Background Paper 4

Bus fares and ticketing, and environmentally friendly buses

1 Bus fares and ticketing

1.1 The bus fares and ticketing system has been modified extensively since 2000 to provide a more passenger focussed system. London's bus ticketing system now provides world leading value for money, features and passenger focus.

1.2 Improvements to ticketing for the over 60s and the disabled have seen the Freedom Pass extended to operate 24/7 and the new 60plus concession introduced by the Mayor. Over 60s and disabled passengers now account for nearly 15 per cent of bus users.

1.3 The offer of free travel for under 11s and for older children through the Zip Card means that London's concessions in this area are unparalleled in taking the burden of child fares away from hard pressed families. Young people travelling free now account for almost 20 per cent of bus users overall and for a third of use in the morning peak.

1.4 Fare paying bus passengers value simple ticketing, a fact consistently supported by market research. Simplifying rules and removing restrictions on tickets' use has been a continuing thread in bus fares development since 2000.

1.5 For example, Travelcard availability on buses has been simplified so that any Travelcard, whatever its zone designation, is valid right across the bus network. Nearly 25 per cent of bus passengers use Travelcards. The Bus Pass season range has also been simplified, with zonal restrictions and variants removed. Bus Pass season tickets account for 20 per cent of bus passengers.

1.6 Single fare payers have been gradually migrated from paying cash on the vehicle to pay as you go (PAYG), with cash use dropping from around 20 per cent in 2003/04 to around 1 per cent today. The migration to PAYG has revolutionised the quality of the bus service - reducing the time buses spend at stops to the benefit of all bus users and other road users.

1.7 Contactless payment is providing a new PAYG option which avoids the need to top-up at a ticket stop and eliminates the risk of running out of credit. It is currently planned that the bus service will go cash-free in summer 2014, saving current cash payers 95p a journey. The PAYG One Day Bus Cap also further reduces the cost of a return PAYG journey involving the use of two buses each way from £5.80 (£1.45 x 4) to £4.40.

1.8 The core ticketing priority is to roll out contactless ticketing to include the entire London public transport network and to support the full range of caps provided by Oyster today.

The Future Ticketing Project (FTP)

1.9 The Future Ticketing Project builds on the technology and customer benefits of Oyster and will eventually update the Oyster technology platform. FTP Phase 1 saw the acceptance of contactless payment cards (CPCs) on London's buses for PAYG single fare travel.

1.10 Since its launch in December 2012 over 10 million bus journeys have been made and over 550,000 unique cars have been used. Currently around 0.8 per cent of bus journeys are made with a CPC compared to around 1 per cent of bus journeys that are still paid by cash; with an average of over 44,000 journeys a day.

1.11 FTP Phase 2 will see the acceptance of CPCs on all TfL's public transport services for PAYG travel and will include both daily capping and a new Monday to Sunday cap. A staff and customer pilot is currently underway to test the new system and roll-out to the public will take place later this year.

1.12 FTP Phase 3, which is planned for 2015, will see season tickets associated with CPCs via an online application process, giving CPC users the same fares options as Oyster users.

1.13 FTP Phase 4 will launch 12/18 months after Phase 3, and will move Oyster onto the same new technology platform as CPC users. This will, for example, make the Monday to Sunday cap available to Oyster users.

1.14 From this point, Oyster and CPCs will run in parallel offering identical fares and caps.

Additional bus single fare features - one hour bus tickets

1.15 Around a third of bus PAYG users already have their fares reduced to some extent by daily capping. In addition, nearly 80 per cent of bus users hold passes of some kind and have completely free transfer as a result. This limits the potential benefit from a new, one hour ticket.

1.16 In 2013 there were 523 million bus PAYG journeys in total, which yielded revenue of £598 million. On an average day there were around 1.4 million bus PAYG journeys on around 840,000 cards as shown in the table below.

Daily journeys	Number of journeys (000s) and (%)	Percentage of journeys	Number of cards used (000s)	Percentage of cards
1	530	37	530	63
2	415	29	208	25
3	118	8	39	5
4	121	9	30	3
5 or more	249	17	36	4
Total	1,433	100	843	100

Table 1: PAYG bus journeys on an average day

1.17 Around 530,000 journeys (37 per cent) were on cards where only one bus journey was made that day, compared to 415,000 journeys (29 per cent) on cards where two bus journeys were made and 370,000 (26 per cent) on cards where four or more bus journeys were made.

1.18 Of the 415,000 daily journeys made on cards with two bus journeys on that day, 70,000 journeys (17 per cent) were started within an hour of each other. This suggests that around 35,000 people per day, or 4 per cent of all bus PAYG users, made either a single trip that involved two bus legs or a quick return trip.

1.19 Of the 121,000 journeys on cards with four bus journeys on that day, 45 per cent or 54,000 journeys are made on cards where the day's travel comprises two pairs of bus journeys that start within an hour of each other. This suggests that around 14,000 people per day, or 1.7 per cent of all PAYG bus users, made a return bus trip that involved two buses on both the outbound and return journeys.

1.20 Overall, this suggests that around 49,000 people, or fewer than 6 per cent of all PAYG bus users, would benefit if a 'one hour' transfer discount was provided.

1.21 Practical issues also limit the likely benefit. The Oyster system for buses is designed with the capability to allow one discounted bus transfer after an initial bus ride. The time interval between the first boarding and the second boarding can be set with the discount applied to the second boarding.

1.22 For example, two consecutive boardings taking place within 45 minutes could qualify for a discount, with the fare on the second ride set to be half the standard fare. There is no limit to the time interval or to the discount level that can be set. The second ride could be made free or charged at a reduced rate.

1.23 Limitations of the Oyster system mean that a one hour bus pass, enabling customers to make an unlimited number of rides in an hour, cannot be created within the current Oyster system.

1.24 A simple 'two rides for the price of one' bus transfer would deliver 80 to 90 per cent of the benefit of a one hour ticket. It would enable customers needing to use two buses to pay the single ride price. The cost would be up to £50 million a year. Any discount could be phased in; and offset by increases elsewhere. A half fare for the second ride in an hour could be a compromise or interim step.

1.25 For the change to be revenue neutral, other fares would need to go up to offset the revenue reductions due to the transfer offer. If spread across all bus tickets, the offsetting increase would need to be at least 5 per cent and, if confined to bus PAYG, 10 per cent.

1.26 Such a 10 per cent increase would not affect the 30 per cent of PAYG journeys already capped. Some 10 per cent of PAYG journeys would see a reduction of up to £1.45 while the remaining 60 per cent would see a 15p fare increase.

1.27 We will, however, look again at developments to the ticketing system once the Future Ticketing Project has been fully implemented.

Additional bus single fare features - early bird bus fare

1.28 TfL operated an early bird fare in 2004/05. It was not clear that this innovation achieved a great deal and its withdrawal attracted minimal adverse comment.

1.29 If a half-price early bird PAYG bus fare, like that applied previously before 7am, was introduced then the likely revenue loss would be about £7 million a year. Some 32,000 passengers a day would benefit from the discount. An increase in bus fares overall of up to 1 per cent would be needed to recoup a loss of £7 million a year.

1.30 It is unlikely that such a series of changes would produce significant net benefits and therefore no plans are in place to introduce an early bird bus fare in the near future.

Part-time workers

1.31 Over the last decade the growth of Oyster PAYG has provided many customers with a flexible alternative to season tickets. London is the only city across the world that offers daily capping, a feature of Oyster PAYG that makes it especially attractive.

1.32 Oyster PAYG and daily capping has been promoted recognising the needs of customers who use the transport system more flexibly than season ticket holders. Since the launch of PAYG, annual fares revisions have made PAYG steadily more attractive. The result of this has been a sharp growth in the use of PAYG.

1.33 In the light of this TfL is looking at new ways to meet the needs of part-time workers with a view to introducing a part-time Travelcard in 2015.

2 Environmentally friendly buses

2.1 London has one of the cleanest, lowest emission bus fleet of any major city in the world. This has been achieved through a number of measures:

- Europe's largest Hybrid Bus Programme - over 600 are now in service and 1700 are planned by 2016
- Development of the New Routemaster – the cleanest double deck hybrid in the world
- Retrofitting Selective Catalytic Reduction (SCR) technology to almost 1000 buses to reduce NOx emissions per bus by over 80 per cent
- Zero tailpipe emission hydrogen and electric buses
- Use of biodiesel made from used cooking oil

2.2 Every type of bus in service is tested over a simulated London route cycle at the Millbrook Proving Ground to assess the emissions performance. The test recreates the conditions of a Route 159 bus travelling from Brixton to Oxford Street with all the accompanying gear changes, calls at bus stops, acceleration, braking and waiting time at traffic lights. By testing vehicles in this way, emissions are measured in 'real world' operating conditions.

2.3 The fleet already meets a minimum of Euro 4 standard for particulate matter (PM) across the board as all Euro 2 and 3 vehicles have been retrofitted with Diesel Particulate Filters (DPFs) which remove up to 90 per cent of PM. The diesel particulate filter traps particulate which is then burned off into carbon dioxide (CO_2). As a result, PM emissions from the fleet have dropped from over 200 tonnes in 1997 to 17 tonnes in 2013.

2.4 As part of the DfT's Clean Air fund, 120 DPFs were retrofitted to newer Euro 4 and Euro 5 buses that were already fitted with exhaust after-treatment in order to lower PM emissions even further. These buses were focused on priority routes where PM emission concentrations were high and buses were a significant contributor in order to have the greatest environmental impact.

London Emissions Modelling

2.5 Kings College London has conducted emissions modelling for 2008, 2011 and 2015 for the Mayor's Air Quality Strategy (MAQS). This shows areas in London that are projected to exceed EU nitrogen dioxide (NO_2) objectives now and in future, and also indicates the major contributory impact of road-based public transport, including buses.

2.6 One of the outputs of this study has been the identification of 187 focus areas where there is greater exposure to NO_2 due to the presence of housing and pedestrians near to busy roads, and where sub-regional transport plans can play a pivotal role in improving air quality locally.

NOx Abatement Programme

2.7 The NO_x abatement programme sets out to achieve a 20 per cent cut in 5,500 tonnes of NO_x emitted by TfL's 8,700-bus fleet each year from 2016, compared to 2012 levels. The scale of this change has led to existing selective-catalytic reduction technology being re-designed and upgraded to achieve the depth of reductions required in NO_2 and NO_x. This now provides the UK with an ideal retrofit model for aggressive improvements to air quality in busy metropolitan areas served by large bus fleets.

2.8 While London's air quality is improving, it remains the poorest in the UK with levels of NO_2 too high and above EU limit values. The UK Government also requires action as failure to deliver an effective solution from a broad range of regional measures will put Britain at risk of fines of up to €300 million. NO_2 can exacerbate lung conditions such as asthma, particularly in children, older people and those with poor health. Significant intervention is needed to reduce exposure and improve Londoners' health.

2.9 TfL is overseeing a step change in the emissions profile of the fleet as part of the Mayor's Air Quality Strategy (MAQS) for London.

2.10 The NO_x reduction programme aims to bring the London fleet up to the Euro 4 engine emission standard for NO_x as well as PM by 2015.

2.11 The first half of the programme to March 2014 entails retrofitting 900 Euro 3 buses with selective catalytic reduction (SCR) equipment that achieves reductions in NO_x of up to 88 per cent in real-world conditions. The DfT and TfL have contributed £5m each towards a £10m programme which represents the most practical, immediate and cost-effective way to cut this pollutant.

2.12 The second half will involve the early replacement of the remaining Euro 3 buses with vehicles that are at least Euro 4 standard by the end of 2015. It would not make sense to retro-fit these as the benefits would be short lived and far less cost effective. These will be replaced ahead of their contract expiry dates, mainly with Euro 6 buses whose exhaust after-treatment systems are anticipated to deliver up to a 95 per cent reduction in NO_x compared to Euro 3 buses.

Hybrid Bus Programme

2.13 After a review of available fuels and technologies, a hybrid bus programme has been implemented in order to reduce the carbon footprint of the bus network and help achieve the Mayor's Climate Change Action Plan target of a 60 per cent reduction in London's CO_2 emissions by 2025. Hybrid buses were chosen as they offer the most cost effective means of CO_2 reduction, produce fewer NO_x emissions and are quieter than conventional diesel buses. Over 600 hybrid buses are now in service with 1700 planned to be on the road by 2016.

2.14 The hybrid buses are powered by a combination of a conventional diesel engine and electric motor. The hybrid driveline utilises regenerative braking to capture electrical energy during braking that would otherwise be wasted as heat. This energy is stored in a battery pack which is used to drive the electric motor. Capturing and utilising this energy means the buses use less fuel and so produce less CO_2.

2.15 Spurred by the hybrid programme, four major bus manufacturers have developed prototype vehicles and then moved rapidly toward mass production of the technology. No other public transport authority in Europe has announced such an ambitious hybrid bus programme and meeting the vehicle targets posed a considerable challenge for industry.

2.16 Emissions testing has shown a significant reduction in fleet average hybrid emissions compared to fleet average Euro 4 vehicles:

- 30 per cent reduction in CO_2
- 21 per cent reduction in NO_x

2.17 The New Routemaster, with second generation hybrid technology, demonstrates even more significant benefits:

- 47 per cent reduction in CO_2
- 78 per cent reduction in NO_x

Electric, Plug-in Hybrid Bus & Induction Charging Trial

2.18 Further electrification has the potential to deliver even more significant carbon savings and zero tailpipe emissions of PM and NOx. Trials of pure-electric vehicles have started which offer a complementary option to reduce emissions alongside hybrid buses. This is the first of a number of planned technology demonstration projects. Two ‘Build Your Dreams’ (BYD) single deck vehicles started service on routes 507 and 521 in December 2013. A further six single-deck pure electric vehicles are planned for route H98 in the first half of 2014.

2.19 TfL is also a partner in the Zero Emission Bus Systems Project (ZeEUS) consortium. As part of the project four range-extended diesel-electric hybrid double deck buses and associated wireless (induction) charging infrastructure will be trialled starting later in 2014.

2.20 The buses will be operated for a period of at least 12 months on route 69 and will be charged wirelessly at the beginning and end of the route. One of the aims is to operate the vehicle on electricity as much as possible; the battery system will be upgraded to theoretically provide all the energy needed to run each leg of the route. The demonstration of the buses will enable detailed evaluation of their performance to be carried out and an assessment made on the feasibility of further roll out.

Hydrogen Buses

2.21 Hydrogen buses also produce zero tailpipe emissions of PM and NO_x with only water being emitted. In January 2007 a three-year trial of three zero-emission hydrogen-powered fuel-cell buses was completed as part of a European project known as CUTE (Clean Urban Transport for Europe), part-funded by the European Commission.

2.22 Following on from the success of this, eight of the next generation fuel cell buses are being operated on Route RV1. The vehicles are boosted by the use of hybrid technology which enables the buses to go longer without refuelling. A brand new hydrogen refuelling station has been built at Lee Interchange. This station is the first of its kind in the UK to be housed in a standard bus depot alongside diesel vehicles. The entire RV1 route that operates from Tower Bridge to Covent Garden is now served by hydrogen buses. The buses operate like a typical diesel bus for 18 hours per day and 364 days per year so this programme has moved beyond being a trial of innovative technology.

2.23 The high cost of hydrogen buses is a major barrier to transport operators but TfL is actively working with a number of other cities around the world to bring forward the commercialisation of the buses by demonstrating to industry that there is a market for this technology. As a result, TfL formed the Hydrogen Bus Alliance in October 2006 which now has the co-operation of ten transport authorities worldwide.