Department for Transport

Technical Note (November 2011)

Concessionary Travel Reimbursement Guidance

Revisions to Marginal Operating Cost Estimate for 2012/13

Introduction

1. The Department for Transport (DfT) commissioned an extensive programme of research by the Institute for Transport Studies (ITS) on Concessionary Travel. The findings of their research were published in a report in 2010 which informed the publication of the DfT reimbursement guidance, published in November 2010, on reimbursing bus operators for carrying concessionary passengers for schemes commencing on or after 1st April 2011 (thereafter referred to as the 2011/12 reimbursement guidance).

2. The reimbursement guidance advised that bus operators should be reimbursed for any net additional costs that they have incurred as a result of the scheme. The reimbursement guidance suggested four categories of additional cost of which one category was marginal operating costs (MOC). Marginal operating costs are defined as the costs to a bus operator of carrying an additional passenger assuming a fixed level of service.

3. The reimbursement guidance recommended a value for marginal operating costs of 7.2 pence per generated concessionary journey (at 2009/10 prices). This figure was based on the ITS research report.

4. This note explains the changes to the recommended value for marginal operating cost in the reimbursement guidance that will apply for schemes commencing on or after 1st April 2012 (the 2012/13 guidance). The changes include a revision to the fuel cost element of the marginal operating cost to reflect the reduction in Bus Service Operator Grant (BSOG) in April 2012. The changes also include revisions to reflect some arithmetic miscalculations that were the basis of the recommended value of 7.2p in the 2011/12 reimbursement guidance[1].

[1] The contents of this technical note represents the considered views of the Department alone.

Fuel, Tyres and Oil

5. The marginal operating cost is composed of five categories of cost, one of which is the cost of fuel, tyres and oil. An additional passenger will increase the weight of the bus which will lead to an increase in the consumption of fuel and oil and an increase in the wear and tear of tyres. The 2011/12 reimbursement guidance recommended a fuel, tyres and oil cost per generated passenger of 1.6 pence (at 2009/10 prices), of which 1.5 pence relate to fuel only.

6. This figure is based on the bottom-up modelling approach to estimate the marginal operating cost as presented in the ITS research report. There are three issues with this estimated figure which have been identified:

- There is an arithmetic error in the calculation of this figure because in estimating this figure ITS have incorrectly applied the impact of an additional concessionary passenger on the rate of fuel consumption.
- There is an error in the price of diesel used in the calculation because it assumes that no fuel duty is applicable to diesel purchased by bus operators. Bus operators receive a fuel duty rebate in the form of BSOG which partly compensates them for the fuel duty element of the diesel price. Therefore the price of diesel that should be used should include the non-recoverable element of fuel duty. The price of diesel excluding fuel duty is estimated to be £0.364 per litre (in 2009). In 2009/10 the fuel duty rate was £0.5619 per litre and the BSOG rate was £0.4321. Therefore the price of diesel to be used is £0.494 per litre (at 2009/10 prices)[2].
- The average journey length that is used in the calculation is based on an assumed average trip length of 4.8 miles. This figure is based on a definition of trips that would include all stages of a journey from the point of origin to destination (and thus is likely to include other modes of transport and not just bus boarding length). Therefore the appropriate figure to use from the NTS is the average bus boarding length by over 60 years of age concessionary bus passholders in England (excluding London), which was estimated at 3.9 miles in 2009/10.

7. Taking into account these three revisions to the calculations mean that the fuel cost element of the marginal operating cost in the 2010/11 reimbursement guidance of 1.5 pence should have been 0.24 pence. The calculations for this estimate are presented in Annex A.

[2] Price of diesel per litre to bus operator = £0.364 + (£0.5619 - £0.4321) = £0.494

8. From April 2012 the BSOG rate is to be reduced by twenty per cent. There is a government commitment to revise the fuel cost element of the marginal operating cost to reflect that with a lower BSOG rate, the fuel cost per generated concessionary passenger faced by the bus operator will be higher. This revision to the fuel cost element of the marginal operating cost increases the fuel cost per generated concessionary passenger from 0.24 pence (at 2009/10 prices) to 0.3 pence (at 2009/10 prices).

9. The ITS research report recommended a nominal allowance of 0.1 pence per generated concessionary passenger to reflect tyre and oil costs. This therefore implies that the fuel, tyres and oil element of the marginal operating cost should be 0.4 pence per generated concessionary passenger (in the bottom-up approach to modelling marginal operating cost) and this has been revised in the 2012/13 reimbursement guidance.

Maintenance and Cleaning

10. Another category of the marginal operating cost is the maintenance and cleaning cost. An additional generated concessionary passenger is likely to increase the wear and tear on the bus interior and increase the amount of deposited dirt. The 2011/12 reimbursement guidance recommends that the maintenance and cleaning costs per generated passenger is 1.2 pence (at 2009/10 prices).

11. This figure is based on the bottom-up modelling approach to estimate the marginal operating cost as presented in the ITS research report. There are two issues with this estimated figure which have been identified:

- The average journey length used in the calculations is 4.8 miles and this should be 3.9 miles as discussed in the fuel, tyres and oil section of this note.
- The calculation of the estimated figure implies that this figure represents an average cost and not a marginal cost. The ITS research report suggests that there are likely to be strong economies of scale in repairing and cleaning the bus and therefore the cost elasticity with respect to passengers is likely to be greater then zero, but not much greater. They present a cost elasticity with respect to passengers of 0.0635 which needs to be applied to the average cost estimate to calculate a marginal cost estimate.

12. Taking into account these two revisions to the calculations means that the maintenance and cleaning element of the marginal operating cost in the 2010/11 reimbursement guidance of 1.2 pence should have been 0.1 pence per generated passenger (in the bottom-up approach to modelling

marginal operating cost). These calculations for this estimate are presented in Annex B.

Additional Time Costs

13. Additional time costs are another category of the marginal operating cost. An additional generated concessionary passenger is likely to increase boarding and alighting time and acceleration and deceleration time associated with additional stops. It will, however, also speed up boarding time for passengers previously purchasing tickets but who are now able to simply use their concessionary pass. The 2011/12 reimbursement guidance recommends that the additional time costs per generated passenger is 0.7 pence (at 2009/10 prices).

14. This figure is based on the bottom-up modelling approach to estimate the marginal operating cost as presented in the ITS research report. There are two issues with this estimated figure which have been identified:

- The reimbursement factor used in the calculation is inconsistent with that used elsewhere in the guidance because it is derived from an earlier version of the Single Demand Curve and not that presented in the final 2011/12 reimbursement guidance.
- The additional cost per vehicle hour figure is inconsistent with that used elsewhere in the guidance because it represents a figure presented in the ITS research paper (of £14.90) and not the figure used in the final 2011/12 reimbursement guidance (of £13.30).

15. Taking into account these two revisions to the calculations means that the additional time cost element of the marginal operating cost in the 2010/11 reimbursement guidance of 0.7 pence should have been 1.3 pence. The calculations for this estimate are presented in Annex C.

Marginal Operating Cost – 2012/13 Recommended Figure

16. The ITS research report presented two approaches to model the marginal operating cost – (i) a bottom-up approach and (ii) an econometric model approach[3].

17. The bottom-up approach estimated an operating cost of 6.7 pence per generated concessionary journey. Revisions to the components of the bottom-up estimate have been explained above and the revised bottom-up estimate is 5.0 pence (in 2009/10 prices). The econometric model

[3] The ITS research report also presented a third approach which was to review past claims and settlements for concessionary reimbursement. They concluded that the information from this approach was not sufficiently accurate to use with much confidence.

approach estimated an operating cost of 8.0 pence per generated concessionary journey.

Revisions to components of MOC bottom-up estimate, pence (2009/10 prices)		
Component	**Original value**	**Revised value**
Fuel, tyre and oil	1.6	0.4*
Of which fuel	*1.5*	*0.3***
Maintenance and cleaning	1.2	0.1
Insurance	2.7	2.7
Information	0.5	0.5
Time	0.7	1.3
Bottom-up estimate of MOC	**6.7**	**5.0*** **

Note: All figures rounded to 1 decimal place

* This figure is 0.3p when the revision to reflect a reduction in BSOG is excluded

** This figure is 0.2p when the revision to reflect a reduction in BSOG is excluded

*** This figure is 4.9 when the revision to reflect a reduction in BSOG is excluded

18. In making a recommendation for an overall MOC estimate, the ITS research team decided to use a weighted average of the estimates from these two approaches. This weighted average resulted in a recommended figure of 7.2 pence per generated concessionary journey which was used in the 2011/12 reimbursement guidance. Maintaining the same weightings but using the revised estimated figure of 5.0 pence for the bottom-up approach implies a recommended marginal operating cost figure for the 2012/13 reimbursement guidance of **6.1 pence per generated concessionary journey (at 2009/10 prices)**.

Annex A – Fuel Cost Calculation

A.1 In this annex we present the steps for calculating the fuel cost element of the marginal operating cost based on the bottom-up approach. These steps are taken from the Institute for Transport Studies (ITS) Research paper on Concessionary Travel. Footnotes are included to highlight the errors that have been identified in the ITS calculations and the corrections that have been made to calculate the recommended marginal operating cost figure for the 2012/13 reimbursement guidance[4].

A.2 The calculations are based on an average for England in the year 2009/10 and all figures are in 2009/10 prices. The source of the figures presented in this annex can be found in the Institute for Transport Research Paper on Concessionary Travel published in 2010.

Step 1: Diesel Price per Litre

- The price of diesel per litre is £0.364 excluding tax and duty
- The fuel duty rate per litre is £0.5619
- The BSOG rate per litre is £0.4321
- Therefore the purchase price of diesel per litre for a bus operator on average is £0.364 + £0.5619 - £0.4321 = £0.494[5].

Step 2: Reduction in BSOG

- The BSOG rate is reduced by 20% → £0.4321*(1-20%) = £0.3457
- Therefore the purchase price of diesel per litre is £0.364 + £0.5619 - £0.3457 = £0.580

Step 3: Diesel Price per Gallon

- 1 gallon = 4.5461 litres
- Therefore the purchase price of diesel per gallon is £0.580*4.546 = £2.638
- Step 4: Fuel Efficiency
- 15 passengers per tonne → weight per passenger per tonne = 1/15
- Fuel efficiency = 3km per litre

[4] The 2012/13 reimbursement guidance refers to the reimbursement guidance that applies to schemes commencing on or after 1st April 2012.
[5] The price of diesel per litre used in the calculation of the ITS figure presented in the 2011/12 reimbursement guidance is £0.364 (rather then the correct figure of £0.494)

- 1km = 0.621 miles
- Fuel efficiency in miles per litre = 3*0.621 = 1.8641
- Fuel efficiency in miles per gallon = 1.8641*4.5461 = 8.4744

Step 5: Fuel Efficiency with additional passenger

- 15 passengers per tonne → weight per passenger per tonne = 1/15
- Impact of additional passenger tonne on fuel efficiency = -0.3 miles per gallon
- Fuel efficiency = 3km per litre
- 1km = 0.621 miles
- Fuel efficiency in miles per litre = 3*0.621 = 1.8641
- Fuel efficiency in miles per gallon = (1.8641*4.546) + (1/15*-0.3) = 8.4544

Step 6: Fuel Cost per vehicle with and without additional passenger

- Journey length = 3.9 miles[6]
- Fuel Cost per vehicle = 3.9*(1/8.4744)* £2.638 = £1.2139
- Fuel Cost per vehicle with additional passenger = 3.9*(1/8.4544)* £2.638 = £1.2168[7]

Step 7: Fuel Cost per generated passenger

- Fuel cost per generated passenger = £1.2168 - £1.2139 = £0.0029, which equates to 0.29 pence

[6] The journey length estimate used in the calculation of the ITS figure presented in the reimbursement guidance for 2011/12 is 4.8 mile (rather the correct figure of 3.9 miles)

[7] The ITS calculation for this step is to multiply journey length by (1-0.02)/8.474, where the 0.02 is the weight per person per tonne (1/15) multiplied by impact of additional passenger tonne on fuel efficiency (-0.3). The calculation should have been to multiply mean journey length by 1/(8.474-0.02).

Annex B – Maintenance and Cleaning Cost Calculation

B.1 In this annex we present the steps for calculating the maintenance and cleaning cost element of the marginal operating costs based on the bottom-up approach. These steps are taken from the Institute for Transport Studies (ITS) Research paper on Concessionary Travel. Footnotes are included to highlight the errors that have been identified in the ITS calculations and the corrections that have been made to calculate the recommended marginal operating cost figure for the 2012/13 reimbursement guidance[8].

B.2 The calculations are based on an average for England in the year 2009/-10 and all figures are in 2009/10 prices. The source of the figures presented in this annex can be found in the Institute for Transport Research Paper on Concessionary Travel published in 2010.

Step 1: Maintenance & Cleaning Cost per vehicle mile

- Maintenance and cleaning vehicle cost per km = £0.015
- 1km = 0.621371 miles
- Maintenance and cleaning vehicle cost per mile = £0.015 / 0.621371 = £0.024

Step 2: Maintenance & Cleaning Cost per passenger

- Mean journey length = 3.9 miles[9]
- Mean Occupancy = 10
- Maintenance and cleaning cost per passenger = (£0.024*3.9)/10 = £0.009

Step 3: Maintenance & Cleaning Cost per generated passenger

- Cost elasticity with respect to passengers = 0.0635
- Maintenance and cleaning cost per generated passenger = £0.009*0.0635 = £0.0006, which equates to 0.1 pence[10,11]

[8] The 2012/13 reimbursement guidance refers to the reimbursement guidance that applies to schemes commencing on or after 1st April 2012.
[9] The journey length estimate used in the calculation of the figure presented in the 2011/12 reimbursement guidance is 4.8 mile (rather the correct figure of 3.9 miles)
[10] The calculation to convert from average costs to marginal costs was not included in the steps carried out to estimate the ITS figure presented in the 2011/12 reimbursement guidance

Annex C – Additional Time Cost Calculation

C.1 In this annex we present the steps for calculating the additional time cost element of the marginal operating costs based on the bottom-up approach. These steps are taken from the Institute for Transport Studies (ITS) Research paper on Concessionary Travel. Footnotes are included to highlight the errors that have been identified in the ITS calculations and the corrections that have been made to calculate the recommended marginal operating cost figure for the 2012/13 reimbursement guidance[12].

C.2 The calculations are based on an average for England in the year 2009/10 and all figures are in 2009/10 prices. The source of the figures presented in this annex can be found in the Institute for Transport Research Paper on Concessionary Travel published in 2010.

Step 1: Passholder Boarding and Alighting Time

- Passholder Boarding time = 3.9sec
- Passholder Alighting time = 2.4sec
- Proportion of boarding and alighting that take place simultaneously = 40%
- Additional time for acceleration / deceleration associated with more stopping = 5%
- Passholder boarding and alighting time = ((3.9+2.4)-(2.4*40%))*(1+5%) = 5.6sec

Step 2: Reimbursement Factor

- Nominal fare increase in National Bus Index (2005-06 to 2009-10) = 18.5% for PTE areas and 17.1% for non-PTE areas
- Reimbursement Factor (using the 2012-13 reimbursement guidance version of calculator) = 49.9% for PTE area and 42.4% for non-PTE areas
- PSV survey shows in 2009/10 that 284 million journeys made in PTE areas and 440 million in non-PTE areas

[11] Cost Elasticity = (∂Cost/∂Passenger)*(Passenger/Cost) where (∂Cost/∂Passenger) is defined as Marginal Cost and (Passenger/Cost) as (1/Average Cost) → Cost Elasticity = MC*(1/AC) which means MC = Cost Elasticity*Average Cost (AC) = 0.0635*£0.009 = £0.0006

[12] The 2012/13 reimbursement guidance refers to the reimbursement guidance that applies to schemes commencing on or after 1st April 2012.

- Weighted reimbursement factor (RF) = 49.9%*(284/724)+42.4%*(440/724) = 45%[13]

Step 3: Timesaving for non-generated passenger for every generated passenger

- Fare paying boarding time = 6.5sec
- Time saving per non-generated concessionary passenger = 6.5 – 3.9 = 2.6sec
- Time saving per non-generated concessionary passenger for every generated passenger = (RF/(1-RF))*2.6 = 2.2

Step 4: Net Boarding and Alighting

- Net boarding and alighting effect per generated concessionary passenger = 5.6 – 2.2 = 3.5

Step 5: Additional Time Cost

- Additional cost per vehicle hour = £13.30[14]
- Additional cost per vehicle seconds = £13.30/(60*60)=£0.0037
- Additional cost time per generated passenger = £0.0037*3.5 = £0.013, which equates to 1.3 pence

[13] The reimbursement factor used in the calculation of the ITS figure presented in the 2011/12 reimbursement guidance is 40% (rather then the 45%)
[14] The additional cost per hour figure used in the calculation of the ITS figure presented in the reimbursement guidance for 2011/12 is £14.90 (rather then the £13.30)

References

Department for Transport (2010) “Concessionary travel for older and disabled people: guidance on reimbursing bus operators (England)"

This document reference is to the Department for Transports Reimbursement Guidance published in November 2010 which applies to schemes commencing on or after 1st April 2011. Revised 2012/13 guidance, published in November 2011, applies to schemes commencing on or after 1st April 2012.

Dargay, J., Lui, Ronghui., Mackie, P., Nelthorp, J., Shires, J., Smith, A., Toner, J. and Wheat, P (2010) “Concessionary Travel – the Research Papers” Institute for Transport Studies, University if Leeds

This document reference is to the report published in 2010 by the Institute for Transport Studies (ITS) which informed the publication of the Department for Transport reimbursement guidance. This includes the recommended value for the vehicle mile unit cost (element of the marginal capacity cost model) used in the 2011/12 reimbursement guidance. These figures can be found in Chapter 10 of the ITS report (Costs).