



CIVITAS

Cleaner and better transport in cities

RENAISSANCE

CASE STUDY



HYBRID BUS IS BETTER FOR BATH

CLEAN FUELS AND VEHICLES



The hybrid bus measure of the CIVITAS RENAISSANCE project was designed to demonstrate the feasibility of operation of a diesel electric hybrid bus alongside conventional diesel vehicles on a Park and Ride routes in Bath. From August 2010 until February 2012, an experimental Wrightbus hybrid electric vehicle (HEV) was used in passenger carrying service on the three Bath Park & Ride services as a substitute for one of the dedicated fleet of eight Volvo B7TL diesel vehicles. Diesel electric hybrid buses use a much smaller diesel engine than usual for a bus to charge batteries which then drive an electric motor to power the bus. The purpose of this system is to effect considerable reductions to the fuel used and the noxious emissions produced by the vehicle whilst maintaining its performance and flexibility of use to be comparable with a diesel vehicle.

MUNICIPAL PROFILE

LOCATION

Bath, United Kingdom

POPULATION

80,000

LAND AREA

29 km²

CIVITAS BUDGET

EUR 2,398,094

Municipal context

Located in the south west of England, the city of Bath has been a UNESCO World Heritage Site since 1987, and is famous for some of Europe's finest Roman remains and 18th century architecture.

The city is a major tourist attraction located in the valley of the River Avon. It was founded by the Romans in AD 63 around the only naturally occurring hot springs in the United Kingdom. During the Georgian era of the 18th century, the city became a popular spa resort, which led

to a major expansion and left a rich heritage of exemplary Georgian architecture crafted from Bath stone. Today, tourists are also attracted by a variety of theatres, museums and other cultural and sporting venues. Over one million overnight visitors and 3.8 million day visitors come to the city each year.

The impact of congestion is a key concern for the city. The contribution of heavy goods vehicles (HGV) traffic to poor air quality, noise, severance and damage to the fabric of historic buildings is disproportionate to the volume of HGV traffic.



BATH IN CIVITAS

Bath participated in CIVITAS RENAISSANCE. Under the motto of “Testing Innovative Strategies for Clean Urban Transport for historic European cities”, the project connects five cities that face mobility challenges through seasonal tourism: Perugia (Italy), Bath (UK), Gorna Oryhavitsa (Bulgaria), Szczecinek (Poland), and Skopje (Macedonia).

PROJECT INFORMATION

CIVITAS RENAISSANCE aims to demonstrate how the legacy of the renaissance can be preserved and developed through innovative and sustainable clean urban transport solutions. The project aims to test and develop a valuable, reliable and integrated package of mobility measures that will make historic cities cleaner and safer.

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Hybrid bus in service in Bath city centre

Introduction

The hybrid bus measure of the CIVITAS RENAISSANCE project was designed to demonstrate the feasibility of operation of a diesel electric hybrid bus alongside conventional diesel vehicles on a Park and Ride routes in Bath.

Hybrid diesel electric technology is emerging as a practical power option for local bus services, and vehicles of this type are now beginning to enter service in quantity in some parts of Europe.

The vehicle chosen for the trial is capable of operation in “zero emissions” or “EV” mode for a section of each journey, during which it operates on electric power alone. Such operation is currently unique in the EU. For this part of the operation, the airborne emissions from the vehicle are nil, thus making a contribution to the improvement of air quality of the city centre and particularly in the air quality management area therein.

Taking a closer look

From August 2010 until February 2012, an experimental Wrightbus HEV hybrid vehicle was used in passenger carrying service on the three Bath Park & Ride services as a substitute for one of the dedicated fleet of eight Volvo B7TL diesel vehicles. The Park & Ride services comprise three routes, one of which is very flat in nature and the

other two involve the climbing and descent of very steep hills. This afforded the opportunity to test the hybrid vehicle under a variety of operating conditions. Diesel electric hybrid buses use a much smaller diesel engine than usual for a bus (of the type used in a car or van) to charge batteries which then drive an electric motor to power the bus. The purpose of this system is to effect considerable reductions to the fuel used and the noxious emissions produced by the vehicle whilst maintaining its performance and flexibility of use to be comparable with a diesel vehicle.

The unique characteristic of the bus is its ability to operate in “zero emissions” or “EV” mode throughout the environmentally sensitive, historic city centre of Bath.

There are a great many areas in town and city centres where such operation is highly advantageous, in order to tackle air quality issues, and operation by battery powered buses brings problems of its own as they have limited range and performance abilities. A bus which is able to

operate a route in the same manner as a diesel, but then to turn off the diesel engine and use only electric power in the most sensitive areas, is a highly desirable technological solution. The next generation of hybrid bus is likely to be able to operate in this manner.

Results

The demonstration period was concluded successfully and it was proved that the vehicle was capable of use as a substitute for a conventional diesel vehicle.

The targets set by the project were met in part. These mainly focussed on reducing emissions and fuel use. They comprised targets to reduce emissions of oxides of nitrogen (target 90 percent; achieved 37 percent); to reduce emissions of carbon monoxide (target 80 percent; achieved 93 percent); to reduce the carbon footprint of the vehicle by reducing carbon dioxide emissions (target 40 percent; achieved 38 percent); and to reduce fuel consumption (target to

BACKGROUND INFORMATION

In Bath, the desire to preserve the historic fabric of the city is in conflict with the need to maintain its accessibility as a tourist destination. Solving problems of transport and access is of paramount importance and Bath and North East Somerset Council has implemented a network of Park & Ride sites to facilitate travel into the city centre using a fleet of Euro III double deck buses built in 2005.



reduce overall fuel use by 40 percent; achieved 28 percent). The other project targets were to reduce noise levels by comparison with a conventional diesel bus (achieved) and to achieve similar or lower operating costs to conventional diesel on the same operating duty cycle (achieved).

Fuel consumption of the hybrid bus showed a 28 percent reduction in fuel used compared with the diesel, this figure differing little on the flat and hilly routes on which it was deployed. Emissions of hydrocarbons, CO₂, CO, and NO_x were all significantly or substantially reduced. Particulate emissions were higher than the diesel vehicles but that is due to the hybrid not being fitted with a "CRT" particulate trap, which the diesel vehicles did have. Surveys of noise perception indicated that this was lower than the diesel vehicle, and when measured, the hybrid was found to produce approximately half the noise of the diesel when idling or accelerating.

Lessons learned

The incidence of failure of the hybrid bus was higher than that of the diesel, and its availability for service was relatively poor at 74 percent compared with the 95 percent of the diesel. If the hybrid bus was to be used more widely, this level of availability would be unsuitable and a benchmark level of 90 percent would need to be achieved. However, much of this unavailability was due to the prototypical nature of the vehicle and its use of non-standard components, which led to significant periods out of use whilst replacement parts were awaited. More recent hybrid buses which have benefitted from the development work undertaken in Bath and elsewhere are now able to offer a similar level of service availability to the diesel equivalents. In terms of the service performance of the hybrid, its ability to operate a full day of work on any of the Park & Ride services, this was considered to be as good as the diesel vehicles.

Overall, it was considered that operation of the diesel-electric hybrid was a success. Participation in CIVITAS has allowed the city to demonstrate that the technology has mainstream applications and has proven the claims of reduced emissions and low carbon technology. The vehicle proved to be popular with passengers, non-users,

operators and other stakeholders, but the case for incentivising public transport use by using "green" technology was not proven and the cost benefit analysis was not positive.

Upscaling and transferability

Use of hybrid buses has increased considerably over the project duration and the transport operator First already operates over 100, with more than 500 similar vehicles now in service in the UK. However, the Bath trial bus remains unique on the basis of its sustained zero emissions operation. The future availability of EV operation is somewhat compromised by the need to meet the ever more stringent Euro 6 (and beyond) engine emissions standards. It is in fact the act of re-starting the diesel engine which causes the most polluting event of its operation and this therefore needs to be minimised. However, there are clearly localised environmental benefits derived from both EV operation and elimination of unnecessary engine idling which would require the engine to be stopped and restarted. These actions also serve to improve fuel economy. It is considered worthwhile to conduct research into optimising the environmental benefits over a given route or duty cycle, for a variety of different means of powering vehicles, including the latest Euro standard diesel, diesel electric hybrid and diesel electric hybrid capable of EV operation, under a variety of scenarios including periods where the diesel engine is not running. This might in turn lead to different means of defining how a vehicle may meet the Euro emissions standards.

In Bath, the success of the hybrid demonstration project has led the Council to award a new Park & Ride contract to First in March 2012 on the basis of operating diesel electric hybrid buses, and a fleet of eight such vehicles has been ordered to fully convert operation of all Park & Ride services in Bath from diesel to hybrid from the autumn of 2012.

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