







Quantifying the emission saving potential of LPG in the UK fleet

For UKLPG

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Objective and summary of findings

Objective

- The objective of this analysis is to quantify the tailpipe emission savings of increased use of Liquefied Petroleum Gas (LPG) in the UK vehicle fleet in the 2030 time horizon.

Approach

- The emission saving potential has been evaluated by estimating the UK vehicle fleet, mileage and corresponding emissions of spark ignition internal combustion engine (SI ICE) cars by 2030, based on a vehicle stock and uptake model developed by Element Energy. The potential impact of LPG vehicles on UK emissions is based on assumptions of the penetration of LPG within the fleet of SI cars and empirical LPG vehicle performance data.

Findings

- By 2030, SI cars will be responsible for over 50% of the estimated 37 Mt TTW car emissions. **Converting 10% of medium to large SI cars to dual-fuel LPG would bring savings of 100kt CO_2.**
- The fleet of LPG cars (774,000) would require an expansion of the refuelling network but the **corresponding LPG use of 290 kt would fall well within the UK production capacity** that currently stands at 3,895 kt.

Estimating the potential emission savings of LPG vehicles requires an understanding of the future SI ICE car fleet mileage

LPG vehicles in the UK

- There are currently no series production LPG-fuelled vehicles on the UK market; vehicles are instead retrofitted after purchase to become dual-fuelled.
- Vehicles compatible for conversion are spark ignition internal combustion engines (SI ICE). There are currently 160,000 LPG vehicles on the UK's roads (ca. 70:30 split between cars and vans), served by a network of 1,436 refuelling stations.
- The fleet of SI vans is small, sales are very low and decreasing (<4,000 p.a.). This suggests that the SI passenger cars are the area of greatest potential for LPG.
- Estimating the potential emission savings of LPG thus requires an understanding of the future contribution of SI ICE cars to the UK fleet mileage and emissions.

Approach

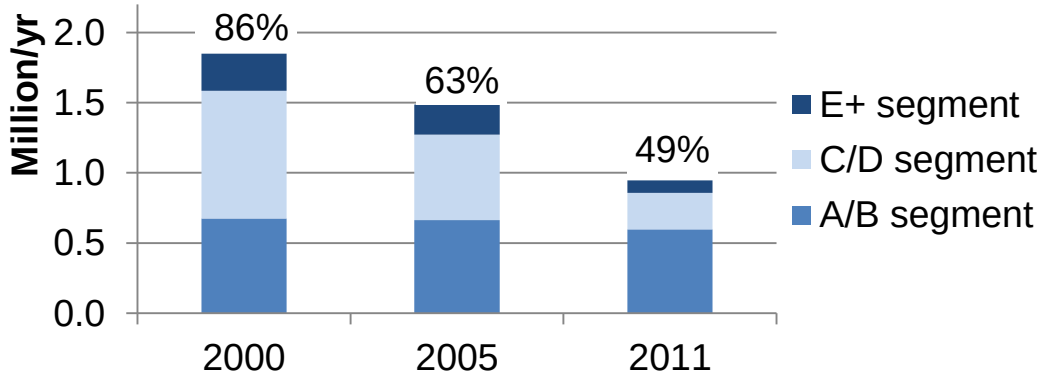
- The following slides detail the projected SI ICE UK car fleet, corresponding mileage and emissions based on the Element Energy vehicle stock and uptake model (originally developed for the Energy Technology Institute in 2011, extended for the Department of Transport in 2012, updated in 2013, currently in use by the DfT).
- The model assumptions are consistent with DfT projected travel trends and EU tailpipe emission regulations (95g/km in 2020, assuming a decrease to 70gkm in 2030) that drive an improvement in fuel efficiency.

Source for LPG vehicle and station numbers: UKLPG/Autogas

By 2030, spark ignition ICE powertrains are expected to represent circa 50% of the car fleet and drive 205 billion km

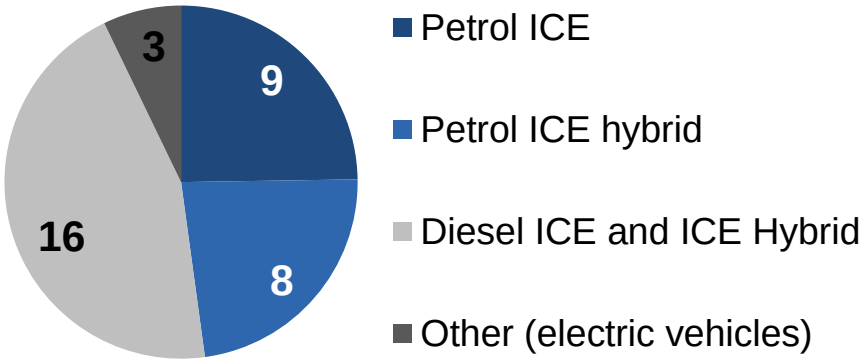
Annual sales of SI ICE cars in the UK and overall market share

Source: SMMT data



2030 UK car fleet composition, million

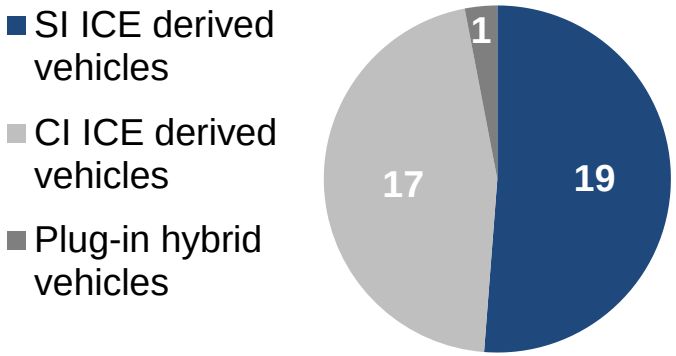
Based on Element Energy vehicle stock and uptake model



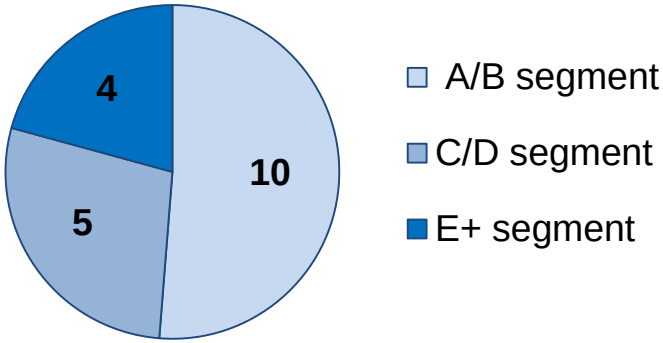
- Sales of petrol cars have been in decline over the last decade as diesel cars gained market share, especially in larger segments.
- The introduction of EURO VI standard from 2014 is however expected to stabilise the diesel/petrol sales split as emission control measures are more costly on diesel engines.
- The future stock of petrol cars (ICE and ICE-derived such as hybrid vehicles) is projected to drop from current c. 70% share to c.50% by 2030, to 17million.
- Based on DfT vehicle km projections and accounting for diesel cars' higher mileages, this petrol car fleet would drive ca. 205 billion km (c. 40% of total vehicle km) in 2030.

Converting 10% of medium to large SI ICE powertrains to bi-fuel LPG would save 100kt of CO_2 emissions in 2030 (TTW)

2030 UK car TTW emissions, Mt CO_2
Total = 37 Mt



TTW emissions from SI ICE derived vehicles, Mt CO_2
Total = 19 Mt



- SI ICE derived powertrains (ICE, HEV) are responsible for 19Mt TTW emissions by 2030, or 51% of total emissions. Converting **10% of the medium to large SI ICE derived powertrains** (C+ segment) to bi-fuel LPG would correspond to c.774,000 retrofits.
- Based on TTW savings of 11%[1], this **LPG vehicle fleet would save 0.1 Mt of CO_2** emissions in 2030.
- The corresponding LPG consumption, c. 290 kt per year, falls well within the UK LPG production capacity of 3,895 kt per year.
- The current distribution infrastructure would need to be expanded, with an additional 1,050 stations, assuming larger throughput (220,000 litres p.a. vs. current 110,000 litres p.a.), i.e. approximately doubling the current number of LPG stations in the UK.

Graphs: based on Element Energy vehicle stock and uptake model

1 – Based on Atlantic Consulting testing and measurement on 1,251 dual-fuelled LPG vehicles

APPENDIX – Acronyms and car segment definition

Acronyms

CI Compression Ignition
DfT Department for Transport
EU European Union
ICE Internal Combustion Engine
LPG Liquefied Petroleum Gas
SI Spark Ignition
SMMT Society of Motor Manufacturers and Traders
TTW Tank To Wheel

Car segmentation based on SMMT segments definition

Car segments (SMMT segments)	Typical characteristics	Assumption relevant for this analysis
A/B 'Small' (A and B)	From 2 door city cars to larger 2/4 doors, up to 1.4l engine. Length up to 3m.	Assumed not appropriate for LPG conversion due to low fuel consumption and lower mileage (making LPG payback lower) and small boot space.
C/D 'Medium' (C and D)	Saloon, from 1.3l to 2.8l engine. Length up to 4.5m.	Assume appropriate for LGP conversion – as per observed trends.
E+ 'Large' (E to I)	Includes executive, luxury and sport cars as well as dual and multipurpose vehicles. Variety of body shapes and lengths. Largest vehicles and engines.	