Aberdeen Rapid Transit

Detailed Options Appraisal

Technical Note G – Economic Assessment

On behalf of:

nestrans

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1 Introduction

1.1.1 To provide quantitative analysis to the economy criteria appraisal, the monetised economic impacts of the options have been estimated for road traffic and public transport and are presented in this section. This was undertaken using the Departments for Transport's (DfT) TUBA (Transport User Benefit Appraisal) software to generate Travel Economic Efficiency (TEE) benefits and, when combined with scheme costs, to provide an indication of the benefit to cost ratio (BCR) for each option.

1.1.2 The TEE analysis focusses mainly on travel time benefits and, as such, the reallocation of road space is only ever going to create significant disbenefits for general traffic when measured using this criterion. To aid understanding of the economic impacts, while an overall BCR figure is presented for each option encompassing the general traffic and public transport benefits and costs, to highlight the specific benefit to buses a purely public transport based BCR is also presented, derived using only the public transport benefits and the infrastructure costs proposed under each option.

2 Transport Economic Efficiency (TEE)

2.1 Approach

2.1.1 Economic appraisal of the road and public transport impacts have been analysed using the Departments for Transport's TUBA (Transport User Benefit Appraisal) version 1.9.17 software with the latest TAG Databook V1.19.0. This reflects the latest TAG data book from May 2022.

2.1.2 Journey time, trip volume and distance skim matrices from ASAM19 have been provided for road and public transport. Additional analysis was undertaken to derive Reference Case distance skim matrices for use within TUBA.

2.1.3 The TUBA inputs for the assessment include a standard TUBA scheme file. The parameters used within the scheme file are presented in the table below. Most of the parameters are the same between the road and public transport files. Values that differ between road and public transport are shown in separate columns in the table.

Table 2.1: TUBA Input Parameters

Parameter	Value Road Scheme File	Value Public Transport Scheme File
TUBA Version	1.9.17	
Economic Parameters	TAG data book version 1.19 (May 2022)	
First Year	2030	
Horizon Year	2090	
Modelled Years	2030 and 2045	
Current Year	2022 (defines the first year in which the discount rate is applied)	
Time Slices	3 time slices (AM, IP & PM)	
Opening Year	2030	
Do Something Costs	As provided in Technical Note F	
Unit of account	Factor cost	
GDP Deflator Index	100.00 (costs input in 2010 prices)	
User Classes	18 user classes – Car Employers Business, Car Commute, Car Other, Car Education, Car Retired, LGV Personal, LGV Freight, OGV1 and OGV2 (LEZ Compliant and Non-LEZ Compliant for all sub-modes)	8 user classes – Public Transport (Non-Rail) Business, Public Transport Commute (Season Ticket + Non-Season Ticket), Public Transport Other (Season Ticket + Non-Season Ticket), PT Education, PT Retired and Rail Business.
LGV and HGV Split Factors	LGV (Personal 0.12 and Freight 0.88) HGV (OGV1 0.26 and OGV2 0.26; includes a 1.9 PCU factor) . *Assumed even split between OGV1 & OGV2*	N/A
Public transport Business Rail Proportion	N/A	91% rail, 9% bus from analysis of 2030 Do Minimum loaded public transport networks. Time period weighted flows showed 91% of passenger distance was by rail.

Parameter	Value Road Scheme File	Value Public Transport Scheme File
Input Matrices	Time (hours), distance (km) and trip matrices	Time (hours), distance (km), fares (£) and trip matrices
Value of Time method	Method 1 – continuous function, based on distance	
Annualisation Factors (Peak/average hour to annual)	AM: 620 IP: 3700 PM: 620 *Factors from LATIS, with ASAM specific values extracted from report.*	AM: 530 IP: 2800 PM: 830 *Factors from LATIS, with ASAM specific values extracted from report.*
Do Something Scheme Cost Profile	As provided in Technical Note F	

2.1.4 TUBA has been run for Options 2 and 5, 5A and 5P with the road and public transport benefits processed separately. The road economic benefits comprise the travel time benefit, fuel vehicle operating cost (VOC), non-fuel VOC and change in tax revenue. The public transport economic benefits include the travel time benefit, change in operator revenue, and change in tax revenue.

2.2 User Benefit Masking

2.2.1 In producing the user benefits for the scheme, and with the ASAM model being a large-scale strategic model, it was necessary to undertake 'masking' of some sector-to-sector movements to exclude potential model 'noise' and help ensure that the monetised impacts reported are reasonably attributed to the options being tested.

2.2.2 The ASAM model is divided into 39 sectors and this sector system was used to determine relevant sector movements for the economic appraisal. The figure below illustrates the sector-sector movements which are included and excluded from analysis:

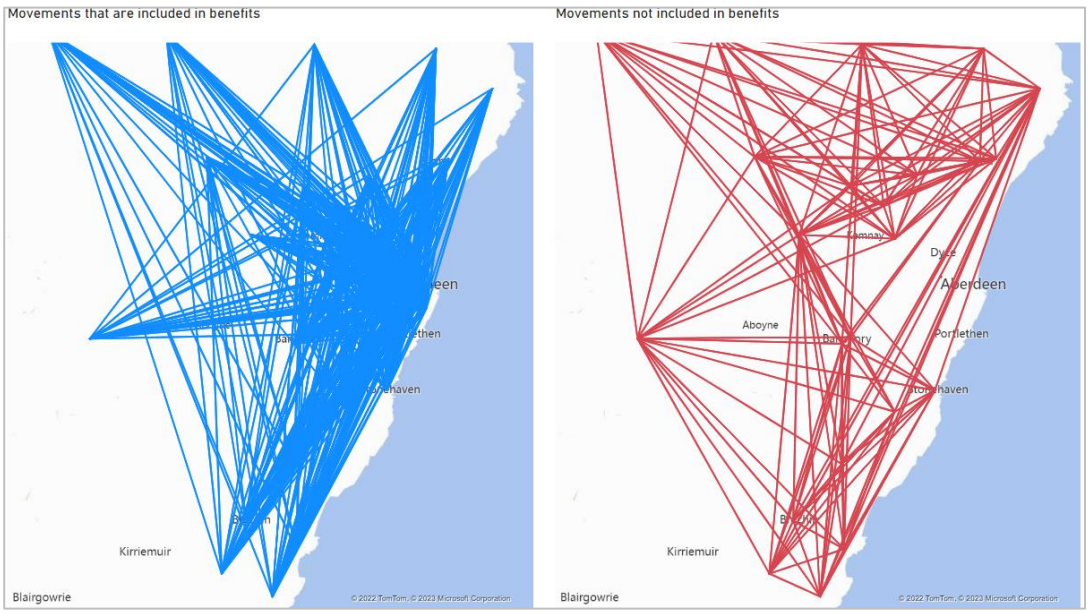

Figure 2.1: Included and excluded sector movements

2.2.3 The 'masking' removed sector pairs that should not be affected by the scheme, e.g., movements between sectors that do not use the ART corridors. Movements which utilise

corridors likely to see strategic rerouting are included. Table 2.2 indicates which sectors have been masked out.

Table 2.2: TUBA Sector Masking ("M" shown if masked out)

Origin / Destination	16	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
16	M				M	M	M			M	M	M	M	M	M			M	M	M	M	M	M
18		M	M	M				M	M	M		M	M	M	M	M	M					M	M
19		M	M	M				M	M	M			M	M	M	M	M					M	M
20		M	M	M				M	M	M			M	M	M	M	M					M	M
21	M				M	M	M				M	M	M				M	M	M	M	M		
22	M				M	M	M				M	M	M				M	M	M	M	M		
23	M				M	M	M			M	M	M	M	M	M			M	M	M	M	M	M
24		M	M	M				M	M	M		M	M	M	M	M	M					M	M
25		M	M	M				M	M	M		M	M	M	M	M	M					M	M
26	M	M	M	M			M	M	M	M			M	M	M	M	M					M	M
27	M				M	M	M				M	M	M				M	M	M	M	M		
28	M	M			M	M	M	M	M		M	M	M	M				M	M	M	M	M	M
29	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
30	M	M	M	M			M	M	M	M		M	M	M	M	M	M					M	M
31	M	M	M	M			M	M	M	M			M	M	M	M	M					M	M
32		M	M	M				M	M	M			M	M	M	M	M					M	M
33		M	M	M	M	M		M	M	M	M		M	M	M	M	M	M	M	M	M	M	M
34	M				M	M	M				M	M	M				M	M	M	M	M		
35	M				M	M	M				M	M	M				M	M	M	M	M		
36	M				M	M	M				M	M	M				M	M	M	M	M		
37	M				M	M	M				M	M	M				M	M	M	M	M		
38	M	M	M	M			M	M	M	M		M	M	M	M	M	M					M	M
39	M	M	M	M			M	M	M	M		M	M	M	M	M	M					M	M

2.3 Economic Benefits

Public Transport Benefits

2.3.1 The results from the TUBA analysis for Public Transport are provided in Table 2.3.

Table 2.3: TUBA Public Transport Benefits

Option	Public Transport Benefits (2010 prices)	
	'With policy' Scenario	'Without policy' Scenario
2	£49M	-
5A	£218M	-
5	£272M	£263M
5P	£286M	-

2.3.2 The table shows significant benefits across all options ranging from £49M (Option 2) to £286M (Option 5P) under the 'with policy' scenario. All options are able to provide some degree of journey time savings and modal shift, although these benefits are more substantial under Option 5A, 5 and 5P where new 'cross-city' services operate.

2.3.3 The use of new 'tram-like' vehicles which are more attractive and permit simultaneous boarding and alighting is expected to increase PT benefits by 25% (i.e., comparing Option 5 with 5A) and the implementation of higher parking charges in Aberdeen City Centre is expected to increase PT benefits by 5% (i.e., comparing Option 5P with Option 5).

2.3.4 Option 5 public transport benefits under the 'without policy' scenario are 3% lower than under the 'with policy' scenario. This reflects the fact that under the 'without policy' scenario, public transport patronage is expected to be lower and a smaller number of people receive journey time savings than under the 'with policy' scenario.

Road Benefits

2.3.5 The results from the TUBA analysis in term of the economic benefits of the scheme for road are provided in Table 2.4.

Table 2.4: TUBA Road Benefits

Option	Road Benefits (2010 prices)	
	'With policy' Scenario	'Without policy' Scenario
2	-£245M	-
5A	-£228M	-
5	-£217M	-£318M
5P	-£177M	-

2.3.6 As is expected, given the reallocation of road space to public transport under all options, the table shows significant disbenefits across all options.

2.3.7 Under the 'with policy' scenario, Option 5P shows the smallest disbenefit at £177M, and Option 2 shows the largest disbenefit of with a total disbenefit of £245M. Under the 'without

policy' scenario, Option 5 generates a disbenefit of £318M – approximately 50% higher than under the 'with policy' scenario. This reflects the fact that the road network is more congested under the 'without policy' scenario so more people experience time disbenefits and the underlying road network is more congested, leading to more re-routing.

2.3.8 The reduction in road capacity has increased road congestion and increased road journey times on ART corridors. This has prompted strategic re-routing across the network which lengthens journeys and increases fuel costs. Fuel VOC disbenefits are expected across all options, with these being highest under Option 2 and lowest under Option 5P. This is assumed to be a function of reduction road space prompting re-routing, longer journeys and higher fuel consumption, balanced with each option's propensity to cause modal shift from car to PT, which reduces the need for fuel.

2.3.9 Indirect taxation disbenefits are expected across the board, with these being lowest under Option 2 and highest under Option 5P. This aligns with the modelling outputs which suggest that Option 5P could remove the most car trips from the roads and Option 2 the least.

2.3.10 Interestingly, Option 2 actually increases greenhouse gas (GHG) emissions generating a disbenefit, while the other options tested reduce greenhouse gas emissions. All options reduce road space and so create more congestion; however, Options 5, 5A and 5P see a reduction in car km which more than offsets the GHG impact of additional congestion. In Option 2, the reduction in road demand is not significant enough to offset the congestion impact. TAG Unit A3 highlights that "if TUBA is being used to estimate the change in carbon dioxide emissions it is essential that all 8,760 hours of the year are included and properly represented in the analysis." Annualisation factors used are from LATIS and so cover the full year, and additionally the same annualisation factors have been applied across all model runs for consistency.

2.3.11 All options will generate traffic rerouting behaviours through reducing road space on ART corridors; however, these effects are countered partially by the transfer of trips from road to public transport. The results indicate that Option 2 will have the greatest impact upon network performance. Whereas, under Options 5 and 5P, new ART services will operate which maximise use of bus priority infrastructure, have a lesser stopping pattern and also use modern 'tram-like' vehicles which are more attractive to users, encouraging modal shift. Modal shift is maximised under Option 5P, which provides the benefits of Option 5 with the addition of traffic restraint measures (increased parking charges used as a proxy) to dissuade car use.

Road and Public Transport Benefits

2.3.12 The results of the combined road and public transport benefits are provided in Table 2.5.

Table 2.5: TUBA Road and Public Transport Benefits

Option	Total Benefits (2010 prices)	
	'With policy' Scenario	'Without policy' Scenario
2	-£195M	-
5A	-£10M	-
5	+£56M	-£55M
5P	+£109M	-

2.3.13 The combined road and public transport results show that Options 2 and 5A will yield economic disbenefits of £195M and £10M respectively, while the Options 5 and 5P will yield economic benefits of £56M and £109M respectively.

2.4 Road and Public Transport Economic Appraisal

2.4.1 The scheme benefits have been compared against the cost of the ART scheme to generate a Benefit-Cost Ratio (BCR) value. This has been undertaken for:

- Public transport benefits *only* against the scheme costs to understand the BCR values – recognising that journey time increases (disbenefits) to general traffic can be viewed as a means to achieving the scheme, and indeed a range of national objectives, and should not necessarily be viewed as 'negative'
- Combined road and public transport benefits against the scheme costs to understand the resultant BCR values in the more traditional economic sense

Public Transport Only Economic Appraisal

2.4.2 Table 2.6 compares the public transport benefits against the costs for each option. This is used to calculate the public transport BCR value for each option.

Table 2.6: TUBA Public Transport Only Benefit to Cost Ratios (BCRs)

Option	Present Value of Costs (2010 prices)	BCR	
		'With policy' Scenario	'Without policy' Scenario
2	£84M	0.6	-
5A	£91M	2.4	-
5	£91M	3.0	2.9
5P	£91M	3.2	-

2.4.3 The results show:

- Under the 'with policy' scenario, **if only public transport benefits are considered against scheme costs, ART (as delivered under Option 5) can be considered 'value for money' in conventional terms, with a BCR of >1** (indeed the BCR is +3.0) i.e., scheme benefits outweigh the scheme costs.
- The potential value for money increases further should supporting traffic restraint measures also be introduced as per Option 5P (where the BCR increases to +3.2), again **reaffirming the additional benefits that ART could achieve if the appropriate supporting traffic restraint measures, such as parking control policy, were implemented**.
- Option 2 has a BCR less than 1 (even when only public transport benefits are considered) indicating the option could not be considered value for money.

2.4.4 These results highlight the potentially quite significant benefits of the combination of new cross-city services, new vehicles and platforms and supporting traffic restraint measures (as per Option 5P). It can be surmised that the BCR for Option 3 would lie closer to that of Option 2, and that of Option 3A closer to that of Option 5A.

Road and Public Transport Combined Economic Appraisal

2.4.5 Table 2.7 compares the total combined road and public transport benefits against the costs for each option. This is used to calculate and compare the overall BCR value for each option.

Table 2.7: TUBA Road and Public Transport Combined Benefit to Cost Ratios (BCRs)

Option	Present Value of Costs (2010 prices)	BCR	
		'With policy' Scenario	'Without policy' Scenario
2	£84M	-2.3	-
5A	£91M	-0.1	-
5	£91M	0.6	-0.6
5P	£91M	1.2	-

2.4.6 The results show:

- The benefits to users of ART are offset by the disbenefits to general traffic in terms of increased journey times. Depending on the extent of this, the BCR could reduce to <1.
- Under the 'with policy' scenario, with general traffic disbenefits included, the BCRs range from approximately -2.3 (for Option 2) to +1.2 (for Option 5P).
- However, these journey time increases to general traffic can be viewed as a means to achieving the scheme, and indeed a range of national objectives. Nevertheless, future scheme development should seek to minimise these impacts for essential traffic and mitigate the impacts of any re-routeing.

2.4.7 Of particular note is the BCR generated under the 'without policy' scenario for Option 5, where the disbenefit to general traffic generates a negative BCR of -0.6 (indicating that the scheme generates overall disbenefits, and could be considered to not be value for money), whereas the BCR under the 'with policy' scenario is approximately +0.6. This range in outcomes should be borne in mind by decision makers when considering full scheme impacts. However, the BCR when public transport benefits alone are considered (+2.9) is very similar to Option 5 under the 'with policy' scenario (+3.0), indicating 'value for money' for the option under both future forecasts.

2.5 Summary

2.5.1 In summary, ART will generate significant public transport benefits, and if only public transport benefits are considered against scheme costs, ART (as per Option 5) can be considered 'value for money' in conventional terms, with a BCR of >1. The potential value for money increases further should supporting traffic restraint measures also be introduced. If the existing network is integrated appropriately into ART, a more operationally robust city-wide bus network can reduce overall operational costs, improving overall scheme value for money. The outputs from the modelling suggest that under the Option 5 variants, the net additional public transport revenue will outweigh the net costs.

2.5.2 Caution should be applied in not placing undue emphasis on the scheme value for money calculated through these standard economic monetised figures, recognising the range of scheme benefits not included within the derivation of the BCRs. The economic vitality of the region, contribution to net zero and accessibility and social inclusion benefits are all additional to the traditional BCR calculations.

2.5.3 Under Options 5, 5A and 5P, the operating costs for the city-wide bus network (with new ART services and an integrated underlying network) is lower than under Option 2 (where additional services are provided on the ART corridors). The change in operator revenue under these options (taking account of gained revenue from ART service and lost revenue from the underlying network) is greater than the change in operating costs. Based on the model outputs, ART could be introduced with a net operating surplus

2.5.4 It is also important to recognise the additional set-up costs required to enable an appropriate delivery mechanism. These are discussed in the main body of the report in the context of scheme delivery, but the set-up costs associated with the development of the regulatory framework as well as the planning and mobilisation for an enhanced public transport offer could be of the order of £300,000. This would increase considerably if franchising was pursued.