# 10 ECONOMY

## 10.1 INTRODUCTION

This section considers the assessment of the economic impacts of the STAG options (see Section 7.1), in terms of potential transport efficiencies that could be made. The assessment provides a measure of the contribution a transport proposal could make to social economic welfare as represented by the costs and benefits incurred by users and operators of the transport system (see Annex K for the Transport Economic Efficiency Report).

The options which have been considered in this assessment are:

- Option 1: Drill and Blast Tunnel
- Option 2: High Level Bridge
- Option 3: Reconfigured Ferry Service
- Option 4: Existing Ferry Service

For the purposes of the assessment Option 4 is the Do Minimum option but this option involves the replacement of ferries and terminals at the appropriate dates together with the annual operational costs.

The chapter describes the methods which have been used for the assessment and the assumptions which have been used in the calculations and sets out the key findings in accordance with STAG for the options.

## 10.2 SOURCES OF INFORMATION

The following sources of information have been used to inform the economic appraisal:

- guidance included in STAG;
- SIC Roads Service;
- SIC Transport Service;
- SIC Ferries Service;
- ZetTrans;
- Scottish Transport Statistics;
- Donaldson's Associates; and
- Halcrow.

## 10.3 METHODOLOGY

The methodology for the appraisal has been defined to ensure that all options were assessed on a common basis (see also Section 7.4.1). The following assumptions were made:

- the appraisal is carried out over a set number of years with all scheme costs and benefits accruing in this period converted to the same price base;
- the standard appraisal period is 60 years;
- the standard price base used is 2002;
- all prices are therefore 2008 values dis-inflated to 2002 prices;
- standard discount rates of 3.5% for the first 30 years and 3% thereafter have been used.

The first stage was to undertake a cost benefit analysis (see Section 10.4.1). For each of the three proposed new options, (Options 1-3) the benefits in terms of reductions in journey times were compared with any costs associated with making that journey. The reconfigured ferry option (Option 3) includes the three variations (Sub-options A to C) in fare levels (see Section 7.5.3).

Following the cost benefit analysis, an assessment of the costs of each of the proposed schemes including the cost savings resulting from the removal of the current ferry service (where applicable) was undertaken (see Section 10.4.2).

These costs were then used to compare each of the proposed options against the Do Minimum (Option 4) (see Section 10.4.3). The results of the cost benefit analysis were fed into Net Present Value (NPV) and Benefit Cost Ratio (BCR) calculations to produce Transport Economic Efficiency (TEE) tables for each of the three proposed new options (Options 1-3). The NPV is regarded as the best measure of the absolute ranking of economic welfare for comparable proposals. It is the sum of the present value of all the costs and benefits of the proposal. The BCR value provides a measure of the value of the scheme to the Government. A BCR value of 1 implies that every £1 invested generates a benefit of £1. It compares total external benefits with the cost to the Government and is defined as follows:

$$\frac{\text{Present Value of Transport Benefits}}{\text{Present Value of Cost to Government}}$$

where the present value of benefits is the sum of the present value of the scheme benefits and the present value of cost to Government is the sum of the present values of all the costs to the public sector less any revenues.

Finally, a number of sensitivity tests of the key assumptions are undertaken. The purpose of these tests is to provide confidence in the economic case produced.

## 10.4 BENEFITS AND COSTS OF TRAVEL OVER BRESSAY SOUND

This section provides an outline of the approach taken, the assumptions made and any relevant results.

### 10.4.1 Assessment of Current Demand

Current ferry demand figures were obtained in this task. These were obtained for the period 01 April 2007 to 30 March 2008 (see Table 10.1 below).

**Table 10.1: Current Ferry Demand Figures (01 April 2007 to 30 March 2008)**

| Ticket Type | Number | Ticket Type | Number |
|---|---|---|---|
| Motorbikes | 48 | Tanker (M) | 42 |
| Cars | 68,414 | Tanker (L) | 0 |
| Bus (S) | 496 | Plant (S) | 24 |
| Bus (M) | 14 | Plant (M) | 16 |
| Bus (L) | 2 | Plant (L) | 4 |
| Trailer | 1,286 | Senior citizens | 26,950 |
| Commercial (S) | 678 | Adults | 64,948 |
| Commercial (M) | 326 | Children + Infants | 25,986 |
| Commercial (L) | 470 | Schoolchildren | 7,166 |
| Tanker (S) | 140 | Disabled | 2,840 |

Current levels of revenue generated on the route were calculated using fare data provided by SIC. Around £331,000 in fare revenue was generated over this same period, 01 April 2007 to 31 March 2008.

### 10.4.2 Estimation of the Cost of Making Existing Trips

The costs, as perceived by users, of making a trip on the existing ferry service, are calculated on the journey time and the wait time for the ferry. In addition, fares and vehicle operating costs for using the existing ferry service are calculated.

Journey times and costs were extracted from current ferry timetables. The current crossing duration is seven minutes with the minimum check in time for the ferry service five minutes. Anecdotal evidence suggests that the majority of passengers using the current ferry service time their journeys to arrive at the terminal just before check in. Although the current ferry service frequency can be anything between 20 minutes to one hour, an assumption that passengers arrive, on average, halfway between services is considered unreasonable as the majority of users know the ferry timetable and plan their travel around this. A combined wait time and ferry egress time of ten minutes has been assumed (STAG recommends that time spent waiting for transport services is valued at twice the disutility as 'in vehicle time' (IVT), as users prefer travelling to waiting for services, so this is equivalent to 20 minutes IVT). It is acknowledged that at certain times of the day this combined time can be significantly shorter or longer. A combined time of ten minutes has been considered to be a reasonable average. This was discussed at the third workshop (April 24, 2008) and found to be considered reasonable.

In the absence of detailed passenger survey data to give origins and destinations of trips using the ferry it has been taken that only the section of each trip between Bressay and Lerwick would be analysed. It has been assumed that the average passenger needs to travel for five minutes between the ferry terminal and their origin or destination on Bressay and one and a half minutes on the Lerwick side[68].

[68] A point on King Harald Street was taken as the generic Origin/Destination in Lerwick and the Brough / Setter fork in Uphouse Road the generic Origin/Destination on Bressay. Taking distances from Google Maps an average speed of 20mph was used to estimate journey times

The journey times are converted to a monetary cost using standard values of time from WebTag[69]; these are:

- £5.04/hr for commuters;
- £4.46/hr for non-work trips; and
- £23.18/hr for trips made in work time.

Travellers making trips in work time have different values of time to those travelling for other purposes; therefore an assumption has been made as to the proportion of trips taken for each purpose. At an earlier stage of the study a questionnaire was issued to ferry users to understand their views of the service. Within this questionnaire interviewees were asked their trip purposes. In addition data were obtained from the Bressay Community Council and Bressay Ferry Crew as to the number of commuters using the service[70]. From these data a 20% commuting, 72% non-work and 8% work trip purpose split was identified for car drivers and for non-drivers an 11% commuting, 80% non-work and 9% work split.

Trip costs include vehicle operating costs for the parts of the journey made by car and fare costs for the ferry leg of the trip. Vehicle operating costs were calculated based on distance travelled and the assumed average speed of 20mph. These costs can be split into two components: fuel and non-fuel and are based on official WebTag costs. Fares are taken from the ferry timetables with the assumption that 80% of travellers have 10 trip tickets.

Table 10.2 presents the costs of all passengers making the trips from 07/08 with the current ferry service.

**Table 10.2: Existing Trip Costs**

| | **Cost £** |
|---|---|
| Journey Time | 630,874 |
| Fares | 331,000 |
| Vehicle Operating Costs | 32,110 |

### 10.4.3 Estimation of Cost Making Trips with Implementation of Options

For each proposed option, the costs of making the same set of journeys would change. For example, where there is a decrease in journey cost, benefits are accrued.

#### 10.4.3.1 Fixed Links (Options 1 and 2)

In terms of trip costs the tunnel (Option 1) and bridge (Option 2) are considered to be identical apart from slightly different crossing times due to different design speeds. Based on the location of the proposed fixed link it is assumed that journey time to the link on the Bressay side is nine minutes and six minutes on the Lerwick side[71]. Time spent crossing the link is assumed to be one and a half minutes for the tunnel and one minute for the bridge.

Included within the fixed link proposals is the introduction of a bus service across the link. It is assumed that bus passengers would know the timetable and hence only wait an average of five minutes for the bus. An additional minute has been

[69] Department of Transport guidance on the conduct of transport studies
[70] November 2006
[71] Journey times taken from Google Maps with same origins/destinations as before

added to the assumed car journey times (to represent time waiting at stops) either side of the link to obtain the bus journey time.

Vehicle operating costs increase as vehicles have to travel further to cross between Bressay and Lerwick. All passengers make a saving of the ferry fare cost although most users of the new bus service would pay a bus fare.

#### 10.4.3.2 Reconfigured Ferry (Option 3)

For the ferry upgrade options no change to the journey time elements of the trip would happen. The only difference is with regards to the fares (see also Section 7.5.3):

- the first option involves no change to the existing fares;
- the second option is to remove fares altogether; and
- the third option includes a reduction in fare cost for plant vehicles and motorbikes. In addition a monthly unlimited travel ticket is introduced at the cost of £100 for cars and £16 for adults. To work out the level of fare to assign per trip to those having a monthly pass an assumption has to be made as to the percentage of passengers owning this pass and the number of trips per month these passengers would make. Based on the trip purposes discussed in Section 10.4.2, it is assumed that 20% of current car trips would be made by people with a monthly pass and that these people would make on average four trips per week. Analysis of the questionnaire data suggests around 70% of foot passenger trips would be made by people with monthly passes.

### 10.4.4 Estimation of Mode Switch with Implementation of Options

Each proposed option would have an impact on the form of transport that people use. This is taken into account in this part of the assessment.

#### 10.4.4.1 Fixed Links (Options 1 and 2)

If a fixed link is introduced it is assumed that few people would cross the link by foot due to its distance from Lerwick and the existing terminal at Bressay. An assessment of the number of non-vehicle drivers likely to switch to making their journey by car (either as a driver or passenger) and the number making their journey by bus is undertaken.

Scottish Transport Statistics for Shetland state that 25% of households in Shetland do not have access to a car and 24% of adults aged 17 and over do not have a driving licence. Therefore it has been assumed that 75% of current non-vehicle drivers would either drive or travel as a car passenger over the proposed link. Car occupancy of 1.64[72] has been assumed amongst these users. The rest of the adults are assumed to use the new bus service. Amongst children it is assumed that 25% would travel as a passenger in a car and the remaining 75% would use the new bus service. It is assumed that disabled travellers would currently be travelling as car passengers rather than drivers and that this would continue upon completion of the fixed link. Table 10.3 presents the number of existing non-vehicle driver trips which would switch to car and bus.

[72] National average car occupancy (2006) from Transport Statistics Great Britain (TSGB) Section 1

**Table 10.3: Number of Trips switching from Foot / Car Passenger to Car / Car Passenger or Bus**

| | Switch to Car / Car Passenger | Switch to Bus |
|---|---|---|
| **Senior citizens** | 20,213 | 6,738 |
| **Adults** | 48,711 | 16,237 |
| **Children** | 4,412 | 13,236 |
| **Schoolchildren** | 1,792 | 5,375 |
| **Infants** | 6,254 | 2,085 |
| **Disabled** | 2,130 | 710 |
| **Total** | **83,511** | **44,380** |

The 83,511 passengers switching to car would generate 50,921 car trips assuming car occupancy of 1.64.

Work undertaken by SIC has forecast that an increase of daily car trips by around 100% would be a conservative estimate of the number of new trips made as a result of the introduction of a fixed link. This equates to 327 cars which are assumed to carry an additional 209 passengers (all assumed to be children or disabled users) based on the standard car occupancy rate of 1.64. It is stated that all of these trips would be made for non-work purposes.

### 10.4.4.2 Reconfigured Ferry (Option 3)

Work done by ZetTrans based on fare elasticities forecasts that if the fares on the ferry service are removed altogether then there would be a 23% increase in passengers and a 38% increase in vehicles using the Bressay service. Table 10.4 summarises the number of new passengers per annum.

**Table 10.4: Forecast generated Ferry Passengers due to Fare Removal**

| **New Drivers** | | **New Foot Passengers / Car Passengers** | |
|---|---|---|---|
| Cars & Bikes | | Senior citizens | 33,149 |
| *Commuters* | 9,869 | Adults | |
| *Non - work* | 76,063 | *Commuters* | 8,345 |
| *Work* | 8,545 | *Non - work* | 64,316 |
| Bus | 707 | *Work* | 7,225 |
| Commercial | 2,034 | Children + Infants | 43,414 |
| Tanker | 251 | Schoolchildren | 21,707 |
| Plant | 61 | Disabled | 3,493 |
| **Total** | 97,530 | **Total** | 181,649 |

The introduction of the seven-seater bus service to the Bressay terminal which would part of the reconfigured ferry option leads to a few people using this service to access the ferry. It has been estimated that the average occupancy on each trip made by the bus will be four passengers. Assuming six services per day it is therefore assumed that there will be a total of forty-eight one way trips made on this service.

### 10.4.5 Costs of All Trips with Implementation of Options

The journey costs (the costs and benefits accruing to users) of the three options can then be calculated by taking into account:

- new car / car passenger and bus trips (transferred from existing foot passengers);
- the existing vehicle trips; and
- the generated trips which would now use the fixed link.

As previously noted the two fixed link options have been considered the same with regards to user journey costs.

Comparing the costs for each of the three proposed options with those in the Do Minimum leads to the opening year costs and benefits to existing passengers and new users of each of the three proposed options. It should be noted that new users only gain half of the benefits that existing users get[73]. Table 10.5 presents these results. A positive number indicates a benefit and a negative number a cost.

**Table 10.5: User Costs and Benefits**

| | Journey Time | Fares | Vehicle Operating Costs |
|---|---|---|---|
| **Option 1 (Tunnel)** | 413,985 | 283,248 | -228,921 |
| **Option 2 (Bridge)** | 426,113 | 283,248 | -228,921 |
| **Option 3a (Ferry, no fare change)** | 0 | -17,520 | 0 |
| **Option 3b (Ferry, no fares)** | 0 | 313,480 | 0 |
| **Option 3c (Ferry, monthly ticket)** | 0 | -11,477 | 0 |

The fixed link options (options 1 and 2) both provide benefits to users as journey times are reduced for both options and users no longer need to pay ferry fares. The upgraded ferry service with no changes to fares (Option 3a) has no benefit that is quantifiable here (there is a benefit in terms of increased service frequency / operating hours but it is not possible to assign a monetary value to this benefit). The ferry options with changes to the fares (Options 3b and 3c) both lead to a benefit to users as some fares reduce.

### 10.4.6 Treatment of Scheme Costs

The next stage of the process is to assess the costs of each of the proposed schemes as well as the cost saving from removing the current ferry service (where applicable).

#### 10.4.6.1 Capital Costs

The first area of costs is capital costs in the form of construction costs for proposed infrastructure. These are applicable for both fixed links (Options 1 and 2) and also apply to the ferry options in the form of new linkspans and terminals (Options 3 and 4).

[73] STAG guidance

The items of infrastructure involved in this study all have different life-spans before they need replacement. Also, items of infrastructure that are removed as a result of the implementation of the scheme would have a residual value (for instance if the ferry is replaced by a tunnel then the ferry could be sold for a proportion of its original value).

The appraisal process takes account of any residual asset values either:

- in the opening year of the scheme when infrastructure becomes redundant; or
- at the end of the asset's life, if it still has some value; or
- at the end of the 60 year appraisal period if the asset has a number of years service left in it.

The assumptions that have been made about replacement years and lifespan are set out in Table 10.6. It is assumed that ferries have 10% of their original value at the end of their lifespan and that all assets experience straight line depreciation over their life.

**Table 10.6: Replacement Schedule and Lifespans for Options 1 and 2**

| | Lifespan | Replacement years |
|---|---|---|
| Existing Infrastructure | | |
| Ferry | 20 | 2012, 2032, 2052 |
| Berthing Structure (Bressay) | 60 | 2035 |
| Berthing Structure (Lerwick) | 60 | 2035 |
| Linkspan | 20 | 2015, 2035, 2055 |
| Bridge | 120 | N/A |
| Tunnel | 120 | N/A |

## Fixed Links

For the fixed links the costs include the construction of the link, any road upgrades required and bus stops for the proposed bus route. The costs are taken from Chapter 7. Table 10.7 provides a breakdown of these costs.

**Table 10.7: Scheme Capital Costs for Option 1 and 2**

| | Base Costs £ | | Including Optimism Bias & Contingency | |
|---|---|---|---|---|
| | Tunnel | Bridge | Tunnel | Bridge |
| Link Construction (including land acquisition) | 26,059,000 | 51,200,000 | 48,469,740 | 95,232,000 |
| Road Upgrade | 200,000 | 200,000 | 328,000 | 328,000 |
| Bus Stops | 30,000 | 30,000 | 30,000 | 30,000 |
| Road Upgrade for Buses | 50,000 | 50,000 | 82,000 | 82,000 |

Government research shows that costs are always underestimated. Official Government guidance in the Treasury Green Book is to add optimism bias to account for this (see Section 7.2). The standard rates are +44% for roads and +66% for fixed links (these uplifts are applied to the base cost estimates). In addition a contingency is added to all capital costs to account for risk within the project. This has been assumed to be +20% on the base cost estimate. The

second set of numbers in the above table includes optimism bias at +66% for the link construction and +44% for the road upgrades and contingency at +20%.

**Ferry Replacements**
The costs of renewing existing ferry infrastructure are contained within Table 10.8. Optimism bias and contingency needs to be added to these costs. In accordance with the Treasury Green Book, this is therefore 66% for optimism bias and 20% contingency on linkspans and berthing structures, but no optimism bias is included on ferry renewal costs[74]. The third column provides the cost with optimism bias included at 66% as well as contingency at 20% for terminal infrastructure.

As can be seen from Table 10.6, during the 60 year appraisal period:

- the ferry would have to be replaced three times;
- the berthing structure once; and
- the linkspan three times.

**Table 10.8: Existing Renewal Costs**

| Item | Renewal Cost (£) | Cost with Optimism Bias (£) |
|---|---|---|
| Ferry | 6,750,000 (x3) | 6,750,000 |
| Berthing Structure (Bressay) | 3,500,000 | 6,510,000 |
| Berthing Structure (Lerwick) | 2,500,000 | 4,650,000 |
| Linkspan (2 replacements each time at £250,000 each) | 500,000 (x3) | 930,000 |

### 10.4.6.2 Operating Costs

In addition to capital costs there are operating and maintenance costs for each of the schemes. These are contained in Table 10.9 for each of the options (these are again taken from Chapter 7). Public transport Sub-option A has been assumed for Options 1 and 2 and Sub-option A has been assumed for Option 3.

**Table 10.9: Scheme Operating Costs (£pa)**

| | Current Ferry | Tunnel | Bridge | Reconfigured Ferry |
|---|---|---|---|---|
| Operating / Maintenance costs (£pa) | 1,301,862 | 100,000 | 100,000 | 1,427,841 |
| Bus operating / maintenance costs (£pa) | 0 | 95,000 | 95,000 | 35,000 |

As the current ferry service does not cover its operating costs by the revenue earned, the Council pays an annual amount for the service. The service is also subsidised by the Scottish Government. In addition the proposed bus service would be financed by the Council although any fare revenue would go to the operator. In terms of overall operating costs the Council would benefit from the removal of the ferry service as it would no longer have to pay the operating costs for the ferry (the required level of bus operating costs are small in comparison).

A further minor benefit which is obtained by the public sector is an increase in fuel duty and tax due to the increased vehicle km travelled. This is relatively minor (in the region of 75k per annum) but has been included within the appraisal.

[74] A sensitivity test was however completed with optimism bias-see Section 10.7

## 10.5 TRANSPORT ECONOMIC EFFICIENCY (TEE) ANALYSIS

This section presents the TEE tables (Tables 10.10-10.14) for each of the options. Each table sets out:

- the costs and benefits discounted over the appraisal period;
- the Net Present Value (NPV); and
- the Benefit Cost Ratio (BCR).

In the TEE table for Option 3a with the upgraded ferry service with existing fares there are no quantifiable benefits, only costs.

**Table 10.10: Option 1 Tunnel TEE**

| **Sub-objective** | **Item** | **Qualitative Information** | **Quantitative Information** |
|---|---|---|---|
| User Benefits | Travel time | | £17,103,782 |
| | User charges | | £6,501,983 |
| | Vehicle Operating Costs | | -£5,254,909 |
| | Quality / Reliability Benefits | | £0 |
| Private Sector Operator Impacts | Investment costs | | £0 |
| | Operating and Maintenance Costs | | £0 |
| | Revenues | | £1,096,161 |
| | Grant/ Subsidy payments | | £0 |
| **Cost to Public Sector** | | | |
| **Item** | **Qualitative information** | | **Quantitative Information** |
| Public Sector Investment Costs | | | £22,891,094 |
| Public Sector Operating and Maintenance Costs | | | £25,254,808 |
| Grant/ Subsidy payments | | | £0 |
| Revenues | | | - £6,765,975 |
| Taxation Impacts | | | £1,788,631 |

| **Monetised Summary** | |
|---|---|
| Present Value of Transport Benefit | £19,447,016 |
| Present Value of Cost to Government | - £2,613,631 |
| Net Present Value | £16,833,385 |
| Benefit-Cost to Government Ratio | 7.44 |

**Table 10.11: Option 2 Bridge TEE**

| Sub-objective | Item | Qualitative Information | Quantitative Information |
|---|---|---|---|
| User Benefits | Travel time | | £17,124,853 |
| | User charges | | £6,255,149 |
| | Vehicle Operating Costs | | - £5,055,418 |
| | Quality / Reliability Benefits | | £0 |
| Private Sector Operator Impacts | Investment costs | | £0 |
| | Operating and Maintenance Costs | | £0 |
| | Revenues | | £1,054,547 |
| | Grant/ Subsidy payments | | £0 |
| **Cost to Public Sector** | | | |
| **Item** | **Qualitative information** | | **Quantitative Information** |
| Public Sector Investment Costs | | | - £61,408,678 |
| Public Sector Operating and Maintenance Costs | | | £24,296,063 |
| Grant/ Subsidy payments | | | £0 |
| Revenues | | | - £6,509,119 |
| Taxation Impacts | | | £1,720,647 |

| **Monetised Summary** | |
|---|---|
| Present Value of Transport Benefit | £19,379,131 |
| Present Value of Cost to Government | - £41,901,088 |
| Net Present Value | - £22,521,957 |
| Benefit-Cost to Government Ratio | 0.46 |

**Table 10.12: Option 3a Upgraded Ferry, Existing Fares TEE**

| Sub-objective | Item | Qualitative Information | Quantitative Information |
|---|---|---|---|
| User Benefits | Travel time | | £0 |
| | User charges | | - £386,906 |
| | Vehicle Operating Costs | | £0 |
| | Quality / Reliability Benefits | | £0 |
| Private Sector Operator Impacts | Investment costs | | £0 |
| | Operating and Maintenance Costs | | £0 |
| | Revenues | | £386,906 |
| | Grant/ Subsidy payments | | £0 |
| **Cost to Public Sector** | | | |
| **Item** | **Qualitative information** | | **Quantitative Information** |
| Public Sector Investment Costs | | | - £97,013 |
| Public Sector Operating and Maintenance Costs | | | - £3,533,553 |
| Grant/ Subsidy payments | | | £0 |
| Revenues | | | £0 |
| Taxation Impacts | | | £0 |

| **Monetised Summary** | |
|---|---|
| Present Value of Transport Benefit | £0 |
| Present Value of Cost to Government | - £3,630,566 |
| Net Present Value | - £3,630,566 |
| Benefit-Cost to Government Ratio | 0.00 |

**Table 10.13: Option 3b Upgraded Ferry, No Fares TEE**

| Sub-objective | Item | Qualitative Information | Quantitative Information |
|---|---|---|---|
| User Benefits | Travel time | | £0 |
| | User charges | | £7,696,602 |
| | Vehicle Operating Costs | | £0 |
| | Quality / Reliability Benefits | | £0 |
| Private Sector Operator Impacts | Investment costs | | £0 |
| | Operating and Maintenance Costs | | £0 |
| | Revenues | | £318,090 |
| | Grant/ Subsidy payments | | £0 |
| **Cost to Public Sector** | | | |
| **Item** | **Qualitative information** | | **Quantitative Information** |
| Public Sector Investment Costs | | | - £97,013 |
| Public Sector Operating and Maintenance Costs | | | - £3,533,547 |
| Grant/ Subsidy payments | | | £0 |
| Revenues | | | - £7,309,696 |
| Taxation Impacts | | | £0 |

| **Monetised Summary** | |
|---|---|
| Present Value of Transport Benefit | £8,014,692 |
| Present Value of Cost to Government | - £10,940,256 |
| Net Present Value | - £2,925,564 |
| Benefit-Cost to Government Ratio | 0.73 |

**Table 10.14: Option 3c Upgraded Ferry, New Fares TEE**

| Sub-objective | Item | Qualitative Information | Quantitative Information |
|---|---|---|---|
| User Benefits | Travel time | | £0 |
| | User charges | | £520,368 |
| | Vehicle Operating Costs | | £0 |
| | Quality / Reliability Benefits | | £0 |
| Private Sector Operator Impacts | Investment costs | | £0 |
| | Operating and Maintenance Costs | | £0 |
| | Revenues | | £318,090 |
| | Grant/ Subsidy payments | | £0 |
| **Cost to Public Sector** | | | |
| **Item** | **Qualitative information** | | **Quantitative Information** |
| Public Sector Investment Costs | | | - £97,013 |
| Public Sector Operating and Maintenance Costs | | | - £3,533,547 |
| Grant/ Subsidy payments | | | £0 |
| Revenues | | | - £133,462 |
| Taxation Impacts | | | £0 |

| **Monetised Summary** | |
|---|---|
| Present Value of Transport Benefit | £838,459 |
| Present Value of Cost to Government | - £3,764,022 |
| Net Present Value | - £2,925,564 |
| Benefit-Cost to Government Ratio | 0.22 |

The analysis indicates that the option with a positive economic case would be the replacement of the existing ferry service with a tunnel (Option 1). The BCR for this scheme is 7.44 which means that for every £1 invested in the scheme £7.44 of benefits are generated. This scheme has an NPV of £16.8m and generates transport benefits of £19.4m over the appraisal period. It is considered that a BCR of this level could help in applying for external sources of funding because it demonstrates clearly the public benefits which would be gained.

The driving factors behind this good economic case are:

- the reduction in journey times (from existing ferry crossing times) resulting from the introduction of a tunnel;
- reduction in user charges due to no longer having to pay ferry fares; and operating cost savings to the public sector as a result of the removal of the ferry service eliminating the need to pay for ferry infrastructure renewals.

All these benefits outweigh the costs of constructing the scheme.

The other three options all have BCRs of less than 1 which, in transport economic efficiency terms, represents poor value for money. A BCR of less than 1 means

that the level of benefits obtained from the scheme is lower than the level of costs needed to construct and operate the scheme.

The bridge option has very similar transport benefits to the tunnel; the reason that the case for the bridge is worse than that for the tunnel is due to the capital cost difference (since increasing the height of the bridge to 60m the cost of the bridge is approximately twice that of the tunnel).

The ferry improvement schemes also have low BCRs due to the fact that there are very few quantifiable benefits resulting from improving the service. In the case where all fares are removed more people would use the service but there are no journey time benefits. The only benefit in both ferry options is in terms of lower user charges.

## 10.6 FURTHER SOURCES OF NON-QUANTIFIABLE BENEFITS / COSTS

There are other benefits in terms of access from the options which it has not been possible to assign a monetary value to[75]. The main ones are as follows:

### 10.6.1 Fixed Link

- In the case of the tunnel, no disruption due to bad weather, this has reliability benefits.
- Less down time for those delivering services who cross to or from Bressay, such as road maintenance workers. This would provide benefits to the Council and other organisations.

### 10.6.2 Improved Ferry Service

- Ability to travel earlier and later, including the chance to connect with other transport services. This may attract trips to the service with the associated benefits.
- A more frequent service makes it easier for users' days to be planned around ferry sailings. Again, this may attract trips to the service with the associated benefits.
- There are also a few additional potential costs associated with the schemes. For instance, if the fixed link is introduced then all vehicles on Bressay would require an MOT. This is a disbenefit to residents of Bressay who would have to pay for an MOT but a benefit to the public sector. In addition, the longer distances required for people to drive to cross a fixed link would very slightly increase the likelihood of accidents.

## 10.7 SENSITIVITY TESTS

Tests to assess the sensitivity of the results for a number of the key assumptions have been undertaken. This ensures confidence in the economic case produced. As the tunnel option is the only one with a positive economic case this is the option used in the tests.

### 10.7.1 Assuming No Additional Trips would be Generated

The first test is to assess the sensitivity of the results to the assumption that a fixed link would generate 100% more trips than are currently made. The economic analysis was therefore undertaken with an assumption that no additional trips

[75] These benefits are considered in other chapters for different purposes (ie in relation to other objectives) but are summaries here for completeness

would be generated. Table 10.15 presents the comparison between the two scenarios.

**Table 10.15: Comparison of Tunnel Scenario With and Without Generated Trips**

| Monetised Summary | Base | No Generated Trips |
|---|---|---|
| Present Value of Transport Benefits | £19,447,016 | £17,582,675 |
| Present Value of Cost to Government | -£2,613,631 | -£3,679,582 |
| Net Present Value | £16,833,385 | £13,903,093 |
| Benefit-Cost to Government Ratio | 7.44 | 4.78 |

It can be seen that whilst these generated trips provide a certain level of benefit, they are not essential to the economic case of the scheme as a BCR of 4.78 still represents good value for money.

### 10.7.2 Different Levels of Optimism Bias

The second sensitivity test which was undertaken is to assess the option with different levels of optimism bias. Whilst the levels used within the main appraisal are in accordance with official guidelines it is a matter of interest to see how far the case for the scheme is driven by the level of optimism bias (see Section 7.2) assumed.

The first test was to set all optimism bias levels to +44% rather than having +66% for the fixed link. It was found that with these lower levels of optimism bias the economic case for the tunnel option increases significantly as there is no longer an overall cost to the Government of the scheme: the cost savings made with this option outweigh the capital costs so the BCR is infinite (the formula which is used produces a negative BCR because the formula in its standard use is unable to deal with such large benefits). In effect as the costs of the tunnel option in the test are less than the Do Minimum option, the tunnel, Option1, effectively becomes the Do Minimum in terms of the discounted costs.

Secondly, all optimism bias was removed. This further improves the case for the tunnel. Even the bridge option has a very slight positive case with a BCR of 1.49, although no impact is made on the reconfigured ferry option. Tables 10.16 – 10.18 show the results of the optimism bias tests for each of the options.

**Table 10.16: Optimism Bias Sensitivity – Tunnel**

| Monetised Summary | Base (As per Govt guidelines) | All 44% | All 0% |
|---|---|---|---|
| Present Value of Transport Benefits | £19,447,016 | £19,447,016 | £19,447,016 |
| Present Value of Cost to Government | -£2,613,631 | £8,891,236 | £12,768,849 |
| Net Present Value | £16,833,385 | £28,338,252 | £32,215,865 |
| Benefit-Cost to Government Ratio | 7.44 | n/a | n/a |

**Table 10.17: Optimism Bias Sensitivity – Bridge**

| Monetised Summary | Base (As per Govt guidelines) | All 44% | All 0% |
|---|---|---|---|
| Present Value of Transport Benefits | £19,379,131 | £19,379,131 | £19,379,131 |
| Present Value of Cost to Government | -£41,901,088 | -£26,000,070 | -£12,991,772 |
| Net Present Value | -£22,521,957 | -£6,620,939 | £6,387,359 |
| Benefit-Cost to Government Ratio | 0.46 | 0.75 | 1.49 |

**Table 10.18: Optimism Bias Sensitivity – Reconfigured Ferry Same Fares**

| Monetised Summary | Base (As per Government guidelines) | All 44% | All 0% |
|---|---|---|---|
| Present Value of Transport Benefits | £0 | £0 | £0 |
| Present Value of Cost to Government | -£3,630,566 | -£3,630,566 | -£3,611,510 |
| Net Present Value | -£3,630,566 | -£3,630,566 | -£3,611,510 |
| Benefit-Cost to Government Ratio | 0.00 | 0.00 | 0.00 |

### 10.7.3 Alternative Ferry Lifespans

The third sensitivity test was to assess the impact on the economic case of having alternative ferry lifespans. Two lifespans were tested: 25 years with ferry replacement due in 2017; and 30 years with ferry replacement due in 2022. With longer ferry lifespans the case for the tunnel drops but still remains positive. This is due to the fact that the public sector would not save as much in renewal costs if a tunnel is introduced as the ferry would not have been renewed as frequently. Table 10.19 presents the comparison.

**Table 10.19: Comparison of Tunnel Scenario with different Ferry Lifespans**

| Monetised Summary | Base (20 year life) | 25 year ferry life | 30 year ferry life |
|---|---|---|---|
| Present Value of Transport Benefits | £19,447,016 | £19,447,016 | £19,447,016 |
| Present Value of Cost to Government | -£2,613,631 | -£5,651,594 | -£7,063,614 |
| Net Present Value | £16,833,385 | £13,795,422 | £12,383,402 |
| Benefit-Cost to Government Ratio | 7.44 | 3.44 | 2.75 |

## 10.8 TRANSPORT ECONOMIC EFFICIENCY SUMMARY

This section provides a summary of the key findings of the TEE appraisal.

- A TEE analysis of the proposed options has been undertaken in accordance with STAG, comparing the options with the Do Minimum (current ferry service). Net Present Values (NPVs) and Benefit Cost Ratios (BCRs) have been

calculated for each option to provide a measure of economic worth and value for money.

- Table 10.20, below, provides a summary of the capital and operational costs for each of the options over a 60 year period, in compliance with Government guidance.
- The capital costs in the table include the cost of any infrastructure required over the 60 years, including any road improvements (e.g. construction of fixed link, or three replacement ferries and one replacement berthing structure and two replacement link spans). The operating costs cover the annual cost of operating the option, over 60 years.

**Table 10.20: Summary of Capital and Operational Costs for each Option over 60 years, expressed in today's Prices**

| | **Tunnel** | **Bridge** | **Reconfigured Ferry (existing fare structure)** | **Current Ferry (Do Minimum)** |
|---|---|---|---|---|
| Capital Costs | £26,339,000 | £51,480,000 | £27,780,000 | £27,750,000 |
| Operating Costs/annum | £195,000 | £195,000 | £1,095,364 | £934,385 |
| Total Operating Costs over 60 years | £11,700,000 | £11,700,000 | £65,721,840 | £56,063,100 |
| **Total Actual Costs** | **£38.0M** | **£63.2M** | **£93.5M** | **£83.8M** |

- Table 10.21 summarises the findings of the economic appraisal. In the model all costs and benefits for each option are expressed in current day prices to allow for like for like comparison. The figures below are for the reconfigured ferry, using the existing fare structure. Two further scenarios were also modelled: no fares and a sample new fare structure.
- Options 1-3 have been compared throughout the STAG process, with the Do Minimum. This is the current ferry service projected forwards for the next 60 years, taking account of any new infrastructure requirements during that time. In the economic model the Do Minimum is only used for comparative purposes and is not appraised itself. The costs and benefits of the current service are therefore taken as zero and the costs and benefits of the three other options are compared against this.
- Net Present Value (NPV) is a measure of the quantifiable benefits minus costs. A positive NPV and Benefit Cost Ratio (BCR) demonstrate better value than the current situation.

**Table 10.21: Summary of Costs and Benefits for each Option, as generated by Transport Economic Efficiency Model (TEE) (including public transport)**

| | Tunnel | Bridge | Reconfigured Ferry (existing fare structure) | Current Ferry (Do Minimum) |
|---|---|---|---|---|
| Present Value of Transport Benefits | £19,447,016 | £19,379,131 | £0 | 0 |
| Present Value of Cost to Government | -£2,613,631 | -£41,901,088 | -£3,630,566 | 0 |
| Net present Value (NPV) | £16,833,385 | -£22,521,957 | -£3,630,566 | 0 |
| **Benefit-Cost to Government Ratio (BCR)** | **7.44** | **0.46** | **0** | **0** |

- Table 10.21 demonstrates that Option 1, the drill and blast tunnel, is the only option with a positive economic case. Including optimism bias at 66% and contingency of 20%, this option was found to have a BCR of 7.44 which means that for every £1 invested by the public sector a benefit of £7.44 is generated. In addition this option has an NPV of £16.8M.
- A number of sensitivity tests were undertaken but none of these were found to impact on the main conclusions from this work. These tests were to:
    - assume no additional trips were generated;
    - assume a ferry lifespan of 25 and 30 years; and
    - assume optimism bias on all options (including the ferry) of 66%, 44% and 0%.
- Taking optimism bias down to 44% or removing entirely significantly increases the economic case for the tunnel option, as there would be no overall cost to the Government of the scheme: the cost savings made with this option outweigh the capital costs.
- When the ferry lifespan was increased to 25 and 30 years the BCR for the tunnel decreased to 3.44 and 2.75 respectively.
- The BCRs of other options were less than 1.

In conclusion, from an economic welfare perspective Option 1 the tunnel is the option that should be taken forward.