An Analysis study of consumer attitudes towards alternative transport fuels in Algeria.

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***Abstract*— This paper tends to highlight some Demand-side solutions in transportation to reach a secure and sustainable energy future. To achieve the purpose of the study, we started with a literature review about consumer behavior and alternative fuels in used in Algeria then we presented the results of a survey providing insight into consumer attitudes and behaviours associated with alternative transport fuels un Algeria. The key findings are: * Most of consumers do care about the type of transport fuel they use, when it comes to the economical aspect. * Most of respondents say they are not willing to shift for alternative transport fuels with lifetime greenhouse gas though their benefits over fossil fuels. * Consumers are generally aware of alternative transport fuels, but they lack the practical understanding required to enable them to modify their behaviours and decisions concerning the environmental dimension. These findings reveal the need for policies that motivate the uptake of alternative transport fuels in Algeria.**

Keywords— Transport Demand-side, Consumer behaviour, Alternative transport fuels, Sustainable energy.

I. INTRODUCTION

Transportation is the vein that interacts with all the sectors in any country, especially the sector of energy. And most of countries in the world tend to find the appropriate source of energy that keeps this vein vital, and sustainable for future generations.

It is a vial sector, because it insures the mobility of humans and freight, Each individual Uses one or more means of transport available in his daily trips of outing, shopping and home-work or home-study trips …etc, and certainly a trade-off behaviour would occur at the moment of a travel decision; However many factors including human ones may affect this decision, and lead to a choice that might be either in the favour to sustainable development or not.

Recent studies shown that having the right attitudes toward daily mobility doesn't mean abandon privet vehicles and use only common means of transport, the right behaviour it to use the appropriate mode in the appropriate trip

In other words, in this context, the stakes in terms of sustainable development are daunting; because, faced with this desire to develop an electro-mobility based on public transport (through the tramway projects in particular) there are challenges in terms of using cars running on abundant and cheap fossil fuels. In these particular economic aspects, the use of personal cars is something inevitable for the majority of Algerians, what rises the importance of this study is how to ensure that the chosen cars are fed with the appropriate energy that have less negative-impacts on the environment and more economic benefits. Starting from this point the study suggests the following question **"what are the main factors that influence car owners' attitudes towards alternative transport fuels in Algeria?"**

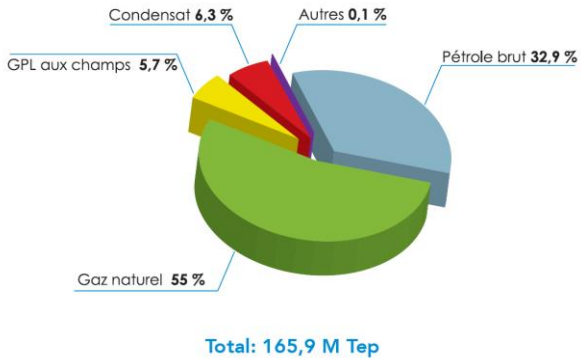
In order to better explain the different aspects of our problematic and the constraints discussed above, we have treated the following hypothesis:

- Personal factors have a statistically significant relationship with the behaviour of trade-off between alternative transport fuels.
- The main type of fuel used in Algerian cars is Diesel "gasoil" due to its cheap cost.
- Car owners favour alternative transport fuels that have less impact on the environment.
- Consumers are not aware of alternative transport fuels characteristics, and they lack the practical understanding required to enable them to modify their behaviours and decisions concerning the environmental dimension

I. CHAPTER ONE: ENERGY IN ALGERIA

A. Energy production in Algeria:

In 2017, Algeria produced a total amount of 165 861 ktoe of energy. The main energy sources are crude oil (32.9%) and natural gas (55%). In comparison, the numbers concerning the renewable energies are much smaller and close to zero. Other energy sources such as coal or nuclear power are not used.

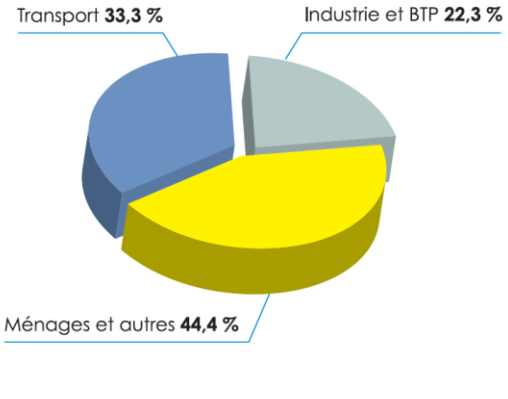


Source: : **Bilan Énergétique National 2017 (édition 2018)** http://www.energy.gov.dz/francais/uploads/MAJ_2018/Stat/Bilan_Energ%C3%A9tique_National_2017_edition_2018.pdf p07

1) Energy Consumption

Algeria's total final consumption (TFC) has been steadily increasing in recent years. While in 2010 the energy consumption added up to around 31,500 ktoe, in 2013 it had increased to 38,543 ktoe, which means that the country has seen an increase of 22% in just three years. In 2017, however, it reached 59,6 ktoe.

Taking a closer look at various sectors, the residential sector (including agriculture) is the one which consumes the most energy 18 584 ktoe (44%), followed by the transport sector 15 057 ktoe (33%) and the industry sector 1 134 (22%).



Source: : **Bilan Énergétique National 2017, Opcit,** p23

2) Renewable Energy

The integration of renewable energies into the national energy mix is a major challenge in terms of preserving fossil resources, diversifying electricity production channels and contributing to sustainable development.

According to the renewable energy development program 2011-2030, these energies are at the heart of Algeria's energy and economic policies, namely the development of photovoltaic and wind power on a large scale, Biomass (waste recovery), cogeneration and geothermal energy, and the development of solar thermal.

The renewable energy program consistency, to be achieved for the national market needs, over the period 2015-2030 is 22 000 MW, of which more than 4500 MW will be achieved by 2020.

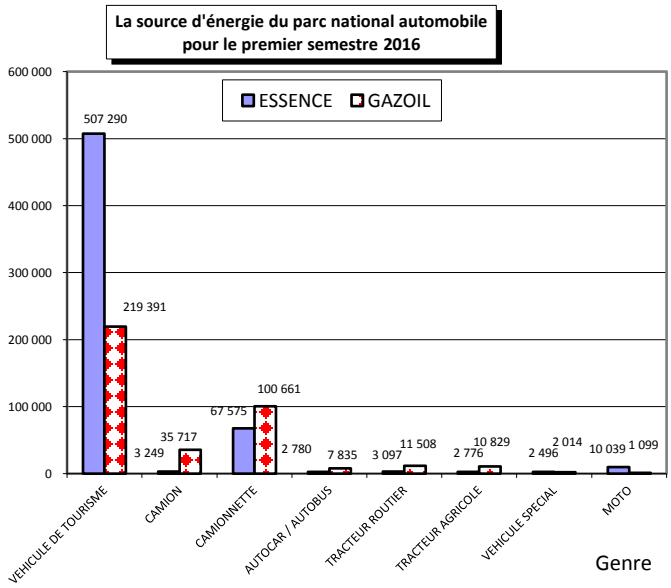
The implementation of the program will make it possible to achieve by 2030 a share of renewable energy of nearly 27%in the national balance sheet of electricity production.

The volume of natural gas saved by the 22 000 MW in renewable energy, will reach approximately 300 billion m3, representing a volume equivalent to 8 times the national consumption of 2014.

3) Main Energy sources used in Algerian automobils parc

Algeria develops various types of fuels used in transport industries, and in road transport we there are three types of generated fuels from petrol: The gasoline "Essence", the diesel "GAZOIL" and the LPG/F "SIRGHAZ".

According to the national office of statistics the main types used in vehicles are the gasoline with 60.64% used in different types of vehicles mainly in touristic cars with 51.33% and the diesel "GAZOIL" with 39.36% used in different types of vehicles mainly in touristic cars with 22.20% and 10.18 in small tracks,



Source : Office National des Statistiques(1er-semestre-2016) http://www.ons.dz/-Au-premier-semestre-2016-.html

II. Chapter Two: Consumer trade-off Behavior

This part of the study deals with theories of how people choose their mode of travel and focus on the differences between psychological and economic theory, and qualitative and quantitative methods. It concludes with a review of methods based on utility maximization.

4.1. The Theory of Reasoned Action:

According to the theory of reasoned action, the intention of a person is a function of two basic determinants; personal and social.

"The personal factor is the individual's positive or negative evaluation of performing the behaviour; this factor is termed attitude

toward the behaviour" (Ajzen, 1985; Ajzen & Fishbein, 1980). In other words the personal factor represents the way the individual perceives the behaviour and not the surrounding environment i.e. objects, people or institutions…,

"The second determinant is the person's perception of the social pressures put on him to perform the behaviour in question. And this factor is termed *subjective norm*". (Ajzen, 1985; Ajzen & Fishbein, 1980).

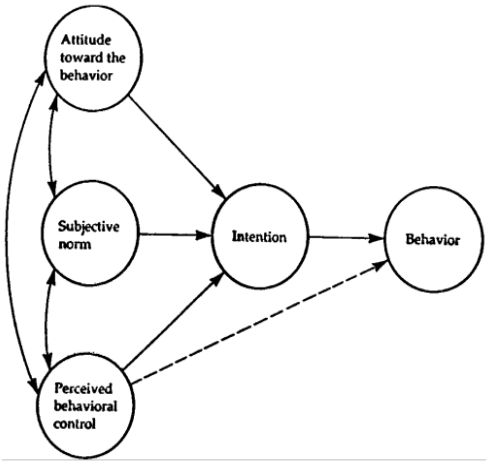
4.2. The Theory of Planned Behaviour:

After the theory of reasoned action, (Ajzen, 1985) developed the so called Theory of planned Behaviour that includes the variable of perceived behavioural control. This theory, the Theory of Planned Behaviour (TPB), assumes that the choice is also dependent on the individual's perception of his or her ability to execute certain behaviours (Ajzen, 1985). TPB has made it possible to explain the choice of travel mode (Forward 1998a, Forward 1998b).

According to TPB, the person acts rationally and his/her decisions are considered consciously and the intention behind certain behaviour depends on the following factors:

- The attitude toward the behaviour;
- The social norm ;
- The perceived behavioural control.

Fig.4 The Theory of Planned Behaviour



Source: Icek ajzen: *The Theory of Planned Behavior. Organizational behavior and human decision processes*, Ed.50, pp 179-211 University of Massachusetts at Amherst (1991) P 182.

The demonstrated in Figure4, TBP shows that it is possible to change a person's behaviour by influencing his attitudes, the subjective norm and his perceived behavioural control. If we want more people to travel by public transport, we can influence their attitudes, for example by offering free test trips, which may give them personal experience. The subjective norm can be influenced by good examples such as celebrities and politicians showing them using train and public transport in their daily trips. However Perceived behavioural control which is a function of control convictions, arises partly out of one's own experiences and partly indirectly, as a consequence of information given by other people for example how difficult someone believes it is to travel by train. (Lindström Olsson, 2003).

4.3. The (TPB) with "habit" variable

Concerning means of transport, "the variable **habit** represents a very important factor in the explanation of the commuting behaviours. By extending the variant of TPB Forward (1998b) added the factor habit to the model" (Lindström Olsson, 2003)

Findings of different studies made in four different cities confirmed that perceived control and habit have a high degree of explanation for travel mode choice and a strong linkage between intention and behaviour. The results show that the discussed

variables help to explain the travel mode choice by between 42 and 69% of the intention to walk, cycle and drive short distances.

4.4. The Theory of Utility Maximization:

A random utility maximizing random choice function assigns probabilities to outcomes as if the decision maker randomly "chooses" a strict utility function and then picks from each option set the maximal element

Let us consider that an individual, at a particular point in the day is to choose an activity to perform and corresponding time expenditure or duration, ***tj***. We can assume that a rational individual will maximize her utility in choosing the activity type to schedule and the total time expenditure on it. In expending time for the chosen activity, however, the individual faces a time budget limitation. This time budget limitation is not constant throughout the day. The day begins with a 24-h time budget limitation which is gradually reduced with the number of activities performed over the course of the day in different locations. The remaining time budget at any point of scheduling an activity is the left-over time after all previously performed activities have been completed. While executing an activity, i.e., defining the duration of a specific activity, the individual trades off between time expenditure to the chosen activity and travel time required to reach the activity location versus total time left over for all other activities to be completed in the balance of the day. As we do not know for certain the causes and factors that influence the individual's trade-offs in choosing alternative activity types and time expenditures out of a limited time budget, it is reasonable to consider the assumption that the utility associated with activity type and time expenditure includes random elements.

Hence, the utility maximizing approach to model activity type choice and time expenditure choice is really a Random Utility Maximizing (RUM) approach. Addressing the facts that the time budget decreases as the day progresses and that the scheduling of any particular activity type is affected by what activities the individual already completed in a given day means that the method captures some (though not all) of the behavioural dynamics of the activity scheduling process. In the context of such a situation the choice of a given activity type at any point in time influences expenditures of the limited amount of time from the left-over time budget, and vice versa.

4.5. The Random Regret-Minimization model of travel choice

The Random Regret-Minimization model is rooted in Regret Theory and provides several useful features for travel demand analysis. Firstly, it allows for the possibility that choices between travel alternatives may be driven by the avoidance of negative emotions, rather than the maximization of some form of payoff. Secondly, it acknowledges that traveller decision-making in the context of multi-attribute alternatives may not be fully compensatory (Caspar G. Chorus, et al, 2008).

Caspar G. represents in the estimable Random Regret-Minimization model of travel choice as an alternative to mainstream Random Utility-Maximization models. Asserting that when making travel choices, people tend to anticipate and avoid the possibility that a non-chosen alternative performs better than the chosen one. This avoidance of anticipated regret, rather than the maximization of utility, is assumed to be specifically relevant in traveller behaviour.

The theory shows how regret-minimization may lead to different choice outcomes in both riskless and risky choice situations: in short, regret-minimization favours alternatives that perform reasonably well on each attribute, whereas utility-maximization favours those that perform particularly well on the most important attribute (Caspar G. Chorus, et al, 2008).

III. CHAPTER THREE: THE EMPERICAL STUDY

The Improvement of the living standards the recent years has had a direct impact on the growth of motorization rate, the increase in car ownership was rather light and progressive over the period 1990-2000. However in 2001, the rate showed a significant increase. It has almost doubled over the period 2001-2008. This net increase is due to the development and economic growth observed over the past decade. In this favourable context, car dealerships have blossomed and sales have been boosted by the car loan. Algerians were quickly equipped cars. Note that the process of buying on credit has been frozen in 2009 and the introduction of a new tax on the purchase of new cars imported. These new arrangements have been made for several reasons:

- The financial crisis that the government is facing from 2014 due to the low prices of oil;
- It has been noticed that many families could not pay the bills;
- From a political point of view, it is more interesting to encourage mortgage as car loans;
- There was still a good tax base for a new tax that may contribute to the fund to support public transport;
- Algeria frozen the importation of cars, and encouraged local investors to implement car manufactories that may cover the needs of Algerians;
- And finally, the transmission began to no longer absorb the surplus of vehicles and congestion problems became increasingly important.

A. Data analyses:

In terms of alternative fuels mode choice used in private cars, we headed a survey in the city of Batna.

The survey was conducted December 2018. That said, the first results of the survey still confirm a general trend of certain hypotheses that we have issued.

B. The factors that influence the trade-off behaviour between different fuel alternatives used in personal cars in Algeria:

we have selected three factors to study the characteristics of the sample and these factors are:- the sex, the age and the Income and according to the theory of planned behaviour these are very important human factors that may influence the trade-off behaviour between different fuel alternatives used in personal cars in Algeria, that is according to the theory cited in the study of Q. Ajzen 1985 and forward 1996.

1. Sex:

The distribution of the sex factor in the sample of the study is presented in the following table

Table 01 The distribution of the sex categories of the sample

		N	%
Sex	Men		
	women		
	Total		

It is seen from the table 01 above that the sex of the sample interviewed is distributed almost close, where the male category occupies ********* which is the mean of this category, while the female category is estimated to *********

This distribution converged between the two categories of male and female sample reflects the reality of the community especially the active and working one, the percentage of female participation in various aspects of life in the community knows a remarkable growing rate, especially in the field of education, health, and various fields of business …

2. Age:

For the age different categories results were as follow:

Table 02 the distribution of the age categories of the sample

		N	%
Age	Less than 20 years		
	20 to 40 years		
	40 to 60 years		
	More than 60 years		
	total		

The table 02 demonstrates that the distribution of age factor was concentrated in the second category (20 to 40 years old), mainly due to several key reasons, in particular that this age group represents the active and working population, which makes dynamic and perpetual mobility, and this is the main reason that made them the largest proportion of respondents during the interviews.

3. Income:

The income factor which have been divided into four categories is presented in the following table

Table 05 the distribution of Income categories

		N	%
Income categories	Less than 15.000		
	From 15.000 to 30.000		
	From 30.000 to 45.000		
	More than 45.000		
	∑		
	Missed data		
Total		1009	

It's clear from Table 05 above that the category of people with an income less than 15,000 DA is the category acquired the largest proportion of the sample with a rate of 59.4 %, followed by the category of income ranged between 15000 DA and 30,000 DA by 21.6%.

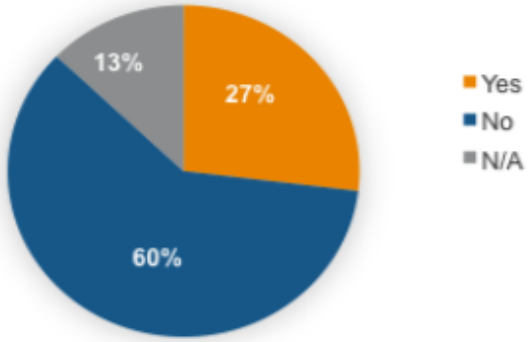
The category of an income less than 15,000 DA are generally the category of students or workers from the working-class. These classes are characterized by their active and frequent movement in urban areas, while the second category which an estimated income between 15000 and 30000 DA may be the category of employees who consider urban mobility an essential activity in their daily lives and that their

movements are relatively limited compared with the first category because of the nature of their movements which are more organized, especially in the peak times.

C. *Factors that influence the trade-off behaviour when it comes to choose between the private car and the common means of transport.*

To know which of the personal factors influence the trade-off behaviour when it comes to choose between the private car and the common transport, we have first studied the opinion of commuters towards their preferred means of transport

Table 09 Figure 19: Do you know whether your private vehicle is able to utilise any alternative transport fuels



Mean	
Mode	
standard deviation	

It is clear from the table 09 that the means of transport the most preferred in urban mobility is the private car, and it was the mode (the most frequent response

And the figure.... displays this fact obviously, where the personal car as the preferred means took 81.5%, and 18.5% representing those who choose collective urban transport as their preferred mode of transport in the urban areas.

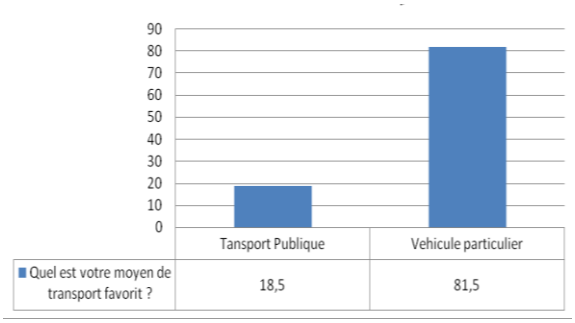


Fig. 02 The opinion of commuters towards their preferred means of transport

1. *The readiness of the sample to shift from the use of personal vehicle to common transport if the later one becomes more convenient.*

Table12 The readiness of the sample to shift from the use of personal vehicle to common transport

Mean	1,37
Mode	
standard deviation	

The results table show that the mean is 1.37 which is near to the value 1 and this means that the majority of respondents answered "Yes" for the question that says "are you ready to shift from the use of personal vehicle to common transport in your urban mobility if the later one becomes more convenient.?" and the mode of the sample was also represented by "yes", and we can say that the items of our sample are stable since the value of the standard deviation is about 0.48

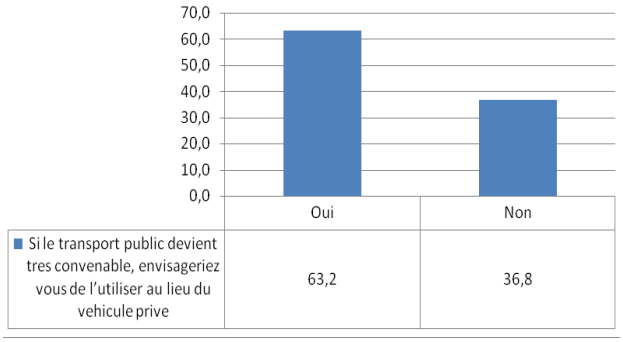


Fig. 03 The readiness of the sample to shift from the use of personal vehicle to common transport:

It is clear that the majority of commuters interviewed in our study are with the shift from the use of the private car to the common transport if this one becomes more convenient and 63.2 of the sample say "yes"

II. Discussions:

The key finding in this study has confirmed the real importance of human factors when it comes to their effect on the trade-off behaviour between the use of the personal car and the common transport, and according to the tests applied on the results studied before we can consider the following:

- From the study we can conclude that Personal characteristics have a statistically significant relationship with the trade-off behaviour, and more precisely: the sex, the age, the educational level and the marital status are statically significant factors and they have a powerful influence on the trade-off behaviour.
- The majority of commuters interviewed in our study are with the shift from the use of the private car to the common transport if this one becomes more convenient and 63.2 of the sample say "yes".

- The Educational level, the Income and the marital status are human factors that influence strongly the decision of shifting from the use the personal vehicle to the use of common transport in urban commuting. the other factors are not statistically significant which means that they are factors that may not influence strongly the decision to shift from the use of personal vehicle to common transport in urban commuting even if the last means of transport are improved.

it is important to mention that human factors influencing the human behaviour, are not limited to the personal characteristics of individuals, but the later ones have an important influence especially on the behaviour of commuting and mode choice behaviour since

people travel whether individually of in groups, according to their financial and marital conditions.

Finally, decision makers should take in consideration the study of personal characteristics as human factors affecting the commuting behaviour, which leads to a better understanding to mode choice behaviour and the trade-off behaviour, and this would certainly make policies and decisions more effective to develop transportation plans leading to a more sustainable mobility in urban areas.

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