

## **Clean Vehicle Research: LCA and Policy Measures (CLEVER)**

### **Report Task 4.2 Barriers to the development of alternative vehicles in Belgium**

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## LIST OF ACRONYMS

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ACEA	European Automobile Manufacturers' Association
BIM	Brussels Instituut voor Milieubeheer
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
CVO	Corporate Vehicle Observatory
DBDMH	Brusselse Hoofdstedelijke Dienst voor Brandbestrijding en Dringende Medische Hulp
E85	85 % Ethanol (15 % Petrol)
EU	European Union
FEBIAC	Fédération Belge de l'Automobile et du Cycle / Belgische Automobielen- en tweewielerfederatie
GHG	Greenhouse Gas
IBGE	Institut Bruxellois pour la Gestion de l'Environnement
LPG	Liquefied Petroleum Gas
MIVB	Maatschappij voor het Intercommunaal Vervoer te Brussel
MBHG	Ministerie van het Brussels Hoofdstedelijk Gewest
MRBC	Ministère de la Région de Bruxelles-Capitale
NGO	Non Governmental Organisation
NMVOC	Non-methane volatile organic compounds
NO <sub>x</sub>	Nitrogen oxides
R&D	Research & Development
STIB	Société des Transports Intercommunaux de Bruxelles
SIAMU	Service d'Incendie et d'Aide Médicale Urgente de la Région de Bruxelles-Capitale
TGAP	Taxe Générale sur les Activités Polluantes

# INTRODUCTION

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The transport sector contributes significantly to CO<sub>2</sub> emissions (about 28% from fossil fuel emissions in EU-25 in 2005), with the road transportation being responsible for about 20% of the CO<sub>2</sub> emissions in EU-25 in 2005<sup>1</sup>. Road transportation is also responsible for the majority of NO<sub>x</sub>, CO, and NMVOCs<sup>2</sup> emissions, and is the second most important source for primary particulate matter emissions in EU-27<sup>3</sup>. For this reason and because of the finite nature of oil resources, important changes in the field of transport are needed.

Alternatives to conventional fossil fuel vehicles (gasoline and diesel vehicles) offer sometimes attractive environmental characteristics and can contribute to a diversification of energy sources. With this aim, the European Union has fixed the objective of substituting 10% of traditional automotive fuels by alternative fuels before the year 2020 in Europe<sup>4</sup>. Of course, it is important to keep in mind that every vehicle is polluting to some extent and that alternative vehicles will not allow for maintaining the current over-utilization of cars (more generally, new technologies do not allow for maintaining the current way of life in our societies). So, promoting alternative vehicles has to go together with a decrease in the current utilization of cars.

In the present study, alternative vehicles include vehicles with alternative propulsion systems (battery, hybrid and fuel cell) and vehicles using alternative fuels (LPG, CNG and biogas, biofuels and hydrogen). Although some of those alternatives could contribute to a diversification of energy sources and to the reduction of the increase of GHG and pollutants emissions, their diffusion on the Belgian market is still low (about 1 % of the Belgian park in 2006<sup>5</sup>).

## *- Objectives*

**The first objective of the present study is to identify the main barriers impeding the development and the diffusion of alternative vehicles in Belgium, and to evaluate their relative importance.** This objective is approached through the **consultation of the different groups of stakeholders**. In this study, a distinction has been made between barriers that prevent the development of alternative vehicles in general and those that more specifically apply to particular technologies or fuels.

In many previous studies, barriers have been considered in a static and independent way, in the sense that they are all considered on the same level without analysis of causality relations and interdependences. However, strong relationships exist between the different barriers; in fact, they are integrated into an aggregation of complex causal connections. Next to the identification of barriers and evaluation of their relative importance, **the second original objective of the study is to derive a systemic scheme representing the interrelations between the barriers**. This allows for a more global view on the barriers which is essential for drawing effective policy measures. Indeed, policy measures aiming at promoting

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<sup>1</sup> European Commission (2008)

<sup>2</sup> non-methane volatile organic compounds

<sup>3</sup> EEA (2008)

<sup>4</sup> <http://www.euractiv.com/en/transport/industry-wants-clear-priorities-alternative-transport-fuels/article-177754>

<sup>5</sup> Federal Public services mobility and transport (2007)

alternative vehicles development could not have the expected results if they fail to take those interrelations into account.

### ***- Methodology***

The first step of the study consisted in performing a literature review on barriers to the development of alternative vehicles. A series of barriers has been pre-identified and classified by category with a typology inspired by literature. The referred studies generally identified barriers in an independent way, without taking interrelations into account.

The literature review helped us to draw up the questionnaires for the **consultation of the stakeholders**, which is the second and main step of this study. The objective of this consultation was to identify barriers to the development of alternative vehicles. Barriers to the purchase and utilisation of alternative vehicles/fuels are different from the barriers to the supply of alternative vehicles/fuel. Also, from the demand-side point of view, it is expected that barriers perceived by individual consumers are different from barriers perceived by companies (private and public) owning a fleet of vehicles. For this reason, stakeholders have been classified into different groups: the demand-side stakeholders, divided between individual consumers and fleet managers, the supply-side stakeholders (vehicles makers, fuel distributors...) and the “experts” from various institutions (research centres, policy makers, NGO’s...) who offer a more global and analytic view on barriers. Those four groups (including the two groups of demand-side stakeholders) have been sounded out concerning barriers to the development of alternative vehicles from their point of view.

The data and information collected from the stakeholders’ consultation have been treated through statistical and/or qualitative analysis.

In a third and last step, a **systemic diagram representing the interrelations between the barriers** expressed by the different stakeholders has been derived from a transversal analysis of the results. This analysis has been complemented by elements of the literature about the “technological lock-in” concept.

### ***- Content***

In a first introductory part, the classification of barriers by category is presented (typology of barriers).

The second part includes the results of the stakeholders’ consultation and is divided into four chapters: the first one presents the barriers to the purchase and use of alternative vehicles from the individual consumer’s point of view and the second one, from the point of view of the fleet managers from private and public companies. The third chapter presents the identified barriers to the supply of alternative vehicles from the supply-side stakeholder’s point of view. Barriers to the development of alternative vehicles according to the “experts” (which include demand-side and supply-side barriers but also barriers “upstream”, i.e. linked to the broader context in which the automobile sector operates) are presented in the fourth chapter.

The third part of the study is dedicated to a transversal and systemic analysis of the barriers identified through the stakeholders’ consultation. In the first chapter of this part, some characteristics and consequences of the “technological lock-in” process are given. On this basis and on the basis of the results of the stakeholder’s consultation, a dynamic view of the



barriers is proposed and a systemic scheme representing the interrelations between barriers is presented in the second chapter. Some general elements of policy recommendation following our results are given in the third chapter of this part.

Main conclusions of the study are presented in the fourth and last part.

*- Note for the reader*

**A first rapid reading of this report is possible by reading only the first part, the first chapter of the second part, the third part and the conclusion.**

## **PART 1: TYPE OF BARRIERS AND CLASSIFICATION**

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Alternative vehicles are confronted with a wide range of barriers impeding their market introduction and their diffusion. Indeed, numbers of factors can explain the low demand and supply of those vehicles.

A first identification of barriers has been done, based on a literature review<sup>6</sup> and on a first consultation of a sample of experts. In most of those referred studies, barriers are considered in a static way, in the sense that they are all considered on the same level without analysis of causality and interdependence. Those pre-identified barriers are listed in the questionnaire (for experts and supply-side stakeholders) in the appendix 4. Some of those barriers impede the development of barriers in general and other (more specific) barriers applied to some category of alternative vehicles only. In the questionnaires and in the study in general, this distinction has been made.

Although those barriers are not independent and are often highly interconnected, they have been classified by group according to their nature in order to facilitate the analysis. The typology used in the study is inspired by previous works<sup>7</sup>. However, classification is sometimes highly debatable, and varies from one study to another. For this reason, the classification used in this study will not correspond exactly to one particular reference (although it is very much inspired by literature), but is specific to this study according to what we consider as relevant. In economics, the supply and demand are function of the price of the product (here the alternative vehicle, for example the CNG vehicle), the price of the substitutes (conventional cars -fossil fuel- and the other category of alternative vehicles, like electric vehicles etc.) and the price of complementary products (fuel price -like the CNG price-, maintenance costs...), and also other “external” (non economic) factors influencing the demand and the supply curves: quality, taste, habits, legislation etc. In this regard, typology of the barriers presented below includes these different elements.

The barriers - which can explain the low demand and supply of alternative vehicles -, have been delimited and classified according to the following categories:

- **Economic barriers**: this category includes all the barriers related to price and cost (high purchase price of the vehicle, high cost of refuelling/recharging infrastructure, high fuel prices...).
- **Technical barriers**: this category refers to the possible technical problems or technical disadvantages of alternatives vehicles (limited range, long refuelling time, tank heavy and cumbersome ...).
- **Psychological barriers**: this category refers to the “non-rational” behaviour of the consumers, the emotional side influencing their preference and the process of purchase decisions. Those barriers are related to habits (routine behaviour), apprehension/fear of new systems, influence of advertising, symbolic content of the car for some people (associated

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<sup>6</sup> The literature review used for the questionnaire was mostly based on the following studies: Favrel et al. (2001), Kofoed-Wiuff and al. (2006), Murray and al. (2000), Smith (2001) and Troelstra (1999).

<sup>7</sup> Favrel et al. (2001) and Smith (2001)

with personality, social status ...) and the representation of the concept of a car: image of freedom (so a car has to be fast, with a long range etc.),...

- **Legislative barriers**: this category includes possible lack of legislation (e.g. lack of standard or lack of harmonised standards for alternative fuels) and possible inappropriate legislation.

- **Political barriers**: this category includes barriers related the lack of necessary policy measures.

- **Institutional barriers**: this category is referring to barriers related with institutions, conflicts of interest or lobbying of various socio-economic groups.

It has to be noted that the frontiers between legislative, political and institutional barriers are not always clear, so it happens in the report that we group those categories together when classifying a barrier.

- **Environmental and societal barriers**: this category includes the possible lack of conviction of stakeholders about the environmental or the societal benefits of alternative vehicles (controversies about energy efficiency of biofuels or hydrogen, impact of biofuel on food sector etc.).

- **Market barriers**: this category refers to all the other factors which have a negative influence on the supply and demand for alternative vehicles and which are not included in the previous groups. We distinguish ***demand-side market barriers*** (including the factors with a negative influence on the demand for alternative vehicles) and ***supply-side market barriers*** (including the factors with a negative influence on the supply of alternative vehicles).

***Demand-side market barriers*** include for example the lack of information of consumers on alternative vehicles<sup>8</sup>, the lack of development of those vehicles (implying that people prefer to wait for others to use such vehicles before adopting them themselves), lack of general competitiveness of the alternative compared to conventional cars for various reasons (as a consequence of other barriers) etc. ***Supply-side market barriers*** include for example the lack of fuel availability (lack of refuelling/recharging stations) which prevent vehicle makers from developing and commercializing alternatives (on a massive scale) and vice versa ("chicken and eggs" problem), the lack of maintenance and after-sale services etc.

Beside this, we have to consider that a short supply (quantitative and qualitative e.g. lack of available models) of alternative vehicles represents of course an important barrier to the purchase for consumers; in this case, when talking about barriers from the consumer's point of view, the "**supply barriers**" will refer to the impact of short supply on consumer purchase behaviour. Symmetrically, when considering barriers from the supply-side point of view, the "**demand barriers**" will refer to barriers perceived by vehicle makers as they expect no demand for alternative vehicles (a reason why they do not develop their supply).

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<sup>8</sup> The barrier "lack of information" is sometimes considered separately in the study.

## **PART 2: IDENTIFICATION AND EVALUATION OF THE IMPORTANCE OF BARRIERS IN BELGIUM THROUGH STAKEHOLDERS' CONSULTATION**

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All the stakeholders are not confronted with the same barriers or will perceive differently the importance of barriers. For this reason, they have been classified in the different groups listed below:

1) Demand-side stakeholders, who are expected to react to demand side barriers; they are divided into 2 groups:

- Individual consumers

- Fleet managers (Companies/administrations with a fleet of vehicles)

2) Supply-side stakeholders: vehicle makers (and federations), fuel distributors, LPG fitters... who are expected to react to supply-side barriers

3) "Experts" (from research centre, politics, NGO's...), who offer a more global and analytic view on the question (about demand and supply-side barriers, but also about the "upstream" barriers, e.g. related to the context in which the automobile sector operates).

Those four groups (including the two groups on the demand-side) were sounded out concerning the barriers to the development of alternative vehicles from their points of view. However, the applied methods were different for each group. For the individual consumer's group, a survey was carried out at the Brussels Motor Show in January 2008. A specific questionnaire was drawn up for it, and a sample of 263 people was interviewed. For the supply-side stakeholders and the experts, a more detailed questionnaire was drawn up. In those cases, smaller samples of stakeholders (about 20 for each group, with various contributions) were met to answer the questionnaire directly and to allow for an in-depth interview-discussion. For the companies and administrations with a fleet of vehicles, a sample of 14 fleet managers (as well as 2 taxi drivers) was sounded out by phone. The majority of them were from public institutions, from Brussels in particular.

The results of the stakeholders' consultations are presented below. As the questionnaires and the answers were different for each group of stakeholders, the presentation of the results varies for each group. The first chapter of this part presents the results of the survey at the Motor Show, which are indicative of the barriers to the purchase and to the use of alternative vehicles/fuels from the point of view of the Belgian individual consumer. The second chapter presents the results of the fleet managers' consultation, giving information on the barriers to the introduction of alternative vehicles in companies/administrations owning a fleet of vehicles. The third chapter is dedicated to the results of the supply-side stakeholders' consultation, revealing barriers met by industries and actors on the supply-side. Finally, the last chapter of this part is devoted to the opinions of experts about the existing barriers to the development of alternative vehicles.

## **2.1. Barriers to the purchase/use of alternative vehicles from the individual consumer's point of view: survey results**

Barriers to the purchase of alternative vehicles were assessed by a survey performed at the Motor Show of Brussels in January 2008.

The **general objectives** of the survey were the following:

- Identification of barriers to the purchase/use of alternative vehicles (in general and by technology/fuel) in the context of Belgium from the consumer's point of view through open questions;
- Validation (or invalidation) of “demand-side” barriers pre-identified in the literature;
- “Quantitative” evaluation of the “demand-side” barriers’ relative importance;

The sample is composed of 263 individuals. However, respondents had the possibility to answer only some parts of the questionnaire (see section 2.1.1.). Although the representativeness is discussed in the first section below, it has to be underlined that this survey does not pretend to be representative of the all Belgian population and it was not the purpose. Indeed, the purpose of the survey was focused on the collect of opinions and on an in-depth analysis of the answers (many open questions in the questionnaire).

The chapter is divided in 6 sections; the first section brings out some basics of methodology about the survey and discusses the question of representativeness of the sample. The second section is dedicated to the penetration onto the market of alternative vehicles in the survey sample (current users), the reasons from buying an alternative car and the problems encountered on the one hand (sub-section 2.1.2.1), and the purchase intentions of the survey population on the other hand (sub-section 2.1.2.2.). The third section concerns the lack of information of people about alternative vehicles. As the lack of information represents a very important barrier, it has been decided to devote a particular section to this topic. Furthermore, it is a particular barrier in the sense that it can generate barriers than do not actually exist (prejudices resulting from bad information) or it may hide possible other barriers. The fourth section presents the results about the importance of barriers to the purchase/use of alternative vehicles in general. The fifth part presents the results about the importance of barriers by vehicle technology. The sixth part introduces some types of policy measures proposed by the respondents to encourage the purchase of alternative vehicles and the last part concludes and summaries the main results of the survey.

### **2.1.1. Methodology and representativeness of the survey in brief**

#### ***- Structure of the questionnaire***

In order to meet the objectives mentioned above, the structure of the questionnaire consisted in 3 main parts:

I. General questions (mainly open questions) on knowledge about the different alternative technologies, on purchase intentions, on barriers to the purchase of alternative vehicles, on policy measures...

II. Personal evaluation of the importance of barriers to the purchase/use of alternative vehicles in general (pre-identified barriers and barriers identified by the respondent).

III. Open question about barriers to the purchase/use of specific categories of alternative vehicles and personal evaluation of the importance of barriers by category of alternative vehicle (pre-identified barriers and other barriers identified by the respondent).

Respondents were given the option of not answering part III (according to their knowledge). Most respondents only filled in part I and II (general barriers), and about 25% also answered part III.

#### ***- Methodology for the data treatment***

The methodology for the data treatment was the following:

- Qualitative information from open questions was first codified according to the type of response. Then, those codified answers were classified by category of barriers following the typology described in part I. Finally, those answers were treated through *frequency of occurrence* (software: excel).
- For quantitative information from closed questions where the respondents had to select an answer on a scale (e.g. between 0 and 10 for the evaluation of the importance of barriers), *the averages* of the answers were computed, as well as *the standard deviations* (software: excel).
- Associations between the different answers were tested (*bivariate analysis*), e.g.: are reasons for no intention of buying alternative vehicles linked to degree of knowledge or to respondent attributes? (Software: SAS). Three types of statistical tests (according to the nature of the variables considered) have been performed to identify possible relations between the answers:
  - *Analyses of variance (ANOVA test)* were used to test the relation between a discrete variable and a continuous variable. The objective is to test if significant differences between means of different groups exist. The homogeneity of the variances ("homoscedasticity"), which is the most important condition for using this test, has always been checked.
  - *Khi-2 tests* were used to test the relation between two discrete variables. The objective is to test the independence between the distributions.
  - *Correlation coefficients of Pearson ( $r^2$ )* were used to test the linear correlation and its direction between two continuous variables.

Those tests have been done for all possible relations between variables; only significant results are mentioned in the following sections, and the p-value is given for each test. The acceptable error rate (significant level) for the p-value is 0.05 (5 %).

#### ***- Type of survey and representativeness***

The questionnaire included many open questions and the interviewers read the questions to the respondents to ensure a right interpretation. Such **in-depth interviews** were only possible with a restricted sample of interviewees. This implies that **the purpose of the survey was not to be representative of the Belgian population but rather to collect detailed information from the public as to their reasons for not buying alternative vehicles. However, for information, representativeness is discussed below.**

Above all, final results will have to be interpreted with caution concerning representativeness of the Belgian population. Indeed, we can reasonably assume the presence of 2 uncontrolled biases; the first one (and the most important) is that **visitors to the Motor Show** have specific characteristics as they decided to go to the salon (for example, they are probably more

interested in cars than the average population). The second bias comes from the fact that people who accepted to answer the questionnaire may also have some specific characteristics (interests on environment for example)<sup>9</sup>. Those biases have to be kept in mind when considering the results.

Beside this point, representativeness of the sample was evaluated by **comparing the characteristics of the sample population group with those of the Belgian population**. It was observed that the percentage of people in the different social statuses (share of municipal officers, workers, employees and independent) is roughly equal to the corresponding percentage of the Belgian population. On the other hand, we noticed a strong over-representation of men in the sample (80%), corresponding to the proportion of men visiting the Motor Show. Concerning the distribution of age in the sample, an over-representation of people between 20 and 39 years old and an under-representation of people of more than 50 (which is again a characteristic of visitors to the Motor Show) was observed. Finally, it was noticed that the level of education of the sample was above the level of the Belgian population, while average household income in the sample was below the average household income of the population.

## **2.1.2. Current users and purchase intentions**

In this section, the current users of alternative vehicles, their reasons for buying (advantages) and the possible problems (disadvantages) they have met are presented in a first sub-section. In a second one, the purchase intentions of the respondents and the reasons for their intentions are described.

### 2.1.2.1 Current users, their reasons of purchase/use and the problems encountered

Among the interviewed people, 5% (13 people) had an alternative vehicle. Of course this 5 % is not representative of the proportion of alternative vehicles in the whole population (where the proportion is about 1%<sup>10</sup>). As a reminder, it was not the objective of the survey to know the rate of penetration of alternative vehicles on the market in Belgium but rather to discuss the reasons of buying those cars and the advantages and disadvantages of the user.

Among this 13 people using an alternative vehicle, we had:

- 9 with an LPG car
- 2 with electric vehicles (one had a small motor bike and the other had a vehicle, a scooter and an electric bike)
- 1 with a Terios ethanol
- 1 with a Prius LPG

Without surprise, most of the alternative vehicles used are LPG vehicles.

**Generally speaking**, among the total 23 advantages mentioned by the owners about their alternative vehicle, 13 are economic and only 4 are environmental (the others are quite diversified).

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<sup>9</sup> The interviewers were moving around the different halls in order to obtain a sample which is as representative as possible of the visitors to the Motor Show (with their different interests).

<sup>10</sup> Federal Public services mobility and transport (2007)

It was observed that **LPG is mainly chosen for economic reasons rather than for environmental reasons.**

Among the disadvantages encountered for LPG<sup>11</sup>, the LPG users have mentioned:

- Limited space (at the back of the car)
- Range limitation
- Poor performance
- High tax
- Not fully achieved (immature technology)
- Lack of refuelling stations and lack of availability to refuel at night
- Lack of access to underground parking

This implies that for LPG users, the economic advantage of LPG compensate for the range of disadvantages mentioned.

For **electric cars**, the advantage of silence is firstly mentioned for the 2 people involved. The other advantages mentioned are: environmental, economic, less maintenance needed and easy to use for short distances. About the disadvantages, the problem of limited range is mentioned, as well as the maintenance required for the batteries and the problems with the batteries.

For the **Terios ethanol**, the advantage mentioned is economic (price of the fuel). No disadvantage is mentioned.

For the **Prius LPG**, the economic advantage (less cost/km) is mentioned.

So it is interesting to note that among the small sample who own an alternative vehicle (in most cases an LPG vehicle), the first motive of purchase is often **economic**.

#### 2.1.2.2 Purchase intentions

Respondents were asked if they had the intention of buying an alternative vehicle in the future. To this question, about 40% of the sample answered "yes" and about 60% answered "no"<sup>12</sup>.

It must be mentioned that 6% of the whole sample had answered yes, but when specifying which category of clean vehicle they meant, they mentioned a conventional car with low fuel consumption. As this is not an alternative vehicle, we considered the answer as negative (so they are included in the 60% of negative answers), and the competition with low consumption conventional cars as an obstacle (see section 2.1.4.).

Of course we have to interpret these results (40% of people who have the intention of buying an alternative vehicle) with caution, as it seems to be over-optimistic. This raises the question of the real purchase intention of the respondents, and the difference between the theoretical idea of buying an alternative vehicle and its translation into concrete action. Indeed, the question is asked without precision in time, so respondents who answered positively should

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<sup>11</sup> One person mentions 0 disadvantage

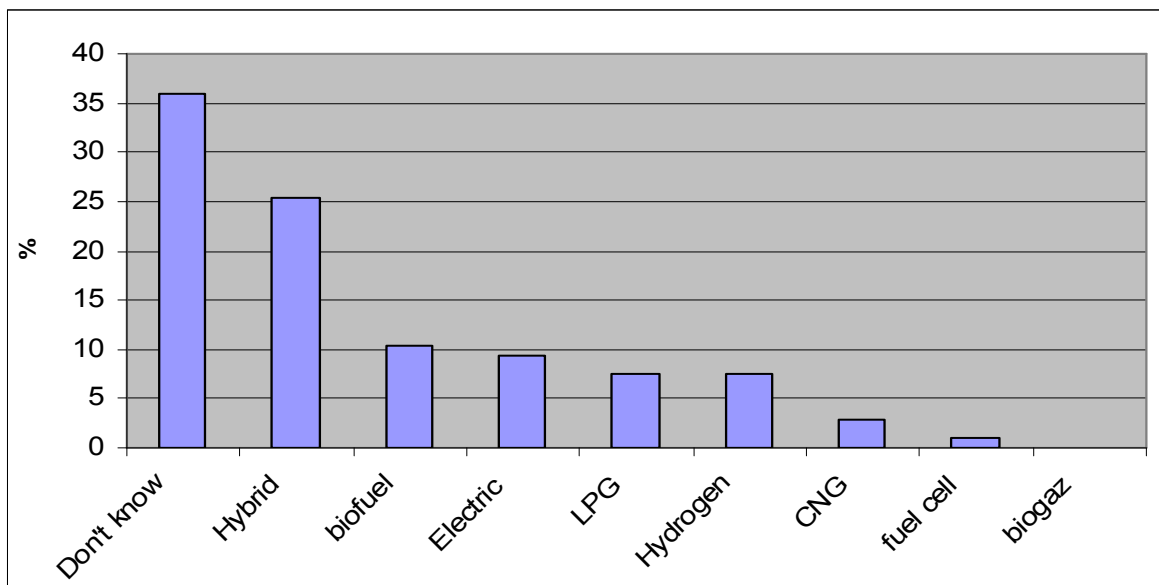
<sup>12</sup> 106 respondents have answered "yes" and 152 have answered "no" (5 respondents did not answered to this question).



be considered as the people not against the idea of alternative vehicles (rather than people with actual intentions of buying in the short run). Also, the respondents may be willing to give a positive image of themselves, even if it is not translated into actual facts (“social desirability bias”). Finally, it may also illustrate a case of "counterintentional habits"<sup>13</sup>, in the sense that those people have the "rational" intention to buy an alternative vehicle, but their habits (routine behaviour) make them acting in another way and generate "inertia" towards a possible change of car technology. Anyway, in general, people who answered “yes” may differ from others in the sense that they are likely to be more concerned with the environment (if they want to give a green image of themselves) and so probably more open to buy a cleaner car.

The graph below (graph 1) indicates which kind of alternative vehicle the respondents want to buy, among those who have the intention to buy an alternative vehicle in the future.

**Graph 1 : Purchase intentions by category of alternative vehicle (% of the population who intend buying an alternative vehicle in the future)**



*N (sample size) = 106*

We notice that more than 35 % of the people who have answered that they had the intention to buy an alternative vehicle in the future (106 respondents) didn't know which sort of vehicle they would like to buy. This can indicate a lack of information about the different kinds of alternative. This lack of information can either come from an objective lack of documentation and advertisements about alternative vehicles, or from a lack of motivation from people to look for information. This latter possibility would confirm that those people are not against the idea of buying an alternative vehicle in theory, but they are not ready to translate it into action by collecting information etc. (mental laziness). It can also come from a biased search process of people with strong habits, i.e. that people develop expectations about their behaviour consumption pattern which lead to a kind of "tunnel vision"<sup>14</sup>, implying routine consumption behaviour and no active search for information about alternatives.

Moreover, among the people who don't know which kind of alternative vehicle to buy, a lot of them gave certain conditions or moderated their choice (at the question: "Do you have the intention to buy an alternative vehicle, they answer for example: “yes, but in a far future”,

<sup>13</sup> Maréchal K. (2009).

<sup>14</sup> Verplanken B. and Wood W. (2006).

“yes, but in the future because there is still a lot of progress to be made”, “yes, but it will depend on the price”, etc.)<sup>15</sup>.

We can see in graph 1 that the first vehicle mentioned is the hybrid; bio fuels vehicles, electric vehicles, LPG and hydrogen vehicles come quite far behind. It has to be noted that among the different categories of alternative vehicle, LPG and hybrid vehicles are the most available and developed ones in Belgium. With regards to this, it is interesting to compare the position of the hybrid and the LPG concerning purchase intentions: we can see that hybrid is much more successful than LPG, despite the fact that LPG is the best known alternative (see graph 2 below), is more spread (older technology) and is also cheaper. The fact that the hybrid is much more successful than the LPG here may indicate that **non-economic factors are potentially stronger than economic ones**, even if it is the contrary which is explicitly mentioned by the respondents (see sections 2.1.3 and 2.1.5). This preference for hybrid cars may reveal the good effect of advertisement (fashion), the fact that the brand (Toyota) is famous, and also the fact that the hybrid does not imply a change in habits (same refuelling systems...); LPG is a gas, and as we will see, people are afraid of it (see section 2.1.5). Also, LPG is often considered as an old system. Moreover, LPG vehicles show some disadvantages, like the problem of access to underground car parks, as well as possible technical problems (for converted vehicles). The lack of dedicated LPG vehicles, which imply a need to convert the vehicle after purchase, may also influence purchase intentions.

Among the people who expressed an intention to buy an alternative vehicle in the future and who do not know which one to buy, most of them mentioned the environment as a reason for buying an alternative vehicle. This indicates that those people are concerned about the environment but they probably do not have enough information about alternative vehicles.

Among people expressing the reasons why they have the intention of buying a specific kind of vehicle (64 people), 36% in total of the reasons they mentioned concern environment and society and 28% are economic reasons. So, **environmental and economic reasons seem to be the main expressed motivations for having the intention of buying a specific kind of alternative vehicle in the future**. However, in practice, economic arguments seem to prevail for the few respondents who actually own an alternative vehicle (mainly LPG). See point 2.1.2.1. Also, the fact that hybrid is preferred to LPG indicates that other factors influence purchase intentions (see above).

Various other opinions or remarks made by the respondents are worth mentioning. The lack of development and the lack of availability of alternative vehicles are expressed by some people (one respondent mentioned that “for the moment when an alternative exists, the supply is too short and it is too expensive”). It comes out that some people would choose one type of vehicle because it is the most developed or the most famous one (“the one which is most talked about” was the argument of a respondent to choose biofuel vehicle), or because it is the only one that they know; the brand seems also to play a role for some people: it appears that if the brand is famous, it inspires confidence and reliability (“brand loyalty”); we notice also that some people use the information they have to make short cuts: “hydrogen vehicles are the most famous so they are probably the most developed alternatives (and developed by vehicle maker - brand - that I like)”; this shows that people use their limited or incomplete

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<sup>15</sup> Some of those remarks were taken up as a barrier (section 2.1.3) since they give reasons why people do not want to buy an alternative vehicle at the current time (e.g. if a person answered “yes, but if the range is better”, range is currently an obstacle).

information to conclude things that are not always correct<sup>16</sup>. A respondent expressed his desire to buy a biofuel vehicle because it is “cool”, which may indicate that the idea or the use of the word “biofuel” may sound pleasant for some people.

For hybrid, it is also interesting to note the transitory aspect of this solution, as some people opt for hybrid because "it is the best compromise in the short run" (by waiting for a better alternative). The fact that it is like a conventional car (“like the others” as mentioned by a respondent) seems also to contribute to its success, which indicates the influence of habits in car preference.

Among the few people who plan to buy an electric car, some of their reasons are: the increase of oil price (economic reason), the fact that “it is the future” or the fact that they can charge it at home. So, what could be perceived as a disadvantage may possibly turn out to be considered as an advantage...

It is important to note that statistically, people who do not intend to buy an alternative vehicle differ from the other (those who do have this intention) in the sense that the barrier "lack of confidence in safety" is more important for them (see section 2.1.4.).

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<sup>16</sup> Another respondent mentioned that he would choose a hydrogen vehicle “on the condition that it is always water”, which indicates the lack and/or the wrong information of some people.

### **2.1.3. Lack of information and type of information asked by the respondents**

In the first paragraph of this section, the lack of information on alternative vehicles that arises from the survey is highlighted through different findings. In the second paragraph, the kind of information that respondents would like to obtain is given.

#### ***- Lack of information on alternative vehicles***

Lack of information on alternative vehicles represents a very important barrier to their purchase. Of course, this lack of information could be a consequence of the lack of development of these vehicles that would be quickly solved in the instance of a massive development of their supply. However, in the short run, providing people with more and better information could enhance the actual demand for alternative vehicles, so encouraging vehicle makers to develop the supply. Moreover, it could reduce the perception of other barriers (see below). But we will also see that while good information is a necessary condition to the development of alternative vehicles, it is not a sufficient one. Indeed, the impact of overcoming the barrier “lack of information” on the development of alternative vehicles will depend on the other existing barriers and their importance.

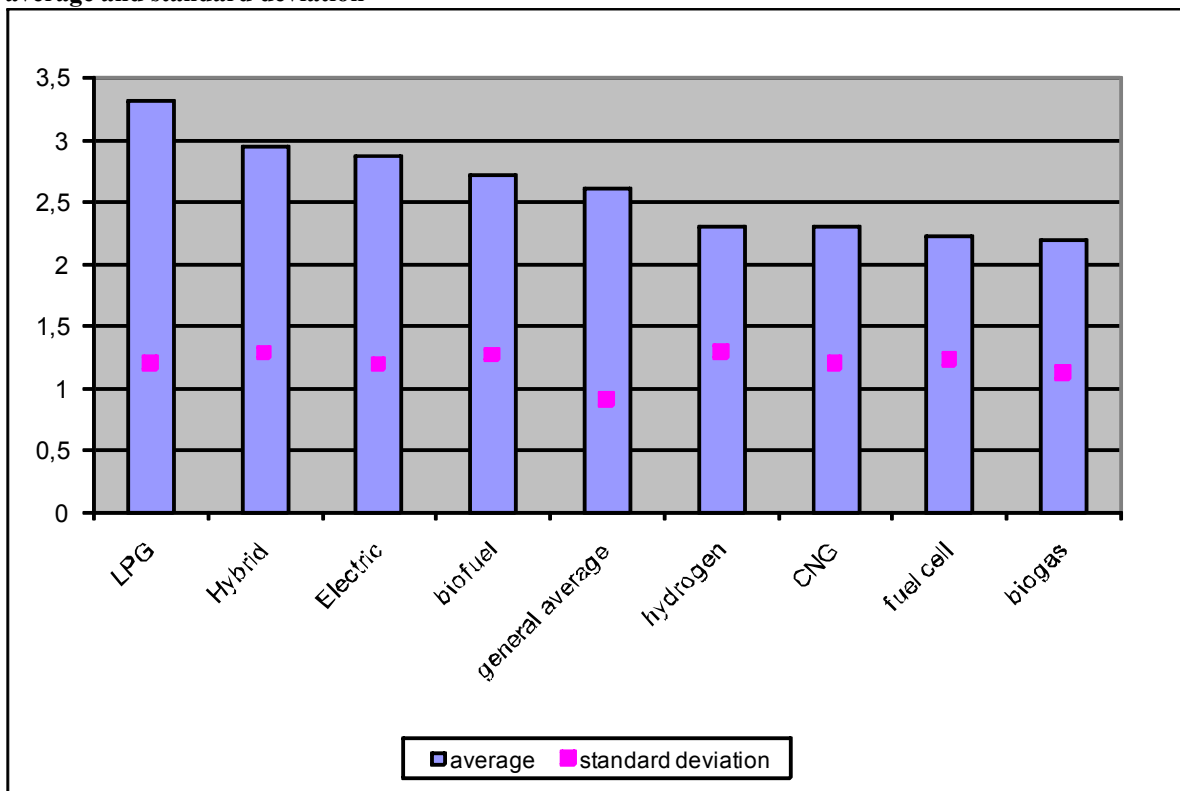
Several results of the survey indicate that there is an important lack of information about the different categories of alternative vehicles.

Firstly, only 25 % of the respondent answered the second part of the questionnaire (concerning the barriers by category of alternative vehicle. See above section 2.1.1). This means that people usually have a general idea about alternative vehicles but do not know enough about the different kinds to answer questions on specific technologies.

Secondly, as we have seen in the previous section, most people who claim to have the intention of buying an alternative vehicle do not know which category they would like to buy. This again indicates the fact that there is a lack of information (or at least that the information they have do not allow them to come to a decision).

Thirdly, all the respondents were asked to evaluate their relative knowledge about the various kinds of alternative vehicles. People had the possibility to choose between 5 degrees of knowledge (between “low” and “very high”); for average and standard deviation computation, we gave a quotation to the different propositions between 1 (= “low”) and 5 (= “very high”). Results are presented in the graph (Graph 2) below.

**Graph 2 : Level of knowledge of the different kinds of alternative vehicles (from 1 = low to 5 = very high): average and standard deviation**



*N* (sample size) = 263

As we can see, the general average knowledge about alternative vehicles is not very high. Indeed, the general average knowledge is between “rather low” and “middle”, with quite a small standard deviation. We notice also that even the vehicles with the relatively higher score remain not so high in absolute terms (“middle” knowledge), which indicates that knowledge about alternative vehicles is still low for most people. Moreover, we can suppose that visitors to the Motor Show are better informed about cars than other people, which could lead to even more pessimistic conclusions with respect to the knowledge of the whole population. On the other hand, we may also assume that visitors to the Motor Show are very keen on cars and may be less concerned about the environment than the majority of people, so it is difficult to say if these results are upside or downside biased.

We also observe that LPG vehicle is the best known alternative, followed by hybrid (with a standard deviation higher for hybrids than for LPG). The first position of LPG in the degree of knowledge can be explained by the fact that it is an “old” technology, and it is also the most developed alternative in the Belgian fleet<sup>17</sup>. Hybrid is a new technology but is very mediatised and developed by famous car brands. They are followed by electric and biofuel vehicles, which is not surprising since electric vehicles are somehow “famous” because they have been existing for a long time, and since biofuel vehicles are much “present” in the medias nowadays. Below the general average, we have first of all hydrogen, followed by CNG, fuel cells and biogas.

Results of the survey have indicated that the lack of information is perceived by respondents as an important barrier to the purchase/use of alternative vehicles (see section 2.1.4, graph 5).

<sup>17</sup> 0,9 % of the Belgian fleet in 2007 (source: FEBIAC)

Statistical analysis has also shown that the personal evaluation (perception) of the importance of the barrier “lack of information” is decreasing with the level of knowledge about alternative vehicles, which is a consistent result (see section 2.1.4). This confirms that more and better information would reduce the importance of this barrier. **However, while the lack of information represents an important barrier for non-informed people, it is not certain whether the fact of overcoming this barrier will obviously have a positive impact on the development of every alternative vehicle. This would depend on the other existing barriers and their importance (stacking of barriers).** Indeed, in the case of LPG, we can observe that the better degree of knowledge/information (see Graph 2) does not imply a better success of this category of alternative concerning purchase intentions (see Graph 1). **Conversely, we also noticed that a low level of knowledge has a statistical positive influence on the importance of some other barriers** (the perception of the importance of some barriers is greater if the degree of knowledge about alternative vehicles is low. See point 2.1.4).

A strong dependency between the levels of knowledge of the different kinds of alternative vehicles has been observed<sup>18</sup>. It means that when one person has a low level of knowledge about one type of alternative, he/she usually has a low level of knowledge about the other ones (and vice versa).

We also noticed that gender has a statistical influence on the level of knowledge: women have usually a weaker level of knowledge about the different kind of alternative vehicles<sup>19</sup>, except for biogas (the difference between the degree of knowledge of men and women is particularly significant for LPG). This implies that our results probably overestimate the average knowledge of the Belgian population, as the proportion of women in our sample (20%) is much weaker than in Belgian population (50%).

#### ***- Kind of information respondents would like to obtain***

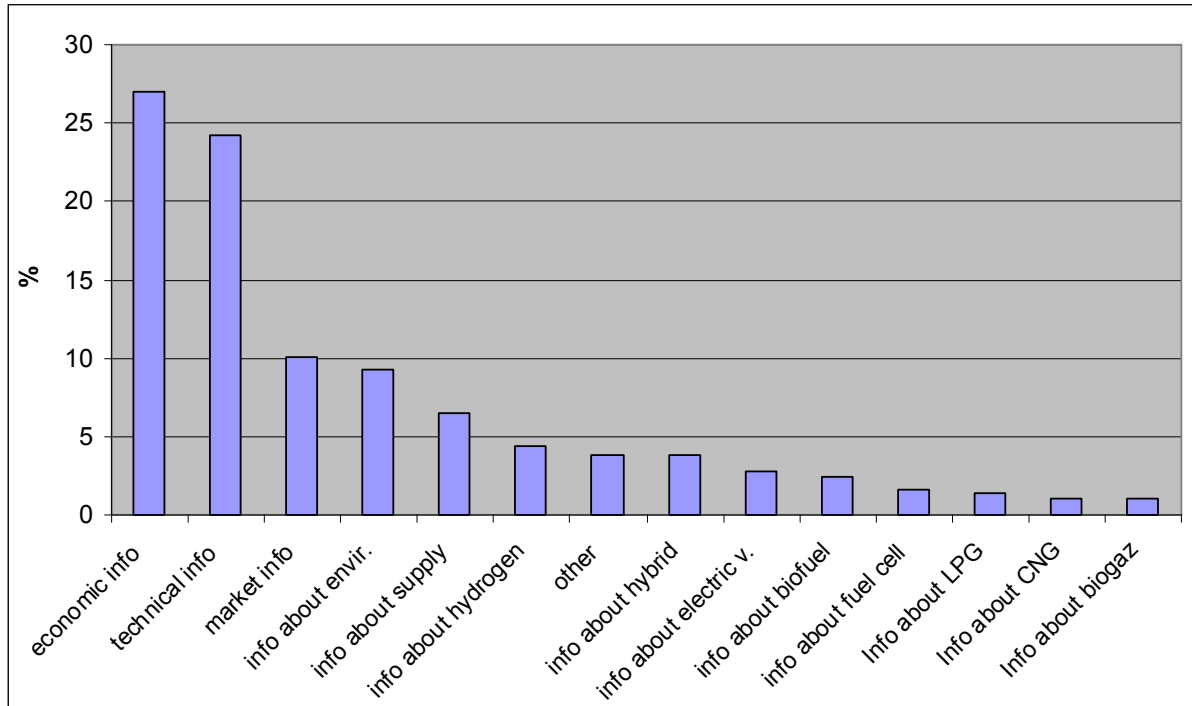
The questionnaire allowed us to obtain –through an open question- the type of information respondents do not have and which they would like to obtain in priority.

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<sup>18</sup> The Khi-2 test (as well as the maximum likelihood test and the Khi-2 Mantel-Haenszel test) is significant (p-value always smaller than 0, 0001).

<sup>19</sup> Khi-2 test is significant and the p-value is smaller than 0, 01 for general knowledge, LPG, CNG and hydrogen and smaller than 0, 05 for the other.

**Graph 3 : Kind of information people want to obtain (% of the total of information asked)**



*N (sample size) = 216 (47 abstention)*

This graph informs us about the information lacking and the type of information that they consider as important about cars. So it also indicates the important factors for a car purchase, as it is what the respondents want to know in priority.

We can see that **economic information is the first kind of information people are asking for** (more than 25% of all the criteria mentioned). It is closely followed by technical information<sup>20</sup>. It shows that this information is often lacking and it reflects an important rational factor for the consumer in car purchase decision: the quality-price ratio. Economic and technical information are followed by "market" information (see below), information about the effect on the environment (and on society) of such cars, and information about the supply.

A general remark has to be made: **we have to keep in mind that the questionnaire was conceived to appeal mainly to rational and “conscious” factors, so the emotional and unconscious components of a car purchase decision (which are known to be important) do not appear directly.**

The kind of *economic information* asked by people concerns mainly the prices of alternative vehicles, but also the fuel consumption. The *technical information* asked is mostly general, but information about range, life time, and to a lesser extent questions concerning the ease to use these vehicles and their reliability are also frequently asked. *Market information* includes here mainly general information about the vehicles. A number of people would like to have simplified and clear information's (e.g. to have a comparative and synthetic board with a description of the different categories, and their advantages and disadvantages); they ask for public information, information to the dealer point, on TV and internet, in the press, in specialised magazines, in advertising, etc. Other asked for the best alternative and how to

<sup>20</sup> Including safety (only 3 occurrences)

choose between the different technologies. Sometimes people expressed doubts and lack of confidence about alternative vehicles (“why aren’t these vehicles on the market?” is an example of a question from sceptical people); some of them asked about the general advantages of these technologies, or more specifically about their environmental advantage. Lack of interest is sometimes clearly expressed by a few respondents (“the information is there but I am not interested in alternative vehicles” as affirmed one respondent). A respondent asked for the difference between alternatives vehicles and “normal” cars, which may indicate a certain apprehension about changing habits.

This section has highlighted the important lack of information about alternative vehicles. So, **measures dedicated to spread clear information about the different existing alternatives, their advantages and disadvantages, their costs etc. through different channels are necessary. Moreover, as we will see, this could contribute to the reduction of the perception of the importance of other barriers (see section 2.1.4). However, while the lack of information is a very important barrier, overcoming it would not always guarantee a better development of the alternative; this will depend on the other existing barriers and their importance.** Indeed, we have seen that LPG is the best known alternative vehicle but is not very successful concerning purchase intention. **So, overcoming the barrier “lack of information” is a necessary but not sufficient condition to the development of alternative vehicles.**

#### **2.1.4. Identification and importance of barriers to the purchase/use of alternative vehicles in general**

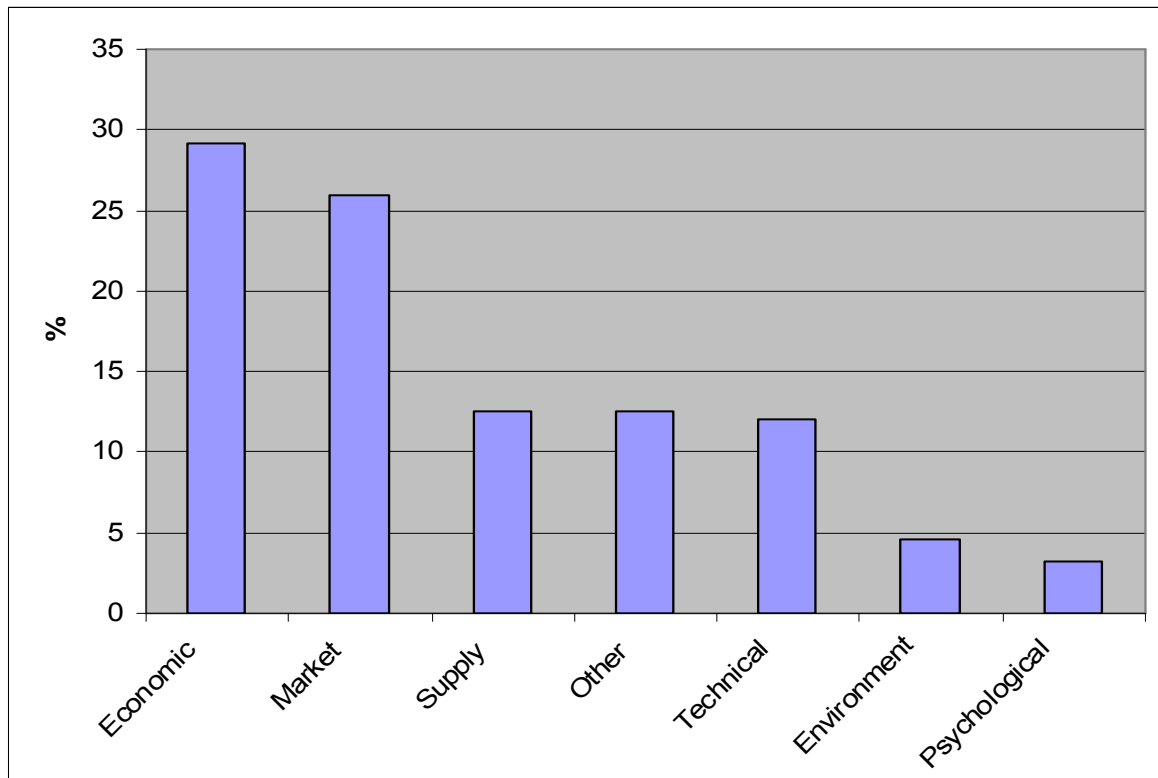
This section includes different information coming from different questions of the questionnaire. In the first paragraph, we present the result of an open question where the respondents were asked to give their main reasons for not having the intention to buy an alternative vehicle. This allowed us to have people’s spontaneous feelings (without restrictions), to identify new barriers and to have an idea about the relative importance of barriers according to the frequency of the different obstacles mentioned. In another question which results are presented in the second paragraph, respondents were asked to give a quantitative evaluation of the importance of a list of proposed barriers. A quotation system was given to the respondents. So we obtained a quantitative evaluation of the importance of a list of different pre-identified barriers (identified beforehand through literature review). Statistical associations (correlations) between answers to this question and other answers are also analysed in the last paragraph.

##### ***- Reasons for no intention of buying an alternative vehicle: results of open question***

The answers to the open question were codified and classed by group of barriers. The results of the frequency of occurrence are presented below (Graph 4) by group of barriers. A remark has to be made: as we have mentioned before, a group of people (6% of the all sample) had answered at the same time “yes” to the question relative to the intention to buy an alternative vehicle, and when specifying which category of them, they mentioned a conventional fossil fuel car with low fuel consumption. As this is not an alternative vehicle, we considered the answer as negative, and the competition with low consumption conventional cars as an obstacle. This obstacle was included in the group of “market barriers”.



**Graph 4: Reasons why people do not want to buy an alternative vehicle (in % of the total of the reasons mentioned)**



*N (sample size) = 154*

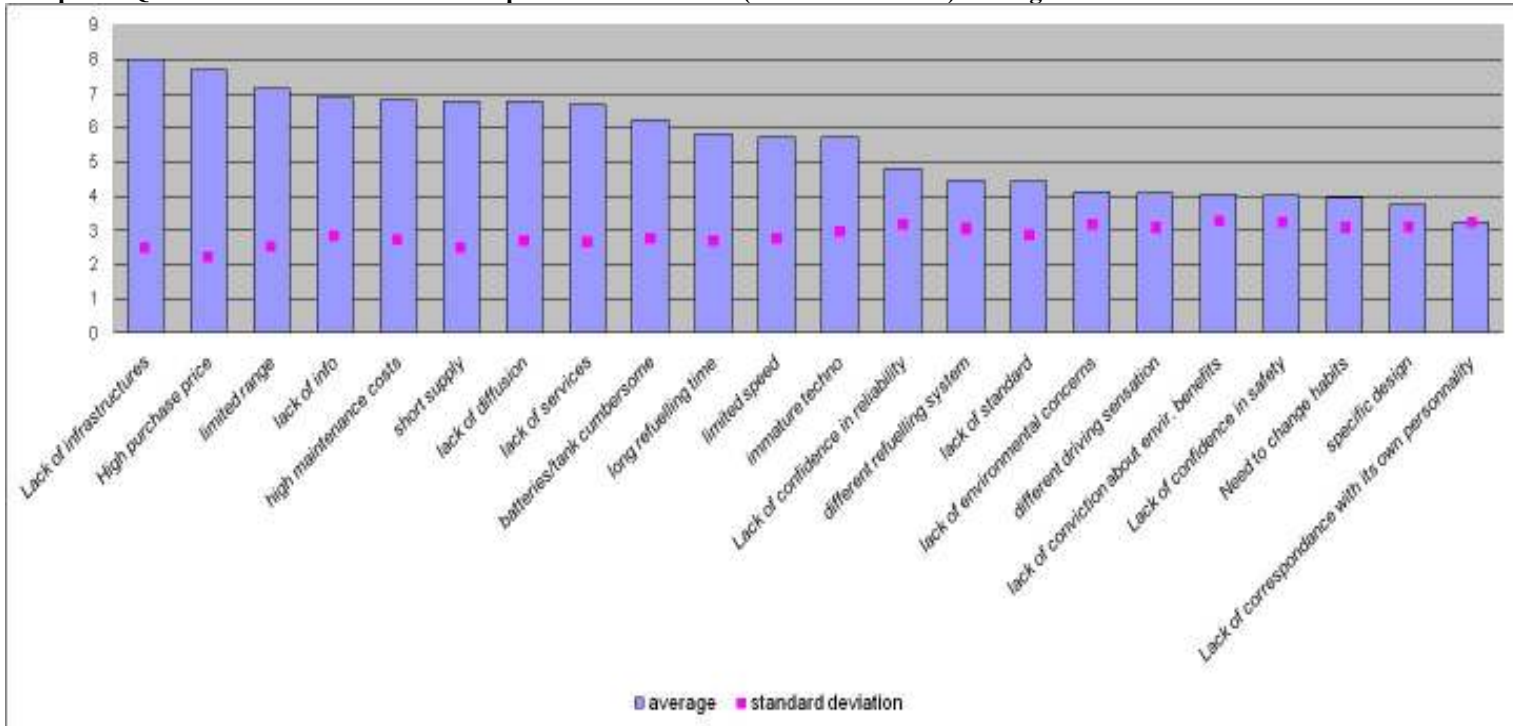
We can see that in the total of the reasons mentioned, **the economic ones represent the highest share (price too high)**. This implies that on the one hand people think alternative vehicles are expensive, and on the other hand that they are not ready to pay more for an alternative vehicle. Different answers reveal also the importance of the quality-price ratio (people don't want to pay more for a less performing or less reliable car). Then come the market barriers, which are mainly composed of 3 important groups: **competition with conventional vehicles considered as clean** (which have a relatively low fuel consumption and for which a grant is sometimes allocated), **lack of information** and **lack of diffusion** (fear of potential problems, and preference to wait for others to adopt the technology or to test it before adopting it themselves). After market barriers come supply barriers. In the supply barriers, the **lack of diversified models** is prominent (not enough choices, unpleasant look, no convenient models, no big vehicles etc.), then come the lack of availability of the vehicles (quantitative) and the lack of refuelling stations. The category "other" includes mainly people who have just bought a new car, and some others who have a company car (so they do not always have the choice or the possibility to use alternative vehicles). The group of technical barriers is split between a lot of different items, which implies that those barriers do not appear so significant in the open question; however, the only barriers that come up more than twice are "immaturity" (directly linked to the market barrier: "lack of development"), "limited range" and "reliability" (feeling that alternative vehicles are not reliable). Environment (environmental barriers) refers to the people's lack of conviction that alternative vehicles are beneficial to the environment or to society. We have noticed that the "true ecologists" have doubts about the environmental advantages of those vehicles and so prefer not to have a car (they would rather use bike, public transport, car-sharing...). Psychological barriers include change of habits (e.g. one respondent mentioned that he was too old to change), driving

sensation (e.g. one respondent liked the sound of the engine, so do not want an electric vehicle) and lack of confidence in safety<sup>21</sup>.

**- Quantitative evaluation of different pre-identified barriers**

Respondents were asked to evaluate the importance of a list of proposed barriers by giving them a quotation between 0 (not a barrier) and 10 (very important barrier). Two types of information are contained in the answers. Firstly, it informs us about the perceived barriers which are possibly prejudices as it indicates what people think to be the characteristics of alternative vehicles. Secondly, it brings the information about the importance of the various items for the car purchaser. It has to be noted that the respondents to this question include the ones who had the intention of buying an alternative vehicle as well as the ones who did not.

**Graph 5 : Quantitative evaluation of the importance of barriers (between 0 and 10)-average and standard deviation**



*N (sample size) = 251<sup>22</sup>*

We notice that the highly quoted barriers are usually the ones which show the smallest standard deviation. This implies that the differences between the answers (variation from the average) were not very important, at the contrary of the lowest quoted barriers, which show relatively larger standard deviations. This means that measures that could be taken to overcome the most important barriers (the highly quoted barriers) are likely to be even more efficient since they represent very important barriers for most people.

We can see in Graph 5 that the two most important barriers are the lack of refuelling/recharging infrastructures (supply barrier) and the high purchase price (economic barrier), with a smaller standard deviation for the second barrier. The limited range (technical

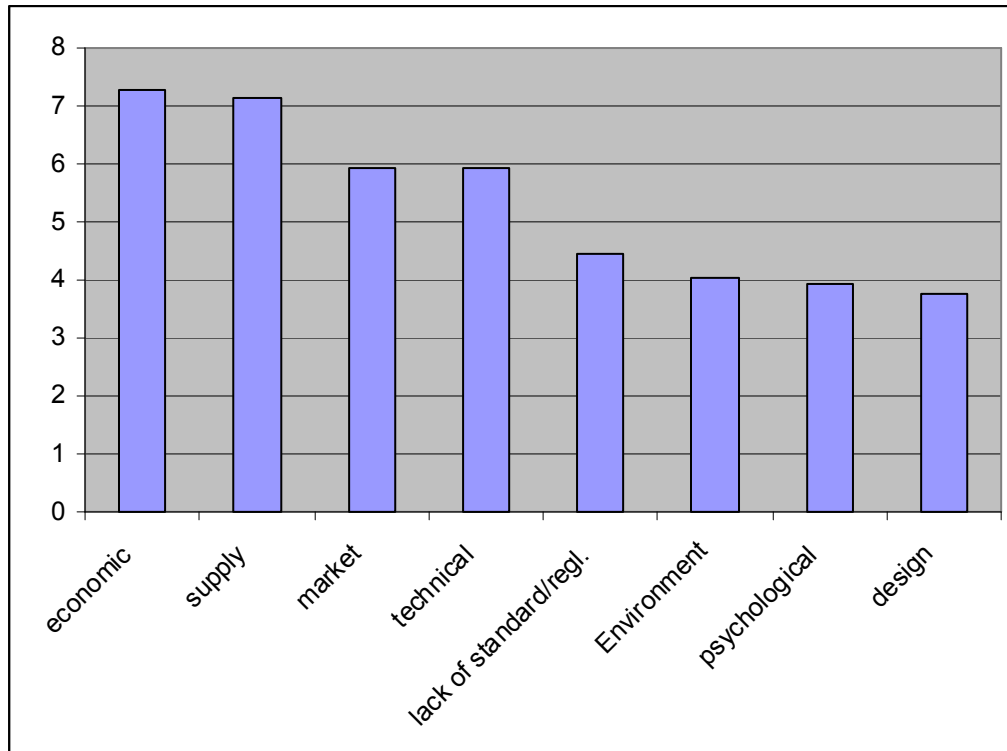
<sup>21</sup> Psychological barriers may be underestimated, as the questionnaire was conceived to appeal mainly to rational and “conscious” factors (see general remark page 17 and the conclusion).

<sup>22</sup> 3 abstentions and 9 respondents answered only to the part of the questionnaire by technology.

barrier) is also perceived as an important barrier. We notice that psychological barriers (“need to change habits”, “lack of correspondence with my personality”, “lack of confidence in safety”) and “too specific design”<sup>23</sup> are not highly quoted; again, we have to interpret this result with caution, because psychological barriers are typically unconscious and emotion-related; however, this question is asked to appeal to the rational behaviour and the conscious thinking of the consumers, so the emotional factors may be underestimated.

In the graph below (Graph 6) we have grouped the barriers from Graph 5 by category, to have a clearer view of the most important categories of barriers<sup>24</sup>.

**Graph 6 : Quantitative evaluation of barriers by category of barrier**



*N (sample size) = 251 (see graph 5)*

We observe from graph 6 that the **most important categories of barriers are economic and supply barriers (i.e. barriers linked to short supply: lack of availability of vehicles, lack of refuelling/recharging infrastructures and of after-sale and maintenance services), then come market and technical barriers.**

<sup>23</sup> The barrier "too specific design" could be considered as a psychological barrier or as a supply barrier. Here and in graph 6 we decided not to classify this barrier in one specific category.

<sup>24</sup> We calculate the average value of barriers by group. The different categories includes: economic barriers (purchase price and maintenance costs), technical barriers (limited range, limited speed, batteries and tank heavy and cumbersome, long refuelling/recharging time, immature technology, lack of confidence in technical reliability), supply-side barriers (lack of refuelling/recharging stations, lack of after-sale and maintenance services, short quantitative and qualitative vehicle supply), market barriers (lack of information, lack of development/diffusion of the vehicles, lack of environmental concerns), psychological barriers (different driving sensation, need to change habits, lack of confidence in safety, lack of correspondence with one's own personality, different tank system). "Lack of regulation and standard", "too specific design" and "lack of personal conviction of the environmental benefit of alternative vehicles" (= environment) have been kept separate.

It has to be mentioned that **this graph (Graph 6) cannot be directly compared to Graph 4 for different reasons**; firstly, the group of barriers does not include exactly the same barriers: indeed, in Graph 6 the groups include the pre-identified barriers from Graph 5 (see footnote 24 for the details) and in Graph 4 the groups include all what has been mentioned in the open question. It has to be noted that the legislative barrier “lack of standard and regulation”, was not mentioned in the open question (so it is absent in the Graph 4), and the barrier “too specific design” has been separated from the “supply barriers” (which was not the case in Graph 4) because the average value was too different (much lower) from the other “supply barrier”. Secondly, Graph 4 indicates the frequency of the different reasons for not having the intention to buy an alternative vehicle, while Graph 6 is the average of a quantitative evaluation of the importance of the pre-identified barriers. Thirdly, the respondents (and so the sample size) are different in the two graphs: in Graph 4, the respondents are only those who do not have the intention to buy an alternative in the future, and in Graph 6 every respondent had to evaluate quantitatively the importance of the list of pre-identified barriers (the ones who had the intention of buying an alternative vehicle as well as the ones who did not). So in some way, barriers are better represented in Graph 4 than in Graph 6, as the latter also includes people who consider that barriers are surmountable (as they had the intention to buy an alternative vehicle). Moreover, barriers presented in Graph 4 correspond to the spontaneous feeling of respondents without any restrictions (open question).

#### ***- Statistical associations between the different answers***

Some interesting statistical links have been observed between results presented in Graph 5 (quantitative evaluation of the importance of barriers) and other answers. Firstly, we noticed that the importance of the barrier « lack of information » is strongly linked with the average level of knowledge about alternative vehicles. Indeed, the weaker the average knowledge about alternative vehicles is, the more the barrier "lack of information" is important (consistency)<sup>25</sup>. Secondly and importantly, interactions between different barriers have been observed; indeed, **statistical tests have shown that the better the average level of knowledge is the less the barrier “different refuelling system” is important<sup>26</sup>. There is also a positive correlation between the importance of the barrier “high purchase price” and the barrier “lack of information”<sup>27</sup>**. So (as we have already mentioned in section 2.1.3), **this implies that those perceived barriers could be reduced if people were better informed.**

Importantly, we also observed that **for the people who intend to buy an alternative vehicle in the future, the barrier “lack of confidence in safety” (psychological barrier)<sup>28</sup> is less important than for the others<sup>29</sup>**. This was the only statistically significant difference between people who had the intentions to buy an alternative vehicle and the ones who did not. So we can conclude that, even if this barrier is not highly quoted (see graph 5), the lack of confidence in safety seems to play an important role in people’s purchase intention.

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<sup>25</sup> Anova test significant (p-value < 0,0001) and the assumption of homogeneity of variance is accepted

<sup>26</sup> Anova test significant (p-value < 0,028) and the assumption of homogeneity of variance is accepted

<sup>27</sup>  $R^2 = 0,22$  and p-value < 0,0004

<sup>28</sup> As alternative vehicles are in general not less safe than conventional ones (Favrel et al (2001b)), this lack of confidence in safety is considered as a psychological barrier (as it probably comes from the fear of the unknown).

<sup>29</sup> Anova test significant (p-value < 0,0189) and the assumption of homogeneity of variance is accepted

### *- Conclusions from the four last sections*

We can conclude from those results that **economic, market and supply barriers appear to be the most important categories of barriers to the purchase/use of alternative vehicles in general when considering people's conscious (expressed) motivations. However, while the barrier "lack of confidence in safety" (psychological barrier) is not highly quoted, it appears that it influences the people's purchase intentions.** Indeed, people who do not have the intention to buy an alternative vehicle differ from the others in the sense that the barrier "lack of confidence in safety" is more important for them. We also noticed the **presence of an interaction between barriers**, in this case between the barrier "lack of information" and "high purchase price" (economic barrier). Also, we found a negative relation between the level of knowledge about alternative vehicles and the importance of the barrier "different refuelling system" (psychological barrier). **This implies that measures aiming at overcoming the barrier "lack of information" will have a positive effect on the reduction of other barriers. However, overcoming the barrier "lack of information" is a necessary but not sufficient condition to foster the development of alternative vehicles.** This will depend on the other existing barriers and their importance (see the example of LPG above).

#### **2.1.5. Identification and importance of barriers to the purchase/use of alternative vehicles by technology**

Respondents could choose to answer to the question about barriers by category of vehicles, rather than to answer to the question about the evaluation of the importance of barriers to alternative vehicles in general. So, only the respondents who had a relatively good knowledge about the different categories of alternative vehicle have answered this part. Unsurprisingly, the response rate was much lower for this part (about 25 % of the whole sample, but the exact sample size differ for every technology). However, the main results presented here bring some interesting elements about barriers to the purchase/use of specific alternative vehicles. **The response rate for the questions about each category of vehicle and the graphs with the frequency of the different obstacles mentioned are presented in appendix 2.** In this section only the main conclusions and some interesting elements are given.

##### 2.1.5.1. Hybrid

The high purchase price (**economic barrier**) appears to be the most frequent barrier. It is directly followed by supply barriers, which include in majority the lack of available diversified models and the inconvenience of the models currently available, as well as their too specific design (unpleasant look). Two people mentioned the lack of after-sale services, and one of them made the following deductive reasoning: "lack of diffusion so lack of after-sale services". So this person uses his/her partial information to make short cuts and draw conclusions that prevent him/her from buying the vehicle. One person mentioned that hybrid vehicle is not beneficial in his/her case since he/she drives mainly on motorway.

##### 2.1.5.2. Electric

The group of technical barriers<sup>30</sup> is clearly the most important group of barriers for electrical vehicles. In this group, **limited range** is by far the most important technical barrier, and then but far below, come the long recharging time and the limited space of the car.

#### 2.1.5.3. Fuel cell

Here the difference in the frequency between the various groups of barrier is narrower than for electric and hybrid vehicles (barriers mentioned are more disparate). By decreasing number of frequency, we have the group of **technical barriers**, then not very far below the group of market barriers and finally the economic and supply barriers. In the technical barriers, various items are mentioned, but the question of space, immaturity and range come up more often. In market barriers we have mostly the **lack of information**, and also but far below, the lack of diffusion. A few people mentioned the question of safety (**psychological barriers**). About the environment, the question of recycling is mentioned. One person also stated that it is better to use directly electricity (electric vehicles).

#### 2.1.5.4. LPG

**Technical barriers** are the first kind of barriers mentioned. It is followed by **psychological barriers** and then by economic barriers. In technical barriers, there are various items; the most frequent are the problems of access to underground car parks and the reduced space in the car. Psychological barriers are mainly the **fear associated with gas**; one person mentioned also that it is an “old system” (which means that he/she has a bad image of LPG). In economic barriers, mainly the price of installation and the tax system are mentioned.

#### 2.1.5.5. CNG

The group of supply related barriers is the most important one (mainly the **lack of refuelling stations**). It is followed by **psychological barriers (lack of confidence in safety and fear of gas)**, and then by technical barriers (various). After these come economic barriers and market barriers (which include mainly the lack of information).

#### 2.1.5.5. Biogas

The response rate for biogas is lower than for CNG. Similarly to CNG, the supply barriers come first (**lack of refuelling stations**). Then we have in decreasing order: technical, market and psychological barriers (lack of confidence in safety). It is interesting to note that psychological barriers (lack of confidence in safety) seem to be less important for biogas than for CNG.

#### 2.1.5.6. Biofuel

Supply related barriers (mainly **lack of refuelling stations**) are the most frequently mentioned barriers. Then come **environmental and social (“ethical”) barriers** (impact on food supply and price, deforestation...). Quite far below we have economic, technical and market barriers (lack of information/ diffusion).

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<sup>30</sup> Here the safety was included in technical barriers because the fear was about the light weight of the electric vehicles (can be dangerous in case of accident).

### 2.1.5.7. Hydrogen

The ranking of barriers for hydrogen is quite similar to that of CNG. Supply barriers (**lack of availability of the fuel** and of refuelling stations) come first, and just after come **psychological barriers (lack of confidence in safety)**. Then (in decreasing order) come technical (various), market (lack of information and diffusion) and economic barriers. Two people also mentioned environmental barriers (too much energy required to produce hydrogen).

### 2.1.5.8. Summary

Interestingly, **we noticed that economic barriers are much less important when considering barriers by technology than when considering barriers in general, except for hybrid**. This observation may indicate different things: firstly, it may imply that high price is a barrier corresponding to a prejudice for people who do not really know existing alternatives, and so it is linked to the **lack of information**. Indeed, people who answered only the first part of the questionnaire (about alternative vehicles in general) are probably less informed about alternative vehicles than the ones who answered to the second part (questions detailed by technology of vehicle). Moreover, the link between the importance of economic barrier and the barrier “lack of information” (positive correlation) has been confirmed by a statistical test (see section 2.1.4). Secondly and along the same line, it is likely that when uninformed people think about alternative vehicles, they associate them with the hybrid vehicle, as this is a quite famous and developed alternative. Yet, hybrids are more expensive so that implies a greater economic barrier. Finally and more importantly, **it reveals the importance of a range of non economic barriers, which implies that overcoming the economic barriers would not be sufficient to foster the purchase/use of alternative vehicles**. For all the alternative fuels except LPG, the **lack of fuel distribution is the first barrier (supply barrier)**. For electric vehicles, the problem of **limited range** appears to be the first barrier (technical barrier). This section has also revealed **the fear of gas and the lack of confidence in safety concerning gas fuel (psychological barriers)**, which are often the second most important barriers mentioned for most alternative fuels. So making alternative vehicles at the same price than conventional ones is not expected to give impressive results. Only an economic incentive sufficiently high to compensate for the other problems mentioned (in such a manner that alternative vehicles would be financially attractive compared to conventional cars) could have a possible effect but still, it would probably not be sufficient.

### **2.1.6. Type of policy measures to implement (according to the respondents)**

All respondents were asked about the **measures that would encourage them to buy an alternative vehicle**. It comes out that economic measures are the most frequent type of measures people are thinking of (about 65% of the suggested measures)<sup>31</sup>. This includes reduction of purchase price (through grants for example) and fiscal incentives; they mainly ask for fiscal advantages (reduction of TVA for example) related to cleaner cars, and sometimes, but much less often, to a “punishing” tax for more polluting cars (someone suggested more excises on diesel for example). Of course, we have to temperate this result as it is clear that economic incentives are not sufficient to motivate alternative cars purchase for example in a case of non-availability of cars and/or refuelling stations (supply barriers). Also,

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<sup>31</sup> See graph in the appendix

as we have already seen, non-economic barriers prevail in most cases when considering barriers by technology. Finally, many studies have shown that economic incentives are not sufficient to change consumer behaviour. For example, a study carried out by Bartiaux et al (2006) about socio-technical factors influencing residential energy consumption has demonstrated that a mix of different kinds of policy instruments (combination of instruments) will have more impact than a smaller number of instrument. Indeed, interviews lead in the context of this study has shown that economic incentives won't be enough as they fail to address social and psychological barriers<sup>32</sup>.

Some interesting propositions related to the supply (about 10 % of the suggested measures), can be mentioned: some people asked for more beautiful cars with one of them suggesting "a modern but not futuristic design". Other people suggested that measures should concern the vehicle makers (they would buy the cars "when the vehicle makers only focus on alternative vehicles"). A significant part of the respondent asked for more refuelling stations, and one person asked for "finding the alternative fuel every where in Europe". In the technical measures (about 7% of the suggested measures), solving the problem of limited range is the one which is mentioned the most (technological improvement), but also the improvement of performance and the facility to use. Concerning the suggested "market measures" (about 5%), people ask mainly for informational measures. Finally, measures linked to the environment (about 5%) are related to the assurance that there is a real environmental benefit from alternatives (e.g. "to find ecological ways of producing the fuel").

### 2.1.7. Conclusion of the survey at the Motor Show

A range of barriers, with their importance and nuances came out from the survey. In this section, findings of the survey are summarised and presented by category of identified barriers.

- **Economic barriers:** the survey has revealed the **importance of economic barriers and the importance of "quality-price" ratio** (people do not seem to be willing to pay more<sup>33</sup> for a less performing or less reliable car). Indeed, economic barrier is very often mentioned as a reason for not having the intention to buy an alternative vehicle and is also very highly quoted barrier in the ranking of importance. So, it seems that people are really not keen on paying more for a cleaner car. Indeed, in the case of cars, the individual costs of purchasing an alternative car is upper the individual benefits, as the benefits are social. Conversely, the environmental cost of the polluting cars is not borne by the car user. As a result, cleaner cars are a typical example of goods that should be financially encouraged by the society (through policy measures), in order to internalise external costs. Moreover, respondents have clearly expressed that the measure that would encourage them to buy an alternative vehicle are economic incentives, in particular fiscal incentives. **However, while economic barriers seem very important when talking about alternative vehicles in general, it appears to be much less important (relative to other barriers) when considering the expressed barrier by category of alternative vehicles, except for hybrid. This reveals the importance of a range of non-economic barriers, and implies that overcoming economic barriers won't be sufficient to foster alternative vehicles purchase/use.** The fact that hybrid is preferred to LPG concerning purchase intention also indicates that non-economic barriers are potentially

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<sup>32</sup> See also Maréchal K. (2007, 2009).

<sup>33</sup> For more detailed analysis about willingness to pay for alternative vehicles, see the task 3.2 of the Clever project about price elasticity: Turcksin L. and Macharis C. (2009)



stronger than economic ones<sup>34</sup>. So it is likely that only an economic incentive sufficiently high to compensate for the other problems mentioned (in such a manner that alternative vehicles would be financially attractive relative to conventional cars) could have a possible effect on purchase behaviour (but still, it would probably not be sufficient). Results indicate also that the perception of the importance of economic barriers seems to be linked with the level of information of people, as the lack of information may possibly create an overestimation of the price of alternative vehicles. **The link between the perception of the importance of economic barrier and the lack of information has been confirmed by a statistical test.**

- **Market barrier:**

- **Lack of information.** The survey has revealed the important lack of information about alternative vehicles which represent a significant barrier to their purchase. We have observed that the lack of information has an influence (statistical correlation) on some other barriers, indicating the existence of an **interaction between barriers**. **As a result, the importance of the barrier “high purchase price” (an economic barrier) and “different refuelling system” (a psychological barrier) could decrease if people were better informed.** However, **more and better information (to overcome the barrier “lack of information”) is a necessary but not a sufficient condition to foster the purchase/use of alternative vehicles.** Indeed, we have seen that LPG is the best known alternative vehicle but is not very successful concerning purchase intention.
- **Lack of development** of alternative vehicles represent a barrier for consumer’s as they fear to have problems, and people wait for other people to adopt the technology to test it before adopting it themselves.
- **Competition with conventional vehicles that have a low fuel consumption** and are subsidised (granting of a premium) represents a barrier to the purchase of alternative vehicles. Indeed, a large range of conventional cars, financially encouraged and presented as environmentally friendly is proposed to the consumer. So, it seems that as long as there will be a supply of conventional vehicle (which imply no change in habits), with low consumption, relatively cheap and encouraged by policy measures, there is little chance that the consumer would choose an alternative vehicle.

- **Supply barriers:** the short supply of cars and refuelling stations appear to be unsurprisingly a very important barrier to the purchase of alternative vehicles from the consumer’s point of view. So measures aiming at developing the supply is thus of first importance.

- **Technical barriers:** technical immaturity of alternatives seems to be perceived and to constitute an important barrier. **The limited range** seems also to be an important barrier, in particular for electric vehicles<sup>35</sup>.

- **Psychological barriers:** the lack of confidence in safety<sup>36</sup>, even if the importance of this barrier is not clearly expressed by respondents, seems to play a role in the purchase intention. Indeed, **statistical test has shown that the barrier “lack of confidence in safety” is more**

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<sup>34</sup> Read explanations below in "psychological barriers".

<sup>35</sup> We have to note that this barrier (limited range) can, to some extent, be also considered as a psychological barrier, as it implies to organise differently and to change habits.

<sup>36</sup> As a reminder, the barrier “lack of confidence in safety” has been classified in psychological barrier because most alternative vehicles are not less safe than the conventional ones (Favrel et al. (2001b)). So this barrier comes from the feeling of people about new technologies (which they don’t know well).

**important for people who do not have any purchase intention than for people who plan to buy an alternative vehicle.** This is the only statistical difference between people with the intention of purchasing an alternative vehicle and the others. Also, the **fear of gas**, as people are **not used to** it, appear to be important when considering barriers to the purchase/use of gas fuel. The lack of confidence in safety and in particular the fear of gas indicates that people apprehend the “new”. This would imply again that **economic measures would probably not be sufficient if there aren’t combined with other policy measures that act on psychological barriers (such as educational measures for example), as well as on other non-economic barriers.** The fact that hybrid is preferred to LPG when considering purchase intention may also be a consequence of psychological effect. Indeed, as LPG is less expensive than hybrid, it is likely that the fact that hybrid has the same characteristics of an ordinary car, with the same comfort and which doesn’t imply to change habits, has an influence on purchase intention. This conclusion (influence of habits on purchase consumption behaviour) is in line with other studies about consumer purchase/consumption behaviour. For example, in a recent article, Maréchal K. (2009) highlights the importance of taking into account the role of habits in energy consumption patterns when designing policies. He also touches on one specific feature of habits, which is their low level of consciousness. This makes that people underestimate the role of habits in their consumption behaviour, which seems to be confirmed in our survey. Indeed, respondents do not think “consciously” that psychological barriers are important (see graph 4 and 5 section 2.1.4). However, as we have mentioned, elements of the survey results clearly indicate the presence and the influence of psychological barriers (habits and apprehension of new system) in car purchase behaviour and purchase intentions.

- **Environmental barriers**: the questionnaire has revealed the presence of **doubts and scepticism about environmental advantages** of alternative vehicles from a few people; in particular, **the “true ecologists” prefer not to have a car and would rather use other way of transportation** than private car (bike, public transport, car-sharing...). So, if even the public of “green people” are not buying alternative cleaner cars, it is difficult to find a market segment for this category of cars...

- **Barriers by technology**: results have also revealed important differences between barriers for each technology. Indeed, it appears that **the hybrid is the only technology for which the economic barrier (the high price) is the most important one.** For electric vehicles, the problem of **limited range** appears to be by far the first barrier (technical barrier). For the LPG, The first category is the technical barriers. For all the alternative fuels except LPG, the **lack of fuel distribution is the first barrier (supply barrier).** **The fear of gas and the lack of confidence in safety concerning gas fuel (psychological barriers)** come generally in second position in the occurrence of frequency for nearly all gas fuel. For biofuel, the environmental and societal barriers ("ethical barriers") come in second position in the frequency of barriers mentioned. It is important to note that the number of barriers from different natures vary greatly according to the technology. It appears that for some vehicles, there are only a small number of barriers but which are very important. For other, there are many barriers but which are less important. The reader interested by these considerations should refer to the appendix 2.

We have to note that many of these barriers are linked to the supply-side of the market. Indeed, the short supply and lack of development may induce a lack of information and a lack of confidence about alternative vehicles. Also, the competition with conventional low emission cars is a market barrier also linked to the supply. Finally, economic and technical

barriers may partly decrease with an increase in production (economies of scale, learning effect...). So policy measures aiming at encouraging the supply-side of the market (availability of alternative fuels and alternative vehicles) would help to reduce a significant part of demand-side barriers. Of course, in the short run, those barriers slow down the introduction of new technology and prevent the supply itself from developing.

The survey has revealed that economic incentive is needed for encouraging people to use alternative vehicles. However, we have seen that it wouldn't be sufficient as non-economic barriers appear to be also an important brake to the purchase/use of alternative vehicles. This conclusion indicates the need for a mix of policy instruments (combination of policy instruments) that would act on the different categories of barriers.

## **2.2. Barriers to the introduction of alternative vehicles in private and public companies fleet: interviews results**

Fleets of vehicle represent an attractive market for alternative vehicles. Indeed, private and public company vehicles account for a significant part of the Belgian fleet (about 20% of the Belgian fleet and 49% of the matriculation of new vehicles in 2007)<sup>37</sup>. Moreover, fleets of vehicle are usually much more used in terms of kilometer per vehicle than private vehicles (about twice)<sup>38</sup>. Concerning public companies, they are also likely to make some extra effort in this field to set an example. Finally, in the case vehicles are fuelled at one or some fix points of location (e.g. bus), the company can install the alternative fuel infrastructure for its vehicles before the development of public infrastructures<sup>39</sup>.

While fleets of vehicle represent an interesting market for alternative vehicles, the position of Belgium concerning the percentage of clean vehicles (including conventional low-emission cars) in private company fleets is not exemplary. Indeed, according to the Corporate Vehicle Observatory Barometer (2008), the percentage of company using at least one alternative vehicle is the smallest in Belgium compared to the other countries of the survey<sup>40</sup>.

Barriers to the introduction of alternative vehicles in company fleets are expected not to be exactly the same as barriers for individual users; firstly, fleet managers have to deal with administrative and regulatory framework which may constitute barriers that do not exist for individual users. Secondly, fleet managers have the responsibility to satisfy a group of employees on the one hand and possible specific needs of the company on the other hand, which is not the case for private users.

However, fleet managers' behaviors are not homogenous and will depend on the type of company, its function and specific needs<sup>41</sup>. That's a reason why only a few studies are performed on this subject<sup>42</sup>.

This chapter is divided into 4 different sections. Firstly, a brief description of the sample and methodology for our interviews are given (section 2.2.1). In a second section (2.2.2), identified barriers to the introduction of alternative vehicles in fleets of vehicle in general (main trends of the interviews) are presented. This section contains barriers that have been mentioned by several fleet managers and can be considered as a summary of the third section. So, the third section present barriers by company or type of companies in more detailed (rough results). Finally, some elements of policy measures suggested by fleet managers to encourage the purchase of alternative vehicles for fleets of vehicle are given in the fourth and last section of the chapter. It has to be noted that some sections of the chapter are complemented by the results of the CVO Barometer survey (2008).

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<sup>37</sup> Personal calculation based on FEBIAC statistics; [www.febiac.be](http://www.febiac.be)

<sup>38</sup> National Survey of MOBEL (« La mobilité quotidienne des Belges »), 1998 in Conseil Central de l'Economie (CCE), 2007

<sup>39</sup> Nesbitt K. and Sperling D. (2000).

<sup>40</sup> The other considered countries are : Italy, Germany, Switzerland, France, Poland, Portugal, Czech Republic and Spain.

<sup>41</sup> Nesbitt K. and Sperling D. (2000).

<sup>42</sup> Idem

## 2.2.1. Sample and methodology

A sample of fleet managers from different companies and public administrations as well as taxi drivers has been interviewed. The sample includes fleet managers from a private company, 3 communes of Brussels, 2 police services from Brussels, the 5 public administrations concerned with “ordonnance air - ordonnantie lucht”<sup>43</sup> (STIB-MIVB, SIAMU-DBDMH, Bruxelles propreté-Net Brussel, IBGE-BIM, MRBC-MBHG), a federal public service, the Walloon region, the Flemish region and 2 taxi drivers. Of course, the purpose of these interviews was not to be representative of Belgian company’s fleet management concerning alternative vehicles, but to have an idea about main barriers through deep interview-discussions for various types of company.

All the interviews were done by phone during the second semester 2008, and took the form of a discussion about barriers to the introduction of alternative vehicles in the company fleet, future purchase intention and policy recommendations.

## 2.2.2. Barriers to the introduction of alternative vehicles in company fleets in general

This section resumes first the main barriers mentioned by most (or at least several) fleet managers interviewed (sub-section 2.2.2.1). It is complemented by results of the survey of the Corporate Vehicles Barometer, 2008 (sub-section 2.2.2.2).

### 2.2.2.1. Main barriers to the introduction of alternative vehicles in company fleets in general: our interviews’ results

This sub-section presents the interesting elements that came out from the interviews and which seem to reflect common barriers for fleet managers in general (main trends of the ideas coming out from the interviews). It can be considered as a summary of the next section (2.2.3).

#### **- Combination of economic, technical and supply barriers**

Every fleet manager and the taxis interviewed mentioned at first the **economic** barriers, combined with **technical problems or disadvantages (profitability and performance-price ratio)**. Moreover, they mentioned that the **supply of alternative vehicles (not enough models) is too short and/or the fuel distribution is lacking (all the infrastructures are dedicated to gasoline/diesel)**. So, fleet managers clearly expressed that it is the **combination of those different barriers that make alternative vehicles unattractive**.

#### **- No best option**

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<sup>43</sup> The “ordonnance air”-“ordonnantie lucht”, applied in the context of the evaluation and improvement of air quality in Brussels, constrained (through a decree) public administrations/companies with a fleet of more than 50 vehicles to reach 20% of vehicles considered as clean in 2008. Source: IBGE-BIM (2007). The decree is being modified concerning among other, re-definition of a clean vehicle according to new threshold of ecoscore (progressive threshold every year). Communes will probably be concerned from 2010. Source: IBGE-BIM (2007).

They also generally argue that there is no one alternative that comes out and which is satisfying (no best option). Only for some fleet managers, hybrid is mentioned as the only alternative which is technically mature, but which is too expensive.

**- Lack of information and too much uncertainties**

Some fleet managers mention that they are still too many uncertainties about the total cost, some technical questions and the viability of the different options. Some of them underlined also a lack of information and the contradictory nature of information about alternative vehicles (many controversies).

**- Fear of technical problems because of bad past experience**

Some administrations had **bad experiences** with electric cars some years ago (problems with batteries), but also with CNG and LPG that were not properly installed (technical problems). It generates a lack of confidence and discourages them to try again.

**- Various problems linked to short supply of alternative vehicles**

- Some fleet managers mentioned a practical and legislative barrier linked to the lack of supply: the problem with **public market legislation**. Every new purchase of vehicle is made according to the public market procedure. However, if a company wishes to buy a hybrid for example, it won't be legal if there is only one supplier, as competition is required for a public market procedure<sup>44</sup>. So here, the problem of short supply (supply barrier) is combined with a legislative barrier which may prevent the purchase of alternative vehicles.

- A lot of company cars are in leasing. This implies that fleet managers have to deal with **the vehicles available in leasing companies**. Those generally propose only hybrid vehicles (Toyota Prius) as alternative vehicle, which is again very expensive.

- **For intervention vehicles** (polices or SIAMU-DBDMH), **no convenient alternatives** exist up to now. Indeed, as the vehicle has to be powerful (fast and with a good range), there is no satisfying alternatives (even the hybrid is too heavy and not enough powerful).

**- Market barrier: diesel as major competitor**

**Diesel** appears again as a major competitor to alternative vehicles for several reasons: economic (in particular for private companies and taxi's), reason of supply (for example, vans exist only in diesel for some car brands), and because it is often considered as the best environmental option considering the current supply and the "environment-price ratio" (best compromise combining environment and economy). So, most administrations are planning to focus on low-emissions diesel car with particle filters to satisfy future environmental legislation. One stakeholder also mentioned that diesel engine is still improving. **More generally, the interviewed stakeholders are planning to buy conventional low-emission cars rather than alternative ones.** This is in line with the results of the Corporate Vehicle Observatory survey (2008) concerning private company fleets. Indeed, today clean vehicles used by private companies are mainly conventional low-consumption vehicles (15% of the

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<sup>44</sup> It has to be noted however that public administrations are often taking into account the environment in their public markets, and the criteria used is often the ecoscore.

interviewed companies affirm to have at least one clean vehicle and among those 15%, 10% affirm having at least one alternative vehicle). According to the companies surveyed by the CVO (2008), this proportion of alternative vehicles among vehicles considered as clean (1/3) is expected to be about the same in the short run.

**- Barriers are “upstream”**

It is important to note that most of the fleet managers interviewed consider that the problem don’t come from them but is “upstream”: they consider that the supply has to develop first, with means of policy measures. Only when the supply of alternative vehicles and fuels will be developed, technically mature and at a reasonable price, fleet managers wouldn’t hesitate to introduce them in their fleet.

2.2.2.2. Barriers to the introduction of alternative vehicles in company fleets in general: results of Corporate Vehicle Observatory survey (2008)

Next to our interviews results, it is interesting to give also the results of the Corporate Vehicle Observatory survey about barriers. This survey was concerning only private companies, but is probably also indicative of barriers faced by all companies with a fleet of vehicles. The survey sample counted 418 fleet managers. There were asked to evaluate the importance of a list of mentioned barriers presented on table 1.

**Tab. 1 : Discouraging motives to use clean vehicles: percentage of fleet managers of private company that consider the mentioned barriers as “definitely” discouraging (result of the CVO Barometer 2008)**

Restricted number of refueling points	39%
Models not adapted to the activity of the company	38%
Restricted number of garages able to maintain and repair those vehicles	27%
Higher purchase price	27%
Limited number of available models	22%
Lack of adapted supply of leasing companies	20%
The brakes (reserves) from drivers of the company to use those vehicles	9%

Source: Corporate Vehicle Observatory Barometer (2008)

So, we can see that pre-identified barriers proposed by the interviewers to fleet managers can be grouped in 3 categories: supply barriers, economic barriers and a barrier specific to fleet managers: the brakes (reserves) from drivers of the company to use those vehicles (for whatever reasons). Interestingly, we can observe that among those barriers, the most important ones appear to be in the category of supply barriers (barriers resulting from the short supply). Lack of refueling infrastructures seems to be the first barrier, follows by the lack of models adapted to the company and finally, the lack of services (maintenance and reparation). They are followed by economic barriers. Those results corroborate roughly our results.

### 2.2.3. Barriers to the introduction of alternative vehicles in company fleets by type of company/administration

In this section, barriers are presented by companies (or types of companies) in more detail than in the previous section. They are rather “gross” results of our interviews. In some cases, it includes also information about barriers by category of alternative vehicles. Such detailed information may be interesting for public authorities if they decide to draw up specific programs to remove barriers adapted to each stakeholder.

#### - Private companies

- The *fleet manager from the private company* interviewed had a 100% **diesel** fleet, and it seems to be (according to him) the general trend for private companies. Reasons are of course **economic**, as diesel is particularly attractive for long distance driven.

The **lack of information and the contradictory information** (there is no consensus) is an important barrier as well, as **uncertainties** about the environmental sustainability of alternatives, about technical questions (ex.: compatibility with conventional engine for some fuel), about life cycle costs etc. It is “**too risky and too soon for fleet managers to take such an initiative**”, and such an investment has to be justify and will be accepted only if it is financially profitable on the long run. More generally, “**fleet managers can not experiment "hazardous" alternatives and can't be considered as first actors**”. He insists that measures have to be taken “upstream”: fleet managers are waiting for development and diffusion (no one wants to be the initiator for testing the technologies). Nevertheless, they are really interested on this question and **wait for a reliable and financially attractive alternative** (they speak a lot about “green fleet”).

#### - Taxis

Taxis usually use **diesel** for **economic reasons**. They mention also the need of perfect reliability (must be resistant) and good performance (need to drive fast). About LPG, there is too many practical disadvantages (lack of refueling stations, problem of access to underground parking's...) and customers are also afraid of gas.

#### - Polices

The main problem is that there is **no convenient alternative for interventions vehicles** (see above). Other barriers are mainly **economic (short of budget)**. There is also a **lack of information** (one fleet manager mentioned that he was a policeman not specialized in environmental alternatives, but he was open to alternative vehicles and was planning to work with a consultant centre for analyzing the best options). However, for the "police of proximity", electric vehicles could be a good option for the future.

#### - Communes

The main barrier is **economic (short of budget)**.



**Political and administrative barriers** have been also mentioned, as the purchase decision must be approved by the college, the financial services etc. Communication between the different services is quite important. Also, it seems –according to some respondents- that the presence of alternative vehicles in the fleet of communes depends on the political color of the political representatives in the commune.

**The lack of availability of alternative vehicles in the supply of important distributors (brands)** is also a barrier.

It has to be noted that one commune has bought 14 LPG vehicles and one hybrid in 2006 with the help of subsidies<sup>45</sup> offered by IBGE-BIM at that time (they answered to a call for project). They wanted also LPG vans, but it was not possible as there are only diesel vans (supply barrier). The only problem mentioned with **LPG** from this commune is the **restricted number of refueling stations**.

Another commune had a **CNG** transformed van and the recharging infrastructure but they had a **lot of problems**:

- Technical barriers:

- Long recharging time (12 h)
- Recharging at night but it is noisy (and because they didn't know it, the infrastructure is installed next to houses)
- The range is very limited (30 to 50 km)

- Economic barrier:

- High maintenance expenditures because of technical problems (it was badly installed).

They have also an **LPG** transformed vehicle because they evaluated that it was profitable from a certain number of km driven. The only problem is that there is **no refueling station in their commune (supply barrier)**.

They own also one **electric vehicle** for small distance for the “green image”; however, it was not economically interesting because they had to change the batteries after 4 years and it would have been more profitable to buy a diesel. So they decided **to keep it for the “green image”** and also for some advantages of the vehicle: silent, easy to use, no local pollution... so in this case, the economic barrier was overcome by other advantages.

- **Federal public services**<sup>46</sup>

The Federal Public Services have the possibility to command an LPG vehicle, but it is hardly ever used.

Up to now there haven't been public markets for alternative vehicles. But even if there was a demand, **the supply is currently insufficient for a public market** (supply and legislative barrier).

- **Administrations concerned with “Ordonnance Air-Ordonnantie Lucht”**

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<sup>45</sup> 2000 EUR for an LPG transformation and 10.000 EUR for the Prius

<sup>46</sup> It has to be noted that a circular is in project that would impose more points given for environment in public market, based on the ecoscore (with derogation when needed).

Most barriers have been mentioned above (see general barriers).

Those administrations have tested some alternatives but usually it was not very successful:

- **Electric vehicles:**

- Economic barrier: too expensive (the vehicle and the cost of battery replacement)

- Technical barriers:

- Limited range (some employees didn't like it and they were worry to break down)
- Too much maintenance needed
- Dead batteries (very soon)

Finally some administrations replaced their electric vehicles by small conventional vehicles. However, some have electric scooters.

- **CNG used by the STIB-MIVB (first generation of CNG buses):**

- Technical barriers: various technical problems

- Supply barriers: There is also the problem of infrastructure as it needs a lot of space, it has to respect strict safety rules, it is very expensive and for the moment there is only one at Haren which is insufficient.

However, the STIB-MIVB is planning to buy about 70 new CNG buses and the extra cost would be born by regional authorities.

Another administration mentions that they don't want to try CNG because of bad experiences of several cities (like in Anvers, according to one administration):

- Technical barriers:

- Various technical problems
- Need to regulate finely the engine according to the gas quality
- Tank heavy and cumbersome

- Psychological barrier:

- Fear of gas

- Economic barrier

- High cost

- **LPG**: some administrations have LPG transformed vehicles but they usually ride with gasoline because of technical problems.

- Technical barriers:

- Some of the vehicles were actually not adapted for LPG (the cylinder head was not reinforced), which implies various problems; for example, drivers had to fill in the tank with lubricant but they usually forgot it.

- Psychological barrier:

- They consider that it is also more difficult and dangerous to refuel with LPG: the personnel are not used to it and are afraid of gas.

Others mentioned also about LPG:

- Supply barrier:

- The problem of lack of LPG refueling stations

- Technical barriers:

- The lack of power

- Problem of access in underground parking (they even can not go in their own parking)
- Environmental barrier:
- The benefit in terms of CO<sub>2</sub> is not so good
- **Hybrid**: No specific problem is mentioned except the price which is too high (economic barrier).

Those administrations are thinking not to buy again gas (LPG and CNG) because of these bad experiences and they have generally decided to orient their fleet towards low-emissions diesel vehicles with particle filters (rather than alternative vehicles) to respond to environmental legislation. Fleet managers from some administrations mentioned also that they will or do rather choose leasing vehicles instead of buying them (it seems to be the trend).

It has to be noted that the MRBC-MBHG had to respect a circular in which a certain percentage of gas vehicles was required. Now it has been modified to allow for diesel vehicles.

#### **- The Walloon region**

It follows the same trend that Brussels public companies. The main barriers mentioned are: the price and the uncertainties about life cycle cost, as well as the short supply.

They had experience with **electric vehicles** but they find them extremely expensive relative to their small size (economic barrier). The **Prius** is also too expensive (economic barrier). About **LPG**, they consider that there are too many disadvantages: less station and need for pump assistant (supply barrier); limited space (technical barrier); problem of access to underground parking's (technical barrier) etc.

#### **- The Flemish region**

They have some **Prius** and there are satisfied but the price is too high (economic barrier). They don't have gas (they haven't thought about it). The barrier mentioned is mainly the lack of choice.

The current "ordonnantie" for the Flemish region doesn't include environmental criteria (even if it is taken into account in public market), but the new one will fix a minimum ecoscore for every vehicle.

### **2.2.4. Measures suggested by fleet managers**

In this section, the types of measure mentioned by the fleet managers that would encourage them to introduce alternative vehicles in their fleet are given in the first sub-section 2.2.4.1 (results of our interviews). It is complemented by results from the survey of the Corporate Vehicles Barometer, 2008 (sub-section 2.2.4.2).

2.2.4.1. Type of measure to encourage the introduction of alternative vehicles in fleets of vehicle: results from our interviews

- **Economic measures:** most of the fleet managers interviewed mentioned that subsidies would encourage them to buy alternative vehicles.
- **Measures aiming at increasing the supply** are also often mentioned, like for example:
  - Developing the supply of alternative vehicles in leasing companies (with tax incentives for example)
  - Developing recharging/refueling stations. For example, public authorities could invest in public recharging and refueling stations (to encourage the private and show the example).
  - Various incentives to develop the supply of alternative vehicles in general, and in particular of electric vehicle (as other categories of alternative vehicles are according to one fleet manager, not sustainable).
- **Technical improvement:** Some of the fleet managers mentioned that technical problems should be first solved (R&D...).
- The possibility to **make an essay** with different alternatives to see how it works and evaluate the total cost is also a suggestion mentioned by some fleet managers.

2.2.4.2. Type of measures to encourage introduction of alternative vehicles in fleets of vehicle: results from Corporate Vehicle Observatory survey (2008)

Next to the examples of measures mentioned by fleet managers during our interviews, it is interesting to complement them with the results of the Corporate Vehicle Observatory survey (see sub-section 2.2.2.2 for information about the sample of this survey). Fleet managers interviewed by the CVO were asked to evaluate the importance of a list of mentioned measures that would encourage them to introduce alternative vehicles in their fleet. The proposed drivers are presented on table 2.

**Tab. 2 : Measures that would encourage the purchase/use of alternative vehicles in fleets of vehicle: percentage of fleet managers of private company that consider the mentioned measures as “definitely” encouraging (result of the CVO Barometer 2008)**

A fiscal incentive for company to use those vehicles	54%
A guarantee from the vehicle makers longer for alternative vehicles than for conventional vehicles	37%
Higher taxes on polluting vehicles	34%
Better information on the global utilization cost of those vehicles	30%
A better technical information on those vehicles	25%
The support of a leasing society in case of technical problems	14%

Source: Corporate Vehicle Observatory Barometer (2008)

We can observe that the fiscal incentive (economic measure) is the most successful policy for respondents of this survey. A longer guarantee for those vehicles seems also to be an interesting measures, which can indicate the lack of confidence in reliability and the apprehension of new systems from fleet managers (similarly to individual users). Fiscal

incentives for cleaner vehicles could be combined with higher taxes on more polluting vehicles (as it appears to be also a possible driver).

### 2.2.5. Conclusion of the fleet managers' interviews

A lot of barriers to the introduction of alternative vehicles in fleets of vehicle are the same as for the individual consumers. Main barriers are supply-side barriers (lack of supply of vehicles and lack of refueling stations), economic barriers, technical and market barriers.

However, some new elements and some particular barriers came out from the interviews. *Firstly*, interviews have revealed clearly that it is the **combination of several barriers** (supply, economic, technical and market) that make alternative vehicles particularly unattractive (except the hybrid, for which the main barrier is economic). *Secondly*, bad experiences (technical problems) with some types of vehicles (like electric, CNG and LPG vehicles) imply a **lack of confidence** in those vehicles. Policy measures should aim at restoring confidence in those vehicles, and maybe could encourage R&D to ensure vehicles **technical reliability**. Also, the existence of many **uncertainties** (about total cost, technical reliability, viability of the different options, etc.) implies that **more and better information is needed**, together with other measures like for example the possibility to make an essay. *Thirdly and importantly*, **the short supply creates sometimes the impossibility for companies to buy or to lease alternative vehicles**. Indeed, **public market legislation** prevents the purchase of a vehicle if there is no competition between several vehicle makers. Also, the **lack of supply of alternative vehicles in leasing companies** and the **inexistence of alternative for intervention vehicles or vans limit greatly the development of alternative vehicles in vehicles fleet**. In this case, barriers come not from the companies but from the supply-side of the market.

We also notice that **the trend is to use diesel low-emission vehicles with particle filter and more generally conventional low-emission vehicles rather than alternative vehicles**.

Fleet managers have an important responsibility and often mentioned that it is difficult to justify an extra-investment for vehicles that are less reliable, with less refueling stations etc. this implies a need either for an economic incentives possibly combined with a constraining legislation (to oblige company to have a certain percentage of alternative vehicles in fleets of vehicle) either to focus on policy measures aiming at developing (qualitatively and quantitatively) the supply (of vehicles and of the fuel). A mix of these different policies would probably give the best results.

## **2.3. Barriers to the supply of alternative vehicles from the supply-side stakeholders point of view: interviews results**

As we have seen in the first two chapters, the short supply of alternative vehicles and fuels appear to be an important barrier for demand-side stakeholders. The purpose of this chapter is to understand barriers faced by the supply-side of the market through results from the consultation of supply-side stakeholders.

This chapter is divided into 6 sections. The first section gives some methodological elements concerning the interviews and describes the sample. The second section summarizes the results of the interviews concerning barriers to the supply of alternative vehicles in general (without distinction between the different categories of alternative vehicles). Some policy measures recommended by the stakeholders to overcome those barriers are addressed in the third section. Barriers to the supply by category of alternative vehicles as well as possible policy measures to overcome them are treated in a fourth section. In a fifth section, the types of alternative vehicle that would be most easily introduced in the Belgian market according to the supply-side stakeholders are discussed. The sixth and last section concludes the chapter.

Note that supply-side stakeholders provided us with a lot and detailed information about barriers and policy recommendations. In particular, the fourth section 2.3.4 (about barriers and policy recommendations by category of alternative vehicles) goes in much detail as concerned supply-side stakeholders are facing a lot of precise barriers. We decided that it was important to keep this detailed information as it is interesting for possible policy measures aiming at promoting one specific category of alternative vehicle. However, for a quick reading, we recommend the reader to rather focus on the other sections of this chapter, and to read the section 2.3.4 only in case of a special interest about barriers to specific categories of alternative vehicles.

### **2.3.1. Sample and methodology**

#### ***- Structure of the questionnaire***

A detailed questionnaire (see in annexe) has been drawn for the supply side stakeholders (which is the same for the experts). The questionnaire was composed of 3 main parts. The thematic and structure of the different parts of the questionnaire were the following:

I. General questions (mainly open questions) about:

- Barriers to the supply of alternative vehicles/fuels (in general and by technology)
- Measures suggested for stimulating alternative vehicles diffusion
- Type of clean vehicles better adapted to the Belgian market

II. Evaluation of the importance of barriers to the development of alternative vehicles in general (pre-identified barriers and “new” barriers identified by the respondent)

III. Evaluation of the importance of barriers specific to the development of the different categories of alternative vehicle (pre-identified barriers and “new” barriers identified by the respondent)

The “supply-side” stakeholders could answer only to the parts relative to one specific category of alternative vehicles according to their special field. They could choose also to

answer only one (or some) of the 3 parts of the questionnaire. In a few cases, the respondents only answered to the general open question about barriers.

### **- Sample and way of consultation**

A sample of 20 stakeholders from the supply-side of the market has been interviewed. This has allowed for **in-dept interview-discussions**. Most interviews were face-to-face, but also sometimes by phone or by e-mail or post-mail (according to the respondent preference and availability). The consultation took place through the year 2008.

The sample includes 2 stakeholders' group: the first one is concerned with alternative vehicles in general and the second one is concerned only with a specific category of alternative.

- a) The first group includes: the ACEA and FEBIAC which are federations of vehicle makers, Federauto (which is a confederation of cars trade and reparation sectors and other related sectors), three vehicle dealers (Citroën, Volvo trucks and D'Ieteren) and a salesman of second-hand vehicles.
- b) The second group includes: Toyota (hybrid vehicles), Saab (E85 vehicles), a biofuel producer, Biowanze (bio-ethanol factory), the Belgian Petroleum Federation (concerned with biofuels), Octa + (fuel distributor concerned with E85), the Reva importer and mechanic (electric vehicles), an LPG fitter, Drive systems (LPG-CNG), Primagaz (LPG), Totalgaz (LPG) and BMW (hydrogen).

**Although the results from the consultation of the second group of stakeholders are mainly presented in the point 2.3.3 (barriers by category of alternative vehicles), some of them had sometimes opinions on barriers in general that have been included in the point 2.3.2 (barriers in general).**

### **- Treatment of the information**

All the information coming from the interviews (or filled-in questionnaires) were treated in a qualitative way, as quantitative analysis had no sense with such a small sample. Results presented in the next sections summarize the main ideas that come out from the interview, as well as new and interesting ideas that emerge. This means that **every barrier mentioned in this chapter were not necessarily mentioned by all the stakeholders.**

**Barriers have been classified and presented by category** according to their nature (see first part of the report).

It has also to be noted that all what is written in this part **do not reflect personal opinion of the authors**, but resume all the ideas that were mentioned by one or several supply-side stakeholders.

## **2.3.2. Barriers to the supply of alternative vehicles in general**

This section summarized what has been mentioned by supply-side stakeholders concerning barriers to the development of alternative vehicles in general.

It comes out from the interviews that vehicle makers meet several important brakes that prevent them to develop massively and commercialize alternative vehicles in general. Those

barriers are mentioned and explained in this section. As we will see, many of the barriers are related to the demand, as vehicle makers expect no or little demand for alternative vehicles for several reasons. Many of those reasons (mentioned here below) correspond to the results mentioned by demand-side stakeholders.

1. **Economic barriers:** the **higher cost** of alternative vehicles implies a non-acceptable price for consumers. At this price, the demand would be too weak and would not compensate investments. It was also mentioned that fossil fuel costs were not high enough to encourage consumers (and thus vehicle makers) to look for alternatives. So it is not yet financially interesting enough to develop them massively (and public helps are not yet enough). One stakeholder mentioned also that financial resource for investment is limited because of current economic context (increase of steel price, of oil and of the Euro) and also more recently because of the economic crisis.

2. **Technical barriers:** some alternatives are not yet mature or/and have too many **disadvantages** compared to fossil fuel cars.

It has to be noted that in general stakeholders agreed that economic and technical barriers will decrease with development (thanks to economies of scale, learning effects...).

3. **Market barriers:** for these two reasons (1 and 2), alternative vehicles are at the moment **not competitive** relative to conventional cars, it is thus unlikely that the demand for those vehicles will compensate the important investments needed. Moreover, some vehicle makers mentioned the other following **demand-side barriers:** firstly, the consumer's have habits, and have apprehension concerning new systems (psychological barriers). Secondly, there is a lack of information among the consumers about alternative vehicles. Finally, one vehicle distributor mentioned that the current demand trend goes at the opposite side of the alternative vehicles characteristics: consumers are asking for more and more comfort and options, with the possibility to drive long distances etc. and at acceptable costs. Such requirements are not compatible with the characteristics of most alternative vehicles.

Importantly, today strategy of most vehicle makers is to **focus on improvement of conventional fossil fuel cars - diesel car in particular** - in terms of efficiency and reduction of emissions. Indeed, supply-side stakeholders mentioned that it allows for reduction of emissions while maintaining a reasonable price (technology has been developed for years), offers the same comfort, implies the same habits for consumers, etc.

4. **Supply-side market barriers:** the **fuel availability** is a big problem for vehicle makers to develop alternative vehicles. Indeed, if there would be alternative fuels distribution, it would be an impulse for the car industry to develop and commercialise alternative vehicles ("chicken and eggs" problem).

5. **Environmental and societal barrier (linked to market and political barriers):** supply-side stakeholders mentioned that there are too **many possible alternatives and too many uncertainties about the future of each technology**. It is too risky to invest a lot in a complex and costly technology, to train workers etc. if they have to abandon it some years later (in case we realise that it is not such a good environmental option). For example, biofuel was presented as a very good solution some years ago, and now it is highly debated. Also, there are a lot of controversies about the environmental benefits of hydrogen, hybrid, and electric cars since electricity is not produced with renewable energy. Some vehicle makers consider



that there are pushed to go too fast, as there is still a need for more R&D and for a clearer message about good and bad environmental options.

**6. Political and legislative barriers:** the barriers mentioned above could be reduced with policy measures. However, stakeholders mentioned very often a lack of appropriate policy measures.

Firstly, as alternatives are not yet competitive, there is a **need to create incentives for consumers**. However, **today tax system is inappropriate** as it is not linked to environmental criteria.

Secondly and more generally, there is a **lack of clear, well-defined and harmonised policy** to encourage development of cleaner cars. Heterogeneity of legislation (between countries and inside Belgium) is a major problem for vehicle makers. For example, there is a difference in Flanders where the criteria used for policy measures is based on the Ecoscore and in Wallonia where it is based on CO<sub>2</sub> emissions. Policies should be harmonised at Belgian but also at European level (and ideally at global level). In the same line, there are too many **uncertainties about long-term policies and legislation**. For those reasons, **vehicle makers are unable to define a strategy**.

Thirdly and in the same line, there is a **lack of clear policy for the introduction and the promotion of alternative fuel**, which would overcome the barrier of fuel availability and give a positive signal to the industry to bring corresponding alternative vehicles on the market.

Finally, there is a **need for supporting R&D**, which would allow for a clear and long-term message from policy makers about the alternatives that have to be promoted.

It has to be noted however that some stakeholders have insisted on the fact that financial supports in general should be technologically neutral (based on environmental criteria rather than technology-based).

Uncertainties about public support and promotion are thus an important brake for vehicle makers. Note that those uncertainties are reinforced by a lack of confidence because of past lack of political support and because of changing message through time. Indeed, for example, one interviewed evoke a kind of **“frustration” from the automobile sector** resulting from the evolution of policies: in the 80<sup>th</sup>, vehicle makers were solicited to reduce harmful gas like CO. Thus they developed systems where the CO was combined with O<sub>2</sub> to emit only CO<sub>2</sub> (at this time we didn't speak much about CO<sub>2</sub> and GHG emissions). That was the first phase of the “ecological move”. Now we are in the second phase in which the focus is on CO<sub>2</sub> reduction. Moreover, at the time, environmental initiatives proposed by the industry were not well received (lack of interest from politics, public and media). So they abandoned them and have developed other models. And now, they are pushed to take measures very quickly...

## **7. Institutional barriers**

Some stakeholders mentioned the presence of a **lobby** against the development of alternative fuels from **oil companies** on the one hand, but also from some **environmental NGO's and associations on the other hand against some category of alternative vehicles because the environmental benefits are contested** (cf. Biofuel for example). It seems to exist also a

lobbying in favour of diesel development from the diesel automobile industry, particularly at European level, which can have an indirect impact on alternative vehicles development. Some stakeholders admit that **there is a lobbying from some vehicle makers against constraining measures or environmental objectives** (that could indirectly enhance the development of alternative vehicles), **in particular if the objectives are too ambitious for the time horizon proposed**<sup>47</sup>. However, there is no lobbying against alternative vehicles in general and in the long-run as it represents an opportunity for the automobile industry.

Some observations about the interviews can still be mentioned:

- **The interviewed stakeholders have often various opinions about the different alternatives. Every car brand seems to develop its own strategy**, following what they think to be the option of the future. **The strategies they will generally choose seem also to depend on what is easier for them to develop, according to their current supply. Symmetrically, they often criticized other options.** For example, some car brands that are mainly focusing on diesel are very critical about LPG.
- One interviewed expressed a **feeling of unfairness related to the eagerness on the automobile sector** about environment while the residential sector is even more responsible for GHG emissions.
- Another interviewed argued that there is a lack of coherence in policy, and that it makes no sense to start with alternative vehicles development while some other policies are missing; for example, we should first focus on rearranging the infrastructure (fewer traffic lights), encouraging teleworking, developing tramways, etc.

### **2.3.3. Measures suggested by the supply-side stakeholders to overcome barriers in general**

This section summarises policy measures suggested by the supply-side stakeholders for overcoming barriers to the development of alternative vehicles in general.

#### **In general**

- Need for **harmonisation (inside regions of Belgium and between European countries) and clear and long-term policies**. Those points are imperative for allowing vehicle makers to define a strategy, to reduce costs, uncertainties and make sustainable decisions.
- Some vehicle makers suggested that incentives for the industry should be “technologically neutral”. However, it has been mentioned by one vehicle maker that policy encouragement that would be applied to too many models would discourage R&D. This can indicate that the opinion inside the automobile industry may sometimes differ (and seem to depend on the type of supply of the vehicle maker, i.e. if they propose already an alternative vehicle or not).
- It was suggested from some vehicle makers that measures in general should concern the whole park and not only new vehicles.

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<sup>47</sup> See the European objectives on CO<sub>2</sub> reduction for the automobile industry and the pressure from German vehicle makers to reduce those objectives (EURACTIV 22/01/07)

### Legislative measure: a new fiscal system

- Most vehicle makers (and federations) suggested **an automobile tax system based on simple environmental criteria, combined with an incentive to change old polluting cars to new less polluting cars. At European level, the automobile industry proposes a tax system based on CO<sub>2</sub> emissions for vehicles and fuel.** In their opinion, this taxation must be linear and not progressive, and of course harmonised between countries. However, a vehicle maker was rather in favour of a premium at the purchase rather than “delay incentive” like tax incentives. This difference indicates again **that the position may differ inside the automobile industry.**

### Economic (and supportive) measures

- To support **R&D** with subsidies.

- Some vehicle makers suggest a **clearer support to alternative fuels for which the technology already exist, like biofuel (high blend) and CNG<sup>48</sup>.** The government has to **ensure the supply of fuel** along with making the vehicle fiscally attractive.

### Diverse non-economic measures

- **The introduction of alternative vehicles in public fleets** would be a first step: it would encourage the industry as it offers to vehicle makers the guarantee of a market on the one hand, and is a good way to educate society by setting an example on the other hand.

- **To educate the public about alternative vehicles (training, school, academics...).**

- Creation of **environmental zones, etc.**

Remark: some stakeholders insisted on encouraging eco-driving, and suggest often to take other measures to reduce pollution rather than focusing on alternative vehicles. It may for example consist in modifying the structure of the city (less traffic lights...) etc.

## **2.3.4. Barriers to the supply of alternative vehicles by category of alternative**

In this section the results of the supply-side stakeholder’s consultation concerning barriers to the development of specific category of alternative vehicles are presented. This may be of high interest at the moment to design policy programs adapted to each category of alternative. The content mainly comes from stakeholders that are concerned only with a specific category of alternative. However, the barriers mentioned are often complemented by the opinion of general supply-side stakeholders (which are not concerned with one specific alternative) about barriers to specific category of alternative vehicles (reasons why they don’t develop each alternative).

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<sup>48</sup> No mention is made about LPG among vehicle makers we interviewed.

For every category of alternative vehicle, barriers are firstly mentioned and are sometimes followed by specific policy measures suggested by the stakeholders concerned with the specific category of alternative (however it is not always the case because for some categories of vehicles, the suggested measures are more general - cf. above - or because stakeholders of a specific technology haven't been interviewed – cf. fuel cells and hydrogen).

As a reminder, barriers (and suggested policy measures) are those mentioned by the concerned supply-side stakeholders, without any modification so as to have really the perceived barriers from the supply-side stakeholders' point of view.

#### 2.3.4.1. Hybrid vehicle

##### **2.3.4.1.1. Barrier to the development of hybrid vehicles**

1. **Economic barrier:** the **extra-cost** (because of the battery), not acceptable for a large public, is the first barrier. Also, it is difficult for the consumer to evaluate the saving on fuel consumption when using a hybrid (compared with a classic car).
2. **Technical barriers:** some technical barriers exist, like the question of reliability and performance of the batteries, their weight, the space taken by the batteries, or some technical difficulties to develop hybrid-diesel vehicles. Most of these barriers can be solved but it will take time.
3. **Market barrier: diesel** is a major competitor for alternative vehicles because it is fiscally encouraged, it is seen as better than gasoline because of less CO<sub>2</sub> emissions, and it is now widely spread in Belgium and in Europe. According to the interviewed stakeholder, gasoline hybrids are well developed in the US because they don't have Diesel.
4. **Supply-related market barrier: lack of available models:** there are not a lot of different models of hybrid vehicles in Europe up to now. There are only a few very luxurious cars and the Prius since 1997. The problem is the **space needed for the batteries, which implies that small vehicles are very loaded** (but this can evolve with new generation of batteries). Also, the **design** of the Prius is rather special and is not appreciated by every one.
5. **Demand side market barrier:** there is a **lack of information** of the consumer about hybrid vehicles. Something which contributes to the diffusion of bad information is “ethic pollution” or “greenwashing” from some “non ethical” vehicle makers using the term “hybrid” even when it is not a “true” hybrid. For example, the stakeholder interviewed argued that some so called “micro-hybrids” were not “true” hybrid vehicles but vehicles with a system similar to the system start & stop; in this case the word “hybrid” has only been used for marketing and can generate wrong information or scepticism from the consumer about “true” hybrids.
6. **Legislative barrier:** there is a refund (premium) of 15 % on vehicles which emit less than 105 g of CO<sub>2</sub>/km (the Honda Civic has a reduction of 3 % on the purchase price because the emissions are more than 105 g of CO<sub>2</sub>/km and less than 115 g of CO<sub>2</sub>/km). An important barrier is that **this advantage do not apply for company cars** (so it is still too expensive for companies) **and in the second-hand cars market**.

7. **Environmental and societal barrier (linked to market and political barrier)**: more generally, some vehicles makers decided not to develop hybrid because of the **fear to invest in such a complex and costly technology if it is only temporary (uncertainties about the future)**. Some also underlined that **environmental benefits of hybrids are sometimes not so important** and depend on the type of hybrid and the type of use (cf. No or little benefits on motorway). They sometimes underlined that small diesel can be better than currently developed hybrid vehicles.

#### 2.3.4.1.2. Suggested measures to overcome barriers to the development of hybrids

##### *Economic measures*

- **Coherent policy about purchase incentives**: the **purchase incentive** (for cleaner vehicles in general) must be (a) financially **significant** (minimum 15% of the purchase price) and (b) **immediate**: reduction obtained directly on the invoice at the moment of purchase. Policies based on postpone or **delay incentives (like future tax reduction) must be avoided**. Also, **policy encouragement that would be applied to too many models would discourage R&D**.

- **Incentive policy applied to the whole life cycle of the vehicle**: incentives must be applied also in the **second-hand market** (following the example of the "Eco-Bonus" of the Wallonia region which applies to new and second-hand vehicles).

- **Incentive policy applied to the different segments of sale, like the fleet vehicles**. Indeed, it is still too expensive for companies to lease or to buy hybrids. Purchase incentives related to cleaner company cars are not yet sufficient. The current refund allowed to the individual user (when purchasing a clean car) should be applied also to companies.

- **A policy linked to the family situation should exist**: families with a lot of children need to purchase a mono volume. However, those would always emit more than a small car. As a consequence, it doesn't exist in Belgium incentives to choose the less polluting mono volume as there are all considered as pollutant. This problem doesn't encourage vehicle makers to develop a supply of hybrid mono volumes on Belgian market. But a policy linked only to the size or the weight is also to proscribe because it would not encourage people to continue to buy lighter vehicles.

##### *Non economic measures*

- **Protection of the hybrid concept**. Public authorities should protect the "hybrid" appellation (read above).

- Beside economic incentives, other policies are needed (like environmental zones for cleaner cars etc.).

#### 2.3.4.2. Electric vehicles

##### 2.3.4.2.1. Barriers to the development of electric vehicles

1. **Demand-side barrier: psychological barrier:** A very important barrier to electric vehicles development is related with **mentalities**. Indeed, the car is charged with emotions: for many, it is a symbol (of freedom...), it represents social status etc; people have also a precise idea of what is a car and how it should be (it has to be spacious, fast, etc.). The Reva (which is at the time of the study, the only electrical car proposed in Belgium) represent the “anti-car” as it small, not aggressive, silent, with a limited range etc.

2. **Some technical disadvantages can be mentioned, but are considered by the stakeholder interviewed as psychological barriers:**

- The **limited range** is an important barrier. However, for some consumers, the fear of limited range can be psychological and can correspond to a non-rational behaviour. Indeed, families have often two cars with one used mainly inside the city to drive small distances (which do not require an important range).

- The maintenance of the batteries (which are fragile) requires some new habits, like filling a tank with distilled water (more or less every 10 days) and to avoid driving with empty batteries because it can get broken.

- The long recharging time can also be perceived as a problem.

3. **Technical barrier:** a garage is needed or a place to recharge the batteries.

4. **Supply-related market barrier: lack of supply of electric vehicles** (quantitative and qualitative). This short supply implies a short number of after-sales and maintenance services. The lack of public recharging stations is also mentioned.

5. **Economic barrier: high purchase price** for a small car as well as the short life cycle of current batteries (replacement every 3, 4 years) and their high price.

6. **Political and institutional barriers:**

- **Lack of coherent and voluntary support from public authorities.** Example: the reduction offered by the federal government on low-emission vehicles does not apply to electric vehicles because those are considered as “quadricycles” and not as vehicles. Electric vehicle has currently a “double” competitive disadvantage as it is more expensive and it does not receive the reduction.

- **Conflicts of interest and various lobbies (from socio-economic groups),** as the passage to electric cars implies a **change of socio-economic “paradigm”**. It has also to be noted that the electric vehicle need much less maintenance than conventional cars. That can be a problem for maintenance services benefits.

7. **Market barriers:** more generally, vehicle makers do not develop electric vehicles because of the batteries limited capacities which make electric vehicle **not competitive with conventional cars (in terms of space, range, speed and cost)**. They are **waiting** for the new generation of batteries.

8. **Environmental barrier:** some vehicle makers mentioned also that it makes no sense to develop electric cars since most of the electricity is not (yet) produced with renewable energy in Belgium (**uncertainties about the viability of this option**).

#### 2.3.4.2.2. Suggested measures to overcome barriers to the development of electric vehicles

There is a need for a **coherent and voluntary support from public authorities:**

- Tax system: need to tax more polluting vehicles and make electric vehicles free of tax

→ Need for a significant financial advantage in terms of cost/km.

- Apply the federal premium (refund) to electric vehicles also.

- Take the example of Norway:

- Tax exemption (no registration tax and no VAT on electric cars)
- Electric cars can ride on bus zones (environmental zone)
- Free parking, public recharging stations etc.

- Need to give more and better information to the consumers about the advantages (less maintenance needed etc.)

#### 2.3.4.3. Barriers to the development of fuel cell vehicles

Remark: the number of mentioned barriers to fuel cells and hydrogen vehicles is small (i.e. often the same barriers are mentioned) but each of them is particularly important. This is because the technology is still in its infancy and it is still in process of development. Other more "practical" barriers will emerge at the moment of possible commercialisation. Most of the interviewed planned their market introduction for about 2020. No stakeholder specifically linked with this technology has been interviewed.

1. **Economic barrier**: cost still too high to be commercialised at large scale.

2. **Technical barrier**: not yet technically mature (problem of space, weight...).

3. **Supply-related market barrier**: importantly, the availability of hydrogen is too uncertain on the short run and there are numerous challenges linked to hydrogen production and distribution (see below).

#### 2.3.4.4. Barriers to the development of hydrogen vehicles

1. **Supply-related market barrier**: the uncertainties about the sustainability and the availability of the fuel impede the introduction of hydrogen cars on the market.

2. **Environmental barrier**: those uncertainties concerning the fuel are related to the important controversies about its environmental benefits. There are many debates about the source of energy that must be used to produce hydrogen (need for renewable energy...), and about the way of producing it.

3. **Economic barrier**: Important production cost and high cost of infrastructures (need for supporting measures).

4. **Demand side barrier (psychological barrier)**: fear of explosion.

### 2.3.4.5. LPG vehicles

#### 2.3.4.5.1. Barriers to the development of LPG vehicles<sup>49</sup>

1. **Legislative barriers: Diesel is the most important competitor of LPG because it has a fiscal advantage (less excises).** This generates other barriers mentioned below (point 2). **Moreover, there is an added circulation tax for LPG vehicles,** which, even if it's quite low in itself, represents a psychological barrier for people. So, tax systems on fuel and circulation tax are **inappropriate** to encourage LPG vehicles development.

2. **The important development of diesel vehicles in Belgium (and in Europe) appears to generate important market and institutional barriers to LPG development:**

- **Market barriers:** more than half of the Belgian park is composed of **Diesel** cars (54,5% in 2007)<sup>50</sup>. This can be considered as a barrier to LPG vehicles development as an LPG system makes sense on gasoline car but not on diesel car, which reduces the number of possible transformations.

- **Institutional barrier:** as a consequence, some vehicle makers are not interested in LPG because of the spread of diesel cars. Therefore, some vehicle makers do not support LPG. According to LPG stakeholders, there is an important **lobbying** in favour of diesel and indirectly against LPG from some vehicle makers on the European market.

3. **Political barrier:** there is **not enough promotion from the government** in favour of LPG, so there is **no message about the societal/environmental benefits of LPG to the consumers.** Also, there is **no financial incentive** for LPG installation; indeed, the premium (refund) that existed before (in 2001-2002) has been cancelled. However, this incentive, combined with a public advertisement about the LPG benefits, was very effective: at the time, the utilisation of LPG vehicles increased, but then decreased as soon as the premium was suppressed.

4. **Market barriers:**

- As a consequence of lack of promotion, there is an important **lack of awareness/information of the consumers about the LPG and its advantages.**

- **Leasing companies don't propose LPG,** which reduce significantly their development in fleets of vehicles.

5. **Psychological barriers:** in addition to the lack of information, there is a **bad perception** (bad image) of LPG, which is often perceived as an old system, with an impression of "dirtiness", and sometimes considered as the "fuel of the poor". Additionally, the **fear of gas,** associated with explosion, increase the psychological barriers. Finally, as all the LPG fitters are not reliable, bad adjustment can happen implying that some people experienced technical problems (which reinforce bad image).

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<sup>49</sup> It has to be note that in some countries like Italy or Poland, the LPG is quite well-developed.

<sup>50</sup> Source : FEBIAC statistics



To summarize those points and according to the stakeholders, the causality relations between barriers are the following: inappropriate tax system → diesel development → lobbying → lack of political motivation/support for LPG → lack of information and prejudice of the population about LPG.

#### **6. Supply-related market barrier:**

- The **reduced number of refuelling stations** is also a barrier. The interdiction to refuel in station without a pump assistant is a problem (according to some stakeholders, there is no such interdiction in other countries) as it reduces much the availability of refuelling points. Also, there is no station in the city centre for safety reasons.

- **The lack of dedicated LPG vehicles**, implying an additional step for consumers to make the transformation is of course a barrier. Moreover, people **usually lost the guarantee of the vehicle makers when the vehicle is transformed.**

**7. Technical/legislative barrier: the lack of access to most underground parking** is of course also an important technical/legislative barrier.

**8. Environmental barrier:** some vehicle makers mentioned that it is not a good option because it is still a fossil energy (limited resource) on the one hand, and because it doesn't have such good environmental performance on the other hand.

#### **2.3.4.5.2. Suggested measures to overcome barriers to the development of LPG vehicles**

- **To reform the tax system** on fuel and on the vehicle use (circulation tax) on the base of the Ecoscore, and to define long-term sustainable tax system (like in Germany for CNG. Read below).

- **To Promote and to create incentives to the purchase/installation** (like the premium introduced in 2001-2002). But the message should be stable trough time. Indeed, the quick suppression of the premium at the time was a problem for the investment made from the LPG fitters (trainings of workers etc.), and create uncertainties and lack of confidence among the different market segments.

- To organise **roundtables with all the LPG stakeholders to agree on a common view and a coherent discourse** towards public authorities and consumers.

- Suppression of the interdiction of access to underground parking and of refuelling without a pump assistant (according to one stakeholder).

#### 2.3.4.6. CNG and biogas

##### **2.3.4.6.1. Barriers to the development of CNG and biogas vehicles**

#### **1. Supply-related market barrier:**

- The lack of refuelling stations for CNG (and biogas) is the main barrier.

- There is a lack of trained people to install a CNG system (as well as people trained for maintenance and reparation).

2. **Legislative barrier:** there is no legislative framework for CNG; indeed, the tax system (excises) for CNG is not defined. Also, safety standards for the installation of the system and refuelling stations do not exist.

3. **Technical barrier:**

- CNG/biogas vehicles are less powerful and have limited range (better for city use).

- The long refuelling time is also an inconvenient (those two barriers can be considered as psychological).

- The space needed for the tank can also be a problem.

4. **Market barrier:** there is a lack of information and knowledge of the population about CNG/biogas.

5. **Psychological barrier:** fear of gas (explosion).

6. **Environmental barrier:** for CNG, it is also mentioned that it is a limited resource.

7. **Market barrier:** for biogas, the production capacity is quite limited and has to be close to the place of utilisation (local utilisation).

**Remark:**

- **From the car industry point of view, the technology (CNG vehicles) is mature but the uncertainties about the availability of the fuel and the unclearness about future legislation in Belgium prevent their market introduction.** This alternative is already quite well developed in Germany and Italy.

#### **2.3.4.6.2. Suggested measures to overcome barriers to the development of CNG/biogas vehicles**

- Initiatives to develop a network of refuelling infrastructures (by private and public stakeholders working together and by way of subsidies).

- **To define a sustainable tax system framework for CNG:** for example in Germany the government has committed itself to fix the excises and guarantee a low price of CNG until 2020; by this way there is no uncertainty for the industries and they can plan a strategy and invest on this technology. Policy measures to support CNG in Germany were very successful.

#### 2.3.4.7. Biofuel

##### **2.3.4.7.1. Barrier to the development of biofuel<sup>51</sup>**

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<sup>51</sup> For a more detailed analysis on barriers to the development of biofuel see BIOSSES project, supported by the Belgian Science Policy.

Various stakeholders linked to the industry of biofuel have been consulted, from biofuel producer, to distributors and biofuel vehicle makers. As a lot of information has been obtained, this sub-section has been organized as follow: in a first point, barriers to the production of biofuels are presented. Barriers to the distribution of biofuels are presented in a second point. In the third point, a barrier to the supply of biofuel's vehicles (adapted for a high blend) is mentioned. The fourth point includes barriers to the demand of biofuel vehicles (according to supply-side stakeholders' point of view). Finally, the last point is dedicated to more general barriers to the diffusion of biofuels, with some elements of causality relations between barriers.

a) Barriers to the production of biofuel

**1. Legislative barriers:**

- **Limited volume of production** (quota) for the internal Belgian market that can be tax exempted: for biodiesel, the quota is 380 000 m<sup>3</sup>/year and for bioethanol it is 250 000 m<sup>3</sup>/year (distributed by the government between different approved selected producers). However, 380 000 m<sup>3</sup>/year of biodiesel 250 000 m<sup>3</sup>/year of ethanol won't be sufficient to meet the objective of 5,75% of biofuel in fuel consumption in 2010 (as the quantity has been calculated in 2004 and the fuel consumption is increasing). Also, we are for the moment far from using those quantities of biofuels in Belgium.

- The **lack of constraining measures in Belgium that would oblige oil companies to buy a certain amount of biofuel** generates an insufficient demand for biofuel, and so limits the production even below the quantities that can be tax exempted (tax exemption not sufficient)<sup>52</sup>.

- **Need to legalize E85** which is currently forbidden to sell (cf. Octa + has a E85 pump which is embedded) and there is no specific tax exemption.

**2. Economic barriers:**

- Biofuel price is **not competitive with current fossil fuel price. Also and importantly, even with the tax exemption, it is still more expensive for oil companies to buy biofuel (rather than to use their own fossil fuel) because of some logistic or administrative costs** (e.g. checking the quality, the percent of incorporation etc.). This implies again a lack of demand for biofuel.

- Problem of **international competition**: European production of biofuel is more expensive than in developing countries (not so good if we want energetic independency and strict rules of sustainable production). Also, some biofuel are sometimes subsidized, like for example the American biodiesel, which is currently creating important pressure on Belgian biofuel producers (unfair competition).

→ The lack of constraining measures in Belgium to oblige oil companies to buy a certain amount of biofuel, combined with the international competition of foreign biofuel (which is sometimes subsidized like for example the American biodiesel) generate important pressures on biofuel factories which face an **insufficient demand**.

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<sup>52</sup> Indeed, in Belgium, the tax exemption on biofuel was not sufficient to reach the objectives, and the question of the obligation of incorporation for oil companies is currently in discussion in the government.

## *b) Barriers to the distribution of biofuel*

### **1. Legislative barriers:**

- **European standards about fuel quality limit the incorporation to biodiesel in diesel and to ethanol in gasoline**, which is a technical limiting factor of development. For biodiesel, the maximum incorporation in diesel is 5% in volume (CEN diesel standard EN 590). For the bioethanol, the maximum incorporation of ethanol in gasoline in volume (CEN gasoline standard EN228) is about 5% and about 15% for ETBE which is equivalent to 7% of ethanol.
- **For bioethanol: there is a contradiction between the Belgian and the European legislation** from a technical point of view. Indeed, in Belgium, if an oil company buys bioethanol to an approved operator, it will obtain a tax exemption on it only if he proved that the incorporation of bioethanol in gasoline is minimum 7 %. However, at the same time, the European standard fixes the maximum incorporation of ethanol in gasoline to an equivalent of 7%. This implies that 7% is just the technical limit to respect the Belgian and the European legislation. The problem is that it is very difficult to obtain such a precise incorporation (and it implies a very heavy administrative procedure), and it quickly goes out of the standard.
- **Oil companies mention that it is imperative for them to respect strictly European standards and to respect the limit of incorporation.** Oil companies are not for a “proliferation” of specific standards for different fuel (with specific incorporation of biofuel). The reasons are that they consider as essential to maintain a good “interchangeability” of fuel at European level (flexibility of exchange, common standards in every member state etc.).
- **The diversity of legislative and administrative framework concerning biofuel in every member state and in particular in neighbour countries is a problem for oil industry** (difference in fiscal incentives, in the percentage of incorporation, etc.).

### **2. Economic and political barrier**

- **Oil companies are not financially interested in buying biofuel** (tax exemption is an insufficient incentive). There is a lack of appropriate policy measures to ensure a demand of biofuel from oil companies:
  - Inappropriate tax system and lack of financial encouragement: **current fiscal advantage is not sufficient**. Also, there is no tax exemption for high blend like E85.
  - **Lack of constraining measures that would oblige oil companies to incorporate a certain percentage of biofuel in their fossil fuel.**

A general remark was that **in Belgium, the supply of biofuel has been organised** (fixation of quotas and selection of approved producers) **but not the demand** (there is very little demand for biofuel from oil companies).

- 3. Technical barrier:** according to oil companies, the quality needed for biodiesel is not always met, which has consequences on the quality of the diesel mix (biodiesel producers seem to have difficulties to meet the level of quality needed).

**4. Market barrier:** there are delays and uncertainties concerning the start of production factories of biofuel, implying problems of organisation for oil companies.

*c) Barrier to the supply of biofuel vehicles (high blend)*

The technology is mature but **the uncertainties about the distribution of biofuel and the unclearness of legislation** in Belgium prevent the market introduction of biofuel vehicles.

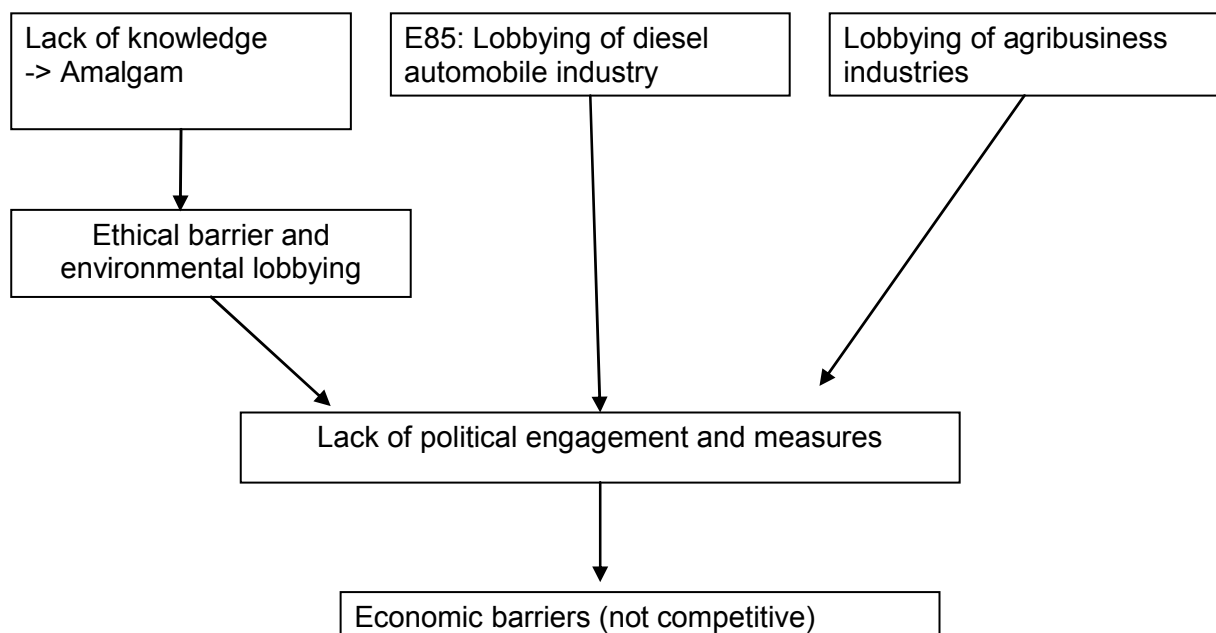
*d) Barrier to the demand of biofuel (for the consumer)*

The main barrier mentioned by supply-side stakeholders is related to “**ethical barriers**”, linked to the **controversies about the environmental and societal effect of biofuels** because of an **amalgam** between the different kinds of biofuels (the environmental effects vary greatly according to the raw material and the way of producing the biofuel).

*e) General barriers: interaction between political, institutional, market and economic barriers*

According to some stakeholders, there is a **strong environmental lobbying (from environmental NGO’s and associations) against biofuels because of an amalgam between the different kinds of biofuel and the different type of production** (public opinion is mixing bioethanol, biodiesel, the different raw materials used, location of production etc). More generally, **public opinion is also sceptical** (because of this amalgam) and **a bad image is conveyed to the consumers trough the medias (over-mediatisation)**. There is also a **lobbying against E85 from some vehicle makers because of the spread of diesel cars** (the important share of diesel cars is a barrier in itself for bioethanol). Finally, it exists also a **lobbying against biofuels from agribusiness** (like Monsanto or Nestlé) because of the fear of the increase of some product price. All **this prevents politicians to take position and measures** to promote biofuels because they make themselves the amalgam on the one hand and they are confronted with various lobbying on the other hand. As an important barrier is economic, there is a need for financial support (tax exemption etc.); if no measure, there is no demand.

**Figure 1: Barriers to the development of biofuel according to supply-side stakeholders and relations between barriers**



#### 2.3.4.7.2. Suggested measures to overcome barriers to the development of biofuel

- To legalize E85

- Policy measures to encourage/to oblige oil companies to buy biofuel:

- Financial encouragement and tax exemption on E85
- Obligation for oil companies to incorporate biofuels<sup>53</sup>
- French model (“TGAP”<sup>54</sup>): environmental tax, avoidable if incorporation (if not environmental punitive tax).
- Increasing excises on gasoline and particularly on diesel.

- Need for more and information for the civil society and need for European standards, as well as directives with environmental and social criteria for the production of biofuel.

#### 2.3.5. Category of alternative vehicles that would be more easily introduced in the market according to vehicle makers

Supply-side stakeholders were asked to mention which kind of alternative vehicles could be more easily introduced in Belgium and why.

While their answers are influenced by their own supply strategy, the answers that come out the most often are: **hybrid and biofuel vehicles** (for the short term) **because there are no differences of utilisation compared with conventional cars (no change of habits) and they can be used with current infrastructures**. CNG is then sometimes mentioned, as well as electric vehicles (but at medium term) while hydrogen vehicle is planned at very long term. However, some vehicle maker’s remark that new models of **diesel** (with particle filter) have to be promoted first, as it implies no change of habits, of infrastructure, and of vehicle makers’ strategies.

#### 2.3.6. Conclusions of the supply-side stakeholders interviews

Different kind of barriers to the development of the supply of alternative vehicles came out from the supply-side stakeholders’ consultation.

##### **Demand barriers: economic, technical and psychological barriers**

An important barrier for vehicle makers which prevent them to develop alternative vehicles in their supply is related to the fact that they expect no (or not enough) demand for those vehicle because there **consider them as not competitive with conventional vehicles for several reasons: economic (higher price), technical (alternatives have often some disadvantages), psychological (habits of the consumers) and also the actual trend of the characteristics of**

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<sup>53</sup> Currently in discussion in Belgium.

<sup>54</sup> «Taxe générale sur l’activité polluante »

**the demand (more and more requirements of the consumers for more comforts, options, at an acceptable costs).**

This is exactly the reverse situation than demand-side stakeholders (individual users and fleet managers), for whom one important barrier was linked to the short supply. However economic and technical barriers are expected to decrease with mass production and development. But for the moment, **the market is “stuck” because supply-side stakeholders expect no demand and demand-side stakeholders wait for supply development. This implies a need for policy intervention to release this “locked” situation.**

**Supply-side barrier: lack of distribution of alternative fuel (“chicken and eggs” problem)**

Next to the higher price and the possible technical disadvantages, the lack of alternative fuel availability is a **major brake for vehicle makers to develop and commercialise alternative vehicles**, even when the technology is mature (e.g. CNG or biofuel).

**Market barrier: competition of conventional low emission cars, diesel cars in particular**

Also and importantly, while vehicle makers are developing slowly alternatives, their current strategy is rather to **focus on the improvement of conventional fossil fuel cars-diesel car in particular-** in terms of efficiency and reduction of emissions. Indeed, it allows for reduction of emissions while maintaining a reasonable price (technology has being developed since years), offers the same comfort, implies the same habits for the consumers, etc. We can deduce from our interviews that diesel is often considered as major competitor for alternatives, also because it is fiscally encouraged.

**Environmental and societal barrier**

There are too **many possible alternatives and too many uncertainties about the "sustainability" of the different alternatives.** It is too risky to invest a lot in a complex and costly technology, to train workers etc. if they have to abandon it some years later because it appears to be not such a good environmental option.

**Political barrier**

Given the current context, **alternative vehicles would not spontaneously emerge from the market but need an impulse trough policy intervention. The lack of coherent and global policy measures to promote alternative vehicles and fuel is a major barrier to their introduction. Moreover, there are a lot of uncertainties about the evolution of future legislation.** Policy should be **clear** (legislation based on clear criteria), **harmonised** (between countries and inside Belgium), **and defined on the long run, to enable the industry to define a strategy.**

There is a **lack of clear policy for the introduction and the promotion of alternative fuel:** policy measures should ensure alternative fuel distribution. More generally, policy makers have to promote alternative vehicles/fuel and take a clear position. In order to play this role, policy makers have to ensure about the “sustainability” of the different options (trough R&D etc.).

**Today tax system is inappropriate** as it is not linked to environmental criteria: there is a need to create incentive for the consumers. Also, educational and informational measures have to be taken in order to bring a clear message to change mentalities, habits, prejudices and fear of the public.



## **2.4. Barriers to the development of alternative vehicles according to the experts: interviews results**

The “experts” include different groups of stakeholders from the society: universities and research centers, NGO’s and associations, and politicians. This group is supposed to be “neutral” in the sense that they are not consulted as demand-side stakeholders or supply-side stakeholders. The “experts” have a more global view on the question, about demand and supply-side barriers, but also about the barriers “upstream”, e.g. related to the context in which the automobile sector operates.

This part is divided into 3 chapters: the first one is about the sample and the methodology for the interviews (same as the previous chapter), the second one is about barriers in general from the expert’s point of view and the third one is about the policy measures suggested by the experts to overcome barriers. **Opinions of experts about barriers by category of alternative vehicles are given in the appendix<sup>55</sup>.**

As we will see and without surprises, a significant number of barriers mentioned by the “experts” have already been mentioned by the previous groups of stakeholders, which reinforce and confirm their existence and their importance. However, some new ideas are also emerging.

### **2.4.1. Sample and methodology**

**The questionnaire and the methodology was the same as for supply-side stakeholders (see point 2.3.1).** A sample of 18 “experts” has been interviewed. This has allowed, as previously, for in-dept interview-discussions. As for stakeholders of the supply-side, most interviews were face-to-face, but also sometimes by phone or in writing (according to the preference and the availability of the interviewed). This consultation took place through the year 2008.

The sample includes people from the European Commission (Energy and Transport DG), the European Council, the IBGE-BIM, Minaraad<sup>56</sup>, 2 ministerial cabinets (Smet and Huytebroek), 2 Federal Public Service (transport & mobility, and public health and environment<sup>57</sup>), Transport & Environment (T&E), Inter-environment Bruxelles, le Centre Interuniversitaire d’Etudes de la Mobilité (CIEM), Green Propulsion, le Centre de recherches routières (CRR), the European Commission joint Research Centre, an automobile journalist, a consultant and a centre of automobile training (Autoform).

As a reminder, all the information coming from the interviews (or filled-in questionnaires) were treated in a qualitative way, as quantitative analysis had no sense with such a small sample. The results presented in the next sections resume the main ideas that come out from

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<sup>55</sup> In appendix, we give a summary of what have been said by the experts about barriers by category of alternative vehicles. To facilitate presentation, barriers have been classified and are presented in a synthetic way in a box for each category of alternative. The results correspond roughly to the barriers mentioned by the previous group of stakeholders, but some new ideas of barriers often related to more environmental or social criteria (but also other kinds) have been added by the experts.

<sup>56</sup> Het natuur- en milieuvadvisorgaan van de Vlaamse Regering en het Vlaams Parlement

<sup>57</sup> Service Public Fédéral santé publique, sécurité chaîne alimentaire et environnement.

the interviews, as well as new and interesting ideas that emerge. This means that every barrier mentioned in this chapter is of course not necessarily mentioned by all the stakeholders.

**Barriers have been classified and presented by category** according to their nature (see first part of the report).

It has also to be noted that all what is written in this part **do not reflect personal opinion of the authors**, but resumes all the ideas that were mentioned by one or several “experts”.

## **2.4.2. Opinion of “experts” about barriers to the development of alternative vehicles in general**

This section resumes what has been said by the experts about barriers to alternative vehicles in general. We will see that many barriers have already been mentioned by the other groups of stakeholders, which confirm their existence and reinforce their importance. But consultations with “experts” have also allowed us to highlight some new barriers to the development of alternative vehicles, in particular institutional, political and legislative barriers.

### **1. Institutional barrier**

One expert highlighted an important barrier referring to history: the fact that society has made the technological “choice” of fossil fuel vehicles in the past. So, societies have invested so much and since such a long time on fossil fuel engine and on related infrastructures that the costs of using fossil fuel vehicles are lower and the general performance (except about the environment) is “better” compared to the other technologies. Also, the performance of gasoline and diesel engines are still improving, implying that the gap between the technologies is maintaining. This implies a lack of competitiveness of alternatives from an economic and technological point of view. This expert mentioned that the other barriers could come from this technological past choice and proposed some causality relations between barriers. This has been used and more developed in the next part of the report (part 3).

### **2. Economic barriers**

The economic barriers (higher prices), making alternative vehicles not economically competitive, are mentioned by most experts and considered as very important.

### **3. Technical barriers**

Experts often mentioned the problem of technical disadvantages (compared with conventional cars), and in particular the combination of economic and technical disadvantages (making the vehicle particularly unattractive).

Some expert’s mentioned that those obstacles (economic and technical) are more important in the short-run, as they will decrease with diffusion and mass production (thanks to economies of scale, R&D...).

### **4. Market barriers**

Experts mentioned that the **large range of alternatives, each one with advantages and disadvantages, is also a significant barrier**. Indeed, vehicle makers (and consumers) don't know what to choose, as there is not really one solution which imposes itself and comes out. Also, the (long run) credibility of the technology is important for vehicle makers, as they don't want to invest a lot in a "transitional" technology. However, vehicle makers face uncertainties about the viability of the different options and so about the future of each alternative vehicle market.

## 5. Supply barriers

Because of those previously mentioned barriers, there is a **lack of supply of vehicles (quantitative and qualitative)**, which can be considered as a barrier for the consumers, as often mentioned by the experts (the fact that there is not yet diesel-hybrid in Europe is also mentioned). Also, the consumer faces an **uncompleted product (lack of refuelling/recharging infrastructures and lack of maintenance services etc.)**. Indeed, the **lack of distribution** of the fuel is of course a very important barrier, often mentioned by the expert. About this subject, one expert noted the advantage of "liquid fuel" which is easy to transport (as all the infrastructures exist), and the fact that it is not easy to switch to gas, notably because there is not always enough space in station to add a new product (logistic barrier).

## 6. Psychological barriers

Some experts mentioned the **"use effect" and the attachment of people to conventional vehicles**, as well as the force of the **symbol**, the image of the traditional vehicles with good range and high speed (image of freedom...). **Unconsciously, people are stuck in their habits and there is a kind of "mental laziness", causing resistance to change and maintaining the same purchase behaviour**. The way the alternative vehicles are perceived by consumers is thus a barrier.

This is reinforced by a **lack of general confidence in alternative vehicles**, in particular concerning **safety** (risks) associated with new technologies, which is related to the **fear of the unknown**.

## 7. Demand side market barriers

Psychological barriers are enhanced by a **lack of information or bad information about alternative vehicles**, which is considered as an important barrier according to the experts. Indeed, some experts underlined that **the information is complicated and full of contradictions, which discourage the consumer**. This is true at a precise point in time (e.g. hydrogen is sometimes presented as the ultimate solution, sometimes as a non-sense) or through time (biofuel was considered as a good alternative some years ago, and now it is much debated). This implies **no clear message** for the consumer who loose confidence and don't know what to choose. In this case, economic incentives will not be useful if the information and the message is unclear and if people are not confident about the alternatives (economic barriers can be supplanted by other barriers). Some experts also mentioned a need for a **more important environmental awakening of the population**, for more "environmental advertising" and for a clearer view about the environmental impact of every category of alternative vehicle.

## 8. Political and institutional barriers:

Several experts mentioned that there is a **lack of policy measures and political encouragement (financial and informational) at national and European level (lack of “political view” and of voluntary policies)** to encourage the development of alternative cleaner vehicles (which is considered as an important barrier for the expert). Some of them mentioned the lack of legislation and of binding measures (applied to both supply-side and demand-side of the market). For example, some experts mentioned a need to oblige vehicle makers -by way of legislation- to respect more ambitious limited emissions value for all the vehicles, as well as to fix even more ambitious objectives on the long-run.

The lack of (sufficient) policy measures in general have been explained by the experts by various factors:

- At national level, one expert underlined the fact that in Belgium it is more difficult to take national measure (for national competences like tax system) as the 3 regions must agree (**institutional barrier**).
- Psychological barriers (and other demand-side barriers) reduce the political willingness of policy makers (they don't want to take unpopular measures), who prefer to wait for a change of mentalities.
- The fact that the car market is a globalised market can also reduce the room of action for national politicians.
- The **wide range of alternatives** -mentioned by the experts- with no perfect solution and with every one being much debated, can constitute a problem for politicians and prevent them to promote one alternative. Also, it comes out from the expert's consultation that there are no agreement about which alternative is good or bad for the environment (the opinions are very diverse) what makes difficult possible agreements.
- **Lobbying**: there seem to exist some kind of lobbying indirectly or directly against alternative vehicles development, which could prevent politicians to take ambitious policy measures: on the one hand, and according to some NGO's and politicians, there exist various **economic lobbying** from various industries and socio-economic groups that could directly or indirectly have an impact of alternative vehicles development. On the other hand, we noticed through the interviews a kind of **lobbying from some environmental NGO's or associations against some alternatives**.

According to some NGO's and politicians, **economic lobbying** (from oil industries, some vehicle makers and other various socio-economic group), in particular at European level, is an important institutional barrier to significant policy measures. For example, some vehicles makers are lobbying against ambitious objectives in terms of CO<sub>2</sub>. Also, Diesel-related stakeholders would lobby to keep the fiscal advantages, which have also an indirect impact on alternatives (as it places diesel as a major competitor for alternative vehicles). Europe is roughly the only important market for diesel, which can explain that it is important for this industry to keep their market part. Lobbying has an influence on technological choice and on maintaining one technology. Note that some NGOs consider at current time that the alternatives developed by vehicle makers are generally shown rather for the image (“marketing”) than for real purpose of commercialisation in the short run.

As mentioned, it seems also to exist a kind of lobbying against alternative vehicles from some environmental NGO's and associations. Indeed, as **alternative vehicles are still bad for the environment** (even if they are less pollutant), those stakeholders

consider that “collateral effects” are sometimes even worst (see for example the debate about biofuels...). Also, alternative vehicles encourage the current trend to the “overuse” of the car and contribute to the (wrong) idea that it is possible to maintain our current ways of consumption. It is related to the idea that “salvation” will come from new technologies, which is a mistake. Many environmental NGO’s and associations would rather lobby for a reduction of the number of cars (in order to improve quality of life, the proofing of the grounds etc.); according to this view, the federal premium for low-emission cars is not good because it encourages the purchase of cars.

- In the same line, it also came out from the interviews is that alternative or clean vehicles by themselves **do not constitute a political priority** for green politicians (it is secondary). As some environmental NGO’s and associations, green politicians would act rather for a more global and structural change: reduction of the use and the number of cars, reorganisation of public space (which is currently dedicated to cars), etc. Also, like some NGO’s, they remind that **alternative vehicles are still bad for the environment** (no one is satisfying) even if there are less pollutant, and they are often highly debated from an environmental point of view (**environmental barriers**). Also, one politician mentioned that even if alternatives are cleaner, it is likely that the technological improvement will not compensate for the current trend towards the vehicle park increase. Moreover, cleaner vehicles could contribute to the trend towards a structure of urbanization and “peri-urbanization” cars-oriented by encouraging the trend to the “overuse” of cars. One stakeholder mentioned also that alternatives technologies and energies come in third position in the hierarchy of their priority: public transport and soft mobility (bike, car sharing...) come first, and then come the efficiency improvement of vehicles in general (cf. European legislation about emissions). Alternative vehicles are considered as a “last recourse” solution (we first have to avoid a maximum to use individual cars). Also, according to one NGO, all the vehicles should decrease emissions and it is technically possible to reduce significantly the consumption of conventional vehicles; alternative vehicles may be a way to reach CO<sub>2</sub> objectives (in particular for bigger cars) but should not be an objective in itself.

As we will see in the next point, the lack of appropriate policy measures implies some inadequate policies that results in legislative barriers which are described in the next point.

## 9. Legislative barriers

It is interesting to note that some of the inappropriate policies mentioned by the experts are the same than those mentioned by the supply-side stakeholders. However, they have also highlighted some new barriers.

- Most of experts agree that current **tax system is inappropriate**. There is a lack of adequacy between the final cost for the user and the cost (direct and indirect) for the society (the fact that environmental costs -damages- are not taken into account in vehicle prices are considered as an important barrier); tax system should be based on environmental criteria. If we do so, the possible problem of higher initial cost could be overcome. If we don’t change anything the alternatives will be more expensive, and the consumer is not ready to pay more as his individual benefit is smaller than the social benefits (need for intervention). There is a need

for a tax that would decrease the use of car and encourage clean vehicles purchase. Moreover, there is a need for fiscal incentives because of the risk associated with a new product (need for an extra-advantage to compensate).

- According to most experts, the **price of Diesel** is really **too low** and shouldn't be supported by the state. Indeed, diesel price is encouraged as if it was a clean fuel so it gives a wrong message to consumers (contradiction). It places diesel as a major competitor for alternatives. Not only diesel is not enough taxed, but it is encouraged by legislation based on CO<sub>2</sub> (like "bonus-malus" in Wallonia, or the European objectives on CO<sub>2</sub>...). So, according to most experts, diesel should be more taxed; this would also allow the less polluting fuel to be free of tax (or less taxed); of course, it's not politically easy... A remark was that diesel is an appropriate fuel for road transport (not in city), so it would be necessary to "delink" fuel price for professionals' users and for private users: tax for private user should be higher than for professional users. As this is difficult to implement in practice, it may constitute a barrier. Moreover, Europe is more or less the only diesel market in the world (diesel is not much spread in Japan and United-States) which implies a lobbying from diesel related industry.

- Some experts mentioned also that **the circulation and registration taxes** are based on criteria which have nothing to do with the environment (and even can encourage more polluting older cars). Green politicians are working to change that (tax based on the ecoscore) but they are political oppositions from other parties as the measures could overtax poor households who have older cars.

- **Uncertainties about environmental legislation** are also considered as important for most experts (one expert noted that at the end of the 70ies, a lot of researches and projects have started and have been stopped in the 80ies when petrol prices have gone down). This implies that vehicles makers are facing **uncertainties about the viability of the possible projects** (due to uncertainties about future policies). In order to create a market for alternative technologies there is a need for a stable, coherent and harmonised legal context with clear policies defined at long-run that has to come from the different level of authorities (supranational, national and local); inclusion of social cost of emissions trough national or European tax system and local policies like special zones should be part of a coherent and voluntary program.

- Legislation for **company cars** (which are much more used than private vehicles) is **inappropriate**, as incentives for using low-emissions cars are not sufficient and alternatives are hardly ever used.

- The existing legislation to encourage clean vehicles in public administrations fleet in Brussels ("**ordonnance air**"/"**ordonnantie lucht**") was a "fiasco" according to some experts: only 5 administrations -which have more than 50 vehicles-, are concerned (with not all the vehicles concerned) and the definition of clean vehicles was not so clear. But now some changes are in process implying among other that every new vehicle will need a minimum ecoscore (except for vehicles with specific functions).

### **2.4.3. Measures suggested by the experts to overcome barriers**

In this chapter we summarised what have been mentioned by the experts about measures to implement to overcome barriers.

In general, according to the experts, public authorities should set up a favorable context to create a supply and a demand for alternative vehicles. This has to be done through coherent, clear, harmonized and stable (long-run) policies. Those policies have to guarantee to vehicle makers and fuel distributors that they will be able to develop and maintain their business (alternative vehicles/fuel production and distribution) in the long run in a clear and stable context, and that they will be able to get a return in their investment.

Measures suggested by the experts have been classified in 6 different categories: development of niche markets, general financial instruments, encouragement to R&D and infrastructures development, regulatory instruments, information and education and other complementary measures.

### *1. Development of niche market*

Initially, it would be interesting to focus on niche markets: captive fleets, vehicles fleets of public administrations etc. this could be done through compulsory measures. Example: to reorient the replacement of the fleet by imposing that every new vehicle bought has to be alternative or clean, or at least a certain percentage of the fleet (cf. “ordonnance air”-“ordonnantie lucht”). It is important to create the necessary conditions to allow the acquisition of alternative vehicles for public administrations: environmental clauses in public market for vehicle acquisition or specific public market for the acquisition of such vehicles...

### *2. General financial instruments*

Those instruments should allow **compensating the price differential between alternative and conventional vehicles, and giving an incentive for consumers to buy alternative/clean vehicles.**

The instrument that is suggested by most experts' concerns **green car taxation**. As mentioned by one expert, people are very “receptive” to tax incentives. Tax system should be based on the external cost of the vehicles, in such a way to create the adequation between private and social cost. So tax system should be based on environmental performance, for the purchase and the use of the car (circulation and registration taxes as well as excises on the fuel). Some experts suggested that the environmental criteria could be the ecoscore or even better the LCA but it's more complicated (for example for electricity the sources have to be known) and need to be more developed. They often mentioned that the criteria shouldn't be CO<sub>2</sub>-based as it would encourage diesel vehicles. So, the new tax system would imply to tax more diesel (more excises), which is not politically easy. One expert mentioned that tax increase on diesel must concern only the individuals, and not the commercial vehicles (see above). Some experts mentioned also the need for tax exemption on some fuel and for the suppression of discouraging tax (like the complementary tax on LPG). It has been highlighted that green taxation should also be applied to company cars; also, some particular measures could be done at this level, because it would allow for a more rapid introduction of alternative vehicles, as those cars are quickly replaced (important turnover)<sup>58</sup>.

A system of tax exemption for green vehicle makers could also be an option.

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<sup>58</sup> It has been remarked that company have a fiscal advantage to offer a car to their employees with current legislation, which is a non-sense from an environmental point of view.

**Premiums and subsidies** are other instruments that could encourage consumers to buy alternative vehicles. Indeed, the premium for the LPG in 2001-2002 had a significant effect on LPG use. Indeed, premium allowance encourages people financially but also gives a certain confidence in the product.

Some experts mentioned a need for a **public-private partnership**, in which stakeholders would look at what is needed to have a “complete product” (enough supply of the alternative vehicle, availability of the fuel, after sales and maintenance services, etc.) and public stakeholders could lend to private stakeholders at a low or with no interest rate (in such a way that the extra cost at the beginning is born by the public), with refunding when it’s commercially sustainable (so when the market is well set). Before the public-private partnership, some experts consider that the different private stakeholders of the industry should first make a “brainstorming” together in order to determine every need and problem relative to each alternative (good organisation between actors for every technology) and make then part of their need to public authorities.

### *3. Encouragement to R&D and infrastructures development*

There is a need to **encourage (financially) R&D to improve the technologies and to evaluate the sustainability of the different options.**

**Public authorities must ensure and set up the necessary conditions to the development of fuel distribution infrastructures.** Public sector can invest directly on infrastructure or lend to the private sector at the beginning (see above). If infrastructures need a very important investment, it may be preferable to start with captive fleets.

### *4. Regulatory instruments*

Environmental standards of production of vehicles must be designed (regulatory framework for vehicle makers). At European level, a restrictive limited value of emission (more ambitious than today) for every vehicle should be imposed.

### *5. Information and education*

Public authorities have to play a role to overcome psychological barriers, by making campaign of information and “advertising” (to insist on environmental benefits and other positive attributes of alternative vehicles -like the silence for electric car for example-). It will allow reducing the lack of confidence of the public about new technologies. More generally, the environmental consciousness of people has to be developed.

Another interesting educational measure is to introduce alternative vehicles in drive school so that driving licence would include the use of alternative vehicles.

### *6. Other complementary measures*

Diverse advantages for users of alternative/clean vehicles: low-emission zones, free parking’s etc.



#### 2.4.4. Conclusion of consultation with experts

An important range of barriers identified by the experts are from the same nature than those expressed by demand-side and supply-side stakeholders, which confirm their existence and reinforce their importance. However, some new barriers (institutional, political and legislative) have been underlined by the experts.

Among barriers that had already been expressed by the other group of stakeholders, we have **economic barriers**, of which the importance have been confirmed by the experts, and **technical barriers** (technical disadvantages). As mentioned by the experts, those barriers (economic and technical) are more important at short run and will decrease with development (thanks to economies of scale, learning economies, R&D...). **Psychological barriers** have been underlined, including the problem of habits, the lack of confidence in safety and the apprehension of new systems. Other **demand-side barriers** have been mentioned, like the **lack of bad information** and the **lack of clear message** to the consumer about the advantages of the different alternatives. Also a **lack of sufficient environmental consciousness** of the population has been mentioned. **Supply barriers** (lack of availability of alternative vehicles and fuel...) have also been confirmed by the experts (as a barrier for demand-side stakeholders). **Market barriers**, in particular the **existence of many alternatives with no “perfect” solution** has been mentioned as a barrier for vehicle makers, consumers and policy makers. Also, the **uncertainties about the viability** of each option are a barrier for vehicle makers to invest massively and commercialise new technologies (too risky).

**The inappropriate tax system (legislative barrier), already mentioned by the supply-side stakeholders, has been underlined by most experts: current tax system should be replaced by green car taxation.** Tax system should be based on the external costs of the vehicle. Experts specified that **diesel price is too low** (which gives a wrong message to consumers) and it creates competition with cleaner fuel. **Like supply-side stakeholders, lack of coherent and clear policies as well as uncertainties about environmental legislation are considered by experts as an important barrier** (as it causes uncertainties about the viability of possible projects and prevents supply-side stakeholders to plan a strategy). About legislative barrier, the inappropriate legislation for company cars (not enough incentives to use clean/alternative vehicles) and the weak impact of the “ordonnance air”/“ordonnantie lucht” have also been mentioned.

Experts particularly insisted on the **lack of policy measures and political encouragement to promote alternative vehicles**, which is an important barrier to their development (political barrier). Lack of policy measures has been explained by **various reasons**; firstly, at national level, one expert underlined that it is **difficult to take national measures as the 3 regions must agree** for some field like taxation (institutional barrier). Another mentioned that the **globalized level of vehicle's market** can also reduce the room of action of national government. Also, **psychological barriers** (kind of “reluctance” of people towards alternative vehicles) impede politicians for taking measures as they don't want to take unpopular measures. The **wide range of alternatives** with no perfect solution is also a barrier for politicians to take measures (as each solution is somehow open to criticism). Secondly, there seem to exist lobbying that brake the implementation of important policy measures: on the one hand, according to some NGO's and politicians, **there would be an economic lobbying from some industries and socio-economic groups, notably for example from the automobile industry and oil companies** against ambitious environmental measures (that would indirectly encourage the development of alternative vehicles); on the other hand, we

noticed through the interviews a kind of **lobbying from some environmental NGO's and associations against some alternative vehicles** (or against the idea that alternative vehicles are a good solution). Also, it appears from the interviews that **alternative and clean vehicles do not constitute a political priority for green politicians. Like environmental NGO's, green politicians would rather act for a more structural change of the society**: reduction of the use of the car, use of bikes and public transport etc., because alternative technologies are still bad for the environment (environmental barrier) and because it can make people think (wrongly) that we don't have to change our current way of consumption (use of cars). The fact that alternative vehicles do not represent a political priority for green politicians and the fact they would more orientate their policies for a reduction of car is in line with the result from the survey at the Motor show, where it has been noticed that “true” ecologists prefer not to have a car than buying a vehicle, even cleaner.

Last but not least, one expert highlighted an important barrier referring to history: the fact that society has made the technological choice of fossil fuel in the past, implying a development which has reduced costs and improved performance of fossil fuel vehicles. This would explain the wide range of barriers to the development of alternative technologies that societies are facing. This idea will be developed in the next chapter.

About policy measures, **an array of policies from different natures was suggested by the experts**: development of niche markets, general financial instruments, encouragement to R&D and infrastructures development, regulatory instruments, information and education as well as other complementary measures. So, according to the interviews of experts, this would imply that a mix of instruments would be necessary to overcome the different categories of barriers.

### **PART 3: TRANSVERSAL ANALYSIS OF THE INTERVIEWS: TECHNOLOGICAL LOCK-IN AND SYSTEMIC SCHEME OF THE INTERRELATIONS BETWEEN BARRIERS**

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The results of the consultation of the different groups of stakeholder typically illustrate a situation of technological locked-in. Because of past choices, we are “stuck” in what has been named a “socio-technical complex system”. As a result, the different parts of our society are designed in accordance with the generalised use of fossil fuel cars, with very strong links and interdependences between the different elements.

Thinking in terms of system when apprehending the barriers appear to make more sense than considering them separately and in a static way. It implies to have a holistic view of the different elements of the network that characterise an energy system. This allows for apprehending the interrelations between barriers. Understanding the framework and the dynamic of the system will help to find the possible driving forces to overcome barriers and to create the necessary environment for alternative vehicles to develop. This is essential for drawing up effective and ambitious policy measures based on an integrated approach. Indeed, policy measures aiming at promoting alternative vehicles development could not have the expected results if they fail to take into account the interrelations between barriers.

Evolutionary economists have studied and developed a theory describing the characteristics of the technological lock-in process. This description fits particularly to the barriers to alternative vehicles mentioned by the stakeholders, and brings a theoretical framework to our conclusions. Indeed, the issue of the barriers to the development of alternative vehicles can be replaced in a more global question referring to a change of “technological paradigm”.

In this chapter we will describe in a first section the characteristics of a technological locked-in situation, as it summarizes particularly well the barriers (to the development of alternative technologies) met and perceived at the different levels of the society. Moreover, it shows the complex and strong interrelations as well as the interdependences between the different kinds of barriers. So, this wide array of interrelated barriers explains what has been qualified as the “lock-out” of alternative technologies. In a second chapter we have used the information coming from the stakeholders' consultation by including it in an analytical framework inspired by the “lock-in” process. A systemic scheme representing the interrelations between barriers will be proposed together with possible levers (type of policy measures) for overcoming this lock-in situation.

### **3.1. Fossil fuel cars: technological lock-in**

In this chapter, some elements on the characteristics of the lock-in situation based on literature are presented.

It is necessary to better depict the context wherein alternative vehicles have to develop in order to identify the potential triggers that could help to overcome the barriers preventing their wider diffusion (“lock-out” situation). **Alternative vehicles do not come up and operate in a “virgin” environment. Indeed, conventional cars with internal combustion engine working with fossil fuel have been used for decades. This implies that alternative vehicles must compete with this old and well-developed pre-existing technology for which the linked technologies, economic sectors, institutions, infrastructures etc. are well established.**

The automobile market belongs to the “**fossil fuel energy system**”, which can be considered as a “Techno-Institutional Complex” (TIC)<sup>59</sup>. A TIC corresponds to a specific organisation of the different facets of society. It consists in a wide range of interrelated and complementary elements (components of the society) including specific infrastructures (physical organisation), institutions, social organisations and mentalities. **In the case of the automobile system, it is composed of the following interconnected elements<sup>60</sup>: cars, refuelling infrastructures, garages, firms, lobbies, culture (e.g. automobile sport), shaped mentalities (symbolic of the car and representation of what should be a car), etc. So, all these components of the system are related to fossil fuel vehicles; we speak about a “locked-in” situation (inertia) when the technological system follow a trajectory which is difficult and costly to change (path-dependent process)<sup>61</sup>.**

**Technological lock-in emerges from a path-dependent process with increasing returns to scale, improving efficiency, and narrowing relationships between the different stakeholders that become interdependent<sup>62</sup>. In this context and due to increasing returns to adoption, the technology which has gained an initial lead will gradually exclude other competitors<sup>63</sup> (as its advantages intensify with development). Four types of increasing returns identified by the lock-in literature can be mentioned<sup>64</sup>: “scale economies”, “learning economies”, “adaptive expectations” and “network externalities”. Scale economies occur as firms invest in an initial technology and the increase of production implies a decrease of the price per unit. It goes often together with “learning economies”, as the competencies and skills are developed and actors learn from experiences which reduces also the cost of production. “Adaptive expectations” refers to a behaviour in which people based their future expectations on what happened in the past. It occurs when actors from the demand and the supply-side of the market are more and more confident in the quality of the technologies (weak level of uncertainties). Finally, and this is a very important characteristics of the lock-in process, “network externalities” appear when the diffusion (growing number of users) of the technology increases its value for each individual user. The network starts with the development of firms and infrastructures resulting from the production, the distribution**

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<sup>59</sup> P. del Rio, G. Unruh (2005)

<sup>60</sup> Maréchal K. (2007)

<sup>61</sup> Maréchal K. (2007)

<sup>62</sup> P. del Rio, G. Unruh (2005)

<sup>63</sup> Maréchal K. (2007)

<sup>64</sup> Arthur (1994) in Maréchal K. (2007)

and the services linked to the technology/fuel (roads, refuelling infrastructures, garages...). Then, other relations between firms or industries are created (for example, the plastic industry uses by-product from oil refineries). So, strong relations and interdependencies between firms and industries emerge. Development of the network goes together with development of various lobbies<sup>65</sup>.

The development of the industries network implies a parallel development of the civil society by the way of advertising, medias etc. which modulates the demand according to the supply. Also, **beside the decreasing costs mentioned, the building of the system also implies a decrease of “social cost” because of a “use effect” (habits) to the technology. Indeed, agents adopt “routine” behaviour in their purchase decision to avoid mental effort and to ensure satisfaction (no uncertainties).** So, it results that **agents are “locked-in” in routine consumption patterns, which have often been observed in the energy field (and can explain non-rational behaviour and non-efficient decision).** Routine behaviour can also expand to firms and institutions.

The lock-in process goes together with **harmonised standards and legislation**, which can reach an international level, increasing again network externalities etc.

**Public institutions and governments play also a major role in fostering (or inversely discouraging) the development of one technology trough policy measures like specific tax system, subsidies, legislation etc.**

A **decrease of transaction costs** result also from those various processes.

**The lock-in is also strengthened by a lock-in of ideas, in the sense that R&D focuses more on the improvement of the current technology rather than on radical changes.**

So, the lock-in process implies that **society at large is “stuck” in a specific technology because of past choice, as it has reached a point where economic and social costs are low enough because of network externalities<sup>66</sup>.** As we have seen, **the entire society is designed in accordance with the general use of this specific technology, with strong links between the different components of the society and reinforcing lock-in effects.** This framework offers a background helped us to draw a scheme with the interrelations and relations of causality between barriers to the development of alternative vehicles.

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<sup>65</sup> Flink (1970,1988) in Maréchal K. (2007)

<sup>66</sup> It has to be mentioned that those externalities can eventually lead to a lock-in in a non-efficient technology. However, the consideration whether internal combustion engine working with fossil fuel was (at the beginning of its development) the most-efficient choice is beyond the scope of this study.

### **3.2. Systemic diagram of the interrelations between barriers**

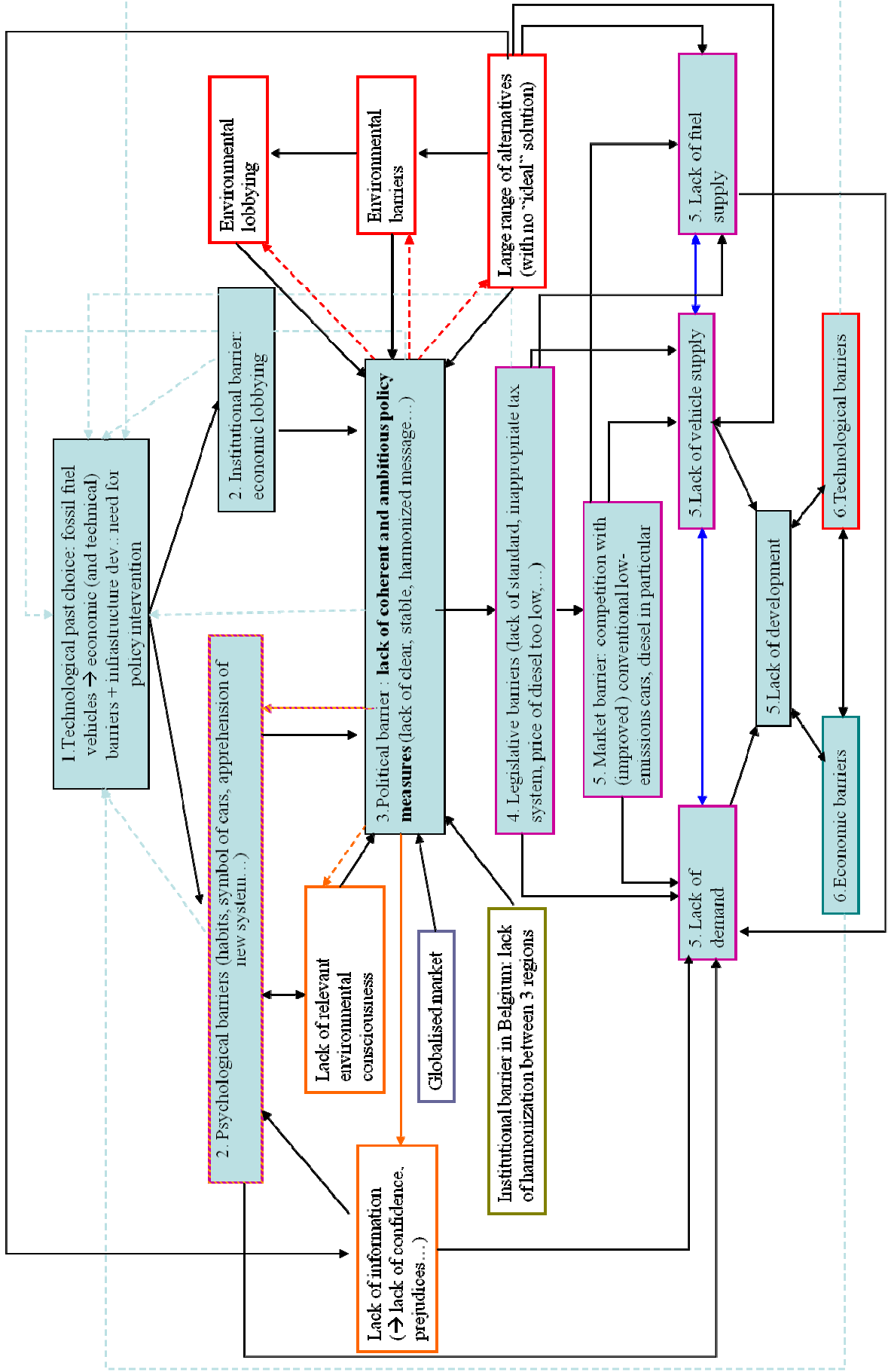
In this chapter, the information about barriers coming from the stakeholders' consultation has been included in an analytical framework inspired by the literature on the “technological locked-in” process. A systemic diagram representing the interrelations between barriers is proposed. This diagram is inspired by the opinion of some experts, by a transversal reading of the results from the stakeholders' consultation and by the elements of the lock-in process.

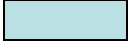







The diagram below summarizes the different kinds of barriers and represents the interrelations between them. Interrelations and their causality directions are represented by arrows. The blue boxes correspond to the element of the lock-in process described in the previous section, and the blue arrows in dotted line indicate the “buckle” of the lock-in created by the different barriers and maintaining fossil fuel technology domination. Colored border boxes and arrows represent (according to the color) barriers that could be released through one specific example of policy measures (see legend below the diagram)<sup>67</sup>. It has to be mentioned that, as we can see, there are many barriers implying a lack (or an insufficiency) of policy measures. However, it is also strong policy measures which can eventually overcome those barriers.

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<sup>67</sup> For more in-depth analysis of policy measures see task 1.3 or task 5 of the clever project.

**Figure 2 : Interrelation between barriers, lock-in process and examples of policy measures to overcome barriers**



-  Lock-in process
-  Type of policy measure to implement : support to R&D
-  Type of policy measure to implement: educational and information measures
-  Type of policy measure to implement: tax system based on environmental criteria + regulatory measures
-  Type of policy measure to implement: subsidies
-  Need for supra national measures
-  Need for harmonised measures
-  Need for stimulation of the market through coordination/cooperation between consumer's, vehicle makers and fuel distributors (meeting organisation...)

### *a) Interrelation between barriers and lock-in process*

1. We are “**stuck**” in fossil fuel technology, as a result of past choices: as mentioned, there have been **decades of investments in fossil fuel vehicles and related infrastructures**, implying increasing return to scale (thanks to economies of scale, learning economies, adaptive expectations and network externalities. See chapter 3.1.) and efficiency improvement. This implies a **lack of competitiveness of alternative vehicles from an economic and technological point of view**. Also, as a consequence of network development, the entire current **infrastructure is designed for the fossil fuel technology**. Moreover, actors of the automobile sector are trained and offer services for fossil fuel cars (workers qualified in this technology), and the relations between firms and industries are well established. This makes difficult the impulse to introduce alternative vehicles. For all these reasons and as number of experts underlined, **it is not economically interesting or possible for the industry to invest and develop massively alternative vehicles. In parallel, it is not interesting for the consumer to buy the possible alternatives** for economic reasons but also technical (disadvantages) or because they face an “uncompleted product” (lack of refuelling stations or after sales services...). For overcoming this “technological domination” of fossil fuel vehicle, there is a **need for strong policy measures**, as the current characteristics of the market will not bring alternative vehicles “spontaneously”. However, we can observe that **such strong measures are not taken** (and as we will see, current policies are inappropriate). Why?

2. The lack of policy measures can be explained (among others) by **two important reasons (which are barriers in itself)**:

Firstly, the decades of fossil fuel vehicles have shaped **mentalities** and imply that the **population is used to the characteristics of conventional cars: consumers have a precise idea of what a car should be (with a long range and high speed, a certain comfort and way of refuelling etc.) and are lock-in in their habits (routine behaviour)**. While consumers are very confident in fossil fuel cars (no uncertainties), there are afraid of new systems and are not confident in alternatives (e.g. Fear of gas). Those are **psychological barriers**. They are reinforced on the one hand by the **lack of “relevant” environmental consciousness of the population** (individuals are more and more conscious about environment but it often doesn't translate into concrete actions), and by the **lack of information** about alternatives on the other hand. This lack of information (or bad



information) exacerbates the apprehension about new systems and generates some prejudices. Indeed, we have seen that the perception of the importance of some barriers is greater with a lack of information (see section 2.1.4). Those factors have a direct and negative impact on the consumer's behaviour towards the purchase of alternative vehicles (lack of demand).

Secondly, there is an **important economic lobbying from different groups preventing alternative vehicles development** directly or indirectly linked to the automobile market. This is also the result of the expansion of the network, which characterise the lock-in process. This kind of lobbying, preventing alternative vehicles/fuel development is sometimes "direct" and often "indirect" (when lobbyists are against environmental measures that would indirectly foster cleaner and alternative vehicles development). This latter kind of lobbying include for example pressure against ambitious environmental measures that are not always financially "feasible" for the concerned sectors; another example is the Europe's media corporations, which lobby against the European proposition to write environmental performance of the car in advertising; this is because the free press, which is quasi totally financed by car advertising, fear that it may result in a decrease of car advertising (as the advertising would be less attractive) which would have important consequences on their business<sup>68</sup>. Diesel industry and related sectors would lobby to keep its fiscal advantages, which have also an indirect impact on alternatives (as it places diesel as a major competitor for alternative vehicles). Lobbying has an influence on technological choice and on maintaining one technology.

These two important barriers contribute to reduce the room for manoeuvre and the willingness to act of policy makers. However, at the same time and reversely, it is also by way of ambitious policy measures that the breakdown of these barriers would be possible.

Another lobbying against alternative vehicles (or some categories of alternative vehicles), from a completely different nature, is exerted by some environmental NGO's and associations, as a result of **environmental problems associated with alternative vehicles (environmental barriers)**. Indeed, environmental benefits of most alternatives are often disputed. Moreover, interviews have highlighted that **alternative vehicles do not represent a political priority for green politicians**. Indeed, for many "green people", the environmental solution is to reduce the number and the use of cars rather than to develop less polluting cars (than could possibly generate other kinds of environmental problems).

The large range of alternatives each with advantages and disadvantages impede also policy measures, as no perfect solution is coming out.

The problem of globalisation of automobile market reduce the possibility for national government to take effective measures, and implies that measures should be taken at a supra-national level (internationalisation of the lock-in). Indeed, as mentioned by vehicles makers, the measures should be harmonized between countries (at least at European level).

Finally, the lack of harmonization of environmental measures about cars and the need for an agreement between the different regions of Belgium represents also an institutional barrier.

3. So, those reasons would contribute to prevent politicians to take the necessary measures. **The lack of policy measures and more precisely the lack of clear, stable (long-term), harmonized and coherent policy scheme generate too many uncertainties for supply-side**

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<sup>68</sup> EURACTIV, 25/10/2007

**stakeholders (making the investments too risky and preventing them to plan a strategy).** Also, it goes together with a lack of clear message for the demand-side stakeholders.

**4. Some current policies result in legislation which is preventing the development of alternative vehicles.** Indeed, the lack of appropriate policy measures creates or maintains **legislative barriers**; it includes for example **the lack of standards** for some alternative fuels or vehicles (at the contrary of fossil fuel for which the standards are well-developed and harmonised between countries). Also and importantly, the **inappropriate tax system** (which should be based on environmental criteria) and in particular the **price of diesel which is too low** are important barriers to alternative vehicles development. So, it contributes to maintain fossil fuel vehicles domination.

**5. - Another characteristic of the lock-in is that actors of the society focus more on the improvement of current technologies than on new ones.** Indeed, as we have seen through the interviews, **supply-side and demand-side stakeholders are more oriented to conventional low consumption cars and sometimes on hybrid models, rather than on completely new concepts (like electric cars).** Indeed, the context of technological lock-in implies that hybrid vehicles are more convenient than complete alternative ones such as electric vehicles: hybrid vehicles (up to a certain degree of hybridisation) exploit the fossil fuel technology and infrastructures, do not disrupt too much the economic balance (role of the firms and relations between firms) and correspond to the socially accepted standard of cars (about the same comfort, performance etc.). However, it comes out from the interviews that **the focus is mainly on diesel cars**, as they are conventional cars (no psychological and social barriers, no problem of infrastructure...) which are encouraged through fiscal incentives. Success of diesel cars is explained by different factors: firstly, tax policies have had major effect on buying patterns and as a result, on the supply of vehicles makers (wide range of models and equipments). This has generated a lobbying from these actors. Also, a wide range of environmental legislation at country and at European level are CO<sub>2</sub>-based (which can be linked to the importance of the diesel sector in Europe and to lobbying), which tend to encourage diesel even more. This has allowed for an improvement of the efficiency of the technology...and a “sub-lock-in process” has emerged inside the “fossil fuel technological lock-in”. In this case, policy measures have strongly influence the process. However, the important effect resulting from it was unsurprising as there was no technological revolution (fossil fuel cars with same characteristics than gasoline cars).

- Inappropriate tax system (and other legislative barriers), competition with low-emission diesel cars, and the co-existence of a wide range of alternatives (with no “ideal” solution) imply a lack of demand and supply of alternative vehicles and fuel. Lack of demand is enhanced by psychological barriers and lack of information of the public. At this level, **strong interactions between the lack of demand and the lack of supply, as well as between the lack of supply of vehicles and the lack of fuel distribution exist.** Indeed, consumers face a **short supply of vehicles and fuel and an uncompleted product, which represent an important barrier to the purchase/use of alternative vehicles.** At the same time and reversely, **vehicle makers and fuel distributors do not develop the supply because there is (or they expect) no demand from the consumers.** Also, **vehicle makers do not develop their supply of alternatives because there is a lack of fuel distribution and vice versa (“chicken and eggs” problem).**

6. This causes (and maintains) **economic and technical barriers** resulting from the lack of development of alternatives, **which reinforce the lack of demand and supply and maintain fossil fuel vehicles domination.**

It results in **a cycle where society is stuck and every barrier reinforces the others.** As we have mentioned, we face a complex system with many interrelations between barriers. A large part of the barrier mentioned corresponds to the characteristics of the lock-in situation.

#### ***b) Some policy measures***

Colored border boxes and arrows represent (according to the color) example of type of policy measures that can have an impact on reducing barriers (see legend below the diagram). For example, environmental barriers (and linked barriers) could be partly reduced with a *stimulation of R&D* which can help to determine which are the “best” and sustainable alternatives that would make sense to encourage. Also, R&D can contribute to reduce technical barriers. Barriers contributing to the lack of demand (from the consumer’s point of view), like psychological barriers and lack of information, could be reduce with *educational and informational measures*. About legislative barriers, an interesting policy to implement would be a *tax system based on environmental criteria*, along with *regulatory measures* (e.g. standard of production fixing limited value of emissions for every car). *Stimulation of the market through coordination/cooperation between consumer’s, vehicle makers and fuel distributors* (meeting organisation...) could also contribute to reduce “chicken and eggs” problem. Finally, economic barriers could be reduced trough various kind of *subsidies*. It has to be note that those policy measures are only general examples (list non exhaustive). Also, **policy measures mentioned would not have an effect only on the barriers in colour border boxes; indeed, because of strong interrelations between barriers, there would be indirect effects on other barriers as well. The colours in the schema are indicative of the direct effect of the measures. In the same line, some policy measures could fail if they don’t consider interrelations between barriers. For example, trying to overcome the economic barrier only by way of subsidies is expected not to give very good results, as economic barriers are resulting from a wide range of other barriers and mechanisms that have also to be overcome.**

It is also important for policy makers not to create a new technological lock-in with a technology that is not the most efficient or which is not sustainable. To this regards, development of “niche” market would be an interesting solution to test the technology. Also, “hybridization” is also an interesting way to overcome barriers resulting from the technological lock-in. Both “niche” market and “hybridization” development are possible ways to overcome gradually the technological lock-in situation<sup>69</sup>.

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<sup>69</sup> Maréchal K. (2007).

## PART 4: CONCLUSION

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This study has allowed us to identify barriers to the development of alternative vehicles in Belgium through the consultation of different groups of stakeholders, and to draw a systemic diagram with the interrelations between barriers and possible levers to overcome those barriers. In this study, a distinction has been made between pre-identified barriers that temper the development of alternative vehicles in general and those that more specifically apply to certain technologies or fuels<sup>70</sup>. It has to be noted that our results about barriers differ according to the category of alternative vehicles. However, in this conclusion, only barriers in general are presented<sup>71</sup>. Stakeholders have been identified and classified into different groups: the demand-side stakeholders, divided between individual consumers and fleet managers, the supply-side stakeholders (vehicles makers, fuel distributors...) and the “experts” from various institutions (research centres, policy makers, NGO’s...) which offer a more global and analytic view on barriers. Those four groups (including the two groups of demand-side stakeholders) have been sounded out about barriers to the development of alternative vehicles from their point of view. Survey and interviews have revealed the existence of a wide array of barriers from various types, with strong interrelations between barriers.

It is important to note that although the list of barriers identified in this study is as much exhaustive as possible, it is of course always possible to find new or other ones according to the focus considered criteria (according to the type of vehicle, the stage of development of the vehicle, the level of detail considered etc.).

### **Barriers to the purchase and use of alternative vehicles from the individual users point of view**

A survey at the Brussels Motor Show has highlighted several types of barriers to the purchase and use of alternative vehicles from the individual users' point of view: economic (high price...), supply (short supply of vehicles and fuel...), market (lack of development...), technical (technical immaturity and limited range...), etc. **While economic barriers appear to be very important<sup>72</sup>, results have shown that other aspects have also a significant impact on consumer behaviour about alternative cars, sometimes even more important than economic aspects.** Indeed, it appeared that economic barriers are much less important when considering barriers by technology than when considering barriers in general (revealing the importance of other non economic barriers), except for hybrid. Also, it came out that hybrid vehicle is preferred to LPG vehicle when considering purchase intention, despite the fact that LPG vehicle is cheaper (and better-known). This may indicate that **non-economic factors are potentially stronger than economic ones. More specifically, results have shown that psychological barriers have a significant impact on consumer behaviour**

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<sup>70</sup> It has to be noted that our results about barriers differ according to the category of alternative vehicles. However, in this conclusion, only barriers in general are presented.

<sup>71</sup> The reader interested by the results about barriers by category of alternative vehicles must refer to the section 2.1.5. for barriers from the individual consumers point of view and to the section 2.3.4 for barriers from the supply-side stakeholders point of view.

<sup>72</sup> This is in line with the results from the survey of the task 3.2 of the CLEVER project (Turcksin L. and Macharis C. (2008)) which show that the first selection criteria of a new car are based on rational factors, economic factors in particular (most important car attributes according to the "spontaneous" answers of the respondents).

**about cars:** some elements of the survey indicated the role of **habits** (preference for conventional vehicles or vehicles that are rather similar to conventional cars), and a clear apprehension of new systems (e.g. lack of confidence in safety and fear of gas). Survey has also illustrated the low level of consciousness of habits, in the sense that people do not think consciously about the influence of habits in their purchase behaviour (so do not expressed it directly), but analysis of their answers have revealed that they do play a role. Indeed, **economic, market and supply barriers appear to be the most important categories of barriers to the purchase/use of alternative vehicles in general when considering "conscious" motivations of people. However, while the barrier "lack of confidence in safety" (psychological barrier) is not highly quoted when asking people to evaluate the importance of barriers, it appears that it does influence their purchase intentions.** Indeed, our survey results shown that people who don't have the intention to buy an alternative vehicle statistically differ from the others in that the barrier "lack of confidence in safety" is more important for them<sup>73</sup> (this is the only statistical difference between the 2 groups). The fact that hybrid vehicle is preferred to LPG vehicle when considering purchase intention (despite the fact that LPG vehicle is cheaper and better-known) may also indicate people preference for a car that do not imply to change habits (same refuelling system<sup>74</sup>, same comfort, etc.). Finally, the fear of gas is the second most frequent expressed barrier for all gas fuel (the first is the lack of refueling stations, except for LPG). This clearly indicates an apprehension of "the new".

About the importance of barriers expressed by the respondents, **problems related to the short supply (of vehicles and fuel) are of course major barriers to the purchase/use of alternative vehicles.** Often, the consumer faces an "uncompleted product" (lack of refuelling stations, or lack of after-sale services...). Market barriers appear also to be important; this group includes the lack of development of the market (people prefer to wait that the other use a new technology before adopting it themselves), the **competition with low emission conventional cars** (a sample of people prefer to choose a conventional low-emission cars rather than an alternative one) and the lack of information. Indeed, the survey has highlighted the **important lack of information about alternative vehicles** among people, which represent an important obstacle to the purchase (statistical analysis has shown that the personal evaluation of the importance of the barrier "lack of information" is decreasing with the level of knowledge about alternative vehicles<sup>75</sup>). Moreover, statistical analyses have revealed the **presence of an interaction between barriers:** we noticed that the better the average level of knowledge is the less the barrier "different refuelling system" is important<sup>76</sup>. Also, there is a positive correlation between the importance of the barrier "high purchase price" and the barrier "lack of information". **This implies that measures aiming at overcoming the barrier "lack of information" will have a positive effect on the reduction of the perception of other barriers. However, while the lack of information is a very important barrier, overcoming it would not always guarantee a better development of the alternative.** Indeed, we have seen that LPG is the best known alternative vehicle but is not very successful concerning purchase intention. It implies that **more and better information (to overcome the barrier "lack of information") is a necessary but non-sufficient condition to foster the purchase/use of alternative vehicles.** Finally, the survey has also revealed the presence of **doubts and scepticism about the environmental**

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<sup>73</sup> Anova test significant (p-value < 0,0189).

<sup>74</sup> For the currently sold hybrid like the Prius (non plug-in).

<sup>75</sup> Indeed, the weaker the average knowledge of alternative vehicles is the more this barrier is important (consistency): anova test significant (p-value < 0,0001) and the assumption of homogeneity of variance is accepted

<sup>76</sup> Anova test significant (p-value < 0,028) and the hypothesis of homogeneity is accepted

**advantages** of those vehicles; in particular, the “true ecologists” prefer not to have their own car and would rather use other way of transportation (bike, public transport, car-sharing...). So, if even the “green people” are not supporting alternative cleaner cars, it is difficult to find a market segment for alternative vehicles.

### **Barriers to the introduction of alternative vehicles in fleets of vehicle**

Interviews of fleet managers have highlighted that it is the **combination of several barriers** (supply, economic, technical and market) that make alternative vehicles particularly unattractive for introducing them in fleets of vehicle (except hybrid, for which the main barrier is economic). Also, previous bad experiences (technical problems) with some types of vehicle (like electric, CNG and LPG vehicles) imply a **lack of confidence** in those vehicles. Fleet managers expressed as well the inaccurate nature of the information and the presence of many **uncertainties** (about the total cost, the technical reliability, the viability of the different options, etc.) implying that **more and better information is needed**. Finally and importantly, **the short supply (and the short number of suppliers) creates sometimes the impossibility for companies to buy or to lease alternative vehicles**. Indeed, **public market legislation** prevents the purchase of a vehicle if there is no competition between several vehicle makers. Also, the **lack of supply of alternative vehicles in leasing companies** and also the **inexistence of alternative for intervention vehicles or vans limit greatly the development of alternative vehicles in some fleets of vehicle**. In this last case, **barriers come not from the companies but from the supply-side of the market** (fleet managers often expressed that measures have to be taken "upstream").

We also noticed that **the current trend is to use diesel low-emission vehicles with particle filter and more generally conventional low-emission vehicles rather than alternative vehicles**.

### **Barriers to the supply of alternative vehicles**

An important barrier which prevent vehicle makers to develop alternative vehicles in their supply is related to the fact that **they expect no (or not enough) demand for those vehicles, as there are not be competitive with conventional vehicles** for several reasons: economic, technical and psychological (people are used to conventional fossil fuel cars), and because of the actual trend of the characteristics of the demand (more and more requirements of the consumers for more comforts and options at an acceptable cost). Also, the lack of fuel availability (e.g. CNG or biofuel) is a **major brake for vehicle makers to develop and commercialise alternative vehicles**.

Some vehicles makers mentioned also that there are too **many possible alternatives and too many uncertainties about the sustainability of the different options**. It is too risky to invest a lot in a complex and costly technology, to train workers etc. if they have to abandon it some years later because in case it would appear to be not such a good environmental solution. Also and importantly, while vehicle makers are slowly developing alternatives, their current strategy is rather to **focus on the improvement of conventional fossil fuel cars-diesel in particular-** in terms of efficiency and reduction of emissions. This is in line with the trend of the demand (see results of the demand-side stakeholders' consultation).

Given the current context, alternative vehicles would not spontaneously emerge from the market but need an impulse trough policy intervention. **The lack of coherent, clear** (based on

a clear criterion) **and harmonised** (between country and inside Belgium) **policy measures to promote alternative vehicles is thus a major barrier to their introduction. Moreover, there are a lot of uncertainties about the evolution of future legislation.** The lack of clear, global and **long** run defined policy scheme **prevent the industry from defining a strategy**<sup>77</sup>. In the same line, there is a **lack of clear policy for the introduction and the promotion of alternative fuel:** policy measures should ensure alternative fuel distribution. More generally, policy makers have to promote alternative vehicles/fuel and take a clear position. In order to play this role, policy makers should first make sure about the sustainability of the different options (through subsidies to R&D etc.). Importantly, **current car tax system is inappropriate** to create a favourable context to alternative vehicles, as it is not linked to environmental criteria. There is a lack of adequacy between the final cost for the user and the cost (direct and indirect) for the society (the fact that environmental costs –damages - are not taken into account in vehicle prices is considered as an important barrier). More specifically, we also deduced from our interviews that **diesel is often considered as a major competitor for alternatives, as it is fiscally encouraged (price of diesel is too low) and is widely spread in Europe.**

### **Barriers at society level**

Currently, the market is “stuck” because supply-side stakeholders expect no demand and demand-side stakeholders wait for supply development. This implies a need for policy intervention to release this locking mechanism. However, there is a lack of policy measures to promote alternative vehicles. Interviews of "experts" have brought several type of barriers "upstream", and gave also some reasons why there is a lack of policy and supportive measures for alternative vehicles. On the one hand, according to some NGO's and politicians, **there would be a lobbying from the automobile industry and oil companies** against some environmental measures (that would indirectly encourage the development of alternative vehicles) because those are not always feasible or realistic from an economic point of view. On the other hand, we noticed through the interviews a kind of **lobbying from environmental NGO's against many alternative vehicles.** Also and importantly, it appears from the interviews that **alternative and clean vehicles do not constitute a political priority for green politicians. Like environmental NGO's, green politicians would rather act for a more structural change of the society:** reduction of the use of cars, promotion of the use of bikes etc., because alternative technologies are still bad for the environment (environmental barrier) and make people think (wrongly) that we don't have to change our habits of consumption. This lack of social support for alternative vehicles from green activists and green politicians (that would rather orientate their policies for a reduction of car) is in line with the result from the survey at the Motor show, where it has been noticed that “true ecologist” prefer not to have a car than buying a vehicle, even cleaner.

### **Technological lock-in and interrelation between barriers**

It has appeared that the results of the consultation of the different groups of stakeholder illustrate typically a technological locked-in situation. Some evolutionary economists have studied and described the characteristics and the consequences of the technological lock-in process. This description appears to correspond to the barriers to alternative vehicles mentioned by the stakeholders, which brings a theoretical framework to our conclusions.

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<sup>77</sup> The need for a stable framework for the car industry has also come out from the stakeholders consultations lead by VITO in the context of the task 5 of the Clever project (Vanderschaeghe M., 2008).

Because of past choices, we are “stuck” in what has been named a “socio-technical complex system”; as a result, the different parts of our society are designed for fossil fuel cars (infrastructure, legislation, institutions, mentalities etc.), with very strong links and interdependences between the different elements. Indeed, **decades of investments in fossil fuel vehicles and infrastructures** have implied a decrease of economic costs (thanks to economies of scale, learning effects, etc.) and social costs (routine behavior...). This implies that **alternatives are not competitive from an economic, technical, social etc. point of view. Interrelations and causality relations between barriers have been presented in a systemic diagram in the third part of the study (chapter 3.2).**

Thinking in terms of system when apprehending the barriers appear to make more sense than considering them separately and in a static way. It implies to have a holistic view of the different elements and help to find the possible driving force to overcome barriers and to create the necessary environment for alternative vehicles to develop. This is essential for drawing up effective and ambitious policy measures based on an integrated approach. Indeed, policy measures aiming at promoting alternative vehicles development could not have the expected results if they fail to take into account those interrelations.

### **General policy recommendations**<sup>78</sup>

Spurring the barriers implies **creating a new system that will allow for a significant development of alternative vehicles**<sup>79</sup>. As we have seen in the previous chapter, the different barriers are highly interconnected. As a result, **policy measures to implement will be effective only if they are combined or if they have an effect on the different elements that constitute a system.** Moreover, **different policies can have mutual reinforcing effects** as a result of interrelations. As a result, **a mix of policy measures acting on the supply and the demand side of the market as well as on the broader environment in which the automobile market operate would give the better results.** The need for a mix of policies had already been recommended by the report of the task 1.3 of the Clever project ("Overview of policy measures")<sup>80</sup>, in which a "combination of carrots (incentives), sticks (disincentives) and regulations" including "a mix of target audiences" (industries, public and private consumers) is presented as working best. The importance of diversification of policy instrument has also been highlighted in other studies concerning energy consumption<sup>81</sup>.

As mentioned by the different groups of stakeholders, financial incentives and encouragements appear to be an important condition to foster the development of alternative vehicles. However, **while financial incentives are important, they are far from sufficient as they don't operate on a wide range of non economic barriers, like psychological barriers (routine behavior...) etc.** Campaign of good and clear information as well as educational measures is also essential for public acceptance. Also those measures should go together with regulatory measures (standards of production...).

**Public authorities can play a major role in fostering the development of alternatives.** Indeed, a **“highly supportive institutional framework”**<sup>82</sup> including important financial support but also stable, clear and certain promotion scheme through accurate legislation is a

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<sup>78</sup> For more detailed analysis of policy instruments and policy recommendations, see task 5 of the Clever project.

<sup>79</sup> Del Rio P., Unruh G. (2005), for the all paragraph.

<sup>80</sup> Tobias D., Govaerts L. (2007)

<sup>81</sup> Example: Bartiaux et al. (2006)

<sup>82</sup> Del Rio P., Unruh G. (2005)



necessary condition to encourage the development of alternative vehicles. However, this can occur when R&D has demonstrated that the alternative shows clearly environmental benefits also on the long run (to make sure about the viability of the alternative)<sup>83</sup>. Indeed, public authorities have to be careful not to develop a new “lock-in” of an unsustainable technology (which can happen if decisions are taken in emergency)<sup>84</sup>. To this respect, it can be better to define policy based on environmental criteria rather than focus on a specific technology. Also, development of “niche” market would be an interesting measure to test the technology and to overcome gradually the current technological lock-in<sup>85</sup>.

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<sup>83</sup> Del Rio P., Unruh G. (2005)

<sup>84</sup> Maréchal K. (2007)

<sup>85</sup> Idem

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## APPENDIX

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### **Appendix 1: Questionnaire for the Motor Show of Brussels<sup>86</sup>**

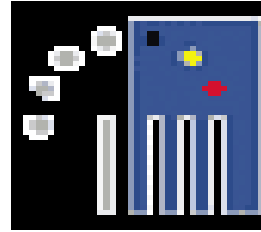
#### **A. Questionnaire for the Motor Show of Brussels: French version**

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<sup>86</sup> In this questionnaire alternative vehicles are named as « clean vehicles » ; this can be considered as a semantic experimental error but it has been corrected by the interviewers (which precise that we were considering only alternative vehicles).



Centre d'Etudes Economiques et Sociales  
de l'Environnement (Université Libre de Bruxelles)



Politique scientifique fédérale

## Enquête sur les obstacles au développement des véhicules propres

Madame, Monsieur,

Plusieurs centres de recherche du pays<sup>87</sup> collaborent activement en vue de proposer aux autorités des mesures qui pourraient encourager la diffusion des véhicules plus respectueux de l'environnement<sup>88</sup>, dits « véhicules propres »<sup>89</sup>. En tant que consommateur intéressé par la nouveauté dans le domaine de l'automobile, vous pouvez nous aider à découvrir les obstacles les plus importants à la diffusion des véhicules propres<sup>90</sup>.

Nous vous proposons, pour ce faire, de consacrer environ 15 minutes de votre temps à répondre au questionnaire ci-joint. Le formulaire de réponse est bien évidemment anonyme et sera traité en respectant une totale confidentialité<sup>91</sup>.

Merci d'avance pour votre collaboration

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<sup>87</sup> Le Centre d'Etudes Economiques et Sociales de l'Environnement de l'Université Libre de Bruxelles (CEESE-ULB), le département Transport et Logistique de la VUB (MOSI), l'unité de recherche sur les technologies de transport ETEC de la VUB, l'Institut pour la recherche technologique VITO et RDC environnement

<sup>88</sup> CLEVER "Clean Vehicle Research: LCA and Policy Measures" financé par le Service Public Fédéral de Programmation Politique Scientifique.

<sup>89</sup> Les « véhicules propres » désignent ici des véhicules contribuant relativement peu à l'effet de serre (réchauffement climatique) et à la détérioration de la qualité de l'air et à la nuisance sonore. La qualité écologique d'une voiture peut être mesurée par son « Ecoscore ». Il s'agit d'un indicateur dont la valeur varie entre 0 et 100 et qui intègre les différents impacts de cette voiture sur l'environnement. Un indicateur élevé correspond à une voiture moins polluante et vice versa. Par définition, pour un véhicule propre, l'Ecoscore atteint une valeur de 70 et plus.

<sup>90</sup> Le CEESE (ULB) est chargé du volet du projet « CLEVER » qui concerne l'identification des obstacles à la diffusion des véhicules propres

<sup>91</sup> Les réponses resteront en la seule possession du Service Public Fédéral de Programmation Politique Scientifique.

## Questions préliminaires

1. Comment estimez-vous votre niveau de connaissances générales sur les véhicules (réputés) propres suivants ? Entourez votre réponse.

a. Hybrides	très bon	bon	moyen	plutôt faible	faible
b. Electriques (à batteries)	très bon	bon	moyen	plutôt faible	faible
c. A pile à combustible	très bon	bon	moyen	plutôt faible	faible
d. Fonctionnant au LPG	très bon	bon	moyen	plutôt faible	faible
e. Fonctionnant au gaz naturel (CNG)	très bon	bon	moyen	plutôt faible	faible
f. Fonctionnant au biogaz	très bon	bon	moyen	plutôt faible	faible
g. Fonctionnant au biocarburant (biodiesel, bioethanol,...) <sup>92</sup>	très bon	bon	moyen	plutôt faible	faible
h. Fonctionnant à l'hydrogène <sup>93</sup>	très bon	bon	moyen	plutôt faible	faible

2. Lorsque vous estimez votre niveau de connaissance insuffisant, quelle sorte d'information souhaiteriez-vous obtenir en priorité?

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.....  
.....  
.....  
.....

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<sup>92</sup> Nous considérons ici les véhicules qui nécessitent une transformation pour fonctionner au biocarburant (biocarburant pure ou mélange à haute concentration)

<sup>93</sup> Avec un moteur à combustion interne

**3. Possédez-vous un véhicule propre/Utilisez-vous un carburant alternatif?**

- Oui**
- Non**

**Si oui, lequel ?**.....

**Citez les avantages de ce type de véhicule/de carburant**

.....  
.....  
.....  
.....  
.....  
.....

**Citez les inconvénients/problèmes éventuellement rencontrés**

.....  
.....  
.....  
.....  
.....  
.....

**4. Avez-vous l'intention d'acheter un véhicule propre/d'utiliser un carburant alternatif?**

- Oui**
- Non**

**Si oui, lequel ?**.....

**Pourquoi ?**

.....  
.....  
.....  
.....  
.....  
.....

**Si non (vous n'avez ni l'intention d'acheter un véhicule propre ni l'intention d'utiliser un carburant alternatif), pourquoi ?**

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**5. Quels types de mesures vous encourageraient à acheter un véhicule propre/à utiliser un carburant alternatif?**

.....  
.....  
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.....



*La partie I du questionnaire a trait aux obstacles à la diffusion des véhicules propres en général (questions 6 et 7).*

*La partie II du questionnaire a trait aux obstacles à la diffusion de certaines catégories de véhicules propres (questions 8 à 16).*

*Si vous le souhaitez, vous pouvez ne répondre qu'à l'une des deux parties.*

*Merci de répondre en tout cas à la partie III (données personnelles).*

## **Partie I : Obstacles à la diffusion des véhicules propres en général**

**6. Evaluer l'importance que vous attribuez aux différents obstacles suivant en leur attribuant une cotation de 1 (pas important) à 10 (très important). Entourez le 0 dans le cas où cet obstacle vous paraît inexistant.**

- Prix du véhicule à l'achat élevé	0	1	2	3	4	5	6	7	8	9	10
- Autonomie limitée	0	1	2	3	4	5	6	7	8	9	10
- Vitesse limitée	0	1	2	3	4	5	6	7	8	9	10
- Batteries ou réservoirs lourds et encombrants (espace utile réduit)	0	1	2	3	4	5	6	7	8	9	10
- Temps de ravitaillement/de recharge plus long	0	1	2	3	4	5	6	7	8	9	10
- Peu d'infrastructures de recharge et de ravitaillement	0	1	2	3	4	5	6	7	8	9	10
- Services après-vente et de maintenance insuffisants	0	1	2	3	4	5	6	7	8	9	10
- Offre restreinte (quantitativement) et peu variée	0	1	2	3	4	5	6	7	8	9	10
- Manque d'informations	0	1	2	3	4	5	6	7	8	9	10
- Préoccupation environnementale personnelle insuffisante	0	1	2	3	4	5	6	7	8	9	10
- Manque de conviction personnelle par rapport à l'utilité environnementale de ces véhicules	0	1	2	3	4	5	6	7	8	9	10
- Sensation de conduite différente	0	1	2	3	4	5	6	7	8	9	10
- Nécessité de modifier ses habitudes	0	1	2	3	4	5	6	7	8	9	10
- Diffusion de ces véhicules encore trop restreinte	0	1	2	3	4	5	6	7	8	9	10
- Manque de confiance concernant la sécurité	0	1	2	3	4	5	6	7	8	9	10
- Manque de confiance concernant la fiabilité technique	0	1	2	3	4	5	6	7	8	9	10

- Design trop spécifique	0	1	2	3	4	5	6	7	8	9	10
- Manque de correspondance avec ma personnalité	0	1	2	3	4	5	6	7	8	9	10
- Manque de réglementation et de normes	0	1	2	3	4	5	6	7	8	9	10
- Système de ravitaillement différent	0	1	2	3	4	5	6	7	8	9	10
- Technologie immature	0	1	2	3	4	5	6	7	8	9	10
- Coût de l'entretien élevé	0	1	2	3	4	5	6	7	8	9	10
- Autre ? .....	0	1	2	3	4	5	6	7	8	9	10
- Autre ?.....	0	1	2	3	4	5	6	7	8	9	10

**7. Lors de l'achat d'un véhicule, accordez-vous surtout de l'importance au prix d'achat ou accordez-vous surtout de l'importance au coût du véhicule sur l'ensemble du cycle de vie (prix du carburant, de l'entretien etc.), au point d'effectuer les démarches nécessaires pour obtenir ces informations? Cocher si possible l'une des deux alternatives :**

- Prix d'achat**
- Coût sur l'ensemble du cycle de vie du véhicule**

**Partie II : obstacles à la diffusion de certaines catégories de véhicules propres**

**8. Quels sont les principaux obstacles qui vous empêcheraient d'acheter un véhicule hybride ?**

.....  
.....  
.....  
.....  
.....  
.....

**9. Quels sont les principaux obstacles qui vous empêcheraient d'acheter un véhicule électrique ?**

.....  
.....  
.....  
.....  
.....  
.....

**10. Quels sont les principaux obstacles qui vous empêcheraient d'acheter un véhicule à pile à combustible?**

.....  
.....  
.....  
.....  
.....  
.....

**11. Quelles sont les principaux obstacles qui vous empêcheraient d'utiliser du LPG ?**

.....  
.....  
.....  
.....  
.....

**12. Quelles sont les principaux obstacles qui vous empêcheraient d'utiliser du gaz naturel ?**

.....  
.....  
.....  
.....  
.....

**13. Quelles sont les principaux obstacles qui vous empêcheraient d'utiliser du biogaz ?**

.....  
.....  
.....  
.....  
.....

**14. Quelles sont les principaux obstacles qui vous empêcheraient d'utiliser du biocarburant ?**

.....  
.....  
.....  
.....  
.....

**15. Quelles sont les principaux obstacles qui vous empêcheraient d'utiliser de l'hydrogène ?**

.....  
.....  
.....  
.....  
.....

**16. Évaluez pour chacune des catégories de véhicules, l'importance que vous attribuez aux différents obstacles mentionnés en leur attribuant une cotation de 1 (pas important) à 10 (très important) dans la case correspondante. Indiquez 0 dans le cas où cet obstacle vous paraît inexistant.**

	A pile à						
	Hybride	Electrique	combustible	LPG <sup>94</sup>	CNG <sup>95</sup>	Biocarburant	Hydrogène
Prix du véhicule à l'achat élevé							
Autonomie limitée							
Vitesse limitée							
Batteries ou réservoirs lourds et encombrants (réduit l'espace utile)							
Temps de recharge/de ravitaillement plus long							
Peu d'infrastructures de recharge et de ravitaillement							
Services après-vente et de maintenance insuffisants							

<sup>94</sup> Liquid petroleum gas

<sup>95</sup> Compressed natural gas

**A pile à**

<b>Hybride</b>	<b>Electrique</b>	<b>combustible</b>	<b>LPG<sup>96</sup></b>	<b>CNG<sup>97</sup></b>	<b>Biocarburant</b>	<b>Hydrogène</b>
----------------	-------------------	--------------------	-------------------------	-------------------------	---------------------	------------------

Offre de véhicules restreinte (quantitativement) et peu variée						
Manque d'informations						
Manque de conviction personnelle par rapport à l'utilité environnementale de ces véhicules						
Sensation de conduite différente						
Nécessité de modifier ses habitudes						
Diffusion de ces véhicules encore trop restreinte						
Manque de confiance concernant la sécurité						
Manque de confiance concernant la fiabilité technique						
Design spécifique						
Manque de réglementation et de normes						

---

<sup>96</sup> Liquid petroleum gas  
<sup>97</sup> Compressed natural gas

	A pile à										
	Hybride	Electrique	combustible	LPG <sup>98</sup>	CNG <sup>99</sup>	Biocarburant	Hydrogène				
Système de ravitaillement différent											
Technologie immature											
Coût de l'entretien élevé											
Prix des batteries élevé											
Problème d'accès aux parkings souterrains											
Surcoût pour l'adaptation du véhicule au LPG											
Taxe annuelle supplémentaire											
Autre ?											
Autre ?											

<sup>98</sup> Liquid petroleum gas

<sup>99</sup> Compressed natural gas



### **Partie III : Données personnelles**

**17. Quel est votre sexe?**

- Masculin
- Féminin

**18. Quelle est votre date de naissance?**

.....

**19. Combien de personnes compte votre ménage?**

- Nombre d'adultes: ...
- Nombre d'enfants: ...

**20. Quelle est votre plus haut niveau de formation ?**

- Enseignement primaire
- Enseignement secondaire (inférieur)
- Enseignement secondaire (supérieur)
- Enseignement supérieur
- Universitaire
- Post-universitaire

**21. Quelle est votre statut professionnel?**

- Fonctionnaire
- Ouvrier
- Employé
- Pensionné
- Etudiant
- Indépendant
- Autre (spécifiez): ...

**22. Dans quelle tranche de revenus nets se situe votre ménage (allocations sociales, familiales et pensions comprises)?**

- Moins de 900 € net/mois
- Entre 901 et 1300 € net/mois
- Entre 1301 et 1700 € net/mois
- Entre 1701 et 2100 € net/mois
- Entre 2101 et 2900 € net/mois
- Entre 2901 et 3300 € net/mois
- Entre 3301 et 3700 € net/mois
- Entre 3701 et 4100 € net/mois
- Plus de 4100 € net/mois

**23. Souhaitez-vous participer à une enquête supplémentaire via internet concernant votre comportement en matière d'achat de voiture ?**

- Oui, mon adresse e-mail est la suivante

.....

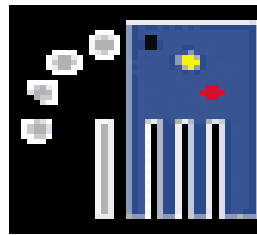
- Non

*Nous vous remercions pour votre collaboration*

## **B. Questionnaire for the Motor Show of Brussels: Dutch version**



Centrum voor Economische en Sociale Milieustudies van de Universit  Libre de Bruxelles (CEESE-ULB)



Federale Overheidsdienst voor Wetenschapsbeleid

### **Enqu te over de hinderpalen voor een brede verspreiding van milieuvriendelijke voertuigen**

Geachte Mevrouw, Geachte Heer,

Verschillende Belgische onderzoekscentra<sup>100</sup> werken actief samen met de bedoeling om maatregelen uit te werken ter verspreiding van meer milieuvriendelijke voertuigen<sup>101</sup> en om deze aan de overheid voor te leggen<sup>102</sup>. Als consument met interesse voor nieuwe ontwikkelingen in de automobielsector, kan u ons helpen om de voornaamste hinderpalen voor een brede verspreiding van schone voertuigen te identificeren<sup>103</sup>.

In deze context stellen we u voor om 15 minuten van uw tijd te besteden aan het invullen aan volgende vragenlijst. Het antwoordformulier is uiteraard anoniem en zal volledig confidentieel behandeld worden<sup>104</sup>.

Alvast hartelijk dank bij voorbaat voor uw medewerking

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<sup>100</sup> Het Centrum voor Economische en Sociale Milieustudies van de Universit  Libre de Bruxelles (CEESE-ULB), het departement Transport en Logistiek van de Vrije Universiteit Brussel VUB (MOSI-T), de onderzoekseenheid transporttechnologie van de vakgroep ETEC van de VUB, de Vlaamse Instelling voor Technologisch Onderzoek (VITO) en RDC environment

<sup>101</sup> We defini ren een milieuvriendelijk voertuig als een voertuig dat zowel een beperkte bijdrage levert aan de opwarming van de aarde (CO<sub>2</sub> emissies), als aan de verslechtering van de luchtkwaliteit (stofdeeltjes, NO<sub>x</sub> emissies,...) en weinig lawaaihinder veroorzaakt. De milieuvriendelijkheid van een wagen kan gemeten worden aan de hand van zijn Ecoscore. In deze Ecoscore worden verschillende schade-effecten in rekening gebracht zoals het broeikas-effect, gezondheidseffecten en effecten op ecosystemen en geluidshinder. De Ecoscore geeft een score tussen 0 (oneindig vervuilend) en 100 (emissievrij en stil). Een Ecoscore van 70 is hierbij de referentiewaarde voor een milieuvriendelijk voertuig.

<sup>102</sup> CLEVER "Clean Vehicle Research: LCA and Policy Measures" gefinancierd door de Federale Overheidsdienst voor Wetenschapsbeleid.

<sup>103</sup> Het CEESE (ULB) heeft binnen het « CLEVER » project de opdracht om de hinderpalen voor de verspreiding van milieuvriendelijke voertuigen te identificeren

<sup>104</sup> De antwoordformulieren blijven in het uitsluitend bezit van de Federale Overheidsdienst Wetenschapsbeleid.

## **Voorafgaande vragen**

**1. Wat is volgens uzelf het niveau van uw algemene kennis van volgende voertuigen die doorgaans als milieuvriendelijk bestempeld worden ?**

<b>a. Hybride Voertuigen</b>	zeer goed	goed	matig	eerder zwak	zwak
<b>b. (Batterij) Elektrische Voertuigen</b>	zeer goed	goed	matig	eerder zwak	zwak
<b>c. Brandstofcelvoertuigen</b>	zeer goed	goed	matig	eerder zwak	zwak
<b>d. LPG-voertuigen</b>	zeer goed	goed	matig	eerder zwak	zwak
<b>e. Aardgasvoertuigen (CNG)</b>	zeer goed	goed	matig	eerder zwak	zwak
<b>f. Biogasvoertuigen</b>	zeer goed	goed	matig	eerder zwak	zwak
<b>g. Voertuigen op vloeibare biobrandstoffen (biodiesel/bio-ethanol,...)<sup>105</sup></b>	zeer goed	goed	matig	eerder zwak	zwak
<b>h. Voertuigen op waterstof<sup>106</sup></b>	zeer goed	goed	matig	eerder zwak	zwak

**2. Over welke bijkomende informatie zou u prioritair wensen te beschikken voor de voertuigen waarvan u het niveau van uw kennis als ontoereikend bestempeld heeft?**

.....  
.....  
.....  
.....  
.....

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<sup>105</sup> Men beschouwt hier enkel de voertuigen die een aanpassing vereisen voor het gebruik van de biobrandstoffen

<sup>106</sup> Met verbrandingsmotoren

**3. Bent u eigenaar van een milieuvriendelijk voertuig of rijdt uw voertuig op een alternatieve brandstof?**

- Ja
- Neen

**Zo ja, verklaar nader over welk type voertuig of brandstof het gaat?**

.....

**Noem de voordelen van dit type voertuig of brandstof op**

.....  
.....  
.....  
.....  
.....  
.....

**Noem de nadelen of ervaren problemen er van op**

.....  
.....  
.....  
.....  
.....  
.....

**4. Wenst u een milieuvriendelijk voertuig aan te schaffen of wenst u een alternatieve brandstof te gebruiken?**

- Ja
- Neen

**Zo ja, verklaar om welk type voertuig of brandstof het gaat.....**

**Waarom ?**

.....  
.....  
.....  
.....  
.....  
.....

**Zo neen, wat verklaart uw beslissing?**

.....  
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.....  
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.....

**5. Welke soort maatregelen zou u kunnen aanzetten om een milieuvriendelijk voertuig aan te schaffen of om alternatieve brandstoffen te gebruiken?**

.....  
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.....  
.....  
.....  
.....

*Deel I van de vragenlijst betreft de hinderpalen voor de verspreiding van milieuvriendelijke voertuigen in het algemeen (vragen 6 en 7).*

*Deel II van de vragenlijst betreft de hinderpalen voor de verspreiding van bepaalde categorieën milieuvriendelijke voertuigen in het bijzonder (vragen 8 tot 16).*

*Indien u het wenst, kan u ervoor kiezen om slechts 1 van beide delen te beantwoorden.*

*Wel vragen we u om in ieder geval deel III van de vragenlijst (persoonlijke gegevens) te willen beantwoorden.*

## Deel I : Hinderpalen voor de verspreiding van milieuvriendelijke voertuigen in het algemeen

**6. Gelieve, naar uw mening, het belang van volgende hinderpalen in het algemeen aan te duiden. Ken hiervoor een score toe gaande van 1 (niet belangrijk) tot 10 (zeer belangrijk). Duid 0 aan indien dit u geen hinderpaal lijkt te zijn.**

- Hoge aankooprijks van het voertuig	0	1	2	3	4	5	6	7	8	9	10
- Beperkt rijbereik	0	1	2	3	4	5	6	7	8	9	10
- Beperkte snelheid	0	1	2	3	4	5	6	7	8	9	10
- Zware en hinderlijke batterijen of brandstoftank (verminderen de nuttige laadruimte)	0	1	2	3	4	5	6	7	8	9	10
- Langere tank- of laadtijden	0	1	2	3	4	5	6	7	8	9	10
- Ontoereikende infrastructuur voor tanken, en landen	0	1	2	3	4	5	6	7	8	9	10
- Ontoereikende dienst na verkoop en onderhoudsdienst	0	1	2	3	4	5	6	7	8	9	10
- Kwantitatief beperkt en weinig gevarieerd aanbod	0	1	2	3	4	5	6	7	8	9	10
- Gebrek aan informatie	0	1	2	3	4	5	6	7	8	9	10
- Gebrek aan milieubewustheid	0	1	2	3	4	5	6	7	8	9	10
- Gebrek aan persoonlijke overtuiging omtrent de milieumeerwaarde van deze voertuigen	0	1	2	3	4	5	6	7	8	9	10
- Verschillende rijervaring	0	1	2	3	4	5	6	7	8	9	10
- Vereiste om gewoonten te veranderen	0	1	2	3	4	5	6	7	8	9	10
- Verspreiding van deze voertuigen is nog te beperkt	0	1	2	3	4	5	6	7	8	9	10
- Wantrouwen betreffende de veiligheid	0	1	2	3	4	5	6	7	8	9	10
- Wantrouwen betreffende de technische betrouwbaarheid	0	1	2	3	4	5	6	7	8	9	10



- Design is te kenmerkend	0	1	2	3	4	5	6	7	8	9	10
- Gebrek aan regelgeving en normen	0	1	2	3	4	5	6	7	8	9	10
- Verschillend tanksysteem	0	1	2	3	4	5	6	7	8	9	10
- Technologie is nog niet rijp	0	1	2	3	4	5	6	7	8	9	10
- Hoge onderhoudskosten	0	1	2	3	4	5	6	7	8	9	10
- Komt niet overeen met mijn persoonlijkheid	0	1	2	3	4	5	6	7	8	9	10
- Andere ?.....	0	1	2	3	4	5	6	7	8	9	10
- Andere ?.....	0	1	2	3	4	5	6	7	8	9	10

**7. Wanneer u een voertuig aanschaft hecht u voornamelijk belang aan (vink het gepaste antwoord aan) de aankoopprijs of voornamelijk aan de kost van het voertuig over de hele levenscyclus (prijs van de brandstof, onderhoud, ...) waarover u dan ook bereid bent om moeite te doen om informatie te verzamelen**

- De aankoopprijs
- De kost van het voertuig over de hele levenscyclus

**Deel II : hinderpalen voor de verspreiding van sommige soorten milieuvriendelijke voertuigen in het bijzonder**

**8. Wat zijn de voornaamste hinderpalen die ervoor zorgen dat u geen hybride voertuig zou kopen?**

.....  
.....  
.....  
.....  
.....  
.....

**9. Wat zijn de voornaamste hinderpalen die ervoor zorgen dat u geen elektrisch voertuig zou kopen?**

.....  
.....  
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.....  
.....

**10. Wat zijn de voornaamste hinderpalen die ervoor zorgen dat u geen brandstofcelvoertuig zou kopen?**

.....  
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.....  
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**11. Wat zijn de voornaamste hinderpalen die ervoor zorgen dat u geen LPG zou gebruiken?**

.....  
.....  
.....  
.....  
.....

**12. Wat zijn de voornaamste hinderpalen die ervoor zorgen dat u geen aardgas zou gebruiken?**

.....  
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.....  
.....  
.....

**13. Wat zijn de voornaamste hinderpalen die ervoor zorgen dat u geen biogas zou gebruiken?**

.....  
.....  
.....  
.....  
.....

**14. Wat zijn de voornaamste hinderpalen die ervoor zorgen dat u geen biobrandstof zou gebruiken?**

.....  
.....  
.....  
.....  
.....

**15. Wat zijn de voornaamste hinderpalen die ervoor zorgen dat u geen waterstofgas zou gebruiken?**

.....  
.....  
.....  
.....  
.....

16. Gelieve, voor elk type voertuig, het belang van volgende hinderpalen aan te duiden. Ken hiervoor een score toe gaande van 1 (niet belangrijk) tot 10 (zeer belangrijk). Duid 0 aan indien dit u geen hinderpaal lijkt te zijn.

	Hybride	Electrisch	Brandstofcel	LPG <sup>107</sup>	CNG <sup>108</sup>	Biobrandstoffen	Waterstof
Hoge aankoop prijs van het voertuig							
Beperkt rijbereik							
Beperkte snelheid							
Zware en hinderlijke batterijen of brandstof tank (verminderen nuttige laadruimte)							
Langere tank- of laadtijden							
Ontoereikende infrastructuur voor tanken en landen							
Ontoereikende dienst na verkoop en onderhoudsdienst							

<sup>107</sup> Liquid petroleum gas

<sup>108</sup> Compressed natural gas

**Hybride    Electriche    Brandstofcel    LPG<sup>109</sup>    CNG<sup>110</sup>    Biobrandstoffen    Waterstof**

Kwantitatief beperkt en weinig gevarieerd aanbod

--	--	--	--	--	--	--	--

Gebrek aan informatie

--	--	--	--	--	--	--	--

Gebrek aan persoonlijke overtuiging omtrent de milieumeerwaarde van deze voertuigen

--	--	--	--	--	--	--	--

Verschillende rijervaring

--	--	--	--	--	--	--	--

Vereiste om gewoonten te veranderen

--	--	--	--	--	--	--	--

Verspreiding van deze voertuigen is nog te beperkt

--	--	--	--	--	--	--	--

Wantrouwen betreffende de veiligheid

--	--	--	--	--	--	--	--

Wantrouwen betreffende de technische betrouwbaarheid

--	--	--	--	--	--	--	--

Design kenmerkend

--	--	--	--	--	--	--	--

Gebrek aan regelgeving en normen

--	--	--	--	--	--	--	--

<sup>109</sup> Liquid petroleum gas

<sup>110</sup> Compressed natural gas

	Hybride	Electrische	Brandstofcel	LPG <sup>111</sup>	CNG <sup>112</sup>	Biobrandstoffen	Waterstof
Verskillend tanksysteem							
Technische is nog niet rijp							
Hoge onderhoudskosten							
Hoge kost van de batterijen							
Problemen van toegang tot ondergrondse parkeerruimten							
Extra kost om het voertuig tot LPG voertuig om te bouwen							
Bijkomende jaarlijkse belasting voor LPG							
Andere ?							
Andere ?							

---

<sup>111</sup> Liquid petroleum gas

<sup>112</sup> Compressed natural gas

## **Deel III : Persoonlijke gegevens**

**17. Wat is uw geslacht?**

- Mannelijk
- Vrouwelijk

**18. Wat is uw geboortedatum?**

.....

**19. Uit hoeveel personen bestaat uw gezin?**

- Aantal volwassenen: ...
- Aantal kinderen: ...

**20. Wat is uw hoogste voltooide opleiding ?**

- Lager onderwijs
- (Lager) middelbaar onderwijs
- (Hoger) middelbaar onderwijs
- Hoger onderwijs
- Universitair onderwijs
- Post-universitair onderwijs

**21. Wat is uw beroepssituatie?**

- Ambtenaar
- Arbeider
- Bediende
- Gepensioneerd
- Student
- Zelfstandige
- Andere (specifieer): ...

**22. In welke inkomensklasse bevindt uw gezin zich (inclusief sociale uitkeringen, kinderbijslag en pensioenen)?**

- Minder dan 900 € netto/maand
- Tussen 901 en 1300 € netto/maand
- Tussen 1301 en 1700 € netto/maand
- Tussen 1701 en 2100 € netto/maand
- Tussen 2101 en 2900 € netto/maand
- Tussen 2901 en 3300 € netto/maand
- Tussen 3301 en 3700 € netto/maand
- Tussen 3701 en 4100 € netto/maand
- Meer dan 4100 € netto/maand

**23. Zou u geïnteresseerd zijn om eventueel deel te nemen aan een computer gestuurde enquête met betrekking tot uw aankoopgedrag van wagens?**

- Ja, mijn e-mailadres is: .....
- Neen

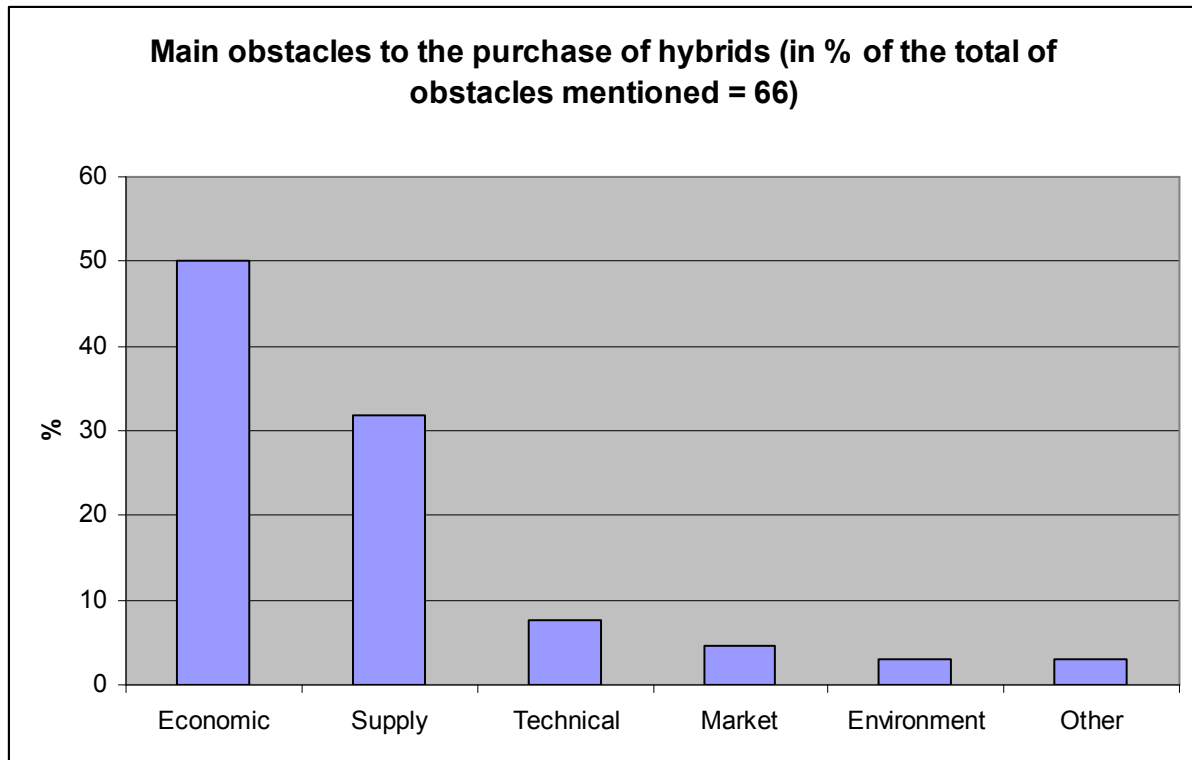
*Wij danken u voor uw medewerking.*



## Appendix 2: Barriers to the purchase/use of alternative vehicles by technology (results of open questions)

### a. Hybrid

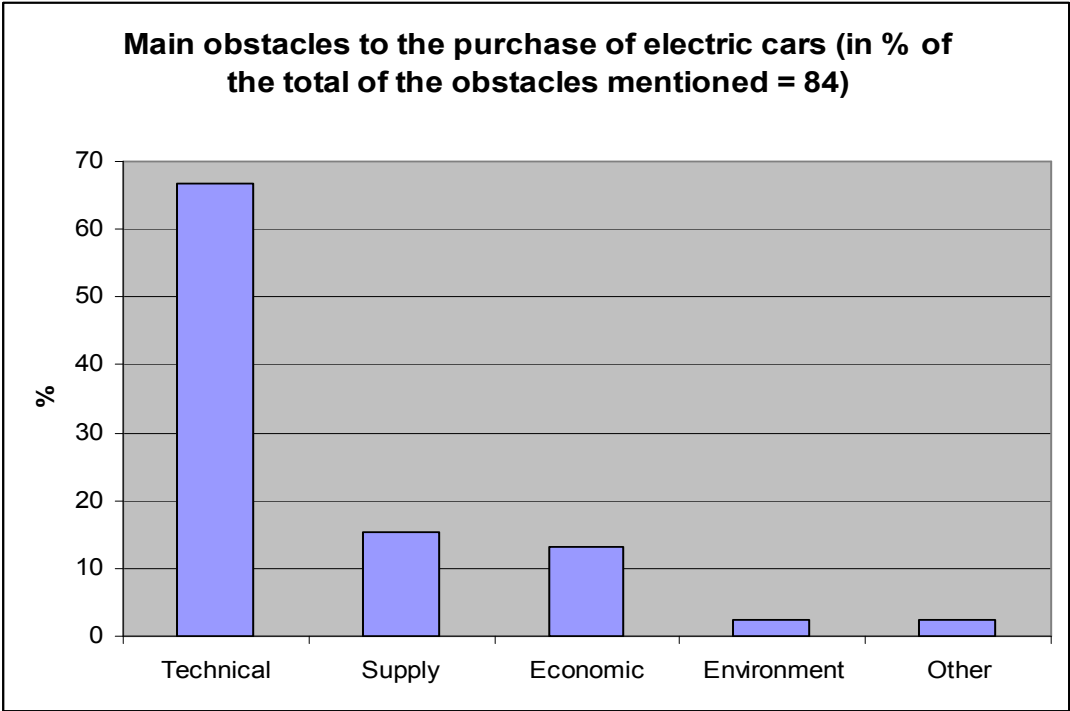
Response rate = 48



- Supply barriers: non convenience of the models, the design and the lack of models are the main groups of barrier. 2 people mentioned the lack of after-sale services, whose one used its information as: “lack of diffusion so lack of after-sale services” (short cut).
- Other barrier: one person mentioned that hybrid is not profitable in his case as he drives mainly on motorway.

**b. Electric vehicles**

Response rate = 51

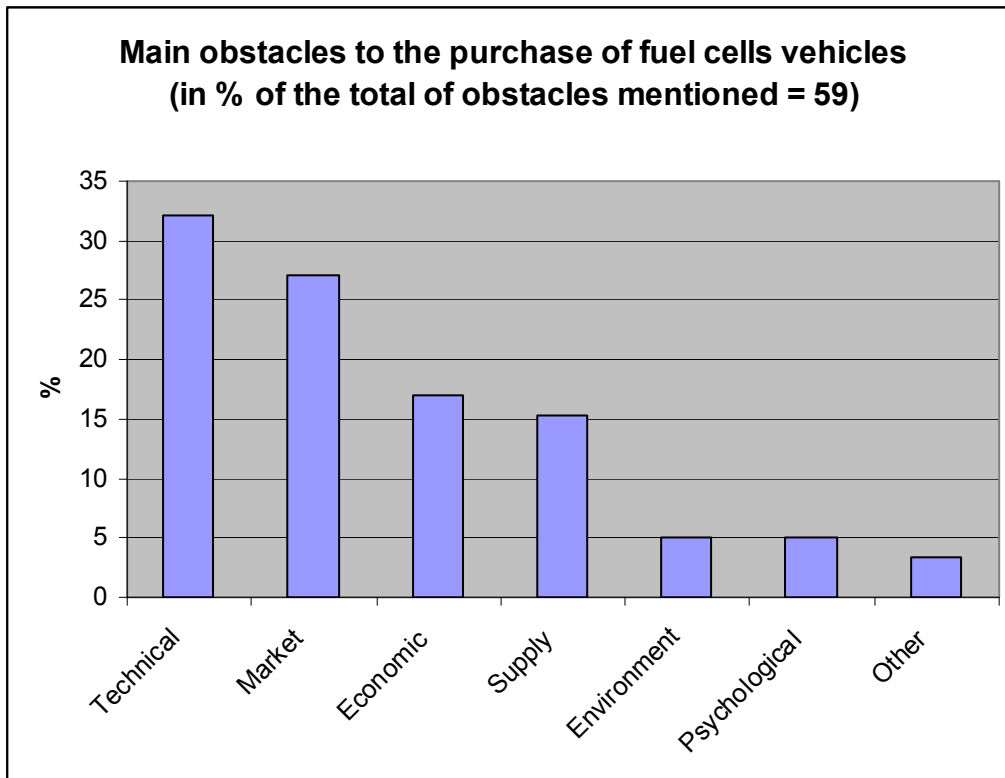


- Technical barrier: limited range is by far the most important technical barrier, then but far below, we have the long recharging time and the space of the car<sup>113</sup>.

<sup>113</sup> Here the safety was put in the technical barriers (only 2, whose one was related to “safety with other vehicles”)

### c. Fuel cells

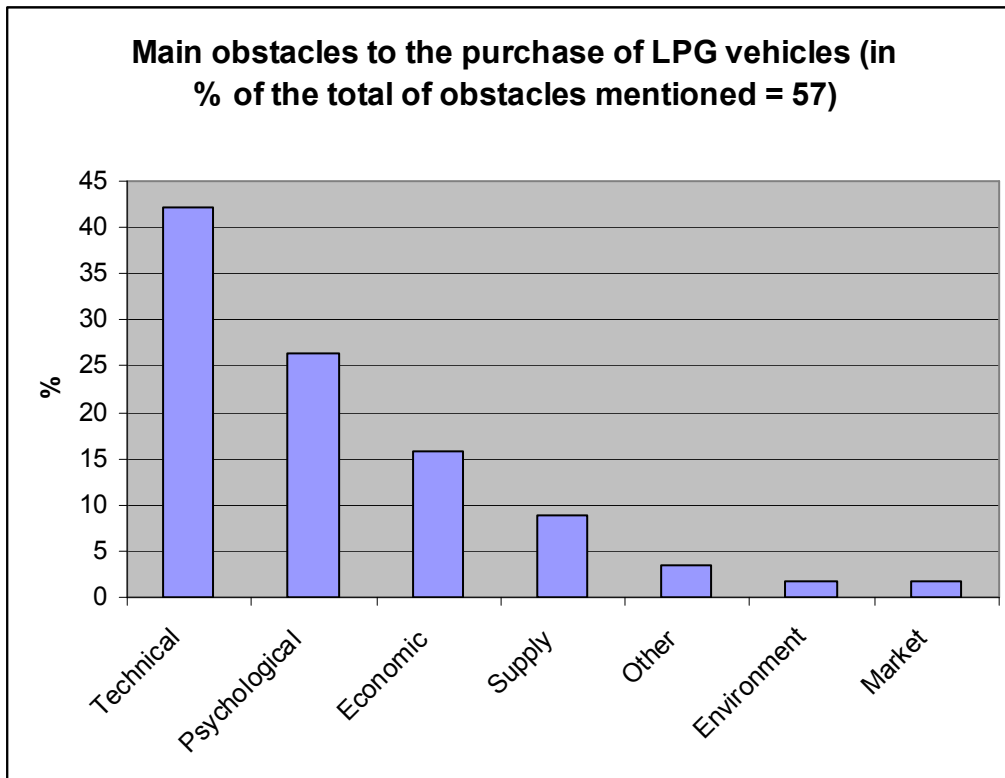
Response rate = 43



- Technical barriers: various items are mentioned, but the question of space, immaturity and range are coming more often. In market barriers we have mostly the lack of information, and also but far below the lack of diffusion.
- Environmental barriers: question of recycling is mentioned. One person mentioned that it is better to use directly electricity (category “other”).
- Psychological: lack of confidence in safety.

#### d. LPG

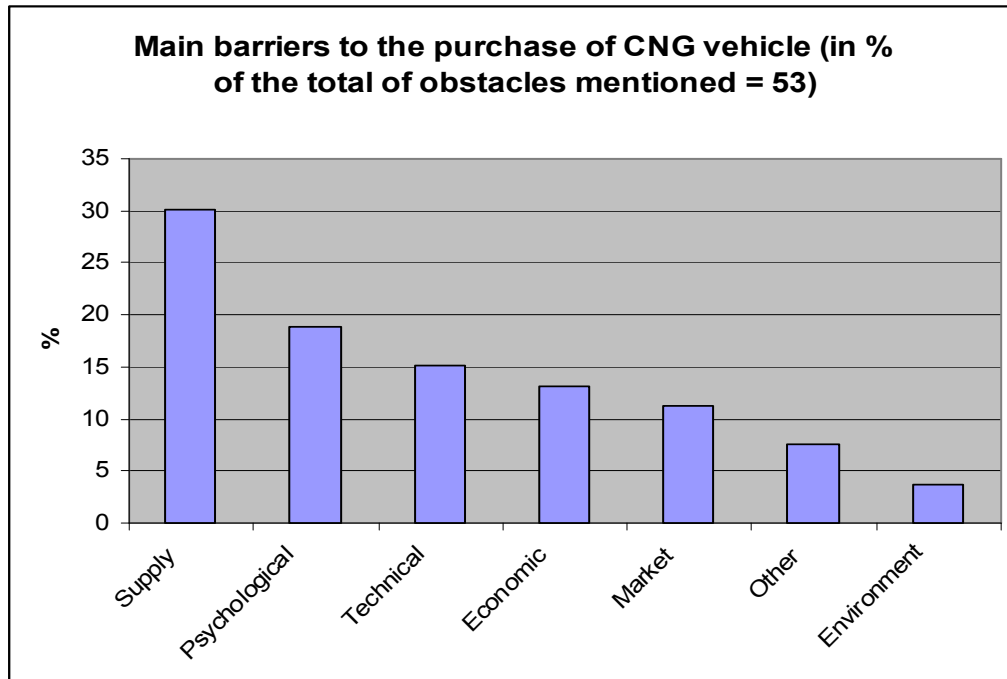
Response rate = 37



- Technical barriers: various items; the more frequent ones are the problems of access to underground parking and the space in the car.
- Psychological barriers: mainly the fear associated with gas; one person mentioned also that it is an “old system” (bad image).
- Economic barriers, we have mainly the price of the installations and the additional tax.

### e. CNG

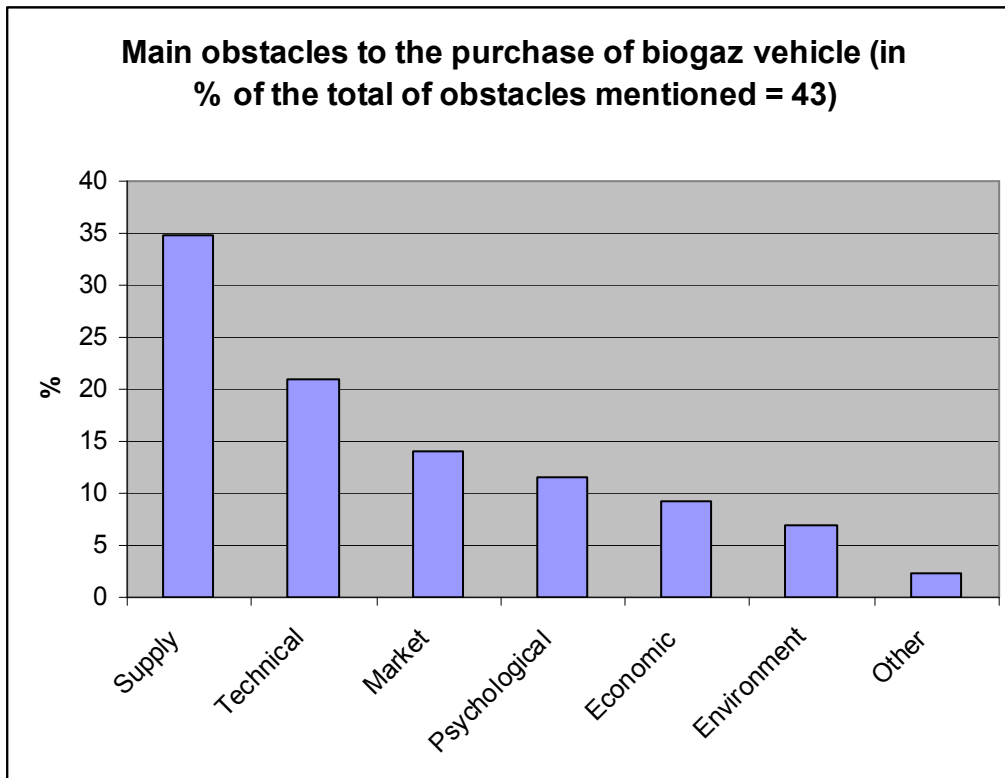
Response rate = 36



- Supply barriers: mainly lack of refuelling stations (and far below lack of vehicles).
- Psychological barriers: lack of confidence in safety (fear of gas).
- Market barriers: lack of information (one person asked the difference between LPG and CNG).

**f. Biogaz.**

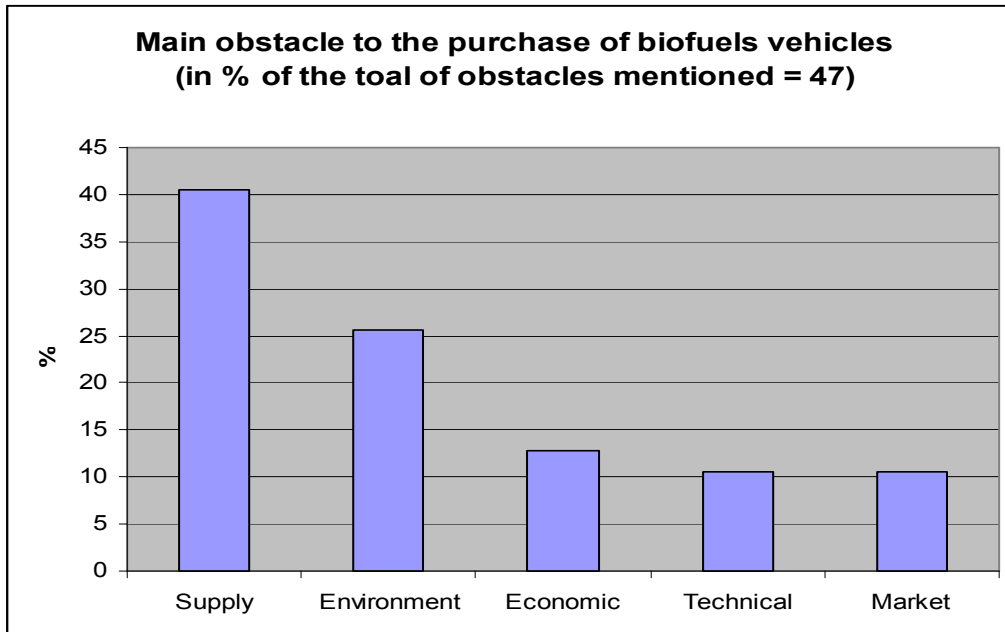
Response rate = 32



- Supply barriers: mainly lack of refuelling stations
- Psychological barriers: lack of confidence in safety

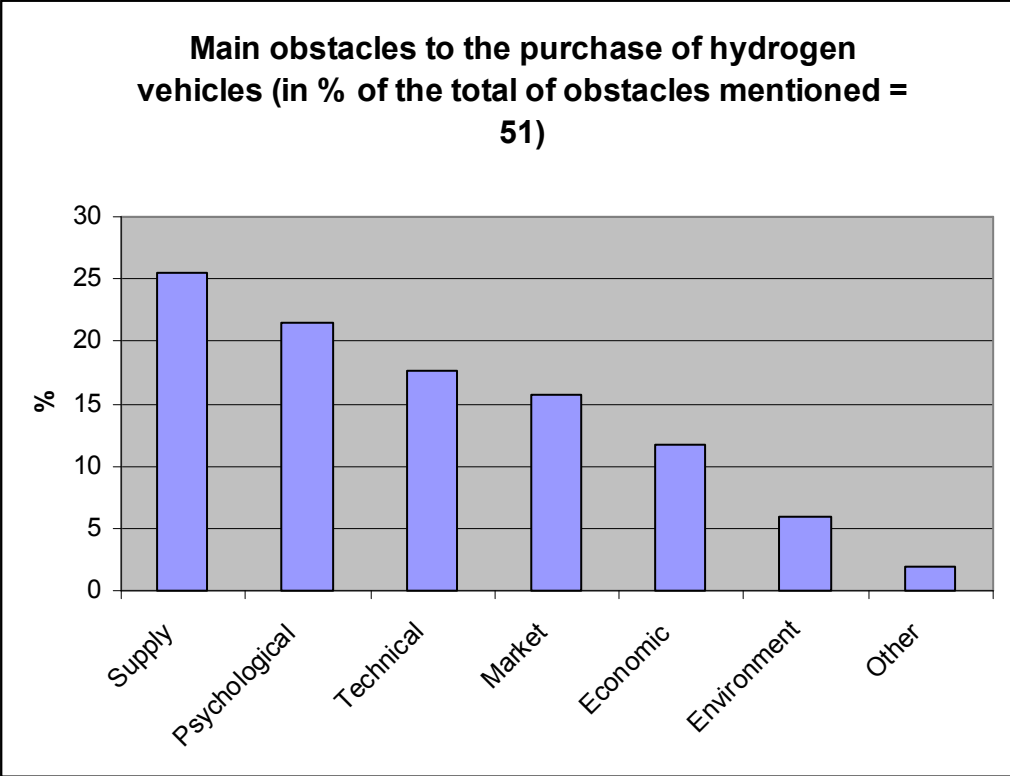
### g. Biofuel

Response rate = 38



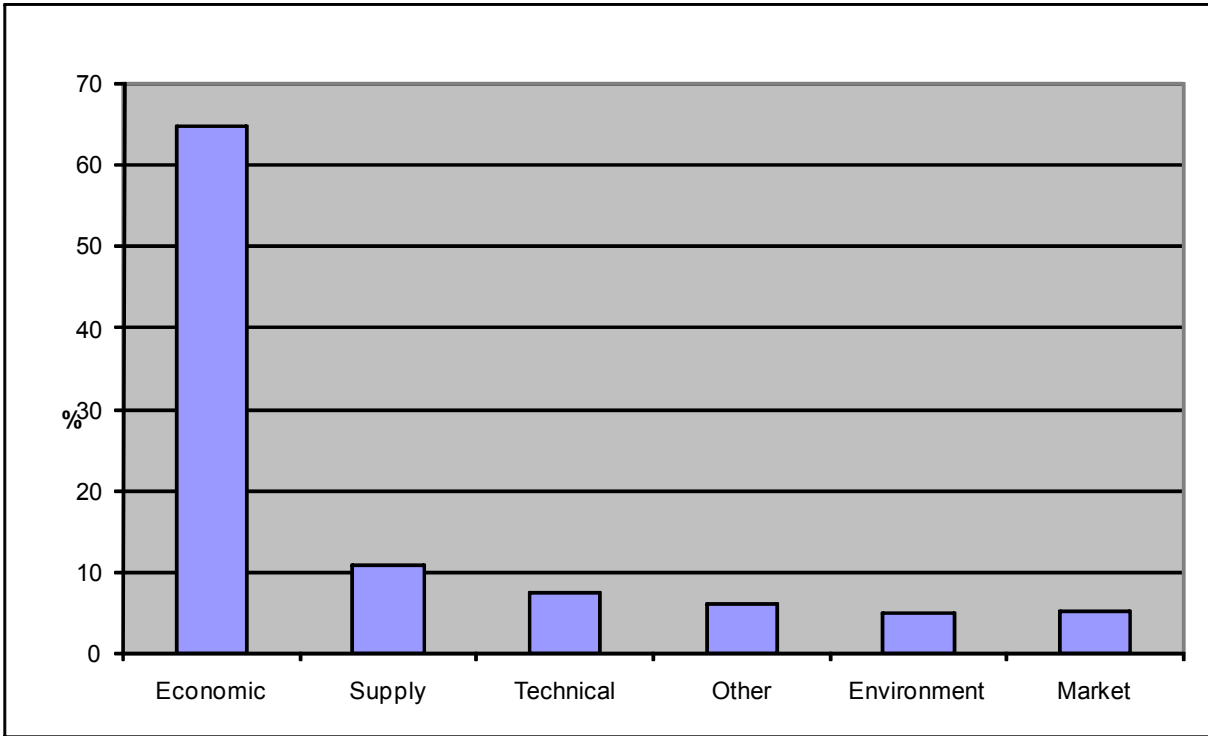
- Supply barriers: lack of refuelling stations
- Environmental barriers: in this category we have the “ethical barriers” and the environment barriers (non conviction about the environmental benefits)

**h. Response rate = 37**





**Appendix 3: Type of policy measures to implement according to the respondents of the Motor Show (% of the total of suggested measures)**



*N (sample size) = 218*

## Appendix 4: Questionnaire for supply-side stakeholders and "experts"<sup>114</sup>

### A. Questionnaire for supply-side stakeholders and experts: French version



Chère Madame, cher Monsieur,

Ce questionnaire, développé par Marion Englert, du Centre d'Etudes Economiques et Sociales de l'Environnement de l'Université Libre de Bruxelles (CEESE-ULB), s'inscrit dans le cadre d'une étude sur les véhicules propres (« projet CLEVER ») impliquant plusieurs partenaires universitaires belges<sup>115</sup> et commandité par la politique scientifique fédérale (Belspo).

**Les objectifs de ce questionnaire sont de déterminer les barrières au développement des véhicules propres en Belgique, et d'évaluer l'importance relative de ces différentes barrières.**

Par véhicule propre, nous entendons un véhicule qui utilise des technologies alternatives et/ou des carburants alternatifs aux véhicules à moteur à combustion fonctionnant uniquement aux carburants fossiles (essence et diesel), et en principe caractérisé par un impact environnemental global plus favorable. En l'occurrence il s'agit :

1) des véhicules à mode de propulsion alternatif :

- Hybrides
- Electriques (batteries)
- A pile à combustible

2) des véhicules utilisant des carburants alternatifs :

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<sup>114</sup> Note that in the questionnaire the categories of barriers may slightly differ from the list used in the study and presented in part I. This is because it appears (during the data treatment and treatment of the information) that it was sometimes more relevant to split one pre-identified category into different ones, or to add new categories. For example, the category of "environmental and societal barriers" (mentioned in part I) do not appear directly in the categories mentioned in the questionnaire, and was added during data treatment as it was considered as an important and quite specific barrier.

<sup>115</sup> Le Centre d'Etudes Economiques et Sociales de l'Environnement de l'Université Libre de Bruxelles (CEESE-ULB), le département Transport et Logistique de la « Vrije Universiteit Brussel » VUB (MOSI), l'unité de recherche sur les technologies de transport ETEC de la VUB, l'Institut pour la recherche technologique VITO (« Vlaamse instelling voor technologisch onderzoek ») et RDC environnement

- LPG (liquid petroleum gas)
- Gaz naturel comprimé (CNG)
- Biocarburant (bioéthanol, méthanol, biodiesel, huile de colza)
- Biogaz
- Hydrogène

Une série de barrières (actuelles) ont été pré-identifiées sur base d'un travail de recherche et d'une revue de la littérature. Celles-ci peuvent être classées par groupe selon leur nature :

- a) Barrières techniques (inconvenients techniques constituant des désavantages par rapport aux véhicules conventionnels. Ex. : autonomie limitée,...)
- b) Barrières économiques (ex. : surcoûts, prix,...)
- c) Barrières de marché (autres facteurs influençant négativement l'offre et la demande de véhicules propres. Ex. : manque de concessionnaires, d'infrastructures de ravitaillement,...)
- d) Barrières législatives et réglementaires (ex. : manque de normes harmonisées pour les nouveaux carburants,...)
- e) Barrières sociales et psychologiques (relatives aux comportements « non-rationnels » des consommateurs. Ex. : effet d'habitude,...)
- f) Barrières institutionnelles et politiques (lobbying, insuffisance de dispositions contraignantes,...)

Bien évidemment, il existe de fortes interrelations entre ces différentes barrières. En effet, celles-ci s'intègrent dans un ensemble de relations causales complexes. Un objectif secondaire de la présente étude est de dégager un éventuel schéma représentant ces interrelations.

Certaines des barrières pré-identifiées freinent le développement des véhicules propres en général et d'autres (plus spécifiques) ne s'appliquent qu'à certain(e)s technologies/carburants.

Nous vous avons contacté en tant qu'expert afin de compléter la liste des barrières pré-identifiées, et d'évaluer l'importance relative de ces différentes barrières.

Le questionnaire comprend différentes parties ; si vous le souhaitez, vous avez la possibilité – en fonction de votre temps et/ou de vos connaissances – de ne répondre qu'à certaines parties du questionnaire (cf. page 4). Au total, le temps de réponse est d'environ 1 heure.

Nous vous remercions vivement d'avance pour l'accueil que vous voudrez bien réserver à ce questionnaire et pour votre précieuse collaboration. Nous vous prions de croire, Madame, Monsieur, à l'expression de nos meilleurs sentiments.

## **Plan du questionnaire**

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*La partie II du questionnaire a trait aux obstacles à la diffusion des véhicules propres en général.*

*La partie III du questionnaire a trait aux obstacles à la diffusion des différentes catégories de véhicules propres.*

**Si vous le souhaitez, vous pouvez en fonction de vos connaissances et de votre temps disponible, ne répondre qu'à l'une de ces deux parties. De même, au sein de la partie III, vous pouvez également ne compléter que les questions relatives aux catégories de véhicules propres pour lesquelles vous estimez vos connaissances suffisantes.**

*Merci de répondre en tout cas à la partie I (questions générales, principalement ouvertes) et à la partie V (données personnelles).*

## **I. Questions générales**

**1) Comment estimez-vous votre niveau de connaissance relative aux véhicules suivants ?**

### **a. Hybrides**

très bonnes       bonnes       moyennes       plutôt faibles       faibles

### **b. Electriques (batteries)**

très bonnes       bonnes       moyennes       plutôt faibles       faibles

### **c. A pile à combustible**

très bonnes       bonnes       moyennes       plutôt faibles       faibles

### **d. Fonctionnant au LPG**

très bonnes       bonnes       moyennes       plutôt faibles       faibles

### **e. Fonctionnant au gaz naturel (CNG)**

très bonnes       bonnes       moyennes       plutôt faibles       faibles

### **f. Fonctionnant au biogaz**

très bonnes       bonnes       moyennes       plutôt faibles       faibles

### **g. Fonctionnant au biocarburant**

très bonnes       bonnes       moyennes       plutôt faibles       faibles

### **h. Fonctionnant à l'hydrogène**

très bonnes       bonnes       moyennes       plutôt faibles       faibles

**2) Selon vous, quels sont les principaux obstacles au développement des véhicules propres à l'heure actuelle**

**a. En général?**

**b. Par type de véhicule ?**

- Type de propulsion alternatif :
  - Hybrides
  
  - Electriques (batteries)
  
  - A pile à combustible
  
- Type de carburant alternatif :
  - LPG
  
  - Gaz naturel comprimé (CNG)
  
  - Biocarburant
  
  - Biogaz
  
  - Hydrogène

**3) Selon vous, les barrières (actuelles) se situent-elles plutôt du côté de l'offre ou plutôt de la demande ? Pourquoi ?**

**4) Selon vous, quelles sont les mesures à prendre pour stimuler le développement des véhicules propres ?**

**5) Selon vous, quels types de véhicules propres pourraient le plus facilement être introduits dans le marché belge à court et à long terme? Pourquoi ?**

**6) Utilisez-vous des véhicules propres dans votre institution ? Si oui, de quels types sont-ils? Quels sont les éventuels problèmes rencontrés ?**



## **II. Evaluation de l'importance des barrières pré-identifiées au développement des véhicules propres en général**

1) Certaines barrières au développement des véhicules propres en général (qui s'appliquent à toutes les technologies) ont été pré-identifiées et listées ci-dessous.

Veillez évaluer l'importance de chacune des barrières en leur attribuant, de façon indépendante, une cotation entre 0/10 (barrière non existante) et 10/10 (barrière très importante).

**Vous pouvez ne pas répondre aux questions pour lesquelles vous estimez qu'une approche générale n'est pas adaptée.**

### **Barrières techniques**

- Les technologies alternatives montrent en général certains désavantages techniques par rapport aux véhicules conventionnels (voir point III pour plus de précisions car ces barrières sont spécifiques à chaque type de véhicules)

### **Barrières économiques**

- Prix d'achat généralement plus élevé pour la plupart des technologies alternatives (par rapport aux véhicules conventionnels)
- Coûts du cycle de vie total du véhicule (de la production à la mise au rebut) souvent plus élevé (pour le consommateur)
- Absence de marché de seconde main (difficulté de revente pour le consommateur)
- Risques de « coûts cachés » (ex. : coûts d'apprentissage etc.) des nouvelles technologies (incertitudes pour le consommateur et le producteur)
- Coûts de production trop élevés pour le producteur
- Non prise en compte des coûts environnementaux (externalités) dans les prix des véhicules conventionnels
- Autres?

### **Barrières liées au marché côté demande**

- Peu d'infrastructures (de ravitaillement, de recharge, de services de maintenance...), ce qui décourage le consommateur
- Offre peu variée et quantitativement insuffisante
- Manque d'informations (→ manque de confiance des utilisateurs potentiels quant à la fiabilité et aux performances des véhicules)
- Manque de conscience environnementale au sein de la population
- Manque de conviction quant à l'utilité environnementale des véhicules propres (en tenant compte des effets environnementaux du cycle de vie total)
- Autres?

### **Barrières liées au marché côté offre**

- Manque de confiance des producteurs quant à la taille, la rentabilité et la viabilité des marchés
- Incertitudes des producteurs quant à la tendance à la hausse des prix du pétrole
- Incertitudes des producteurs par rapport à l'évolution des prix des carburants alternatifs
- Incertitudes sur les politiques futures (sur la législation par rapport aux émissions, les régulations de sécurité et les régimes de taxation), qui ont tendance à varier dans le temps (causant également des incertitudes quant à la taille du marché)
- Peu d'infrastructures (de ravitaillement, de recharge, de services de maintenance...), ce qui décourage la production de véhicules (problème de « l'œuf et la poule »)
- Problème de financement des investissements étant donné les incertitudes, la petite taille des marchés et les temps longs de remboursement (→ les prêts sont perçus comme risqués par les organismes de financement)
- Free-riding (les producteurs attendent que d'autres producteurs développent la technologie et que le marché se développe avant d'adopter eux-mêmes la nouvelle technologie)
- Autres?

### **Barrières législatives et réglementaires**

- Existence de barrières administratives décourageant la production d'un « nouveau » type de véhicule ou d'un « nouveau » carburant
- Les politiques visant à développer les véhicules propres ne sont pas harmonisées entre les pays (par exemple les primes ou avantages fiscaux ne sont pas accordés en fonction d'une règle commune)
- Manque de réglementation et de standards communs internationaux sur les systèmes de ravitaillement et la qualité des carburants
- Autres?

### **Barrières sociales et psychologiques (comportement non rationnel)**

- Influence de la publicité, modes, importance du « look », de la signification symbolique du véhicule traditionnel (image de liberté individuelle et sentiment de puissance associé au véhicule traditionnel) et des pratiques socioculturelles reliées (ex. : sport automobile)
- Effet d'habitude : appréhension due à une sensation ou façon de conduite éventuellement différente, à la nécessité d'adapter son comportement (ex. : précautions à prendre différentes), au fait de changer le mode et/ou les lieux de ravitaillement etc.
- Sentiment d'insécurité (crainte d'explosion etc.)
- Autres?

### **Barrières institutionnelles et politiques**

- Importance du réseau d'infrastructure et d'institution existant (ex. : existence de filières académiques comme l'ingénierie mécanique) lié à la filière des combustibles fossiles
- Lobbying des industries automobiles
- Lobbying des acteurs de la filière du pétrole
- Lobbying d'autres acteurs/groupes ? Si oui, lesquels ?
- Manque de « lobbyistes » en faveur des véhicules propres (peu de groupes de pression qui bénéficient financièrement de l'introduction des nouvelles technologies)

- Manque de politiques d'encouragement financier
- Manque de politiques d'encouragement au niveau de la diffusion de l'information et de la promotion des véhicules/carburants alternatifs
- Manque de mesures contraignantes vis-à-vis des véhicules plus polluants
- Autres ?

**Autres?** (Veuillez indiquer les éventuelles autres barrières au développement des véhicules propres en général en leur attribuant une cotation)

**2) Parmi les groupes de barrières susmentionnées, pouvez-vous mentionner les éventuelles relations de causalité existantes (par exemple sous forme de schéma)?**

### III. Evaluation de l'importance des barrières pré-identifiées spécifiques aux différents types de véhicules propres

Des barrières spécifiques à chaque type de véhicules ont également été pré-identifiées

Veillez compléter cette question comme à la question précédente, pour chaque type de véhicule.

#### 1) Véhicule électrique

Évaluez l'importance des barrières au développement des véhicules électriques à batteries en leur attribuant, de façon indépendante, une cotation de 0/10 (barrière inexistante) à 10/10 (barrière très importante)

##### Barrières techniques

- Autonomie particulièrement limitée
- Vitesse maximale limitée
- Batteries lourdes et encombrantes (réduit l'espace utile)
- Temps long de recharge sur prise standard pour la plupart des batteries
- Autres ?

##### Barrières économiques

- Coût élevé à l'achat
- Prix élevé des batteries lors de leur remplacement
- Autres ?

##### Barrières de marché

- Manque d'infrastructures de recharge publiques (risque de panne à cause de batteries plates)
- Offre de véhicule très limitée
- Manque de services après-vente

Problème des services de maintenance (les garagistes ne sont pas toujours formés pour réparer les véhicules électriques)

Autres ?

### **Barrières psychologiques**

Appréhension concernant la sécurité associée au système électrique (décharge,...)

Sensation et façon de conduire différentes

Crainte de tomber en panne et de ne pas pouvoir recharger sur place

Autres ?

**Autres?** (Veuillez indiquer les éventuelles autres barrières au développement des véhicules électriques à batteries en leur attribuant une cotation)

## 2) Véhicule hybride

Évaluez l'importance des barrières au développement des véhicules hybrides en leur attribuant, de façon indépendante, une cotation de 0/10 (barrière inexistante) à 10/10 (barrière très importante)

### Barrières économiques

- Prix d'achat élevé
- Coût élevé des batteries lors de leur remplacement
- Autres ?

### Barrières de marché

- Peu de modèles disponibles (offre peu variée)
- Problème des services de maintenance (les garagistes et mécaniciens ne sont pas toujours formés pour réparer les hybrides)
- Manque de conviction quant à l'importance de l'avantage environnemental des véhicules hybrides (cf. gain faible au niveau de la conduite autoroutière,...)
- Autres ?

### Barrières psychologiques

- Façon de conduire différente (pour garantir une économie significative de carburant)
- Autres ?

Autres? (Veuillez indiquer les éventuelles autres barrières au développement des véhicules hybrides en leur attribuant une cotation)



### 3) LPG (liquid petroleum gas)

Évaluez l'importance des barrières au développement des véhicules LPG en leur attribuant, de façon indépendante, une cotation de 0/10 (barrière inexistante) à 10/10 (barrière très importante)

#### Barrières techniques

- Autonomie relativement faible
- Réservoirs importants et lourds pouvant réduire l'espace utile (ou prendre la place de la roue de secours)
- Système de ravitaillement en LPG un peu plus compliqué (précautions à prendre)
- Autres ?

#### Barrières économiques

- Coût additionnel de transformation du véhicule (si véhicule non dédié)
- Les propriétaires de voitures équipées au LPG doivent payer une taxe de circulation complémentaire
- Autres ?

#### Barrières de marché

- Manque d'infrastructure de ravitaillement LPG
- La plupart des véhicules LPG sont des véhicules conventionnels transformés, ce qui demande au consommateur une démarche supplémentaire (offre de véhicules dédiés très limitée)
- La transformation en véhicule LPG ne s'applique qu'aux moteurs à essence (pas diesel)
- Problème des services de maintenance (les garagistes et mécaniciens ne sont pas toujours formés pour réparer les véhicules au LPG)
- Problème de disponibilité à long-terme du carburant (sous-produit du raffinage du pétrole → source d'énergie limitée)

Autres ?

### **Barrières législatives**

L'absence de norme internationale de qualité du carburant entraîne la nécessité d'un réglage du moteur des véhicules pour chaque composition du carburant (varie quelque peu d'un pays à l'autre)

L'absence de norme internationale implique que les méthodes de ravitaillement en LPG peuvent varier dans les différents pays (ex. : certains pays nécessitent des connecteurs spéciaux)

Accès aux parkings souterrains interdit (excepté pour les parkings respectant certaines conditions)

Autres ?

### **Barrières psychologiques**

Crainte d'explosion associée au LPG (gaz comprimé inflammable)

Autres ?

**Autres ?** (Veuillez indiquer les éventuelles autres barrières au développement des véhicules LPG en leur attribuant une cotation)

#### 4) Gaz Naturel

Évaluez l'importance des barrières au développement des véhicules au gaz naturel en leur attribuant, de façon indépendante, une cotation de 0/10 (barrière inexistante) à 10/10 (barrière très importante)

##### Barrières techniques

- Faible autonomie
- Temps long de ravitaillement pour les systèmes normaux (existence d'un système rapide mais plus cher)
- Méthode de ravitaillement pouvant varier dans les différents pays (certains pays nécessitent des connecteurs spéciaux)
- La proportion en méthane est variable ce qui peut poser problème, le moteur n'étant pas conçu pour cette variabilité
- Réservoirs importants (pressurisés) pouvant réduire l'espace utile
- Autres ?

##### Barrières économiques

- Coût à l'achat élevé
- Coût élevé des stations de ravitaillement en gaz naturel (en particulier pour les systèmes de ravitaillement rapides)
- Coût élevé de l'installation domestique de ravitaillement en gaz naturel
- Autres ?

##### Barrières de marché

- Manque d'infrastructures publiques de ravitaillement en gaz naturel
- Problème des services de maintenance (les garagistes et mécaniciens ne sont pas toujours formés pour réparer les véhicules au gaz naturel)
- Incertitudes sur l'évolution des prix

Incertitude quant à l'offre de gaz à long-terme (source d'énergie limitée)

Autres ?

### **Barrières législatives**

Manque de législation spécifique et de certification de sécurité harmonisée pour le gaz naturel destiné aux véhicules (composition variable)

Autres ?

**Autres ?** (Veuillez indiquer les éventuelles autres barrières au développement des véhicules au gaz naturel en leur attribuant une cotation)

## 5) Biocarburants

Évaluez l'importance des barrières au développement des véhicules au biocarburant en leur attribuant, de façon indépendante, une cotation de 0/10 (barrière inexistante) à 10/10 (barrière très importante)

### Barrières techniques

- Rendement énergétique inférieur au carburant fossile (pour un même volume de carburant on parcourt moins de km)
- Caractère corrosif du bioéthanol et du biodiesel + toxicité de méthanol → doivent être manipulés avec précaution
- Si trop grande proportion de biocarburant dans le carburant classique, pose problème de compatibilité avec les moteurs ou les infrastructures → nécessite adaptation
- Variation de la production pendant l'année, en fonction des cultures
- Formation de dépôt dans le réservoir de la voiture si longue période de stockage (biodiesel)
- Le filtre doit être remplacé plus souvent
- Autres ?

### Barrières économiques

- Coûts de production du biocarburant plus élevés que carburant classique (donc prix du carburant plus élevé)
- Coûts des matières premières
- Autres ?

### **Barrières de marché**

- Problème de disponibilité (surfaces agricoles limitées et compétition pour l'utilisation des terres)
- Incertitudes par rapport à la demande et au prix (rentabilité) → manque de confiance des producteurs
- Certaines matières premières servant à produire du biocarburant sont plus rentables si on les utilise pour d'autres applications (bois, nourriture)
- Manque de conviction car bilan environnemental contesté (effets environnementaux néfastes de la production agricole intensive → pesticides, consommation et pollution des ressources en eau, appauvrissement des paysages et des sols etc.), et effets collatéraux (déforestation, augmentation des prix des matières premières, problèmes de monocultures etc.)
- Autres ?

### **Barrières législatives**

- Les permis pour la production/l'utilisation de biocarburant sont difficiles à obtenir (les procédures d'approbation sont lentes et coûteuses)
- Au niveau européen, les normes de qualité définies pour les carburants fossiles limite l'incorporation de biodiesel au diesel et de bioéthanol à l'essence à 5% (norme E590 pour le diesel et la norme EN228 pour l'essence)
- Manque de norme pour les mélanges à haute concentration et pour l'huile de colza (problèmes pour les fabricants de moteurs et le public)
- Pas d'avantages fiscaux particuliers pour les mélanges à haute concentration en biocarburant.
- Autres ?

### **Barrières politiques**

- Manque de mesures contraignantes (ex. : obligation pour les pétroliers d'acheter un certain pourcentage de biocarburants)
- Autres ?

**Autres?** (Veuillez indiquer les éventuelles autres barrières au développement des véhicules au biocarburant en leur attribuant une cotation)

## 6) Piles à combustible (PAC)

Évaluez l'importance des barrières au développement des véhicules à PAC en leur attribuant, de façon indépendante, une cotation de 0/10 (barrière inexistante) à 10/10 (barrière très importante). Remarque : les barrières spécifiques à l'hydrogène sont à évaluer dans le point suivant.

### Barrières techniques

- Technologie immature: pas encore assez fiable, efficacité et capacité de stockage limités, durée de vie limitée
- Diversité des technologies en matière de PAC (utilisation de différents carburants) -> empêche la standardisation des PAC nécessaire à la baisse des coûts de production
- Problèmes liés à l'hydrogène (pour les PAC à l'hydrogène)
- PAC lourdes et encombrantes
- Autres ?

### Barrières économiques

- Coût de production de la pile élevé ce qui implique un prix du véhicule très élevé
- Autres ?

Autres ? (Veuillez indiquer les éventuelles autres barrières au développement des véhicules à PAC en leur attribuant une cotation)



## 7) Hydrogène

-> Il s'agit ici des véhicules alimentés directement à l'hydrogène (sans réformeur)

**Évaluez l'importance des barrières au développement des véhicules à hydrogène en leur attribuant, de façon indépendante, une cotation de 0/10 (barrière inexistante) à 10/10 (barrière très importante)**

### Barrières techniques

- Grande dimension et poids du réservoir (diminue l'espace utile)
- Problèmes de sécurité et complexités liés au stockage, au transport et à l'infrastructure de ravitaillement
- Débat sur la matière première à utiliser et les techniques de production d'hydrogène
- Autres ?

### Barrières économiques

- Coût de l'infrastructure de ravitaillement en hydrogène élevé
- Coût de compression et de stockage au niveau de la distribution
- Coût de production élevé
- Coût d'entretien élevé

### Barrières de marché

- Pratiquement pas d'infrastructure de ravitaillement en hydrogène
- Problème des services de maintenance (manque de formation des garagistes et mécaniciens)
- Manque de conviction car bilan environnemental contesté (dépend de la matière première utilisée pour la production d'hydrogène)
- Autres ?

### Barrières législatives

- Absence de réglementation et de normes pour la production, la distribution et l'utilisation d'hydrogène

**Barrières psychologiques**

- Danger associé à l'hydrogène (demande certaines précautions)
- Autres ?

**Autres ?** (Veuillez indiquer les éventuelles autres barrières au développement des véhicules à l'hydrogène en leur attribuant une cotation)

**IV. Avez-vous des commentaires à ajouter (remarques sur le questionnaire ou autres...)?**

## **V. Données personnelles**

**Institution :**

**Fonction:**

**Formation professionnelle:**

## **B. Questionnaire for supply-side stakeholders and experts: Dutch version**



Geachte Mevrouw, Geachte Heer,

Deze vragenlijst, die uitgewerkt werd door Marion Englert, van het Centrum voor Economische en Sociale Milieustudies van de Universit  Libre de Bruxelles (CEESE-ULB), kadert in een studie omtrent schone voertuigen (het «CLEVER project») in opdracht van het Belgische Federale Wetenschapsbeleid (Belspo) waaraan verschillende Belgische universiteiten als partners<sup>116</sup> deelnemen.

**De opzet van deze vragenlijst is om de hinderpalen voor de verspreiding van milieuvriendelijke voertuigen in Belgi  te identificeren, alsook om het relatieve belang van deze hinderpalen te bepalen.**

Met “milieuvriendelijk voertuig”, wordt hier verwezen naar voertuigen die uitgerust zijn met een alternatieve aandrijving of die rijden op alternatieve brandstoffen (en dus niet volledig afhankelijk zijn van benzine of diesel). In principe worden deze voertuigen globaal gekenmerkt door een lagere milieu-impact. In dit geval gaat het om:

1) Voertuigen met alternatieve aandrijving :

- o Hybride voertuigen
- o (batterij-) Elektrische voertuigen
- o Brandstofcelvoertuigen

2) Voertuigen die gebruik maken van alternatieve brandstoffen:

- o LPG (liquid petroleum gas)
- o Samengeperst aardgas (CNG)
- o Biobrandstof (bio-ethanol, methanol, biodiesel, koolzaadolie)
- o Biogas
- o Waterstof

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<sup>116</sup> Het Centrum voor Economische en Sociale Milieustudies van de Universit  Libre de Bruxelles (CEESE-ULB), het departement Transport en Logistiek van de Vrije Universiteit Brussel VUB (MOSI-T), de onderzoekseenheid transporttechnologie van de vakgroep ETEC van de VUB, de Vlaamse Instelling voor Technologisch Onderzoek (VITO) en RDC environment

Een reeks (huidige) hinderpalen werden op voorhand geïdentificeerd aan de hand van onderzoekswerk en van een literatuurstudie. Deze hinderpalen kunnen naargelang hun kenmerken per categorie ingedeeld worden:

- a) Technische barrières (technische nadelen ten opzichte van conventionele voertuigen. B.v.: beperkt rijbereik,...)
- b) Economische barrières (b.v.: meerkost, prijs,...)
- c) Marktbarrières (andere factoren die het aanbod aan en/of de vraag naar milieuvriendelijke voertuigen negatief beïnvloeden. B.v.: een gebrek aan verdelers, aan bevoorradingsinfrastructuur,...)
- d) Wetgevingsgerelateerde barrières (b.v. : gebrek aan geharmoniseerde normen voor nieuwe brandstoffen,...)
- e) Sociale en psychologische barrières (met betrekking tot « irrationeel » gedrag van de verbruikers. B.v.: Gewoontepatronen,...)
- f) Institutionele en politieke barrières (lobbywerk, gebrek aan dwingende maatregelen,...)

Uiteraard bestaan er sterke verbanden tussen deze verschillende hinderpalen. Inderdaad, deze passen in een complex geheel aan causale verbanden. Een bijkomende doelstelling van deze studie bestaat erin om een overzichtelijk schema van deze verbanden te kunnen opstellen.

Sommige op voorhand geïdentificeerde barrières belemmeren de ontwikkeling van milieuvriendelijke voertuigen in het algemeen en andere, meer specifieke barrières betreffen slechts bepaalde technologieën/brandstoffen.

Men heeft u gecontacteerd omdat u, als expert, de lijst met op voorhand geïdentificeerde barrières verder zou kunnen vervolledigen alsook omdat u het relatieve belang van de verschillende barrières zou kunnen inschatten.

De vragenlijst bestaat uit verschillende delen: indien u het wenst, kan u – naargelang uw tijd en/of kennis - ervoor kiezen om slechts sommige delen van de vragenlijst te beantwoorden (cf. Pagina 4) . In totaal neemt het beantwoorden van de vragenlijst ongeveer één uur in beslag.

Wij danken u alvast hartelijk bij voorbaat voor uw behulpzaamheid en voor het beantwoorden van deze vragenlijst.

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*Deel II van de vragenlijst betreft de hinderpalen voor de verspreiding van milieuvriendelijke voertuigen in het algemeen.*

*Deel III van de vragenlijst betreft de hinderpalen voor de verspreiding van bepaalde categorieën milieuvriendelijke voertuigen in het bijzonder.*

*Indien u het wenst, kan u– naargelang uw tijd en/of kennis - ervoor kiezen om slechts 1 van beide delen te beantwoorden. In deel III kan u er eveneens voor kiezen om enkel die vragen te beantwoorden omtrent de schone voertuigtechnologieën waarvoor u over voldoende kennis beschikt.*

*Wel vragen we u om in ieder geval deel I (algemene, doorgaans open, vragen) en deel V (persoonlijke gegevens) van de vragenlijst te willen beantwoorden.*

## **I. Algemene vragen**

1) Wat is het niveau van uw algemene kennis van volgende milieuvriendelijke voertuigen?

### **a. Hybride Voertuigen**

Zeer goed       Goed       Matig       Eerder zwak       Zwak

### **b. (Batterij) Elektrische Voertuigen**

Zeer goed       Goed       Matig       Eerder zwak       Zwak

### **c. Brandstofcelvoertuigen**

Zeer goed       Goed       Matig       Eerder zwak       Zwak

### **d. LPG-voertuigen**

Zeer goed       Goed       Matig       Eerder zwak       Zwak

### **e. Aardgasvoertuigen (CNG)**

Zeer goed       Goed       Matig       Eerder zwak       Zwak

### **f. Biogasvoertuigen**

Zeer goed       Goed       Matig       Eerder zwak       Zwak

### **g. Voertuigen op biobrandstoffen (biodiesel/bio-ethanol)**

Zeer goed       Goed       Matig       Eerder zwak       Zwak

### **h. Voertuigen op waterstof (met verbrandingsmotoren)**

Zeer goed       Goed       Matig       Eerder zwak       Zwak



**2) Wat zijn volgens u, op dit moment, de voornaamste hinderpalen voor de ontwikkeling van milieuvriendelijke voertuigen**

**a. In het algemeen?**

**b. Voor de specifieke voertuigtypes?**

- Alternatieve aandrijvingen:
  - Hybride
  
  - (Batterij) Elektrisch
  
  - Brandstofcel
  
- Alternatieve brandstoffen :
  - LPG
  
  - Samengeperst aardgas (CNG)
  
  - Biobrandstoffen
  
  - Biogas
  
  - Waterstof

**3) Bevinden de (huidige) hinderpalen zich volgens u eerder aan de aanbodzijde of eerder aan de vraagzijde? Waarom?**

**4) Wat zijn de maatregelen die volgens u getroffen zouden moeten worden om de ontwikkeling en verspreiding van milieuvriendelijke voertuigen aan te moedigen?**

**5) Welke soort milieuvriendelijke voertuigen vertonen volgens u de grootste kans op succes (op korte termijn en op middellange termijn) op de Belgische markt? Waarom?**

**6) Wordt er binnen uw instelling gebruik gemaakt van milieuvriendelijke voertuigen? Zo ja, om welke type voertuig gaat het dan? Welke eventuele problemen worden hierbij ondervonden?**

## **II. Evaluatie van het belang van de op voorhand geïdentificeerde hinderpalen voor de verspreiding van milieuvriendelijke voertuigen in het algemeen**

1) Sommige hinderpalen voor de ontwikkeling van milieuvriendelijke voertuigen in het algemeen (die van toepassing zijn voor alle technologieën) werden op voorhand geïdentificeerd en worden hieronder opgesomd.

Gelieve het belang van de volgende hinderpalen individueel weer te geven aan de hand van een score gaande van 0/10 (onbestaande hinderpaal) tot 10/10 (zeer belangrijke hinderpaal).

U kan ervoor kiezen om bepaalde vragen niet te beantwoorden wanneer u van mening bent dat een algemene benadering niet aangepast is.

### **Technische barrières**

- Alternatieve technologieën vertonen meestal technische nadelen (hinderpalen) ten opzichte van conventionele voertuigen (zie punt III voor verduidelijking aangezien deze hinderpalen voor elk type voertuig verschillend zijn)

### **Economische barrières**

- Aankoopprijs van de alternatieve technologieën is doorgaans hoger (ten opzichte van conventionele voertuigen)
- De kosten over de volledige levenscyclus van het voertuig (van de productie tot de ontmanteling) zijn vaak hoger (voor de gebruiker)
- Ontoereikende tweedehandsmarkt (moeilijkheden bij doorverkopen van het voertuig)
- Nieuwe technologieën houden een risico op « verborgen kosten » in, bv.: kosten die gepaard gaan met “kinderziektes” van de technologieën (er bestaat een onzekerheid doordat gebruiker en constructeur nog ervaring moeten opdoen met de technologie)
- Te hoge productiekost (voor de constructeur)
- De milieukost (externe kosten) wordt niet opgenomen in de prijs van de conventionele voertuigen
- Andere?

### **Marktgerelateerde barrières (gebonden aan de vraag)**

- Beperkte infrastructuur (voor bevoorrading, opladen, onderhoud,...), werkt ontmoedigend voor de gebruiker
- Weinig gevarieerd en beperkt aanbod
- Gebrek aan informatie (→ gebrek aan vertrouwen van potentiële gebruikers betreffende de betrouwbaarheid en prestaties van de voertuigen)
- Gebrek aan milieubewustheid van de bevolking
- Gebrek aan overtuiging van de werkelijke meerwaarde van milieuvriendelijke voertuigen op het milieuvlak (rekening houdend met de milieu-effecten gedurende de volledige levenscyclus van het voertuig)
- Andere?

### **Marktgerelateerde barrières (gebonden aan het aanbod)**

- Gebrek aan vertrouwen van de constructeurs ten aanzien van de omvang, de rentabiliteit en de leefbaarheid van de markt
- Onzekerheid van de constructeurs ten aanzien van de stijgende olieprijs
- Onzekerheid van de constructeurs ten aanzien van de evolutie van de prijzen van alternatieve brandstoffen
- Onzekerheid ten aanzien van het toekomstig beleid (omtrent de emissiewetgeving, de veiligheidsbepalingen en het fiscaal stelsel), dat de neiging vertoont om met de tijd te variëren (wat eveneens onzekerheden veroorzaakt omtrent de omvang van de markt)
- Gebrekkige infrastructuur (voor bevoorrading, opladen, onderhoudsdiensten...), ontmoedigt de productie van deze voertuigen (het probleem van « de kip en het ei »)
- Financieringsprobleem van de investeringen omwille van de onzekerheden omtrent de omvang van de markt en de lange terugbetalingstermijnen (-> de leningen worden als risicovol ervaren door de financiële instellingen)
- Free-riding (sommige constructeurs wachten tot wanneer anderen de technologie ontwikkelen en dat de markt zich ontwikkelt vooraleer ze zelf de nieuwe technologie aanwenden)

Andere?

### **Wetgevingsgerelateerde barrières**

Het bestaan van administratieve barrières die ontmoedigend werken voor de productie van een “nieuw” type voertuig of van een “nieuwe” brandstof

Het beleid omtrent de ontwikkeling van milieuvriendelijke voertuigen is niet geharmoniseerd in de verschillende landen (de premies of fiscale voordelen worden bijvoorbeeld niet toegekend op basis van gemeenschappelijke regels)

Gebrek aan reglementering en gemeenschappelijke internationale standaarden voor de bevoorradingssystemen en voor de kwaliteit van de brandstoffen

Andere?

### **Sociale en psychologische barrières (“irrationeel” gedrag)**

Invloed van reclame, mode, belang van de « looks », van de symboliek die verbonden is met de conventionele voertuigen (individuele vrijheid en machtsgevoel worden vaak geassocieerd met de conventionele voertuigen) en met de socioculturele praktijken die eraan verbonden zijn (b.v.: autosport)

Doorbreken van gewoontepatroon: bezorgdheid te wijten aan een potentieel verschillende rijervaring, te wijten aan de noodzaak om zijn gedrag te wijzigen (b.v.: verschillende voorzorgsmaatregelen), te wijten aan de verandering van de plaats en manier van bevoorrading,...

Onveiligheidsgevoel (vrees voor ontploffing enz.)

Andere?

### **Beleidsgerelateerde barrières**

Het belang de bestaande infrastructuur en instellingen (b.v. de bestaande academische opleidingen als mechanische ingenieurstechnieken...) en van het bestaande bevoorradingennetwerk voor fossiele brandstoffen

Lobbywerk van de automobiel industrie

Lobbywerk van de olie industrie

- Lobbywerk van andere actoren/groepen? Zo ja, welke?
- Gebrek aan « lobbyisten » in het voordeel van milieuvriendelijke voertuigen (weinig belangengroepen die financieel baat hebben aan de invoering van nieuwe technologieën)
- Gebrek aan financiële aanmoedigingsmaatregelen vanuit het beleid
- Gebrek aan toelichting en aan promotie van alternatieve voertuigen/brandstoffen
- Gebrek aan dwingende maatregelen omtrent de meest vervuilende voertuigen
- Andere?

**Andere?** (Gelieve de eventuele andere barrières voor de ontwikkeling van milieuvriendelijke voertuigen in het algemeen aan te geven met een weergave van hun belang)

**2) Kunt u (bijvoorbeeld met behulp van een schema) de causale verbanden tussen de bovenvermelde hinderpalen beschrijven?**

### III. Evaluatie van het belang van de specifieke, op voorhand geïdentificeerde, hinderpalen voor de verspreiding van milieuvriendelijke voertuigen

Specifieke hinderpalen voor de verschillende soorten milieuvriendelijke voertuigen werden op voorhand geïdentificeerd.

Gelieve deze vraag evenals de vorige te beantwoorden voor elke soort voertuig die in de vragenlijst vermeld wordt.

#### 1) Elektrisch voertuig

Gelieve het belang van de volgende hinderpalen voor de verspreiding van (batterij) elektrische voertuigen weer te geven aan de hand van een score gaande van 0/10 (onbestaande hinderpaal) tot 10/10 (zeer belangrijke hinderpaal).

#### Technische barrières

- Bijzonder beperkt rijbereik
- Beperkte maximumsnelheid
- Zware en omslachtige batterijen (beperken nuttige ruimte)
- Lange oplaadtijd van de meeste batterijen op standaard stopcontact
- Andere?

#### Economische barrières

- Hoge aankoopprijs
- Hoge kostprijs van de batterijen (bij vervanging)
- Andere?

#### Marktgerelateerde barrières

- Gebrek aan openbare laadinfrastructuur (risico op stilstand bij ontladen batterijen)
- Zeer beperkt aanbod aan voertuigen



- Ontoereikende dienst na verkoop
- Problemen gepaard met de onderhoudsdiensten (de garagisten en mechaniekers zijn niet altijd opgeleid om elektrische voertuigen te herstellen)
- Andere?

### **Psychologische barrières**

- Vrees voor risico's die gepaard gaan met het elektrisch systeem (elektrische schokken,...)
- Verschillende rijervaring en rijstijl
- Vrees om in panne te vallen en niet ter plekke te kunnen herladen
- Andere?

**Andere?** (Gelieve de eventuele andere barrières voor de ontwikkeling van batterij elektrische voertuigen aan te geven met een weergave van hun respectievelijk belang)

## 2) Hybride voertuig

Gelieve het belang van de volgende hinderpalen voor de verspreiding van hybride voertuigen weer te geven aan de hand van een score gaande van 0/10 (onbestaande hinderpaal) tot 10/10 (zeer belangrijke hinderpaal).

### Economische barrières

- Hoge aankoopprijs
- Hoge kost van de batterijen bij vervanging
- Andere?

### Marktgerelateerde barrières

- Weinig modellen beschikbaar (weinig gevarieerd aanbod)
- Problemen gepaard met de onderhoudsdiensten (de garagisten en mechaniekers zijn niet altijd opgeleid om hybride voertuigen te herstellen)
- Gebrek aan overtuiging omtrent de meerwaarde van hybride voertuigen op het vlak van milieuvriendelijkheid (cf. beperkte vermindering van het verbruik op de autosnelweg,...)
- Andere?

### Psychologische barrières

- Rijstijl dient aangepast te worden (om een significante brandstofbesparing te verkrijgen)
- Andere?

Andere? (Gelieve de eventuele andere barrières voor de ontwikkeling van hybride voertuigen aan te geven met een weergave van hun respectievelijk belang)

### 3) LPG-voertuigen (liquid petroleum gas)

Gelieve het belang van de volgende hinderpalen voor de verspreiding van LPG voertuigen weer te geven aan de hand van een score gaande van 0/10 (onbestaande hinderpaal) tot 10/10 (zeer belangrijke hinderpaal).

#### Technische barrières

- Behoorlijk beperkt rijbereik
- Omvangrijke en zware brandstoftank kan de nuttige ruimte beperken (of de plaats van het vervangwiel innemen)
- LPG-bevoorradingsprocedure is een beetje complexer (er dienen bijkomende voorzorgsmaatregelen getroffen te worden)
- Andere?

#### Economische barrières

- Bijkomende kost voor het ombouwen van het voertuig (indien het geen “dedicated” voertuig is)
- De eigenaars van LPG-voertuigen dienen een bijkomende verkeersbelasting te betalen
- Andere?

#### Marktbarrières

- Gebrek aan bevoorradingsinfrastructuur aan LPG
- Het merendeel van de LPG-voertuigen zijn omgebouwde conventionele voertuigen die dus inhouden dat de gebruiker een bijkomende stap en dus inspanning moet leveren (het aanbod aan “dedicated” voertuigen is zeer beperkt)
- Het ombouwen van een voertuig naar een LPG-voertuig is enkel van toepassing op benzinevoertuigen (niet op dieselveertuigen)
- Problemen gepaard met de onderhoudsdiensten (de garagisten en mechaniekers zijn niet altijd opgeleid om LPG-voertuigen te herstellen)

Problemen van de beschikbaarheid van de brandstof op lange termijn (nevenproduct van olie de olieraffinage → eindige energiebron)

Andere?

### **Wetgevingsgerelateerde barrières**

Het gebrek aan internationale kwaliteitsnormen vereist de instelling van de voertuigmotoren opdat ze compatibel zouden zijn met de verschillende samenstellingen van de brandstof (die variëren naargelang het land)

Het gebrek aan een internationale norm omtrent de bevoorrading leidt ertoe dat de bevoorradingsmethode voor LPG naargelang het land kan verschillen (in sommige landen is er b.v. een speciale connector nodig om te tanken)

Toegang tot ondergrondse parkeergarages verboden voor deze voertuigen (uitgezonderd voor parkeergarages die voldoen aan bepaalde voorwaarden)

Andere?

### **Psychologische barrières**

Vrees voor ontploffingsgevaar die geassocieerd wordt met LPG

Andere?

**Andere?** (Gelieve de eventuele andere barrières voor de ontwikkeling van LPG-voertuigen aan te geven met een weergave van hun respectievelijk belang)

#### 4) Aardgas

Gelieve het belang van de volgende hinderpalen voor de verspreiding van aardgasvoertuigen weer te geven aan de hand van een score gaande van 0/10 (onbestaande hinderpaal) tot 10/10 (zeer belangrijke hinderpaal).

##### Technische barrières

- Beperkt rijbereik
- Lange bevoorradingstijden bij gebruik van de normale systemen
- Bevoorradingsmethode kan verschillend zijn in verschillende landen (in sommige landen zijn speciale connectoren vereist)
- Het methaangehalte is variabel, wat problemen kan stellen aangezien motoren niet ontworpen zijn om deze variabiliteit aan te kunnen
- Omvangrijke brandstoftank (onder hoge druk) die de nuttige ruimte kan beperken
- Andere?

##### Economische barrières

- Hoge aankoopprijs
- Hoge kost van de bevoorradingstations (in het bijzonder voor de sneltanksystemen)
- Hoge kost van de huishoudelijke gasbevoorradinginstallatie
- Andere?

##### Marktgerelateerde barrières

- Gebrek aan openbare bevoorradinginfrastructuur voor aardgas
- Problemen gepaard met de onderhoudsdiensten (de garagisten en mechaniekers zijn niet altijd opgeleid om aardgasvoertuigen te herstellen)
- Onzekerheid omtrent de evolutie van de prijzen
- Onzekerheid omtrent aanbod van aardgas op lange termijn (eindige energiebron)

Andere?

**Wetgevingsgerelateerde barrières**

Gebrek aan specifieke wetgeving en veiligheidscertificatie voor aardgas voor voertuigtoepassingen (variabele samenstelling)

Andere?

**Andere?** (Gelieve de eventuele andere barrières voor de ontwikkeling van aardgasvoertuigen aan te geven met een weergave van hun respectievelijk belang)

## 5) Biobrandstoffen

Gelieve het belang van de volgende hinderpalen voor de verspreiding van biobrandstofvoertuigen weer te geven aan de hand van een score gaande van 0/10 (onbestaande hinderpaal) tot 10/10 (zeer belangrijke hinderpaal).

### Technische barrières

- Energetisch rendement is lager dan voor fossiele brandstof (met eenzelfde hoeveelheid brandstof legt men een kleinere afstand af)
- Bio-ethanol en biodiesel vertonen bijtende eigenschappen + methanol is toxisch -> er dienen voorzorgsmaatregelen getroffen te worden
- Indien de brandstof een te groot aandeel aan biobrandstof bevat, kan dit tot compatibiliteitsproblemen leiden met de motoren of met de infrastructuur -> aanpassingen vereist
- Variatie van de productie in de loop van het jaar, in functie van de teelt
- Afzettingen in de brandstoftank bij een lange stilstand van het voertuig (biodiesel)
- De vervanging van de filters dient vaker te gebeuren
- Andere?

### Economische barrières

- Hogere kost voor de productie van biobrandstoffen ten opzichte van de kost van de productie van conventionele brandstoffen (leidt tot een hogere brandstofprijs)
- Kostprijs van de grondstoffen
- Andere?

### Marktgerelateerde barrières

- Probleem van beschikbaarheid (aangezien de oppervlakte van de landbouwgrond beperkt is ontstaat er competitie voor het gebruik van de gronden)
- Onzekerheid op het vlak van de vraag en van de prijs (rentabiliteit) -> gebrek aan vertrouwen van de producenten

- Sommige grondstoffen die gebruikt worden voor biobrandstoffen vertonen een hogere rentabiliteit wanneer men ze gebruikt voor andere toepassingen (hout, voedsel)
- Gebrek aan overtuiging omdat de milieubalans in twijfel getrokken wordt: negatieve gevolgen op het milieu door intensieve landbouw (bestrijdingsmiddelen, gebruik en vervuiling van de waterreserves, verlies aan landschapsdiversiteit, vermindering van de bodemvruchtbaarheid enz.) en door de schadelijke neveneffecten ervan (ontbossing, stijgende kosten van de grondstoffen, problematiek van monocultuur enz.)
- Andere?

### **Wetgevingsgerelateerde barrières**

- De vergunningen voor de productie/het gebruik van biobrandstoffen zijn moeilijk te verkrijgen (de goedkeuringsprocedures zijn traag en duur)
- De kwaliteitsnormen die op Europees niveau vastgelegd werden voor fossiele brandstoffen beperkt de toevoeging van biodiesel aan diesel en van bio-ethanol aan benzine tot 5% (E590-norm voor diesel en EN228-norm voor benzine)
- Gebrek aan een norm voor de mengsels met hoge concentratie en voor koolzaadolie (probleem voor motorproducenten voor de consument)
- Er bestaan geen specifieke fiscale voordelen voor mengsels met een hoge concentratie aan biobrandstof
- Andere?

### **Politieke barrières**

- Gebrek aan dwingende maatregelen (b.v. : de verplichting voor de olieproducenten om een bepaald aandeel aan biobrandstoffen aan te bieden)
- Andere?

**Andere?** (Gelieve de eventuele andere barrières voor de ontwikkeling van biobrandstofvoertuigen aan te geven met een weergave van hun respectievelijk belang)



## 6) Brandstofcelvoertuigen

Gelieve het belang van de volgende hinderpalen voor de verspreiding van brandstofcelvoertuigen weer te geven aan de hand van een score gaande van 0/10 (onbestaande hinderpaal) tot 10/10 (zeer belangrijke hinderpaal). Opmerking: de barrières die specifiek waterstof betreffen worden in het volgende punt van de vragenlijst besproken.

### Technische barrières

- Technologie is nog niet rijp: nog niet voldoende betrouwbaar, opslagcapaciteit nog te beperkt en nog niet voldoende efficiënt, levensduur is nog te beperkt
- Verschillende brandstofceltechnologieën (gebruik van verschillende brandstoffen) -> verhindert standardisatie van de brandstofcellen die nodig is om de productiekosten te beperken
- Beperkingen omtrent waterstof (geldt voor brandstofcel- en waterstofvoertuigen)
- Zware en omslachtige brandstofcellen
- Andere?

### Economische barrières

- Hoge productiekost van de brandstofcel leidt tot zeer hoge kostprijs van het voertuig
- Andere?

Andere? (Gelieve de eventuele andere barrières voor de ontwikkeling van brandstofcelvoertuigen aan te geven met een weergave van hun respectievelijk belang)

## **7) Waterstof (verbrandingsmotor)**

-> Het betreft hier de voertuigen die rechtstreeks voorzien worden van waterstof (zonder reformer)

**Gelieve het belang van de volgende hinderpalen voor de verspreiding van voertuigen op waterstof weer te geven aan de hand van een score gaande van 0/10 (onbestaande hinderpaal) tot 10/10 (zeer belangrijke hinderpaal)**

### **Technische barrières**

- Groot gewicht en grote afmetingen van het reservoir (vermindert de nuttige ruimte)
- Specifieke veiligheidsproblematiek en complexiteit van opslag, transport en bevoorrading
- Er bestaat nog discussie omtrent de te gebruiken grondstof alsook omtrent de productietechniek voor waterstof
- Andere?

### **Economische barrières**

- Hoge infrastructuurkost voor waterstofbevoorrading
- Hoge compressie- en stockagekost gedurende de distributie
- Hoge productiekost
- Hoge onderhoudskost

### **Marktgerelateerde barrières**

- Ontoereikende infrastructuur voor bevoorrading aan waterstof
- Gebrekkige onderhoudsdiensten (gebrek aan opleiding van de garagisten en mechaniekers)
- Gebrek aan overtuiging doordat de milieubalans in twijfel getrokken wordt (afhankelijk van de grondstof die gebruikt wordt om waterstof te produceren)
- Andere?

### Wetgevingsgerelateerde barrières

- Gebrek aan reglementering en normen voor de productie, verdeling en gebruik van waterstof

### Psychologische barrières

- Gevaar geassocieerd met waterstof (vraagt bepaalde voorzorgsmaatregelen)
- Andere?

**Andere?** (Gelieve de eventuele andere barrières voor de ontwikkeling van waterstofvoertuigen aan te geven met een weergave van hun belang)

**IV. Wenst u bepaalde opmerkingen toe te voegen (opmerkingen omtrent de vragenlijst e.d.m....)?**

## **V. Persoonlijke gegevens**

**Instelling:**

**Functie:**

**Opleiding:**

## Appendix 5: Opinions of experts about barriers by category of alternative vehicle

In this part we summarized what have been said by the experts about barriers by category of alternative vehicles. To facilitate presentation, barriers have been classified and are presented in a synthetic way in a box for each category of alternative. The results correspond roughly to the barriers mentioned by the previous group of stakeholders, but some new ideas of barriers often related to more environmental or social criteria (but also other kinds) have been added by the experts.

### 1. Hybrid vehicles

#### **Economic barrier:**

- High price but a sample of experts insists on the *cost-benefit* relation. Indeed, they mentioned that the financial cost is upper the environmental benefits. They mentioned that some conventional diesel vehicles have better cost-benefit relations. It has to be noted that the cleaner the hybrid is (high degree of hybridization) the more expensive it is.

#### **→ Environmental barrier:**

- Need to drive in a specific way to have significant environmental benefit (environmental benefits for city use but not on motorway).
- Need for clarification of the word “hybrid” (sometimes it’s just marketing sometimes it’s ecological) which have to be classify in function of the degree of hybridization. According to one expert, in the case of Prius the electrical range is rather weak.
- One expert mentioned that the production of the batteries has environmental impacts which balance the advantages of the emissions reduction at the use phase.

#### **Technical barrier:**

- Batteries are heavy and cumbersome (the vehicle is heavier).
- More consumption on motorway (environmental barrier).

#### **Psychological barriers:**

- Fear of problems of the consumer because of 2 engines (idea that it’s twice more risky) and fear of the unknown.

#### **Supply problems:**

- Limited choices of vehicles.
- Big car only.
- No diesel hybrid in Europe.

#### **Information:**

- Contradictory information about the environmental benefit of hybrid vehicles.

#### **Legislative barrier:**

- No homologation cycle adapted for plug-in hybrid (to determine the fiscal category).

## 2. Electric vehicles

### **Economic barrier:**

- High price of the vehicle and of the batteries (which have to be replaced).

### **Technical/psychological barriers:**

- Limited range (considered as a very important barrier for all the experts) and limited speed (considered as less important by most experts). However performances are expected to evolve with the new generations of batteries.
- Long recharging time

→ Economic and technical barriers may decrease with development.

### **Psychological barrier:**

- Too special design (cf. Reva)

### **Supply barrier:**

- Only small vehicles and very short supply: only the Reva (which is not a famous car brand).
- Lack of after-sale services...

### **Environmental/political barrier:**

- Green people and politicians are not always supporting electric vehicles because of nuclear power. More generally, the question of the source of energy used for electricity production is directly linked to the debate about developing electric vehicles for environmental reasons; and use of renewable energy for electric production is a very sensitive question for politicians... Also, we don't know exactly the environmental assessment of electric vehicles as it depends on the source of production of electricity (moreover, a part of the electricity is imported). It represents also an important problem in case of possible implementation of a green tax system and excises based on environmental criteria linked to the LCA (→ **legislative barrier**).

### **Other remarks:**

- It has been mentioned that electric vehicle is an interesting solution for captive fleets, as distances driven are short (limited range is not a problem) and they recharge at a fix point (no problem of access to recharging points).
- One expert was wondering about the reasons why commercialisation of electric vehicles does not come as we speak about it since a long time. He was questioning about possible lobbies of oil industries against electric vehicles development, which would pressurize politicians and prevent electric vehicles promotion.
- Electric vehicles development can be associated to a change of energetic "paradigm" and come up against fossil fuel locked-in, implying a wide range of barriers (see part 3 of the report).

### 3. Fuel cell vehicles

Most barriers to the development of fuel cell vehicles mentioned by the experts **are related to hydrogen.**

**Economic barrier:**

- High cost

**Technical barrier:**

- Immature technology

**Remarks:**

- There seem to be a lack of knowledge about fuel cell vehicles among the experts.

#### 4. LPG vehicles

**Economic barriers:**

- Installation costs
- Additional annual tax

**Environmental/societal barriers:**

- Poor efficiency has been mentioned as well as no significant CO<sub>2</sub> improvement at least for transformed engine (but we don't know so well the emissions of transformed vehicles)
- LPG production is linked to oil (so it is still a limited resource)

**Technical barriers:**

- LPG vehicles have some technical disadvantages (e.g. LPG system take place in the car) which make them not attractive.
- All the engines aren't adapted for an LPG transformation and we don't know it always in advance (when it is the case, many technical problems occur).
- In general people loose their guarantee when they transform their vehicles.
- Diesel engine is not adapted for LPG.

**Technical/legislative barriers:**

- Problem of access to underground parking's.

**Psychological barrier:**

- Fear of gas (explosion)

**Political barrier:**

- LPG is not supported/promoted enough by public authorities: additional tax<sup>117</sup>, suppression of the premium which was allowed in 2001-2002...  
→ No (or not enough) incentives.

However, one expert mentioned that there shouldn't be too many incentives to develop LPG use because its availability is limited.

**Supply barriers:**

- Nearly no dedicated vehicles
- Lack of refuelling stations (not everywhere, not at night...)
- Need to go to an LPG specialist for maintenance and reparations

**Remarks:**

- There are many barriers but they are usually not considered as very important.
- As mentioned by one expert, the advantage of LPG is that it is a waste (so it is produced anyway). The question is if automobile use is the best utilisation (can be also used for heating appliances).

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<sup>117</sup> It has to be note that the additional circulation tax is used to compensate the tax exemption on the fuel, which is used to prevent the risk of defraud with domestic gas.



## 5. CNG vehicles

### **Economic barriers:**

- Installation of refuelling infrastructure cost (need for subsidies)

### **Legislative barrier:**

- Absence of legislative framework, in particular, uncertainties about excise and so about the price of the fuel (should be tax exempted to avoid defrauds and with a complementary tax as for LPG).

### **Psychological barrier:**

- Fear of gas (explosion).

### **Supply barrier:**

- No refuelling infrastructures (which is complex and expensive).

### **Technical barriers:**

- Limited range.
- Long refuelling time.
- Tank heavy and cumbersome (take space in the car).

### **Environmental barriers:**

- One expert mentioned that there is a lot of uncertainties about the energetic efficiency and about the environmental benefits  
→ Need for a complete analysis from well-to-wheel (he notes that if gas comes from Russia it uses a lot of energy for the transport).
- Compression of natural gas increases energy consumption

### **Remarks:**

- Some experts are quite positive about CNG vehicles: they often consider that it is an interesting and realistic alternative (as it is already quite developed in Italy and Germany).
- One expert was wondering if automobile use is the best application.
- It is still fossil energy (limited resource)

### ***Specific remarks have been made for biogas:***

- Feasibility only near the production zone of biogas.
- Good solution for captive fleet.
- Application for vehicles is, according to one expert, not the most efficient one. It's better from an environmental and a logistical point of view to recover methane to produce heat or electricity on the spot.

## 6. Biofuel vehicles

### **Economic barriers:**

- Too expensive for oil industry
- There will be imports of biofuel because Europe won't be competitive  
→ this can create new geopolitical dependencies and imply environmental costs of transport
- Price of raw materials may increase.

### **Environmental barriers:**

- Environmental and social impacts depend on the type of biofuel (very various according to the raw material use, the localisation etc.)
- Problems related to intensive agriculture (use pesticides and water, soil depletion
- Difficulties to check the environmental and the social conditions of imported biofuel (e.g. forest destruction in Brazil...).

### **Ethical barrier:**

- Possible competition with food sector: increase of price, use of ground...  
→ Problem in particular for developing countries

### **Psychological barrier and bad information:**

- Contradictory information: message conveyed by the medias is different from some years ago. Indeed, some years ago it was presented as a very good solution and now it is the opposite. Also, opinions differ from one expert to another. People often are confused because they make the amalgam between the different kinds of biofuel.
- Emotional debate because of the ethical and environmental questions related to biofuel. The emotional nature of the debate implies that it is difficult for policy makers to take position.

### **Legislative barrier:**

- Lack of legislation for high blends (E85 not allowed and no existing standard for this fuel in Belgium).

### **Remarks:**

- Biofuel will always remain a partial solution (limited volume of production)
- Need for a control of environmental and social criteria
- Need to focus on second generation of biofuel, which imply much less ethical and environmental barriers.

## 7. Hydrogen vehicles

### **Economic barrier:**

- High cost of production and storage of hydrogen.

### **Technical barrier:**

- There are still a lot of technical questions that have to be solved.

### **Environment/technical barriers:**

- Question and debate about the way of producing H<sub>2</sub> and the raw material that should be used.
- Problem of bad yield of hydrogen production (need a lot of energy).

### **Supply barriers:**

- No supply of vehicles for the large public.
- No fuel distribution (no infrastructures).

### **Psychological barrier:**

- Fear of explosion.

### ***Important remarks:***

- Some experts mentioned that it is a non sense to use hydrogen in vehicles because it is competed with all the energy it comes from (electricity, natural gas,...) because of bad yield; so it is better to use directly electricity or natural gas as a fuel.
- Opinions of experts are very diverse and it seems that there is a lack of knowledge about hydrogen vehicles among the experts.
- One expert mentioned that the success of hydrogen may be explained by the fact that it is a proposition for a car very closed to conventional vehicle, with same performance (and with no emission at the use phase).

