



Info-package 3

E-Buses & Charging Stations



Mobility



Introduction

In addition to the 45 e-buses that have been operating in Nottingham for the past 4 years, the introduction of 13 BYD e-buses to serve Nottingham's two bus park and ride sites, will help with the REMOURBAN funded charging infrastructure to support the city's Clean Air Zone ambitions. By working with local bus operators, we will deliver a Euro VI or better emission standard across the city bus network by 2020. This will dramatically reduce harmful emissions of Nitrous Oxide and Particulate Matter through a mix of electric, biogas, retrofitted and clean diesel buses.

In Tepebaşı demo site, 4 e-buses were purchased by Tepebaşı Municipality within the scope of the REMOURBAN Project. 2 portable charging devices were included with the e-bus procurement to charge the batteries. E-buses will provide clean, quiet transport and are therefore perfectly suited for busy city traffic: Their electrical drives will help protect the climate, lower harmful emissions, reduce noise levels in cities, and meet the European Union's strict air pollution standards. Tepebaşı Municipality has received the first Conformity Certificate from Turkish Standards Institution (TSI) for the e-bus in Turkey.

In Valladolid, 5 PHEV buses were purchased by the City Council, two of them with financing sources from REMOURBAN project, being allocated in the line 7 that covers an area of 6 kms from south to north of the city, crossing the city centre. Two pantographs were fully installed. The pure electric routes were about 67%, approximately 4.1km of the line route.

Description



Figures





Goals

- Cutting operating costs, improving air quality & reducing noise pollution are the project's main objectives.

	Nottingham	Tepebaşı	Valladolid
Start	Since 2012	Since 2016	Since 2016
Distance reached with E-Bus	1,609,344km	150,000 km	17,520,000 km
Fuel costs savings	£300,000	□ 250,000	30% fossil fuel
CO2 emission reduction	1,050 tonnes	105 tonnes	150,88 tonnes
Equivalent trees grown from seeding over 10 years	27,000	2,700	5,733

- The fuel cost savings of an electric bus when compared with a diesel bus, and including the 6 pence per km DfT Low Carbon Emission Bus Incentive Grant, are around 85 percent. There are further savings due to lower maintenance costs (around 40 percent) and no liability for vehicle excise duty. Analysis of operating figures indicates that, on average, the buses are travelling around 1 km per kilowatt hour of electricity consumed.
- The savings in fuel costs of using Nottingham's first 45 e-buses, instead of diesels has been around £300,000 pa. This has enabled bus services to be maintained in the face of severe cuts to Council resources over the past 5 years. It is expected a comparable level of savings will be able to be achieved from the 13 BYD buses and supporting infrastructure that were funded as part of the REMOURBAN Project.
- There are also the added benefits to local air quality provided by the vehicle's zero emissions drive-train, for Nottingham for example providing NOx savings of 15 tonnes and PM10 (the tiny particles which can enter the bloodstream, causing problems for heart health) reductions of at least 83kg, when compared with equivalent Euro 5 diesel buses.
- Considering the energy consumption and the system's efficiency, the actual performance of the buses and charging system can be proven to be reasonably comparable to and consistent with the theoretical one.
- Electric buses are to varying degrees, more expensive than conventional buses. The purchase price is considerably higher than for conventional buses whereas the operating costs are lower due to lower energy consumption and easier maintenance.
- Valladolid's buses can operate in three modes: hybrid mode (diesel-electric hybrid), partially full electric mode and fully electric mode. Testing and evaluating different options, and taking into account several variables and parameters (battery capacities, orography, etc) the technical team decided to implement a partially full electric mode as usual mode for these buses. Therefore, the bus enters automatically into full electric mode when it arrives to the city centre, covering 70% of the line in this mode (4 kilometres out of the 6 kilometres of the length of the line)





Progress

Valladolid operates 5 Plug-In Hybrid buses on route 7 with opportunity charging via pantograph on both termining. Line 7 was the first electrified commercial line in Spain. It covers 6 km of the city crossing the city centre from north to south.



The electric buses have proved to be very reliable with no significant mechanical / drive train problems experienced. Regenerative braking used whilst the vehicles are in operation is recovering in the region of 30-50% of battery energy, depending on individual driving styles and traffic conditions



An overall analysis of the buses has been carried out according to the ambient conditions, driver influence on the performance, vehicles' capabilities, profile of the route as well as the driving and battery conditions. E-bus recuperates up to 75% of its brake energy, which increases the bus's range significantly.



Lessons learnt

- 01** A good working relationship and after sales support with the vehicle manufacturer is important to ensure the success of an e-bus project
- 02** E-buses are as, if not more reliable than diesel buses on urban routes
- 03** Battery range of 250km is sufficient for urban bus operations
- 04** Electric buses deliver zero exhaust emissions and have the potential to offer solutions to the air quality challenges of urban mobility. Obvious advantages are lower noise levels and zero emission which make it natural to regard electric buses as the next step for inner city bus fleets.
- 05** Electric buses should be used where their advantage is most emphasized, such as on routes that allow them to cover distances long enough to exploit their low operating costs. Moreover, routes should limit the need for charging stations and the size of the battery pack.
- 06** Battery issues such as the range limitations and the recharging times of the battery packs, rule out the use of electric buses on an economic basis when they are compared with a diesel counterpart.
- 07** While transportation demand rises, the dependence on fossil fuels grows. Smooth, clean and quiet public electric buses are an attractive but also cost-efficient way to address the problem.





Produced for REMOURBAN by:

Owen Harvey
Nottingham City Council
Owen.Harvey@nottinghamcity.gov.uk

Murat Aksu
Tepebaşı Municipality
murat.aksu@tepebasi.bel.tr

Ángela Rivada
Valladolid City Council
arivada@ava.es



www.remourban.eu



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