

# UKLPG Briefing Paper

## The future of LPG and its use as an automotive fuel over the next 35 years

April 2015

A briefing on the future use of Liquefied Petroleum Gas (LPG) in the wider transport context through to 2050: A low carbon automotive fuel for today and tomorrow.

This briefing document is based on *'Millbrook Evidence Report: The Future of LPG and its Use as an Automotive Fuel over the Next 35 Years'* (February 2015), commissioned by UKLPG and independently produced in February 2015 by Millbrook Proving Ground. All page numbers refer to the Millbrook Evidence Report, copies of which can be obtained from UKLPG on request.

The 2050 date was chosen as it reflects the timeframe being considered by the Automotive Council in its Energy & Fuels Road Map (launched 23<sup>rd</sup> March 2015); the Low CVP Infrastructure Road Map (launched April 2015) and the European Commission's Transport 2050 strategy to cut transport carbon emissions by 60% by 2050.

***"The research, backed by supporting evidence, clearly identifies the potential for a strong future for automotive LPG through to 2050. We're keen to work together with the automotive industry and policy makers to develop the future of low-carbon road transport in which automotive LPG plays a key role."***

Rob Shuttleworth, CEO, UKLPG

### Contents:

1. Introduction and context
2. Environmental returns
3. Powertrain opportunities
4. Supply and infrastructure
5. Long term support and policy
6. Conclusions and next steps

## 1. Introduction and Context

There are currently more than 144,000 LPG vehicles in the UK, served by a refuelling infrastructure of more than 1,400 points. There are also more than 2,000 private depots including LPG refuelling facilities for Non Road Mobile Machineries (NRMM) and it is estimated that 30% of all forklift trucks (FLT) in the UK run on LPG.

With a new political momentum building in road transport driven by the importance of Air Quality and affordability, UKLPG recently commissioned independent test facility, Millbrook Proving Ground, to undertake a comprehensive review of the European environment, evidence and literature in order to investigate the role LPG could play in the future of the transport sector through to 2050.

This research is a further step, following the launch of the industry's LPG Autogas Blueprint in January 2015, in providing the evidence base to position the role of automotive LPG in the transport and infrastructure road maps through to 2050 and beyond.

## 2. Environmental Returns

While it is clear that a continued investment in robust engine performance and emission testing data is needed for automotive LPG to further support its case, Millbrook's Evidence Report has demonstrated that there is a significant research base already in existence.

Using international reports from Atlantic Consulting and Element Energy, as well as information sourced directly from European authorities and the vehicle manufacturers themselves, Millbrook's engineers have reinforced the potential environmental returns from automotive LPG.

For example, the EU Fuel Quality Directive publishes carbon intensities of the current major fuels and notes that LPG has 23% reduced carbon intensity versus diesel and a 21% reduction versus petrol.

The evidence examined by Millbrook indicates that LPG may well be more favourable than many competing options, especially when a sustainable or 'bio' proportion is taken into account.

Greater recognition of the air quality benefits of automotive LPG is also crucial. These benefits were recently championed by environmental expert, Dr Eric Johnson of Atlantic Consulting. Referring to data from an independent German test facility, Johnson noted that compared with petrol and diesel, automotive LPG cars are lower carbon. Compared with diesel, LPG is lower on the pollutants that are harmful to human health.

### 3. Powertrain Opportunities

There is no doubt that the technological mix of vehicles on our roads will be markedly different in 2050 to what we see today. Indeed, the various energy, technology, fuel and infrastructure road maps available have set forth a vision in which internal combustion engines, electric propulsion (pure EV, fuel cells, hybrid or plug-in hybrids) and low carbon liquid and gaseous fuels will all have a role to play.

To produce the Evidence Report, Millbrook's engineers undertook a thorough review of existing OEM and aftermarket technology, as well as assessing the potential for automotive LPG to be used in hitherto unexplored powertrain combinations. Identifying that both plug-in hybrid and petrol market share should remain relatively strong through to 2050; the Millbrook Evidence Report has confirmed that this could give a good platform for LPG to make inroads either as a mono or dual fuel (*pg. 7, 11, 12, 23*).

- **Fuel cells:** Further research may yield an efficient method of producing hydrogen from LPG on-board vehicles. LPG's direct use in fuel cells could become an advantageous future substitute for pure hydrogen (*pg. 21/22*).
- **Plug in hybrids:** With appropriate development LPG could be used as the single fuel in such vehicles when a compatible IC engine is used, with similar advantages to its use in conventional petrol vehicles. Alternative types of APU (free piston engines, rotary engines, Stirling engines, etc.) are in the research and development phase, and some of these may also lend themselves to using LPG as the fuel (*pg. 23*).
- **Full hybrids:** LPG could also be used as the single fuel in such vehicle types (*pg. 24*).

- **Micro/Mild hybrid:** It does not generally require significant additional complexity or package space in the vehicle, and so LPG may be applied as a dual or single fuel.
- **Commercial and off-road fuel cell APUs:** This could be a potential area of exploitation for LPG to provide for such needs as high heat and power which could be a more efficient way than simply idling the IC engine (pg. 24, 25).
- **Commercial and off-road HGVs:** This represents an important potential opportunity for LPG provided compatible vehicles are available to the market place and the commercial considerations are favourable. A technology allowing LPG to penetrate the diesel market would be valuable
- **Buses:** They frequently operate within urban areas where air quality can be a very significant issue. This can give added impetus to adopt alternative powertrains for such vehicles. As LPG powered vehicles can be produced with very low levels of regulated emissions, this can be expected to result in an important advantage (pg. 12).

***“With appropriate development LPG could be used as a single fuel in plug-in hybrid vehicles when a compatible IC engine is used, with similar advantages to its use in conventional petrol vehicles... this could well be a fruitful area for investigation.”***

Millbrook Evidence Report (pg. 23)

#### **4. Supply and Infrastructure**

The Millbrook team has reinforced the importance of a strong distribution network and infrastructure, identifying that the number of existing LPG fuel stations in the UK is reported to be around 1,400. This is a substantial number, well in advance of other alternative fuels and enough to give ready access for the majority of drivers. The costs for extending this network further would be expected to be relatively modest (pg. 27).

In addition, the recent LowCVP Transport Infrastructure Road Map to 2050 (released after Millbrook’s engineers undertook their research), outlined a scenario in which 40,000 LPG conversions will be required per year until 2030.

Based on this modelling, the demand for petrol and diesel could decrease by 50 to 80% between now and 2050, while total LPG demand for transport could increase from 100 kt to c. 300 to 400 kt pa, especially if bio-propane/bio-LPG is produced at scale. This would also necessitate an increase in public refuelling infrastructure to 3,000 to 4,000 sites by 2050.

## 5. Long-term Support and Policy

While the various Automotive Council road maps (passenger car low carbon technology; power train technology; commercial and off-road technology; bus technology) suggest a significant shift away from conventional petrol/diesel vehicles to alternative propulsion based on electrification (batteries or hydrogen) by 2050, there is still a recognised space for sustainable liquid/gaseous fuels (pg. 25).

UKLPG continues to work with government, lobbying to ensure that LPG is considered and included in policy making decisions for the transport sector. This includes calling for parity for LPG in its fuel duty differential and its inclusion in the National Policy Frameworks revisions resulting from the Alternative Fuel Directive to name a few examples.

***“Existing solutions are in place which allow LPG to be used as either the primary or secondary fuel for virtually all types of vehicle. The market take-up of these solutions varies between sectors, but in principle there is no reason why much greater penetration cannot be achieved.”***

Millbrook Evidence Report (pg. 29)

## 6. Conclusions and Next Steps

Liquefied Petroleum Gas is an incredibly versatile, plentiful and clean fuel which deserves greater recognition for its air quality credentials.

Following the launch of the LPG Autogas Blueprint in January 2015 and the Millbrook Evidence Report of February 2015, UKLPG is calling for a number of steps to be taken in partnership with UK and European policymakers and the automotive industry.

- Overtly promote an integrated fuels strategy that sets out a framework for all fuels, including automotive LPG

- Implement a level playing field by setting the same duty rate for all gaseous fuels to achieve fuel parity in the UK
- Explore LPG applications in line with upcoming powertrains and the requirements of the OEMs
- Establish LPG/bio-propane as an integral player in the long term strategy for emissions reduction

***“As an incredibly versatile, plentiful and clean fuel, automotive LPG deserves far greater recognition for its air quality, low-carbon and cost effective benefits. Stronger collaboration across the automotive sector can help reduce harmful emissions, decrease fuel bills and make better use of the established infrastructure at the UK’s disposal.”***

Rob Shuttleworth, CEO, UKLPG