

# Transport Roadmaps

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**A guide to low carbon vehicle, energy  
and infrastructure roadmaps**

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Prepared by Low Carbon Vehicle Partnership

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## **INTRODUCTION**

The UK automotive sector has been revitalised during the last decade through the alignment of both private and public investment with the objective of cutting carbon.

This was only possible by collectively recognising the importance of cutting carbon and the role road transport could play in that objective, and clearly communicating how this will be achieved through a collection of 'roadmaps'.

This document provides signposts to the most important roadmaps that have helped inform the collective view.

## **PURPOSE OF A ROADMAP**

The technology roadmaps are a vital tool for directing investment, R&D and policy and are also a vital source of information for technology developers and investors in the automotive sector.

The importance of technology roadmapping is in highlighting how an objective is to be achieved. In the UK a number of roadmaps have been produced setting out the vehicle technologies, transport energy and infrastructure which will be required to deliver the decarbonisation of road transport by 2050.

The technology roadmaps are plans which match short-term and long-term goals with the specific technology solutions to help meet the goal of decarbonising road transport. These plans apply to a vehicle, energy and infrastructure products, processes, and emerging technologies, and how they will be deployed over time.

The development of these roadmaps has served three major purposes: To help reach a consensus about a set of needs and the technologies required to satisfy those needs; to provide a mechanism to help forecast technology developments; and to provide a framework to help plan and coordinate technology developments.

## WHO PRODUCES ROADMAPS?

A number of organisations have undertaken technology roadmaps in the road transport sector.

In September 2013, the Automotive Council published a set of roadmaps to illustrate the advances that will be made in automotive technology in the coming decades.

More recently, the Advanced Propulsion Centre has brought together a set of propulsion roadmaps, which incorporate key Automotive Council documents.

The LowCVP has also been instrumental in working with stakeholders to develop specific vehicle technology roadmaps including technology roadmaps for buses, but also in developing fuel and, most recently, infrastructure roadmaps. Key roadmaps are available from the following organisations.



**elementenergy**



## VEHICLE TECHNOLOGY

The Automotive Council has published 11 roadmaps to illustrate the advances that will be made in automotive technology in coming decades.

These were developed through the Automotive Council technology working group and sub groups and, in some instances, the Automotive Council adopted roadmaps developed by the LowCVP and Ricardo in their entirety.

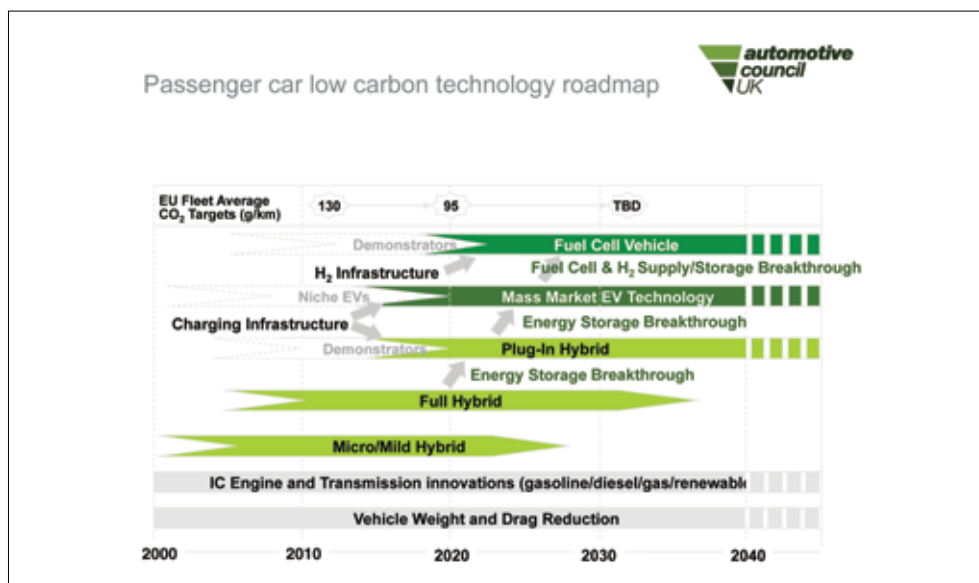
The roadmaps included four vehicle sector roadmaps:

- Passenger car low carbon technology
- Commercial and off-road technology
- Bus technology
- Motorsport technology

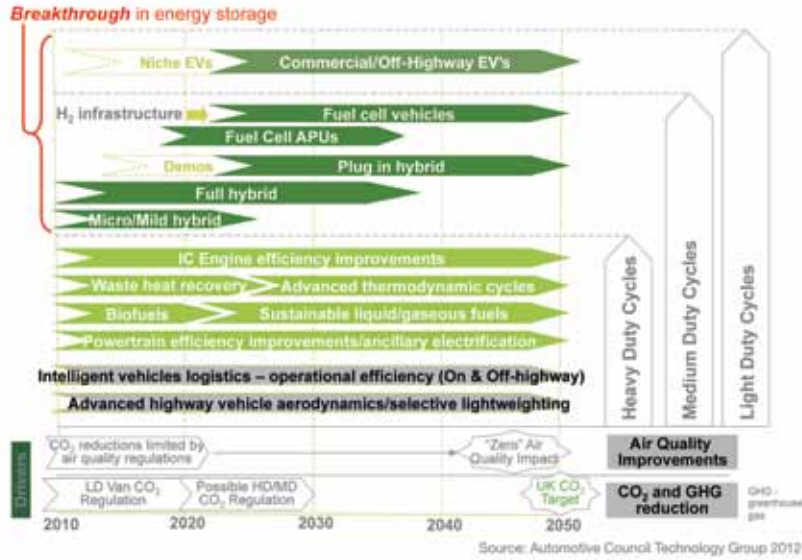
### Passenger Cars

Efficiency improvements, driven by EU level tailpipe emissions targets and air quality regulations, underpin the passenger car roadmap. Electric vehicles (PHEVs, BEVs and/or FCEVs) are expected to become a mainstream offer between 2020 and 2030 – assuming energy storage breakthroughs and adequate grid capacity. Development of these technologies is driven by the need to meet the long term UK CO2 targets.

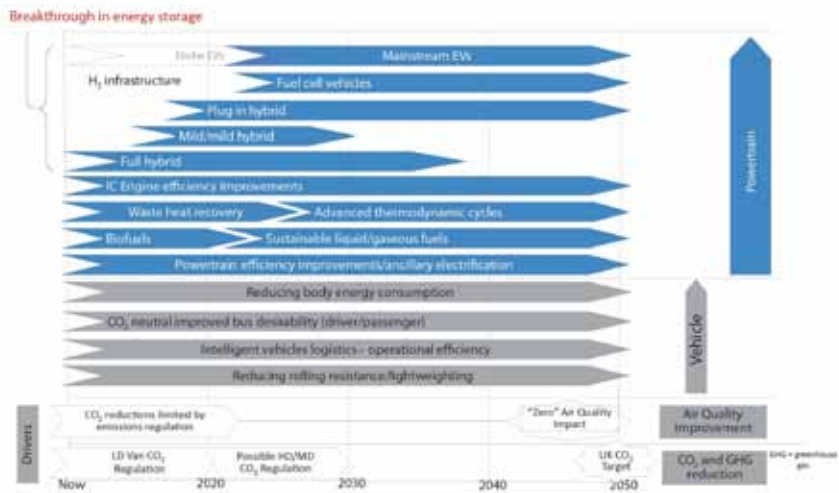
The EC transport goals are also expected to become a driver for Zero Emission Vehicles, e.g. CO2-free city logistics in major urban centres by 2030 and phasing out conventionally fuelled cars in cities by 2050.



# Commercial and off-road technology roadmap



# Bus technology roadmap



### **Trucks, Buses and Off Road Vehicles**

As with cars, efficiency gains are an essential part of the commercial vehicle roadmaps and the decade between 2020 and 2030 will see powertrains being increasingly hybridised, with full electric powertrains expected to be suitable for some duty cycles.

However, the roadmap does not include a cross-cutting liquid fuel strategy (e.g. type and blends of biofuels, diesel/gasoline balance), and there is no explicit roadmap for gas vehicles.

### **Motorsport**

Motorsport is also moving to adopt low carbon technologies and is likely to act as a proving ground for many technologies before their emergence in mainstream vehicles.

The main focus is on reducing losses from transmission, improved aerodynamics, improved energy recovery and the introduction of electric machines.

### **Other Key Technologies**

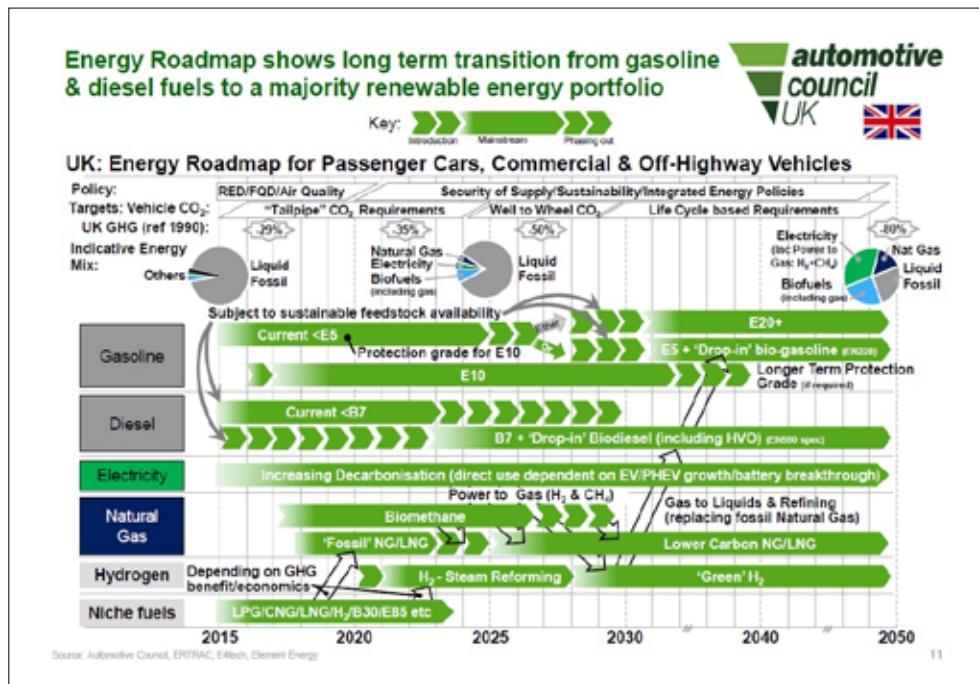
The Automotive Council has also published seven roadmaps focused on specific technology areas. These are:

- Lightweight vehicle and powertrain technology
- Powertrain (internal combustion engine) technology
- Power electric technology
- Traction motors and generation technology (<40kW)
- Traction motors and generation technology (>100kW)
- Energy storage and Echem technology
- Intelligent mobility technology

The vehicle technology roadmaps are available online from the Automotive Council and Advanced Propulsion Centre websites.

## TRANSPORT ENERGY

The LowCVP has developed a number of key reports and a roadmap focused specifically on transport energy in the UK. The Automotive Council developed a fuels roadmap based on this report as well as the views of its members and two notable reports which looked at transport energy at a European level, produced by European Road Transport Research Advisory Council (ERTRAC) and a consortium which commissioned a report by E4tech.



The Automotive Council fuels roadmap is available online from Ricardo's website.

### Road Transport Fuels for the UK

The LowCVP Fuels Roadmap highlights a number of key themes.

Electrification of vehicles is likely to become a mainstream offer in the decade from 2020, providing there are advances in electricity storage technology and assuming adequate grid capacity. This must be matched with reductions in the carbon intensity of the grid if transport is to make a contribution to long term carbon reduction goals.



Beyond 2020, the European Commission's transport goals are also expected to begin driving the volume introduction of Zero Emission Vehicles, potentially through CO<sub>2</sub>-free urban logistics and the phasing out of conventionally fuelled cars in cities before 2050.

In terms of commercial vehicles, efficiency gains will be an essential component of advances in the 2020–2030 timeframe with an increasing use of hybridised and some full electric (battery electric and fuel cell) powertrains for specific applications.

There is sufficient sustainable ethanol to enable vehicles to move to a higher blend than E10 gasoline. This also brings potential for further efficiency gains if vehicle engines are manufactured to take advantage of potential, higher octane levels from higher ethanol content.

Methane and biomethane will have a key role to play in road transport in the time horizon to 2030. This will require a robust strategy to ensure that the potential well-to-wheel emissions benefits are realised. The report also sees a role for LPG and the intriguing potential for bio-LPG.

### **Renewable Fuels 2020**

The LowCVP commissioned Element Energy to look at how the UK could meet the Renewable Energy Directive transport targets for 2020 as part of its fuels roadmap. Key conclusions and recommendations were:

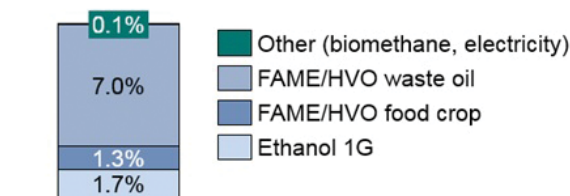
In order to comply with Renewable Energy Directive transport target, maximising the use of fuels which count double towards the target—used cooking oil (UCO), and fuels from other waste material, as a feedstock for B7 biodiesel will be needed and will reduce the risk of unintended consequences such as indirect land-use change (ILUC). However, this approach is not without its challenges; maximising the use of UCO and waste sources requires close scrutiny to ensure fuel quality and vehicle operability are maintained under all conditions.

The deployment of E10 petrol will also be required. The UK produces ethanol with a low ILUC risk and the investments in these production facilities should be supported. These facilities also provide a route to advanced fuels.

Vehicles powered by renewable electricity are unlikely to make sufficient inroads in the time available to meet the 2020 target even with multiple counting of the EV contribution. However, encouraging the deployment of electric and biomethane vehicles, together with the increasing range of niche options available is key to helping alleviate the risks of reliance on E10 and B7 to meet the target.

Encouraging the development and deployment of advanced and drop-in fuels as early as possible will also help alleviate short term reliance on E10 and B7 made from food crops. Advanced fuels include hydro treated vegetable oil (HVO), biomass to liquid (BTL) and ethanol made from waste or ligno-cellulosic material (E2G).

**Contribution to RED target in 2020 – E10&B7 case**



Source: Options and recommendations to meet the RED transport target. Element Energy, 2014

## TRANSPORT ENERGY INFRASTRUCTURE

The LowCVP commissioned Element Energy to produce a series of reports to look at how the UK can develop the necessary infrastructure to deliver the low carbon fuels of the future.

These studies are the ‘missing piece’, complementing the vehicle technology and transport energy roadmaps. The Infrastructure Roadmaps consist of a summary report and roadmaps for four different fuel streams: liquid fuels; methane; electricity and hydrogen.

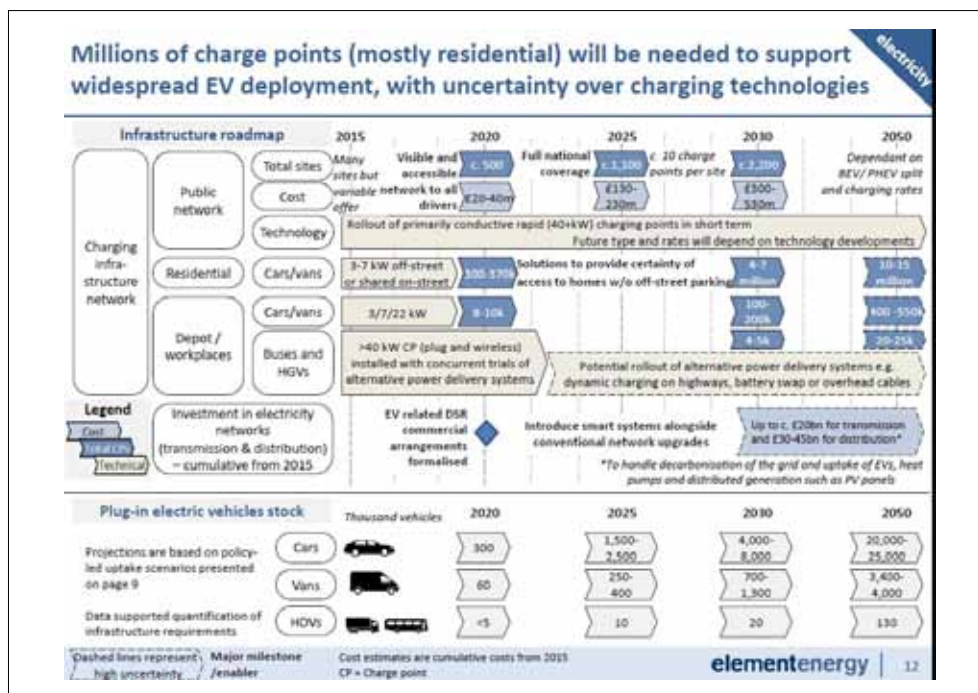
Key conclusions and recommendations from the reports include:

### Electricity

The existing electricity network, utilising smart technologies, is well suited to support the electrification of transport. However, growing electrification of (mainly) cars will present a peak demand but not a generation challenge.

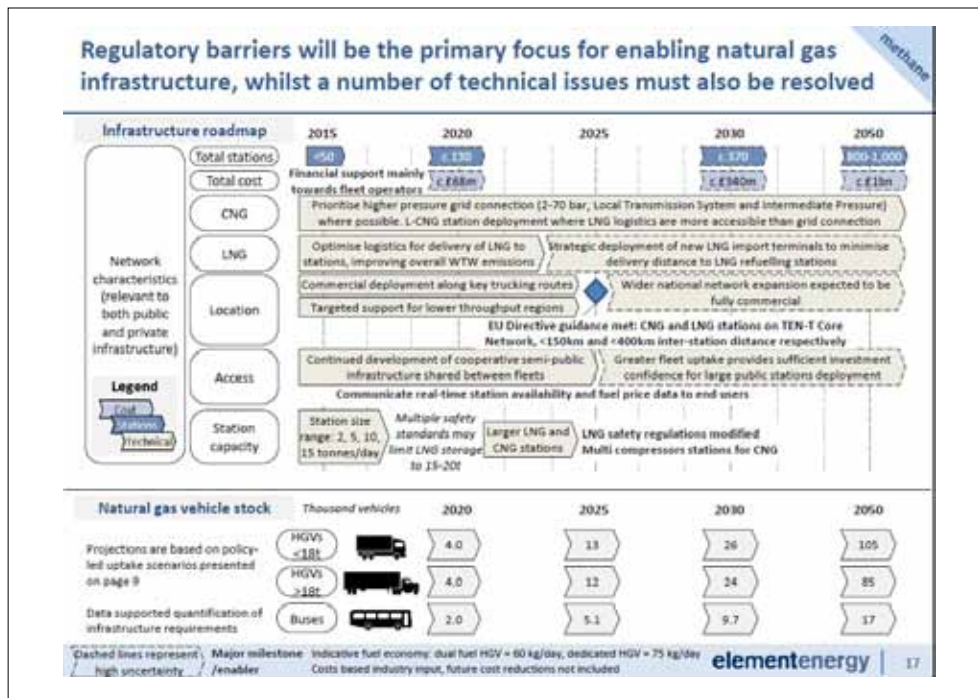
Millions of mainly residential charge points will be needed to support widespread EV deployment and that progress is constrained by uncertainty over future charging technologies.

A visible, accessible and reliable public charging network should be rolled out for light vehicles.



## Methane and Biomethane

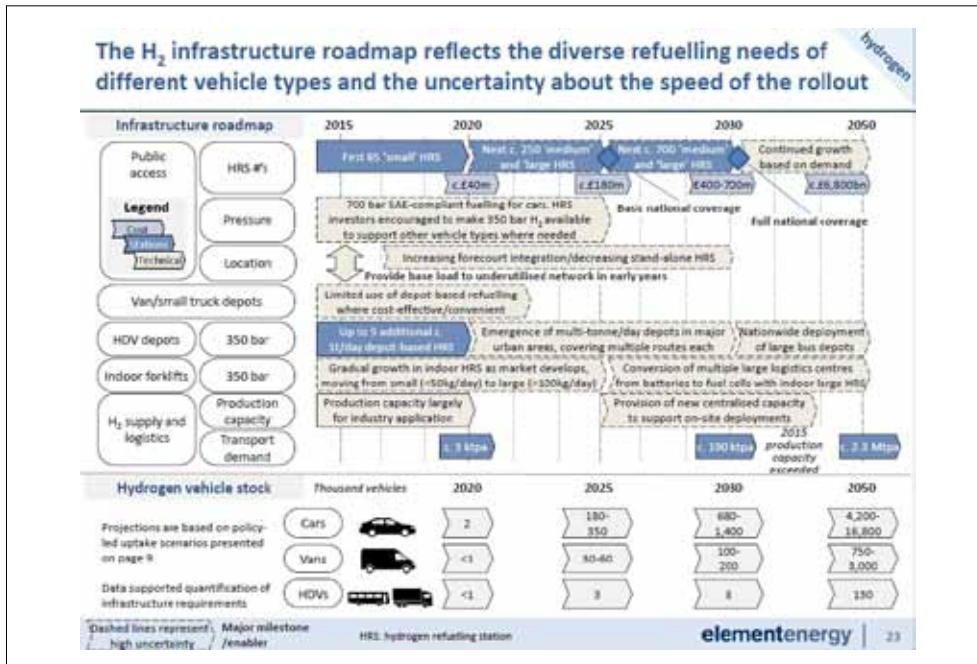
There are opportunities for heavy duty vehicles to use natural gas supported by mature refuelling technologies but that regulatory barriers need to be addressed. The UK, benefits from an extensive high pressure gas grid but the siting of refuelling stations needs to take account of well-to-tank emissions to deliver on targets to reduce carbon emissions.



## Hydrogen

The medium- and long-term potential for hydrogen as a vehicle fuel needs to be matched with a growing infrastructure. Initial infrastructure investments will require financial support from government, and local government can also play a key role in providing 'base load' by adopting hydrogen and fuel cell vehicles in public fleets.

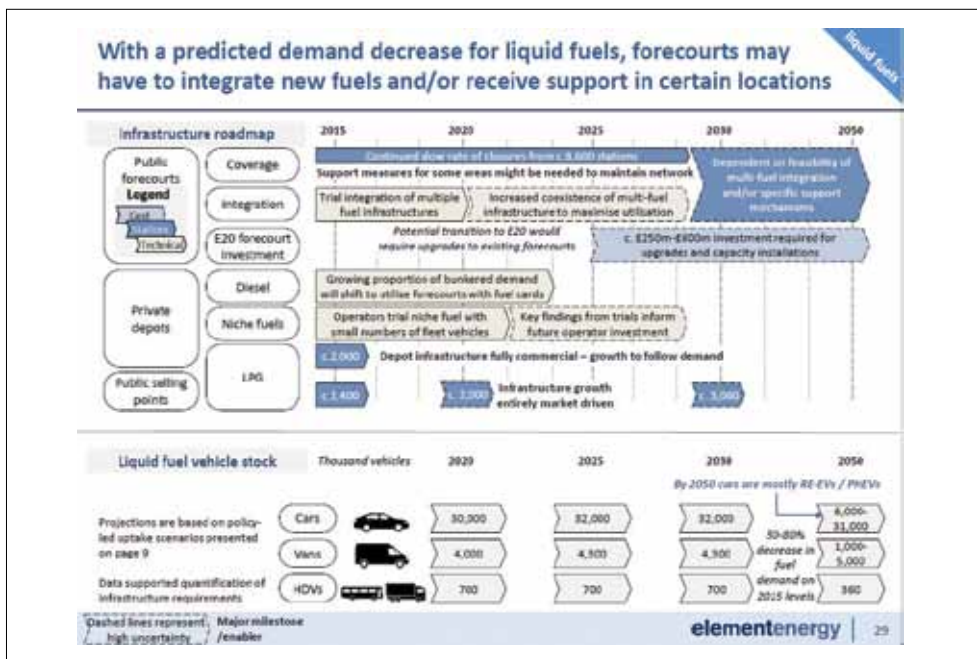
Hydrogen demand from a range of vehicle types, from passenger cars to commercial vehicles and buses, will be needed to sustain the infrastructure during this early phase. Beyond 2020, decreases in fuel cell vehicle costs and access to low cost, low carbon hydrogen is expected to allow a transition to profitable, private sector investments to build a UK-wide refuelling network and provide the same convenience to customers as petrol and diesel cars today.



## Liquid Fuels

The drive for more fuel efficient engines and the introduction of other road transport fuels will inevitably reduce demand for traditional liquid fuels. Post-2030 this will put pressure on the commercial viability of the existing forecourt network, particularly in rural locations.

There is potential for LPG and, in the longer term, for liquid air to contribute to decarbonisation and air quality improvement before 2050.



## MORE INFORMATION

For more information visit the following websites:

- Low Carbon Vehicle Partnership  
[www.lowcvp.org.uk](http://www.lowcvp.org.uk)



- Automotive Council  
[www.automotivecouncil.co.uk](http://www.automotivecouncil.co.uk)



- Advanced Propulsion Centre  
[www.apcuk.co.uk](http://www.apcuk.co.uk)



- European Road Transport Research Advisory Council (ERTRAC)  
[www.ertrac.org](http://www.ertrac.org)



- Element Energy  
[www.element-energy.co.uk](http://www.element-energy.co.uk)



- Ricardo  
[www.ricardo.com](http://www.ricardo.com)



- E4tech  
[www.e4tech.com](http://www.e4tech.com)





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