

Norfolk ZEBRA Scheme

Economic Case



Norfolk County Council ECONOMIC CASE

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Pictures courtesy of Visit Norwich



1 Overview / Executive Summary

1.1.1 This document reports the Economic Case for the Norfolk County Council (NCC) ZEBRA funding submission. The impacts of the proposal are assessed via a Value for Money assessment which considers both monetised and non-monetised welfare impacts with respect to the environment, society, and the economy.

Summary of the Funding Requirement

1.1.2 The total funding requirement (grant and operator contribution) for the proposal is £6.89 million. The ZEBRA grant will support the purchase of the 15 electric buses with a grant of REDACTED towards the capital costs for the required supporting infrastructure.

Summary of Value for Money Assessment

- 1.1.3 The Value for Money Assessment has been undertaken using the Department for Transport's (DfT's) Greener Bus Tool, which uses a range of cost and bus operational performance inputs, emission data, and other economic parameters to establish the scheme's Benefit Cost Ratio (BCR).
- 1.1.4 Further analysis considers the uncertainty of the appraisal results in relation to the use of alternative input parameters and assumptions, or as a result of risks materialising, both of which could change the resulting BCR and Value for Money category. These are explored via a suite of kilometrage tests which vary maintenance costs, mileage, real non-traded carbon values and the duration of the appraisal period.
- 1.1.5 Non-monetised impacts are also considered within the assessment, with 'switching value analysis' used to further test and adjust the Value for Money category.

Overview of Monetised and Non-Monetised Benefits

1.1.6 Following the Value for Money assessment, the scheme falls within the Low Value for Money category with a BCR of 1.41:1 (see **Table 1**) but



following consideration of non-monetised impacts and 'switching value' analysis, the scheme moves into the Medium Value for Money category.

Category	£,2022, PV
Present Value of Benefits	5,436,541
Present Value of Costs	3,865,276
Net Present Value	1,571,265
Benefit Cost Ratio	1.41
Cost Effectiveness Indicator	149.9

TABLE 1: ECONOMIC CASE – BCR – CENTRAL CASE

Monetised Impacts

- 1.1.7 The monetised benefits and costs produce a Present Value of Benefits (PVB) of £5.44 million for the appraisal period of 17 years.
- 1.1.8 The impacts appraised include the following:
 - Greenhouse Gas emissions impacts (carbon, NOx and PM_{2.5}),
 - Indirect tax impacts (fuel duty),
 - Bus Service Operator Grant (BSOG) impact,
 - Vehicle and infrastructure maintenance costs,
 - Operating cost (resource, duty and VAT),
 - Electric vehicle purchase,
 - Supporting infrastructure capital expenditure.

Non-monetised Impacts

- 1.1.9 The non-monetised benefits considered include:
 - Quality of travel benefits / soft factors,
 - COVID recovery / patronage growth / mode shift,
 - Employment and productivity impacts (supply chain impacts),



- Social value and productivity gains through skills training,
- Non-monetised noise impacts,
- Further non-monetised air quality impacts,
- Reduction in environmental impact of diesel operations,
- Shared use of charging infrastructure,
- Supporting social inclusion / Levelling Up the local economy.

Risks and Uncertainties

- 1.1.10 The key risks and uncertainties are, as follows:
 - Zero emission bus vehicle mileage reduced/increased,
 - Battery replacement costs decrease/increase,
 - Change to BSOG rates,
 - Low and High Carbon values (in addition to central in base case)
 Change to non-traded price of carbon,
 - Renewable energy types and cost.

2 Greener Bus Tool

- 2.1.1 To quantify the impacts of the proposal, the DfT Greener Bus Tool (GBT) was used¹. Costs and impacts (benefits) were assessed for a 17-year appraisal period, the assumed life cycle of a new zero emission bus, taking into account battery life, chassis and drive chain construction and maintenance.
- 2.1.2 The GBT quantifies the key costs and impacts (benefits) of a proposed investment in zero emission buses identifying:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/99 8855/zebra-scheme-phase-2-business-case-development-guidance.pdf.pdf



- Costs to the DfT, bus operators and local transport authorities from the purchase of zero emission buses and provision of supporting infrastructure,
- Benefits to society from reduced green-house gases and improved air quality,
- Changes in bus operating and maintenance costs for bus operators,
- Changes in indirect tax and BSOG payments.

2.2 Key Model Inputs

2.2.1 The GBT requires key inputs for the model in order to quantify the impacts of a zero emission bus scheme. The key inputs required are set out in the 'I-User Proforma' sheet of the tool.

The key model inputs are:

- Number of zero emission buses to be delivered over the project life-cycle,
- Unit price of a zero emission bus,
- Unit price of a diesel vehicle which is to be replaced,
- 17-year life cycle for buses aligned with REDACTED,
- Infrastructure costs including maintenance (provision of electric power supply etc.),
- Vehicle life expectancy,
- Vehicle annual average distance travelled (vehicle-kilometres),
- Local electricity costs kWh/km.
- 2.2.2 **Table 2** sets out the inputs used for the NCC ZEBRA appraisal contained within the GBT.



Category	Input	Input Value	Source for assumption	
Vehicles	Number of zero emission buses to be delivered	15	REDACTED	
Vehicles	REDACTED	REDACTED	REDACTED	
Vehicles	REDACTED	REDACTED	REDACTED	
Vehicles	REDACTED	REDACTED	REDACTED	
Vehicles	REDACTED	REDACTED	REDACTED	
Vehicles	REDACTED	REDACTED	REDACTED	
Vehicles	REDACTED	REDACTED	REDACTED	
Vehicles	REDACTED	REDACTED	REDACTED	
Vehicles	REDACTED	REDACTED	REDACTED	
Supporting Infrastructure	REDACTED	REDACTED	REDACTED	
Supporting Infrastructure	REDACTED	REDACTED	Not applicable	
Supporting Infrastructure	REDACTED	REDACTED	Not applicable	
Supporting Infrastructure	REDACTED	REDACTED	Not applicable	
Cost and carbon dioxide emissions per kWh of electricity	REDACTED	No	Not applicable	
Cost and carbon dioxide emissions per kWh of electricity	Is local evidence available on the cost per kWh of electricity	No	Not applicable	



- 2.2.3 The price base is 2021 and VAT of 20% is included. The appraisal base year is 2021.
- 2.2.4 The breakdown of supporting infrastructure costs provided by First Bus is set out in **Table 3.**

TABLE 3: BREAKDOWN OF SUPPORTING INFRASTRUCTURE COSTS

Cost Item	Cost £	Appendix reference
REDACTED	REDACTED	quote
REDACTED	REDACTED	quote
REDACTED	REDACTED	Not applicable
REDACTED	REDACTED	Not applicable
Total	1,338,444	Not applicable

2.2.5 The GBT includes assumptions used to quantify the impacts based on the inputs described above. The parameters used for the NCC ZEBRA bid are set out in **Table 4.**



TABLE 4: PARAMETERS USED

Category	Parameter	Value
Appraisal Assumptions	Current fleet	Diesel
Appraisal Assumptions	Proposed fleet	Pure electric bus
Appraisal Assumptions	Non-Traded Cost of Carbon Scenario	Real Non-Traded (Central)
Cost Inflation	Vehicle Capex, Do Min Vehicle Replacement Capex, Infrastructure Capex, Vehicle Maintenance Costs, Infrastructure Maintenance Cost & Operating Costs	GDP Deflator
Optimism Bias	Vehicle Capex, Do Min Vehicle Replacement Capex, Infrastructure Capex, Vehicle Maintenance Costs, Infrastructure Maintenance Cost & Operating Costs	3% of capex
Damage Cost by Pollutant Selection	NOx	Road Transport Urban Large / Central
Damage Cost by Pollutant Selection	PM2.5	Road Transport Urban Large / Central
Vehicle Maintenance Cost Technologies	Pure Electric Bus	Battery electric
Vehicle Maintenance Cost Technologies	Sector incurring vehicle maintenance cost	Private

- 2.2.6 A summary of the input costs is shown in **Table 5**.
- 2.2.7 Vehicles would all be operational within the required ZEBRA timeframe of 2 years from funding award (assumed to be March 2024). The supporting infrastructure is scheduled to be in place for the expected vehicle delivery in 2024. The outline programme for vehicle delivery and infrastructure implementation is as follows:
 - April 2022: Order placed on electrical power upgrade.
 - May 2022: Vehicle order placed.



- January 2023 onwards Driver and engineer training.
- April 2022 December 2022: Electrical upgrade works
- June 2022 April 2023: Electrical infrastructure works.
- October 2023 January 2024: Vehicle delivery.
- February 2024 March 2024: Vehicle operation

TABLE 5: NORFOLK ZEBRA	PROGRAMME

Category	2022	2023	2024	
Electric Bus Delivery Not applicable		REDACTED	REDACTED	
Bus Cost	Not applicable	REDACTED	REDACTED	
Bus Grant	Not applicable	REDACTED	REDACTED	
Infrastructure Cost	REDACTED	REDACTED	REDACTED	
Infrastructure Grant from Government	REDACTED	REDACTED	REDACTED	
Total Public Sector Investment	REDACTED	REDACTED	REDACTED	
Total Operator	REDACTED	REDACTED	REDACTED	
Total Cost	£1,271,522	£3,766,922	£1,850,000	

2.3 Use of Non-DFT Base Case Assumptions

2.3.1 This section provides further detail on the application of non-DfT default values as inputs to the GBT appraisal.

Life Expectancy of Zero Emission Buses

- 2.3.2 The default life expectancy of a zero emission bus in the GBT is assumed to be 17 years, the value of which has been adopted for this bid. REDACTED
- 2.3.3 The warranties cover the vehicle, batteries, power train and structural.The warranty periods are as follows:
 - Vehicle 2 years,
 - Batteries REDACTED,
 - Power train 5 years,
 - Structural 12 years.

Vehicle Annual Average Distance Travelled



- 2.3.4 A non-default value was used for the Vehicle Annual Average Distance Travelled (kilometres) input of 84,674 vehicle kilometres. This is based upon local operational data provided by First Bus (see below).
- 2.3.5 The routes chosen for this bid will operate in Greater Norwich and are based on the ability to operate single deck vehicles, from a capacity perspective, and the ability to operate the associated mileage, from a battery range perspective based on a single overnight charge.
- 2.3.6 The vehicle annual average distance travelled was provided by First Bus for the routes to be served by the 15 electric buses. The value for kilometrage includes live and dead journeys. The calculation of average vehicle-kilometres was based on the actual kilometrage operated by the Purple Line (service 39), Yellow Line (service 29), Charcoal Line (services 40 / 40A) and the Green Line (services 15, 15A / 15B).
- 2.3.7 The figure of 84,674 vehicle kilometres per annum, breaks down as follows
 - a) 84,674km = 52,614 miles per annum
 - b) 52,614 miles per annum = 1,011 miles per week
 - c)1,011 miles per week = 155 miles per day (based on 6.5 days as Mon-Sat operation would be slightly longer)
 - A daily mileage of 155 miles is well within the stated range and reflects the fact that the Yellow and Charcoal Line routes are both serving destinations beyond the outskirts of the city. The Purple Line 39's are much shorter routes, but this is balanced off by the Green Line being the longest of all four.
- 2.3.8 These routes are shown in **Figure 1** below.





FIGURE 1: FIRST BUS NETWORK IN NORWICH

Annual maintenance as percentage of capital expenditure (capex)

2.3.9 The average annual maintenance costs for the supporting infrastructure REDACTED.

2.4 Supporting Information

- 2.4.1 Information confirming the validity of the cost assumptions contained within the GBT are contained within the Appendices. These includes:
 - Letters of support,
 - Guarantees from suppliers.



2.4.2 Other letters of support are provided within the Commercial and Management Cases (related to procurement and stakeholders respectively).

2.5 Key Model Outputs

- 2.5.1 The key outputs from the GBT are shown in **Table 6**. Monetised values are positive if there is a saving to the private sector and negative if there is a cost to the private sector.
- 2.5.2 The PVB (£, 2022) is £5.44 million. An analysis of the areas of impact (PVB) shows:
 - A positive impact of a reduction in greenhouse gases of £4.42 million,
 - A reduction in indirect tax income of £3.54 million,
 - Net private sector expenditure of £4.56million.
- 2.5.3 Present Value Costs (PVC) to the broad transport budget are £3.87 million representing an electric vehicle purchase grant of £2.58 million, a grant for supporting infrastructure of £1.19 million and £0.099 million for BSOG.

TABLE 6: BCR – CENTRAL CASE, £ 2022, PV

Table redacted

2.6 Model Sensitivity Tests

- 2.6.1 Sensitivity tests which vary the input parameters of the central case of the appraisal were performed and included:
 - Forecast value of zero emission buses vehicle mileage was reduced and increased by 10%,
 - The BSOG based sensitivity test where the BSOG remains at 6p (assuming base case assumption is 22p),



- Low and High Carbon values were applied instead of the central carbon values,
- A REDACTED the 17-year appraisal period which is the model default.

2.7 Key Financial Metrics

2.7.1 **Table 7** shows the key financial metrics calculated to demonstrate Value for Money. The costs presented relate to the implementation of the ZEBRA scheme only.

TABLE 7: NORFOLK ZEBRA KEY FINANCIAL METRICS

Metric	Metric	Value	
Bus Costs	Not applicable	Not applicable	
Bus Costs	Electric Bus	REDACTED	
Bus Costs	Battery Replacement	REDACTED with vehicle life	
		cycle	
Bus Costs	Number of electric buses	15	
Bus Costs	Kilometrage per annum	84,674	
Bus Costs	Carbon Savings (tonnes total)	18,132	
Bus Costs	Carbon saving (tonnes) / bus	1,209	
Infrastructure Costs	Not applicable	Not applicable	
Infrastructure Costs	ZEBRA Costs	1,338,444	
Infrastructure Costs	ZEBRA Costs / bus	89,230	
Infrastructure Costs	Grant Costs / ZEBRA Bus	66,922	
Life Cycle Total Costs	Not applicable	Not applicable	
Life Cycle Total Costs	Upgrade Costs / km operated over life	5.08	
Life Cycle Total Costs	Grant / km operated over life	2.41	
Life Cycle Total Costs	Upgrade Cost / carbon saving tonne	380	
Life Cycle Total Costs	Grant Cost / carbon saving tonne	180	
Cost Effectiveness Indicator	Not applicable	149.9	

3 Non-Monetised Impacts

3.1.1 This section describes the non-monetised impacts expected to be generated by the scheme. These include any non-quantified, non-monetised, or qualitative impacts that are not captured by the GBT, but which are described within the Theory of Change logic model (in the Monitoring and Evaluation Plan).



.1.2 These impacts (benefits) include:

- Quality of travel benefits / soft factors,
- COVID recovery / patronage growth / mode shift,
- Employment and productivity impacts (supply chain impacts),
- Social value and productivity gains through skills training,
- Non-monetised noise impacts,
- Further non-monetised air quality impacts,
- Reduction in environmental impact of diesel operations,
- Shared use of charging infrastructure,
- Supporting social inclusion / Levelling Up the local economy.
- 3.1.3 When these other impacts are considered, the Value for Money of the scheme is considered to greater than solely the value of the BCR.
 'Switching value analysis' is used to further test and adjust the Value for Money category.

Quality of Travel Benefits / Soft Factors

3.1.4 The DfT Databook, which provides economic input data to be used in conjunction with TAG, enables the monetisation of interventions (termed soft factors), which result from improvements in the quality of the bus passengers' journeys. The ambience or quality of travel for bus passengers is quantified using the change in Generalised Journey Time (GJT) and values of generalised minutes for each applicable soft measure². This full soft-factors quality appraisal has not been undertaken as part of this ZEBRA project, so the monetised impacts of changes to passenger journey quality have not been included within the BCR, they are however described qualitatively below.

 $^{^2}$ DfT TAG Databook 2020 provides a value in GJT minutes for each of the types of soft measure (Table M.3.2.1 of the TAG Databook).



- Bus passengers on the four lines where the 15 electric bus vehicles will be placed in operation will experience enhanced levels of passenger comfort, journey quality and satisfaction compared to a counterfactual scenario where the existing Euro 3 fleet remain in operation. This is because the electric buses purchased are designed to modern standards with enhanced legroom, seat comfort, and climate control (REDACTED) compared to their older diesel counterparts, on board CCTV will increase feelings of safety and security, and audio announcement, and visual displays will indicate the next stop and ultimate destination, enhancing information provision.
- 3.1.6 Whilst these impacts haven't been quantified here, they are likely to increase the scheme benefits and would likely move the BCR into the medium Value for Money category based upon experience from other projects, such as the Lincoln Transport Hub project which used a similar methodology.

COVID recovery / Patronage Growth / Mode Shift

- 3.1.7 There is strong local evidence that bus patronage in Norwich has been growing over time (as described in the Strategic Case). Pre-COVID, there were around 45,000 passengers per day travelling on the bus network in Greater Norwich. Sustained bus patronage increases were occurring, with First Bus reporting annual growth of 5-10% for all bus services in the 5-year period up to the onset of the pandemic. Bus patronage is currently in the recovery stage nationally following the drop in demand associated with COVID. In October 2021, the DfT released bus and rail demand recovery data showing that bus travel outside London was around 60% of pre-pandemic levels and increasing. Data from First Bus indicates that patronage within Norwich in November 2021 was between 70-80% of pre-COVID levels.
- 3.1.8 This ZEBRA scheme has the potential to accelerate the rate of recovery in the bus corridors served by the new zero emission buses by the bus



journey quality improvements described above. Any increase in demand over the current baseline of patronage (the baseline set within this COVID demand drop, which is approximately 30% lower than the pre-COVID situation) is not captured within the BCR. Such potential uplifts in patronage are therefore additional to the patronage level assumed for the central case of this appraisal.

- 3.1.9 Further patronage increases are also likely as part of the wider programme of bus investment in the city, which seeks to introduce bus priority measures, improve ticketing, enhance the frequency of services and improve accessibility to bus by enhancing route coverage. This ZEBRA project will be incorporated into the wider Transforming Cities Fund (as described within the Management Case) and is fully consistent and aligned with the principles set out within the Norfolk Bus Service Improvement Plans for the city. Considering all of the bus investment complementary projects and programmes within the city together, it is likely the programmatic benefits will be greater than the benefits of each of the scheme summed in isolation.
- 3.1.10 These increase in patronage to accelerate the recovery from COVID, and beyond if considered as part of the wider programme of bus investment, is likely to drive the scheme into higher Value for Money categories.
- 3.1.11 Employment and productivity impacts (supply chain impacts)
- 3.1.12 REDACTED to expand their operation and create new jobs to accommodate the growing demand for electric buses. These 'green jobs' are exactly the type of high-end manufacturing jobs the government has committed to invest in within its Ten Point Plan and the type outlined within the recent Spending Review: low-carbon, high-skilled and highproductivity jobs. New and more productive jobs will improve Norwich's economic performance, measured by changes to Gross Value Added within this sector.
- 3.1.13 Should this Norwich ZEBRA bid be successful, REDACTED.



- 3.1.14 REDACTED.
- 3.1.15 These potential wider impacts and increased productivity gains, particularly in the green manufacturing sector are in full alignment with UK government's commitments.
- 3.1.16 REDACTED are summarised in the **Figure 2** below. Whilst it is acknowledged that this single Norfolk ZEBRAs scheme will not deliver all these benefits, First's total Zero Emission Bus purchase, which includes the already successful Leicester Fast track ZEBRA bid is likely to increase the probability of this occurring.

FIGURE 2: WIDER IMPACTS ASSOCIATED WITH MANUFACTURING PLANT

Figure redacted.

3.1.17 Even a small share of these impacts would be enough to push the scheme into higher Value for Money categories.

Social Value and Productivity Gains Through Skills Training

First

3.1.18 The investment in training by First Bus in its drivers and maintenance engineers in the new zero emission technology enhances skills within the industry, with skills training another known driver of improving productivity and Levelling Up.

REDACTED

3.1.19 REDACTED

Non-monetised Noise impacts

3.1.20 The DfT's Value for Money Framework permits the monetisation of noise impacts within scheme appraisal. However, due to the limitations of the



use of the GBT, the lack of a full Variable Demand Model with Mode Choice functionality covering the study area, which would usually provide the inputs to undertake a full Environmental Impact Appraisal, monetisation of noise impacts has not been feasible for use within this ZEBRA analysis and submission. Noise impacts are however described qualitatively below.

3.1.21 The Norfolk ZEBRA scheme will provide a reduction in noise pollution compared to the existing situation, because electric buses operate at much lower noise levels than the current diesel bus fleet. The 15 strong zero emission bus fleet will operate on the 4 bus service lines in areas of higher population density along these bus routes into Norwich city centre, and this will have a positive impact on residents' lives. In addition, the lower noise levels associated with zero emission buses in depot operations will provide a benefit to the area immediately in the vicinity.

Further Non-monetised Air Quality Impacts

3.1.22 REDACTED.

Reduction in Environmental Impact of Diesel Operations

3.1.23 As this ZEBRA scheme deployment of 15 zero emission buses is a step towards overall zero emissions operations, it is a move closer to the removal of diesel from First Bus operating locations, including the removal of the delivery and storage requirements and reducing environmental and safety risks associated with fuelling and storing diesel.

Shared Use of Charging Infrastructure

3.1.24 First Bus is committed to work collaboratively with NCC and other businesses to maximise the local benefit from the charging infrastructure at the bus depot, through the exploration of suitable options for shared used of infrastructure, improving access to electric charging facilities which could further increase the uptake of low emissions vehicles in the area.



- 3.1.25 REDACTED.
- 3.1.26 REDACTED.

Supporting Social Inclusion / Levelling Up the Local Economy

- 3.1.27 As described in the Strategic Case, Norwich performs poorly across a range of socio-economic metrics both regionally and nationally, and as demonstrated through the use of the DfT's forthcoming Levelling Up toolkit, which incorporates place-based analysis, is deemed to be a place in need of Levelling Up.
- 3.1.28 The bus route corridors identified for deployment of the 15 electric buses serve areas which are within the 10% most deprived areas in the UK on the Index of Multiple Deprivation. Place-making will be enhanced by introducing the electric buses demonstrating investment in transport services for these communities. An improved public bus network will provide a positive signal to the communities served creating a stronger sense of place and social involvement in the city. **Figure 3** shows the bus routes identified for the ZEBRA bid electric buses in relation to the areas with low scores on the Index of Multiple Deprivation.

Norfolk County Council FIGURE 3: PROPOSED ROUTES AND INDEX OF MULTIPLE DEPRIVATION



4 Consideration of Uncertainties

4.1 Key Uncertainties

- 4.1.1 Key uncertainties are as follows:
 - Zero emission bus vehicle mileage reduced/increased,
 - Change to BSOG rates,
 - Low and High Carbon (NOx, PM_{2.5}) values (in addition to central in base case) Change to non-traded price of carbon.
- 4.1.2 Note, REDACTED the 17 year appraisal period in the selected procurement approach.



4.2 Sensitivity Testing of Uncertainties

- 4.2.1 Sensitivity tests were carried out on key parameters, as follows:
 - Test 1 & 2- Forecast zero emission bus vehicle mileage reduced/increased 10%
 - Test 3 BSOG based sensitivity, BSOG remains at 6p (assuming base case assumption is 22p).
 - Test 4 & 5 Low and High Carbon values (in addition to central in base case). Change to non-traded price of carbon
 - Test 6 REDACTED the 17 year GBT default.
- 4.2.2 The summary appraisal results for the sensitivity tests are shown in Table8 below

TABLE 8: NORFOLK ZEBRA SENSITIVITY TESTS

£, 2022, PV	Core Case	Test 1: 10% Reduction in average vehicle- kilometrage	Test 2:10% increase in average vehicle- kilometrage	Test 3: Zero emission BSOG Rate of 6p	Test 4: Low Carbon Values	Test 5: High Carbon Values	Test 6: appraisal period
Present Value of Benefits	5,436,541	4,764,936	6,108,147	3,432,851	3,292,115	7,580,968	5,125,222
Present Value of Costs	3,865,276	3,855,393	3,875,159	1,861,586	3,865,276	3,865,276	3,861,736
Net Present Value	1,571,265	909,543	2,232,987	1,571,265	-573,162	3,715,692	1,263,486
Benefit Cost Ratio	1.41:1	1.24:1	1.58:1	1.84:1	0.85:1	1.96:1	1.33:1
Cost Effectiveness Indicator	149.9	180.8	124.6	149.9	149.9	149.9	165.7



Sensitivity Testing Conclusions

- 4.3.1 An increase in carbon (damage) values is the most likely scenario to occur of each of the scenarios and sensitivity tests undertaken. There is direct evidence from changes to the DfT's TAG Databook, and from the carbon values provided by BEIS that carbon damage values have increased over the last 3 years, most recently (and approximately) tripling from the previous values. This is in direct response to government's stated objective of delivering transport decarbonisation and achieving Net Zero by 2050 and the change in Carbon Budget values. Only the adoption of the low carbon damage value, of all the sensitivity tests undertaken, decreases the scheme BCR to less than 1 (at 0.85:1), taking it into the poor Value for Money category, whilst increasing carbon damage values (which is more likely over the appraisal period) pushes the BCR to 1.96:1, which means the scheme remains in the medium Value for Money category, but on the cusp of High Value for Money (i.e. a BCR of 2).
- 4.3.2 A reduction in the average kilometrage travelled by the ZEBs by 10% lowers the BCR compared to the core assessment (to 1.24:1), with the Value for Money category remaining the same (low). Increasing the average kilometrage travelled (by 10%) increases the BCR to 1.58:1, pushing the scheme into the medium Value for Money category.
- 4.3.3 Similarly, retaining the BSOG rate at 6% also pushes the scheme into the medium Value for Money Category, with a BCR of 1.84:1. This is a result of the transfer payment from DfT to the private sector decreasing.
- 4.3.4 These tests should give decision-makers increased certainty and confidence in the VfM category, prior to any upward adjustments associated with non-monetised impacts, as described above.

5 Consideration of Risks

5.1 Key Risks for Delivery of Benefits or Costs and Mitigations in Place

- 5.1.1 The top risks and mitigation that could compromise delivery of benefits, or increase costs are provided below:
 - The delivery of energy on site on time in full communication and have clear detail from all parties within infrastructure provision.
 - REDACTED.
 - EV batteries don't provide sufficient / predicted vehicle range bus routes have been selected based on ability to operate within the manufacturer's battery range
- 5.1.2 These are described in more detail within the Management Case.

5.2 Risk Sensitivity Analysis

5.2.1 The potential impact of these risks are presented within the sensitivity analysis where possible.

5.3 Risk Register

5.3.1 A full risk register is included in the Management Case. Risks have been quantified by probability and impact and have been addressed as part of the risk management process. Costs, where they are not fixed costs i.e., those subject to a contract, include a level of contingency³, which provides a relatively simple cost-risk adjustment. Given the components of the project, the lack of a lengthy or complex construction period and process, a Quantified Risk Assessment which uses Monte Carlo analysis has not been adopted to provide a more sophisticated risk-adjusted cost. The likely effect of risk on the scheme Value for Money category is dealt with through the risk sensitivity analysis above.

³ See financial case for further detail of the contingency values adopted. Contingency has however been applied to the Civil Engineering Costs at a rate of 20%. As all other costs are fixed by quotations, these have not been adjusted.

6 Summary Value for Money

6.1 Monetised Benefits

- 6.1.1 The BCR generated by the scheme, estimated by use of the GBT is
 1.41:1. This places the scheme in the Low Value for Money category.
 However, following consideration of non-monetised impacts and
 'switching value' analysis, and wider impacts such as those generated
 within and by the supply chain via, the scheme moves into the Medium
 Value for Money category.
- 6.1.2 The non-monetised benefits include:
 - Quality of travel benefits / soft factors
 - COVID recovery / patronage growth / mode shift
 - Employment and productivity impacts (supply chain impacts)
 - Social value and productivity gains through skills training
 - Non-monetised noise impacts
 - Further non-monetised air quality impacts
 - Reduction in environmental impact of diesel operations
 - Shared use of charging infrastructure
 - Supporting social inclusion / Levelling Up the local economy
- 6.1.3 The assessment of risks via sensitivity analysis indicates the scheme Value for Money is unlikely to change as a result of varying input parameters within the GBT, providing a high degree of certainty in the appraisal reports for decision makers.

6.2 Delivering VFM

6.2.1 The scheme is considered to offer Value for Money because the Present Value of Benefits outweighs the Present Value of Costs. Furthermore, in line with the Green Book, schemes which help deliver the governments



objectives⁴, and transport decarbonisation and Levelling Up are two of the government's priority objectives (which this scheme contributes towards), should be considered Value for Money.

7 Conclusions

- 7.1.1 The Value for Money for this proposed investment seeking government grant support was assessed using monetised and non-monetised economic impacts, key financial indicators and sensitivity tests to assess the level of risk around the core assumptions.
- 7.1.2 The Greener Bus Tool produced a BCR of 1.41:1 for the core scenario representing Low Value for Money.
 - Quality of travel benefits / soft factors
 - COVID recovery / patronage growth / mode shift
 - Employment and productivity impacts (supply chain impacts)
 - Social value and productivity gains through skills training
 - Non-monetised noise impacts
 - Further non-monetised air quality impacts
 - Reduction in environmental impact of diesel operations
 - Shared use of charging infrastructure
 - Supporting social inclusion / Levelling Up the local economy
- 7.1.3 Overall, the proposal is considered to offer Good Value for Money once the non-monetised benefits are included, as these are likely to push the scheme into the Medium Value for Money categories. In particular, the proposal is well-aligned with key objectives of the ZEBRA fund and wider government policies:

⁴ Discussing the Green Book Review and updated Green Book: "Options will be assessed first and foremost on whether they deliver relevant policy objectives" (National Infrastructure Strategy, 2020)



• Supporting the development of new electric vehicle technologies to create new business sectors and creating new jobs

8 Annex

8.1.1 All Appendices can be found in a separate Appendices document.

9 Glossary of Abbreviations and Defined Terms

- AQAP Air Quality Action Plan
- AQMA Air Quality Management Area
- BCR Benefit Cost Ratio
- **BEV** Battery Electric vehicle
- **BID** Business Improvement District
- BSIP Bus Service Improvement Plan
- BSOG Bus Service Operator Grant
- CO2 Carbon Dioxide
- CSS Combined Charging System
- CYC City of York Council
- DEFRA Department for Environment, Food and Rural Affairs
- DfT Department for Transport
- DNO Distribution Network Operator
- EOI Expression of Interest
- EQIA Equality Impact Assessment
- EV Electric Vehicle
- **GBT** Greener Bus Tool
- GDP Gross Domestic Product
- **GJT** Generalised Journey Time



- GNR Greater Norwich Region
- ICE Internal Combustion Engine
- ITT Invitation to Tender
- JCS Joint Core Strategy
- LED Light-Emitting Diode
- LEP Local Enterprise Partnership
- LEZ Low Emission Zone
- LTA Local Transport Authority
- LTP Local Transport Plan
- **M&E** Monitoring and Evaluation
- NBS National Bus Strategy
- NCC Norfolk County Council
- NNUH Norfolk and Norwich University Hospital
- NO2 Nitrogen Dioxide
- NOx Oxides of Nitrogen
- NRP Norwich Research Park
- NSIDP Norfolk Strategic Infrastructure Delivery Plan
- OEM Original Equipment Manufacturer
- OfGEM Office of Gas and Electricity Markets
- ONS Office of National Statistics
- **PIPs** Punctuality Improvement Partnerships
- PM10 Particulate Matter
- PM2.5 Particulate Matter to 2.5 microns
- PSVAR Public Service Vehicles Accessibility Regulations
- PVB Present Value of Benefits
- PVR Peak Vehicle Requirement

- **R&D** Research and Development
- SCRT Selective Catalytic Reduction Technology
- SLA Service Level Agreement
- SRO Senior Responsible Owner
- SSE Scottish and Southern Elect
- TAG Transport Analysis Guidance
- TCA Trade Cooperation Agreement
- TCF Transforming Cities Fund
- TfN Transport for Norwich
- ToR- Terms of Reference
- UEA University of East Anglia
- UKPN UK Power Networks
- VfM Value for Money
- VQP Voluntary Quality Partnership
- WHO World Health Organisation
- **ZEB** Zero Emission Bus
- ZEBs Zero Emission Buses