



## Transport for London: hydrogen bus project

### Bringing hydrogen to London's streets

Five state-of-the-art hydrogen fuel cell buses will operate on a busy London bus route; carrying passengers to their destination on a quiet and emission free journey around the capital.



## Summary

Air Products is working with Transport for London (TfL) to bring hydrogen technology to the roads of London. This project commits London to one of the largest fleets of hydrogen buses in Europe. TfL and the bus operator, First Group, will be using the latest in hydrogen production, transportation, storage, and vehicle fuelling technology.

The supply and production of hydrogen fuel and a dedicated fuelling station for five hydrogen fuel cell buses will be provided by Air Products. London will be the first to house the refuelling equipment within a standard bus depot.

## Background Facts

- Between December 2003 and January 2007 London took part in a trial of the first generation of zero-emission fuel cell buses aimed at reducing air pollution and noise in the city.
- Following the successful trial, TfL introduced a programme to deliver five hydrogen powered buses and a refuelling station to London by 2010.
- Air Products is the world leader in hydrogen infrastructure development and was chosen, after a competitive procurement process, to provide fuel and a dedicated fuelling station for the project.
- Air Products is number one worldwide producer of industrial hydrogen. It is the supplier to the largest number of fuelling stations in the UK and in the world, and over the last year, made the highest number of safe fuellings (over 100,000) worldwide.

## Project Objectives

**Climate change:** This project is motivated by TfL's desire to minimise CO<sub>2</sub> emissions from road transport in the city.

*London is committed to the ambitious target of reducing its carbon emissions by 60 per cent by 2025. Although hydrogen currently comes from fossil fuels, the “well to wheel” emissions are still considerably lower than for conventionally powered vehicles. Once the emissions caused by the hydrogen production are factored in, it is estimated that the hydrogen-powered buses will produce 50% less carbon dioxide than diesel buses. Moreover, high profile projects such as this one will help drive the large scale production of CO<sub>2</sub>-free hydrogen from solar, wind, hydroelectric and biomass sources, as customers and the public demand environmentally-friendly fuel and the cost of renewable power becomes more competitive.*

**Air quality:** The hydrogen buses will help London to reduce harmful emissions and improve air quality.

*The United Kingdom is subject to the highest levels of traffic fumes in any country in Europe and most of these fumes are focussed on cities.*

*Air pollution is linked to respiratory disease, strokes and lower life expectancy as well as more minor ailments like eye and lung irritation. Importantly, fuel cell buses give off no CO<sub>2</sub>, or other harmful gases and particulates, while they are operating. The only emission is water vapour. The introduction of fuel cell buses is an important step towards reducing harmful traffic fumes and meeting London's emission targets.*

**Better buses:** The buses will be quieter and smoother than their diesel powered predecessors, without compromising on range, refuelling time and performance.

*As well as cutting emissions, hydrogen buses make for a smoother and quieter ride for their passengers. The process of mixing hydrogen with oxygen in a fuel cell is silent; unlike the process of burning fuel inside an engine.*

## Project Specifics

### Hydrogen buses

The buses used will be state of the art hydrogen fuel cell buses. The fuel cell in a hydrogen bus works like a battery: energy is produced by the reaction in the fuel cell between hydrogen and oxygen. ISE will provide the buses, Ballard will supply the fuel cell and Wrightbus will manufacture the bus bodywork.

### Fuelling facilities

Air Products will install a bespoke refuelling facility, specifically designed for the needs of TfL, and will supply onsite fuel pumps, similar to those found on conventional fuel station forecourts.

The refuelling equipment and hydrogen storage will be owned and operated by

Air Products. Air Products will deliver hydrogen from its liquid hydrogen production plant in Rotterdam, using a specifically-designed vehicle, called a Hydra. The Hydra will be replenished on an as needed basis depending on usage.

Subject to planning permission, First Group's bus depot on Temple Mills Lane in Leyton will house the refuelling facilities; therefore, as with the normal fleet buses, all five hydrogen buses will be housed and refuelled there overnight.

### Route

The hydrogen powered buses will operate on the busy central London RV1 route, between Covent Garden and Tower Gateway.

## Liquid hydrogen

Liquid hydrogen provides the highest purity of hydrogen, which is important for maximising the life of the fuel cell. It comes from steam methane reforming and is liquefied at the Air Products facility in Rotterdam.

Air Products and TfL are working to evaluate and minimise emissions generated in hydrogen production and distribution and will continue to do this throughout the life of the project.

The process of producing hydrogen from natural gas and steam is currently the most reliable and cost effective method. This transition process will allow the industry to commercialise hydrogen use and more sustainable ways of producing economical hydrogen will emerge once mass deployment of vehicles is underway.

## Delivering the hydrogen supply

Air Products has developed a new delivery vehicle which allows for the safe transportation of the hydrogen as liquid before it is vaporised for high pressure on site storage.

The delivery vehicle converts the gas between different states and pressures and can supply medium or high pressure gas in addition to liquid hydrogen. This means that large quantities of hydrogen can be transported, thereby reducing distribution costs and minimising the equipment needed at the point of use. The Hydra therefore offers considerable cost advantages in hydrogen fuelling applications.

Air Products is guaranteeing supplies of hydrogen, avoiding any unplanned shortages at the refuelling facility.

## Hydrogen and climate change

Faced with the combined challenge of climate change and an over-reliance on imported oil and gas in the medium-long term, hydrogen is a genuinely environmentally-friendly alternative that is both abundant and renewable.

Unlike conventional carbon based fuels, hydrogen produces no harmful by-products. Only energy and clean water are produced when hydrogen is combined with oxygen in a fuel cell.

Of the potential alternatives to fossil fuels, including electric cars, only a fuel cell vehicle can give the same range, performance and refuelling time of a conventional vehicle.

## Hydrogen and safety

Hydrogen is as safe as traditional fuels when used with the proper safety controls. Air Products' fuelling facilities meet or exceed all European codes and standards. Safety features such as automatic shutdown with leak detection, fuelling by personal identification number (PIN) to permit access only by qualified users and complete Hazard and Operability Study (HAZOP) analysis are included in the fuelling facilities.

## Air Products

Air Products is proud to be at the forefront of developing hydrogen infrastructure in the UK. This kind of groundbreaking project is an important part of the wider effort to tackle some of the great challenges of our age: climate change, pollution and energy security.

For more information,  
please contact us at:

**European Headquarters**

Diana Raine

Air Products PLC

Hersham Place Technology Park

Molesey Road

Walton-on-Thames

Surrey KT12 4RZ

UK

T +44-1932-249378 (direct line)

T +44-1932-249200 (switchboard)



tell me more  
[airproducts.com](http://airproducts.com)