



WP3: Specifications of the empirical studies

D 16 from the BARENERGY project

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"Limiting the fuel consumption of vehicles "

Main barriers and drivers towards a mobility behavioural change

by

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1. INTRODUCTION

The BARENERGY Project is developed within the seventh Framework Programme of the European Union, Theme 5: Energy. The objective of the BARENERGY Project (BARriers for ENERGY changes among end consumers and households) is to develop methods to identify the relevance and strength of various barriers for energy behaviours changes among end consumers and households, and to discuss how activities from political authorities, energy producers and NGOs can overcome these barriers.

Limiting the fuel consumption of vehicles is one of the major areas in which energy-saving measures can be taken. This topic will be discussed in the present Position Paper (D16). It is part of Work Package 3, in which a review of energy-related behaviours (domestic energy, appliances and cars) will be presented and which consists in “Specifications of the empirical studies”.

1.1 Objectives of the Work Package 3

The objective of WP3 is to collect the most relevant results provided by social sciences which have already shed some light on these barriers and levers¹ in the field of energy-related behaviour changes so as to propose some “analysis dimensions” (“empirical specifications”) for the three next WP (WP4-5-6, empirical studies).

To do so, the teams taking part in WP3 carried out a collaborative review of empirical case studies on energy-related behaviours, barriers and levers for action toward reducing energy consumption, and the initiatives already taken to reach this objective.

This empirical state-of-the-art document will serve as a base for the next work packages (qualitative stakeholder interviews, quantitative survey and consumer focus groups), in that it helps designing protocols for empirical studies, by defining some assumptions, asking appropriate questions, giving specific results for each country, suggesting which people to meet and identifying sample groups.

State of art research is defined as follows:

- the 6 countries of the contributory teams (France, the Netherlands, Switzerland, UK, Norway and Hungary).
- on the three following fields/topics: PP1: Domestic energy use (in particular heating and cooling of accommodations) ; PP2: Household appliances (energy efficiency, turn down and switch off); PP3: Fuel consumption of cars (energy efficiency, drive less or more economically and renewable resources).
- more specifically, focusing on the three following behavioural dimensions: energy saving in households (turn down/switch off), improvement of energy efficiency in households (purchase and use of energy-efficient appliances), change to more sustainable and renewable energy technologies (change in energy carrier). => USE – PURCHASE – CHANGE.
- focusing on end-user behaviours (domestic consumers and households).
- integrating data from several social science disciplines, to have the best overall analysis on energy-related behaviours.
- analysing the behaviours by breaking them down in three groups: energy-related behaviours in general (habits and representations of energies in each country), energy-saving behaviours (who already saves energy, why, what kind of, with which current limits?), and behaviours linked to specific initiatives (local trials), to understand if they have led to any behavioural changes.

This state of the art research enables to suggest some specifications for the carrying-out of empirical studies, for instance:

- Identifying barriers and levers for action to assess their strength and relevance in empirical studies
- Suggesting some “windows of opportunity”, in the life-cycle to be tested in empirical studies
- Identifying some social and demographic characteristics, some lifestyles that support or slow down behaviour changes and which should be investigated in studies (strategic groups)
- Investigating the “gender questions”
- Identifying the stakeholders that individuals associate to the energy savings.

¹ In order to designate the triggers or driving forces to overcome barriers, the term used in the Barenergy documents is often “drivers”. It is not the case in the D16 – to avoid the confusion in this document that deals with mobility and car driving – but we preferred to use the expression “levers for action”.

To do so, we proposed a collaborative work broken down into into four stages²:

- Each contributory team reviews the scientific literature considered as the most important and the most relevant for its country and makes a summary of it (one-page document) [April-May, 2008],
- the Leading team of the WP3 studies and analyses these documents and submits a general outline for each position paper [May-June, 2008] ;
- The contributory teams meet for a mid-course workshop to debate the outline, the first results and validate the state progress [June 26th, 2008] ;
- The leading team writes down the three position papers, asking contributions from the contributory teams [July, 2008], and then submit these documents to the latter for rereading, comments and validation [August, 2008].

It was decided that the review of the documents should be carried out in a collaborative way between teams. As a matter of fact, the objective is not to get an exhaustive state of the art per country, but rather a variety of approaches and of study purposes, in order to provide action points for the teams involved in the studies/surveys. The contributory teams have focused on disciplinary competences, and therefore cover a large social sciences research field. Moreover, for language reasons and to prevent the "duplications", we decided that each country made the review in a priority way of the literature of its own country.

We thus analysed 125 " one-page documents", proceeding from 7 partners. [Refer to the references table in annex]³.

1.3 Outline of the D16 position paper

Work package 3 is divided up into three "deliverables":

- Domestic energy use (D14)
- Household appliances (D15)
- Fuel consumption of cars (D16)

The three deliverables are focused on the understanding of the energy-related behaviours in Europe, on the identification of the barriers preventing a positive behavioural change in the energy behaviours and on the analysis of the identified levers for action. But these behaviours are embedded in the political, economic, social, material institutions, and we try to understand how this institution-individual interaction comes in a variety of forms. [Refer to WP2, D11, *Theoretical and methodological clarifications*].

The D16 deliverable carries out a state of the art of the recent social sciences literature about the use of the private car, in order to underline the main trends of mobility related behaviours in Europe and to identify some key issues on which the next Work packages could focus.

1.4 Fuel consumptions of cars, a major issue in Europe

As said in the D14 document, the energy consumption of the European households (direct and indirect energy) related to the housing and to the transport are an important point in the current political agenda and are in the centre of major political concerns, in particular the Environmental protection and the EU Kyoto obligations. Moreover, "the new energy price rise on the world markets and especially the oil prices, stimulated renewed interest in management demand". Finally, there is the question of "supply security" [Green Paper on Energy Efficiency, 2005].

In Europe, mobility of people has extensively increased during the last decades, whatever the mode of transport you consider. For instance in France, passengers miles increased with 58% between 1980 and 2004⁴. Also CO2 emissions have grown with 20% between 1990 and 2000. Air transport and road transport especially accounted for this growth. Therefore, road transport is a major sector concerning

² Céline Gandillet, doing an internship in EDF R&D, helped Magali Pierre (EDF R&D) summarize and analyse the data and all along the collaborative work. She drafted complete paragraphs of this document.

³ These documents are mentioned in square brackets, with the name of the author, the publication date, and the team code. Moreover, we used additional references, which are not directly in the purpose of the request, but they help to specify it. The latter are mentioned in parenthesis. All the bibliographical references are at the end of this document.

⁴ Cf. www.ifen.fr referring to DAEI-SESP, 2005.

energy consumption in Europe. The 2007 UK Energy White Paper points out that emissions from the transport sector and increased mobility are one of the major factors in the UK's rising pollution levels (a contributory factor to as much as a 3% increase per annum according to Druckman and Jackson, 2008).

The main issue regards individuals, who are highly concerned with this increase and partly responsible for it (growth of tourism and air transport, increase in car ownership, growth of passenger miles, etc.). In France, for instance, the average passenger miles per day was 20 km during the 70's and is 40 km today. The number of private cars in the United Kingdom currently stands at 27 millions. This works out to approximately 1.1 cars per household (Goodall, 2007). Private mobility engage not only professional trips (including commuting) but also leisure time during week-ends and holidays, which often lie on energy-intensive modes of transport (by plane or car for instance). For instance in Switzerland, the main reason for travelling in 2005 was to indulge in leisure activities, followed by commuting to work or education/training (SFSO, 2007). In 2007 there were 447 cars per 1000 inhabitants in Norway (SSB, 2008). Out of a total of 39,63 average passenger kilometres per day in 2006, 30,27 were by private car (Monsrud, 2008). 39% of all Norwegian households have two or more cars (Svensson et al., 2008)

In France, transport has now become the second largest item of expenditure in the family budget after housing and ahead of food (Le Breton, 2008). The French now devote 17.5% of their budget to travel expenses compared to less than 10% in 1960. This is due among other things to the "urban sprawl" which today characterises French towns and cities and those throughout Europe. The town centre, where jobs are concentrated, is surrounded by suburbs in which the scattered residential areas are varying distances away.

But there are also some signs in favour of the decrease of mobility. An example in France: the economist Zahavi explained some years ago that mobility is stable in the western world and that every people spends in average one hour travelling each day⁵. However, in Lyon and Lille, it seems that this traditional conjecture is not true any more and that mobility by car is a part of the explanation; in these 2 cities the individuals use less their car than previously (Joly, 2006). The reason is not only the gasoline price, but also public policies (public transport offer) and the growth of old persons' proportion. More generally, the share of car use seems quite stable in France since 1995 (DAEI-SESP, 2005).

Behaviours are traditionally more considered as a barrier against change in mobility behaviours than as a fruitful ground. To say it quickly, people are attached to their cars. We have to take into accounts behaviours, values, attitudes that support this car primacy. The strategies that the individuals can adopt to change their car use have been defined as (see the *Description of Work* document):

- Changes in car purchasing: buying a more energy efficient car (or buying no car at all)
- Changes in the use of the car: driving less or more economically
- Changes to renewable energy resources which is similar to the first item (purchasing), in the case of consumptions on fuel for vehicles.

As said in the D14 document, the understanding of the energy behaviours of the households is thus an important scientific and political stake. There are several "fragmented" investigations, on a practice, on a social group, on a technology, on a legislative and regulation device, etc. But there is not yet an overall AND in-depth view at the European level of energy behaviours.

The questions to which this literature review (state-of-the-art) seeks to provide answers are the following:

- What are the obstacles (barriers) to bringing about a change in behaviour where mobility is concerned? More fundamentally, what are the factors determining mobility-related behaviour patterns among individuals? (part one)
- And how can we change these behaviour patterns, i.e. remove these barriers and encourage energy-efficient behaviours? We draw up an overview of the types of measures introduced to eliminate the main obstacles. (part two)

To conclude, we highlight those points requiring further investigation or which form solid basis for subsequent empirical surveys (WP4-5-6).

⁵ In Switzerland, an average of one and a half hour is set aside each day for travel – half for leisure activities (SFSO, 2007).

2 WHY IS IT SO HARD TO REDUCE CONSUMPTIONS ON FUEL FOR VEHICLES? THE MAIN BARRIERS

What are the main barriers preventing behavioural changes concerning fuel for vehicles? There are many barriers preventing these behavioural changes⁶. They mix different interconnected levels that we can organise from macro to micro perspectives [cf. *Description of Work* document].

2.1 Structural barriers: spatial planning and infrastructures

It is first and foremost the supply of available transport which explains the use of a given means of transport. In other words, given that a reduction in car use can only be achieved by means of an increase in the use of other means of transport, only those areas possessing sufficient means of transport are likely to achieve a transfer from one travel method to the other.

Moreover, people's perception of the various means of transport varies according to the population density of their place of residence, and highlights the differences between the inhabitants of city centres or suburban areas.

Positive attitudes to public transport and negative attitudes to cars are more prevalent in town centres; and in contrast the negative attitudes to public transport and positive attitudes to cars are especially prevalent among inhabitants of outlying suburban neighbourhoods. [Kaufmann et al., 2001/EDF-41]

In most occidental cities, and especially for people living in the suburbs, spatial planning requires car use. For instance, one needs a car to reach most shopping centres. To be more accurate, road and collective transport infrastructures vary a lot from one town to another – presence of subway lines, of bus stations, of car parks, etc.

There are large differences in consumer behaviour among these five cities. In Groningen people use the bike for shopping while the majority in Södermalm in Stockholm walked to the shops. In the three other cities (Padua, Guildford and Fredrikstad) people used their cars. The differences is not related to consumer attitudes or norms, but may be explained by the way the cities are organized and planned. [Stø et al., 2005/SIFO-11]

✉ In WP5 and 6, (focusing on consumers), structural elements should be considered as an important barrier. For example, in view of the considerable influence of urban density upon the available supply of public transport and on car use, it could be interesting to compare the energy-efficient behaviour of a number of subgroups differentiated according to their residential location. Those people living in an urban centre travel differently from those living in rural areas, and both groups therefore have different energy-efficiency behaviour patterns, particularly where mobility is concerned.

2.2 Political barriers: accepting and supporting measures.

Barriers related to political factors (laws, directives and regulations, etc.) are also important in order to understand the success/failure of means of transport in reducing energy use. City and town councils have a great deal of influence when it comes to promoting a given means of transport. Manufacturers and the supply chain authorities in charge of the implementation of these measures and innovations also have to be convinced that they are expedient.

Additionally, the organisation of the institutions concerned by these innovations is not always adapted to the introduction of these laws and innovations. For example, in the case of innovative transport systems such as "self-service" vehicles or tramways, the appointed operator may be battling with local authorities at a number of different levels, and may consequently find his task all the more difficult.

✉ Among the key players at a macro-social level, having an influence upon the behaviour of

⁶ Of course this document doesn't mean to be exhaustive but intends to underline the main barriers and reflects on examples of how social sciences deal with them in empirical studies.

individuals (particularly for WP4), we should mention the mayors of districts having supported an innovative policy where individual mobility is concerned, and particularly with regard to a reduction in car use (including towns possessing a pedestrian area, or urban toll system, etc.).

Political barriers concern a field in which individuals have very little influence, and it is not our intention to develop them further in this paper. Still, the question of public opinion (for example concerning the acceptability of policies that intend to reduce car use) is also a feature where political barriers are concerned. One of the factors put forward in the documents collected concerns opposition by individuals to restrictive or dissuasive measures, particularly when these involve a financial contribution. For example, urban toll systems which require payment to enter densely populated areas have encountered opposition in those towns and cities in which they have been introduced⁷. Moreover, in relation to the fact that the price is the same for all social groups, the question of social and spatial equity of the urban toll is controversial (cf. also CDAT, 2007a/EDF-31 and Raux, 2007/EDF-32).

The obstacles to remove concern for the introduction of an urban toll are found at the legal level (modification of the law to authorize experimentation and levying a toll outside of new structures), institutional level (what authority is in charge of the toll?), technical level and at the level of social and spatial equality. [Klaerr-Blanchard, 2000/EDF-28]

All the studies are in agreement regarding the definition of certain aspects of the question of fairness: social equity, which focuses on the plight of those in the lowest income categories; territorial equity, which relates to the taking into account of the differences in geographic locations of individuals and jobs; and finally the equity expressed by the freedom enjoyed thanks to greater fluidity of traffic and the fact that only those who use the road infrastructure are asked to make a financial contribution to it. [Souche, 2003/EDF-30]

[The urban toll] is not without raising questions of social equality because of the selection by money that it induces. In addition, it traditionally raises fears with merchants who foresee the attractiveness of the town centre reduced. [CDAT, 2007b/EDF-26]

2.3 Social barriers: car dependency is based on social factors

Understanding social barriers is essential when seeking to understand obstacles to energy-efficient behaviours where fuel consumption is concerned. Indeed, these barriers concern the very manner in which individuals organise their lives and their pace of life, in addition to those interactions which explain their large-scale use of individual means of transport such as the car.

Firstly, as shown by the functionalist approach, the car fulfils certain social functions more effectively than other means of transport. Secondly, according to the morphological approach, the socio-demographic characteristics of individuals match their means of transport. Thirdly, as demonstrated by sociologists working on a daily basis, mobility behaviours are entrenched thanks to powerful social routines. Fourthly, approaches focusing on the rationality of those involved highlight the comparative advantages of the car.

Social functions of the car: *car dependency*

The car fulfils a number of extremely important social functions that are “objective” assets (Steg, 2003) from the point of view of car users:

- Providing mobility,
- Facilitating the transportation of third parties (whether humans or items),
- Providing access to other aspects of social integration, particularly work,
- Etc.

Viewed in this light, the car can be seen as an indicator of a person's inclusion or exclusion within the mobility system and within society as a whole. The difficulty in managing without a car clearly demonstrates the level of car dependency within our society.

The autonomy that it allows comes to the detriment of people who don't drive. [AMVBF et al., 2006/EDF-36] (Cf. also Eric Le Breton, 2008)

⁷ But most studies also show acceptance after initial protest...

The predominance of the car is an aspect of the *car dependency* highlighted by Gabriel Dupuy (Dupuy, 1999/EDF-35). This in turn is related to the growth of the *car system*. The *car system* was defined by Peter Hall in 1988 as a mass production system which has made cars affordable to average households, all the service centres, standard codes, traffic controls, road and infrastructure networks and areas intended specifically for drivers. The automobile system draws its strength from the expansion and upgrading of the road network and the organisation of an environment designed for cars, encouraging drivers to drive even more. Its success is often achieved at the expense of alternative transport systems and is further enhanced by the positive aspects of the "club" and "network" image it conveys.

Car dependency is based on participation in certain circles, access to which may additionally be considered as a benefit, especially:

- A club effect: having a license is like joining a club.
- A fleet effect: acquiring a vehicle.
- A network effect: driving on the road network. [Dupuy, 1999/EDF-35]

Each of these effects marks a further stage as we enter the car system. Joining the car system brings with it major social benefits.

The car is thus a means of access to all the goods and amenities that are available to us in society, with the result that it becomes difficult to do without it. [Pierre, 2008/EDF-45]

📁 The social functions fulfilled by the car (individual travel, transportation of third-party persons or objects, access to social integration, signs of social status, etc.) are of vital importance for individuals on a day-to-day basis. It may be of interest in the statistical survey (WP5) and in the focus groups (WP6) to subtly reveal (i.e. via indirect questions) the importance of these social aspects which take the form of both practices (transportation and travel are objective advantages compared to alternative modes of transportation) and perceptions (status is a subjective advantage compared to alternative modes of transportation).

The socio-demographic aspects of mobility behaviour

The socio-demographic aspects of both households and individuals are relatively decisive when seeking to understand mobility-related behaviours. A number of these morphological variables (sex, possession of a car, etc.) are related to factors determining whether or not to travel by car (such as the opinion an individual may have of public transport, etc). These include:

Motorisation, i.e. the ownership of a car (or even several);

The higher car ownership, the less time spent in a car is perceived negatively, and vice versa for public transport. [Bonnell et al., 2004/EDF-34]

The status of the individual;

"There is a strong contrast in the use of modes according to status." This status combines with variables associated with the roles of the individuals in the household: sex, age, profession, position in the household, presence of children, etc. [Bonnell et al., 2004/EDF-34]

The criteria for purchasing cars (of which the four main ones are its mechanical condition, the fuel type, the power and the brand of the vehicle) are influenced by living standards (as these are related to social perceptions of prestige, freedom, and the social status conferred by the brand and power of the vehicle), and lifestyles - they differ significantly according to the persons marital status, the size of the household, the place of residence, age, sex and educational level (Cahiers du CLIP, 2001).⁸

📁 The means of transport for individuals are related to their socio-demographic characteristics (including gender, age, working or otherwise, etc.) and their level of motorisation (i.e. the number of cars in the household). These are important morphological factors to be taken into account when drawing up representative criteria for the target population for the statistical survey (WP5).

⁸ Please see also the typology proposed by Beslay C., Golovtchenko N., Zelem MC. and Joubert T., 1999, La lutte contre les pollutions automobiles: la place des usagers - *The fight against car pollution: the role played by users* - Toulouse, CERTOP-IUP, Applied Sociology, June 1999.

The importance of habits and routine

Cars are associated with a number of benefits (the ability to accompany someone, a sense of freedom and independence, etc.) - as discussed in the *car dependency* part - which explain their primacy. One of the factors favouring car use is a sort of inertia effect : car is deeply embedded in one's way of life (domestic planning) which is difficult to modify. Lifestyles are built around it and around all what car makes possible.

"Individuals are rarely able to challenge their mobility-related habits". Indeed, the use of a particular means of transport completely changes the person's plans and activities to the extent that it can be very difficult to envisage such a change. [Bonnell et al., 2004/EDF-34]

Whereas a classical car is associated with habits, freedom and immediate availability, the use of an electric car requires planning and anticipation both concerning the trips to be made (anticipating requirements the previous day), but also the time of driving (traffic planning) as demonstrated by surveys carried out into the use of electric vehicles. Using an electric vehicle (EV) means changing one's way of thinking.

The structural disruption induced by the electric car on the lifestyle of the individuals, i.e. the organization of their activities and their mobility, is perceived like the main cause of this rejection. Car driving is associated with control of time, while the constraint of the battery autonomy imposes a budget - distance management. Circumventing this constraint requires a common management from the users (negotiations among the members of the family) and a planning of mobility, which are perceived as bringing into question the lifestyle, and even the choice of living in a suburb. [Faivre d'Arcier, 1997/EDF-04]

Introducing this type of vehicle among the vehicles owned by the family means challenging the notion of "to each driver his vehicle" in favour of a notion of "to each purpose its vehicle". Rather than managing time, it is distance which must be managed (Faivre d'Arcier, 2008).

📁 In view of the fact that cars are associated with deeply entrenched social routines, before envisaging any change in the use of the car – (for example, if the focus groups (WP6) propose projective methods) - it may be a good idea to consider changes in lifestyles, in order to lay the ground for changes in car use.

The choice of means of transport analysed by rationalist theories

The dominant role of the car when people choose their means of transport is explained not only by the availability or otherwise of alternative transport (please see structural barriers) but also the subjective perception of the quality of the various means of transport. More precisely, public transport is often seen as having an overall cost (mainly in terms of price and travel time) which is higher than that of the car. In opposition to public means of transport, car is often considered as the fastest and the cheapest even with a greater awareness of issues such as longer-term environmental consequences.

The duration and cost of transport are two main variables to take into account. Thus, individuals choose the mode of transport offering the lowest generalized cost" – this generalised cost involves the (perceived) price of travel, the (declared) time of travel and the value that individuals assign to this time (it varies in particular according to the activity at the destination). [Bonnell et al., 2004/EDF-34]

The perception of comfort and security in the transport are important as well. On these points, cars also benefit from a more positive valence than public transport.

Some of the more interesting findings in the research related to some of the advantages and disadvantages of buses and private car use. Some interviewees who were non-users argued that there was a lack of control when using public transport over issues such as time, comfort and convenience. They also cited issues such as cost and overcrowding as being reasons why they preferred private car use. [Beirao and Sarsfield, 2007/RESOLVE-12]

Theories which insist in their analyses on the rationality of the users, assume that individuals in the household take above all into consideration the characteristics of the journey they are about to start when they must choose a means of transport; among these characteristics there are the moment in the day and in the week – car is more performing during the WE from this point of view because public transports reduce their transit frequency during the week-end – and the reasons to travel (working, shopping, accompanying someone, etc.). The purpose of the trip plays an important part, whether public transport, private car or bicycle is chosen to meet the need for mobility (SFSO, 2007).

Individuals sometimes focus on the comparative advantages of the car in terms of travel time, cost, comfort and safety. A number of these advantages are subjective (particularly financial cost and safety), and as such can be easily contested and challenged (for example via the focus groups) (WP6).

2.4 Economic barriers: the misperception of the financial cost of transport

The collective cost of the car in terms of health, space and infrastructures' need is largely underestimated by people when travelling. These costs are not considered at all when individuals are choosing a means of transport (Turrentine and Kurani, 2006).

Where individuals are concerned, it is first and foremost the individual cost which is taken into consideration, and particularly the financial cost. The latter is generally misjudged where cars are concerned. People tend to forget parking charges, fuel, etc. (Turrentine and Kurani, 2006) whereas it is overestimated for public transport (ib.). A number of scholars put forward an explanation of the differentiation between the initial cost and secondary costs to explain this: for the car, it is above all the initial investment which is high.

The study compares the influence of eco-labelling with other product attributes (such as brand, displacement, fuel type) and investigates whether the planned introduction of a bonus-malus-system can reinforce the effect of the EU energy label. The influence of the European energy-efficiency rating on car purchases is much smaller than for housing appliances. [One of the reasons is the fact that] the decision-making processes are not the same for cars and household appliances. Energy consumption is more important for household appliances because the share of energy costs in total life-cycle costs is higher for household appliances than for cars. While gasoline consumption accounts for roughly 15 percent of total lifecycle costs of a car, energy costs for refrigerators amount to more than 30 percent of its lifecycle costs and up to 80 percent for lighting. The effect of the disclosure of the energy efficiency class seems to be more important for products where operating costs are high in comparison to initial costs. [Wüstenhagen and Sammer, 2007/UNISG-17]

As a result, some initial costs are so high that additional costs (insurance + petrol + maintenance) are not taken into consideration – also because they are long term.

Virtually none of the households interviewed considered their car fuel costs to be a serious worry, needing to be taken into account when budgeting for the home. Most of the time, people were unaware of the true cost of this expense and simply forget about it after driving away from the fuel pumps. This non-rational approach helps explain the fact that at the time they purchase a vehicle drivers tend not to worry about this particular expense (Turrentine and Kurani, 2006).

Additionally, a number of studies have shown that the costs for "cleaner" cars are currently prohibitive. [One of the] 'hotspot' factors which influence consumer adoption/rejection of low carbon goods or cleaner technology products [is the cost]. The higher purchase prices and longer payback periods which are often associated with many low carbon products may often act as a disincentive barrier. The research found for instance that the lease cost for a Prius car 'involves a significant premium over comparable conventional models' (Lane and Potter, 2007:13). The researchers argue that the high cost is due to high servicing costs alongside the fact that the car is currently distributed through a relatively small network of distributors. [Lane and Potter, 2007/RESOLVE-15]

Concerning the specific cost of petrol, studies carried out about price variations for energy show that consumption takes a while to adapt to energy price increases. When prices increase, car use elasticity is weak in the short term – but stronger in the long term.

In this paper, the demand for gasoline and the stock of cars is empirically explained for the Swiss economy. Statistical methods from modern time series analysis are applied to annual data over the period 1962-85. The short-run price and income elasticity of gasoline consumption are -0.3 to -0.45 and 0.7 respectively and therefore about the same as in other countries. It is furthermore shown that the price elasticity becomes substantially higher in absolute value after the first OPEC shock in 1973. Pollution control measures introduced in 1982 negatively affect the stock of cars. Longer run effects operating over changes in the size of the stock and the fuel efficiency of cars are stretched out over several years as shown by a variety of simulation experiments. [Waserfallen and Güntensperg, 1988/UNISG-18]

2.5 Technological barriers: counter references which sap confidence in alternative solutions

When considering innovative technical solutions such as electric vehicles, people usually decide that they are not ready to put their trust in such a solution for the time being. In addition to the cost, people often consider that they can not trust electric vehicles.

Although the ecological cost of the vehicle is never spontaneously mentioned, this item is perceived [by those interviewed] as a "half car", because of the technical constraints⁹ which significantly reduce the overall functionality of the vehicle (Faivre d'Acier, 2008).

People fear a lack of technical reliability (Beillan et Legris-Desportes, 1995), and these kinds of barriers are frequent in the innovations history. One example of this consists in the slow take-up of unleaded petrol in the Norwegian market.

There could be several reasons why the consumers reacted slowly: much confusion over which car models that could use the lead free alternatives, too low tax differentiation, popular myths on (the need for) the lubricative properties of lead, problems with universal availability of 95 and 98 unleaded alternatives. The introduction of the catalytic converter gave the final push towards completely lead free gasoline. [Stø et al., 2005/SIFO-02]

This technical barrier is also a psychological one, in the sense that it deals with trust and confidence. Thus, public reactions to electric vehicles could be considered as fairly negative. The technological barrier therefore constitutes an obstacle to be removed, by retrofitting technology and improving communication in order to avoid counter-references.

2.6 Individual and psychological barriers: an extremely powerful factor

In view of the highly symbolic nature of the car within Western societies, individual barriers¹⁰ to change in fuel consumption behaviour are significant and widely discussed by the literature mentioned.

Generally speaking, the images associated with the car are positive, giving it an advantage over public transport. Cars and public transport can be compared via four image-related aspects: mobility factors (speed, efficiency, speed of access, flexibility, availability and access to different areas of activity and autonomy), cost, travel conditions (i.e. comfort), environmental consequences and human-related risks.

Scholars [Kaufmann et al., 2001/EDF-41] analyse the relevance of the representations of the various means of transport so as to understand the predisposition to use cars. According to them, the various means are assessed thanks to 4 major criteria:

- The journeys they hope to make:

“For cars and public transport, the main criterion refers to the notion of mobility the considered means provides”. More precisely, individuals would assess the efficiency (fast or slow) of the means of transport and the autonomy it provides (makes autonomous or inconvenient). In general, public transport is considered to be less and less fast and more and more inconvenient as one moves away from the town centre.

- Cost-related factors;
- Qualification of the transport conditions provided (comfortable vs crowded);
- The consequences (environmental and human risks) of mobility. [Kaufmann et al., 2001/EDF-41]

In view of these factors, the car is better placed than public transport. Additionally, these images may be considered in relationship to transport habits. Users of cars tend to have more positive images than non-users.

Non-users underline its pollution, noise and danger aspect more than users. The latter are more sensitive to the cost of the car and its comfort.” Two observations: The question of freedom provided by the use of a car is less sought for by non-users. And users are fully aware that cars pollute. [Kaufmann et al., 2001/EDF-41]

⁹ In this article, the listed constraints of the electric vehicle are mainly the autonomy of the vehicle (how far you can go) and the time that you need to recharge it.

¹⁰ We are including the cognitive aspect within the individual aspect even if the two are considered separately in the *Description of Work* document.

Alongside these images focusing on the instrumental benefits of car use, we should also add the emotional and symbolic aspects. Via advertising and photographs, cars are portrayed as an emotive item, a bringer of sensations of power and pleasure associated with speed or conveying a certain image of social status.

“Besides, other motives seem to play an important role, such as feelings of sensation, power, superiority, arousal and pleasure. (...) Moreover, the way people talk about their car illustrates that for many, the car is a symbol for status and success and a way to express themselves.” [Steg, 2007/RUG-13]

The car: “object of desire, success, prestige, power, social status, instrument of construction or adaptation of the territories” [Dupuy, 1999/EDF-35]

Psychological factors play a major role compared to functional arguments.

Symbolic and affective motives may even play a more important role when considering mode choice for types of trips that are less functional, such as recreational trips. [Steg, 2007/RUG-13]

Thus, psychological factors determine mobility-related behaviour quite apart from the functional characteristics. Indeed, the car industry's marketing has successfully adapted the product (cars) and the advertising to extremely different target groups (for men, working women, households with children, etc.) unlike the advertising for public transport which does not segment its customer base to such an extent. Furthermore, these emotional and symbolic images are segmented according to social category and especially to gender. Cars enjoy advantages over public transport from the point of view of autonomy for both sexes, while the same time providing an impression of control and self-esteem for men and security for women.

Autonomy (control, flexibility, convenience) is particularly important for both sexes; protection is particularly important for women, and prestige more so for men. Thus, the study indicates that cars have a different significance for men and women, feeding into different meanings in terms of potential psychosocial benefits. Men's self-esteem is more strongly related to car access than women's; on the other hand, for women, mastery was more closely related to car access, emphasising perhaps the practical rather than the symbolic importance of cars in women's lives. This difference in the role of cars is further reflected in the findings that car type is associated with psychosocial benefits for men but not for women. [Ellaway et al., 2003/RESOLVE-17]

These emotional and symbolic reasons explain the resistance to reduce car use. This resistance is such that people trivialize the disadvantages of car use: individuals go out of their way to justify their use of the car by minimising for example its financial cost or what the road infrastructure costs to the society in general. We can speak about lack of knowledge, false and partial perceptions (for instance on the trip costs and duration) and giving a *posteriori* rationalisation of behaviours (see Economic barriers 1.4).

Its inconveniences on the other hand are minored (notably, the cost of the infrastructure is hard to see) [Pierre, 2008/EDF-45]

Car users experienced a discrepancy between their environmental attitude and their actual behaviour. Such a discrepancy causes an unpleasant psychological tension, a phenomenon called cognitive dissonance. People are motivated to reduce this tension. The easiest way to do is changing their attitudes (rather than their behaviour). [Steg, 2007/RUG-13]

When faced with situations of cognitive dissonance between behaviour and attitude, people will also attempt to reduce tension by modifying their attitude, and sometimes enter a state of denial.

“Habits result in selective attention: people tend to focus their attention on information that confirms their choices and tend to neglect information that is not in line with their behaviour. (...) Habits may also result in misperceptions, e.g., people tend to overestimate the costs of travelling by public transport, while costs of car use are underestimated.” [Steg, 2007/RUG-13]

For all these reasons related to psychology aspects of car use, achieving a transfer from one means of transport to another is difficult, as is a reduction in fuel consumption. Indeed, this consumption is based on a well-anchored and well-entrenched car use pattern and on a market system in which energy efficiency gains for vehicles (particularly in terms of motorisation) are offset by the development of vehicle ranges favouring higher engine power and equipped with energy intensive features.

3 HOW TO REDUCE CONSUMPTIONS ON FUEL FOR VEHICLES?

Faced with these obstacles in reducing energy consumption for vehicles, a number of measures, laws, innovations, regulations and standards aimed at changing mobility-related behaviours have already been deployed, and we will begin by mentioning those initiatives. Secondly, we will be explaining the main areas of action intended to overcome obstacles to energy savings, as identified in the collaborative literature review.

3.1 What has already been done? Analysis of the initiatives, experiments and political measures

A number of measures, initiatives, experiments have already been implemented in order to reduce energy consumption. In the following paragraphs we are mentioning the main ones, and in any case those which were identified in the literature review.

Developing technical innovations (motorisation and fuel)

These technical innovations take several forms and chiefly involve:

- Improving the environmental quality of the motorisation

Technical improvements have been made in the field of private mobility (motorisation, etc.), but these improvements are counterbalanced by adverse trends such as car weights and engine power (Cahiers du CLIP, 2001).

There are many technical solutions (hybrid and rechargeable engines, biofuels, etc.) but they are not fully developed for the time being (ex: fuel cells).

Moreover, the potential target group for these technological innovations may be affected by a rebound effect: studies focusing on groups of individuals sensitive to these technological innovations show that among these individuals, it tends to be the technological argument rather than the economic argument which prevails (Pierre, Jemelin and Louvet, 2007). Thus, these technophiles may have well-developed car use habits, may possess several vehicles and may have vehicles featuring a high level of comfort (and therefore requiring more energy).

- Promoting the use of electric and hybrid vehicles¹¹

The solution involving the promotion of electric and hybrid vehicles has been deployed in a number of local and urban authorities. These are not national but rather local policies, focusing in particular on captive vehicle fleets used by the staff of the local authorities themselves. The rare studies carried out into the use of electric vehicles aimed at the population for day-to-day travel show that these innovations (as they are currently in the "innovation" phase) only concern "pioneering" segments of the population and are necessarily limited in nature. Subsequently, these innovations will only concern small segments of the population including households with several vehicles carrying out routine journeys, and those living in single-family dwellings, for general-purpose local use (Pierre, Jemelin and Louvet, 2007; Beillan et Legris-Desportes., 1995). However, the use of an electric vehicle involves a modification in the individual's daily activities (see The importance of habits and routines, 1.3.3).

- Changing fuel types

In some respects, changing fuel can be seen as a technical solution, even if this is based upon a series of actions which involve changing vehicle too. Although biofuels are not yet sufficiently well distributed, a study of social science literature contains a wealth of information concerning the distribution of new fuels in the past (with these today being widely used fuel types¹²) including diesel and unleaded petrol. These examples from the past show that diesel is a fuel with a "rebound" effect [Orfeuil, 1997/EDF-05]. And unleaded petrol is a classic example of the "top-down" distribution of innovation [Stø et al., 2005/SIFO-02]. Will biofuels succeed in reaching a more ecologically-minded section of the public (but recent controversy) than these two other fuels? [Douaud, 2006/EDF-19]

¹¹ These solutions effectively involve reducing fuel consumption and consequently the consumption of fossil fuels. Despite this, their degree of energy efficiency (and therefore ecological reliability) will be dependent upon the energy mix of each country, i.e. the electricity production source used.

¹² Even if their energy efficiency needs to be improved, we are mentioned them in this paper as they shed light on the distribution process for a mobility-related innovation.

Modifying access rules to towns and to road infrastructures

In order for cars to no longer prevail in towns, one of the solutions tried out by the town councils involves changing the rules governing access to the urban centres and the access conditions for road infrastructure (roads and parking in particular). The use of parking penalties is a key factor in restricting the presence of vehicles in the town centres. When the car parking is facilitated in a city, the use of a car is also encouraged there¹³.

Importance of car parking: “Massot and Orfeuil (1991) showed that individuals with a designated parking space at work used public transport to go to work half as much as those without one.” [Bonnell et al., 2004/EDF-34]

This boosts access to cleaner vehicles where pollution is concerned, such as electric cars for example (in France, the distribution of electricity for electric vehicles is free of charge in public areas, and in Norway, these vehicles are allowed to park for free, etc.). However, the penalisation/facilitation of parking is rather controversial measure. Indeed, its opponents often point out that charging for parking involves taxing vehicles which are stationary (and therefore not generating any pollution).

On the other hand, measures to limit traffic levels by means of structural decisions (bus lanes or pedestrian areas) generally affect the volume of traffic and therefore the target group. These are being increasingly deployed by city councils [Philibert, 2005/EDF-20], accompanied by the availability of parking areas at multimode hubs offering an alternative method of getting into the town centre, using public transport (railway stations, edge of town locations, etc.) in order to allow for intermodality. In this same category (restricting traffic) we should also include the urban toll system¹⁴ already tried out in a number of European cities. The latter is a real tax against car use. Economically viable, these measures (road charging, urban toll, etc.) are more or less accepted, depending on multiple factors including the level of difficulty.

Economic measures

The economic measures aimed at reducing fuel consumption are of various forms and scales (taxes levied on an annual basis or alternatively on a situation-by-situation basis) and concern different characteristics (the vehicle itself, its fuel, parking or traffic in the event of urban toll systems). These solutions vary according to the countries concerned. In France, for example, a tax disc and bonus/penalty system was recently introduced in order to encourage people to buy vehicles which generate less pollution. If we wish to segment these measures, we may consider that they concern two separate moments in the consumption process:

- When purchasing

The products subject to price variations are the cars themselves but also the fuel, which does not have the same relevance in the eyes of vehicle users. For example, the introduction of the bonus/penalty system in France seems to be exceeding even the most optimistic forecasts. According to the studies, economic incentives work when the decision process is simple [Wüstenhagen and Sammer, 2007/UNISG-17]. Consequently, these measures are more effective concerning the purchasing of fuel than the purchasing of vehicles. Varying the price of fuel results in genuine reductions in traffic levels [Waserfallen and Güntensperg, 1988/UNISG-18]. However, research then points to an increase in demand for less costly vehicles.

- When using the car

There is a battery of incentives and constraints (road tax disc, etc.) aimed at reducing fuel consumption and which focus on the usage (and not on purchase) phases. The assessment of these measures varies according to the situation and the country, etc.

📁 Energy is quite invisible and its cost is minimised. The 5-6 WPs could investigate how the people make their consumption visible (do they have bills, etc.)? Do they think that they use their car a lot? Is it true (in time of time-budget of transport of instance) or is it a misperception?

¹³ This is not a causality link but a correlation.

¹⁴ This innovation could also be included in the following paragraph, in as far as the limitation on traffic is achieved in this case via pricing and is therefore an economic measure.

Promoting changes in car use (car-sharing, etc.)

Reducing fuel consumption of the car can be achieved when it is used, for example by ensuring maximum capacity use of the passenger space in vehicles. Car sharing can take various forms, according to whether it is carried out on a formal or informal basis:

- Car sharing

Informal car sharing works best when all the passengers belong to a similar group or environment (work colleagues, friends, etc.). Car sharing above all concerns younger, wealthier people, and high socio-professional categories living in the suburbs.

In London, informal car sharing involves several social groups. It is fairly widespread (particularly when transporting friends) and is carried out on regular routes (to and from work, etc.). However, only 1% of Londoners have taken up car sharing through a company-run scheme. [Department for transport, 2007/RESOLVE-16]

- car sharing in self service

This is often carried out using electric cars, as part of French case studies. Its limitations lie in the combination of two separate innovations: one technological and one organisational [Massot, 2000/EDF-23; Massot et al., 2004/EDF-03].

- car pooling

This innovation in the mobility field has enjoyed a certain degree of success in a number of European cities. It is often organised by private companies. The success of this transport system is often based on the satisfactory management of the vehicle fleet and of the flow of requests (via the information system): it needs to be carefully managed.

Nevertheless, car pooling can have a number of unwanted side-effects, as shown by the studies carried out, by attracting people who previously used a means of transport other than the car to get around.

Changing driving habits

Reducing fuel consumption can also be achieved through bringing about a change in people driving habits. Drivers can drive their vehicles in a less energy intensive manner... or simply drive less.

- Eco-driving:

“Ecodriving has become a key element of national strategies to reduce CO² emissions in a number of countries; notably the Netherlands, Austria, Germany, and Spain while ecodriving is widely encouraged also in Canada, Japan and the United Kingdom” (International transport forum, 2007).

Speed limitation and other eco-driving tricks are implemented in some driving schools (for instance in Germany) and in dedicated fleets (International transport forum, 2007). In the latter case, the organisation concerned is seeking to make its staff more aware of the need to develop gentler and slower driving habits.

One of the major effects of eco-driving other than the noticeable gains in fuel efficiency is that by making people aware of other driving styles, it reduces the tendency to see the car as a vehicle associated with speed. It lays the ground for the use of other means of transport.

- Drive less:

Taking the car less often to travel around can be an occasional practice for some individuals or virtually automatic for others, who may have chosen to live in a pedestrianised or eco-district. Naturally, this concerns those people who attach a high degree of importance to ecological issues when planning their activities.

Driving less becomes a distinctive practice.

Ecological factors influence the choice of means of transport, and also encourage a lower level of car usage. Consequently, in Western Europe, driving less has become a distinctive practice. Caution is required however, as this line of thinking may sometimes make its mark where values and attitudes are concerned, without ever being translated into concrete action. Under what conditions can both theory and action best combine? [Gärling and Steg, 2007/RUG-06]

📁 For the surveys/studies (WP5-6): let's propose to the interviewees to organise the listed measures into a hierarchy from the more acceptable to the less acceptable ones.

📁 The barriers towards the behavioural changes are not located only at the consumers' level.

Therefore, let's try to highlight the barriers, constraints, representations, world visions of the stakeholders too.

3.2 From barriers to the action levers helping to overcome them

The collaborative literature review has identified areas for action aimed at overcoming obstacles to energy saving where mobility is concerned. We have based our analysis of these documents on the classification proposed in the *Description of Work* document (also used in the first part of this *position paper*), with the areas of action concerned spanning all levels from "macro" down to "micro"¹⁵. Indeed we intend, without pretending to be exhaustive, to go from the barriers to the forces enabling to overcome them and to underline the main forces that can lead to behavioural changes.

Structural aspects: urban flow management and infrastructure

Surveys into consumption management (reducing car use) have mainly focused on voluntary behaviour (via knowledge and perceptions) but have scarcely considered context-related changes. Nevertheless, these can have a structural effect upon the behaviour of individuals. However, the structural level includes a number of areas for action having a major impact upon individuals.

The vehicles of the future (electric vehicles for instance) will need a special infrastructure (ex: charging stations) and some services (after sale services, maintenance, etc.). The whole channel of manufacturing, supplying, maintenance, etc., has to be set up.

[One of the] 'hotspot' factors which influence consumer adoption/rejection of low carbon goods or cleaner technology products [is the lack of systems integration]. A lack of what the researchers describe as 'systems integration' with products and systems can often mitigate against the purchase of low carbon products. They point for instance to the situation for battery electric vehicles where the recharging process of several hours could be inconvenient in relation to conventional cars. Servicing and maintenance is also seen as a problem as eco products are more specialized areas of expertise. [Lane and Potter, 2007/RESOLVE-15]

Consequently, the obstacles to the development of infrastructure allowing for the use of more energy-efficient vehicles must be removed. Several of these are structural in nature. For instance, measures relating to urban flows (road pricing, speed limitation, etc.¹⁶) may encourage individuals to modify their journeys on a daily basis (or even to move to a more densely populated region).

Context-related changes should not be excluded from subsequent WPs, as they play a major structural role where individuals are concerned.

Political forces: the tool mix

There are number of political tools and factors to be considered too (i.e. concerning laws, regulations, the reorganisation of the key players involved or simply a stronger political will to bring about change). Several scholars have suggested that in order for measures to be satisfactorily accepted by the population, it is necessary to minimise the contradictions setting them apart from one another, and to weld them into a coherent package of measures. This means ensuring that the publicity and

¹⁵ However, the factors put forward do not automatically correspond to the barriers mentioned in the sections dealing with the same field. For example, the structural factor which involves establishing recharging points for electric vehicles needs to be considered in relation to the absence or presence of available electric vehicles in the market, and consequently is not only a structural obstacle (i.e. the lack of a market) but also a political, social or technical obstacle (a lack of participants, supply and demand within this market). Similarly, the technical aspect may equate to barriers of various kinds, and particularly those of a psychological nature (a lack of confidence in the reliability of the proposed technology).

¹⁶ A number are economic in nature – (urban toll systems for example) - as well as structural. We mention them in this paragraph as they result in structural modifications to the access to urban centres.

communication concerning public policy measures stress their coherence, for example by associating urban toll measures with the free use of public transport on the route concerned.

The taxes are only accepted as a means for obtaining something which has interest in itself, i.e. matched with a complete project for reinvesting funds. For this reason, the urban toll only emerges from a local political logic. Financing public transport seems to constitute a special reinvestment of environmental toll funds, first because it corresponds well to the requirements of being concrete and useful. Then, because this leads to favouring people with modest incomes in that they use public transport the most. [Lauer, 2007/EDF-27]

What exactly are the necessary features in order for a measure to be more or less acceptable? A number of researchers have noted that political measures in the mobility field are generally accepted, as they concern the whole population and that although they result in costs for the individuals concerned, these sums are not automatically deducted from the individual's bank account (such as taxes, etc.). Regulation measures (mandatory maintenance check, restricted use of vehicles¹⁷, etc.) are more accepted than economical ones (*Cahiers du CLIP*, 2001). Dissuasive measures are less accepted than incentives [Klaerr-Blanchard, 2000/EDF-28]. Consequently, taxes and individual benefits have to be associated.

The paper elaborates on policy strategies that may be employed to achieve sustainable transportation by changing car use. It was concluded that increasing the attractiveness of sustainable transport modes by means of pull measures is not sufficient to reduce the level of car use. Besides, car use should be made less attractive by means of push measures to force drivers to reconsider their travel behaviour. The acceptability of such policies may be increased by clearly communicating the aim of these policies, and the expected positive consequences (e.g. less congestion, improved environmental quality). Moreover, possible negative effects for individual freedom may be compensated by implementing additional policies aimed at facilitating the use of sustainable transport modes. [Steg, 2007/RUG-13]

Furthermore, individuals must be convinced of the effectiveness of a policy if they are to support the action in question.

Putting a toll booth on a section that was formerly free will raise spontaneous reactions of misunderstanding and rejection. The experiences abroad show that the coherence of the whole plan is a major element of the success of these projects. One is favourable to the urban toll that in return is an advantage (save time, better accessibility, quality of life). (...) The scope of application, the pricing system and the use of toll receipts are the principal mechanisms for setting up an effective and equitable toll, associated with information, dialogue and transparency. [Klaerr-Blanchard, 2000/EDF-28]

📁 In view of the fact that individuals are more willing to commit to a course of action when they are convinced of its effectiveness, it may be a good idea to work on highlighting the tangible benefits of the policies at an individual level.

📁 With this in mind, once certain practices favouring energy savings in the mobility field have been identified, do the individuals concerned identify a link between this and restrictive public policies (WP5-6) ?

Social forces: Bringing about changes in chosen means of transport

Socio-cultural factors can also play a role in encouraging behavioural changes where mobility is concerned. These operate at both a macroscopic, micro-social and micro-individual level, and are related to highly specific actions. We can break down the main factors identified in the literature review based on the following aspects:

✓The marketing that promotes “green vehicles” has to improve their promotion.

Work on the symbols developed by marketing departments in order to promote cars in relation to environmental themes is certainly an area for action. However, it should be noted that this issue is a source of controversy in scientific circles.

¹⁷ For example, in France during the periods of peak pollution certain vehicles are allowed on the road and others are not according to the odd or even registration number of their car registration plate.

[One of the] 'hotspot' factors which influence consumer adoption/rejection of low carbon goods or cleaner technology products [is the visibility]. The Open University research found that many drivers liked to display their eco-credentials 'by using a highly observable product' (Lane and Potter, 2007:14). The researchers argue that this raises the issue of the car as a status symbol. The research found that the status of conventional cars was linked to preference for solo driving, greater levels of commuting and less of an awareness of the environment as a problem. The researchers argue that marketing must work on the future marketing of these vehicles with these kinds of issue in mind. [Lane and Potter, 2007/RESOLVE-15]

Additionally, it is necessary to tone down the social representation of electric cars, and to have it promoted not so much as a replacement for heat engine-driven vehicles but rather as an addition to them. Instead of being constantly compared to mobility patterns typical of the heat-engine powered car, the emphasis should instead be placed on specific urban uses for which the electric vehicle is suitable. This means reviewing a number of standards and benchmarks (including the services expected from a car, the social image conveyed, and the notion of community-mindedness).

Observation of the use of cars within the household suggests that the electric car could meet certain mobility needs. Electric cars would thus not replace heat engine cars but be complementary. B. Faivre d'Arcier thus recommends focusing on alternative uses. [Faivre d'Arcier, 1997/EDF-04]

Users must [get rid of] the idea that every vehicle must be suitable to every use. [Agence Internationale de l'énergie, 1994/EDF-33]

☞ Car marketing is subject to regulation, and some European countries in particular ban references to "green vehicles". As part of WP4, it may be of interest to interview numerous marketing managers from European car manufacturers concerning their room for manoeuvre on this particular point.

✓ **Trials on innovative transport systems sensitise the individuals, encourage them to revise their modal habits and to enrich their transport skills.**

Local initiatives or experiments such as Praxitèle or Liselec (self-service electric cars) offer the possibility for the gradual build-up of "green vehicles" as part of the urban scene. The trial can provide an opportunity for change if it proves successful. It therefore brings about a modification in the "mobility capital"¹⁸ that the person has accumulated and developed throughout his life.

As such, experimentation (often provoked) with a sudden change in habits may constitute a factor for change, encouraging usage if the results are positive (Rocci, 2008).

After having experimented with a particular method, individuals learn more about it and by force of habit and routine become rather "expert" in their trips. However, the higher the level of knowledge of the mobility system, of the various means of transport and of the town, the greater the extent to which journeys can be optimized. Getting around is part of a learning process. (Rocci, 2008)

These new experiments are often carried out at changes in the life cycle and encouraged by the social network.

✓ **Life cycles play an important role in behavioural changes:** transitional moments offer the opportunity to question one's modal habits. They encourage people to experiment with new means of transport and add to their "mobility capital".

Education, house moves, work, encouragement from friends, relatives and colleagues, or one-off constraints can all provide an opportunity to carry out such trials when sudden changes and transitions in the life cycle occur. Experimentation then offers a usage potential which can be either rejected or otherwise, further increasing the individual's range of possibilities where means of transport are concerned. In order to help to bring changes in means of transport, it is important to give individuals the possibility to boost their "mobility capital" (Rocci, 2008)

As we have seen in the section covering obstacles to behavioural changes in terms of car use and energy savings, the activity circuit is characterised by its rigidity. For this reason, the life cycle-based approach appears to be useful regarding its modification and reconstruction. Indeed, the transitional

¹⁸ The "mobility capital" is the mobility capacity of individuals in terms of skill, knowledge of the means of transport and/or mobility system but also in terms of experience and willingness to discover new possibilities" (Rocci, 2008)

moments appeared to provide an opportunity for the activity circuit to embrace new forms of deployment. The adaptation of the individual's activity circuit brought about by a life cycle change is carried out according to the level of constraints and limitations preventing him from using his usual means of transport (the car).

If the level of constraint is low, the individual seeks to maintain those activities or trips which he considers essential by restructuring the spatial or temporal organisation of those activities which he considers less important. The higher the level of constraint, the more he will do away with some of these until finally he envisages a change in his place of residence. The rules governing the adaptation process for the activity circuit are not intangible (Faivre d'Arcier, 2008).

There also are some temporary mobility practices which can bring about behavioural changes. For example, an individual who often takes the TGV (high-speed train) for his business trips may consequently become aware of the advantages offered by this means of transport and apply these in other areas of his life, for example for private and pleasure trips too.

☞ Once those persons having modified their transport practices in favour of reduced car usage have been identified (WP5), during the interviews (WP6) it would be interesting to analyse the factors bringing about this change in daily life, in addition to the decision-making aspects considered as having encouraged this change in means of transport.

☞ A position may change after a personal experience. For this reason, in subsequent studies it would be a good idea to focus on the moments in which the individual's life cycle changes (for example the moment he takes up a job or moves house, etc) as these are all ideal moments to change means of transport.

✓ **The club effect for the early adopters such as carpooling or electrical vehicle (discussion forums, free parking, etc.) is a good argument to launch "green cars" and mobility innovations.**

Car rental must be user-friendly (club effect, with member appreciation) to break in (the consumer's requirements.) [Collectif, 2006/EDF-38]

The "club" effect and the interpersonal benefits appear to be structural aspects of transport practices. The contact-related aspects will for example be decisive in practices such as car sharing and car pooling.

Meeting methods also influence the regularity of this practice: institutionalised and association-based car pooling schemes appear to be used on an "as-needs" basis to a certain extent. On the other hand, we observe more regular practices of this kind where informal car sharing is concerned (Vincent, 2008).

The notions of sharing, dialogue and social contact appear to be factors in consolidating this type of practice, more so than awareness of the environment.

The interpersonal relationship between the two team members, the sociability and the pleasure of being together (or otherwise) then forms the cornerstone for the future of the car pooling solution (...). For some people, sharing a car can be something of a committed, environmentally-friendly and community-minded stance. However, idealistic convictions ultimately have very little influence on the material constraints related to this practice. (Vincent, 2008)

☞ Although the statistical survey (WP5) makes it possible to identify those persons having changed their means of transport in favour of reduced car use, it may be of interest to discover more about the factors which brought about this change, particularly in terms of life cycle (age, change of status within the family, house moves, etc).

☞ The cultural aspect is scarcely mentioned in the literature review and merits further investigation. There are some big differences between countries and cultures in regard to the social forces to reduce the use of cars. The example of car renting shows that countries have different reactions to this. Consequently, this practice is far more developed in Germany than in France, in view of the different image of the cars owned¹⁹. Therefore, we may include some

¹⁹ Tissier-Desbordes Elisabeth, 2006, "Quatre pays européens face à la location", International seminar: *Acheter ou louer les biens de consommation?*, organised by the Institut pour la Ville en Mouvement (January 26-27, 2006).

institutional aspects of different countries as well (e.g., political, structural and social practices) and look whether this explains some of the differences in energy consumption (multi-level analyses).

Economic forces: The cost of the car itself

Eco-labelling of gasoline consumption helps people become more aware of how much car costs and tax incentives are instrumental in encouraging people to purchase cars which generate less pollution.

As an energy policy measure, hybrid vehicles are eligible for tax rebates in parts of Switzerland. We found evidence that these tax rebates indeed lead to significantly higher sales. A rough cost estimate of such tax rebates as CO₂ abatement policy tool is presented. [SIFO-09]

One may assume that an improved knowledge of individual costs such as this would facilitate certain behavioural changes. For example, some studies show the long-term effect of energy price variations on fuel consumption. For instance, the Fuel Price Escalator eventually compromised political expediency on delivering low cost fuel.

However, careful attention must be paid to the unexpected effects which these types of measures may generate, and which chiefly affect low income households most severely. Moreover, it is interesting to note that in the UK, fuel demonstrations forced the Government to back down on continuing, the Fuel Price Escalator as a policy mechanism introduced to tax fuel and address road travel) when petrol prices then became the highest in Europe. Citizens actively lobbied politicians rather than change their behaviour (Fudge and Mulugetta, 2008).

“Environmental groups and organizations continue to be unhappy about the scrapping of the FPE alongside what has been seen as a ‘dumbing down’ of other associated tax levies on fuel consumption. Groups such as Friends of the Earth (2000) argue that higher taxes are essential policy mechanisms in addressing climate change, particularly in beginning to change the behavioural norms that often characterize vehicle use. In opposition to the time-span of research produced by analysts such as Glaister and Graham, many environmental groups argue that policies such as the FPE were not given time to mature as *long-term* strategies in directing people to cut down on unnecessary journeys, to use smaller, more fuel efficient vehicles, to make greater use of public transport, or inform decision-making on future road construction.” (Fudge and Mulugetta, 2008).

On the other hand, individuals are more likely to agree to such initiatives if they enable them to achieve benefits in the way of financial savings.

Pricing measures to limit car use and encourage uptake of more efficient or sustainable fuelled vehicles were considered the most effective in promoting behavioural change. [Bristow et al., 2004/CSE-05]

The national survey, however, showed that car buyers are receptive in principle to comparative information about environmental performance and fuel efficiency and the environmental label could fulfil this role. The pilot of the prototype label in showrooms, however, demonstrated a lack of interest in the environmental performance of cars more consistent with the focus group results. The researchers conclude that for the environmental label to be effective on cars there needs to be a clearer link between the environmental costs and personal costs i.e. between emissions and fuel consumption/running costs. At present consumers do not seem to comprehend this link. [Department for transport, 2005/CSE-02]

These kinds of benefits (energy savings and money savings) have to be calculated at various moments. However, the financial aspects alone are insufficient when trying to understand the choices and behaviour of individuals.

Psychological studies show that information and money, two of the major policy tools for conservation, are more complex and multidimensional than standard technical economic policy analysis assumes and that money is not the only important motive for conservation. These insights can be used to improve the implementation of energy conservation programs. [Stern, 1992/RUG-10]

📁 Ask if households already benefiting from such economic measures.

📁 In view of the recent fuel price increases, it would be interesting to question (WP5-6)

individuals regarding changes in their fuel consumption as a result of this economic factor. Moreover, it would also be interesting to highlight alternative strategies encountered: for instance, when they use their car less, what do they replace it with? (Travel less? Use public transport? Recourse to car pooling? Etc.?)

Individual and psychological forces: giving information and improving communication

The individual level includes cognitive factors and involves several aspects dealing with the reception of some information and communication. Some of them have been considered on a thematic basis by the literature examined and notably :

- giving information in order to convince
- highlighting concrete effects of the daily mobility on climate change.

As said in the empirical clarifications (Stø and Poppe, 2008, referring to Steg and Abrahamse), even if “energy use is not based on environmental considerations only”, “policies appear to be more acceptable when people value the environment, when they are aware of energy problems and when they think they can and should contribute to possible solutions to these problems.”

Information can be efficient but if changes are too difficult to introduce, expensive or uncomfortable, people won't change their behaviours, they will just change their attitudes. Furthermore, it seems that the ecological aspects are rarely taken into account when purchasing a vehicle.

📁 Ask questions to the households on what they know about the awareness campaigns in their country, and if this changed something in their practices.

📁 The ecological argument should be used with caution when promoting the use of vehicles allowing for reduced energy consumption. It generates controversy and clashes directly with the usual image of the car. However, it may be advantageous in WP5-6, to analyse the manner in which a number of highly specific campaigns were perceived.

Technical forces – an additive key?

Acting by means of technology is not enough.

The emissions modelling showed that reduction targets were only met when technological change was combined with behavioural changes. [Bristow et al., 2004/CSE-05]

The persons who change technology in the mobility field are also those who drive the most (the rebound effect) as shown by studies concerning "pioneers" possessing an electric vehicle (Pierre, Jemelin et Louvet, 2007). But some improvements will occur concerning the technical performance of motorisation (EV-HV- fuel cells) and concerning the reduction of the fuel demand of cars (for example based on a better insulation of cars).

"The contribution made by a driver to the greenhouse effect is largely dependent upon the characteristics of his car, including its model, its equipment, the type of fuel used and its mechanical condition". However, cars are becoming heavier and more powerful, and additional comfort and security accessories are being added. "Consequently, any progress made in terms of fuel consumption has above all been used to offset changes in weight (+130 kg equivalent to +14% over the space of 10 years), in power (+10%) and the addition of features to vehicles (such as air-conditioning). As a result, the unitary fuel consumption of vehicles had not fallen significantly" by the late 1990s (Les Cahiers du CLIP, 2001).

Such improvements may help individuals change their representations of cars (e.g. vehicles for long and short trips are complementary). This may also concern innovations which not only improve energy efficiency for cars but also which allow for the elimination of car use in the first place, such as teleworking for example. However, according to some scholars this will not result in a reduction in physical mobility but rather in a reorganisation of it: the persons with the highest levels of technological usages are also those for whom mobility levels are highest (Urry, 2001).

Counterparts to dissuasive measures may be technological advantages (e.g. stop and go systems, automatic cruise control). Technologies providing drivers with an overview of their driving conditions (GPS, gear shift indicators, cruise controls and onboard computers) can support ecodriving.

“Large savings are possible with GPS-based guidance systems that plan optimal speeds according to tides, currents, water levels and weather conditions. (...) In-car equipment such as gear shift indicators, cruise controls and onboard computers giving feedback on the current fuel consumption help improve fuel economy” (International transport forum, 2007).

4 CONCLUSION

Within the context of this project, our multi-disciplinary approach allows to analyse mobility behaviours and fuel consumption patterns from various points of view, showing the action capacities and the constraints of the individuals. The crossed look enables to better understand the complexity of behaviours which is revealed by the multitude of the various barriers, but also by the multitude of levers for action.

5. SPECIFICATIONS FOR THE NEXT WORK PACKAGES²⁰

5.1 Work Package 4 – Interviews with stakeholders

Examples of stakeholders to meet

- ✓ Market: car manufacturers, distribution network, maintenance.
- ✓ Policy: “makers” and “disseminators” (education system, associations, driving school instructors teaching eco-driving as is the case in Germany for example, etc.)
- ✓ Civil society: individual “opinion leaders”, Internet forums, non-structured groups, , groups of “pioneers” using alternative means of transport or living in eco-districts; initiatives at the workplace/office play a role in the dissemination of energy awareness + Cities networks + fleet staff using electric vehicles (for example La Poste in France).
- ✓ The actors concretely in relation with the “consumers”/ the households: garage mechanics, car dealers, etc.

Examples of questions/themes

- ✓ In the stakeholders’ mind, what are the easiest and what are the most difficult behavioural barriers to overcome? → Adapt the question to the various types of barriers.
- ✓ What do they think citizens/consumers can accept? What is negotiable? Non negotiable?
- ✓ What do they personally judge acceptable? Unacceptable?
- ✓ Do they think a fast change is possible? In which conditions?
- ✓ Representations of the “energy consumer” and of the “good” level of action
- ✓ What are the constraints, the agency, the strategies, the interests, the values of each stakeholder? (Barriers are also in the side of stakeholders)
- ✓ In their opinion, what are the efficient policies/“devices” for a reduction of energy consumption?
- ✓ Evaluation of the policies by different stakeholders
- ✓ How to overcome the initiatives who are addressed to “pioneers”/environmentally conscious people towards a “general public” policy?
- ✓ What are the (three) main problems they have [to implement a policy/a service/ a commercial proposition]?
- ✓ Do the stakeholders blame other stakeholders for their actions/ non-actions?
- ✓ Who are there partners, co-operation network? With whom do they communicate?
- ✓ Pay attention to the activities of “go-betweenes” situated between supply and demand, namely press and advertising organisations, the marketing chain for new vehicles (marketing departments, sales staff for dealerships or branches, etc).

²⁰ The most part of the specifications are within the text – paragraphs beginning with the sign:



5.2 Work Package 5 and Work Package 6 – Consumers focus groups and quantitative survey

Examples of variables / social groups to take into account

- ✓ People living in dense urban areas versus those living in rural areas versus those living in the suburbs.
- ✓ The inhabitants of areas covered by urban toll systems or other measures of this type. For instance, inhabitants of eco-districts
- ✓ People equipped with one or several cars, and those without a car. Among those people with several cars, “Technology sensitive” people and more generally people adopting new mobility technologies (electric vehicles for example).
- ✓ The influence of the neighbours, friends, colleagues and social networks on the behaviours, and the influence of the behaviours on the social networks are rarely studied. Let’s investigate the *club effect*.
- ✓ Socio-demographic data: Education level, Income, Household composition, Gender, Generations/ages. Indeed, these factors have a significant influence on mobility practices.

Examples of questions/themes

- ✓ There are moments in life to change the mobility organisation. Study how to take into consideration the behaviour evolutions and their dynamics: there may be a progressive change in the behaviours (more and more involving, a threshold not to exceed, etc.).

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