to analyze which are the most important factors affecting the customers' fuel choices. These factors are important to address in order to understand why ethanol failed in the Swedish market. Data was collected through a survey. The results contribute to improved knowledge about which factors that are important for the fuel choice of flex-fuel car owners in Sweden. Such knowledge is crucial, both for policy makers, the automotive industry and for a number of other actors involved in the development of the future Swedish energy system.

1. INTRODUCTION

There is currently a governmental aim in Sweden to have a fossil fuel-free vehicle fleet in 2030. In order to meet future environmental goals, and reduce the dependence on fossil fuels, biofuel driven vehicles will likely be a part of the future vehicle fleet, together with for example electric vehicles. Ethanol (E85) was introduced in Sweden about ten years ago as an effort to decrease the dependence on fossil fuels. Several policy instruments (e.g., tax exemption for biofuels), was introduced simultaneously to stimulate an increased use of biofuels. Furthermore, the use of biofuels were initially supported by the Swedish Act on the Obligation to Supply Renewable Fuels (the Pump Act/Pumplagen, 2005) that stipulated access to biofuels in the whole country by forcing all fuel filling stations to provide a fossil free alternative to petrol. Together with several economic incentives, ethanol thus became the most commonly used biofuel in the Swedish market. Figure 1 illustrates the development of ethanol use (the blue line), as well as the price difference between ethanol and petrol (the red line) between 2005 and 2015. Ethanol consumption initially increased significantly, especially at times when the price spread between petrol and ethanol was in favour of ethanol. However, in the end of 2012 we note that the use of ethanol starts to decrease.

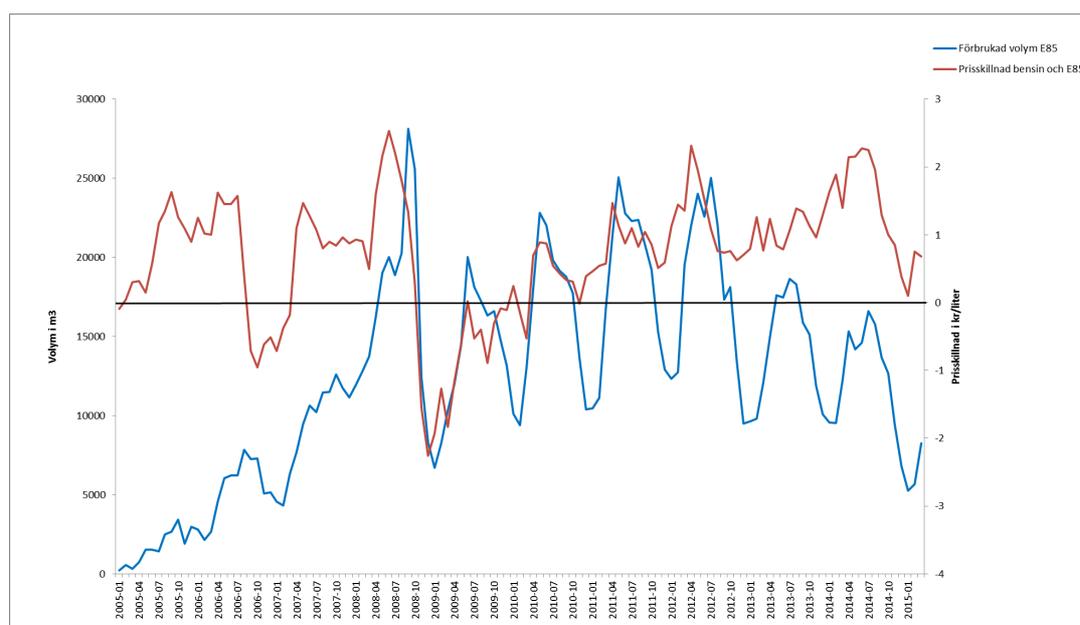


Figure 1. E85 consumption and price difference E85 and petrol. Source: SPBI.

During this ten year time period there have been a number of debates, both in media and among researchers, concerning the pros and cons of ethanol as biofuel. After the consumption peak in 2008, a major dip is noted in 2009. At that time there had been several discussions in media regarding biofuel vs. food production. Ethanol was accused of causing the food crises, and thus making people in the third world starve. Although the biofuel vs. food combat was

supported by several researchers at that time (see e.g., [1], [2] and [3]), in a review of previous research Batista [4] found that a majority of previous research actually showed that biofuel production did not affect food prices (see e.g., [5], [6] and [7]).

The discussion about ethanol's climate impacts has also been ongoing both in media and in academia. In a report of previous research on this issue, conducted by Wibe [8] to the Expert Committee for Environmental Studies in Sweden, it was concluded that the production and use of ethanol will lead to an increase of CO₂ emissions, at least the 50 to 60 initial years. More recent research does however on the contrary find that the use of ethanol reduces greenhouse gases [4]. The main explanation is that the CO₂ benefits are dependent on how and from what source ethanol is produced, and with the next generation ethanol which is mainly produced from cellulose and waste, the CO₂ savings are positive. Furthermore, with the use of next generation ethanol the biofuel vs. food debate is no longer relevant.

Another issue, which may have caused uncertainty and doubt for the consumers, is the alarming reports about ethanol having a detrimental effect on the motor and its performance. When the debate started in 2010 imported ethanol contained a high blend of sulphate, which caused motor damages. Several cars had to be repaired at considerable costs, and since no one took responsibility for the damages, the car owners had to pay themselves. However, after this issue was recognized, a standardization of ethanol has been made and motor damages do no longer occur. Still, the issue is popping up in media, latest in 2014, where in interviews mechanics recommended flex-fuel car owners to fill their cars with petrol instead of ethanol.

The purpose of the present paper is to contribute to improved knowledge about the most important factors influencing the consumers' fuel choices. There are a number of questions that we will address: Why do consumers choose petrol, even in situations when ethanol is cheaper? What are the main incentives to choose ethanol, or petrol, for owners of flex-fuel¹ cars? Do the consumers' environmental attitudes influence their choice of fuel? How does information affect the consumers' choice? These are questions that are important to address in order to understand why ethanol failed in the Swedish market.

The results will be vital for decision makers in order to avoid the mistakes that were made when promoting future biofuels. It is necessary to understand how households value and perceive different fuels to know how fossil free fuels should be promoted in the future. If it is, for instance, shown that price is an important factor, new fuels might need to be subsidized to be able to penetrate the market. In case there is instead a strong influence of the debate in the media of possible pros and cons of ethanol, this implicates that information is vital. In such a case it is important to clarify misunderstandings and rumors that occur straight away for the customers to have a fair chance of making the choice of fuels based on facts. The results contribute to improved knowledge about why many flex-fuel car owners are reluctant to fuel their car with ethanol.

¹ A flex-fuel car is a car that can be fuelled both with ethanol and petrol.

The paper proceeds with a description of the survey design and how the data was collected. In chapter three the results from the survey are presented and discussed. The results consist at this point primarily of a discussion regarding the factors of importance when buying a flex-fuel car, choice of fuels at different prices, as well as factors of importance when fuelling. Finally, in the last section some concluding remarks are made.

2. SURVEY DESIGN AND DATA COLLECTION

A survey format has been used to collect the data for the analysis. The survey was sent by mail to 600 owners of flex-fuel cars in Sweden in March 2016. It was possible to answer the survey questions either by mail or in an electronic version. A reminder was sent two weeks after the first sending. The sample was randomly selected by Statistics Sweden from a database over all flex-fuel owners in Sweden. The response rate of the survey was 40%. Before it was sent, the survey was tested in extensive pretesting. The pilot group consisted of both students and the general public. The results of the testing led to several revisions and clarifications of the survey questions.

The first part of the survey collected information about the respondents' driving habits and motives for buying a flex-fuel car. In the second part of the survey the respondents were asked whether they would fill the tank with ethanol or petrol the next time they were fueling. They were asked to make four repeated hypothetical choices, each with a different price spread between the two fuels. They were also asked about their attitudes and norms concerning different fuels and the degree of their environmental engagement. Finally the survey collected information about the respondents' socioeconomic background.

A majority of the respondents are male, which corresponds to the fact that more men are the registered owner of cars in general. The income among the respondents is higher than the average income for households in Sweden. Also, the age distribution among the respondents is higher than in the Swedish population as a whole. This might be explained by the average age of car owners being higher and people with higher incomes being more likely to own a car. The fact that the age of the respondents are higher can also be a result of older people being more likely to respond to this kind of surveys.

3. RESULTS

In the first part of the survey respondents were asked about their motives for choosing a flex-fuel car, as well as about what kind of car they would choose if they were to buy another car today. If they were to buy a new car today, about 13 percent reported that they would go for a car fuelled with ethanol or other biofuels, 45 percent stated that they would choose a car fuelled with petrol or diesel, almost 30 percent reported that they would go for an electric or hybrid car, the additional 11 percent stated that they did not know. Based on these results electrical vehicles may thus be a more viable option to fossil fuels than ethanol in the future.

Table 1 summarizes how important different motives were when the previous choice of a flex-fuel car was made.

Table 1: Factors of importance when buying a flex-fuel car (%)

<i>Statements</i>	<i>Disagree entirely</i>				<i>Agree entirely</i>	<i>Do not know</i>	<i>Number of respondents</i>
I wanted to fuel ethanol for economic reasons	32	14	21	15	13	5	234
I bought the car for environmental reasons	22	10	23	17	24	3	235
I wanted a lower vehicle tax	23	10	19	18	24	6	234
I wanted to take part of the environmental bonus	47	8	10	7	16	12	233
It did not matter that it was a flex-fuel car, other factors were more important	20	9	19	15	29	8	237

As shown in table 1 the importance of different reasons for buying a flex-fuel vehicle is not unambiguous, in general the answers are quite spread out. Only 29 percent of the respondents agree, entirely or partially, that they wanted to fuel ethanol for economic reasons. Also when it comes to the other incentives that were available responses show that their impact may have been quite limited; responses are quite evenly spread when it comes to the impact of the lower vehicle tax, between respondents stating that they disagree entirely and agree entirely. There are also a significant proportion of the respondent that seems to be uncertain with regard to the importance of the lower vehicle tax.

Based on these responses, the first impression is that the environmental bonus has been an even less important motive for choosing a flex-fuel car, 47 percent state that they disagree entirely with the statement “I wanted to take part of the environmental bonus”. This may be explained by the fact that the majority of the respondents (78 percent) bought their car second hand and could therefore not take part of the bonus. When focusing only at the respondents that bought their car new, the majority (59 percent) fully or partly agree that they wanted to take part of the environmental bonus.

The importance of the economic incentives presented may however be different when we focus on when the respondents bought their flex-fuel car; before or after 2009. For the respondents who bought their flex-fuel car before 2009, when most of the economic subsidies were still in place, it is evident that the economic reasons for buying a flex-fuel car are potentially more important. This provides an indication that economic incentives are important, at least in an initial phase, in order to increase the use of a certain environmentally friendly vehicle. Some of the free comments in the end of the survey also stated that “the environmentally friendly choice also has to be economically viable”.

Furthermore based on the responses, environmental reasons seem to have been relatively important when choosing a car with ethanol as a fuel option although there seem to be different views also regarding this, about 41 percent agree that it influenced their purchase (agree fully or somewhat) while about 32 percent state that they disagree with the statement that they choose the car for environmental reasons. About every fourth, 23 percent report that they neither agree nor disagree with this statement.

In some Swedish municipalities flex-fuel car has had free parking and exemptions from road toll. Respondents were also asked to what extent they agree or disagree with statements about the importance of these incentives for flex-fuel cars. Most respondents reported that they disagreed that parking and road toll was important when they bought a flex-fuel car, since most of the respondents were not affected by those means the low impact of these statements can be expected. It is however possible that these measures may have had an impact on the local, municipal, scale.

Finally, quite significant proportions of the respondents (44 percent) agree completely or partly that it was not important that the car was a flex-fuel car for their choice and that other factors were more important. Some of the free comments in the end of the survey reveal that some respondents considered the vehicle in general as good value for money and in the right price range.

Every person that owns a flex-fuel car has the opportunity to choose whether to fuel petrol or ethanol every time the car needs to be fuelled. Each respondent was asked which fuel they would choose, given different hypothetical prices for ethanol and petrol. Table 2 shows the distribution of these stated choices between ethanol E85 and Petrol 95 at different price levels.

Table 2: Stated fuel choice at different price levels (%)

<i>Statement</i>	<i>Ethanol E85</i>	<i>Petrol 95</i>
Which alternative would you choose next time you fuel if the cost of Ethanol 85 was 6 SEK/litre and the cost of Petrol 95 was 12 SEK/litre?	86	14
Which alternative would you choose next time you fuel if the cost of Ethanol 85 was 9 SEK/litre and the cost of Petrol 95 was 12 SEK/litre?	58	42
Which alternative would you choose next time you fuel if the cost of Ethanol 85 was 12 SEK/litre and the cost of Petrol 95 was 12 SEK/litre?	10	90
Which alternative would you choose next time you fuel if the cost of Ethanol 85 was 15 SEK/litre and the cost of Petrol 95 was 12 SEK/litre?	3	97

As presented in table 2 the relative price of ethanol and petrol affects the (stated) choice of fuel. At price levels where ethanol is relatively cheaper most respondents state that they would choose ethanol and vice versa for petrol. In the third alternative where the price is 12 SEK/liter for both ethanol and petrol it is important to note that what at first sight seem to be

an equal price is not, since the engines consumes more fuel when run on ethanol. When comparing ethanol to petrol a conversion factor of 1,3-1,35 is usually used. This implies that the second option, i.e. when the price of ethanol is 9 SEK/liter and the price of petrol is 12 SEK/liter, is more representative of an equal price. It is interesting to note that at this price, there are more respondents that would choose the more environmentally friendly option (58 percent compared to 42 percent).²

Although table 2 suggests that price is an important factor it is likely not the only factor affecting the stated choice of fuel. In table 3 the degree to which respondents support the importance of different additional factors is described.

Table 3: Factors of importance when fuelling (%)

<i>Statements</i>	<i>Disagree entirely</i>				<i>Agree entirely</i>	<i>Do not know</i>	<i>Number of respondents</i>
I feel a personal responsibility to make environmental considerations when fuelling	13	14	31	25	13	4	236
I choose ethanol since I believe it is better from a climate impact point of view	24	12	23	16	18	7	233
I do not believe that ethanol is particularly good for the environment	19	26	20	7	7	21	232
I think environmental consideration is more important than the price of fuels	20	19	32	16	10	3	236
I am worried that ethanol is competing with food production	31	13	15	10	6	25	232
I am worried that ethanol will damage the engine of my car	30	12	14	16	23	5	237
My car mechanic has recommended me to fuel less ethanol and more petrol	46	8	9	8	17	12	236

The debate in e.g. the media after ethanol was introduced in Sweden has concerned perceived advantages and, perhaps not least, perceived disadvantages of ethanol. Some serious concerns that have been raised with regard to ethanol is that the production of ethanol competes with food production, that it may also be harmful for the environment, as well as that the use of ethanol can seriously harm the engine of the vehicle. Table 3 summarizes the responses on a number of questions connected to these areas. Table 3 also presents responses regarding the environmental engagement and concern for climate change of the respondents.

Again, the responses generally show a large variation. Although both the statement that ethanol production competes with food production, and that ethanol is not particularly good from an environmental perspective are rejected (completely or partly) by almost half the

² There is though a possibility that some of the respondents are not aware of the conversion factor.

respondents and supported by few. Relatively large proportions chose the “do not know” alternative for these two questions. Even though it is stated that most respondents disagree about the competing interests of food production and ethanol this might have had an effect on fuel choice, in particular during the time when this was frequently debated in the media.

Also when it comes to the question of whether ethanol can harm the engine there is no general view among the respondents, 42 percent disagree (completely or partly) and 49 agree (completely or partly). Although almost half of the respondents disagree entirely when they are asked whether their car mechanic has recommended them to fuel more petrol than ethanol, these results suggest that there may be significant proportions of flex-fuel car owners avoiding ethanol because they believe it is harmful for their engine. This even though the substances that could have a negative impact have been removed. Today, this should no longer need to be a source of concern.

When it comes to perceptions about the environmental effects and climate change impacts of ethanol, although about 40 percent of the respondents state that they feel a personal responsibility to make environmental considerations when fuelling their car (i.e. agree completely or partially to this statement), there seem to be widely different opinions also in this area. In spite of this, the statement where environmental considerations are set against the price, about every fourth of the respondents seem to be willing to state that environmental considerations should come first.

Summing up, these results reveal that there were a variety of motives for choosing to buy a flex-fuel car across respondents, some state that economic motives were important while others refer to concerns for the environment and climate change and some respondents claim that they simply did not pay much attention to the possibility to use different fuels at all, they chose the car for other characteristics.

Also when it comes to the choice of fuel when refilling, there seem to be a variety of opinions and perceptions among the respondents, not only with regard to which factors that are more or less important to consider but also regarding the actual impact of choosing ethanol, for the engine as well as for the environment and the climate.

4. CONCLUSIONS

The main purpose of the present paper was to contribute to improved knowledge about the most important factors influencing the owners of flex-fuel cars vehicle and fuel choices. This is important as there is currently a political aim in Sweden to achieve a fossil free-fuel vehicle in 2030. The experience of the introduction of ethanol in Sweden in 2005 can provide information that are important for policy-makers regarding future policies aimed at achieving the stated goal. A survey was sent to 600 owners of flex-fuel cars in March 2016, and a response rate of 40 percent implies that 240 answers were received. The results indicate that only few of the respondents would choose a flex-fuel car today if they were buying a new car.

This result supports in some sense that the strong implementation of ethanol in the Swedish market can be seen as a failure, despite the initial strong incentives from the Swedish government to increase the use of ethanol.

The results from the survey shows that both environmental and economic reasons were important motives for buying a flex-fuel car. However, many respondents state that other reasons than that the car was a flex-fuel car were more important for their choice of vehicle. The results further indicates that there are a large variation in the answers, which makes it difficult to draw general conclusions. However, economic incentives have been important for flex-fuel car owners and there are indications that respondents want to make environmentally friendly choices, but these have to be economically viable.

The results presented in this paper are mainly descriptive in character and constitute a first preliminary step of this research. In order to improve future implementation of fossil free-fuels more knowledge regarding the relative importance between different factors is needed, therefore further econometric analyses based on an extended data set will next be conducted.

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