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Exploring the market for Compressed Natural Gas light commercial vehicles in the United Kingdom



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ABSTRACT

This paper examines the potential market for natural gas as a transportation fuel in the light commercial vehicle sector in the United Kingdom. In order to understand this market and identify barriers to growth and possible solutions interviews were conducted with a number of professionals with experience in this market. These interviews were open and exploratory enabling the application of grounded theory techniques in analysis. Clear priorities for potential users were cost and carbon reduction and the main constraint a lack of refuelling infrastructure. Small scale and low cost policy interventions were identified, at national level including maintaining tax differentials; easing payload restrictions; and limited support for refuelling facilities alongside local policy initiatives, for example, restoring the exemption from the London Congestion Charge for gas vehicles, that could help to kick-start the market at least at a niche level.

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Introduction

Concern over fuel security and the emissions of petrol and diesel vehicles has led to a search for replacement fuels and vehicle technologies. Natural gas has become an attractive option due to its availability, diverse sources (IEA, 2010) lower emissions of local air pollutants, especially nitrogen oxides (NOx), Carbon Monoxide (CO) and particulate matter, and its suitability for heavy-duty vehicles (Engerer and Horn, 2010; Park and Tak, 2012). In Armenia, Bangladesh and Pakistan over half the fleet is powered by natural gas (NGVA, 2012b). In Europe growth has been slower but natural gas vehicles now exceed a 1% market share in Bulgaria, Italy and the Ukraine (NGVA, 2013). Some countries have sought to use bio-methane as a more sustainable less carbon intensive direct replacement for fossilised natural gas given that current Compressed Natural Gas (CNG) vehicles have only a slight advantage in terms of CO₂ emissions with respect to their diesel and petrol counterparts. The UK the market is negligible with only 559 mostly heavy duty dual-fuel vehicles on the road in 2011 (NGVA, 2013). This paper aims to shed light on the fledgling UK market in natural gas vehicles to explore barriers to market development and identify ways of overcoming these.

Various attempts have been made to introduce natural gas vehicles to the UK market including small scale infrastructure investments; grants for heavy duty vehicles and publicity campaigns; but these had very little lasting impact (Carslaw and Fricker, 1995; Crowe, 2004; NGVA, 1995). Reasons for this included the need for vehicle conversion in the absence of original manufacturer vehicles in right hand drive versions, and refuelling problems arising from the use of wet gas from the grid (CNG-Services, 2011). Now grid gas no longer causes such problems and original right hand drive vans (3.5 tonnes and

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below) are available from three major manufacturers, namely Iveco, Mercedes Benz and Volkswagen. This is an opportune moment to explore the potential market for such vehicles and the constraints upon it.

The paper explores the questions: what are the barriers to the successful development of a market in natural gas vans in the UK? And how might these barriers be overcome? Thus the focus is on commercial vehicles at and below 3.5 tonnes (hereafter referred to as vans). To address these questions interviews were conducted with a number of professionals with experience in this market. The interviews were open and exploratory enabling the application of grounded theory techniques in analysis. Interviewing commercial van operators as potential early adopters adds a new understanding of the purchaser's position in this wider debate as, to our knowledge, no previous studies have examined the potential barriers and opportunities for natural gas light commercial vehicles in the UK.

The paper is organised as follows. The following section, CNG market evolution, briefly reviews the limited number of studies of the CNG market and draws on evidence from the wider literature on the development of markets for alternative fuels and vehicles. Opportunities and constraints contains discussion and policy implications and is followed by a brief concluding section.

CNG market evolution

Few studies examine CNG vehicle markets. [Yeh \(2007\)](#) looked at the evolution of relatively mature markets for gas vehicles, including Italy, Argentina, Brazil and Pakistan, where tax rebates and a gas price maintained at around 40–60% of that of diesel/petrol leading to payback periods of less than 3 years were common characteristics in sustaining the CNG vehicle market. A study of Argentina ([Collantes and Melaina, 2011](#)), also identified the fuel price differential as key alongside additional government support through regulation with regard to safety and standards together with private investment in infrastructure. However, the authors observe that government-led low prices are likely to create an unsustainable situation of over-consumption, placing strain on reserves. In New Zealand government support in the form of incentives for conversion and refuelling stations and price controls on fuel kick-started the market but the sudden removal of this support led to market collapse ([Gwilliam, 2000](#)), a similar pattern was observed in Canada ([Struben and Sterman, 2008](#)). In the only study of the UK, [Beresford et al. \(2003\)](#) discuss government initiatives that were in place in the early 2000s to encourage UK freight operators to use alternative fuels. A number of these targeted CNG vehicles, by offering grants for refuelling infrastructure, clearly with no long term success.

Most of the wider literature on markets for alternatively fuelled vehicles focuses on passenger vehicles. Early work by [Nesbitt and Sperling \(1998\)](#) in the freight sector provides lessons still pertinent today. They observed that some of the reasons why fleets were often seen as a potential market for alternative technology vehicles, like the potential for central refuelling, focus on price, and information availability, were not necessarily true, and often the same barriers encountered in the passenger vehicle market also apply. They noted that central refuelling was becoming less popular amongst freight operators in the USA, and that in any case most operators did not have the necessary space to install in-house alternative technology refuelling facilities. Fleet managers did not always compare life-cycle costs but concentrated on the purchase price. Importantly, fleet managers did not appear to be well informed about costs, performance and incentive programmes relating to alternative technology vehicles and often had misconceptions with regards to the reliability and safety of these vehicles.

Barriers to the development of markets for alternative vehicles are normally categorised as financial, regulatory and legal, and physical ([Browne et al., 2012](#)). [Wiedmann et al. \(2011\)](#) explored the barriers to the further development of a market for CNG vehicles in Germany, identifying a number of risk factors that seem to affect the purchase of these vehicles and therefore act as barriers to market development. These are financial risks (cost fluctuations and payback periods), performance risks (especially driving range), physical risk (danger) and time risk (time spent learning a new technology).

Lack of refuelling infrastructure (a physical barrier) and the cost of portable or semi-mobile installation (a financial barrier) are certainly among the most important barriers. The provision of public refuelling infrastructure is an expensive investment when demand is not (or not yet) strong enough. Studies have estimated that in order to sustain the development of alternative technology vehicles, suitable fuels need to be available in about 10–30% of refuelling stations in a given country ([Melaina and Bremon, 2008; Nicholas et al., 2004; Sperling and Kurani, 1987; Yeh, 2007](#)). [Achtnicht et al. \(2012\)](#) estimated that making Liquid Petroleum Gas (LPG)/CNG available in one out of three service stations in Germany could take such vehicles to 14% of the fleet by 2030. Finally, in terms of break-even distances 40,000 km per vehicle is seen as a critical threshold for acceptability ([Hu and Green, 2011](#)).

Some incentives identified for private consumers may also be important for commercial vehicles. Examples include: exemptions from congestion or road user charges and free parking ([Ozaki and Sevastyanova, 2011](#)); tax reductions ([Gallagher and Muehlegger, 2011](#)), and programmes funding the development of refuelling infrastructure ([Wiedmann et al., 2011](#)). Other factors, like peer and network effects ([Axsen and Kurani, 2011](#)), could have a role especially in smaller business clusters, where a number of small operators could share experience and potentially spread the costs of infrastructure investment. Better information for potential consumers about available models, performance, environmental impacts and costs is also needed, as even in countries where the market is more mature, like Italy, lack of proper information about prices for example, was seen to be slowing the take up rate ([Pascoli et al., 2001](#)).

Most government intervention in the CNG market has, understandably, been at a national level and provided incentives, subsidies and price support for infrastructure, vehicles and fuel. This can be expensive and does not guarantee a sustainable

market. This paper focuses on decision makers in the gas van market to identify interventions that might kick-start the market at relatively low cost.

Method

The main research questions: what are the barriers to the successful development of a market in natural gas vans in the UK? And how might these barriers be overcome? are very open in nature. Therefore an interview approach was adopted and an inductive approach applied, drawing on grounded theory analysis techniques ([Goulding, 2002](#)), so that factors were identified through the data rather than being imposed upon it. This inductive approach accessed the grass roots perspective of the market so often alluded to within the inner circles of the industry but yet to be recorded and understood in the wider domain. Stakeholder (and potential customer) based in-depth interview approaches are fairly common in transportation and energy research, and have been used to gather information about new or immature markets, for example, bike-sharing schemes ([Parkes et al., 2013](#)), urban freight tram systems ([Arvidsson and Browne, 2013](#)) and electric vehicles ([Graham-Rowe et al., 2012](#)) as well as the more mature market of CNG vehicles in Argentina ([Collantes and Melaina, 2011](#)).

The interviews centred on the following questions:

1. Can you tell me about the experience you have had with natural gas vehicles?
2. What is your opinion of natural gas vehicles?
3. What are the main barriers faced by you/your customers in adopting NGVs?
4. What could be done?
5. In your opinion how do natural gas vehicles compare to other alternative fuel vehicles?
6. Other comments

The most effective sampling approach for the first round of interviews proved to be through snowballing, utilising contacts made during the setting up of a small number of gas van vehicle trials in 2012. Following the coding and analysis of these initial interviews, this snowball sampling approach was coupled with a 'theoretical sampling' approach more akin to the grounded theory method specifically targeting respondents who were relevant to the developing line of enquiry. A total of fifteen one to one and two group interviews were conducted between September 2011 and October 2012. Interviewees included four gas vehicle manufacturer or dealership representatives, three drivers with experience of gas vehicles, six fleet operators with experience of gas vehicles and four refuelling equipment manufacturers and suppliers. The final participant in these interviews was a market analyst with experience of organising natural gas vehicle trials.

The majority of the interviews were recorded and later transcribed. Two early interviews were not recorded but rather annotated through detailed note taking by the interviewer. Following compilation of notes and transcriptions, an abbreviated form of grounded theory was used to analyse the interviews. Initial open coding was used to draw out concepts from the data. Selective coding was then employed to identify relationships between these initial concepts. Finally, constant comparative analysis was undertaken throughout data collection and across data sets until theoretical saturation was achieved. Triangulation across the data ensured accuracy. However, as a further means of verification once key themes had been identified these were incorporated into further interviews to test their validity. Each concept was then developed in the form of a detailed memo. These memos were then analysed collectively and make up the backbone of this paper.

In order to explore ways in which these barriers may be overcome and to situate this analysis within the wider debate regarding market success for new products, the themes identified are considered against [Cooper's \(1994\)](#) marketing theory of the factors which drive success in new products. These factors are:

1. Unique attributes and characteristics for the customer.
2. Good value for money for the customer.
3. Superior to competing products in terms of meeting customer needs.
4. Excellent relative product quality – relative to competitors' products and in terms of how the customer measures quality.
5. Superior price/performance characteristics for the customer relative to competitors' products.
6. Product benefits or attributes easily perceived as being useful by the customer.
7. Highly visible benefits which are very obvious to the customer.

Even though the managerial process behind new product development has been widely examined in the recent marketing literature (see for example [Land et al., 2012](#)) the factors above have remained an important reference point for practitioners since their publication. Few dimensions have been added, one being environmental performance ([Gotzsch, 2008](#)), which arguably is already included within the original seven factors.

Results

The open style required by the inductive approach meant that each interview was unique in its own right with participants free to digress onto additional areas of interest when appropriate. However, despite this disparity, the open

and selective coding exercises revealed a number of key themes recurring across respondents: carbon, infrastructure cost, capital vehicle cost, absence of residual value, withdrawal of congestion charge exemption, local air pollutants, payload and awareness. Additional barriers that emerged with less clarity were: vehicle availability and the size of the natural gas refuelling industry. The key themes are discussed in turn below with the use of illustrative quotes from the interviews coded by the role of the interviewee.

Carbon

CNG has a higher hydrogen to carbon ratio than petrol or diesel and thus produces less CO₂ per unit of energy. However, CNG vans on the market at present have engines based on a petrol engine and are typically less efficient than the equivalent diesel vehicle. Consequently any carbon savings over diesel are marginal at best.

“in terms of CO₂, diesel vehicles are so good these days that’s the problem at this end of the market for natural gas really that the competing fuel is diesel and if the measure is CO₂...then diesel is very good.”

(Gas refuelling specialist)

This could change with the introduction of bio-methane into the fuel mix as bio-methane from waste arguably produces a ‘negative carbon balance’ as emissions would have been released into the atmosphere anyway through decomposition (Dearnley, 2007).

“You’ve got to have an element of the bio in the fuel to make the carbon saving.”

(Gas refuelling specialist)

As a result some large organisations who have already switched to gas powered vehicles have done so by using 100% bio-methane rather than fossilised natural gas:

“People like Tesco, Coca-Cola are always going to want 100%.”

(Gas refuelling specialist)

Bio-methane supply is a niche market with only one UK company Gasrec providing bio-methane as a transportation fuel (to the best of our knowledge at the time of the interviews). Consequently, 100% bio-methane is simply not an option for all commercial vehicle operators. One solution is the blending of fossilised natural gas and bio-methane to generate a fuel which is both cost effective and offers carbon savings over diesel (Gas refuelling specialist).

“I think natural gas is going to be the enabler, it’ll be the catalyst towards bio-methane.”

(Gas refuelling specialist)

Cost

As expected cost emerged as a key incentive and barrier in five dimensions and these are discussed below.

Fuel cost

“It is the prime mover, cost.”

(Vehicle dealership)

“The underlining factor always comes down to budget and the bottom line.”

(Gas refuelling specialist)

“It was the costing, what they [X Council] could get the fuel at compared to what they were running with diesel...they were trying to save money.”

(Vehicle dealership)

Cost is a potential market driver through the savings which can be made in reduced fuel costs. Currently, natural gas is around half the price of diesel after tax (CNG-prices, 2013). However, this is dependent on Government maintaining the existing fuel duty differential. Thus, in terms of vehicle use, even with a less efficient engine, there is a significant cost saving to be made from using natural gas over diesel. However, there are four cost related barriers to market development which at present outweigh any operating cost savings in fuel: refuelling infrastructure costs, capital cost of the vehicles, lack of residual value and removal of exemption from the London Congestion Charge.

Refuelling infrastructure costs

The lack of a public refuelling network means that potential users also have to take on the costs of refuelling equipment through lease or purchase. Four models are examined below.

Depot based refuelling was historically, a common solution offered to fleets interested in transferring to natural gas as a vehicle fuel. Fleet operators invest in the refuelling infrastructure necessary to run the vehicles from the depot.

"Providing you are using the right amount of fuel and therefore you've got the right amount of vehicles then you can make the model [depot based refuelling] work in terms of putting in a piece of kit to refuel vehicles."

(Gas refuelling specialist)

"A decent compressor station, with storage, connected up is 150–200 thousand pounds."

(Gas refuelling specialist)

"I would say, 4–5 tonnes of fuel a week, that's the golden number typically...once you have hit that mark you can probably, fairly safely say you can justify having your own kit on the ground, okay..."

(Gas refuelling specialist)

Therefore, this model is limited to operations with: high mileage vehicles which return to base regularly enough to refuel and depots large enough to accommodate such stations. This was recognised:

"Obviously you see here in the city centre we are not ideally placed, we haven't got a yard or anything"

(Commercial van operator)

Furthermore, of those organisations suited to this model not all will be comfortable with the idea of housing refuelling equipment on site:

"I think firstly most fleets don't actually want to own and operate a gas station...they see that as quite an onerous thing to have on site."

(Gas refuelling specialist)

A depot based refuelling station is one solution to the refuelling void, but is suitable for a very small market segment albeit of large fleet operators. Consequently, alternative refuelling models have been developed including anchor stations, strategically located refuelling hubs and slow fill compressor stations.

Anchor stations are similar to depot based refuelling stations but open to third party access. Test beds for this model have developed among local authorities such as Leeds and Camden wanting to move their own fleets over to gas with the assistance of support from the Department for Transport's Alternative Fuels Infrastructure Grant Programme designed to support smaller vehicle infrastructure (DfT, 2009). The basic premise of this model is:

"You have a refuelling facility and the local borough council is the anchor/user if you like of the facility, so they commit to having a minimum number of vehicles. So you allow that facility to be used by public and private party third sector users. So all of a sudden this small van operator who has two vehicles, who wants to go out and do it, but the cost of having his own refuelling facility just doesn't make any sense. This enables him to at least have somewhere to refuel."

(Natural gas vehicle refuelling specialist)

This model was endorsed repeatedly at interview by refuelling specialists and commercial van operators alike. The test beds for this type of station seem to be showing some signs of success, Camden Council have a number of external users including two Mercedes Sprinters and a Volkswagen Caddy Ecofuel as well as their own gas vehicles (24 vans and one car) (Gas Vehicle Hub, 2013; Gasrec, 2013a). However, the anchor model is complex to install successfully requiring cooperation and coordination between multiple stakeholders. As one interviewee recalled in relation to a previous attempt:

"[Organisation A] didn't want their vehicles going to [organisation B's] site and [organisation B] didn't want their vehicles going to [organisation A's] site. So, there was a bit of a standoff and it never really got sorted."

(Gas refuelling specialist)

Allowing third party access onto commercial depots can be a complex task from the planning point of view and is not suited to all depots.

"They [large organisations] often have their busy depots anyway and they can't...they can't...you know they're not willing to consider having to make those depots open to third parties and let people onto a secure depot"

(Technical Specialist)

Although local authorities are arguably a more suitable base for such a model, this constraint may apply here too. Consequently, although this model has potential to open up the market to smaller operators on a local level and has seen some success in test applications, due to the various complexities involved it is likely to be time consuming and difficult to roll out nationally.

Strategically located refuelling hubs would be located where demand is expected to be strong. There are two approaches depending on whether the fuel is sourced from the grid or tanker. For natural gas extracted from the grid, dominant trucking routes for large operators of HGVs were mapped over the existing high pressure natural gas network by CNG Services. Where the two networks meet is a suitable place to install a grid connected refuelling point.

'If you look at the high pressure grid and if you look where that is and then if you look where our motorways are and you look where our distribution depots, obviously the motorways and distribution depots are next to each other and so is the high pressure grid line and we've got 6000 km of it and it's just luck, no one has ever thought of it, until we looked at it

last year, no one has ever thought of doing this, it's like obvious now.'

(Gas refuelling specialist)

These stations are primarily aimed at the HGV market where efficiency savings are greater but they also offer a knock-on effect refuelling solution for light duty vans:

"Where there is a CNG filling station for trucks, like the likes of [X], then you can do vans because you have covered the cost on the trucks and as long as you've got a dispenser that will do the van."

(Gas refuelling specialist)

The second approach is based on tanker delivery and so is not constrained in choice of location. Thus, a wider mapping exercise by Gasrec has taken place involving a number of major UK HGV fleet operators coming together to consult on where the need for refuelling would be greatest. As a result of this consultation Gasrec intend to build and manage seven refuelling hubs nationally to initiate this market:

"These stations, these FPF [future proof fuel] stations will be able to fuel between 400 and 500 vehicles a day if necessary...emmm...99% liquid, there will be some compressed product on site as well, but we see liquid as being the thrust of the operation...If there were small vans in that location who wanted to use it...no problem."

(Gas refuelling specialist)

These sites are being developed primarily motorway based HGVs and as such the seven locations are located near to major HGV routes, the first opened in Daventry in 2013 ([Gasrec, 2013b](#)). Smaller (NGV2) nozzles have been built into the station plans to accommodate vans. However, the locations of these stations will limit the target van market to those primarily operating on motorways which is a small proportion of the total market.

Slow fill compressor stations are single units capable to refuelling a vehicle from a standard gas connection over a period of up to 10 hours. The same principle as charging electric cars and vans from home using a cable connected to a domestic plug.

'there's some potential in the...slow fill unit,'

(Technical specialist)

A potential 5 year payback if used with a single vehicle with an annual mileage of around 11,000 (*ibid*). However, these stations still represent a notable capital outlay as compared to nothing to access diesel.

Vehicle purchase cost

The additional cost over a diesel equivalent vehicle ranges from around £1900 for the Volkswagen Caddy ([VW, 2012](#)) to £3410 for the larger Mercedes Sprinter ([Edwards, 2012](#)). Fleet managers have highlighted the higher purchase price as a disincentive to adopt natural gas vehicles (Commercial van operator). It has been suggested that as the cost of diesel increases and the European regulations for local air pollutants become more stringent, the subsequent investment in diesel vehicle development needed to meet these demands will narrow this capital cost gap (Vehicle manufacturer; Gas refuelling specialist). However, the most effective way of reducing the cost gap between natural gas and diesel vehicles is believed to be in production volumes:

'when you're doing 100,000 diesel engines and 1000 gas engines, the fact that the gas one ends up more expensive than the diesel one is probably inevitable.'

(Vehicle manufacturer)

However, a comparison of vehicle costs in the Italian market, which is more developed than the UK market with 1.83% of the vehicle parc running on gas ([NGVA, 2012a](#)), reveals a cost differential similar to that found in the UK today.

Residual value

The lack of a reliable residual value projection for gas powered vehicles has been identified as a secondary level inhibitor after infrastructure constraints and vehicle cost (Vehicle manufacturer; Commercial vehicle operator). Thus, despite [Nesbitt and Sperling's \(1998\)](#) evidence that fleets do not look at the whole-life costs of vehicles, it seems that for those involved in this research, residual value does impact on vehicle purchase. Perhaps because the process of entertaining a new option encourages consideration of the whole picture rather than the business as usual pattern. Given the current logistical limitations on refuelling the residual value of a vehicle is effectively zero.

Removal of London Congestion Charge exemption

Prior to 2010 natural gas and bio-methane vehicles were exempt from the London Congestion Charge. This exemption appears to have driven some growth in the market in areas close to the capital:

"it came about because of London essentially, people are always asking questions to find an alternative way of driving vehicles in London because of congestion charges, which is quite expensive."

(Vehicle Dealership)

Camden Council in West London invested in a natural gas refuelling station, designed to act as an anchor station for smaller operators in the area. However, in 2010 new admissions to the alternative fuel discount were stopped and the exemption criteria revised to a focus on CO₂ reduction, through the Greener Vehicles Discount (GVD) exempting vehicles which emitted less than 100 g/CO₂ per km and met Euro 5 standards and all electric and hybrid vehicles effectively removing the exemption for natural gas powered vehicles (Greencarsite, 2013). The GVD was in turn removed and from 1st July 2013 only Ultra Low Emission Vehicles meeting Euro 5 standards and emitting less than 75 g/CO₂ per km qualify for an exemption alongside a few specified plug in hybrids (TfL, 2013). Element Energy (2012) suggest that the value of this exemption at around £2000 per year for regular users could provide a tipping point in making electric vehicles as attractive as diesel as soon as 2020. It is not then surprising that removal seems to have had a significant effect on the gas market:

“Everything [gas vehicle sales] just collapsed because they weren't going to be congestion exempt.”

(Vehicle Dealership)

Local air pollutants

Although Euro standards have led to significant reductions in pollution from petrol and diesel vehicles, CNG retains a significant advantage with respect to local air pollutant emissions such as NOx, CO and PM emissions (Engerer and Horn, 2010; Park and Tak, 2012). The continuing failure to meet EU air quality limits on NO₂ particularly in urban areas has led to the European Commission launching legal proceedings against the UK in 2014 (European Commission, 2014), this follows earlier legal action on PM₁₀. However,

‘People don't seem to be that bothered about air quality.’

(Gas refuelling specialist)

An exception was Leeds City Council who have a legal requirement to reduce local air pollutants and thus rated this benefit as a primary factor in switching to gas (Council officer).

Awareness

Respondents from regional dealerships commented that not only is there a lack of awareness in the market place, but there is also a lack of awareness within some dealerships, with staff unaware of CNG versions of the diesel vehicles they sold (Commercial van operator; Vehicle dealership; Vehicle dealership):

“we've had other dealers in the network that aren't X order CNG vans by accident and we've had to end up taking them on because they don't know anything about it.”

(Vehicle dealership)

There appear to be a number of other factors contributing to the low profile of natural gas in the market.

“There is obviously a lot of financial support offered to electric/hybrid and so on and there is nothing to gas.”

(Gas refuelling specialist)

“A lot of people don't know that a CNG van is actually methane...you say I've got a CNG van and they say what LPG and you say no methane and it's natural gas and it's what you cook on at home.”

(Commercial van operator)

Payload

A further logistical problem identified by interviewees is the UK law regarding gross vehicle weights. Natural gas tanks are made from steel and are heavier than fuel tanks in diesel vehicles. Consequently, a gas van is typically one to two hundred kilos heavier than its diesel equivalent (Gas refuelling specialist) and therefore has a smaller available payload. Therefore CNG vans are less attractive to operators concerned with utilising the full weight limit:

“The other negative point would be pay load because of all the associated kit that needs to be fitted to it, you lose 300 kilos probably pay load?”

(Commercial van operator)

Some fleet managers have overcome this difficulty by choosing to move from 3.5 tonne vans to 7.5 tonnes so as to accommodate the full load of a diesel van (Gas refuelling specialist). However, this move can prove costly as firstly the larger vehicles are more expensive and, secondly, to drive anything over 3.5 tonnes requires an additional C1 driving licence if a driver passed the standard driving test on or after January 1st 1997 (DirectGov, 2012). For fleets with drivers without this qualification, switching to these larger vehicles can be a costly and time consuming exercise.

“Payload is an issue and it's still one which we keep lobbying on”

(Vehicle manufacturer)

Other issues

The main themes emerging from the analysis of the interviews have been discussed above. However two remaining issues, touched upon in the interviews, are mentioned here for completeness. The first is the limited choice of vehicles, essentially three van types from three different manufacturers, compared with a seemingly infinite range of diesel variants. The second relates to the fuel supply chain, which is at an early stage in development and dependent on a small number of relatively small companies and is perceived to lack reliability. A related issue is the lack of a mature competitive market for the supply of refuelling infrastructure and hence an uncertainty related to price and availability.

Opportunities and constraints

Within an industry built on the use of petrol and diesel for a variety of operations, breaking into the market in a substantial way is proving challenging for all alternatives. We now map the interview findings against [Cooper's \(1994\)](#) framework of product superiority, see [Table 1](#).

Clearly for the van market the barriers outweigh the growth incentives. This is particularly true with respect to value for money and visible and perceived benefits.

CNG vans available in the UK carry a price premium, here we consider how the lower operating costs might offset this. [Table 2](#) shows an operating cost comparison between the VW Caddy Ecofuel (CNG) and the equivalent diesel version based on manufacturer data.

In a small number of gas van trials in 2012 actual diesel consumption (in the trial companies existing vehicle) was found to be reasonably close to the manufacturer specification giving confidence in these estimates (unfortunately we were unable to accurately monitor CNG consumption in these trials). [Table 2](#) indicates that the initial additional cost of a CNG van would be recovered after about 27,000 miles. However, this assumes access to a public refuelling station. Given the lack of CNG refuelling points in the UK, any company wishing to use CNG vehicles would have to invest in or hire refuelling infrastructure. As mentioned in the Results section a refuelling station may require an investment of about £150,000 to £200,000, and a portable refuelling station about £100 per week to hire (personal communication, Tony King, the Hardstaff Group – 31.08.12) to which transport costs for refilling the station would be added. For small fleets this would clearly offset any fuel cost saving. Larger companies might invest in a station primarily for HGV operation, giving an option to run smaller vehicles as well. Some intervention is clearly required to enable the take up of CNG in this sector.

The 2012 Technology Strategy Board (TSB) low carbon truck competition involved a £23 million investment in the industry, including £2.4 million to support the provision of publicly accessible refuelling stations ([TSB, 2012](#)). This initiative is helping to provide a strategic network of gas refuelling stations, largely on the motorway network. Although aimed at HGV operators, this will be accessible to vans and will also help to raise awareness of the fuel amongst potential users through visibility. Further support for anchor stations in more urban locations might assist the market, unfortunately the scheme that provided part of the financial costs of the Leeds and Camden stations was discontinued in 2010 due to budget cuts ([CENEX, 2014](#)). There is clearly scope to revive this type of matching funding support, perhaps through a future TSB initiative.

Table 1
Interview themes mapped against [Cooper's \(1994\)](#) framework of product superiority.

| Cooper's (1994) seven areas of product superiority | Growth incentives | Barriers |
|---|--|--|
| 1. Unique attributes and characteristics for the customer | Lower cost of fuel Lower emissions of local air pollutants Potential use of bio-methane and thus lower CO ₂ | Fossil fuel natural gas CO ₂ emissions on a par with diesel |
| 2. Good value for money for the customer | Lower cost of fuel | Higher capital cost of vehicle Capital cost of refuelling station Low or no Residual value |
| 3. Superior to competing products in terms of meeting customer needs | Lower emissions of local air pollutants | Reduced payload Lack of refuelling infrastructure Limited choice of vehicle |
| 4. Excellent relative product quality – relative to competitors' products and in terms of how the customer measures quality | Reported as competitive with diesel in terms of performance | Lack of refuelling infrastructure |
| 5. Superior price/performance characteristics for the customer relative to competitors' products | Lower cost of fuel Lower emissions of local air pollutants | Higher capital cost of vehicle Capital cost of refuelling station Low or no residual value CO ₂ on a par with diesel |
| 6. Product benefits or attributes easily perceived as being useful by the customer | Lower cost of fuel | Local pollutants not always a priority Unawareness |
| 7. Highly visible benefits which are very obvious to the customer | | Complexity of case by case suitability No clarity on refuelling infrastructure costs |

Table 2

Comparison between VW Caddy diesel and VW Caddy Ecofuel.

| | Fuel cost per kg/l (£) | Miles per kg/l (combined drive cycle) | Fuel cost per mile (£) | Mileage necessary to recover premium price (£1900) |
|--------------------------|------------------------|--|------------------------|---|
| Volkswagen Caddy Ecofuel | 0.8 ^a | 10.90 ^c | 0.07 | 27,150 |
| Volkswagen Caddy diesel | 1.44 ^b | 10.18 ^c | 0.14 | |

^a Natural gas fuel costs are based on gas sale price data provided by The Hardstaff Group (personal communication, Tony King, 31.08.12).^b Based on the per litre cost of diesel (£1.44 per litre), the Automobile Association, May 2012.^c Sourced from Volkswagen, 2012.

The UK government has a number of initiatives to support electric and hybrid technology and is committed to continue to do so for the near future (DfT, 2013) but this has not yet boosted a significant development of the market for these vehicles (Rowney and Straw, 2013). Despite the barriers demonstrated in Table 1 CNG vehicles have a clear competitive advantage over electric vehicles in terms of range, relative purchase price and familiarity. Thus, the CNG market may not require quite so much of an investment, both private and public to get it moving. It is also useful to note that, should shale gas extraction develop at any scale in the UK, this would add an additional, albeit controversial, source for CNG, and strengthen fuel security arguments which might influence government policy.

Local intervention may also be effective. For example, the restoration of the London Congestion Charge exemption might enable other London Boroughs to develop anchor stations learning from and building upon the experience of Camden. An exemption would make the life cycle costs of a CNG van far more competitive to diesel and thus more attractive to any van user needing to access the charge zone. This would clearly assist with policies relating to air quality targets. Once the cost constraints start to ease allowing some growth, other related constraints such as residual values should also start to ease. Finally, another obvious area where low or no cost regulatory intervention could assist is in relaxing the payload limit for alternatively fuelled vehicles.

Conclusions

This paper examined the market for CNG vans in the UK through in-depth interviews identifying common themes limiting the development of this market. A number of barriers were identified, with the most important being the lack of refuelling facilities, however, opportunities were also identified, namely fuel costs as well as pollution reduction potential.

Maintaining the price differential between petrol/diesel and CNG at a level the literature suggests is required to develop the market will be critical. We have identified a number of additional relatively low cost policy interventions including; relaxing payload limits; part-funding of anchor stations and exemptions from local road user charging schemes. Such measures might together provide sufficient impetus to kickstart the market for CNG vans.

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