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FACTORS INFLUENCING CONSUMER ADOPTION OF LIQUEFIED PETROLEUM GASOLINE AS A VEHICLE FUEL IN SOUTH AFRICA

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A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Business Administration

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ABSTRACT

This study focuses on the factors that influence consumer adoption of liquefied petroleum gasoline as an alternative vehicle fuel in South Africa. Numerous factors emerged from the qualitative analysis, among the most notable of which was the influence of fuel cost savings. It was found that fleet operations achieved significant reductions in fuel theft, through liquefied petroleum gasoline uptake. The environmental benefit derived from LPG as an alternative fuel for vehicles was considered to be of far less consequence in the adoption decision process.

DECLARATION

I, Godfrey Freddy Rajool, declare that this research report is my own, unaided work.

It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg.

It has not been submitted before for any degree or examination in this or any other university.

_____

Godfrey F Rajool

31 January 2007

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1. INTRODUCTION

1.1. Purpose of the study

The purpose of the research is to identify and explore the factors that influence consumer adoption of Liquefied Petroleum Gasoline (LPG) as an alternative fuel for vehicles in South Africa.

1.2 Context of study

Globally, motor vehicles powered by alternative fuels are gaining popularity, as countries promote their uptake as a solution for road-transport pollution and greenhouse gas emissions (Byrne & Polonsky, 2001; Chang, Lo & Wang, 2001; Dagsvik, Wennemo, Wetterwald & Aaberge, 2002; Ewing & Sarigollu, 2000; Hackney & de Neufville, 2001; Johnson, 2003; and Wing-Tat, 2004). Air quality is an important concern in southern California, where the Federal Clean Air Act and the 1990 Regulations by the California Air Resources Board require substantial reduction in vehicle emissions (Dagsvik *et al* 2002). Demand for viable alternative fuels as compared to traditional fuel types, such as petrol and diesel are compounded by limited world resources of oil (Dagsvik *et al* 2002).

In line with global developments, South Africa recently published an emissions strategy document, to control mobile source emissions, which was circulated for public comment (Bell, 2004).

Rockall (2003), from the World Liquefied Petroleum Gasoline Association (WLPGA), comments that LPG is the most widely used alternative fuel for vehicles, powering more than 10 million vehicles worldwide. LPG as an alternative vehicle fuel has been used in automobiles, trucks, buses, and a variety of off-road vehicles since the 1960s (Rockall, 2003).

LPG vehicle fuel is the generic name for mixtures of hydrocarbons that change from a gaseous to liquid state when compressed at moderate pressure or chilled. LPG is derived either as a product from crude oil refining or from natural gas and is transported

and stored locally in pressurised tanks or cylinders. LPG has high energy content per tonne compared to most other oil products and burns readily in the presence of air. These characteristics have made LPG a popular fuel for domestic heating, cooking and increasingly, as an alternative fuel for vehicles (Rockall, 2003).

In most cases, an existing conventional fuel vehicle is converted to run on LPG through the installation of a separate fuel system allowing the vehicle to switch between both fuels. In practice, converting a vehicle to be able to run on LPG involves some relatively minor operational inconveniences. The most important of these are a loss of boot space to accommodate the fuel tank and, in some cases, a marginal loss in acceleration and speed mainly due to the extra weight of the tank (Rockall, 2003).

Rockall (2003), from the World LPG Association, gives the possible reasons for vehicles to switch from petrol to LPG. These reasons are set out below.

1.2.1 Clean the air

In terms of air-borne emissions of the principal regulated noxious gases, LPG as a vehicle fuel has among the lowest emissions of all automotive fuels available today. According to authoritative scientific testing, LPG yields 50% less carbon monoxide, 40% less hydrocarbons, 35% less nitrogen oxides and has 50% less ozone-forming potential than petrol. Anyon (2003), found that the environmental emissions from LPG as a motor vehicle fuel, are demonstrably superior to petrol and diesel in greenhouse gas emissions and in air quality emissions.

1.2.2 Combat climate change

LPG has among the lowest greenhouse gas emissions of all commercially available fuels, when measured over its full life cycle.

1.2.3 Save money

LPG is generally cheaper than petrol where it enjoys government incentives to encourage its use. Typical government incentives cover vehicle conversion costs, capital equipment purchases and significant tax breaks.

1.2.4 Choice

Ford, GM, DaimlerChrysler, Toyota, Nissan, Mitsubishi, Daihatsu, Vauxhall, Proton, Volvo, Renault, Peugeot, Opel and Fiat have introduced vehicles and new engines specifically engineered to run on LPG. Some models also support dual fuel systems, which allow drivers to effortlessly switch from LPG and petrol, effectively doubling driving range.

1.2.5 Easy refuelling

LPG vehicles enjoy refuelling convenience at over 36 000 refuelling sites around the world. LPG as a vehicle fuel is a highly portable fuel, which means that its refuelling structure can be extended easily over wide areas. Also, the filling time required for LPG vehicles is the same as for petrol vehicles.

1.2.6 Maximise performance

The performance and operational characteristics of LPG vehicles compared to traditional motor fuels are better than other alternative fuel options. LPG is a high octane fuel which allows increased engine-power output and better efficiency, reducing fuel consumption and engine wear and maintenance requirements.

1.2.7 Ensure safety

The safety record of LPG as a vehicle fuel around the world is similar and in many cases, better than that of petrol. LPG tanks are much stronger than conventional petrol tanks and are able to withstand high impact in the event of a collision. New safety valves automatically shut if a leakage occurs in the fuel system, meaning that gas can no longer flow from the tank.

1.2.8 Fleets profit by operating on LPG

Airport and hotel shuttles, taxis, buses, delivery vehicles, rental cars and police vehicles can all use LPG. Fleets can profit by operating on LPG, taking advantage of the convenience and lower costs associated with central refuelling. Moreover, fuel costs are an important business expense, which can be significantly cut by switching to LPG. Rockall (2003), refers to a report from the International Energy Agency, and states that LPG as a motor vehicle fuel offers significant advantages in terms of performance, cost and range. Given the suitability, supply security and availability of LPG, Johnson (2003) has recommended its uptake as an alternative fuel for transportation in Europe.

It is against this backdrop that the factors that influence consumer adoption of LPG as an alternative vehicle fuel in South Africa were considered.

1.3 Problem Statement

1.3.1 Main problem

The research is concerned with the factors that influence consumer adoption of LPG in South Africa as an alternative fuel for vehicles.

1.3.2 Sub-problems

The first sub-problem is to identify the factors that influence consumer adoption of LPG as an alternative fuel for vehicles.

The second sub-problem is to examine the factors of most interest that influence consumer adoption of LPG as an alternative fuel for vehicles.

1.4 Significance of the study

The research identifies and qualifies the factors that encourage consumer adoption of LPG as an alternative fuel for vehicles in South Africa. The research offers recommendations for the purpose of marketing LPG successfully as a vehicle fuel in South Africa.

Rockall (2003), from the WLPGA, states that LPG is the most widely used and accepted alternative vehicle fuel in use today, with over 10 million LPG-powered vehicles around the world; however, the product as a vehicle fuel is still concentrated in a small number of countries, such as Korea, Japan, Poland, Turkey and Australia. The study will help explain the disparity around the world, in terms of LPG uptake as a vehicle fuel, given the many benefits as stated by the WLPGA.

The literature review has shown that there is much information available on alternative fuel vehicles in the developed world (Byrne & Polonsky, 2001; Chang *et al,* 2001; Hackney & Neufville, 2001; Dagsvik *et al,* 2002; Johnson, 2002; Gasca, Ortiz, Castillo, Jaimes & Gonzalez, 2003; and Wing-Tat, 2004). The work of Byrne & Polonsky (2001) deserves particular mention, as it has dealt with the impediments to consumer adoption

of AFVs. However, limited information exists specific to LPG as a vehicle fuel within South Africa.

It is believed that the identification and an understanding of the factors that influence consumers to switch their vehicles to LPG will inform the marketing process of developing LPG as a viable alternative vehicle fuel in South Africa. The possibility exist that factors constraining the use of LPG as a vehicle fuel in South Africa will differ from the factors that constrain the use of LPG in other countries.

1.5 Delimitations and Limitations

1.5.1 Delimitations

The study will be done from a fleet end-user or organisational perspective, with focus on the fleet manager or decision makers who purchase vehicle fuel on behalf of the organisation.

1.5.2 Limitations

The limitations of this study relate to the newness of the research topic, the minimal amount of research that has been conducted to date in this area, in the world in general and South Africa in particular. The methodology involves formal interviews of decision makers within fleets that currently use the technology. The limitation also relates to the size of the actual users of LPG as a vehicle fuel in South Africa currently which is limited, and therefore the sample size selected for the study.

1.6 Definition of terms

The definitions relevant to this research:

Liquefied Petroleum Gasoline (LPG) is the generic name for mixtures of hydrocarbons that change from a gaseous to liquid state when compressed at moderate pressure or chilled. LPG is derived either as a product from crude oil refining or from natural gas or oil production. LPG is a popular fuel for domestic heating and cooking, and is increasingly becoming popular as an alternative vehicle fuel.

Autogas is the abridged name for LPG used as an automotive vehicle or transport fuel.

Dual fuel vehicles refer to conventional-fuel vehicles converted to run on LPG by installing a separate fuel system allowing the vehicle to switch between the two fuels. In many parts of the developed world, LPG dedicated vehicles from the motor manufacturers are available. The dual fuel system has the added benefit of doubling the driving range.

Alternative fuel vehicles (AFVs) are vehicles running fuels other than petrol or diesel. These are vehicles that have originally been designed to operate on conventional fuel, but have been altered to run on an alternative fuel such as natural gas, liquefied petroleum gasoline, ethanol, hydrogen, bio diesel, electricity and methanol.

The **consumer** in this context is defined as commercial vehicle owners, specifically fleet owners or fleet end-users.

1.7 Assumptions

The following are the assumptions that, if they do not hold, will influence the outcome of the research:

It is assumed that there are factors that influence consumer adoption of LPG as an alternative vehicle fuel.

It is assumed that respondents will be able to articulate the factors that influence consumer adoption of LPG as an alternative vehicle fuel.

It is assumed that respondents will be is a position to understand the consequences of not switching to LPG as an alternative vehicle fuel.

2. LITERATURE REVIEW

This chapter provides an overview of the literature that was used as a basis for deriving the propositions for the research.

The range of alternative fuel for vehicle types is widely varied, including natural gas, ethanol, hydrogen, bio-diesel, electricity, hybrids (multiple-fuel utilisation such as the Toyota Prius) and LPG, amongst others. A review of the literature in the field of consumer adoption of LPG as a fuel for vehicles shows that research has concentrated on the generic class - alternative fuel vehicles, as opposed to LPG specifically.

The literature review helps identify the factors that influence consumer adoption of LPG as a vehicle fuel, albeit the generic class of alternative vehicle fuel (AFVs). These factors will be grouped together to derive key propositions for solving the stated sub-problems.

2.1 Introduction

According to Rockall (2003) from the WLPGA, LPG used as a vehicle fuel is by far the most widely used and accepted alternative automotive fuel in use in the world today, with over 10 million LPG vehicles in use around the world.

LPG use is growing at a rate of 12 -15% per year, due to the fact that LPG is a clean transportation fuel with impressive environmental benefits and therefore driving fuel choice decisions worldwide (Rockall, 2003).

According to Byrne & Polonsky (2001), there are numerous challenges facing consumer adoption of available sustainable alternative fuel vehicles. Their findings suggest numerous impediments to widespread adoption of AFVs (Byrne & Polonsky, 2001). Further, it has been found that AFV consumers are sceptical of suppliers, as they make often make unsubstantiated marketing claims, making the choice of AFV all the more difficult (Hackney *et al*, 2001).

It is interesting to note that Hiroshi Okuda of the Toyota Motor Corporation (Okuda, 1997), recognises the need for alternative fuel vehicles, and has publicly stated that the means and responsibility exist to explore a wide range of technologies as customers are looking for cars that they can feel good about owning and will not wait.

Research and Markets (2001), in their report titled ‘Global Automotive LPG’, note that the outlook for automotive LPG is very positive, with global demand forecast to average 5.9% per annum between 1999 and 2009. The report concurs with the WLPGA’s finding that government backing and support are regarded as a fundamental cornerstone towards the successful introduction, development and continued existence of autogas markets across the globe. Rockall (2003), from the WLPGA states that without government support, even with favourable market characteristics, an autogas market could not develop.

According to Rockall (2003) from the WLPGA, although most of the countries of the world profess an understanding of environmental concerns, the real driver behind the use of LPG as an alternative vehicle fuel is its price advantage over other fuels. Research and Markets (2001) concurs and notes that price is a crucial factor in stimulating demand for autogas.

2.2 The regulatory and fiscal environment for AFVs

According to Ewing & Sarigollu (2000), most governments fail to provide rewards or incentives for greening and sustainability. Governments are unwilling to implement penalties on traditional users and thus provide limited incentive for consumers to change purchase behaviour. For this reason petrol vehicles continue to remain the most cost-effective and convenient option (Ewing & Sarigollu, 2000).

According to Botha, Stone, Bell & Taylor (2001), the South African government has no clear direction on their stance regarding road taxes on gaseous fuels. As a direct result, the oil companies have limited investment into critical refuelling infrastructure, which has retarded growth of LPG as a vehicle fuel.

Byrne & Polonsky (2001) explain that the concept of the AFV is to provide consumers with an environmentally sensible and regulatory-compliant vehicle. 'Proactive regulatory encouragement of AFV adoption may be an important tool for removing one potential impediment to consumer purchase' (Byrne & Polonsky, 2001:1522). The absence of regulatory encouragement affects consumer demand adversely, which results in low proliferation of AFV offers. Byrne & Polonsky (2001) note that consumer demand for AFVs is dependent on price, regulatory encouragement, and infrastructure availability.

Taiwan represents an example from around the world of where LPG has been adopted as part of a strategy to address urban air pollution: 'Liquefied petroleum gas (LPG) is currently used in a small fleet of taxis as an alternative fuel to gasoline in Taipei, as part of an incentive program promoted by Taiwan Environmental Protection Agency to improve urban air quality' (Chang *et al*, 2001:6201).

A key strategy to improve Hong Kong's air quality is to discourage dirty fuels (e.g., leaded petrol and high-sulphur diesel) and to promote the use of clean fuels (e.g., low sulphur diesel and LPG) (Wing-Tat, 2004). Wing-Tat's paper supports Hong Kong's clean fuel programmes. Wing-Tat (2004) notes that higher subsidies result in faster adoption of cleaner fuels. This statement supports the reason for LPG becoming a

leading alternative fuel in Australia, where numerous incentives exist for consumers to switch to LPG (Anyon, 2003).

Rockall (2003) from the WLPGA notes that fiscal and other forms of financial incentives are the most important types of measures required to promote LPG as an alternative fuel for vehicles. The single most important approach is the imposition of a lower rate of excise duty on LPG (Rockall, 2003). These measures have been found to directly reduce the cost of running LPG vehicles *vis-à-vis* petrol and diesel vehicles, and shorten the conversion-payback period (Rockall, 2003). The lower the rate of taxes on autogas relative to other fuels, the bigger the financial incentive to switch fuels.

Van der Ham (2001) notes that for LPG to be accepted as an automotive fuel on any scale will require clear and consistent government policy with respect to taxation of LPG. Even though no road tax is levied on LPG currently, prospective users require assurance from the local government that this will remain the case 'for at least 5 years if it were to be attractive to convert vehicles for LPG use' (Van der Ham, 2001:111).

Byrne & Polonsky (2001) note that consumers find that government intervention directly removes purchase barriers associated with AFVs. Some of the examples listed include vehicle subsidies, tax credits, fuel subsidies and AFV-only commuter lanes, which may all contribute towards lowering downstream adoption costs, and increase the likelihood of consumer uptake.

Byrne & Polonsky (2001) add that proactive regulatory encouragement of AFV adoption may be an important tool for removing an important impediment to consumer purchase. They state that while automobile companies may be directly influenced by government regulations to increase production of AFVs, consumers may also find that government intervention directly removes purchase barriers. Byrne & Polonsky (2001) state that the imposition of environmental impact taxes for traditional fuel vehicles may further lower the AFV purchases hurdle, as it would raise the cost of traditional fuel vehicle ownership and usage.

According to Byrne & Polonsky (2001) most governments are unwilling to implement penalties on traditional fuels and provide limited incentive for consumers to change

purchase behaviour, as petrol vehicles are still the most cost-effective and convenient option. Environmental sensitivity remains a worthwhile goal, however consumers do not see it as reason enough to switch from petrol to AFVs (Byrne & Polonsky, 2001).

Ewing & Sarigollu (2000) found that regulation alone would not be sufficient to create a market for alternative fuel vehicles. The authors recognise the role that government can play by guaranteeing the existence of a market by becoming the industry's first customer (Ewing & Sarigollu, 2000).

Therefore the author proposes that clear and consistent government policies as they relate to the taxes environment and general incentive schemes will have a positive impact on LPG adoption.

2.3 Buyer behaviour within organisations with fleets

Kotler (2003) comments that most organisations have specific purchasing objectives, policies, procedures, organisational structures and systems. According to Kotler (2003) they occur more as strategically oriented purchasing departments, with a mission to seek the best possible value from quality suppliers. He also notes that the average number of people involved in a typical buying decision ranges from three to five. Therefore to reach the entire decision-making unit within an organisation involves both time and resources and the establishment of quality communications programmes (Kotler, 2003).

Nesbit & Sperling (2001) note that virtually all organisations, public and private, operate a fleet of vehicles, and these vehicle fleets are attractive first markets for new vehicle products and service innovations for the following reasons:

- Fleet vehicles are on average driven twice as far as household vehicles on an annual basis and, thus, the benefits derived from using a new technology, like for example emission reductions, are maximised. High mileage accumulations also reduce the timeframe for assessing long-term vehicle performance.
- High vehicle turnover facilitates rapid penetration of new technologies into the vehicle market
- A significant number of fleet vehicle purchases are by government agencies that are politically more compliant that other market sectors. Targeting these organisations demonstrates practical applications for new vehicle technologies and services.
- Targeting fleets is efficient because less than 2% of fleets account for approximately 35% of all light-duty vehicles
- Many fleet vehicles are regularly fuelled at one location, maintained in-house, and have fixed daily routes, and thus can be switched to new fuels and vehicle types even before a public refuelling infrastructure and service network is established.

Nesbit & Sperling (2001) state that the only commonality among fleets is that they operate vehicles, and that important fleet decisions are made in teams rather than by individuals within the business. Nesbit & Sperling (2001) also found that the

environmental benefits derived from using AFVs mean very little to the typical fleet manager whose primary responsibility is to keep the vehicles running at a minimum cost (Nesbit & Sperling, 2001). Nesbit & Sperling (2001) also found that because of their unique attributes and potential organisational implications, AFVs will take fleets into the realm of strategic decision making, implying that the purchase decisions are analysed from a broader perspective and therefore must take into consideration the needs of the entire organisation (Nesbitt & Sperling, 2001).

The fleet may be a minor part of an organisation's business or essentially the whole business, (e.g., taxi services). Larger organisations dedicate a full-time position to fleet management while others assign the duty to an employee who already has other job responsibilities. Indeed, fleet managers themselves are diverse, representing a wide spectrum of backgrounds and, depending where the fleet management responsibilities might be assigned, often make for very different purchase decisions (Nesbitt & Sperling, 2001).

According to Nesbitt & Sperling (2001), the purchase of an AFV will not be made in a routine manner because of the importance of the decision in terms of actions taken, resources committed, and precedents set. Fleets are part of organisations, and organisational buyer behaviour is seen as a complex process, as it takes place over extended periods of time and encompasses many inter-organisational relationships (Webster & Wind, 1972). These findings are similar to those of Aggarwal, Cha & Wilemon (1998) where it was discovered that the adoption of an alternative powered vehicle represents a significant behavioural change. 'To convince a person to buy an electric car over a gasoline-powered car would be extremely difficult as the behavioural change associated with such a switch is significant' (Aggarwal *et al,* 1998: 358).

Nesbitt and Sperling (2001) have categorised and motivated a vehicle fleet typology in terms of the contextual dimensions of centralisation and formalisation. Further, they have found the approach of categorising organisational decision-making behaviour in terms of contextual dimensions, consistent with the findings of other researchers

Nesbitt and Sperling (2001) has defined formalisation as the extent to which rules and procedures guide the fleet decision process, whilst centralisation has to do with the

number of people involved in fleet decisions and their decision-making autonomy. A decision-making structure is considered as highly centralised when decisions are made at a single point in the organisation by one or two individuals without further authorisation required.

Nesbitt & Sperling's (2001) classification scheme does not attempt to categorise fleets by function, size, or vehicle characteristics but rather distinguishes fleets by the different decision-making structures that determine behaviour. They identify four possible configurations of centralisation and formalisation that form the basis of the typology and is shown as Appendix E.

Nesbitt & Sperling's (2001) typology categorises fleets into four groups based on the decision-making approach and process adopted, with the management implications of each summarised below:

- Autocratic decision-making structure;
- Bureaucratic decision-making structure;
- Hierarchic decision-making structure; and
- Democratic decision-making structure.

2.3.1 Autocratic decision-making structure

Fleets with autocratic decision-making structures exhibit very informal, highly centralised decision behaviour. Decisions are typically made by one individual, (e.g. the business owner) who is familiar with and fully responsible for day-to-day fleet operations. This behaviour is prevalent in small owner-managed private businesses with functionally simple organisational structures and few levels of management.

Autocratic fleet decision makers purchase vehicles much like private consumers and, because of time and resource constraints, will likely consider only one or two specific AFVs. Autocratic fleet decision makers will likely copy AFV solutions implemented elsewhere, and will likely defer AFV decisions until the potential benefits are proven elsewhere. Many autocratic fleet decision makers do not understand the concept of life-cycle costs, with the final vehicle selection more likely based on a comparison of

purchase prices. This finding underscores the importance of providing autocratic fleets with financial incentives that help defray upfront capital costs. It must also be noted that autocratic fleets assign little value to corporate image benefits associated with AFVs. According to Nesbitt & Sperling (2001) the key to unlocking this fleet type, lies in the provision of better information and incentives that focus on reducing the vehicle purchase price.

2.3.2 Bureaucratic decision-making structure

Bureaucratic fleets are more common amongst public and institutional organisations, and are highly formalised and decentralised. 'Whereas, autocratic fleets rely on personal judgement to reach decisions, bureaucratic decision outcomes are the result of objective formal evaluations carried out systematically through pre-established routines' (Nesbitt & Sperling, 2001:308). There is no single decision maker but, rather, several people who influence the decision outcome. Nesbitt & Sperling (2001) state that the main barrier to innovative purchases in the bureaucratic decision-making structure is the reliance on pre-established procedures.

Generally, bureaucratic fleet decision makers do not recognise problems that are not monitored by the system and, therefore, will not likely be early adopters of AFV technologies (Nesbitt & Sperling, 2001). Governments that purchase AFVs do so as a result of many been targeted by legislative directives that mandate them to use AFVs (Nesbitt & Sperling, 2001).

2.3.3 Hierarchic decision-making structure

Hierarchic decision-making fleets share characteristics with both autocratic and bureaucratic fleets, and are highly centralised and very formalised (Nesbitt & Sperling; 2001). The authors state that decisions are made by only one or two upper-level managers but are guided by policies and standard procedures. Major fleet decisions are made at the top of the organisation, although they may be initiated anywhere within the organisational hierarchy (Nesbitt & Sperling; 2001).

‘Unlike bureaucratic structures, hierarchic fleets are not overly reliant on rules, regulations or computational analysis; and unlike autocratic structures, they are not highly dependent on the judgement of a single individual’ (Nesbitt & Sperling, 2001:311). Hierarchic fleet decision makers are most likely to make reasoned choices and resist government mandates, but will be most responsive to incentives, not only to those that reduce vehicle purchase costs but also to those that reduce operating costs (Nesbitt & Sperling; 2001).

2.3.4 Democratic decision-making structure

Nesbitt & Sperling (2001) state that fleets with democratic decision-making structures is relatively small and often belong to small organically structured organisations, that are highly decentralised and very informal. Nesbitt & Sperling (2001) have also found that although one individual may ultimately be held responsible for the decision, there is no single decision maker, per se.

Nesbitt & Sperling (2001) have also found that the dynamics of group decision making usually result in long delays and little action. Democratic fleets will not likely be the first to enter the AFV market. Organizations with democratic fleets could benefit significantly from measures that educate and inform (Nesbitt & Sperling; 2001).

Nesbitt & Sperling’s (2001) conclusions about the buying behaviour of the four types of fleet groups based on their decision-making approaches and processes are set out below:

Autocratic fleets tend not to analyse life-cycle costs, and make purchase decisions based on purchase prices and are less inclined to value public relations benefits, and are most susceptible to hearsay and rumours. Effective strategies to increase acceptance of new products and vehicles in autocratic fleets include increased access to information, including ‘success’ stories from other fleets and incentives targeted at purchase price.

Democratic fleets are influenced by internal champions or obstructionists who tend to be lower in the organisation but better informed and more broadly analytical. Both

autocratic and democratic fleet types will not be leaders in responding to government mandates and incentives. Being smaller in size, they have limited resources. More importantly, though, autocratic organisations heavily weight purchase price in their decisions (which biases decisions away from new products) and are reluctant to be guinea pigs, while democratic fleets tend to be slow to act because of diffuse decision-making processes. It is more difficult to identify broad strategies for democratic fleets because of their dynamic and unstable decision processes

Bureaucratic fleets follow a slow and veto-prone decision process, with important exceptions. The existence of firm and clear government rules tend to override a bureaucratic fleet's otherwise ponderous decision-making process, especially by fleets operated by governments, regulated companies, and companies with vested interests. The authors conclude that a subset of bureaucratic fleets is likely to be responsive to mandates – probably far more so than to incentives and incentive-based regulations. Bureaucratic fleets not operated by government will likely not be responsive to either government rules or incentives.

Hierarchic fleet decision makers are most likely to make reasoned choices, incorporating both life-cycle cost analysis and larger strategic interests into the decision process. These fleets will likely be most deliberately resistant to government mandates when those mandates do not coincide with the organisation's preferred vehicle choices – even pursuing avoidance behaviour, such as shifting vehicles between geographic offices. Hierarchic fleets will also be most responsive to incentives, not only to those that reduce vehicle purchase costs but also to those that reduce operating costs.

Nesbitt & Sperling (2001) also point out that the diversity of fleet behaviours is especially pronounced during the early years of new product launches. They note that once a particular AFV is successfully incorporated into the fleet, subsequent purchases will generally become more streamlined. 'The first AFV that works satisfactorily, be it electric, hybrid, natural gas, or alcohol fuel vehicle may become, by default, the preferred AFV for future purchases by that fleet' (Nesbitt & Sperling; 2001:315).

The work by Nesbitt & Sperling (2001) identifies the various fleet types and, more importantly, identifies which fleets will be most responsive to which types of initiatives.

This research finding is important to the AFV marketer wanting to develop a viable new business. Rockall (2003) from the WLPGA comments that fleet managers are receptive to the advantages of LPG, provided they are treated as sophisticated buyers, which require candid discussions and facts.

2.3.5 Organisational Buyer Behaviour

There are numerous models that have been developed by marketers for organizational buying behaviour, in order to better understand the processes that occur during industrial purchasing (Robinson *et al.,* 1967; Sheth, 1973; Webster and Wind, 1972).

According to Webster & Wind (1972), industrial buying takes place in an organisation influenced by budgets, cost and profit considerations, and involves many people in the decision process with complex interactions among people and individual and organisational goals.

Du Plessis, Rousseau & Blem (1995), state that the models for understanding organisational buyer behaviour are important as they:

- Provide a reference framework for research and a method by which research findings can be combined into an integrated whole;
- Play an important role in establishment of theory, as new ideas appear during the development of the model;
- Facilitate the acquisition of existing knowledge concerning buying behaviour, as inter-relationships between variables are represented in a logical structure that is reasonably easy to understand;
- Serve as a guide for buying behaviour research and improved marketing strategy decisions, as the comprehensiveness of theory provides a lever for prediction of behaviour; and
- Provide explanations for behaviour, as the model development explains relationships and it becomes possible to predict results under various circumstances.

Specific to the problem statement, the fleet marketer could find a model of buyer behaviour useful in identifying the key factors influencing response to the marketing effort.

2.3.5.1 Webster-Wind Model

The Webster-Wind Model was selected as it represents a comprehensive view of organisational buying that enables an evaluation of the factors that influence consumer adoption of LPG as an alternative vehicle fuel.

The model partitions the buying process into several processes, with every step determined by the subsequent process. The organisation is regarded as a group, with the decision made as a group, consisting of the group as well as individuals. The processes are determined by environmental and organisational factors. Environmental factors comprise technology, politics, law and culture, as well as those factors closer to the environment of the organisation, such as suppliers and customers. These factors define the organisational factors used such as technology used or needed, structure, objectives, tasks and members of the group involved in the buying process. The final buying decision is determined by a mixture of individual and group decision making.

The Webster-Wind model identifies the major variables that must be appraised in developing the information required for planning effective marketing strategies (Du Plessis *et al*;1995).

Kotler (2003) found that compared to consumer markets, business markets generally have fewer and large buyers, a closer customer-supplier relationship, and more geographically concentrated buyers. 'Business marketers need to be aware of the role of professional purchasers and their influencers, and the need for multiple sales calls' (Kotler, 2003:238).

In addition to more recent findings from Kotler (2003), Webster and Wind (1972) found that organisational buying behaviour is a complex process and involves many persons, multiple goals, and potentially conflicting decision criteria. The Webster and Wind model (1972) presents a comprehensive view of organisational buying that enables one

to evaluate the relevance of specific variables and therefore allows for greater insight into the processes of industrial buying behaviour.

As a result of the findings from Webster and Wind (1972), Nesbitt and Sperling (2001) and Kotler (2003), the researcher proposes that decision making processes within fleet operations are complex and difficult.

2.4 Barriers to AFV adoption

The finding of the European Environment Agency (EEA) analysis was that no single factor was of overwhelming significance in terms of promoting this environment, which implies that an integrated approach to facilitating renewable energy implementation is key. These findings are similar to those of Byrne & Polonsky (2001) that broad based sustainable solutions require multiparty action, 'thus a systems approach involving all interrelated stakeholders is essential.' (Byrne & Polonsky, 2001:1521)

Ewing & Sarigollu (2000) suggest that safety concerns related to alternative fuel vehicles can be a serious barrier to consumer AFV purchase. Byrne & Polonsky (2001) add that not much information exists with respect to the safety of alternative fuel vehicles. Future regulations will need to address safety concerns regarding fuel volatility as well as features of the vehicle itself, as both the literature and anecdotal evidence suggest that safety issues can be an impediment to consumer AFV purchase (Ewing and Sarigollu, 2000).

The research findings from Gasca, Ortiz, Castillo, Jaimes & Gonzalez (2003) have shown that there are significant problems that present themselves with vehicles converted to run on LPG. They state that vehicles converted to LPG, often 'exceed the required environmental regulation values for certification, due to poor maintenance of vehicles, insufficient mandatory inspection and unreliable conversion kits' (Gasca *et al*, 2003:3518).

Leiby & Rubin (2000) note a few issues that would need to be addressed in order to effect the transition from a market characterised by small scale, high cost AFV penetration to one in which AFV's have a sizeable market share and realise economies of scale similar to that of petrol vehicles. Leiby & Rubin (2000) note these issues as follows:

- Vehicle and fuel production economies of scale;
- Consumer costs of low retail fuel availability;
- Limited AFV model choice;
- Consumer uncertainty about fuel and vehicle performance and reliability; and

- The slow turnover of durable capital equipment and vintaged vehicle stock.

Leiby & Rubin (2000) also identify various factors influencing fuel choice as follows:

- Fuel price;
- Fuel availability;
- Refuelling frequency (based on range);
- Refuelling time cost; and
- Performance using fuel.

Factors considered in vehicle choice, Leiby & Rubin (2000) identify as:

- Vehicle price;
- Fuel cost;
- Performance;
- Cargo space (loss due to space required for fuel storage); and
- Vehicle diversity.

Leiby & Rubin (2000) conclude by stating that there are significant market barriers to AFV usage. Leiby & Rubin (2000) conclude the findings by stating that in the absence of any new policy initiatives, it may be difficult for the AFV market to get started. 'Government policies, if sufficiently large, can effectively reduce these barriers and can allow alternative fuels to compete in the marketplace with gasoline.' (Leiby & Rubin; 2000:20)

According to Raju (1995), buying behaviour is primarily dependent on whether products or services can be accessed. Access in this context pertains both to physical access as well as to economic access. 'It was seen that the current lack of dedicated automotive re-fuelling structure is a deterrent to the general public to consider conversion.' (Botha *et al*; 2001:10)

According to Byrne & Polonsky (2001), there are many issues that influence consumers within the purchase decision process for environmentally responsible goods. They have identified several impediments to consumer adoption, which includes cost,

maintenance availability / cost, range of vehicle, power / acceleration, fuel availability, refuelling, safety and the environmental benefit. The impediments as they relate to infrastructure includes 'availability of AFVs, availability of fuels, availability of fuel delivery outlets, availability of maintenance services.' (Byrne & Polonsky, 2001:1536)

Byrne & Polonsky (2001) comment as follows with respect to the impediments referred to above:

- The fuel itself must be readily available, to ease transition to AFVs by minimising consumer inconvenience.
- If the fuel is meant as an alternative to petrol, it should be as available as petrol.
- Other running costs must also be in line with those of traditional vehicles, including vehicle maintenance, refuelling time, and fuel pricing, otherwise these costs may serve as a continuing impediment to AFV purchase.
- Establishing outlets require significant investments, which occur as a result of increased demand and profitability of these alternative fuels.

Byrne & Polonsky (2001) suggest that the many impediments to the purchase decision must be overcome before market presentation to the consumer solving the problems as this eases the likelihood of adoption.

On the issue of affordability, it should be noted that Buchholz (1998) and Ottman (1998) found that consumers will pay up to a 10 percent premium for environmentally friendly products. According to Byrne & Polonsky (2001) this may be problematic given the relatively high purchase price of a vehicle, where even a 5 percent premium may make it unaffordable, effectively results in AFVs not being competitively priced compared to traditional fuel vehicles. In addition to price, consumer demand is dependent on regulatory encouragement and on infrastructure availability (Byrne & Polonsky, 2001).

According to Aggarwal *et al* (1998), a related study conducted in Australia indicated that the infrastructure to support the recharging of hybrid electric cars have to be as easily accessible as petrol service stations, to ensure their adoption. Dagsvik *et al* (2002) concur that a lack of infrastructure (refuelling and maintenance) hampers the adoption process of AFVs.

Byrne & Polonsky (2001) define infrastructure as including but not limited to: availability of AFVs, availability of fuels, availability of fuel delivery outlets, availability of maintenance services, and appropriate transportation easements. The availability of fuel delivery outlets and maintenance services are seen as significant impediments to the success of any AFV programme, Byrne & Polonsky (2001). Therefore, a lack of trained after-market maintenance and repair services will act as an impediment to AFV adoption.

According to Byrne & Polonsky (2001) if AFVs are developed by niche manufacturers, service outlets may be limited and thus restrict adoption of AFVs. Byrne & Polonsky (2001) recognise the need for sales infrastructure, especially at the introduction phase, for the consumer needs to be educated as to the benefits and drawbacks of owning an AFV.

According to the findings from Climate Change Process (1999), the top five barriers to widespread adoption of AFVs are:

1. Vehicle purchase price premium;
2. Lack of re-fuelling infrastructure;
3. Range between re-fuelling;
4. Reliability of the vehicles; and
5. Number of maintenance locations.

Byrne & Polonsky (2001) concur with the above finding, stating that in order to achieve market acceptance of AFVs, the fuel itself must be readily available, if for no other reason than to ease the transition to AFVs by minimising consumer inconvenience. These writers state that if the alternative fuel is meant as an equal replacement for traditional fuel, it needs to be as readily available as the traditional fuel.

Nyboer (2004) suggests that there must be no increased risk to the consumer and the product must not cause the consumer hidden costs, such as inconvenience in installation or higher maintenance costs. Byrne & Polonsky (2001) also found that

AFVs to be generally successful they must be conveniently available to all segments of the target market.

Taking into consideration the reference made in the literature to the barriers to the adoption of AFVs, the author proposes that convenient and available refuelling infrastructure as well as after-market services and support are important with respect to the adoption of LPG as an alternative vehicle fuel in South Africa.

2.5 Pricing considerations for AFVs

Ottman (1998) discovered that consumers will pay up to a 10 per cent premium for a product that is more environmentally friendly as compared to current goods. This finding contrasts largely with the research done by Ewing & Sarigollu (2000), where it was found that where the alternative fuel was even 15 per cent less than the conventional fuel, in price, it appeared unlikely to bring about a response (i.e., a switch from a conventional vehicle to the AFV).

According to Byrne & Polonsky (2001) the cost of AFVs may represent a significant cost and serve as a substantial impediment to adoption. The authors therefore suggest that AFVs must be priced at competitive market levels to overcome the pricing issue. Byrne & Polonsky (2001) also recognise other elements that contribute to the overall cost effectiveness of the AFV: direct fuel cost / savings, the ongoing running costs, access to repair services and the time-cost savings through preferential roadway access.

Rockall (2003) from the WLPGA comments that where the savings in running costs are significantly attractive, vehicle owners will convert their vehicles to LPG. Rockall (2003) from the WLPGA also comments that the financial motivation for an end-user to switch to LPG largely depends on the cost of converting the vehicle and the relative cost of the fuel. Van der Ham (2001) states that the use of LPG as a vehicle fuel in South Africa will be economically driven. Ewing & Sarigollu (2000) recognise cost / price as a significant impediment to consumer adoption of AFVs.

Byrne & Polonsky (2001) state that the cost of the alternative fuel must be within reach of the intended target markets, and if the fuel itself is costly, the price will act as an impediment to the purchase of an AFV. These writers add that other running costs

must also be in line with those of traditional automobiles, including vehicle maintenance, refuelling time, and fuel pricing, otherwise they may serve as a continuing impediment to AFV purchase. Byrne & Polonsky (2001) recognise the sustainability of the alternative fuel as another core issue, if AFVs are to be a real long-term environmental solution. The writers note that alternative fuels are doomed to fail if they are derived from a non-renewable resource, or if the environmental impact from production / use is similar to or even greater than that of petrol (Byrne & Polonsky; 2001).

On the basis of the points raised in section 2.5, the author proposes that significant fuel cost savings are required for vehicle users to consider the adoption of LPG as an alternative vehicle fuel.

2.6 Performance and reliability of AFVs

Byrne & Polonsky (2001) notes that performance characteristics such as speed, acceleration, and driving range before refuelling are important concerns for most consumers. Byrne & Polonsky (2001) also notes that perceived safety of AFV fuels is another impediment to purchase, and independent studies and promotion of results are essential. These writers add that whilst recent AFV technology improvements have addressed these concerns, it remains crucial that this information be properly communicated to the consumers if perceptions are to change.

Ewing & Sarigollu (2000) state that though consumers value derived environmental benefits from the product, vehicle performance characteristics remain critical in the choice of a AFV. The writers also found that unless the range, acceleration and recharging issues are resolved, consumer demand is likely to remain limited. These findings concur with that of John Nyboer (2004) of the Canadian Industrial Energy End-use Data and Analysis Centre (CIEEDAC) which suggest that market penetration of AFVs occur more readily through the provision of identical amenity or utility experienced by the petrol customer.

Newer technologies or products are often perceived by consumers as more risky. Research has shown that the perceived risk is a critical determinant of a consumer's willingness to buy a new product (Shimp & Bearden; 1982). Aggarwal *et al*, (1998), state that limited data on actual product performance and limited experience with the product are likely to cause consumers to experience greater uncertainty therefore unlikely to adopt the AFV.

On the basis of the literature discussed under section 2.6, the author proposes that LPG as an alternative fuel must have similar operational performance to petrol, in order to influence consumers positively towards adopting the product.

2.7 Environmental considerations

According to the Rockall (2003) from the WLPGA, the Earth's average surface temperature increased by roughly 0.6 degrees celsius in the 20th century and the average sea level is projected to rise 0.09 to 0.88m by 2100. Rockall (2003) assert that these changes could have catastrophic social and economic effects; hence policy makers worldwide are designing and implementing actions to mitigate climate change. Further, energy policy and climate change are seen to be closely linked because the majority of the world's greenhouse gas (GHG) emissions are in the form of carbon dioxide (CO2) resulting from the combustion of fossil fuels (Rockall; 2003).

Rockall (2003) states that energy practices which are driven by energy policies can reduce carbon dioxide emissions by increasing energy efficiency, reducing reliance on fossil fuels and developing technologies to take advantage of zero-emission renewable energy sources. Consequently, as approach encouraged by the WLPGA is the use of cleaner alternative fossil fuels, particularly liquefied petroleum gasoline, as an alternative fuel for vehicles. Rockall (2003) states that LPG can make a major contribution to delivering real reductions in greenhouse gas emissions, in that LPG features lower emissions of climate destabilising greenhouse gases compared to other fossil fuels and traditional fuels used in unsustainable ways (Rockall; 2003). The growth of the population and economic activity, leads to a relentless rise in energy demand, making the challenge of environmental sustainability both more difficult and more urgent (Rockall; 2003). The WLPGA's view implies that the world will depend on fossil fuels for the bulk of its energy needs for at least the next two or three decades and, therefore, that it is critical to begin using fuels that are both low in greenhouse gas emissions and, facilitate the transition to a sustainable global energy system based on affordable and environmentally acceptable renewable energy technologies (Rockall; 2003).

Rockall (2003) states that LPG can help shift towards a 'low carbon' economy because LPG features significantly lower greenhouse gas emissions than other commercially available fossil fuels. LPG use as an automotive fuel can make an important contribution to improving air quality and reducing greenhouse gas emissions (Rockall; 2003). The WLPGA refers to work done by the US Department of Energy's Argonne National Laboratory, which concluded that compared to conventional motor fuels, LPG

can reduce full life-cycle greenhouse gas emissions by as much as 12-20 per cent (Rockall; 2003).

In summary, Rockall (2003) from the WLPGA comments as follows on the autogas contribution to cleaner air:

- Autogas offers an immediate, concrete solution to improve air quality especially in urban areas. In terms of air-borne emissions of the principal regulated noxious gases, autogas is among the lowest of all automotive fuels available today. According to authoritative scientific testing, autogas yields 50 per cent less carbon monoxide, 40 per cent less hydrocarbons, 35 per cent less nitrogen oxides, and 50 per cent less ozone forming potential compared to gasoline. The health benefits from such lower emissions are significant.

- Autogas can play an important role in mitigating climate change. It has among the lowest greenhouse gas emissions of all commercially available fuels, when measured over its full life. For example, autogas can produce on average 20 per cent less CO2 equivalent compared to petrol when total emissions from well to wheel are taken into consideration.

- The environmental advantages of autogas over conventional and other alternative fuels are even greater with respect to unregulated emissions, including air toxics. Compared to petrol and diesel, autogas was found to have lower VOC (volatile organic compounds), formaldehyde, acetaldehyde, butadiene, and benzene emissions and, therefore has the lowest impact on potential cancer risk.

- Autogas vehicles will maintain their environmental advantages compared to other conventional automotive fuels, especially regarding the current unregulated pollutants. Autogas will also benefit from new automotive technologies that optimise fuel combustion, such as direct injected petrol and diesel vehicles.

- Autogas features far lower nitrogen oxides and particulate matter emissions compared with diesel vehicles, even those equipped with the most advanced technologies such as particulate traps or special diesel particulate filters.

- Congestion driving dynamics tend to increase emissions of carbon monoxide, hydrocarbons, particulate matter and general fuel consumption, mainly due to engine load changes. During these periods, catalysts do not perform at the optimal level – these increases have been found to be far lower for autogas vehicles than for petrol powered vehicles.

- Another positive characteristic of an autogas engine is the reduced emissions at cold engine start. Cold engine start emissions represent a significant percentage of a vehicle's total emissions. When an engine and the associated exhaust catalysts are cold, they do not perform effectively, enabling emissions to escape through the tailpipe. This phenomenon is particularly important for urban fleet vehicles operating on short trips.

- Autogas is an intrinsically clean fuel. It will demonstrate clean emissions over the lifetime of the vehicle, as confirmed in a United States Environmental Protection Agency study that demonstrated that original equipment manufacturer (OEM) autogas vehicles show very little deterioration of emission performance during a vehicle's useful life.

- Finally, an added environmental benefit is that in the event of fuel spill, autogas quickly evaporates into the air. Therefore, in contrast to petrol and diesel, there is never a risk of ground or water contamination. Moreover, autogas vehicles are significantly less noisy than conventional fuel vehicles (Rockall; 2003).

The work of Ghose, Paul & Banerjee (2004) has shown that air quality crises in cities are mainly due to tailpipe emissions. The replacement of old vehicles, reformulating diesel fuel and the introduction of compressed natural gas (CNG) and LPG are among the actions that will be needed to mitigate the air pollution in cities (Ghose *et al*; 2004).

Johnson (2003) argues that LPG should play a greater role in road-transport fuel policy in Western Europe, because it is more secure than conventional and most alternative road-transport fuels; it is superior to most road-transport fuels with respect to public health and environmental impact, and it is available commercially today, where most alternatives are not.

Ewing & Sarigollu (2000) note that concern about transportations adverse impact on the environment has led the United States, the European Commission and Canada to pass regulations limiting greenhouse gas emissions by transportation. As an example, the California Air Resources Board has already established that 10 per cent of new vehicles sold in California in 2003 must have zero emissions (Ewing & Sarigollu; 2000). As a result of this regulation, major motor manufacturers have started investing significantly in AFV development (Ewing & Sarigollu; 2000).

Ewing & Sarigollu (2000) state that in Canada, the Federal Smog Management Plan has mandated the government to pursue opportunities for agreements that would overcome market barriers for AFVs. The authors identified the most relevant attributes in assessing AFV preferences versus conventional petrol powered vehicles, and these attributes are listed below:

- Purchase price;
- Repair and maintenance cost;
- Cruising range (i.e. the maximum distance travelled on a full tank or charge);
- Refuelling time (i.e. the time taken to fill a fuel tank or charge batteries);
- Acceleration; and
- Polluting emissions.

Anyon (2003) notes that transport fuel choice has major impact on the health and wellbeing of people living in Australian towns and cities. LPG is a naturally occurring and inherently low-polluting automotive fuel that offers a number of social and economic benefits when compared with other commercially available fuels. Anyon (2003) points out the following benefits from LPG as an alternative vehicle fuel:

- Greatly reduced emissions of the two most harmful vehicle pollutants (particulate matter and nitrogen oxides), compared with emissions of these pollutants from Euro 3 diesel vehicles;
- Net hydrogen emissions (fugitive plus tailpipe) ten times lower than comparable petrol vehicles;
- Much lower health cost impacts than diesel and petrol (even at fuel quality and technology levels effective from 2006 and beyond);
- 12 to 14 per cent lower greenhouse gas emissions than petrol cars and arguably lower life-cycle greenhouse emissions than diesel, particularly using the latest LPG fuel management systems;
- Abundant long-term supply from naturally occurring Australian sources; and
- Extensive availability through a national network of 3500+ retail service stations, compared with just a handful of compressed natural gas outlets, and no liquefied natural gas infrastructure at all.

Anyon (2003) asserts that the national and community benefits flowing from long-term local supply, widespread retail availability, lower community health costs, lower greenhouse emissions and quieter commercial vehicles makes LPG the logical fuel of choice for vehicles operating in Australia.

On the basis of the findings from the literature discussed in section 2.8, the author proposes that environmental benefits derived from LPG as an alternative vehicle fuel have a positive impact on the adoption rate of the fuel.

2.8 Summary

Through the literature review, numerous factors have been identified that encourage consumer adoption of AFVs and alternative fuel for vehicles. Since research specific to LPG as an alternative vehicle fuel was found to be limited, the literature review drew from findings on the general class of AFVs.

The factors that were discovered through the literature review inform the environment required to develop LPG as a sustainable alternative fuel for vehicles. The results are summarised in the Table 1 below, which identifies the potential factors likely to have a positive influence on the development of LPG as an alternative fuel for vehicles in South Africa.

Authors	Government	Decision-making	Availability	Cost savings	Performance	After-market	Environmental
Anyon (2003)							X
Byrne & Polonsky (2001)	X		X	X	X	X	X
Daksvik *et al* (2002)			X			X	X
Ghose et al (2004)							X
Greene (1997)			X				
Johnson (2003)	X						X
Nesbitt & Sperling (2001)		X		X			
Nyboer (2000)	X	X					X
Reddy & Painuly (2003)	X			X			
Sarigollu & Ewing (2000)			X	X	X	X	X
Wang *et al* (2001)							X
Win-Tat (2004)				X			X
Rockall (2003)	X		X	X	X	X	X

Table 1: Literature review summary

No single factor was identified as being of overwhelming significance. It would seem that it is rather the cumulative benefits of a series of supportive measures that determine the extent to which the LPG as an alternative vehicle fuel maybe successfully exploited. There appears to be certain essential components of successful alternative fuel implementation that help create an environment in which LPG as an alternative vehicle fuel can succeed.

The factors are represented in the ensuing paragraph titled research propositions, which have been extracted from the literature review.

2.9 Research Propositions

From the literature review the following propositions are made for solving the stated sub-problems:

Proposition 1
Clear and consistent South African government policies as they relate to the taxes environment and general incentive schemes will have a positive impact on LPG adoption.

Proposition 2
Decision-making processes within typical fleet operations can be both complex and difficult.

Proposition 3
Refuelling infrastructure must be available and convenient to have a positive impact on LPG adoption.

Proposition 4
Quality after-market services and support will influence fleets to adopt LPG as a vehicle fuel.

Proposition 5
Significant fuel cost savings are required to positively impact the adoption of LPG as a vehicle fuel.

Proposition 6
The operational performance of LPG must be similar to petrol fuel performance, to influence adoption positively.

Proposition 7
Environmental benefits derived from LPG as an alternative vehicle fuel have a positive impact with respect to the adoption of the fuel.

3. RESEARCH METHODOLOGY

The research strategy consisted of semi-structured interviews with both industry experts and decision makers at organisations with fleets that have experience with LPG as an alternative fuel for vehicles. Since the area of LPG adoption as a vehicle fuel is a relatively new area of research, the qualitative study approach provided the means for in-depth analysis of the construct on factors that influence consumers to adopt LPG as a vehicle fuel.

This approach proved to be particularly well suited for this study because it unveiled a multitude of factors that make consumer adoption of LPG such a complex process.

3.1 Qualitative Research

The choice between qualitative and quantitative research depends on the nature of the data to be collected and on the purpose of the research.

According to Leedy & Ormrod (2001) quantitative research is concerned with specific questions about measured variables with the purpose of predicting or explaining phenomena and testing theories. Qualitative research, on the other hand, is used to answer questions about the nature of complex phenomena with the purpose of better understanding or describing the phenomena and for building theory (Leedy & Ormrod; 2001). Leedy & Ormrod (2001) also state that when little information exists on a topic and when a relevant theory base is inadequate or missing a qualitative study can help define what is important and what needs to be studied.

The literature review provided a series of propositions that needed testing. All of the reference material found and consulted had a developed world orientation. There existed a need to better understand and describe the phenomena and building theory within the local South African marketing context. Hence, the qualitative research approach was selected as appropriate for this study.

Given the nature of the research problem and the lack of information within the local market context, an exploratory approach is required. Specific to the exploratory

approach, the phenomenological strategy of inquiry was selected, which drew on the experiences of the participants to understand the central phenomenon: the factors that influence consumer adoption of LPG as a vehicle fuel in South Africa.

The specific research strategy employed, depended almost exclusively on lengthy semi-structured interviews with the carefully selected sample of participants. All of the participants were selected on the basis of having had direct experience with the phenomenon being studied (Creswell; 1998) either through the association as industry experts or as actual users of the technology. 'Technology' refers to standard petrol powered vehicles that have been converted to use LPG. The methodology employed is represented below in a step-by-step process map, see Figure 1.

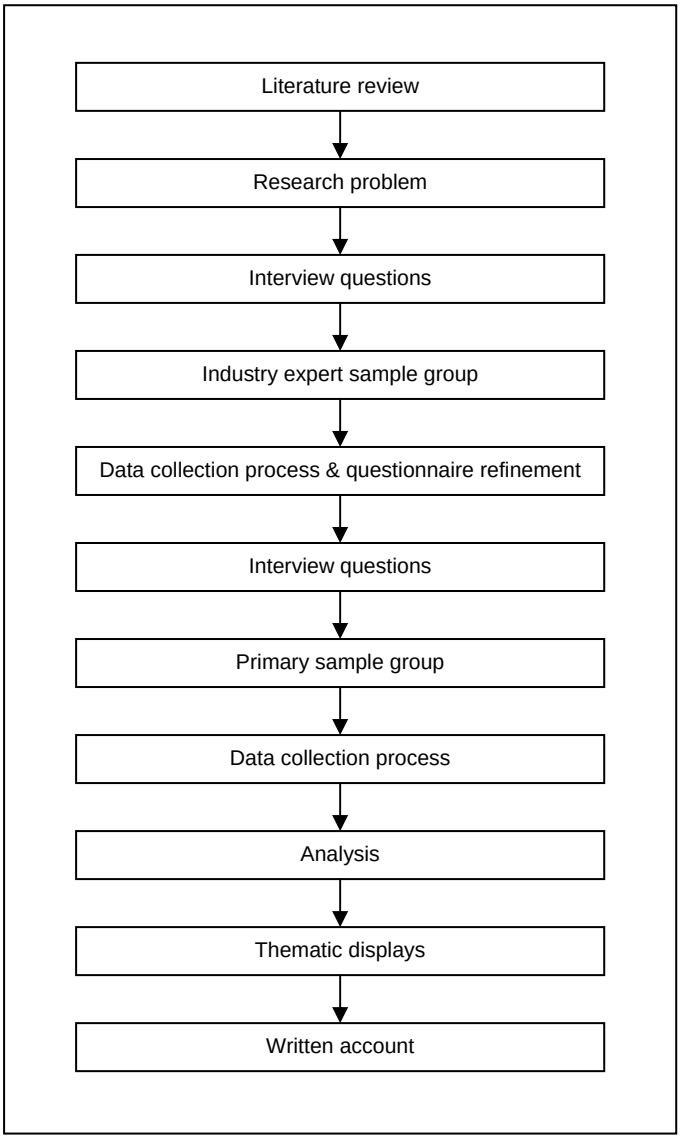

Figure 1: Qualitative methodology process map

3.2 Research Design

The method employed involved interviewing an initial sample group, consisting of industry experts, followed by a primary sample group consisting of actual users, i.e. fleet end-users that use vehicles that have converted to LPG.

A semi-structured interview process was followed, prompted by uniform but non-leading questions, see A & B Appendix.

Interviewing the industry experts served the twin objective of:

1. Acting as a pilot study in refining the interview process for the primary sample group consisting of actual users of the technology.
2. Providing for a more comprehensive process of ascertaining the factors, in addition to interviewing of the primary sample group consisting of users of the technology.

Yin (1994) states that a pilot study is invaluable, in that methodology and some aspects of the theory may be tested, prior to commencing the full study.

Using a qualitative approach provides richer detail for exploring viewpoints in early stages of research and allows the researcher to gain a better initial understanding of the problem and to identify phenomena, attitudes and influences (Leedy & Ormrod; 2001).

According to Leedy & Ormrod (2001), one of the advantages of the interview process is that the researcher can easily shift focus when new data comes to light. The major disadvantage is that the researcher's presence may alter what people say and do and how significant events unfold.

These interviews covered the rationale behind the adoption of LPG as an alternative fuel for vehicles. The influences and the reasons why these factors are seen to be important were compared with the findings from the literature review. The propositions from the literature review were thereafter tested through the interviewing process with the industry experts and primary sample groups.

3.3 Data collection process

According to Leedy and Ormrod (2001) throughout the data collection process, the researcher is required to suspend any preconceived notions or personal experiences that may unduly influence what is heard as opposed to what the participant have to say. This suspension (epoche or bracketing), was incorporated in the data collection process, as is essential for gaining a realistic understanding of actual experiences and hence influences as applied to the problem statement.

The data from this study was validated using triangulation, which, according to Yin (1994) is a way of ensuring valid results. Triangulation requires multiple sources of information. The sources described below were used in the current study.

3.3.1 Industry expert sample group interviews

Interviews were the primary source of data. Initial interviews were conducted with five industry experts, representing various stakeholder communities, as listed, in Table 2 below. The industry experts all have significant experience with LPG, (in excess of ten years), with the exception of the Gauteng Department of Conservation and Environment representative who is an environmental expert. A short biography of the industry experts is attached as Appendix F.

Interviews were thereafter carried out with the primary sample consisting of 13 users of the technology, as listed in Table 3. Each was identified as a key decision maker in purchasing new vehicles; they were business owners, fleet managers, finance department personnel with either direct or indirect responsibility for the respective fleet operations.

Organisation	Contact person	Title
LPGSASA	RH Townsend	General manager
GDACE	A Briel	Environmental manager
African Oxygen Limited	E d'Alessio	Business manager
ADC Engineering	C Brown	Director
The Gas Academy	AJ de Wet	Managing director

Table 2: Industry expert sample group

In order to improve reliability and validity of the study, the writer ensured that the questions were consistent from one interview to the next. The interviews were structured in a manner that permitted flexibility so that important data not anticipated could be captured. The semi-structured interview method was employed, which made use of a pre-defined set of questions as shown in Appendix A. These questions were open-ended, and designed to not guide the participant to an answer. The same interviewing protocol was observed with all the participants.

The interviewees were contacted telephonically to inform them of the research and invitation was given to each to participate in the study. Upon acceptance, the interviews were convened, with confirmation of the time and date agreed to. The interviews were either conducted at the site of the respondent, or over the telephone where respondents were not resident in Johannesburg. The list of questions that appears in Appendix A was used.

Where participants did not allow the interview to be recorded, extensive written notes were made to capture the salient points. Notes were taken on a two-column page, the left-hand side recording actual words and the right–hand side used for initial interpretations. The pilot study interviews were based around the questionnaire shown in Appendix A.

Upon completion the interviews were transcribed, analysed and integrated with other sources of data. The process of analysing data is described in Section 3.4. These interviews helped refine the process and provided triangulation. All respondents were offered a copy of the research report.

3.3.2 Primary sample group interviews

The primary sample was drawn from corporate companies and government departments with fleets that have been exposed to LPG as a vehicle fuel. The primary sample group have direct experience with the product. They were contacted telephonically with the request made for them to participate in the study.

A follow-up letter was sent inviting the primary sample to participate in the study and an explanation of the purpose of the study was given, as appears in Appendix C. Each participant identified was a key decision maker within the fleet organisations or had direct experience with the product, as listed in Table 3 below. During the interviews they were questioned about decision-making procedures, fleet responsibilities and primary concerns and considerations that had influenced them adopt LPG as an alternative vehicle fuel.

The primary sample group interviews were based around the questionnaire shown in Appendix B. A short biography of the primary sample group is attached as Appendix G.

Organisation	Contact person	Title
Red Alert	J McCarthy	Fleet Manager
Business Express Couriers	N Koekemoer	Fleet Manager
Chubb	C van Ryneveldt	Director
Petrogas	T Wessels	Operations Director
Carsport Holland	N du Toit	Owner
Fidility Springbok	A Lotze	Transport Manager
Burglar Alert	S A Shaik	Operations Manager
Parcel Connect Services	D McGraw	Owner
Automobile Association	R Wilcox	Fleet Manager
SMA Security	S Mouton	Managing Director
Kumba Sishen	B Lubbe	Transport Manager
Sentinel Guarding	M Geldenhuys	Fleet Manager
UTI - Upington	N Bosman	Managing Director

Table 3: Primary sample group

3.3.2 Interview database

A database was created for the data that was collected from the interviews, documentation and direct observations. This database allowed for all the data collected to be done in an orderly fashion so that it could be referred to at any stage. The database was in the form of hard-copy notes and data on a compact disk, with raw data ordered chronologically. Processed data was ordered according to the structure of the research report. The purpose of the database was to allow a third party the opportunity to review the data collected and verify the conclusions drawn.

3.4 Data analysis

According to Barritt (1986) the central task during data analysis is to identify common themes in people's descriptions of their experiences. The interview transcripts were consequently carefully assessed for patterns and trends and accordingly grouped together.

The groups were reported as objectively as possible, and the results related to the propositions identified in the course of the literature review. The groups identified became the factors that influenced consumers to adopt LPG as a vehicle fuel and either supported existing theory or added to the body of knowledge.

Creswell's data analysis spiral was used, as described in Leedy & Ormrod (2001:161), for analysing the in-depth interviews transcripts. The following specific steps were undertaken:

1. Identify statements that relate to the topic - the data was organised on a computer database into sentences.
2. Group statements into 'meaning units' - the data was perused several times in order to get a sense of what it contained as a whole, so that possible groupings could be suggested.
3. Seek divergent perspectives - identified general groupings and classified each piece of data accordingly, in terms of patterns and trends.
4. Construct a composite grouping - the data was summarised and the groupings organised back, to relate to the propositions.

3.5 Validity and reliability

According to Leedy & Ormrod (2001) the interpretation of the data in qualitative studies, is often influenced by the researcher's biases and values. The study consequently attempted to get multiple and varying perspectives on related issues, and endeavoured to represent all views and data received as objectively as possible.

At the time of the research the researcher had a business development responsibility role for a leading gas company in the South African market place. Owing to the requirements of this role, the researcher had been exposed to the technology and drew the primary sample group from an existing customer base at the company for which he works. The pilot sample group was drawn from industry experts from academic institutions, environmental public departments, and the local LPG Safety Association of Southern Africa.

Reliability is defined as the extent to which similar research conducted in future will result in similar outcomes (Leedy & Ormrod; 2001). From the semi-structured interview schedule a comprehensive database was compiled and reliability was ensured where possible.

4. RESEARCH RESULTS

4.1 Introduction

This chapter serves to sum up the main findings of the research. It provides a summary of the findings in relation to the seven propositions, and will discuss the management implications of the research. This chapter also puts forward suggestions for future research with respect to the factors that influence consumer adoption of LPG as an alternative vehicle fuel in South Africa.

The chapter begins with a brief overview of the sample demographics.

The pilot sample group consisted of five industry experts, representing leading organisations, relevant public departments and service industries, with direct or indirect exposure to LPG as an alternative vehicle fuel.

The questionnaire prepared for the industry experts as shown in Appendix A was of a broader nature with many open-ended questions. This process allowed for a more focussed questionnaire to be prepared for the primary sample group. Further, allowed for a more comprehensive account of the phenomenon been studied. The primary sample group consisted of a total of 13 participants (Appendix B) who work with various fleets that have had direct experience with the phenomenon been studied.

At the time of the study it was found that local uptake was limited to fleets from mostly private organisations. The researcher was unable to locate any private motorists that had converted to the technology. While of interest, this was not material to the research, which was concerned with the fleet end-user, as opposed to individual motorists or consumers.

4.2 Composite of participants' experiences

Following the interviews and through a process of distilling the common themes, certain factors were identified as influencing consumer adoption of LPG as an alternative vehicle fuel. These factors are described in the paragraphs that follow.

4.2.1 Fuel cost savings

Both sample groups were unanimous that the single biggest factor influencing consumer adoption of LPG as a vehicle fuel was cost savings. All participants expressed the need for real net savings over the full life cycle of the technology. Participants felt that at least 20% net savings was required as compared to the current fuel bill to encourage adoption of LPG.

The primary sample group commented that the cost savings must be determined after taking into account the capital costs to convert a regular petrol vehicle to LPG and the maintenance costs to ensure the ongoing integrity of the gas conversion equipment.

4.2.2 Fuel theft or pilferage

The fleet operators interviewed commented that fuel theft was a significant issue in their lives, with petrol theft accounting for as much as 30 per cent of the fuel bill. They commented that converting their petrol-powered fleet vehicles to LPG had reduced the potential for fuel theft, as LPG was not as 'stealable' as petrol. The product is stored under pressure as a liquid in specialised tanks that are installed in the boot space of the vehicle.

All of the participants expressed 'elimination of fuel theft' as an encouraging factor for LPG adoption as a vehicle fuel.

4.2.3 Convenient and available refuelling stations

All participants expressed the need for convenient and available refuelling sites. Most of the participants' refuelling needs were serviced from dedicated supply infrastructure

installed on their respective sites, and were happy with this arrangement, provided the savings potential was real. It is important to note that participants did not feel that LPG needed to be as common and available as petrol for them to convert their fleets. Some participants were serviced from a common refuelling site, which they were comfortable with, provided access was in relatively close proximity.

4.2.4 Reliability and maintenance

All participants expressed the need for quality maintenance programmes to ensure the ongoing integrity of the conversion equipment. Participants from the industry expert sample group commented that the South African Bureau of Standards, Code of Practice 087 Part 6 governed industry standards. Participants from the primary sample group expressed concern with respect to actual maintenance work carried out by service providers. They commented that LPG maintenance was not freely available and expensive, and that vehicles were still subject to standard service requirements as specified by the motor manufacturers.

Participants wanted access to local certified technicians to maintain and ensure the ongoing integrity of the conversion system. The majority felt that there was a shortage of trained technicians and thus routine service and maintenance was expensive, when available. Access to qualified maintenance technicians featured a strong factor influencing consumer adoption of LPG by all participants. Participants from the industry expert sample group were very knowledgeable about the conversion equipment and commented that it was designed to the correct internationally recognised standard and for ease of use, however expressed concern that motor manufacturers disqualified vehicle warranties that have been converted to LPG. It was interesting to note that most of the participants from the primary sample group did not see the ‘vehicle warranty’ as an impediment to adopt the technology.

4.2.5 Environmentally friendly

Participants from the industry expert sample group felt that the environmental benefit was a significant factor for consumers to consider in adopting LPG as a vehicle fuel. Participants from the primary sample group did not see the environmental benefit as

reason enough to adopt LPG. The exception was the participant from the environmental department who gave this as the principal reason for converting part of their fleet to LPG.

4.2.6 Government taxes on LPG

Participants from the primary sample group commented that while vat was paid for the LPG purchased, as registered organisations the vat was claimed back from the Receiver of Revenue, implying cost savings as compared to the petrol price. Provided LPG was not taxed similar to petrol or other road fuels, this group felt that current pricing levels presented a significant savings benefit or factor that in the long would encourage adoption of LPG as a vehicle fuel.

All participants mentioned that continued ‘no taxes’ and government incentives are required to encourage greater adoption of LPG as a vehicle fuel. Participants from the primary sample group also mentioned that incentives such as subsidised vehicle conversion equipment would go a long way to encouraging LPG uptake.

4.2.7 Decision making in fleets

Participants from the primary sample group varied in terms of their response about decision-making practices at their respective organisations. It was found that in owner managed smaller organisations decision-making was not as complex and drawn out a process as at relatively bigger organisations.

4.3 Discussion

This section compares and contrasts the findings from section 4.2, with the body of theory (propositions) as discovered through the literature review.

4.3.1 Proposition 1 - Clear and consistent South African government policies as they relate to the taxes environment and general incentive schemes will have a positive impact on LPG adoption.

Participants indicated that decision-making processed amongst their respective organisations were complex as it involved many layers that needed convincing. The participants felt that having clear government policies would simplify part of the decision making process, and thus was a significant factor in encouraging adoption of LPG as a vehicle fuel.

Participants commented that current decisions to convert their organisations' fleets to LPG were taken without any government incentives in place. The participants indicated that government incentives would encourage them to consider extending LPG as a vehicle fuel to the entire fleet. The participants also commented that the government had indicated its intention to tax the product similarly to road fuel in the future, which was expressed as a concern to them. However, at the time of the interviews the product remained exempt from taxes, similar to other road fuels. All participants expressed the need for clarity from government, as in the face of uncertainty decision making was difficult.

Therefore we accept the proposition that clear and consistent South African government policies as they relate to the taxes environment and general incentive schemes will have a positive impact on LPG adoption.

4.3.2 Proposition 2 - Decision-making processes within typical fleet operations can be both complex and difficult.

Participants from the primary sample user group, felt that decisions generally happen after factual information has been given as they relate to actual cost and benefits of the

technology. These participants felt that whilst a particular organisation may take longer to make the decision, given its size and complexity, this would impact the time taken to make a decision, as opposed to not making a decision al all. The participants shared the view that decision making in their organisations is often complex, given the multiple layers that needs convincing and the internal decision-making processes that need to be worked through.

Therefore we accept the proposition that decision-making processes in typical fleet operations are complex and would influence consumers in the adoption process of LPG as a vehicle fuel.

4.3.3 Proposition 3 - Refuelling infrastructure must be available and convenient to have a positive impact on LPG adoption.

The participants, i.e. users of the technology, were unanimous in the opinion that a convenient and available refuelling service station was an essential factor in the consideration of switching vehicle fuel. They said that a petrol service station was commonplace in South Africa, implying a convenient offer to market. Users commented that dedicated refuelling stations, situated at their premises, addressed the convenience issue, but, however, limited filling options. Users would like greater access to LPG refuelling pumps, just as they currently enjoy access to petrol service stations. They also commented that having refuelling sites at their premises introduced additional operational and management responsibility, in terms of site safety and inventory control.

Therefore we accept the proposition that refuelling infrastructure must be available and convenient to have a positive impact on LPG adoption.

4.3.4 Proposition 4 - Quality after-market services and support will influence fleets to adopt LPG as a vehicle fuel.

All participants were unanimous on the importance of this reliable and credible after market services. In order to encourage other consumers to adopt the technology, the participants expressed the need for hassle-free operations. An issue that emerged very

clearly was the fact that maintenance-related costs were ever increasing and high. Access to certified LPG installers is difficult, with relatively few qualified installers in the country. Breakdown maintenance most often results in vehicles switching back to petrol, with long periods of time elapsing before the LPG conversion system is adequately attended to.

Therefore we accept the proposition that reliable and credible after-market services are important and encourage consumers to adopt LPG as a vehicle fuel.

4.3.5 Proposition 5 - Significant fuel cost savings are required to positively impact the adoption of LPG as a vehicle fuel.

Responses to the question on which of the factors that encourage LPG adoption, as a vehicle fuel was the most significant, were all similar. All participants called for significant fuel cost savings on a net basis as compared to traditional fuel costs. The participants volunteered an understanding of full life cycle cost of the technology and expressed the frustration at LPG suppliers for quoting gross savings as opposed to the net savings potential at the time of the sale. The participants cited this factor as most significant, which would influence consumer adoption of LPG as a vehicle fuel.

It is interesting to note that nowhere in the literature were any of the AFVs seen as a benefit to fleets, in terms of reduced fuel theft opportunities. Yet, all the fleet operators interviewed commented that fuel pilferage was a significant cost to their business and that in converting their fleets to LPG, away from petrol, they had experienced ‘huge savings’. LPG-converted vehicles effectively reduced the potential for stealing petrol, which is a significant factor that influences consumers to adopt LPG as an alternative vehicle fuel. Perhaps, in South Africa we are aware of thieving more than in other countries.

Therefore we accept the proposition that fuel cost savings is the most significant factor in encouraging consumers to adopt LPG as a vehicle fuel. A new factor however has been discovered in that LPG as a vehicle fuel eliminates fuel theft opportunities and therefore encourages consumers to switch vehicles from petrol to LPG.

4.3.6 Proposition 6 - The operational performance of LPG must be similar to petrol fuel performance, to influence adoption positively.

Participants from the primary sample group indicated that the conversion technology must yield equivalent performance characteristics to that of petrol-powered vehicles. The participants commented that the vehicles performance must be similar to when they were on petrol, without significant loss of power, in order to encourage LPG adoption as a vehicle fuel. It is also interesting to note that the participants emphasized the fact that the fleets are critical to their organisation's success, and therefore without acceptable performance and safety features the vehicles would not have been converted to LPG.

Therefore we accept the proposition that the operational performance of vehicles converted to LPG, must be comparable to that of petrol-powered vehicles to encourage consumers to adopt LPG as a vehicle fuel.

4.3.7 Proposition 7 – Environmental benefits derived from LPG as an alternative vehicle fuel have a positive impact with respect to the adoption of the fuel.

The global experience as revealed in the literature survey showed the environmental benefit as key to consumers considering and making the transition from traditional fuels to alternative vehicle fuels.

From the interviews conducted with the primary sample group it was discovered that while private sector fleets appreciate the environmental benefit of the technology uptake, this was not one of the factors that would influence them to adopt LPG as an alternative vehicle fuel. As mentioned already, the exception was from the environmental department that had converted to LPG primarily because of the environmental benefit.

Therefore Proposition 7 is reworked to read as follows:
Environmental benefits derived from LPG as a vehicle fuel was found to be insignificant as a factor that would encourage private sector organisations to adopt LPG as a vehicle

fuel. However, the environmental benefit is an influencing factor as it applies to public sector departments.

4.4 Factors classified according to a model of buyer behaviour

This section presents the factors that emerged from the interviews relative to the adoption of LPG as a vehicle fuel. The discussion of these factors does not, however, include an analysis of their degree of impact on the adoption process.

The factors that influence consumer adoption of LPG as a vehicle fuel, as presented below, have been classified according to the four categories of Webster and Wind's (1972) General Model of Organizational Buying Behaviour:

- Environmental factors;
- Organisational factors;
- Interpersonal factors; and
- Individual factors.

4.4.1 Environmental factors

Physical influences

All participants were unanimous that access to refuelling infrastructure was an important factor in their decision making process (Proposition 2). Since the fleet operations were a critical part of the organisations' success, participants all required reliable and credible after-market services. The issue of maintenance requirements called into question concerns regarding the quality of support, availability of certified technicians, and related cost issues among other things (Proposition 3).

Technological influences

Participants wanted equivalent operational and safety performance to petrol-powered vehicles (Proposition 6).

Cultural influences

Organisational culture stood out as an important environmental influence on the adoption process, especially in the case of the environmental department interviewed,

the Gauteng Department of Agriculture, Conservation and Environment (GDACE). The GDACE converted a fleet of vehicles to LPG primarily because of the environmental benefit (Proposition 7). All participants felt that having clear government policies would simplify part of the decision-making process, and would be an influencing factor in adopting LPG as a vehicle fuel.

Political influences
The participants did not mention any.

Legal influences
Fleets that converted to LPG were required to contract LPG supply, which they would rather not have done and source the product from any available source.

4.4.2 Organisational factors

Several organisational issues were apparent, with the most notable being that of cost savings and decision-making processes. In all of the interviews, the economic motive for converting to LPG played a major part in influencing the process (Proposition 5). Participants from the primary sample group shared the view that a decision making process in their organisations was an influencing factor. The participants commented that many layers need convincing and that internal decision making processes need to be worked through. Decision making was easier amongst the relatively smaller organisations interviewed (Proposition 4).

4.4.3 Interpersonal and individual factors

A factor that could be considered as both a group and an individual influence was previous experience. Participants from the primary sample group gave examples of some of the negative experiences with respect to adopting LPG as a vehicle fuel.

4.5 Summary

It is difficult to generalise about the factors that influence consumers in the adoption process on the basis of a limited number of users. The study has suggested that the

economic motive is central: fuel cost savings as compared to the petrol fuel bill and the reduced fuel theft opportunity. It is also noted that private sector fleet end-users are not influenced to convert their fleets to LPG by the environmental benefit.

5. CONCLUSION

This report has identified and suggested the factors that influence consumer adoption of LPG as an alternative fuel for vehicles in South Africa.

Through the literature review seven propositions were identified that relate to the factors that influence consumer adoption of LPG as an alternative vehicle fuel. In the course of semi-structured interviews these were confirmed, albeit the environmental benefit to a lesser extent, an additional factor was revealed. LPG as a vehicle fuel was seen as not being as stealable as petrol. Participants from the primary sample group interviewed gave this reason as a key benefit that has influenced their decision-making process in making the switch. This factor represents an important finding, as participants agree that fuel theft was a huge problem in most fleet operations, and was therefore amongst the primary reasons for converting fleet vehicles to LPG as a vehicle fuel.

The factors that encourage consumers to adopt LPG as a vehicle fuel in South Africa are:

- Significant fuel cost savings are required to positively impact the adoption of LPG as a vehicle fuel.
- Fleet operations achieved significant reductions in fuel theft where vehicles have been converted to LPG as a vehicle fuel.
- Clear and consistent South African government policies as they relate to the taxes environment and general incentive schemes will have a positive impact on LPG adoption.
- Decision-making processes within typical fleet operations can be both complex and difficult.
- Refuelling infrastructure must be available and convenient to have a positive impact on LPG adoption.

- Quality after-market services and support will influence fleets to adopt LPG as a vehicle fuel.
- The operational performance of LPG must be similar to petrol fuel performance, to influence adoption positively.
- Environmental benefits derived from LPG as an alternative vehicle fuel have a positive impact with respect to the adoption of LPG by public sector departments.

Of the factors listed, however, it is empirically unknown which would have the greatest influence on the consumer, to adopt LPG as an alternative vehicle fuel. The research does not address the issue of which of these factors is a priority from a market development point of view. However, fuel cost savings was commented by the participants as being the principal factor in adopting LPG as a vehicle fuel. Therefore, the most influencing of factors for fleets to make the 'switch' is suggested as the 'fuel cost savings' factor. It must be noted that the environmental improvements is seen as an essential rationale for governments to promote the use of LPG as a vehicle fuel. A notable finding was that the environmental benefit, of reducing air pollution was not motivation enough for private sector fleet managers in South Africa to adopt LPG as a vehicle fuel.

5.1 Validation of amended propositions

After the formal interview process had been carried out these factors were further validated through the Liquefied Petroleum Gasoline Safety Association of Southern Africa (LPGSASA).

RH Townsend, the General Manager, with over 25 years of relevant experience, was contacted and stated his agreement with the findings of the study. The following general comments were made, with special mention emphasis on the new factor identified, i.e. 'fuel theft as an influencer'.

According to Townsend, until the government decides to stimulate or encouraging demand, the product potential of LPG as a vehicle fuel is limited. Currently, government encourages LPG use as relief energy for electricity shortfalls and also to displace paraffin in low-income households. It is interesting to note that government

encourages paraffin displacement primarily on the back of the environmental benefit, i.e. reducing indoor pollution for health reasons.

An important factor according to Townsend is that without government involvement LPG as an alternative vehicle fuel market is doomed in South Africa. Further, there must be a greater appreciation for environmental benefits that results from LPG as a vehicle fuel as opposed to traditional fuels. Townsend was not surprised to learn that all of the private sector fleets interviews were unconcerned about the environmental benefit, and did not see this benefit as reason enough to convert their respective fleets to LPG.

The fact that significant savings are achieved as a result of removing the fuel theft opportunity positively impacts LPG adoption as a vehicle fuel. Townsend mentioned two specific fleet operations within the country that had converted significant portions of their fleets to run on LPG, as a direct result of fuel theft. Townsend commented that resulting savings, whilst difficult to quantify, ranged anywhere from 5 to 35 per cent of the existing fuel bill.

5.2 Management implications

The findings as suggested through this research are invaluable for marketers wanting to grow LPG as an alternative fuel for vehicles. The findings will benefit the government in its consideration of diversifying the dependence on petrol as a vehicle fuel. Environmentalists would also better understand the issues that would need to be resolved in order to establish a sustainable alternative to the traditional vehicle fuels on offer.

The industry still faces critical barriers to market development, and the government can act to balance environmental improvement with the initial higher costs of converting petrol-powered vehicles to LPG. Government may even consider tax exemptions for vehicle conversions and tax credits for infrastructure development.

It is recommended that the marketing strategist keen on developing this market appreciate that ‘organizational buying behaviour is a complex process and involves

many persons, multiple goals, and potentially conflicting decision criteria.' (Webster & Wind, 1972:12)

It must also be noted that fleet operators are sophisticated buyers, and require honest and factual discussions from the marketer (Rockall; 2003). The research undertaken by Nesbitt & Sperling (2001) is of critical importance to the marketing strategist wanting to develop LPG market, as an alternative vehicle fuel amongst fleet end-users. The research identifies the various fleet types and suggests which fleets will be most responsive to which particular type of marketing intervention.

Finally, it is noted that the factors identified are neither exhaustive nor mutually exclusive. They are suggested to represent the principal influences on consumer adoption of LPG as an alternative vehicle fuel in South Africa.

5.3 Recommendations for further research

The usefulness of the research results for the field of marketing management could be enhanced by adjustments to both research approach and emphasis in a number of areas.

Kauffman (1996) has shown that while most researchers agree that organisational choice is a group effort, most research is actually done at the level of the individual. It would be useful to conduct similar research amongst a group entity as the unit of analysis. The current research study was conducted on a sample of individuals as opposed to a group entity.

This research consisted of identifying the principal factors that influence consumers to adopt LPG as a vehicle fuel. However, it is unknown which of these would have the greatest influence on the consumers' adoption of LPG as an alternative vehicle fuel. An area for future research could include empirical testing of the factors suggested to establish their relative weightings as an influence on the decision to convert to LPG.

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APPENDIX A

Open-ended questionnaire for industry expert sample group

The following questions were put to the industry experts in business, academia and public departments in order to ascertain the factors that they perceived to be important with respect to switching to LPG as an alternative vehicle fuel.

What has been your experience with alternative fuel vehicles?

What do you believe are the primary concerns and considerations for uptake of LPG as an alternative vehicle fuel?

How could some of the barriers of switching to LPG as a vehicle fuel be addressed? What are the incentives required for consumers to consider alternative fuel vehicles?

Are there any other comments?

APPENDIX B

Open-ended questionnaire for primary sample group

The following questions were put to the primary sample group, consisting mostly of key decision makers within various fleet organizations, in order to ascertain the factors that they perceived to be important with respect to switching to LPG as an alternative vehicle fuel.

What, in your opinion, are the factors that encourage adoption of LPG as an alternative fuel for vehicles? Which of the factors mentioned is the most significant?

In your opinion why has there been limited uptake of LPG as an alternative fuel for vehicles?

How could some of the barriers of switching to LPG as a vehicle fuel be addressed? What are the incentives required for consumers to consider alternative fuel vehicles?

How are decisions taken within your organisation?

Are there any other comments?

APPENDIX C

30 March 2006

Dear Fleet Manager/ Industry Expert

I am currently completing my MBA at Wits Business School and in order to obtain this degree must submit a research project. This research will explore factors that impact on consumer adoption of LPG as an alternative vehicle fuel in South Africa.

Related literature on LPG as an alternative vehicle fuel, is limited in South Africa. This research will explore the reasons for both success and failure and in so doing attempt to supplement the literature.

This type of research necessitates an interview, (in person or telephonically) which should take no longer than 30 minutes.

If you have any queries or comments please call me on 084 555 0976.

Your co-operation in this regard is appreciated and upon completion of the research I will forward a summary of my findings to you, which I am sure you will find interesting.

Yours sincerely

Godfrey Freddy Rajool

APPENDIX D

Typology - Fleet decision making

Centralisation	*high* Formalisation	*low*
high	hierarchic	autocratic
low	bureaucratic	democratic

Source: Nesbitt & Sperling (2001)

APPENDIX E

Typology – Fleet category characteristics

	Bureaucratic	Autocratic	Hierarchic	Democratic
Formal written rules guide fleet decisions	Yes or no	No	Yes or no (no, if 2 and 3 are yes)	No
Detailed cost analyses are used	Yes	Yes or no	Yes or no (yes if 3 is no)	Yes or no (yes if 3 is no)
Final choices are made after soliciting bids	Yes	Yes or no	Yes or no (yes if 2 is no)	Yes or no (yes if 2 is no)
Decisions are made by 1 or 2 individuals	No	Yes	Yes	No
Decisions are made by upper management	Yes or no	Yes	Yes	Yes or no
Little or no authorisation / approval is necessary	No	Yes	No	No
Decisions are made at headoffice, implemented at individual sites	Yes or no	Yes or no	Yes or no	Yes or no

Source: Nesbitt & Sperling (2001)

APPENDIX F

Biography - Industry expert sample group

RH Townsend – LPGSASA

Dick Townsend is the General Manager of the Liquefied Petroleum Gasoline Safety Association of Southern Africa. He has led the LPGSASA for over ten years and has industry experience in excess of twenty years.

A Briel – GDACE

Amelia Briel is a qualified environmental manager and works at the Gauteng Department of Agriculture, Conservation and Environmental Affairs. MS Briel played a major role in evaluating the environmental benefits especially of LPG as an alternative fuel for vehicles for the department.

E d'Alessio – Afrox

Enzo D'alessio is a qualified engineer and the business manager for the LPG business at African Oxygen Limited. He has extensive experience with the product, in excess of five years and so convinced of the benefits that had his previous vehicle converted to run on LPG.

C Brown – ADCENG

Craig Brown is currently sales director at one of the largest specialist gas equipment supply companies in the country – ADC Engineering. He has extensive experience of over ten years with the product.

AJ de Wet – Gas Academy

AJ de Wet has over fifteen years of training experience in the industry. Prior to starting the Gas Academy, AJ was the autogas training authority at the LPGSASA for over three years.

APPENDIX G

Biography - Primary sample group

Organisation	Contact/ title	Type of business	Number of vehicles	Years autogas experience
Red Alert	J McCarthy – Fleet Manager	Security company	7	3
Business Express Couriers	N Koekemoer – Fleet Manager	Courier company	6	5
Chubb	C van Ryneveldt	Security company	120	5
Petrogas	T Wessels – Operations Director	Autogas supplier	30	6
Carsport Holland	N du toit - owner	Autogas Installer	30	5
Fidility Springbok	A Lotze – Transport Manager	Security company	6	2
Burglar Alert	SA Shaik – Operations Manager	Security company	6	3
Parcel Connect Services	D Mcgraw – owner	Courier company	6	3
Automobile Association	R Wilcox – Fleet Manager	Roadside assistance company	14	4
SMA security	S Mouton – Managing Director	Security company	4	2
Kumba Sishen	B Lubbe – Transport Manager	Mining operation	3	2
Sentinel Guarding	M Geldenhuys – Fleet manager	Security company	4	2
UTI - Upington	N Bosman – Managing Director	Courier company	5	3